CNMI Division of Fish and Wildlife Coral Reef Management Plan

CNMI Division of Fish and Wildlife Technical Report

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As an agency-guiding document, this DFW Coral Reef Management Plan has been reviewed and approved by Michael Tenorio and Rosemary Camacho, Fisheries Section Supervisor and Acting DFW Director respectively.

Rosemary Camacho, Acting DFW Director

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ii. Acknowledgements

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iii. Table of Abbreviations

Abbreviation	Definitions
BECQ	Bureau of Environmental and Coastal Quality
CAP	Conservation Action Plan
CO_2	Carbon Dioxide
CO_3^{2-}	Carbonate Ion
COTS	Crown of Thorns Starfish
CRCP	Coral Reef Conservation Program
CRI	Coral Reef Initiative
CRMP	Coral Reef Management Plan
CRSF	Coral Reef Stewardship Fund
DCRM	Division of Coastal Resources Management
DF	Division of Forestry
DFW	Division of Fish and Wildlife
DIN	Dissolved Inorganic Nitrogen
DLNR	Department of Land and Natural Resources
ESA	Endangered Species Act
ID	Identification
JAMS	Johnston Applied Marine Sciences
LBSP	Land-Based Sources of Pollution
MINA	Mariana Islands Nature Alliance
MMT	Marine Monitoring Team
MPA	Marine Protected Area
MRA24	Marine Resource Assessment
NFWF	National Fish and Wildlife Foundation
NGO	Non-governmental organization

NOAA	National Oceanic and Atmospheric Administration
PL	Public Law
REA	Rapid Ecological Assessment
REEF	REEF Environmental Education Foundation
SCTLD	Stony Coral Tissue Loss Disease
SCUBA	Self-Contained Underwater Breathing Apparatus
SfM	Structure from Motion
SFR	Sportfish Restoration
SGCN	Species of Greatest Conservation Need
SK	Saltonstall-Kennedy
SNUBA	Surface Nexus Underwater Breathing Apparatus
SOP	Standard Operating Procedure
SWAP	State Wildlife Action Plan
SWG	State Wildlife Grant
USD	United States Dollar

iv. Executive Summary

Coral reefs are among the most biodiverse of ecosystems and serve as habitat for a quarter of all known marine species (McAllister, 1995). Consequently, these ecosystems are essential for life in coastal communities such as the Commonwealth of the Northern Mariana Islands (CNMI). In the CNMI, coral reefs generate valuable ecosystem services for our community. They support our economy with tourism and fisheries, protect our coasts through wave attenuation, and connect residents to recreation and traditional cultural practices (Arkema et al., 2013; Daily, 1997; van Beukering et al., 2006).

The CNMI Division of Fish and Wildlife (DFW) is responsible for protecting coral species and has the authority to draft, implement, and enforce relevant regulations (Fish, Game, and Endangered Species Act, 1980). Proper management of coral reefs, and threats against them, is a priority for our community and an important part of DFW's mandate. In order to safeguard our coral reefs for years to come, DFW has created a Coral Reef Management Plan to guide the development of our Coral Reef Management Program.

This plan addresses and expands upon objectives detailed in DFW's State Wildlife Action Plan (SWAP). It provides additional background information, management recommendations, and detailed actions items to jump-start DFW's Coral Reef Management Program. Our conclusions were generated through literature review, intra-agency meetings, stakeholder discussions, and working group input. During the research process, we combined DFW's mandate and capacity with government objectives from existing plans, such as the CNMI Comprehensive Sustainable Development Plan and the CNMI Coral Reef Management Priorities document. Aligned with the priorities discussed in these documents, we generated four guiding strategies for DFW:

> **Strategy 1:** Improve data collection and standardize fisheries independent coral reef monitoring methods
>
> **Strategy 2:** Improve communication and dissemination of data and analysis to policy makers, invested stakeholders, and community members
>
> **Strategy 3:** Provide technical support and guidance for existing coral restoration efforts
>
> **Strategy 4:** Build DFW Fisheries Research Section capacity

Understanding the threats to corals and deciding which to prioritize for management is a key part of fulfilling these strategies. Many of these threats can be combated through local action because they originate locally. Paving roads to decrease sediment runoff, encouraging sustainable fishing practices, designing and maintaining drainages to limit land-based sources of pollution, and enforcing responsible tourism are all local management actions that can have a compounding

positive effect on coral conservation. Prioritizing community-led efforts on what is within the CNMI's control limits total ecosystem threats to the greatest extent possible.

Beyond threat management, the 2015 SWAP identified several monitoring needs for coral reefs, specifically for Species of Greatest Conservation Need (SGCN) corals. We will implement actions to fill these gaps by incorporating SGCN-specific criteria into existing survey programs, increasing the quantity of benthic data collected per survey, and encouraging community involvement in management. The updated standard operating procedure for our Fisheries Independent Surveys and Habitat Assessments program fulfills many of these criteria as well (Robie and Van Ee, 2024).

The 2015 SWAP also identified a need for coral restoration activity in the CNMI. It is exciting to report that coral restoration projects are growing following several widespread bleaching events in the last 20 years. Since DFW does not currently have the capacity, work space, or funding to accommodate a stand-alone restoration program, we will focus our efforts on acquiring funds to support existing nursery projects. We will also welcome collaboration, sharing resources with partners during times of need, exploring opportunities for public-private partnership, and setting up shared funding structures to lift overall local government capacity.

Planning initiatives are critical to agency success because they generate action. The 11 priority action items generated through the creation of this document are realistic and achievable (Table 2). These foundational tasks should be accomplished before the start of the 2030 fiscal year to lay the groundwork for a Coral Reef Management Program at DFW. They address needs in monitoring, gaps in scientific knowledge of disease, opportunities for community engagement initiatives, and more. Since these action items can be feasibly addressed in the next five years, this plan provides a list of additional coral-related project recommendations that can be applied to different funding opportunities (Appendix A, Appendix C).

Although our coral reefs face challenges in the future, we have the power to affect change locally to safeguard them. Even amidst adversity, there is great hope for the coral reefs that provide gifts for our economy, people, culture, and health. We, as managers and community members, have the power and responsibility to mitigate locally controllable threats facing our island's reefs. By building foundational capacity, increasing monitoring, addressing threats, and uplifting our community, DFW's coral reef stewardship will make a difference for our shared home.

v. Document Purpose & Guide

The CNMI Division of Fish and Wildlife (DFW) is one of the primary agencies responsible for coral reef management and environmental enforcement (Fish, Game, and Endangered Species Act, 1980). Every ten years, DFW produces a State Wildlife Action Plan (SWAP) to set goals, objectives, and determine actions for resource management. The 2015 SWAP outlined several management objectives for corals, particularly for Species of Greatest Conservation Need (SGCN).

This coral reef management plan addresses the aforementioned objectives in detail as an extension of the SWAP. It also serves as a first-step for developing DFW's coral reef management capabilities and as a reference for other environmental managers. The goal of the DFW Coral Reef Management Plan (CRMP) is to provide background information, management recommendations, and specific actions to guide DFW activities. The CRMP addresses DFW's four foundational strategies of coral reef management: Background & Management Principles, Coral Restoration, SWAP Goals, and Program Building. Descriptions of each of these strategies, as well as their relevant sections, are described in Table 1.

After plan strategies and SWAP objectives were clearly identified, action items were created to fulfill them as detailed in Table 2. These actions outline specific steps that will improve DFW coral reef management capacity. Action items build off one another and are supplemented by project recommendations and other possible strategies for the achievement of SWAP goals (Appendix A). The coral reef management strategies and actions detailed in this document are intended to build capacity within the CNMI DFW. They can also be used to augment collaborative partnerships with both government agencies and non-governmental organizations (NGO). By accomplishing these actions and building capacity through collaboration, DFW will be well-positioned to fulfill its goal of sustainable coral reef management for years to come.

Table 1: Major Management Elements of the DFW CRMP with Summary Descriptions. The **Action Item Addressed** shows how action items relate to corresponding management elements. See Table 2 for a list of action items for the next ten years. The **Relevant Sections** column shows sections containing information relevant to the element.

CRMP Strategy	Element Description	Action Item Addressed	Relevant Sections:
Element 1: Background & Management Principles	Provides background information on coral reef ecology, policy, and recommendations for general management.	Provides background on all action items.	Introduction.
			Threats to Corals in Saipan.
			Conclusion.
			Appendix A: Project Recommendations.
			Appendix C: Commonly Occurring Corals in the CNMI.
			Appendix D: Funding Sources for Coral Reef Management.
Element 2: Coral Restoration	Documents current coral restoration efforts and analyzes potential issues and opportunities for DFW involvement.	Directly addresses action items 3, 3.1, 3.2, 4, 4.1, 4.2.	Introduction.
			Threats to Corals in Saipan.
			Coral Restoration.
			Conclusion.
Element 3: Addressing SWAP Goals for Corals	Address research and monitoring needs for SGCN coral identified in the CNMI SWAP.	Directly addresses action item 1, 1.1, 1.2, 2, 2.1, 2.2, 4.	Introduction.
			Threats to Corals in Saipan.
			Addressing SWAP Goals and Objectives.
			Conclusion.
			Appendix B: DFW Standardized Survey Methodology
			Appendix D: Funding Sources for Coral Reef Management.
Element 4:			Introduction.

CRMP Strategy	Element Description	Action Item Addressed	Relevant Sections:
Program Building	Provides recommendations to build capacity for DFW's coral reef management and fish habitat programs.	Directly addresses action item 1.1, 1.2, 3, 3.1, 3.2.	Addressing SWAP Goals and Objectives.
			Coral Restoration.
			Conclusion.
			Appendix A: Project Recommendations.
			Appendix B: DFW Standardized Survey Methodology
			Appendix D: Funding Sources for Coral Reef Management

vi. Division of Fish and Wildlife Coral Reef Management Plan Action Items

Table 2: Action Items Derived from this Management Plan with Basic Descriptions. Action items should be accomplished and reevaluated in ten years in conjunction with the CNMI SWAP.

Action 1: Improve data collection and standardize fisheries independent coral reef monitoring methods.	
Action 1.1: Implement 2024 Fisheries Independent Survey and Habitat Assessment Program methodology.	Implement the 2024 Fisheries Independent Survey and Habitat Assessment Standard Operating Procedure to standardize data collection and improve data quality. Consider combining data streams with other agencies who use similar methodologies.
Action 1.2: Centralize DFW data streams to produce MPA and CNMI-wide species lists.	Streamline data management from all DFW Fisheries Research Section programs to develop a holistic view of CNMI resources. Use these consolidated data to produce products like MPA species lists that achieve SWAP objectives.
Action 1.3: Promote MPA long-term monitoring programs.	Assess the feasibility of developing a DFW MPA long-term monitoring program. Support and collaborate with DCRMs Marine Monitoring Team to gather data that demonstrates change over time.
Action 1.4: Increase benthic data collection and improve substrate analysis.	Increase the quantity and quality of benthic substrate data collected during surveys compared to previous procedures. Implement CoralNet as a tool for benthic identification of photoquadrats in accordance with updated survey methodology. Begin trials of structure from motion photogrammetry (see Action 4.2).
Action 1.5: Partner with a laboratory to improve understanding of disease and coral genetics in the CNMI.	Identify a partner pathology and genetics laboratory with the expertise to analyze coral disease and clarify coral taxonomy. Seek funding to support partnership and sample collection.
Action 2: Improve communication and dissemination of research to policy makers, invested stakeholders, and community members.	
Action 2.1: Develop coral ecology-focused materials to support community outreach efforts.	Design educational outreach materials (stickers, posters, hats, etc.) that can be used to supplement existing DFW outreach programs. These materials should be directly relevant to corals, coral reef ecology, fish habitat, and/or habitat connectivity.

Action 2.2: Build coral reef centered community outreach program with publicly accessible coral reef lecture series.	Increase coral reef outreach via a DFW-led lecture series. Free quarterly lectures with partners like DCRM, NMC, and local schools on coral reef-related topics will help build local capacity, increase interest in marine science, and strengthen community relationships.
Action 3: Provide technical support and guidance for existing coral restoration efforts	
Action: 3.1: Assess the feasibility of building partnerships with privately led coral restoration projects.	Conduct feasibility study and stakeholder assessment of developing public-private coral restoration partnerships as defined in Section 4. Further refine DFWs role in managing coral restoration activities through permitting and technical guidance.
Action 3.2: Identify and utilize collaborative funding sources to support existing coral health initiatives. Provide support to restoration projects when necessary.	Identify funding that can be used to support coral-specific projects within the Fisheries Research Section, especially those that can be used collaboratively. Funding should also enable work in line with existing government plans like the CNMI Bleaching Response Plan.
Action 4: Build DFW Fisheries Research Section capacity	
Action 4.1: Recruit positions with expertise in coral reef ecology both locally and internationally.	Recruit qualified personnel to fill positions that increase coral reef management expertise at DFW. Priority positions to fill are: a Fish Habitat Specialist with experience in structure from motion and CoralNet, a Fish Habitat Conservation Biologist with experience in seagrass, macroalgae, invertebrates, and a Technical Guidance Specialist to update regulations pertaining to benthic dwelling organisms. More positions should be hired as needed. Qualified candidates should be hired locally when possible.
Action 4.2: Build in-house infrastructure to support coral and fish habitat programs.	Level-up infrastructure to support goals in above action items. Procure computers and software with sufficient power to support structure from motion analysis. Increase server storage space to hold increasing photoquadrat and structure from motion data. Fund maintenance of existing assets (dive equipment, boats, compressor, trucks, etc.) and procure additional items (new boat, desks, cameras, etc.).

1 Introduction

1.1 Background

Coral reefs are one of the most biodiverse ecosystems in the world. Despite covering just 0.1% of the marine environment, they serve as habitat to a quarter of all known marine species (McAllister, 1995). In the CNMI, coral reefs promote environmental health and provide valuable ecosystem services that residents depend on (Arkema et al., 2015, 2013; Daily, 1997; Eastern Research Group, 2019; van Beukering et al., 2006). The CNMI's reefs generate economic and social benefits in the form of tourism, fishing, coastal protection from typhoons through wave attenuation, cultural and subsistence harvests, recreation, and more.

Figure 1. Healthy Thickets of *Acropora* in Saipan's Western Lagoon. PC: Nicholas Robie

1.2 Coral Reefs: Our Islands

Saipan, the largest and most populous island in the CNMI, exhibits the greatest diversity of marine habitat and reef structures in the islands (Starmer et al., 2008). The western coast of Saipan features an extensive lagoon that consists of a diverse assemblage of marine habitats, including *Halodule* and *Enhalus* seagrass beds, mangrove areas, upright macroalgae zones, patch reefs, and an extensive barrier reef (Houk and Van Woesik, 2008).

Tinian is located directly south of Saipan. The western waters of Tinian contain the most developed reef system around the island, and spectacular coral reefs can be seen off the southwestern coast (Starmer et al., 2008). Almost two-thirds of Tinian is leased by the United States military and defense-related development is increasing. *Aguijan* (Goat Island), a small,

uninhabited limestone island, lies just south of Tinian. Its largest and most developed reefs are off its northwest coast (Starmer et al., 2008).

Luta (Rota) is the southernmost island in the CNMI. It maintains a degree of spatial separation from the rest of the Commonwealth's islands and is about 41 km closer to Guam than Tinian. The island is surrounded by fringing reefs with significant reef development in the northwest and the Sasanhaya Bay area (Starmer et al., 2008).

The ten islands north of Saipan — Farallon de Medinilla, Anatahan, Sarigan, Guguan, Alamagan, Pagan, Agrihan, Asuncion, Maug, and Uracus (Farallon de Pajaros) — are collectively referred to as the Northern Islands and are younger geologically than the southern islands. They are also sparsely populated. Although the Northern Islands provide valuable coral reef habitat in the CNMI, their direct management is outside the realistic realm of actions outlined in this plan due to limited capacity. When feasible, action items detailed from this document should be applied opportunistically to manage and monitor the health of these remote reef areas.

In this plan, DFW will focus on developing the foundations of its coral reef management capacity on Saipan, where agency capacity and natural resource use are greatest. As agency scope increases, the foundations outlined here should be applied broadly throughout the CNMI.

1.3 Local Importance of Coral Reefs

The CNMI relies heavily on coral reefs for fisheries, reef-associated employment, nutrition, reef-associated export, tourism, and shoreline protection (Burke et al., 2011). An economic report from 2019 estimated the value of coral reef tourism to be over $65 million (Eastern Research Group, 2019). Foreign tourism is responsible for up to 64% of the economic value of reefs, although other activities, like commercial and subsistence fishing, also rely on healthy corals (Eastern Research Group, 2019). Coral reefs provide an important source of income to local fishermen as well, generating an average annual value of $719,089 since 2010 (Van Ee et al., 2024).

Outside of their economic value, coral reefs protect island ecosystems and life on land. Wave attenuation from reefs absorbs energy from storms and typhoons, lessening their destructive power (Arkema et al., 2013). Coral reefs also create habitats for enormous communities of organisms, prevent erosion, and have shaped Saipan's shoreline through the formation of an extensive western lagoon. The hard calcium carbonate structures that make up coral skeletons protect life both on land and at sea, safeguarding and providing a home for the CNMI's natural resources.

In addition to their economic and environmental importance, corals are foundational to CNMI culture. The coral reef fishery, for instance, connects people to traditional cultural practices and subsistence activities that subsidize incomes and feed communities. After fishing harvest, it is typical for bounties to be generously shared with friends and family, a process of reciprocity that builds community and facilitates physical, spiritual, and social wellness. Fishing on coral reefs in the CNMI has both intrinsic and extrinsic value and is a source of recreation that keeps people healthy, active, and fulfilled.

1.31 Local Fisheries

The nearshore reef fishery is the second largest of three fishing sectors in the CNMI, accounting for over 200 species and a market average of 36% of commercial landings (Matthews et al., 2019; Van Ee et al., 2024). It is also the most diverse of all fishing sectors in the islands. Nighttime spearfishing is the most common method of extraction, although hook and line, cast net, and gleaning activities also occur (Van Ee et al., 2024).

On Saipan, reef fish can be easily accessed from shore during most of the year, particularly in the shelter of the western lagoon. This accessibility allows fishers consistent opportunities to harvest while the lagoon's diversity of habitat supports the growth of juvenile fish to replenish stocks under sustainable fishing conditions. The east side of Saipan receives fishing pressure from shore, although weather conditions often limit access. Beyond commercial fishing, the habitat that coral reefs provide supports a subsistence fishery that makes up between one-third and one-half of Saipan's total fisheries (Gillett and Fong, 2023; Hospital and Beavers, 2014; Van Ee et al., 2024). In recognition of this importance and promotion of sustainable fishing, Saipan stewards three sanctuaries, Mañagaha, Forbidden Island, and Bird Island, where fishing is prohibited.

Though Tinian has a smaller population than Saipan, fishing activities are also common. Much of the commercial fishing that takes place on Tinian originates from Saipan because of the close proximity of the two islands (M. Tenorio, personal communication, 2024). Both residents of Tinian and visitors utilize the local fishery. Barcinas Bay is the most common area for residents to fish while the windward-side is used by residents, commercial fishers, and visitors alike. The north-side of the island is utilized when weather allows but is less popular due to limited fish habitat structure (M. Tenorio, personal communication, 2024). Fishing around *Aguijan* (Goat Island) occurs when conditions are favorable.

The key fishing area for residents of *Luta* (Rota) is Sasanhaya Bay. This bay is commonly fished because it contains relatively accessible waters, although it also contains the Sasanhaya Bay Fish Reserve where fish harvest is prohibited. Lying adjacent to the fish reserve is the *Tenetu* fringing reef which provides good habitat for fishing and harvesting grounds when the water is accessible (M. Tenorio, personal communication, 2024). On the opposite side of *Luta* (Rota), near the west

harbor, the waters are relatively calm and fishing is common around Puntan Sailigai, Tatechok, Sonton, Teteto, and Tatgua Beach (M. Tenorio, personal communication, 2025). Outside of these areas, boats will fish in any area where weather permits. Commercial fishers from Saipan and Guam take advantage of calm weather to access areas all around *Luta* (Rota), including Alaguan Bay (M. Tenorio, personal communication, 2024).

Compared to fishing in Saipan, Tinian, and *Luta* (Rota), the Northern Islands are less accessible by virtue of distance and sea conditions. However, spearfishing and bottom fishing still occur in the Northern Islands. Commercial and recreational fishers occasionally travel to the Northern Islands from Guam, although most trips originate in Saipan.

Various fishing methods are utilized around the Northern Islands. For example, spearfishing is known to occur near Anatahan, Sarigan, and Guguan. Although harvest in Farallon De Medinilla is now prohibited due to military activity, the island is known for being a choice spot for bottom fishing. This is usually as far north as fishers are willing to travel for their catch because small boats — fifteen feet or less — lack sufficient fuel capacity. Twenty to thirty foot boats can travel as far as Anatahan for bottom fishing, and larger vessels transporting supplies to residents of the Northern Islands often bottom fish or troll along the way for subsistence or profit (M. Tenorio, personal communication, 2024).

1.4 Coral Reef Management Pillars & Players in the Commonwealth of the Northern Mariana Islands

Effectively managing coral reefs and mitigating anthropogenic threats is a priority for reef-dependent communities. Many government agencies are involved in CNMI coral reef management, including the Bureau of Environmental and Coastal Quality (BECQ), Division of Coastal Resource Management (DCRM), Department of Lands and Natural Resources (DLNR), Division of Environmental Quality (DEQ), Division of Forestry (DF), and DFW. These organizations worked collaboratively with federal partners in 2019 to develop four “Coral Reef Management Priorities” for the next 10 years. The priorities provide a framework for developing management goals (*CNMI Coral Reef Management Priorities*, 2019). They are:

1. Land-based Sources of Pollution
2. Climate Change
3. Coral Restoration
4. Fisheries Management

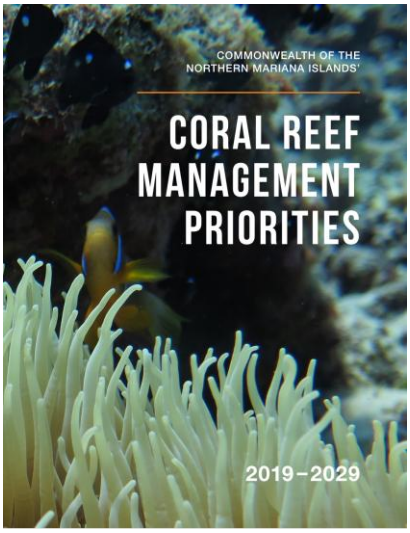


Figure 2. CNMI Coral Reef Management Priorities Provides Management Framework, Goals, and Ecological Information (*CNMI Coral Reef Management Priorities*, 2019).

Because addressing these coral reef management priorities requires myriad approaches, many different agencies and organizations are involved. At the time of writing, the vast majority of coral-specific work done in the CNMI has been led by DCRM, Johnston Applied Marine Sciences (JAMS), Mariana Islands Nature Alliance (MINA), DFW, DEQ, and The National Oceanic and Atmospheric Administration (NOAA). There are many other groups whose scope overlaps with coral reef managers including DF, Office of Planning and Development (OPD), Marianas Visitor Authority, and more. Each of these organizations have plans and objectives that are relevant to coral reef management. OPD's Comprehensive Sustainable Development Plan, which is a guiding document for local government agencies, emphasizes capacity building, management of local threats, increased agency collaboration, and enhancement of resource health through coral conservation. This emphasis tracks well with the 2019 priorities and the goals of this document. Coral reef management has been accomplished through a variety of funding streams, particularly NOAA's Coral Reef Initiative (CRI), State and Tribal Wildlife Grants (SWG), The National Fish and Wildlife Fund (NFWF), and The Wildlife and Sport Fish Restoration fund (WSFR) (Appendix D).

1.5 Existing Local Coral Reef Laws and Regulations in the Commonwealth of the Northern Mariana Islands

Many different government agencies regulate coral reef resources in the CNMI. The following is a list of local environmental laws and regulations that are directly related to coral reef management. Different agencies have distinct jurisdictions over regulations and enforcement. For instance, Public Law 20-79 designates DLNR as the primary agency for its enforcement while Regulation § 65-30-315 is primarily enforced by BECQ. Although this is not a comprehensive list of all marine resource laws and regulations in the CNMI, understanding what

basic coral reef protections exist and who is responsible for them is a good place for managers to begin.

1.51 Public Law 20-79: The Coral Reef Protection Act of 2017

A critical law for coral reef management is Public Law 20-79 (PL 20-79), also known as the Coral Reef Protection Act of 2017 (Coral Reef Protection Act, 2017). This law empowers enforcement agencies to cite fines related to coral reef destruction. Anchoring or otherwise damaging reef areas can initiate enforcement actions from warnings to fines in the thousands of U.S. dollars (USD) per square meter. The law includes a fee schedule for assessing these damages as well. PL 20-79 designates DLNR as the lead enforcement agency for violations, and any fines collected are to be deposited in the Coral Reef Restoration Fund. Here, they can be used for coral reef restoration, protection, education and outreach, or research.

1.52 Public Law 21-28

Public Law 21-28 prohibits the importation, sale, offer for sale, and distribution of sunscreen containing oxybenzone and octinoxate without a prescription. Oxybenzone and octinoxate are two chemicals that have been shown to induce stress and bleaching in corals. Likewise, they have deleterious effects on many other marine organisms' reproduction and development, including shrimp, jellyfish, and fish. Those found guilty of a violation will be subject to a fine between $500 and $1,000 USD in addition to having their illegal sunscreen confiscated. This act is to be enforced by the CNMI Department of Commerce.

1.53 Title 85: Subchapter 30.1. Non-Commercial Fish and Wildlife Regulations

1.531 Regulation § 85-30.1-201

A license is required for the taking of protected fish and game, including precious corals (*Corallim* spp.), hard corals (Scleractinia), soft corals (Alcyonacea), stony hydrozoans such as fire coral (Milleporidae), and any species of fish or marine invertebrates taken by a method or for a purpose regulated by part 400 within this regulation.

1.532 Regulation § 85-30.1-401

The disturbance of coral, dead or alive, is prohibited except in emergencies or by individuals exempt under § 85-30.1-410. For exemption information, see the following section. This regulation also prohibits the use of explosives, poisons, electronic shocking devices, SCUBA, or hookah diving (SNUBA) while fishing.

1.533 Regulation § 85-30.1-410

§ 85-30.1-410 reinforces that all collection and removal of hard corals (Scleractinia), soft corals (Alcyonacea), and stony hydrozoans like fire coral (Milleporidae) is illegal. DFW can issue licenses for the collection of dead coral from beaches for the production of calcium carbonate

afuk from above the lower low water line. DFW can also issue a license for the collection of coral for scientific research purposes. The harvest of *aililing*/*tulompo* (trochus, *Rochia nilotica*), sea cucumber (Holothuriidae), lobster (Nephropidae), and other invertebrates is also regulated under § 85-30.1-415, § 85-30.1-420, § 85-30.1-425, and § 85-30.1-430 respectively.

1.534 Regulation § 85-30.1-450

§ 85-30.1-450 gives DFW the authority to designate marine protected areas in accordance with 2 CMC § 5104(a)(5). Marine reserves prohibit the harvesting of resources, use of bait or attractants, anchoring, any commercial or industrial activity, disturbance of substrate, and dumping of waste, although certain exceptions may be made according to subsections (e) and (f) of the regulation.

1.54 Title 65: Chapter 65-30. Earthmoving and Erosion Control Regulations

1.541 Regulation § 65-30-315

The Division of Environmental Quality enacted this regulation to prohibit earth moving activities and any disturbance of the soil during inclement weather and coral spawning periods. These restrictions limit erosion of soil during this time, thereby decreasing the influx of land-based sources of pollution and sediment into Saipan's lagoon.

Table 3: Action Items and Additional Project Recommendations Relevant to Sub-Section 1.5. See additional information and project recommendations in Table 2 and Appendix A.

Project Name	Goal
Legal Capacity Building	Improve the CNMI's legal ability to regulate natural resources through the recruitment of a policy analyst and/or environmental legal counsel.

1.6 DFW's Role in Coral Reef Management

DFW is mandated to protect "any aquatic [and] marine animal life" (Fish, Game, and Endangered Species Act, 1980). Permitting is a key responsibility for the agency, and any project involving coral restoration, benthic disturbance, or collection of corals must be approved by DFW before it begins. Thus, the enhancement and protection of coral is a critical part of DFW's jurisdictional responsibilities. As such, DFW has the unique power to draft, implement, and enforce laws and regulations that apply to these species. Developing DFW regulations within the scope of existing public laws is the quickest way to change legal policy for protection of coral reefs. New regulations can be developed in-house but must go through a 30-day public comment period before they can be promulgated.

Aside from permitting and regulating, the 2015 SWAP illustrated several management gaps for marine Species of Greatest Conservation Need (SGCN), including three coral species, all staghorn *Acropora* spp., and many species of coral reef dependent fish. DFW has a responsibility to fill these gaps and effectively monitor SGCN to ensure their populations are able to persist (Section 3). As such, this plan is an extension of the SWAP, offering practical solutions to the coral-related needs it identified. Additionally, DFW must collaborate with partners to manage local-controllable threats facing reefs, with the ultimate goal of delisting SGCN and endangered species (Section 2).

The diverse ecological needs of corals necessitate an interdisciplinary approach to stewardship. This document supplies action items, project recommendations, and background information to lay a foundation for DFW's Coral Reef Management Program. It serves as a guiding document to meet the priority objectives of coral SGCN and coral reef ecosystems as described in the 2015 SWAP. It also provides a catalog of identified threats to corals in the CNMI and a framework for general management. By using this plan to build capacity, address threats, safeguard natural resources, and uplift citizens, DFW will make a positive impact on coral reefs and the CNMI community at large.

2 Threats to Coral Reefs in the Commonwealth of the Northern Mariana Islands

There are many threats to coral reefs in the CNMI, including warming ocean temperatures, ocean acidification, pollution, invasive species, severe weather events, and more. The magnitude of these threats can overwhelm resource managers, especially in areas that are still developing their capacity, collaborative relationships, and organizational structure.

For the purpose of bringing these threats to a manageable scale, they have been divided into two categories. The first, dubbed "global uncontrollables," are world-scale phenomena with a root cause that cannot be practically addressed by the CNMI. Warming sea surface temperatures as a result of climate change is an example of a threat in this category. Though issues like this cannot be directly addressed by local work beyond monitoring, modeling, advocacy, and planning, they are still included for context.

The second group, "local controllables," are threats whose root cause is local in origin and able to be mitigated through local action. Examples of local controllable threats include land-based sources of pollution and irresponsible tourism. Over 60% of the world's coral reefs are directly threatened by at least one local threat. (Burke et al., 2011). These threats can be addressed directly through community engagement, scientific collaboration, and policymaking.

While stressors in coral reef ecosystems have traditionally been evaluated independently, it is important to recognize that the cumulative interaction of multiple drivers may have unexpected effects (Hughes et al., 2017).

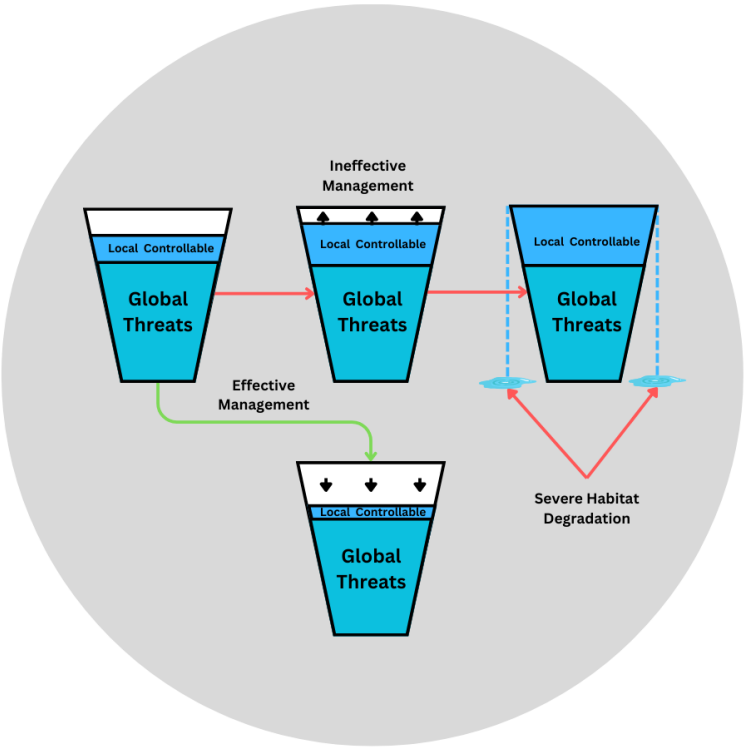


Figure 3. Framework for Management of Environmental Threats

These interactive threats can be visualized as two volumes of water filling a glass. The portion of water representing the impact of local controllable threats can be

decreased with local management. Global uncontrollable threats, in contrast, occupy a discrete amount of space within the glass because they cannot usually be combated by local action alone. Given this, if the portion representing local, controllable threats is reduced enough through effective stewardship, local managers and communities can prevent their 'glass of threats' from overflowing.

To continue improving coral reef management capability, threats to corals should be clearly understood and defined. The following is a list of local and global threats that impact corals in the CNMI. Though this is not an exhaustive or biologically complete description of each threat facing local reefs, it provides useful perspective for present and future managers as they work to address these hazards.

2.1 Global Uncontrollable Threats

2.11 Warming Oceans

As oceans continue to warm, increased thermal stress remains a primary threat to corals globally. Corals live in a symbiotic relationship with photosynthetic dinoflagellates known as symbiodinium or zooxanthellae. These organisms give corals their color while providing around 90% of their nutritional needs (Muscatine, 1990). Symbionts, able to donate up to 95% of their photosynthetic production to their host, are essential for coral health (Muscatine, 1990). When exposed to temperatures beyond their thermal threshold, the symbiotic relationship between corals and symbiodinium breaks down, and symbionts are expelled. This leaves corals without the life-sustaining nutrients provided by their symbionts. This process is commonly known as bleaching because the loss of symbionts reveals the stark white skeleton beneath coral tissue. Corals can survive in a bleached state for some time but will starve if water temperatures do not return to appropriate levels.

Instances of severe widespread bleaching events have been reported in the CNMI in 2000, 2013, 2014, 2016, and 2017 (Heron et al., 2016; Maynard et al., 2018; Raymundo et al., 2019; Reynolds et al., 2014). In relation to these events, an average 67% relative loss of coral cover between 2012 and 2018 was reported after comparative surveys of 35 sites were conducted (Maynard et al., 2015). Additionally, ninety-percent of *Acropora* spp. corals from 17 sites surveyed were reported recently dead, a result attributed to the 2017 bleaching event (Maynard et al., 2018). These reports depict a reality in which multiple severe mortality events have had a negative impact on corals over the last 20 years.

2.12 Ocean Acidification

Ocean acidification is a climate change-related process in which excess CO_2 from the atmosphere is absorbed into the seas, an important global carbon sink. Almost one-third of excess atmospheric carbon dioxide (CO_2) is absorbed by the ocean (Doney et al., 2009). The

transference of excess of CO_2 affects ocean chemistry by reducing pH, the saturation of aragonite, and the availability of carbonate ions (CO_3^{2-}) upon which calcifying organisms, like coral, use to build their skeletons (Burke et al., 2011; Doney et al., 2009). The skeletal density of coral has been shown to be negatively impacted by reduced carbonate availability, a change which has the potential to drive a decline of around 20% of *Porites* spp. in the global tropics due to ocean acidification alone (Mollica et al., 2018). By 2050, only around 15% of coral reefs will be present where aragonite levels are acceptable for growth (Burke et al., 2011). This may cause a shift from coral to algae dominance, an ecosystem effect demonstrated in the CNMI at Maug under volcanically acidified conditions (Enochs et al., 2015). Macroalgae, while an important primary producer in a balanced coral reef ecosystem, can outcompete corals for limited benthic area using physical abrasion, shading, or harmful chemicals to cause coral mortality (Longo and Hay, 2017; McCook et al., 2001).

2.13 Increasing Intensity of Typhoons

Typhoons are an acute disturbance facing coral reef communities. Sustained high winds and wave energy can cause mechanical damage to reefs while precipitation from typhoons can increase land-based sources of pollution (LBSP). Runoff and urban debris, particularly in high-drainage areas, shift nutrient and sediment levels to reduce water quality. High levels of nutrients can cause changes in community ecology by promoting aggressive algal growth, and washed out sediments can settle on coral, smothering them.

Although tropical cyclones are expected to decrease in frequency during the next century as global warming stabilizes the atmosphere, the intensity of typhoons will likely increase in the CNMI (Grecni et al., 2021; Widlansky et al., 2019). A higher likelihood of high-intensity storms means a higher chance of severe typhoon-related disturbance on coral reef ecosystems.

2.2 Local Controllable Threats

2.21 Crown of Thorns Starfish

Acanthaster planci, or the crown of thorns starfish (COTS), is a natural predator of corals that can wreak havoc on reefs during population booms known as “outbreaks” (Kayal et al., 2012). The cause of COTS outbreaks is not well understood, though they are thought to result from high nutrient loads, coral availability, and a lack of natural predators (Great Barrier Park Marine Authority, 2019). In the CNMI, COTS have been observed feeding on *Acropora, Astreopora,* and *Montipora* species (DCRM, 2022).

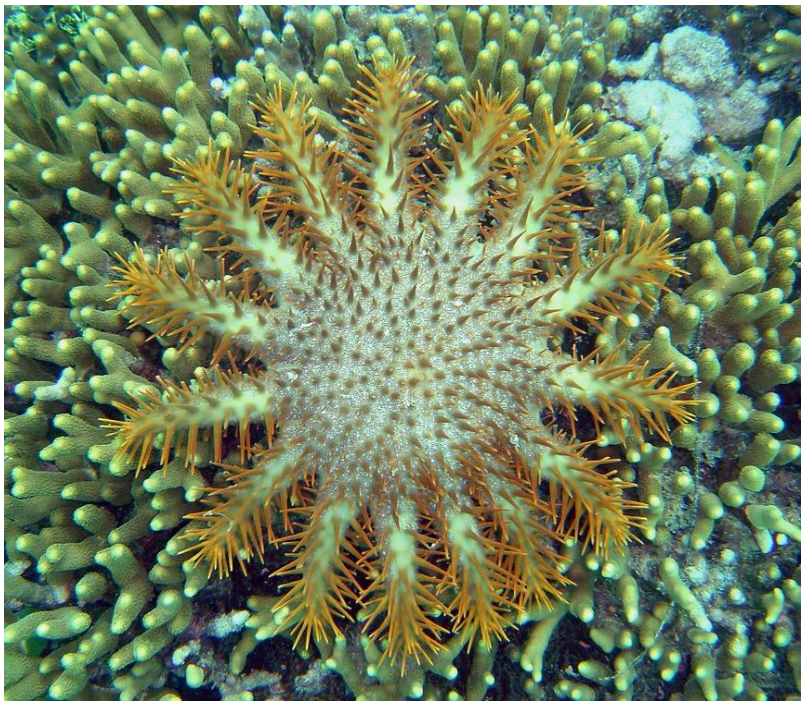


Figure 4. Outbreaks of *Acanthaster planci* Can Cause Severe Damage to Reefs. PC: NOAA Photo Library

The DCRM's Marine Monitoring Team (MMT) monitors *Acanthaster planci* occurrences during surveys. They have observed multiple COTS outbreaks since 2018, and have counted more than 120 and 150 individuals per dive at Bird Island in 2019 and 2020 respectively (Perez et al., 2021). Outbreaks of COTS, starting in 2019, have occurred in densities 48 times higher than the twenty year average (Perez et al., 2021).

COTS can be combated during outbreaks using a quick and cost-effective vinegar injection. The injection is deadly to COTS but has minimal deleterious effects on the surrounding ecosystem. A training was held in Spring of 2023 to share this methodology with resource managers, and a CNMI COTS Response Plan has also been drafted to address these issues (DCRM, 2022). Any activities that promote the removal of native species, like COTS, should be planned and monitored closely to minimize unintended consequences.

2.22 Land-based Sources of Pollution & Development

Development is defined as the "conversion of natural habitats for commercial, residential, or agricultural uses" (Liske-Clarke, 2015). One way that development can impact corals is through a direct event, such as the removal of colonies to dredge a channel. However, development can also be responsible for chronic and indirect effects such as increased runoff, LBSPs, and recurrent sediment plumes. While some marine development in the CNMI directly destroys

corals (i.e. removing corals to build a dock), the greater indirect danger of development lies in LBSPs.

LBSPs are a significant cause of reef declines around the world and are a leading cause of coral reef decline in the southern CNMI (*CNMI Coral Reef Management Priorities*, 2019). LBSPs include sediment, organic matter, herbicides, pesticides, oil, nutrients, sewage, and more. These sources of pollution have been associated with decreased species richness, lower recruit abundance, and overdominance of certain coral species on CNMI reefs (Starmer et al., 2008). LBSPs flow into marine ecosystems through watersheds, particularly during periods of heavy rainfall. These heavy rainfall events are predicted to increase in frequency and severity as climate change progresses (Grecni et al., 2021).

Sedimentation resulting from urban development is another cause of stress for coral reefs. When vegetation is cleared or ground is excavated, land becomes prone to erosion. Without root systems of terrestrial ecosystems to hold the soil together, swaths of sediment are free to run into the ocean. Unpaved roads are also a major source of sediment runoff for this reason. Heavy precipitation during the summer rainy season, coupled with poor stormwater management systems and infrastructure management, contributes to poor water quality for coral reefs. Sediment is especially dangerous for coral reefs because it can decrease light availability while carrying toxins, pathogens, and excess nutrients (Tuttle and Donahue, 2022). These effects can negatively impact coral health throughout their life cycle (Tuttle and Donahue, 2022). In fact, low levels of sediment have the potential to decrease fertilization of coral gametes in the water column (Gilmour, 1999).

Increased dissolved nutrient runoff is another significant LBSP. Loading the water with compounds like nitrogen-nitrate fuels excessive algae growth which can cause coral shading, smothering, and prolonged changes to nearshore water chemistry. These environmental changes stress corals and are associated with the presence of harmful microbes and diseases. Several studies have revealed that high dissolved inorganic nitrogen (DIN) concentrations decrease the diversity and size structure of coral reefs (Houk et al., 2022, 2020; Lapointe et al., 2019; Zhao et al., 2021). DIN enrichment as a result of increased rainfall, and the subsequent runoff, may be an additional stressor that "tips the scale," causing mass bleaching events when water temperatures are high (Lapointe et al., 2019).

Table 4: Action Items and Additional Project Recommendations Relevant to Sub-Section 2.22. See additional information and project recommendations in Table 2 and Appendix A.

Project Name	Goal
Pave Roads	Improve local infrastructure and decrease sedimentation by paving roads and creating drainage catchment systems to limit runoff.

Project Name	Goal
Seagrass Protection and Restoration	Protect, restore, and create legal infrastructure for the protection of seagrass habitat.
Feral Animal Control	Decrease feral animal and pet derived pollution through animal control efforts and community education opportunities.

2.23 Coral Harvest

Live coral is harvested around the world for the aquarium trade, decorative purposes, and the production of *afok* or *bweesch* (slaked lime) used in traditional preparation of betel nut. The take of stony corals (Scleractinia) is currently restricted in the CNMI, although a minimal history of coral harvest exists. Although some anecdotes of take for decorative purposes have been reported, the extent of coral harvest in Saipan is unstudied and thought to be almost nonexistent. Though the extent of coral harvest is not known at present, it should be noted as a potential threat to future reefs. Since corals are far more valuable to the economy in terms of fisheries and tourism, significant coral harvest would have serious environmental and economic consequences and is unlikely to occur in the future.

2.24 Coral Disease

Coral diseases pose a significant global threat to scleractinian corals. Diseases such as Stony Coral Tissue Loss Disease (SCTLD), white band disease, and black band disease have caused massive mortality around the world. In the Atlantic, disease, particularly SCTLD, is one of the most critical threats facing reefs. It is conceivable that SCTLD could proliferate to the Pacific in the future, and the threat of novel disease outbreaks is ever-present.

Figure 5. Unidentified multifocal Growth Anomalies Present on *Isopora palifera* at Pau Pau Beach. PC: Nicholas Robie.

It is difficult to understand the pathology of disease, particularly in the CNMI where there is a lack of sophisticated disease technology and expertise. Little to no work has been done to understand the disease pathology in the Marianas, although observations of growth anomalies, localized bleaching, pigmentation response, focal/multifocal tissue loss, and the presence of ciliates and encrusting sponges, like *Terpios hoshinota*, have often been recorded. Coral disease cannot be adequately described or combatted based on field morphology alone, so increased study and surveillance of disease presence, spread, histopathology, and ecology is a priority of this plan.

Table 5: Action Items and Additional Project Recommendations Relevant to Sub-Section 2.24. See additional information and project recommendations in Table 2 and Appendix A.

Action Item	Description
Action 1.5: Partner with a laboratory to improve understanding of disease and coral genetics in the CNMI.	Identify a partner pathology and genetics laboratory with the expertise to analyze coral disease and genetics to clarify coral taxonomy. Seek funding to support partnership and sample collection in the field.
Project Name	Goal
Coral Disease Assessment Center	Form an intergovernmental coral disease laboratory that is equipped to study coral disease in the Marianas, monitor coral reef health, and lead management of disease outbreaks.

2.25 Fisheries

Unsustainable harvest, particularly of herbivorous animals like parrotfish, surgeonfish, or sea urchins, can cause damage to coral reefs by shifting key ecosystem regulating dynamics. The reciprocal flux between producers (ie. macroalgae and seagrass), and primary consumers (ie. urchins and surgeonfish (Acanthuridae)), is a strong driver for ecosystem function (Brandl et al., 2019). Without herbivores to clear areas of macroalgae overgrowth, excessive algae can dominate reef environments, overcrowding and limiting the benthic space available for corals. These effects are particularly profound post-disturbance, as many coral reef ecosystems become dominated by algae instead of coral (Graham et al., 2015).

Figure 6. A grazing Spotted Parrotfish (*Cetoscarus ocellatus)* roams reefs near Mañagaha. PC: Nicholas Robie

Most attempts at managing fisheries are focused on a particular species or a group of similar species with the goal of maximizing sustainable yields. Few studies have sufficiently investigated the interaction between species functional groups and the reef environment, like changes in fish productivity due to habitat/environmental changes. Future management may benefit from quantifying the value of habitat in terms of fishery productivity to illustrate the value of functional diversity. This will improve the accuracy of fines enforced for coral destruction.

In the CNMI, a diverse group of fishes, including parrotfish (Scaridae) and surgeonfish (Acanthuridae), are targeted in both recreational and commercial fisheries using a variety of methods, including rod and reel, spear, and net. Some methods of harvest, such as traditional gillnet fishing, have been regulated in response to unsustainable take (Van Ee et al., 2024).

Illegal and destructive fishing methods, including chemical fishing and SCUBA spearfishing, pose significant threats to both coral reefs and the broader fishery. Though these methods of fishing are illegal, continued enforcement of fishing activities is important to maintain a healthy and fair fishery. Although the impact of herbivorous fish on reefs is just one driver of coral health, management of these populations has the potential to improve ecosystem dynamics on the whole. DFW is compiling a Fisheries Management Plan that will expand on these issues in the future.

2.26 Irresponsible Use

Corals in the CNMI are threatened by direct physical actions in cases of irresponsible use (i.e. trampling on reefs, ship groundings, and poor anchor management). Several instances of reef degradation as a result have been documented. Harvesters have been recorded using illegal or habitat damaging methods, and abandoned gear, such as nets, has been observed tangled in reef areas.

Beyond harvesting activities, tourism can also play a role in reef degradation. Tourists, for instance, are often seen trampling on top of delicate coral structures in the Mañagaha swim zone, causing severe destruction in some areas. Additionally, the practice of fish-feeding near Managaha is both common and harmful. Other causes of reef degradation may come from irresponsible reef visitors who participate in popular activities such as snorkeling and SCUBA diving. Contact with reefs during SCUBA diving, which can harm corals through skeletal damage or tissue abrasion, is common in many tourist economies (Camp and Fraser, 2012; Krieger and Chadwick, 2012; Luna et al., 2009; Roche et al., 2016). Since repeated stress to popular dive sites can negatively impact coral species over time, increased tourist education and better enforcement of marine conservation laws is important to minimize destruction of natural resources.

Figure 7. Visitors Trample Corals in Mañagaha Swim Zone. PC: Nathan Van Ee

Table 6: Action Items and Additional Project Recommendations Relevant to Sub-Section 2.26. See additional information and project recommendations in Table 2 and Appendix A.

Project Name	Goal
Support and Enhance Tour Guide Operator Program	Enhance the current Marianas Visitor Authority tour guide operator program to bolster ecotourism demand and better educate local businesses, community members, and tourists on environmental stewardship.

2.27 Lack of Sufficient Marine Infrastructure

Marine infrastructure usually serves to increase ocean access for tourism, industry, or the community. In the CNMI, this type of infrastructure commonly includes docks, boat access ramps, moorings, swim zones, and in-water dive lines. This infrastructure can have both positive and negative effects on the benthic environment. For instance, properly installed mooring balls enable boating access to popular areas without risking anchor damage to reefs. Likewise, installed ropes at the Lau Lau and Obyan dive sites on Saipan allow recreationists to pull themselves out of the water safely without coming into contact with the substrate. Fishermen are also known to put out handmade buoys that mark fishing spots and hazards to navigation.

Despite this positive infrastructural development, unregulated moorings may be accidentally placed on, or become tangled in, delicate corals. Likewise, poorly placed swim zone markers may encourage tourists to trample freely on reefs. Even well-intentioned infrastructure can be implemented in ways that damage coral reef habitat. A lack of sufficient and thoughtfully designed infrastructure leads to resource degradation, but strategic placement of interventions like mooring balls and swim zones can prevent it. Local agencies should prioritize communication with tourism operators to improve regulated infrastructure development while minimizing impacts to reefs.

3 Addressing State Wildlife Action Plan Goals and Objectives

This section addresses the 2015 SWAP goals and objectives for SGCN corals. It provides information on designated coral species and offers solutions to address research needs from the 2015 SWAP. Since these objectives will be updated and refined in 2025, the recommendations identified in this section should also be revised as needed to reflect the most up-to-date SGCN priorities.

Although this section includes several improvements to DFW's monitoring program, it is important to remember that monitoring does not equal management. Monitoring is a critical tool that guides managers in decision-making and science communication, but it alone cannot not affect change. Until the root causes of local-controllable threats are adequately managed using information collected from monitoring programs, the CNMI's SGCN will continue to be listed.

3.1 Species of Greatest Conservation Need Corals in the CNMI

There are four groups of Scleractinian corals designated as SGCN in the 2015 SWAP (Liske-Clarke, 2015). These species, rated very highly vulnerable, are *Acropora globiceps, Acropora retusa, Seriatopora aculeata,* and all staghorn acroporids (Liske-Clarke, 2015). Of these, *Acropora globiceps* is the only species listed as threatened under the Endangered Species Act (ESA) within the CNMI region. Globally, *A. globiceps*, *Acropora retusa*, and *Seriatopora aculeata* are listed by the International Union for Conservation of Nature (IUCN) as vulnerable. Another broadly ESA-listed species, *Pavona diffluens,* was recorded in the CNMI during NOAA-funded surveys conducted in 2018 by the Marine Applied Research Center LLC (Maynard et al., 2018). Despite these findings, this species has yet to be officially confirmed in the CNMI, and it remains unlisted locally. This section's primary goal is to address the long-term objective, 10-year objective, priority actions, and research monitoring needs detailed in the SWAP.

Table 7: State Wildlife Action Plan Threat Ranking Table for Coral Species of Greatest Conservation Need. The threat ranking for each species is very high (VH).

Chamorro	Carolinian	English	Type	Bioscore[1]	Threat Ranking[2]
Kuraling	Yeal	*Acropora globiceps* Coral	Coral	23	VH
Kuraling	Yeal	*Acropora retusa* Coral	Coral	23	VH
Kuraling	Yeal	*Seriatopora aculeata* Coral	Coral	15	VH
Kuraling	Yeal	All Staghorn Corals[6]	Coral	23	VH

The three corals identified to species level, *A. globiceps, A. retussa,* and *S. aculeata*, are species which have been broadly listed under the ESA. Each ESA-listed species has the same management and research objectives as defined in the SWAP. The long-term objective is federal delisting and the 10-year objectives are to:

- Maintain or increase abundance and distribution of species across the CNMI.
- Collect baseline information needed to refine objectives.

The priority actions for these species are to determine their distribution and abundance across the CNMI. Additionally, the research and monitoring needs are to:

- Assess potential species-specific impact of land-based sources of pollution.
- Assess feasibility of propagation and seeding.
- Develop and implement a species-specific monitoring protocol.

The fourth group of coral identified in the SWAP as an SGCN is commonly known as "staghorn coral." Staghorn species, in the genus *Acropora,* are branching and shaped like deer antlers (Fenner, 2021). The staghorn species explicitly detailed in the 2015 SWAP include *A.* cf. *pulchra, A. austera, A. aspera, A. muricata,* and *A. intermedia* (Liske-Clarke, 2015). In a field guide to the Marianas, other staghorn species are identified as *A. vaughani, A. palmerae,* and *A. abrotanoides* (Fenner, 2021). Although staghorn corals can be found in many different environments, they often form large thickets in clear shallow waters with high oxygen, light availability, and moderate to high wave energy (Wallace, 1999).

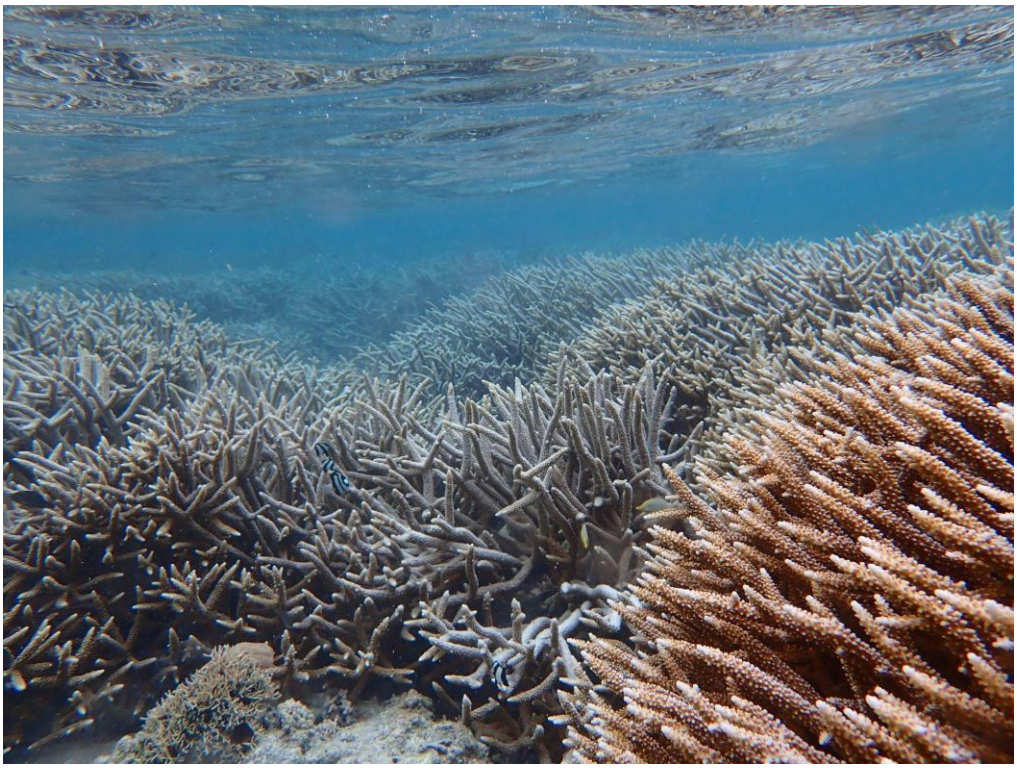


Figure 8. Healthy Staghorn *Acropora* Thicket at Pau Pau Beach. PC: Nicholas Robie

The long-term objective for staghorn corals is not included in the SWAP, though the 10-year objectives are as follows:

- Maintain existing staghorn coral cover in southern islands (Saipan, Tinian, Aguiguan, and Rota).
- Collect baseline information needed to refine the objective.

The priority actions for staghorn corals are to develop a coral propagation and restoration program and to implement appropriate conservation and management regimes. The research and monitoring needs are to:

- Assess potential species-specific impact of land-based sources of pollution.
- Evaluate potential impacts of fish harvest on reef resilience.
- Continue existing coral monitoring programs.

Overall, the SGCN-specific actions for corals outlined by the SWAP can be summarized in the following three items:

- Develop a monitoring program for SGCNs that incorporates estimates of presence, abundance, and distribution.
- Assess and enhance current coral restoration efforts in the CNMI.

- Combat local-controllable threats to coral reefs.

In addition to these species-specific objectives, the SWAP also outlines several other areas of action regarding coral health. The following recommendations are addressed both in this section and in Appendix A: Project Recommendations.

- Install and maintain signage at all marine protected areas (MPA) communicating responsible and allowable uses.
- Maintain a current list of all fish, invertebrate, and coral species present in each MPA; develop a data management system to track annual presence/absence information and streamline updates to the checklist.
- Tour guide certification program for companies operating in the MPA.
- MPA in-water buoy demarcation and management.
- Establish a coral nursery with the infrastructure and staffing expertise needed for propagation and seeding of corals, including ESA-listed corals.
- Determine the presence, abundance, and distribution of SGCN/ESA-listed coral
- Prioritize staghorn coral sites and implement appropriate management.
- Continue implementation of watershed management plans in Garapan, Lau Lau, Achugao, and Talakhaya.
- Map the sources and distribution of pollutants in the Saipan Lagoon in relation to pollution-sensitive marine SGCN; target actions in locations that can most benefit SGCN.

It is appropriate to label these SGCN as highly vulnerable, even though there is a lack of species-specific data present in the literature. There was an average 67% relative loss of coral cover between 2012 and 2018 reported after comparative surveys of 35 sites were conducted, though these surveys were not done along exactly the same transect line between years (Maynard et al., 2018). Of 35 sites surveyed, 10 of them contained ESA-listed *A. globiceps* and 7 sites had a prevalence of a coral that appeared to be *P. diffluens*, a species that is ESA-listed but is not yet confirmed in the CNMI (Maynard et al., 2018). The same study reported 90% mortality of *Acropora* spp. from the 2017 bleaching event alone, though this figure comes from a relatively small sample size (n=17) (Maynard et al., 2018).

Despite the available reports, there remains a need for more coral reef ecosystem monitoring in the CNMI. In addition to monitoring, threats to coral species must be managed in order for recovery to occur. Though the SWAP specifically highlights SGCN, a majority of the objectives and actions listed can apply to the coral reef ecosystem as a whole because many species share similar biological needs.

Table 8: Action Items and Additional Project Recommendations Relevant to Sub-Section 3.1. See additional information and project recommendations in Table 2 and Appendix A.

Project Name	Goal
Genetic Taxonomy	Partner with an outside organization to improve coral species taxonomy and field identification through genetic analysis.

3.2 Coral Reef Monitoring Methodology

3.21 Fisheries Independent Surveys and Habitat Assessments

In conjunction with the development of this plan, DFW has updated its standard operating procedure (SOP) for fisheries independent surveys and habitat assessments (FISHA24) to better address the research and monitoring goals of the 2015 SWAP (Robie and Van Ee, 2024). These modifications were designed to match closely with NOAA's Rapid Ecological Assessment procedure while also satisfying CNMI-specific needs (Ayotte et al., 2015; Liske-Clarke, 2015).

The new FISHA24 methodology gathers many different kinds of data, including percent coral cover, fish biomass, and invertebrate counts, to provide a snapshot of ecosystem health and function. These habitat-stratified surveys reflect the importance of benthic cover and invertebrates on ecosystems by including habitat visual assessments, counts for a greater diversity of invertebrates, and five times as many photoquadrats as previous procedures. Photoquadrats will be analyzed using CoralNet with label sets that are compatible with other monitoring programs in the CNMI. Structure from motion (SfM) photogrammetry will also be tested for use at sites of special significance and for long-term monitoring (Section 3.23).

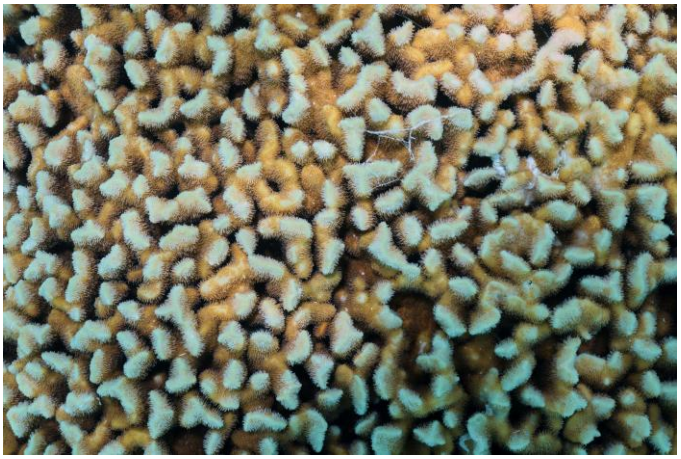


Figure 9. *Pavona cf. frondifera* Encountered During 2023 Southern and Central Lagoon Surveys. PC: Nicholas Robie

This updated survey method was designed to work in a variety of contexts, including regular surveys, ship grounding response, and long-term monitoring. The 2024 Fisheries Independent Surveys and Habitat Assessment Procedure will be the primary method used to maximize DFW's capacity for agency projects. Fiscal years 2024 and 2025 will utilize the new survey methodology to conduct assessments of the northern lagoon and the western forereef of Saipan. These surveys will continue in the future to encompass all areas of interest in the CNMI. To meet the monitoring goals outlined in the SWAP, surveys will include searches for ESA-listed coral species to determine presence, abundance, and density of species at each site.

When ESA-listed species are found within a four meter belt transect, their photos will be taken to confirm identification (ID). ID to lowest taxonomic level, maximum diameter, evidence of disease, estimates of percent old partial mortality, and bleaching extent (%) and severity if applicable (1 = slight paling, 2 = significant pigmentation loss, and 3 = total pigmentation loss) will be recorded (Couch et al., 2021). Presence/absence will also be marked for SGCNs observed outside of the immediate survey area.

By incorporating coral-specific data collection into consistent survey regimes, DFW is well-positioned to make progress on the monitoring objectives stated in the SWAP. These efforts will also contribute to understanding fishery, habitat, and ecosystem health. The data compiled through this program will fulfill many of the 2015 SWAP's research needs, providing DFW with estimates of SGCN presence, abundance, density, and distribution.

Table 9: Action Items and Additional Project Recommendations Relevant to Sub-Section 3.21. See additional information and project recommendations in Table 2 and Appendix A.

Action Item	Description
Action 1.1: Implement 2024 Fisheries Independent Assessment Program methodology.	Implement the 2024 Fisheries Independent Survey and Habitat Assessment Standard Operation Procedure to standardize data collection and improve data quality. Consider combining the data stream with other agencies who use similar methodologies.
Action 1.4: Increase benthic data collection and improve substrate analysis.	Increase the quantity and quality of benthic substrate data collected during surveys compared to previous procedures. Implement CoralNet as a tool for benthic identification of photoquadrats in accordance with the updated survey methodology. Begin trials of structure from motion (see Action 4.2).
Action 4.1: Recruit positions with expertise in coral reef ecology both locally and internationally.	Recruit qualified personnel to fill positions that increase coral reef management expertise at DFW. Priority positions to fill are: a Fish Habitat Specialist that has experience with structure from motion and CoralNet that can conduct benthic analysis, a Fish Habitat Conservation Biologist with experience in seagrass, macroalgae, and invertebrates that will improve analysis of habitat connectivity and update regulations pertaining to benthic dwelling organisms. More positions should be hired as needed.

	Qualified candidates should be hired locally when possible.
Action 4.2: Build in-house infrastructure to support coral and fish habitat programs.	Level-up infrastructure to support goals in above action items. Procure computers and software with sufficient power to support structure from motion analysis. Increase server storage space to hold increasing photoquadrat and structure from motion storage. Fund maintenance of existing assets (dive equipment, boats, compressor, trucks, etc.) and procure additions to support program goals (new boat, desks, cameras, etc.).

3.22 Marine Protected Area Species Lists

The SWAP describes a need to create an annually updating list of all fish, invertebrates, and coral species present in MPAs. DFW currently maintains a list of CNMI fish species that have been recorded inside of MPA's, and DCRM has long-term monitoring data from MPA's. However, a centralized database for coral species and other invertebrates has yet to be implemented. Compiling data from different organizations that conduct surveys in MPAs is the best way to compile a species list while using minimal resources. That said, future planning initiatives should assess whether the benefits of producing a species list product justifies the effort.

Outside of consolidating data to compile species lists, routine roving MPA surveys could play a role in collecting presence/absence information (Bravo et al., 2023). They could also facilitate ID training for DFW staff. However, the roving survey method presents several complications including data biases and high operational costs. Designing a roving survey program for the sole purpose of generating a species list is not the best use of resources because the data collected would lack context and have a high likelihood of being biased by effort and skill level.

A more effective approach to gathering this information would be to include management areas in the updated FISHA24 SOP previously described. The FISHA24 procedure is based loosely on the procedure carried out during surveys in 2023, which was used to assess fish and habitat throughout Saipan's south and central lagoon. Extending these surveys to include in-depth studies of MPA's will create a repository of high-quality data that can be utilized for making future management decisions. When funds and timing permit, data should be gathered from the Northern Islands as well. This approach, combined with other survey strategies (Sections 3.23 and 3.24) is an effective way to fulfill the SWAP objectives while evaluating the health of the CNMI's protected areas.

Table 10: Action Items and Additional Project Recommendations Relevant to Sub-Section 3.22. See additional information and project recommendations in Table 2 and Appendix A.

Action Item	Description
Action 1.2: Centralize DFW data streams to produce MPA and CNMI-wide species lists.	Streamline data management from all DFW Fisheries programs to develop a holistic view of CNMI resources. Use these consolidated data to produce products like MPA species lists that achieve SWAP objectives.

3.23 Marine Protected Area Long-Term Monitoring Program

DFW should collaborate with or develop a long-term monitoring program (LMP) to evaluate the effect of disturbance on coral reefs over time, particularly in management areas. When sufficient capacity is achieved to support a new survey program, DFW should collaborate with DCRM's MMT to designate multiple areas within each MPA that are suited to long-term observation. The DCRM MMT currently surveys close to 60 long-term monitoring sites at least once every two years. Since DFW is the primary agency responsible for MPA management, developing or working with a long-term monitoring program that evaluates ecosystem changes in MPAs is appropriate. Temporal monitoring of sites allows resource managers to track changes over time and adjust strategies to fit current management needs.

If collaboration is not deemed to be feasible, a stand-alone LMP may be developed. Selected areas should be representative of overall MPA habitat. These monitoring sites must be pre-scoped and presented to DFW staff for comment. DCRM's MMT and other coral-adjacent natural resource agencies and NGOs should also be given the opportunity to provide feedback to optimize site selection.

Once sites are selected, markers should be permanently affixed to the substrate and clearly marked. Proper permits must be obtained prior to fixing permanent markers to substrate. Markers should be 30 meters apart and contain labels with arrow headings in the direction of the opposite marker. A 30-meter transect line can then be run between markers, ensuring that repetitive surveys occur along exactly the same area. Water quality sensors should also be affixed at each site to evaluate the effect of ocean conditions on reef habitat.

LMP sites should be resurveyed *at least* once every two years, though more frequent monitoring is highly encouraged when feasible. Repeat monitoring of sites should also take place in relation to disturbances. For instance, it is critical to conduct surveys with high frequency through COTS outbreaks and coral bleaching events, or after typhoons. Having a high quantity of surveys

conducted at these sites will minimize the risks of data misinterpretation due to seasonal variation.

There have been previous efforts to collect data along a time gradient in the CNMI's MPAs, but these projects have ultimately suffered from a lack of standardization and methodological inconsistencies. For long-term monitoring to be worthwhile, survey protocols must be standardized, and data quality must be high. Staff should be provided with training and resources to ensure that the level of data quality is maintained year after year. The FISHA24 SOP details strategies and training methods to bolster staff readiness (Robie and Van Ee, 2024). If collaboration with MMT is deemed feasible, survey approaches should match. Otherwise, the FISHA24 method should be utilized for data collection. Structure from Motion (SfM) photogrammetry should also be collected if technological capacity is available to support it.

SfM photogrammetry is a technique that creates a three-dimensional (3D) model of coral reefs from a collection of images taken from different perspectives. The quality of this model is dependent on the camera used, height/depth of photocapture, and other factors. The size of the area will determine the amount of field time needed to complete data collection. SfM photogrammetry is useful for analyzing reefs in high resolution with limited field time, and there is little methodological bias between SfM and field-based data collection (Couch et al., 2021). Though there is not currently sufficient capacity to effectively compile and analyze SfM data in-house, SfM data will become an invaluable resource in the future. Collaboration with groups that actively use SfM in their surveys should be explored to generate new models of CNMI reefs. A recently installed DFW server system has the storage capacity to begin storing these files, so these data should be collected and efforts to develop DFW's SfM program should continue.

Table 11: Action Items and Additional Project Recommendations Relevant to Sub-Section 3.23. See additional information and project recommendations in Table 2 and Appendix A.

Action Item	Description
Action 1.3: Promote MPA long-term monitoring programs.	Assess the feasibility of developing a DFW MPA focused long-term monitoring program. Support and collaborate with DCRMs Marine Monitoring Team to gather data that demonstrates change over time.
Project Name	**Goal**
MPA Signage	Clarify public knowledge of MPA bounds and improve MPA rule compliance.
MPA Buoy Management	Record an inventory of legal moorings in MPAs, manage them, and design, install, and maintain clear markers of MPA area bounds.
MPA Clean Up Program	Decrease the amount of debris at MPAs while fostering community engagement through the development of community clean-up programs.

3.24 Bio-Blitz, Citizen Science, and Community Engagement

In addition to professional scientific surveys taking place in the CNMI, there is also a need for expanded community engagement and intergovernmental collaboration. DCRM's Eyes of the Reef program focuses on training community members to identify and report threats to corals, but there is a need for more engagement between scientists and local stakeholders. An interagency-led citizen science-focused "Bio-Blitz" can accomplish the dual objectives of community engagement while collecting the presence/absence data prescribed by the SWAP.

A "Bio-Blitz" is a monitoring project in which community members are trained to identify marine organisms. Participants record what they find, take pictures of organisms they can't identify, and learn about the ecosystems hiding away in their "backyard." Bio-Blitz events and other citizen science-centered activities serve a critical role in involving and educating community members on environmental concerns. Data collected is non-specific but can provide useful information on general ecology and topics of public interest.

Accurate taxonomic identification, particularly for corals, remains a challenge. Luckily, there are several existing citizen science frameworks readily available to the CNMI. The website iNaturalist is a platform that utilizes photo uploads and online ID confirmations to demonstrate the distributions of species. Volunteer contribution to a CNMI iNaturalist community, with biologists providing higher level taxonomic identification to images, is one way to structure a Bio-Blitz program. One limitation of using photos for marine image identification is the reliance on underwater cameras, which can be a barrier to participation.

The Reef Environmental Education Foundation (REEF) also facilitates citizen science through roving fish surveys and identification workshops globally but without the use of cameras (Greenberg et al., 2024). Rather than take images of fish seen during surveys, participants record their findings on underwater paper. Observers study fish identification independently with the use of REEF educational materials and can take tests to demonstrate increases in their ability. REEF's process is unique in that it separates observer data by experience and skill level, providing a confidence measurement for assessing data quality.

It is worth considering the public an integral part of broad-scale data collection in areas of limited capacity like the CNMI. Giving community members an active role in environmental management creates buy-in and improved understanding of the environmental, social, and cultural issues of conservation. To facilitate this, DFW will increase public awareness and build bridges through a publicly accessible lecture series held at quarterly intervals. Here, experts from DFW, partner organizations, and the public will give engaging presentations on current research

and topics in marine science. The purpose of these quarterly seminars is to allow scientists, managers, and community members the opportunity to learn more about the CNMI's shared resources, ultimately creating connections with one another that will translate to sustainable stewardship.

Table 12: Action Items and Additional Project Recommendations Relevant to Sub-Section 3.24. See additional information and project recommendations in Table 2 and Appendix A.

Action Item	Description
Action 2.1: Develop coral ecology-focused materials to support community outreach efforts.	Design educational materials (stickers, posters, hats, etc.) that can be used to supplement existing DFW outreach programs. These materials should be directly relevant to corals, coral reef ecology, fish habitat, and/or habitat connectivity.
Action 2.2: Build coral reef centered community outreach program with publicly accessible coral reef lecture series.	Increase coral reef outreach via a DFW-led lecture series. Free quarterly lectures with partners like DCRM, NMC, and local schools on coral reef-related topics will help build local capacity, increase interest in marine science, and strengthen community relationships.
Project Name	**Goal**
Coral Reef Scholars Program	Develop local capacity and provide educational opportunities through a college internship program focused on marine biology related topics.
Coastal Art Collaborations	Improve community awareness and generate "buy-in" to coral reefs by involving local artists through muraling, government-sponsored art classes, and community-centered art projects.

3.25 Water Quality Monitoring

Land based sources of pollution (LBSP) are a primary threat to coral reefs locally and globally (Houk et al., 2022; Lapointe et al., 2019; Zhao et al., 2021). A threshold of 0.10 mg/1 DIN has been identified in both American Samoa and Guam as the limit beyond which coral reef ecosystems are negatively impacted (Houk et al., 2020). The DIN collected during the Guam study was over 85% nitrate, a compound that causes oxidative stress in corals and impairs the coral-symbiont relationship (Houk et al., 2022; Zhao et al., 2021). This stress, in combination with high water temperatures, may be a driving factor in increasing the likelihood of mass bleaching events (Lapointe et al., 2019). Thus, water quality monitoring and management is an essential component of coral reef management.

BECQ's DEQ is the primary agency responsible for monitoring water quality in the CNMI, and they produce comprehensive reports that describe their work (Yuknavage et al., 2022). In addition, DCRM's MMT collects water quality data at their long-term monitoring sites. DFW monitors water quality throughout survey periods as well, although the metrics collected are less specific than DEQ's. DFW sensors are placed at strategic locations within the survey area to better contextualize diver collected data (Figure 2). All of DFW's eleven sensors collect temperature. Two of those sensors also collect pH, and one sensor collects conductivity data. Sensors are typically deployed for four to six months at a time and their data is retrieved bi-weekly. After a project is completed, sensors are removed and returned to the lab for routine maintenance and calibration. Though these sensors collect valuable information during the survey period, they do not provide adequate data for long-term analysis.

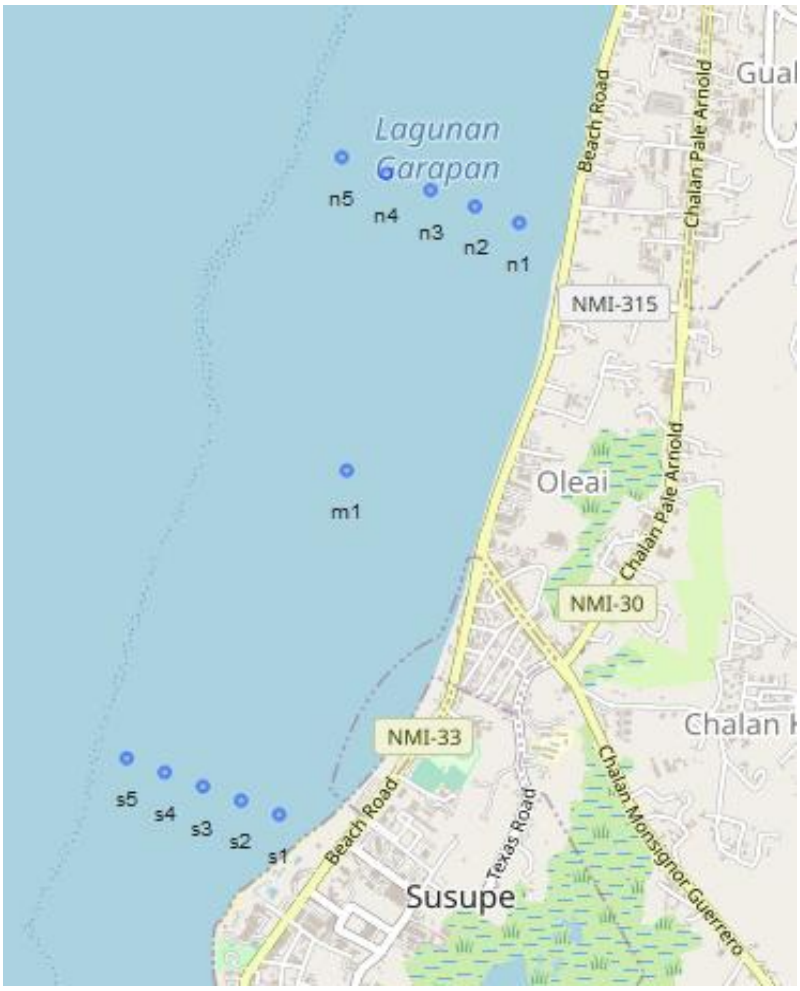


Figure 10. Location of Eleven Water Quality Sensors During FY23 Southern and Central Lagoon Surveys. Source: DRAFT: FY23 Fish Habitat Surveys Technical Report

To better understand the effects of local water quality on coral reefs, DFW should pursue longer-term monitoring efforts with a larger sensor array. Conductivity, temperature, salinity, dissolved oxygen, turbidity, nutrient levels, and pH should be recorded. These sensors should be placed in areas of importance to fisheries, including MPA's and essential fish habitats. They should also be deployed to reflect areas of interest including freshwater inputs, currents, and development zones.

4 Coral Reef Restoration

4.1 Background and Approach

Coral restoration is a relatively new field that has become increasingly popular among both resource managers and the public as widespread reef degradation occurs globally. In the CNMI, coral reef restoration has been identified as a management priority due to observed declines of coral reef areas (*CNMI Coral Reef Management Priorities*, 2019).

Reef restoration can take two different approaches, known as active or passive restoration. Active restoration directly alters reef areas through methods like direct coral transplantation, micro-fragmentation, gamete collection & larval-seeding, artificial structure building, and creation of electrified reef biorock structure (Shaver et al., 2020). Passive restoration, on the other hand, focuses on improving ecological conditions like water quality to naturally repopulate reefs. In most cases, the goal of restoration is to rehabilitate coral reefs to the health, structural complexity, and community composition that existed before impacts of acute and/or chronic disturbance.

While restoration is becoming a popular form of reef management, adequate planning and cost-benefit analyses are often lacking. Before beginning a restoration project, it is important to clearly define specific goals and address risks and limitations associated with restorative work. In all cases, any local controllable factors that caused or contributed to original coral stress and mortality must be addressed prior to restoration activities. Ill-informed restoration efforts can waste very limited resources and may even be detrimental to ecosystems. If genetic and functional diversity are not considered, for instance, restored reefs may be less resilient to threats such as ocean warming and disease in the future. Additionally, while existing restoration technologies and approaches can have positive environmental and social effects on small scales, they are not currently developed enough to have significant impacts on larger ones (Hughes et al., 2017). Overall, restoration should be viewed as a tool in the toolbox of coral reef management, and efforts should be monitored and refined to maximize effectiveness (Huntington et al., 2024).

In the CNMI, coral reef restoration may be effective in the short-term if it is targeted toward high-value sites of economic, cultural, and/or ecological importance where small-scale activities may have more impact. Restoration of reefs that have experienced an acute disturbance, such as a ship grounding, may also be appropriate. The CNMI's Coral Reef Protection Act of 2017 includes the creation of a Coral Reef Restoration Fund that collects money from fines to fund projects like these (Coral Reef Protection Act, 2017). All potential restoration sites should be identified and pre-evaluated to assess feasibility, likelihood of success, and value of restoration in terms of ecosystem services provided (Huntington et al., 2024; Shaver et al., 2020).

Engaging community members in coral reef restoration can be as environmentally impactful long-term as the restoration itself. Hands-on restoration of shared resources spreads awareness for the threats facing ecosystems, creating a sense of responsibility that fosters environmental stewardship. Restorative activities give communities a stake in the management of their environment, thereby encouraging a culture of care applicable to myriad environmental issues. When a person is given the opportunity to cultivate coral fragments themselves, they are more likely to develop a personal connection to the health of their community's reefs. This deeper understanding can inspire additional actions, like cleaning up litter on the beach or lobbying for watershed protection. Involving volunteers and students also eases strain on staffing resources to support larger projects.

In conclusion, coral restoration in the CNMI may be an appropriate strategy for areas that are of particular importance economically, culturally, or ecologically and for sites that have been impacted by acute disturbances such as ship groundings. The CNMI government should prioritize mitigating local-controllable threats, particularly land-based sources of pollution, ahead of limited restoration efforts. Coral restoration has its greatest long-term potential in fostering opportunities for education and community outreach. Direct volunteer-supported rehabilitation of reefs bonds the ecosystem to community members, inspiring continued action and advocacy for the environment.

4.2 Status of Local Coral Restoration Efforts

Restoration efforts in the CNMI began in 2019, largely in response to severe coral bleaching and mortality events that occurred from 2013-2017. There are currently two main coral restoration programs in the CNMI: one managed by the local government and the other by an NGO. All coral restoration work is currently based on Saipan. The CNMI government facilitates a Coral Restoration Working Group (CRWG) that meets regularly and fosters communication and collaboration among these programs and other local stakeholders. The CRWG is managed by the Coral Restoration Coordinator, who is based at DLNR. The following sections 4.21 and 4.22 will provide a brief overview of the CNMI's two active coral restoration programs. Section 4.23 points out challenges and solutions to government-led projects and makes suggestions for DFW involvement in future coral restoration efforts.

4.21 Privately-Led Coral Restoration

4.211 Johnston Applied Marine Sciences Coral Restoration Overview

Johnston Applied Marine Sciences (JAMS) was the first entity to develop a coral restoration program in the CNMI. They launched a pilot nursery in 2018 in collaboration with NOAA, DFW, and other groups, and they have funded their work with increasingly larger NOAA grants to date. JAMS is a private organization and is the most developed contributor to the CNMI's

coral restoration portfolio at the time of writing. The JAMS team, led by Dr. Lyza Johnston, manages an extensive off-shore nursery, is actively developing a large land-based nursery, and has just installed an in-land coral spawning and settlement system. JAMS has quickly developed the capacity to maintain a diversified approach to restoration and is researching the efficacy of novel practices.

JAMS regularly engages with the CNMI government and broader community. They offer volunteering opportunities and regularly attend and contribute to CRWG meetings. They are known to keep the government, community, and compliance organizations informed about their progress and are regular presenters at conferences and community events. They have offered support to other coral-related programs on several occasions and are willing to share expertise and lessons learned with the broader CNMI community.

4.212 Offshore Nursery

The JAMS coral nursery currently consists of 25 coral tree structures and eight tables. An additional 15 trees and two tables will be added by the end of 2024. The JAMS nursery is located in the Saipan lagoon, just east of Mañagaha Island, and it currently houses approximately 2,200 corals representing 12 species from five genera, including three species of SGCN-listed *Acropora.* With the impending nursery expansion, JAMS will increase the number of species they keep and actively propagate for restoration. The JAMS nursery is maintained regularly, in compliance with permits, and in good condition.

In addition to asexually propagated corals in the nursery, JAMS is growing thousands of sexually produced juveniles from gametes collected during coral spawning events. They have succeeded in sexually propagating five species thus far and will begin efforts to start land-based sexual propagation of SGCN and ESA-listed *Acropora globiceps* within the next year. These efforts fulfill recommendation 7.2.3.5 from the SWAP to establish a coral nursery with the infrastructure and staffing expertise needed for propagation and seeding of corals, including ESA-listed corals (Liske-Clarke, 2015).

4.213 Land-Based Nursery

Previously, JAMS has cultured coral larvae and sexual recruits for short periods of time during the summer in a land-based facility using a small, low-tech recirculating seawater system. However, with new funding, JAMS is in the process of building a permanent land-based coral aquaculture facility with over 2,000 gal of capacity. This facility will support both asexual and sexual coral propagation for restoration and applied research. It will also provide additional educational and outreach opportunities as it will be more easily accessible to the community than offshore systems. This expansion allows for coral growth and propagation outside of the confines of offshore nurseries which can be difficult to access and more vulnerable to inclement weather.

4.214 Land-Based Spawning & Settlement System

Additionally, JAMS has recently procured two coral spawning systems from the United Kingdom-based Coral Spawning Lab, Ltd. These systems represent cutting-edge technology that allow control of environmental parameters including temperature, day length, and moon-phase. By controlling these factors, the coral spawning cycle can be manipulated so that the corals spawn more often and/or at different times of the year and day. This will be the most advanced coral restoration system in the CNMI. The sexual propagation of ESA-listed species in this spawning system will be critical to achieving conservation goals in the coming years.

4.215 Research and Development

Though JAMS is rapidly expanding their scope of work, there is an ever-present need for increased nursery and outplanting capacity to effectively restore reefs that have experienced mortality and damage over the last decade. JAMS develops and researches novel restoration techniques and shares what works with the community, promoting evidence-based practices tailored to the CNMI. There are a number of additional research projects that JAMS supports or leads which also provide valuable information to managers.

4.22 Government-Led Coral Restoration

DCRM established an in-water coral nursery in Saipan's lagoon in 2020 that is known as the "Government Nursery," although this name may change in the near future. The Government Nursery houses six coral trees and two tables. It focuses primarily on fast-growing coral taxa including *Acropora* spp., *Isopora* sp., and *Pocillopora* spp. It also houses a few "corals of opportunity" representing other species that were found broken and unattached to the substrate. As of July, 2024, a portion of the nursery trees are actively in use, and there has been one trial outplanting that resulted in low survivorship.

Although the Government Nursery is an important component of the CNMI government's coral reef management portfolio, it has had to overcome several hurdles including inconsistent project leadership and limited local capacity. Many of the challenges facing the Government Nursery are not CNMI specific. Rather, they are difficulties generally associated with high maintenance government projects. Section 4.3 details many of the specific challenges facing government-led coral restoration projects and identifies solutions to them. It also considers the feasibility of DFW involvement in an independent coral restoration program.

Overall, the government-led restoration program has made significant progress through the development of management plans, a draft coral reef restoration action plan, and coordinating collaboration at inter-organizational meetings. The CNMI government is positioned to continue development of restoration infrastructure through the identification of restoration sites, methods, and priorities to begin outplanting in earnest within the next several years. Implementing

solutions to the challenges described in Section 4.3 will be critical to ensuring success for government-led restoration programs.

4.3 Challenges and Solutions for Government-led Programs and The Division of Fish and Wildlife's Role in Coral Restoration

Assessing the feasibility of developing a coral restoration program at DFW was a primary objective of this document. Although government involvement in coral restoration has advantages and can be worthwhile, these programs also face significant challenges. Many of these issues are not CNMI-specific but rather affect governments of all kinds and at all levels. Consistency in project management, long hiring times, procurement delays, and overall limited capacity make high-maintenance projects requiring nimble management difficult without effective, consistent, and proactive leadership.

Quick replacement of damaged nursery structures, for instance, is important for coral survival. Yet, time-intensive government purchasing processes and shipping delays to the CNMI can impede the arrival of critical materials. Using proactive management techniques and having sufficient funding to anticipate problems can minimize these issues. Pre-purchasing and stockpiling extra materials decreases administrative burden and reliance on quick procurement as well. Clearly budgeting and planning for common maintenance problems enables agencies to react quickly when they arise. In addition, contracting or subawarding outside organizations to assist with project support can speed up purchasing. By taking a proactive management approach and partnering with private organizations that have the ability to quickly procure essential materials, delays in government procurement processes can be reduced.

Limited inter-agency collaboration can also hinder progress. Collaboration is important for management because it allows agencies to pool resources and increase overall capacity in times of need. With the recent establishment of the CNMI Coral Restoration Working Group, which meets quarterly, there has been more interagency communication and collaboration. However, these meetings are often limited to abstract discussion because the current funding structure among CNMI government agencies is not set up to easily facilitate material interagency collaboration. The lending of resources like boats or essential equipment during times of need, for instance, is difficult because each grant program has its own restrictions for how its funds and materials are used. Lack of adequate funding and the short-term nature of most funding mechanisms are consistently cited as barriers to building the capacity needed for program development. A pooled financial structure that allows multiple agencies to utilize a collaborative grant as needed would increase infrastructural redundancy and quicken response. Alternatively, large grants that fund inter-agency collaboration can be utilized to leverage staff from a variety of sources. Having collaborators lifts overall capacity and creates redundancy in materials and management, ensuring that project goals are completed with minimal interruptions from changes in staffing or maintenance issues.

Leveraging the use of volunteers or interns is a strategy commonly used in marine science projects to alleviate overall burden on professional staff. Several well-established restoration programs, such as Mote Marine Lab and the Coral Restoration Foundation, have teams of volunteers that help with maintenance of land-based and offshore nursery systems. Many of the programs even teach tourists to assist outplanting corals. Despite these benefits, allowing volunteers to engage in government-led projects is difficult due to concerns over liability. Working closely with sub-awarded private organizations to prioritize volunteering may open up opportunities for ecotourism and community engagement.

While government-led reef restoration has its challenges, it is important that the local government has a leading role in coral reef restoration and management. CNMI government agencies directly represent the interest of local stakeholders and have the ability to shape laws and regulations to fit their needs. Government agencies are also responsible for permitting and guiding restoration activities. This check and balance system protects natural resources by ensuring projects are well thought-out and executed responsibly. Furthermore, local capacity building at the government level creates sustainable growth of CNMI expertise that benefits and uplifts the community.

As a regulatory branch of the CNMI government, DFW has the unique responsibility and jurisdiction of issuing permits, developing regulations, conducting research, and enforcing laws. As such, DFW has the purview of operating within the scope of coral restoration and protection efforts. However, coral nursery management is time-consuming and expensive. It requires ongoing, long-term maintenance and support from dedicated staff, as well as flexible funding and procurement mechanisms that allow for rapid action when needed. While there is a need for further nursery development in the CNMI, without significant change to the institutional processes associated with CNMI local government and federal funding, nursery development and maintenance will continue to be a challenge. Current obstacles to implementing a successful restoration program at DFW include a lack of work space, existing fisheries section project burden, and alternative agency priorities. These issues would need to be addressed prior to project implementation. At this time, DFW does not have the capacity to fulfill these needs on its own.

The theme in addressing many of the project management issues previously detailed is collaboration. Working with partners strengthens projects and increases resilience much in the way a biodiverse ecosystem does. DLNR's Mariana Crow Project, a collaboration between DLNR, DFW, U.S. Fish and Wildlife, University of Washington, the San Diego Zoo, and the Institute for Wildlife Studies, is a good model for this type of teamwork. Each partner brings something of value to the table to accomplish the challenging and logistically intensive goal of restoring a critically endangered population. As a leading regulatory agency responsible for approving and supporting restoration-related projects in the CNMI, DFW needs to take a more

active role in providing technical guidance and emergency support when necessary. Building trusted relationships with adequate agency-support protects resources when unexpected events occur. Pooling coral reef restoration resources and expertise between private and public organizations will benefit government-led projects by raising shared capacity and upscaling restoration activities sustainably.

Formal public-private partnership with tourism operators or non-profits could be a way to maximize restoration capacity as well. Coral restoration projects are beneficial to businesses because they drive ecotourism, provide educational opportunities for guests and community members, and improve organizational image. Scoping communications with hotel operators in the CNMI has revealed interest in this type of collaboration. Government agencies can provide oversight, expertise, support, guidance, and help direct the specifics of outplanting efforts (which corals to outplant, where to outplant, operating procedures, etc.) while NGOs and businesses provide capacity and purchasing efficiency (Figure 3). Government agencies would also be partially responsible for guiding hiring, training, and field collaboration. The NGO would be responsible for day to day management and maintenance, procurement, education, outreach, and staffing.

If this type of collaborative relationship is pursued, it is critical for the government to maintain a high level of oversight over grant activities and progress. The government agency must have at least one full time staff member qualified to manage and oversee the project. Furthermore, all activities that occur within the project must be reported at least quarterly to the Coral Restoration Working Group. Ultimately, the perspective of the CNMI community and governmental experts will guide the restoration activities under this model while working with partners who provide additional capacity and flexibility.

Hesitancy to adopt this management structure by government stakeholders primarily stems from concerns about outsourcing local jobs, taking away government leadership, increasing reliance on the private sector, and decreasing capacity in the local government. These concerns are important to consider if this management structure is adopted. The framework presented here largely avoids these pitfalls by putting local government in the leading role, promoting the voice of the CNMI CRWG, and ensuring direct government involvement in project planning, budgeting, emergency management, staffing, training, and outplanting (Figure 3).

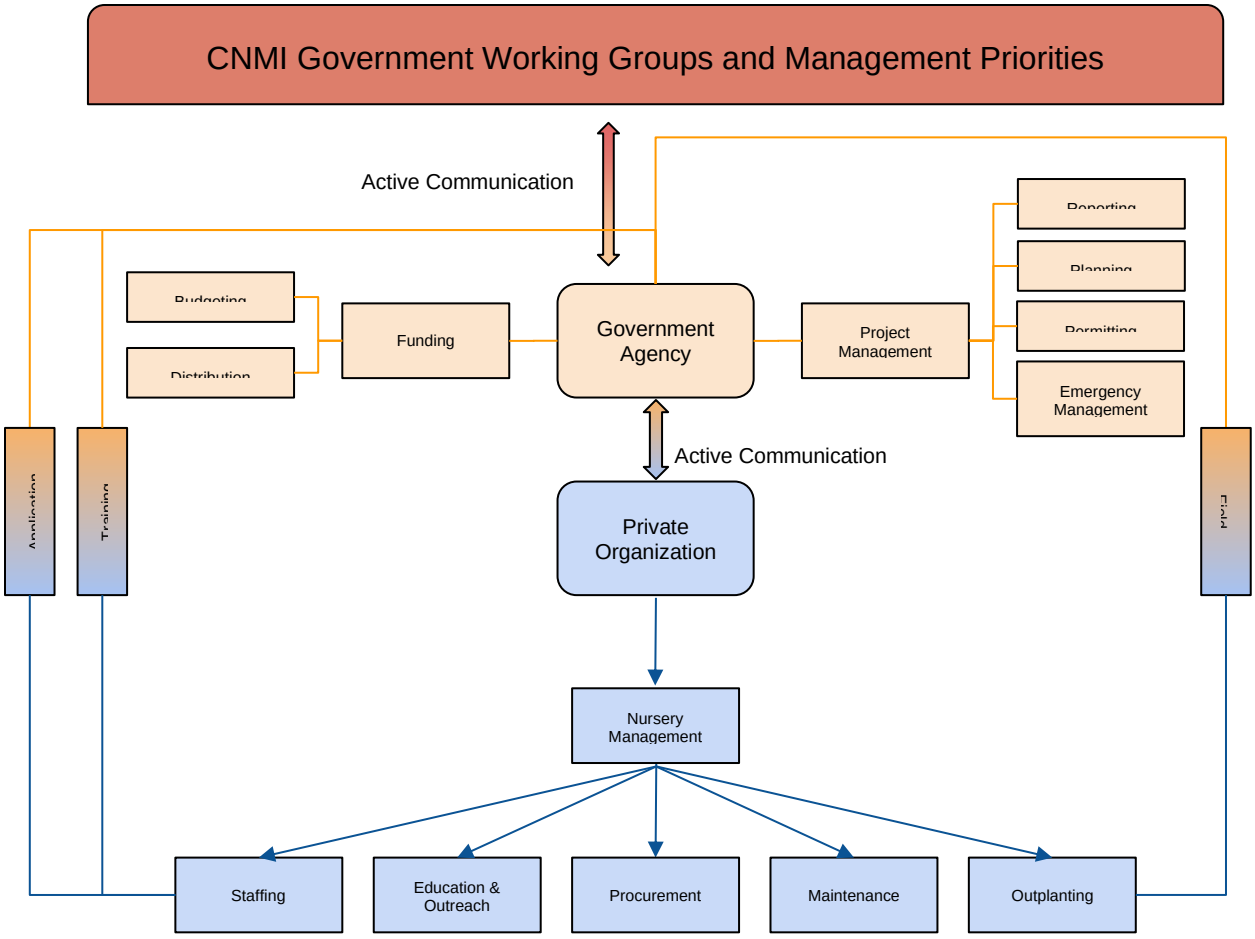


Figure 11: Framework of Responsibilities for Public-Private Coral Reef Restoration Partnership. Public-private partnership is guided by CNMI Coral Reef Management Priorities and intergovernmental meetings. Activities are reported to government partners through quarterly working group meetings. Government agency responsibilities are mostly grant management, budgeting, and project organization. Private groups have responsibilities over daily management, procurement, education and outreach, and staffing. Closer support is provided from the government agency via application review and training for staffing. Field support from the agency is also provided during outplanting events.

Another method of partnership that avoids potential issues of government-commerce conflict is using existing nursery projects for volunteer work and tourism. JAMS, for instance, could work together with a hotel operator or community group to host hands-on tours and restoration activities at their nurseries. These tours would provide support, additional maintenance, and funds to the managing entity while increasing community involvement with restoration programs. Government agencies should support and encourage this type of engagement whenever possible.

In conclusion, shared grant partnerships with the Government Nursery may be a way for DFW to make meaningful contributions to the existing government nursery, but nursery development by DFW alone is currently unfeasible. Collaborative grant programs between DFW and coral

restoration partners would increase CNMI-wide capacity and provide redundancy in case of emergency. By serving in a supporting role to the NGO's practicing coral restoration, government agencies can increase capacity during times of hardship throughout the CNMI. The feasibility of public-private partnerships should be assessed to increase restoration scale. Lastly, DFW should help advise and support its permitted coral restoration and marine activity operators in the case of emergencies, like impending typhoons or active bleaching events, where there is a high risk of damage to infrastructure or marine resources. These realistic strategies will enable DFW to contribute to coral restoration in meaningful ways while building agency foundation for coral restoration in the future.

Table 13: Action Items and Additional Project Recommendations Relevant to Sub-Section 4.3. See additional information and project recommendations in Table 2 and Appendix A.

Action Item	Description
Action: 3.1: Assess the feasibility of building partnerships with privately led coral restoration projects.	Conduct feasibility study and stakeholder assessment of developing public-private coral restoration partnerships as defined in Section 4. Further refine DFWs role in managing coral restoration activities through permitting and technical guidance.
Action 3.2: Identify and utilize collaborative funding sources to support existing coral health initiatives. Provide support to restoration projects when necessary.	Identify funding that can be used to support coral-specific projects within the Fisheries Research Section. Explore funding sources that could be used collaboratively, like CRI, to support existing coral health initiatives. Funding should also enable work in line with existing government plans like the CNMI Bleaching Response Plan.
Action 4.2: Build in-house infrastructure to support coral and fish habitat programs.	Level-up infrastructure to support goals in above action items. Procure computers and software with sufficient power to support structure from motion analysis. Increase server storage space to hold increasing photoquadrat and structure from motion storage. Fund maintenance of existing assets (dive equipment, boats, compressor, trucks, etc.) and procure additions to support program goals (new boat, desks, cameras, etc.).
Project Name	Goal
Recirculating Funding Design	Decrease reliance and increase freedom to pursue projects not directly related to Sport Fish Restoration through the development of recirculating funding structure.
Restoration Ecotourism Development	Partner with local tourism businesses, diving operators, or hotels to form a co-managed coral restoration public-private partnership.

5 Conclusion

In the CNMI, coral reefs are critical to ecosystem health and provide valuable ecosystem services that residents depend on (Daily, 1997; Eastern Research Group, 2019; van Beukering et al., 2006). Effectively managing coral reefs, and mitigating the anthropogenic threats that face them, is a priority for reef-dependent communities. The enhancement and protection of coral is a critical part of DFW's jurisdictional responsibilities, and DFW has the unique power to draft, implement, *and* enforce regulations that apply to these species.

There are myriad threats facing coral reefs in the CNMI. We should maintain separate strategies for the two major threat categories, local controllable and global uncontrollable. Global uncontrollable threats can be addressed through representation, lobbying, and monitoring efforts while local controllable threats can and should be addressed with hands-on intervention. The majority of the local government's efforts should be focused on addressing controllable issues like land-based sources of pollution, invasive/nuisance species control, and irresponsible use. By prioritizing local efforts on what is within the CNMI's control, total stress on reefs can be limited (Figure 1).

The 2015 SWAP gave several goals for the CNMI's SGCN coral species. They can be summarized into three species-specific objectives and have been accompanied by several recommendations to address them in this plan (Table 14).

Table 14: 2015 Coral SWAP Objectives with CRMP recommendations for DFW Action.

SWAP Objective	CRMP Recommendation
Objective 1: Develop a monitoring program for SGCNs that incorporates estimates of presence, abundance, and distribution.	**Action 1.1:** Implement 2024 Fisheries Independent Assessment Program methodology. **Action 1.2:** Centralize DFW data streams to produce MPA and CNMI-wide species lists. **Action 1.3:** Promote MPA long-term monitoring programs. **Action 1.4:** Increase benthic data collection and improve substrate analysis.
Objective 2: Assess and enhance current coral restoration efforts in the CNMI.	**Action: 3.1:** Assess the feasibility of building partnerships with privately led coral restoration projects. **Action 4.1:** Recruit positions with expertise in coral reef ecology both locally and internationally.

SWAP Objective	CRMP Recommendation
Objective 3: Build capacity to combat local-controllable threats to coral reefs.	**Action 1.5:** Partner with a laboratory to improve understanding of disease and coral genetics in the CNMI. **Action 2.1:** Develop coral ecology-focused materials to support community outreach efforts. **Action 2.2:** Build coral reef centered community outreach program with publicly accessible coral reef lecture series. **Action 3.2:** Identify and utilize collaborative funding sources to support existing coral health initiatives. Provide support to restoration projects when necessary. **Action 4.2:** Build in-house infrastructure to support coral and fish habitat programs.

The SWAP also identified a need to augment coral restoration programs, which are growing in the CNMI. DFW's coral restoration efforts should be focused on acquiring funds to increase support of the government nursery. DFW should also begin providing advice and emergency consultation to permit holders. Additionally, the feasibility of creating public-private coral restoration projects needs to be explored following hotel operator interest in coral restoration ecotourism.

Following research for this document, the following action items have been generated to improve DFW's coral reef management (Table 2).

Action 1: Improve data collection and standardize fisheries independent coral reef monitoring methods.

- **Action 1.1:** Implement 2024 Fisheries Independent Assessment Program methodology.
- **Action 1.2:** Centralize DFW data streams to produce MPA and CNMI-wide species lists.
- **Action 1.3:** Promote MPA long-term monitoring programs.
- **Action 1.4:** Increase benthic data collection and improve substrate analysis.
- **Action 1.5:** Partner with a laboratory to improve understanding of disease and coral genetics in the CNMI.

Action 2: Improve communication and dissemination of data and analysis results to policy makers, invested stakeholders and community members.

- **Action 2.1:** Develop coral ecology-focused materials to support community outreach efforts.
- **Action 2.2:** Build coral reef centered community outreach program with free coral reef lecture series.

Action 3: Provide technical support and guidance for existing coral restoration efforts.

Action: 3.1: Assess the feasibility of building partnerships with privately led coral restoration projects.

Action 3.2: Identify and utilize collaborative funding sources to support existing coral health initiatives. Provide support to restoration projects when necessary.

Action 4: Build DFW Fisheries Research Section capacity.

Action 4.1: Recruit positions with expertise in coral reef ecology both locally and internationally.

Action 4.2: Build in-house infrastructure to support coral and fish habitat programs.

Gaps in valuable coral and essential fish habitat data will be addressed through the enhancement of survey protocols, and MPA efficacy will be evaluated by including MPA areas in long-term monitoring strategies. DFW will also continue to engage and educate its community by delivering a free lecture series once a quarter. These talks will provide discussion and engagement opportunities on coral reef science and current events.

As a key regulatory agency responsible for overseeing coral restoration, DFW will take a more active approach and provide technical guidance and oversight of restoration practices. DFW will also assess interest in public/private ecotourism partnerships with local businesses to improve effective restoration capacity, coordination, and standardized practices. Lastly, DFW will take actions to increase capacity within the division including creating positions for a Fish Habitat Biologist and a Fish Habitat Conservation Biologist. These positions will support surveying and assessment work and develop enforceable regulations to ensure accountability for actions that violate the law.

These action strategies will provide the foundation from which DFW's coral reef management program can grow. Five years is a reasonable timeline to accomplish these actions, and additional projects should be pursued to continue program development as possible (Appendix A).

There are significant challenges facing the CNMI's coral reefs in the future, and many of them are out of our control. Issues like climate change and ocean acidification threaten our natural resources, and our way of life. Yet, there is hope. We, as environmental managers and sustainable-use advocates, have the power to control the myriad locally solvable issues that also impact reefs. By building foundational capacity, addressing locally controllable environmental threats, and uplifting the community, we as community members and managers of the CNMI's natural resources can make a difference for our reefs and our people.

Appendices

Appendix A: Project Recommendations

Project Name	Description	Goal
MPA Signage	There is a lack of signage to adequately demarcate and educate the public about the rules within MPAs. There is a disconnect between the public and regulatory agencies regarding MPA bounds, regulations, history, and general environmental information. Through the clear display of MPA regulations and continued community education on CNMI's DFW-managed MPAs, the coral reef ecosystem within each can flourish. The price of sign development and design is a small price to pay for an easy community education strategy.	Clarify public knowledge of MPA bounds and improve MPA rule compliance.
MPA Outreach	Successful MPAs are driven by communities rather than managers. A dedicated MPA education component that provides stewardship and ownership-generating opportunities will improve the public's understanding of the CNMI's MPA system. It is difficult to regulate MPA use without sufficient education and outreach. It is also unfair to enforce MPA rules that are not communicated properly. Further MPA outreach efforts need to take place to craft a caring ethic of Saipan's most treasured protected zones.	Create and implement a community outreach campaign that highlights the CNMI's MPAs while improving public understanding of rules and regulations
MPA Buoy Management	There is currently an abundance of illegal and unused moorings in the Managaha Marine Conservation Area. There may be more illegal and unmaintained moorings throughout the lagoon and in other MPA areas. Many of these moorings are affixed directly to corals and the lines from derelict moorings have been recorded wrapped and tangled in corals. Since DFW is the primary regulating agency responsible for designated marine protected areas, there should be a focused effort to clean them up. These efforts can be funded under SFR since the buoys clearly demarcate MPA areas so that recreational fishers can stay informed and compliant with local regulations. Educational materials, like a "how-to guide to safe mooring," can also be created and shared with the public.	Record an inventory of legal moorings in MPAs, manage them, and design, install, and maintain clear markers of MPA area bounds.
MPA Clean Up Program	Large amounts of marine debris have been allowed to pile up along beach fronts and in MPAs, particularly after	Decrease the amount of debris at MPAs while fostering

Project Name	Description	Goal
	major storms wash free floating trash onto beach areas. It would be beneficial to host service learning and outreach events centered on coastal cleanup. These events create feelings of engagement and ownership while serving as free educational opportunities. Consider creating educational material about securing loose debris prior to storms.	community engagement through the development of community clean-up programs.
Support and Enhance Tour Guide Operator Program	As tourism recovers from the COVID-19 pandemic, it is important to establish guidelines for responsible diving practices. Several different locales have designed tour guide certification programs to better educate tourists on appropriate environmental conduct. In the Florida Keys, tourists diving with companies who are a part of NOAA's Blue Star Operator Program contact reef less than those diving with non-certified companies (Camp and Fraser, 2012; Krieger and Chadwick, 2012).	Enhance the current Marianas Visitor Authority tour guide operator program to bolster ecotourism demand and better educate local businesses, community members, and tourists on environmental stewardship.
Pave Roads	Land-based sources of pollution are a major contributor to coral reef decline. Sediment runoff, which is often a result of unpaved and unstabilized roads, smothers corals. Paving roads will benefit residents of the CNMI, improving access to beautiful reefs like those present at the Lau Lau Dive Site. It will also decrease sedimentation resulting in eroding unpaved roadways. Furthermore, effective drainage systems can ensure that less nonpoint source pollution enters delicate marine environments.	Improve local infrastructure and decrease sedimentation by paving roads and creating drainage catchment systems to decrease the effects of runoff.
Seagrass Protection and Restoration	Recent scientific and anecdotal reports have indicated a decline in seagrass habitat in the CNMI. Many seagrass habitats have become increasingly dominated by macroalgae. Seagrass is an important habitat for juvenile fish, critically endangered sea turtles, and general ecosystem functioning. Regulating, developing, and updating seagrass protections is a priority action for the protection of this critical habitat, particularly within Saipan's Western Lagoon. In addition, restoration of previously designated seagrass habitat should also be prioritized.	Protect, restore, and create legal infrastructure for seagrass habitat.
Coral Reef Scholars Program	Northern Marianas College (NMC) grants associate degrees in the field of natural resource management. Although many students express interest in marine biology, there is not a formal curriculum set up for them. The development of a collaborative "Coral Reef Scholars" program between government agencies and NMC would serve as a pipeline for students to transition	Develop local capacity and provide educational opportunities through a college internship program focused on marine biology related topics.

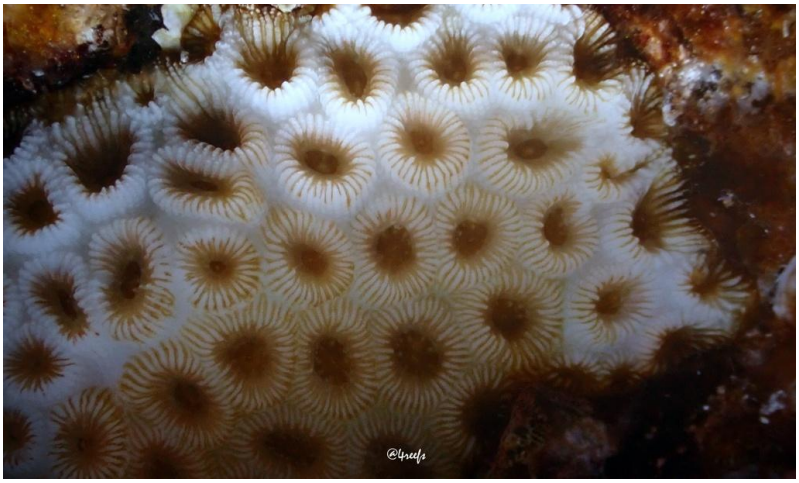
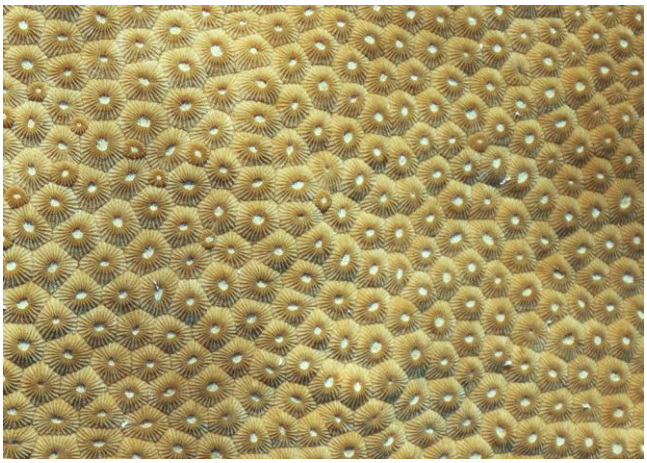
Project Name	Description	Goal
	to roles in local government. They would gain experience and mentorship while local agencies would benefit from the increased capacity.	
Recirculating Funding Design	One key financial issue for DFW is a persistent shortage of local funds. Though DFW has protected federal funding from Sport Fish Restoration, this money can only be used for projects explicitly detailed in federal grant proposals, and projects undertaken must benefit recreational fishers in some way. While these projects are important, gaps in work availability exist for other DFW responsibilities. Enforcement, for example, is restricted in activity because its operational budget is more reliant on local funding. A revolving funding structure, that takes proceeds from small taxes on dock use, fines for environmental infractions, etc., creates recirculating, freely usable funding for projects outside Sport Fish Restoration Fund scope. These funds can ultimately be used to directly manage coral resources, without having to rely on short-term grants.	Decrease reliance and increase freedom to pursue projects not directly related to Sport Fish Restoration through the development of recirculating funding structure.
Feral Animal Control	There are an abundance of feral dogs and ungulates presently roaming Saipan. In addition to feral animals, there is a lack of education regarding responsible pet ownership. Many animals live chained to a fence and their waste is also not disposed of properly. These animals produce waste that eventually runs off into the ocean, increasing nutrient and bacteria loads on nearshore reefs. Improving pet ownership education and decreasing the amount of feral animals on island should be a priority supported by government agencies. Recruiting veterinarians for frequent spay and neuter clinics for pets and feral animals, holding educational workshops about the environmental effects of animal waste, and offering low-cost care for pet owners would enhance reef health by decreasing non-point pollution sources.	Decrease feral animal and pet derived pollution through active intervention and education opportunities.
Coral Disease Assessment Center	Coral disease is understudied in the CNMI, and the underlying pathology behind many observed diseases is completely unknown. Pathology and sampling of coral disease are critical to understanding the underlying origin of symptoms, thereby improving the CNMI's capacity to combat them should they get out of hand in the future. The development of a centralized coral disease lab in the CNMI will enable the collection, basic analysis, and preservation of samples. These samples can later be shipped out in batches to Dr. Thierry Work for analysis and results will be shared with relevant agencies.	Form an intergovernmental coral disease laboratory that is equipped to study coral disease in the Marianas, monitor coral reef health, and lead management of disease outbreaks.

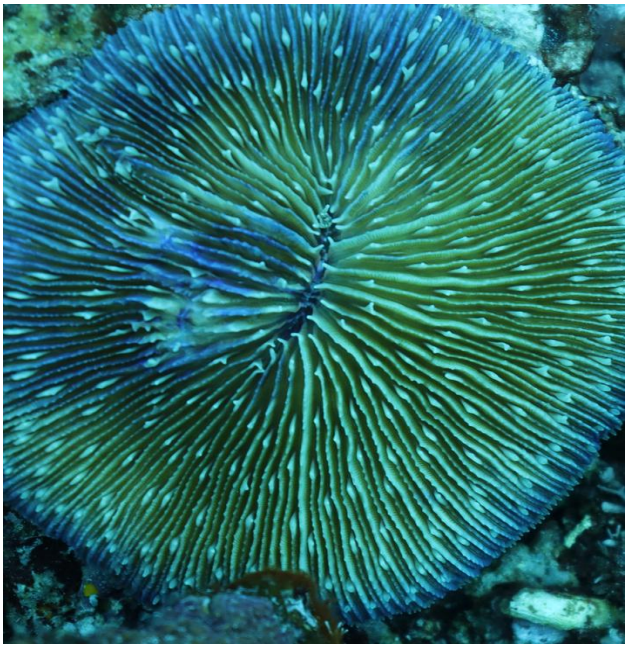
Project Name	Description	Goal
Coastal Art Collaborations	To create a culture of inclusive collaborative shared management, government agencies should delegate funding to local artists, writers, and cultural practitioners for environmentally related work. Projects might include government-sponsored ocean-themed art classes, community muraling projects, writing contests, sustainable arts and crafts events, and more. Though projects like these are not scientific in nature, they hold extreme value for creating a culture of environmental stewardship. They also present an opportunity for continued education and relationship building.	Improve community awareness and "buy-in" to coral reefs by involving local artists through muraling, government-sponsored art classes, and community-centered art projects.
Genetic Taxonomy Development	Coral identification is a difficult task in and of itself. SGCN species, like *Acropora globiceps,* may appear close to identical to other species. In the past, ESA-listed species have been recorded during surveys, but since they cannot be genetically confirmed, management actions do not change. Genetic analysis of coral samples will provide managers with a clearer picture of the exact status of species without unintentionally lumping groups. Partnering with a university to develop the CNMI's field identification and taxonomic accuracy would improve the local government's ability to manage SGCNs and ESA-listed species.	Partner with an outside organization to improve coral species taxonomy and field identification through genetic analysis.
Restoration Ecotourism Development	One of the key issues of coral restoration is that it is hard to scale. Current government nursery efforts are extremely limited, and issues of procurement and bureaucracy can make quick adjustment impossible. Private organizations seeking to position themselves in the ecotourism market could help with these issues.	Partner with local tourism businesses, diving operators, or hotels to form a co-managed coral restoration public-private partnership.
Legal Capacity Building	There is a lack of legal control, enforceable regulations, and general clarity surrounding the CNMI's coral reef-related laws. Having a clear understanding of what is legally enforceable, and continuing to develop appropriate regulations, should be a priority for the CNMI. To streamline and develop enforceable regulations, a policy analyst or environmental lawyer should be recruited and employed. A policy analyst would work collaboratively with DFW FRDS to assess and develop appropriate regulations for the Coral Reef Conservation Act.	Improve the CNMI's legal ability to regulate natural resources through the recruitment of a policy analyst and/or environmental legal counsel.

Appendix B: Commonly Occurring Corals in the CNMI

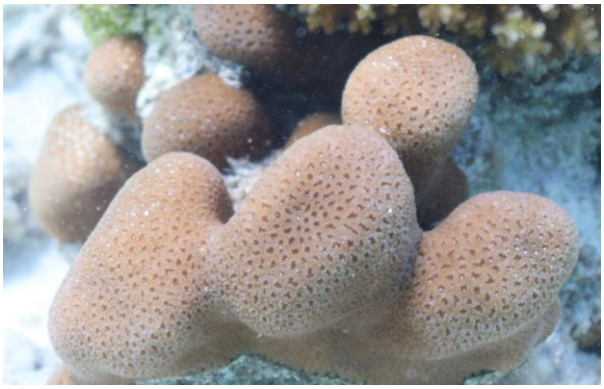
Photo Credit: Nicholas Robie unless otherwise noted. This list is not exhaustive.

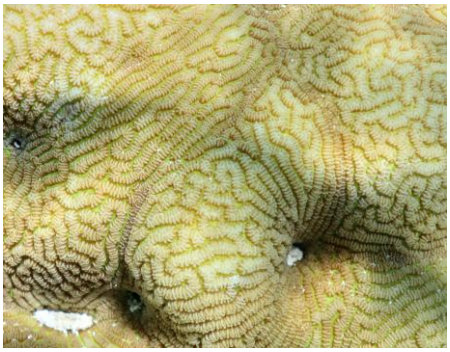
Acropora globiceps	
Acropora pulchra	

Astrea curta (PC: Damaris Torres-Pulliza)	
Astreopora myriophthalma	
Diploastrea heliopora	

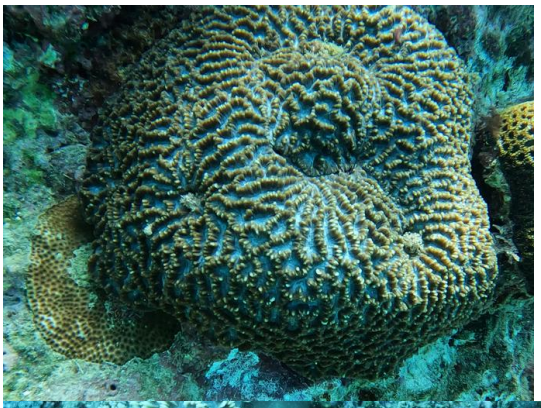
Favites valenciennesi	
Fungia fungites	

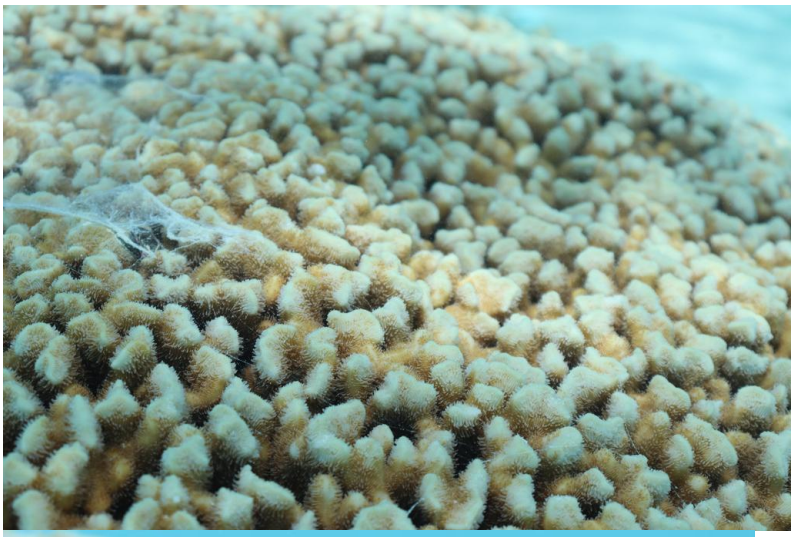
Galaxea fascicularis	 
Galaxea horrescens	

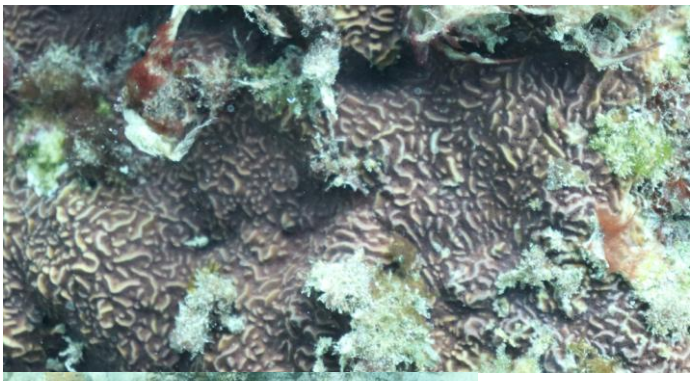
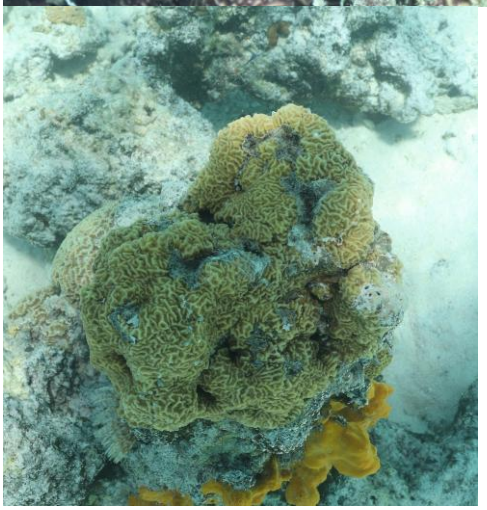
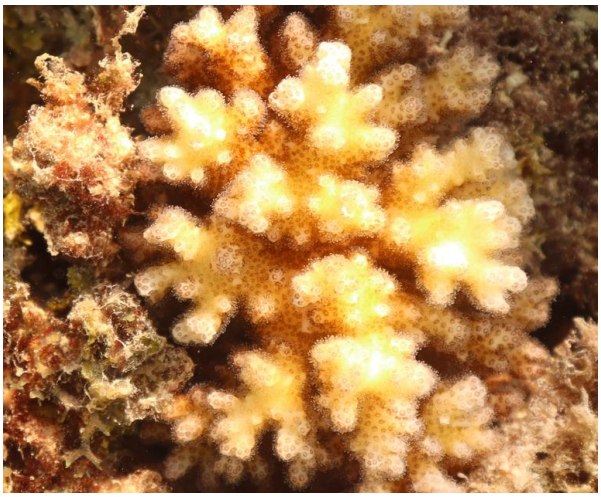
Goniastrea pectinata (PC: Damaris Torres-Pulliza)	
Goniastrea stelligera	
Hydnophora microconos	

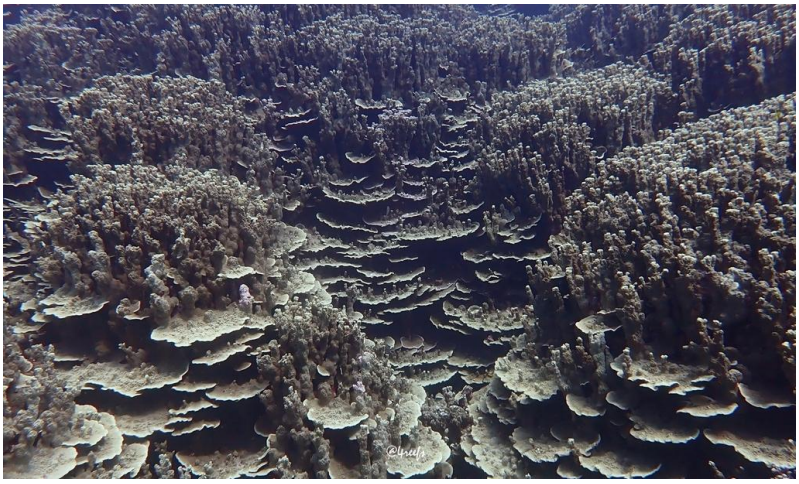
Isopora palifera	 
Leptoria phryigia	

	
Lobactis scutaria	
Merulina ampliata	

Montipora nodosa	
Oulophyllia crispa	 

Pavona decussata	
Pavona frondifera	 

Pavona varians	 
Pocillopora damicornis	

Pocillopora grandis	
Porites rus (Damaris Torres-Pulliza)	
Psammocora haimana	

Stylocoeniella armata (PC: Damaris Torres-Pulliza)	

Appendix C: Funding Sources for Coral Reef Management

U.S. Fish and Wildlife Service

Sport Fish Restoration (SFR)

https://www.fws.gov/program/sport-fish-restoration

SFR collects funds from manufacturer excise taxes on sport fishing equipment, import duties on recreational fishing tackle and boats, and a percentage of revenue from boat gasoline purchases. These protected funds are allocated directly and permanently toward the wildlife agencies of states and territories. In the CNMI, this agency is DFW. SFR funds must be used for projects that directly benefit sport fishing, although some projects may apply to corals because of the essential fish habitat role that corals play on fish in the marine environment.

State Wildlife Grant (SWG)

https://www.fws.gov/program/state-wildlife-grants

SWG grants are used to support projects that benefit both wildlife and its habitat. Since they include species that are not actively hunted or fished, corals can be directly addressed in SWG-funded project goals. SWG projects can address anything from surveys and research to species restoration and habitat management. SWG funds are a primary avenue DFW uses for the development and implementation of programs that benefit species, like corals, that are outside the scope of SFR funding.

National Oceanic and Atmospheric Administration

Coral Reef Conservation Program (CRCP)

https://coralreef.noaa.gov/conservation/funding_opps.html

NOAA's Coral Reef Conservation Program offers several different funding opportunities through many different programs. The Ruth D. Gates Coral Reef Conservation Program, for instance, is currently advertising capacity building, management, and coral innovation grants opportunities. Grant opportunities may change over time may be seen at the above link.

CNMI Coral Reef Initiative (CRI)

https://dcrm.gov.mp/our-programs/coral-reef-initiative/about-the-coral-reef-initiative/

The CNMI's CRI is a CRCP-funded program that is shared between DCRM, DEQ, and DFW. The CRI's goals are to reduce LBSPs, increase the abundance and average size of key fish species for coral reef health, develop legal authority and capacity to evaluate military buildup-related activities, and monitor the impacts of climate change. CRI currently operates on a two-year funding cycle and is at the start of its '23-'25 term. This is slated to change shortly as the Coral Reef Conservation Act is reevaluated, so DFW should check in frequently with partners to ensure it does not miss these funding opportunities.

The CRI is a foundational component of coral reef management that has been designated for the CNMI. It is also an opportunity for collaborative management, allowing for the utilization of resources from three local government agencies. Unfortunately, DFW has not taken advantage of these available funds in recent history. CRI funding should become a priority in the future.

Saltonstall-Kennedy (SK)

https://www.fisheries.noaa.gov/grant/saltonstall-kennedy-grant-competition

NOAA's SK Grant program is an annual funding competition that seeks projects leading to the promotion, development, and marketing of U.S. fisheries. It funds approximately 40 projects for a total of $10 million. It especially looks for applications that will directly benefit U.S. fisheries and include meaningful collaboration with fishers.

National Fish and Wildlife Foundation (NFWF)

Coral Reef Stewardship Fund (CRSF)

https://www.nfwf.org/programs/coral-reefs?activeTab=tab-3

CRSF, managed in partnership with NOAA's CRCP and Aramco, focuses funding on three main areas:

1. Threat reduction at priority reef locations, specifically seed reefs that serve as a larval source for larger reef areas.
2. Active coral restoration projects that focus on nursery to outplant propagation and direct restoration activities.
3. The refinement of management practices and sharing of information that benefits coral reef management throughout the U.S.

These funds go unutilized by DFW although other agencies, like DCRM, use them. CRSF may be a valuable avenue for projects that are explicitly coral-related

U.S. Department of Defense (DOD)

Readiness and Environmental Protection Integration Program (REPI)

https://www.repi.mil/

The REPI Program funds cost-sharing agreements between the military and environmental organizations. Federal agencies, state and local government, and NGOs are eligible to apply for funds. The REPI program seeks to lessen land use conflicts near military installations, address environmental restrictions to military activity, and address climate change. These goals are especially relevant to the CNMI where military presence is growing and concerns over climate change effects are significant.

Appendix D: Marine SGCN Species in the CNMI and Their Priority Actions

Marine Species of Greatest Conservation Need in the CNMI			
Scientific Name	Common Name	Chamorro/Carolinian Name	Priority Actions
Carcharhinus amblyrhynchos	Grey Reef Shark	Halu'u/Limwe	Determine specific abundance and distribution around Saipan, Tinian, and Aguiguan
Cheilinus undulatus	Napoleon Wrasse	Tanguisson/Maam	Measure abundance of juveniles in various habitats around Saipan
Chlorurus microrhinos	Steephead Parrotfish	Laggua/Igan-Wosh	Determine abundance and habitat associations around Saipan; plan additional actions as needed based on research and monitoring results
Leptoscarus vaigiensis	Seagrass Parrotfish	Kabara	Determine abundance and specific seagrass habitat associations around Saipan; plan additional actions as needed based on research and monitoring results
Multiple	Food Fish	Multiple	Plan actions based on research and monitoring results
Stenella longirostris	Spinner Dolphin	Toninos/Ghu	Plan actions as needed based on monitoring results
Eretmochelys imbricata bissa	Hawksbill Turtle	Haggan karai/Wong Maaw	Map foraging habitat
Chelonia mydas	Green Sea Turtle	Haggan/Wong Mool	Continue and expand outreach, education, and enforcement to reduce poaching; establish a community-based wildlife advisory board and implement appropriate management recommendations; map and quantify the extent and quality of foraging areas around the southern islands; continue nest monitoring to track nesting success and deter poaching; work with DPL and regulatory agencies to maintain nesting beach suitability
Tripneustes gratilla	Collector Urchin	Laun/Larr	Determine abundance and specific habitat associations in areas accessible and inaccessible to harvest on Saipan
Panulirus spp.	Spiny Lobsters	Mahonggang/Yuurr	Determine abundance and distribution in areas accessible and inaccessible to harvest
Tridacna spp.	Native Giant Clams	Hima/Tto/Shafeshaf	Determine abundance and distribution in areas accessible and inaccessible to harvest
Gafrarium pectinatum	Pectinate Venus	Tapon/Amsun/Ai'met/Ghatil	Determine abundance and specific habitat associations in areas accessible and inaccessible to harvest
Octopus cyanea	Day Octopus	Gamson/Ghuus	Determine abundance and specific habitat

			associations in areas accessible and inaccessible to harvest
Cassis cornuta	Horned helmet	Do'gas prensa/Mwe'ell	Determine abundance and specific habitat associations in areas accessible and inaccessible to harvest
Charonia tritonis tritonis	Triton's Trumpet	Kulu/Sa'wi	Determine abundance and specific habitat associations in areas accessible and inaccessible to harvest
Lambis lambis	Common Spider Conch	Toro/Liyang	Determine abundance and specific habitat associations in areas accessible and inaccessible to harvest
Turbo spp.	Native Turban Snails	Aliling pulan/Lifott maram	Determine abundance and specific habitat associations in areas accessible and inaccessible to harvest
Chicoreus ramosus	Branched Murex	Do'gas/Abwel	Determine abundance and specific habitat associations in areas accessible and inaccessible to harvest
Acropora globiceps	Coral	Kuraling/Yeal	Determine distribution and abundance across the CNMI
Acropora retusa	Coral	Kuraling/Yeal	Determine distribution and abundance across the CNMI
Seriatopora aculeata	Coral	Kuraling/Yeal	Determine distribution and abundance across the CNMI
Acropora spp.	All Staghorn Coral	Kuraling/Yeal	Develop a coral propagation and reef restoration program; prioritize sites and implement appropriate conservation and management

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