FINAL
FISHERY MANAGEMENT PLAN
FOR
CORAL REEF ECOSYSTEMS OF THE WESTERN PACIFIC REGION

Volume I

Including:

Amendment 7	Bottomfish and Seamount Groundfish Fisharies
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PREFACE

The Fishery Management Plan (FMP) for Coral Reef Ecosystems of the Western Pacific Region is the "first ever ecosystem-based plan for fisheries developed in the U.S." (NOAA 2001-R103, 1/30/01).

The central feature of the FMP is adaptive management, which recognizes the uncertainty, changing conditions and resilience associated with coral reef ecosystems. The emphasis is not on controlling short-term harvest so much as maintaining coral reef ecosystems and their capacity for natural resource regeneration for the long-term.

The many preparers of the FMP were often sharply divided on how to best achieve this objective. Their differences may be explained by "conceptual pluralism" (Norgaard 1994). Following Colchester (1994), Long and Long (1992), Blaikie and Jeanrennud (1996), and Berkes (1999), resource management needs to recognize pluralistic thinking:

1. There exist different actors (i.e., stakeholders) who relate in different ways to resources (coral reef and other);
2. The actors define knowledge, ecological relations and resources in different ways and at different levels of geographic scales;
3. They bring to bear on these definitions their culture and their experience; and,
4. They will use different definitions in pursuit of their own interests or political agendas.

The most fundamental difference is between the Western perspective-that even low levels of human activity are an intrusion on the ecosystem-and the Pacific Island indigenous vision-that proper use of natural resources is essential to their sustainability, and that people who have no personal relationship with the resources lose respect for them.

The Magnuson-Stevens Fishery Conservation and Management Act, Endangered Species Act, and other pertinent U.S. laws, as the products of Western culture, represent but one cultural perspective on natural resource management. Pacific Island management systems represent another. These systems have allowed Pacific Islanders to survive for several millennia by coexisting with coral reef resourees, and are best viewed as adaptive responses that have evolved over time, not as mere traditions (Berkes 1999). As a pluralistic society, the United States should provide room for both Western and non-Western knowledge of and perspectives on coral reef resource conservation.

Rooted in diverse views and cultures, different stakeholders may never be able to reach consensus. This FMP provides a resource management system open to alternative ways of thinking and a methodological framework in which different cultures, stakeholders and knowledge systems can find common ground in the area of coral reef management.

EXECUTIVE SUMMARY

The Fishery Management Plan (FMP) for Coral Reef Ecosystems of the Western Pacific Region was developed by the Western Pacific Regional Fishery Management Council (WPRFMC, or Council) using an ecosystem-based approach. A recent report to Congress by the Ecosystem Principals Advisory Board recommends that FMPs be developed as "Fisheries Ecosystem Plans" covering the ecosystems under a Council's jurisdiction. This FMP represents the first such fishery ecosystem plan developed in the United States.

About 70% of the world's coral reefs and 94% of the coral reefs under U.S. jurisdiction are located in the Pacific Ocean. Coral reefs cover an estimated 15,852 km^2 of the shallow ocean bottom around U.S. Pacific Island areas served by the Council, which includes the State of Hawaii, the Territories of American Samoa and Guam, the Commonwealth of the Northern Mariana Islands, and the Pacific remote island areas (PRIAs) of Johnston Atoll, Kingman Reef, Palmyra and Midway Atolls, and Jarvis, Howland, Baker and Wake Islands. Some 90% of coral reefs in the region's exclusive economic zone (EEZ, or the 200-mile limit) are found in remote areas, away from fishing communities.

Coral reefs are very diverse ecosystems that provide many benefits to mankind. They build atolls, protect island shores from coastal erosion and wave damage, support fisheries of cultural and economic value, provide a natural medicine cabinet for traditional healing and biomedical research, and serve as museums of the world's tropical marine biodiversity.

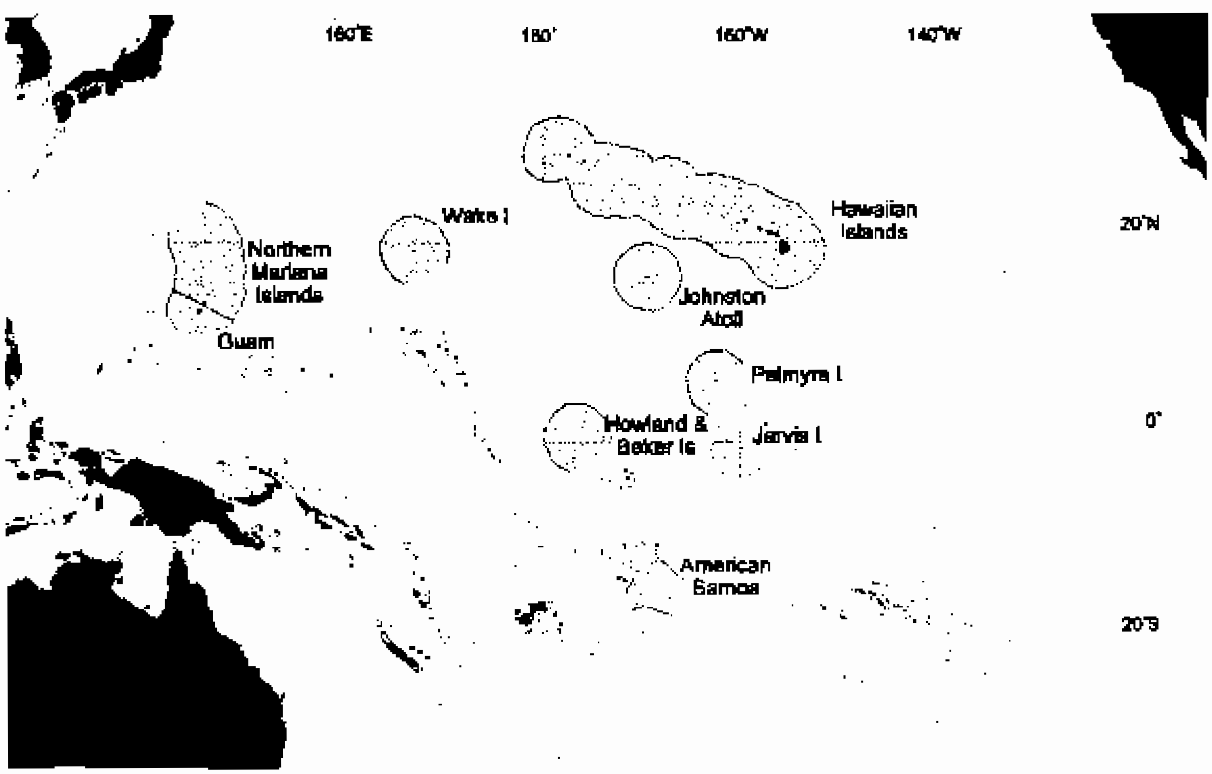

Figure E1: Western Pacific Region. EEZ areas under WPRFMC jurisdiction in grey.

The Pacific Islands were settled long ago, and these indigenous people represent an important part of U.S. Pacific island populations today. Their cultures historically depended on coral reefs to meet varied social-subsistence, economic, and spiritual needs. These needs and values continue to shape and support these distinct cultures today. Resident and tourism-related recreation—important parts of contemporary island economies—also depend on healthy nearshore coral reef resources.

This FMP uses a precautionary approach; in so doing it addresses potential problems before they can occur and establishes a management regime that can quickly adapt to changes. Local regulations control most of the impacts of resource exploitation on nearshore coral reefs in settled areas. This FMP complements these efforts by implementing measures to conserve coral reef ecosystems in the Western Pacific Region's EEZ. Although these areas have as yet been minimally exploited, there is potential for fisheries to expand into them. Possible sources of this expansion include existing nearshore fisheries for coral reef species, new fisheries for the live fish markets in Southeast Asia, expanded fisheries for coral and "live rock" for the U.S. aquarium trade, and developing fisheries for pharmaceutical uses. In addition, the holistic vision intrinsic in this plan allows impacts—stemming from natural environmental changes, other FMP managed fisheries, and non-fishing anthropogenic impacts, such as dredging—to be better understood.

FMP Goal and Objectives

The overall goal of the Coral Reef Ecosystems FMP (CRE-FMP) is to establish a management regime for the entire Western Pacific Region that will maintain sustainable coral reef fisheries while preventing any adverse impacts to stocks, habitat, protected species, or the ecosystem. Based on this goal, and consistent with an ecosystem-based management approach, the Council formulated eight objectives. The objectives promote sustainable use of coral reef resources, especially by fishing communities and indigenous fishermen in the region, an adaptive management approach based on fishery-dependent and fishery-independent research, marine protected areas and habitat conservation, cooperative and coordinated management by the various agencies concerned with the conservation of coral reef resources, and education to foster public support for management. These objectives are:

1. To foster sustainable use of multi-species resources in an ecologically and culturally sensitive manner, through the use of the precautionary approach and ecosystem-based resource management.

2. To provide a flexible and responsive management system for coral reef resources that can rapidly adapt to changes in resource abundance, new scientific information, and changes in fishing patterns among user groups or by area.

3. To establish integrated resource data collection and permitting systems, establish a research and monitoring program to collect fishery and other ecological information, and to collect scientific data necessary to make informed management decisions about coral reef ecosystems in the EEZ.

4. To minimize adverse human impacts on coral reef resources by establishing new—and improving existing—marine protected areas, managing fishing pressure, controlling wasteful harvest practices, reducing other anthropogenic stressors directly affecting coral reef resources, and allowing the recovery of naturally-balanced reef systems. This objective includes the conservation and protection of essential fish habitats.

5. To improve public and government awareness and understanding of coral reef ecosystems and their vulnerability and resource potential in order to reduce adverse human impacts and foster support for management.

6. To collaborate with other agencies and organizations concerned with the conservation of coral reefs, in order to share in decision-making and to obtain and share data and resources needed to effectively monitor this vast and complex ecosystem.

7. To encourage and promote improved surveillance and enforcement to support the plan's management measures.

8. Provide for sustainable participation by fishing communities in coral reef fisheries and, to the extent practicable, minimize the adverse economic impacts on such communities.

Management Measures

In order to achieve its goal, the FMP implements the following management measures.

Marine Protected Areas (MPAs)

EEZ coral reefs in unpopulated areas—the Pacific remote island areas, the Northwestern Hawaiian Islands, and Rose Atoll in American Samoa—are designated MPAs. The outer boundary for these MPAs is the 50-fm isobath. A zone-based management approach is applied to MPA design and designation, distinguishing no-take and low-use areas. Fishing is prohibited in no-take MPAs, including that by existing FMP fisheries. No-take MPAs are delineated by the 10-fm isobath, except for certain ecologically sensitive areas where the boundary is extended to the 50-fm isobath. These areas are French Frigate Shoals, Laysan Island, the northern half of Midway Atoll, Jarvis Island, Howland Island, Baker Island, Kingman Reef and Rose Atoll. All other areas within the 50-fm isobath would by default become low-use MPAs, where fishing is tightly controlled by a special permit requirement and other conditions for fishing. Although not an MPA in the sense of having these restrictions, Guam's Southern Banks is designated as a no-anchoring zone.

All extractive activities would be prohibited in no-take MPAs, except for small harvests related to scientific research and related resource management. Existing FMPs are amended to prohibit take of their respective management unit species (MUS) in addition to this FMP's MUS from no-take MPAs. In low-use MPAs existing fishing activities, and recreational fisheries by residents on certain remote islands, would be allowed under special permits. New fisheries and fishing by indigenous people could be allowed under special permits. Existing FMP fisheries in low-use MPAs would follow the permit and reporting requirements already established in their respective FMPs.

All fishing vessels transiting MPAs, including those regulated under the Council's already-implemented FMPs, would be required to carry insurance in order to pay for the costs of vessel removal and habitat damage mitigation in the event of a grounding. The Council felt that prohibiting large non-fishing vessels, and in particular cruise ships, from entering MPAs would be beneficial. However, the Council does not have the authority to regulate these vessels. Several longer-term, cooperative efforts are proposed to manage the potential impacts of these vessels.

Using the framework process, vessel anchoring areas may be designated in MPAs at a future date. The only immediate restriction in this FMP applies to large fishing vessels (those longer than 50 ft) at Guam's Southern Banks, which would be prohibited from anchoring.

Permits and Monitoring

Locally administered monitoring systems (such as creel surveys) will provide information from populated areas. If needed, a general permit could be developed and implemented for EEZ reef fisheries, using a so-called framework process to modify FMP management measures. For unpopulated areas, where coral reefs would be designated as marine protected areas, special permits would regulate fishing and other types of fishing-related resource use, except in no-take MPAs where fishing would not be allowed. Special permits would also be required for new fisheries on coral reef taxa previously unreported in catch reports. Under this permit regime, the harvesting of live rock and coral would be specifically prohibited. However, the Council identified four exemptions to this permit regime. Permit holders in othar FMP-managed fisheries would not have to obtain an additional permit for incidental catch of coral reef taxa, because they are already required to report all incidental catch. Indigenous people, aquaculture operations, and scientific management activities would be exempted from the prohibition on the harvest of live hard coral and wild live rock. These three activities would require permits: a special permit for the first two and a scientific permit, established under existing regulations and issued by the NMFS Regional Administrator, for the third. In addition, the allowable take would be limited.

Fishing Gears and Methods

Three conditions on gear use, in order to minimize habitat and resource impacts, are incorporated into this FMP. The Council also developed a list of allowable gear types, which includes the following: (1) hand harvest; (2) spear; (3) slurp gun; (4) hand/dip net; (5) hoop net for Kona crab; (6) throw net; (7) barrier net for aquarium fish; (8) surround/purse seine net for targeted schooling fish (e.g., *akule*, baitfish, *weke*) with a minimum of bycatch; (9) hook-and-line (powered and unpowered handlines, rod and reel, and trolling); (10) traps (with conditions); and (11) remote operating vehicles/submersibles. The following gears are specifically prohibited for coral reef management unit species: gillnets, trawls, dredges, tanglenets, longlines, explosives, and poisons. Finally, scuba-assisted spearfishing is prohibited at night in the Pacific remote island areas and the Northwestern Hawaiian Islands.

Other Management Measures

ADAPTIVE MANAGEMENT: A framework process, providing an administratively simplified procedure for FMP modification, is an important component of the FMP.

NON-REGULATORY MEASURES: A set of measures, consistent with FMP objectives, will be implemented by the Council outside of the regulatory regime. This includes the process and criteria for essential fish habitat consultations, formal plan team coordination to identify and address ecosystem impacts from existing FMP fisheries, facilitating consistent state and territorial level management, and research and education efforts.

Consideration for the NWHI Coral Reef Ecosystem Reserve

On 4 December 2000 President Clinton issued Executive Order (EO) 13178 which established the NWHI Coral Reef Ecosystem Reserve (NWHI Reserve). That Order was later amended by Executive Order 13196 issued 18 January 2001. The NWHI Reserve extends from the seaward boundaries of the Hawaiian Islands National Wildlife Refuge and the State of Hawaii to 50 nmi around all NWHI. The NWHI Reserve is intended to be a temporary management regime until completion of the process to designate certain coral reef areas around the NWHI as a National Marine Sanctuary. Conservation and management measures contained in the NWHI EOs include:

1. A cap on commercial and recreational fishing throughout the NWHI Reserve at the "previous year's" (from 4 December 2000) level of effort and take. (The bottomfish level would be based on an individual's average over the previous 5 years).
2. Establishment of 15 Reserve Preservation Areas in which almost all activities are prohibited seaward to 100 fm around most islands. (Bottomfishing and recreational trolling would be allowed in waters deeper than 25 or 50 fm around some islands.)
3. Prohibition on anchoring on live or dead coral, where the bottom can be seen.
4. Prohibition on anchoring where buoys are available or outside a yet-to-be-determined designated area.
5. General prohibition on the removal of living/non-living resources (with exceptions).
6. Prohibition on the taking or touching of living or dead coral.
7. General prohibition on discharging or depositing any material, except cooling water or engine exhaust (with few exceptions).
8. Additional restrictions on non-fishing activities.
9. Native Hawaiian uses to be allowed in yet-to-be-identified sub-areas. These activities would be restricted to subsistence, cultural, and religious purposes and would be allowed in both the Reserve and Reserve Preservation Area.

The NWHI EOs also established the NWHI Reserve Council, whose membership includes Native Hawaiian representatives, representatives from non-Federal scientific communities, representatives from non-governmental organizations, commercial and recreational fishing industry representatives, an ocean-related tourism industry representative, a non-Federal marine conservation representative, a citizen at large representative and one representative from the State of Hawaii. The membership also includes one representative each from the

Department of the Interior, the Departments of State and Defense, the United States Coast Guard, the National Marine Fisheries Service, the Hawaiian Islands Humpback Whale National Marine Sanctuary, the National Science Foundation, the Marine Mammal Commission and the Western Pacific Regional Fishery Management Council. The function of the NWHI Reserve Council is to provide the Secretary of Commerce with advice and recommendations on the Reserve Operations Plan and designation and management of any sanctuary. However, the Council is not tasked with preparing or developing any plans or documents.

Currently, it is unknown how the NWHI EOs will ultimately affect existing fisheries operating within the boundaries of the NWHI Reserve. However, because these executive orders will prohibit almost all extractive activities to 50 nautical miles around most islands, the NWHI Reserve will provide an ideal location for conducting scientific research, as it could provide unique opportunities for:

- Establishing a baseline for assessing the health of coral reef ecosystems;
- Determining the impacts of oceanic regime shifts on reproduction, recruitment and productivity of the coral reef ecosystem and associated marine resources;
- Assessing the effects of oceanic regime shifts on representative coral reef habitats (i.e., effects on the coral reef ecosystem at Kure vs. effects on the coral reef ecosystems at Nihoa);
- Determining the degree of habitat impacts attributed to storms and hurricanes;
- Determining the primary factors influencing the survival of the Hawaiian monk seal;
- Determining ecological relationships between reef fish with the surrounding environment and population dynamics during different life stages; and,
- Assessing and monitoring ecosystem dynamics in an environment relatively free of anthropogenic impacts.

The NWHI Reserve may also provide an impetus to generate funds and direct resources toward cleaning marine debris, avoiding vessel groundings, and cleaning-up toxic sites such as at Tern Island, French Frigate Shoals. Additionally, the NWHI Reserve could also provide expanded opportunities for scientific research and education activities, and closer coordination among stakeholders in determining research priorities. Administratively, the establishment of the NWHI Reserve would alleviate some of the burdens to fishery management agencies tasked with developing fishery management plans and issuing permits for NWHI fisheries.

Scientific data collected on marine organisms in the NWHI in the absence of fishing or other human activities would be relatively academic. The information would reflect an ecosystem where changes in species abundance and productivity would be largely related to prevailing oceanographic and environmental conditions. Because at least portions of this unique coral reef ecosystem, with low species diversity and high endemism, are surviving at or near the limit of suitable environmental conditions, the applicability of this information as a baseline in comparison with unexploited coral reefs in the Western Pacific Region is open to debate.

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CHAPTER 1

INTRODUCTION TO THE PLAN

1.1 Prologue

Long before Western contact and association with the U.S., what are now the U.S. Pacific Islands were settled by seafaring peoples whose continued survival depended on fishing wisely. This is the basis for indigenous islanders' cultural and spiritual relationship with marine resources, especially coral reef resources. It is not surprising, therefore, that the indigenous cultures of the U.S. Pacific Islands abound in proverbs, myths, and legends about coral reef resources. A few of these follow.

Hawaiian

Translated from the Hawaiian chant of creation, *Kumulipo* (Beckwith 1951):

> The night gave birth
> Born was *Kumulipo* in the night, male
> Born was *Po`ele* in the night, female
> Born was the coral polyp, born was the coral, came forth
> .....(over 2,000 more lines of the creation chant follow)

Hawaiians of old used products of the coral reef for nearly every purpose. Some organisms were collected to extract medicine. Some organisms had a darker purpose. *Limu make,* a soft coral *(Palythoa toxica),* contained a deadly poison. Scientists from the Hawaii Institute of Marine Biology traveled to Kanewai, Hana, island of Maui in December 1961 to collect specimens for research. They were warned by native residents of the area that *limu make* was *kapu* (forbidden). That same day, a fire of undetermined origin occurred at their Coconut Island marine laboratory, completely destroying the main building (Titcomb 1978).

Samoan

The *tulavae* is a portion of the fish ner made by one person. All of the *tulavae* made by a section of the village are joined into a *fata*. The totality of the *fata* forms the complete net. A person who has supplied a *tulavae* for the *fata* is entitled to take part in the fishing and to share in the catch.

Ua `ou seuseu ma le fata. "I am fishing because I have helped to make a *foto*."

The saying means: I have the right to take part in the discussion.

Chamorro

Long ago, Guam was inhabited by a race of superhuman people (known as the taotaomona) who were capable of magic. One day, fishermen noticed that Hagatna Bay and Pago Bay were growing. They saw that a giant parrotfish was nibbling at the shoreline and eating away the island. "If this keeps up, our island will be cut into two pieces," they said. Their search could not find the fish, however.

Every day, maidens would gather at Hagatna Springs to wash their beautiful long hair and rinse it with the juice of lemons. The maidens noticed that the discarded lemon peels they had thrown into Hagatna Bay later appeared in Pago Bay. Thinking that the giant fish was tunneling between bays, they were determined to trap it. The maidens cut off their long hair and wove it into a magic net. They sang into the tunnel to lure the fish into Hagatna Bay where it became tangled in the net made from their hair. This is how their island was saved from destruction.

Pacific Remote Island Areas

In Marshallese tradition, Eneen-Kio (Wake Island) was associated with a large bird whose bones were used to fashion tattooing chisels. Legend recounts that when a chief required a tattoo the only suitable chisels were made from human bones or the bones of this large bird, most likely the albatross. The albatross nested on Eneen-Kio but only flew over the other Marshall Islands. When a human sacrifice was selected, he could be spared if he was able to procure the proper bird bones for the tattooing chisel. This required a voyage to Eneen-Kio. Archeological surveys of other Pacific remote island areas provide little evidence of human habitation or use prior to Western contact.

1.2 History of Coral Reef Resource Use and Management

The seafaring people who settled Samoa, Hawaii, and the Mariana Islands depended on marine fisheries–and especially coral reef resources–for protein in their diet. Through much trial and error, the indigenous peoples devised social and cultural controls to foster, in modern terminology, "sustainable" use of these resources several thousand years before Western forms of marine resource management were introduced. After European contact, Westernization eroded island cultures and subsistence economies; but islanders have perpetuated some ancestral fishing techniques, sophisticated knowledge of marine resources, and a code of fishing conduct.

Fisheries for coral reef resources in the U.S. Pacific Islands are multi-species and multi-gear. Harvesting methods include hand gathering, hook-and-line, spear, and various types of nets and traps. The existing fisheries target several hundred different species of inshore fishes, invertebrates, and in Hawaii, seaweeds, with most of the harvest from reef areas near the main populated islands. Many of the fisheries that currently harvest coral reef resources in the U.S. Pacific Islands can be traced back to fishing methods that were practiced by indigenous populations hundreds to thousands of years ago. Population growth, cash economies, Western laws designating the oceans as a commons, breakdown of traditional knowledge, and the introduction of modern, manufactured gear have magnified the impact of these fisheries in modern times. They are managed under island government laws and regulations. (These governments are the Territories of American Samoa and Guam, the State of Hawaii, and the Commonwealth of the Northern Mariana Islands.) More recently, established fisheries that target coral reef resources for the marine ornamental products market are also controlled, to varying degrees, by island governments.

Fishing controls vary among the different island governments, but they include commercial fishing licenses, gear restrictions, bag limits, seasonal closures, and minimum size restrictions for possession and sale of fish. In addition to specific limitations on fishing effort and catch, some island governments have closed particular reefs indefinitely to most types of fishing, and have zoned other areas to separate competing uses. Destructive fishing methods, such as explosives and poisons, are prohibited by the island governments.

A few fisheries reef-related resources are harvested farther offshore in the U.S. Exclusive Economic Zone (EEZ) surrounding U.S. Pacific Islands. These commercial and semi-commercial activities require boats. Bottomfish are taken by hook-and-line on deep slopes in the EEZ around American Samoa, Guam, Hawaii, and CNMI. Spiny and slipper lobster are trapped in some areas of the Northwest Hawaiian Islands (NWHI).

These and other fisheries in the EEZ around the U.S. Pacific Islands are managed by the Western Pacific Regional Fishery Management Council (hereafter, the Council). The Council is composed of government officials and members of the public who reflect various interests. Its primary function is to prepare, evaluate, and revise FMPs, which must balance long-term conservation of fish stocks and fish habitats with optimal use of these resources. These plans must be approved by the Secretary of Commerce before implementation.

1.3 Purpose and Need for Action

Coral reefs are relatively robust and have survived millions of years of natural disturbance. Despite such long-term resiliency, however, reefs undergo episodes of high natural stress. Human uses of, and impacts on, reefs have never been higher, and there is growing concern that human stressors could add to cumulative natural impacts on reefs in the Western Pacific Region. A Fishery Management Plan (FMP) for Coral Reef Ecosystems of the Western Pacific region is needed:

- To establish a management regime for the protection and sustainable use of coral reef ecosystems and their associated marine resources.
- To anticipate and avoid potential damage to essential and non-renewable coral reef habitat.

- To address the secondary effects of all reef-related fisheries on non-target coral reef resonrces, thereby encouraging ecosystem-scale management.

- To ensure that newly emerging coral reef fisheries are managed using precautionary principals and the best avuilable information.

- To manage new underwater harvesting technologies that are extending the depth and time limits at which coral reef resources can be harvested.

- To enconrage coherent and coordinated coral reef management, monitoring, and enforcement across jurisdictional boundaries.

- To facilitate consensual management that considers all types of stakeholders, and adaptive management that considers new data and unforeseen impacts.

- To allow sustained use of the coral reef resources, which are important for the continuity of indigenous cultures in the U.S. Pacific Islands.

Stony corals are among the principal reef-framework-building organisms in the U.S. Pacific Islands. In 1998, global coral bleaching and die-off was unprecedented in geographic extent, depth, and severity. Several studies have related bleaching to the combination of increased ultraviolet radiation and ocean warming, phenomenu that may be exacerbated by human activities. Projected long-term climatic changes are likely to expose stony corals to an increasingly hostile environment and conld possibly lead to mass extinctions.

The degradation and destruction of essential habitats for many coral reef species' reproduction and recruitment is of foremost concern. To date, non-fishing activities—such as coastal and harbor development, watershed land use practices and runoff, industrial discharges, and military use—have caused much of the damage to coral reef habitats in the U.S. Pacific Islands, but fishing and non-fishing vessels also have the potential to degrade habitat through vessel grounding, anchoring, introduction of invasive exotic marine species, and substrate scouring and ghost fishing by derelict gear and other marine debris. Removing live rock and nsing destructive fishing techniques, such as explosives and poisous, can also directly affect coral reef habitats. Because many resources that contribute to coral reef habitat are essentially non-renewable, when gauged by our life span, preventing damage, rather than mitigating its effects, is a far more effective strategy.

1.3.1 Ecosystem Effects of Established Fisheries

Fisheries for coral reef resources are well established around the inhabited U.S. Pacific Islands. Currently, most coral reef fishing occurs on nearshore reefs, which are regulated by U.S. Pacific Island governments, while the Council, through its FMPs, manages fisheries in the federal EEZ. Fishermen use a wide variety of gear and some of these gear types, or the ways iu which they are used, can cause habitat degradation. For example, a new method of reef fishing with gill nets was recently introduced to Hawaii. When retrieved by hydraulically-powered reels from depths of 10 to 100 m, the nets snag and damage the bottom. Lobster tangle nets used in nearshore areas around the main Hawaiian Islands have the same impact. The State of Hawaii has taken action to control destructive gill-netting in state waters around the main Hawaiian Islands, but no equivalent regulations apply in federal EEZ waters surrounding other U.S. Pacific Islands.

Although the Council has already developed and implemented four FMPs—to manage pelagic, bottomfish, lobster, and precious coral fisheries in federal waters—they do not comprehensively address fisheries targeting coral reef resources. In addition, they have been crafted around conventional fishery management objectives: to prevent overfishing; minimize bycatch; and produce optimum yield of target resources. There are, however, no procedures or requirements for monitoring or managing ecosystem effects of reef-related fishing activities. As a result, their management regimes may overlook the potential for secondary effects on non-targeted resources resulting from effects on habitat and other interactions. Such effects, if severe enough, can bring about undesirable structural or functional changes to complex coral reef ecosystems. Fortunately, hook-and-line, longline, lobster traps, and hand harvest—the predominant gear types used in Council-managed fisheries—are not known to cause significant adverse impacts to coral reef habitat (URS Corp., in prep). Several other measures also limit the ecosystem effects of these fisheries. First, these FMPs prohibit fishing with potentially destructive fishing gear such as bottom trawls, bottom-set nets, explosives, and poisons. Second, the Precious Corals FMP prohibits using non-selective gear to harvest precious corals in the MHI. A regulatory adjustment to this FMP—currently being developed by the Council—will extend this prohibition to the entire Western Pacific Region EEZ.

There are two ways that the four implemented Council FMPs, along with this FMP, can more effectively address ecosystem effects. First, recently implemented essential fish habitat (EFH) provisions are designed to prevent, mitigate, or minimize any adverse habitat effects, when it can be documented that these impacts result from fishing. (See Chapter 6 in this volume and Volume III for a discussion of EFH.) These effects can include physical, chemical, or biological alterations of the substrate and loss of, or injury to, benthic organisms and prey species, their habitats, and other components of the ecosystem. Second, this Coral Reef Ecosystem FMP (CRE-FMP) outlines a formal process to coordinate the plan teams established under each of the Council's FMPs. This process will allow plan team members to identify and control the secondary effects that may result from fisheries managed by the Council's four implemented FMPs. Similarly, this CRE-FMP also describes a mechanism to enhance coordination and cooperation with State, territorial, and other agencies managing coral reef resources in the Western Pacific Region.

1.3.2 Ecosystem Effects of Developing Fisheries

Coral reefs represent one of the Earth's most genetically and biologically diverse and undocumented environments (Birkeland 1997a). Because a coral reef ecosystem is composed of many species with a long co-evolutionary history, removing certain species may result in undesirable changes in ecosystem structure or function, such as a predominance of less valuable generalist species. Most species of reef organisms have small body size, restricted dispersal, and small geographic ranges. They often have low population densities and low turnover rates that limit the potential harvest of any single species.

Bioprospecting for emerging biomedical and natural products industries, and the expanding trade in marine ornamental products, coupled with new harvest technologies, could result in the harvest of organisms whose characteristics—particular life cycle, place in the food web, or their abundance and distribution—are poorly understood or completely unknown. Like the tropical rainforest, their terrestrial equivalent, coral reefs harbor hundreds of thousands of mostly cryptic and unnamed species.

Bioprospecting

The search for promising new medicines provides strong incentives to explore coral reef ecosystems for potentially useful resources. This activity is known as "bioprospecting." This search for novel natural products for medicine, industry, and agriculture has become an established field over the past quarter-century. About half of the potential pharmaceuticals being explored are from the ocean, many from coral reef ecosystems.

The companies involved in the business are often billion-dollar corporations. Due to the high profiles of bioprospectors and some initial harmful bioprospecting, advocate groups have been active in impeding wholesale harvest and protecting the rights of local indigenous groups throughout the world. In addition, the Convention on Biological Diversity, drafted at the Rio Earth Summit, recommends strong measures to protect against harmful bioprospecting. These companies now write detailed contracts with local and indigenous groups, strictly regulate harvest, negotiate up-front cash and royalties for successful products, train local people in the field, and offer means for environmental protection.

Pharmaceutical companies are only interested in collecting enough material from the wild to screen for active ingredients that could be useful for biomedical applications. Virtually any coral reef resource could become a target for bioprospecting, including species presently unknown to science and for which there is no understanding of sustainable yield. Million-dollar grants have been given for medical bioprospecting in coral reef ecosystems in the Pacific basin, although not yet in the U.S. Pacific Islands. Coral reef resources that have already attracted research interest include bryozoans, sponges, tunicates, coral, and seaweeds. The most interesting chemicals are usually species-specific; these species may be rare or patchily distributed, and the natural production of the active chemical may vary in time and space (Birkeland 1997a).

Initial screening of the organisms, generally algae, sponges, and lower invertebrates, requires less than 1 kg of sample material. If a potentially useful bioproduct is discovered, the laboratory will make every attempt to synthesize the product in the lab without collection of additional samples. The reason for this is two-fold. Most important, this research requires multiple replications under strict protocols to verify the nature and intensity of bioactivity, and natural variation between samples of the same species can confound these protocols. Therefore, laboratory-grown samples or synthesized products are necessary for large-scale development and production. Second, field sampling is expensive and samples often arrive at the laboratory in poor condition for screening.

Several organizations are bioprospecting on reefs near several U.S. Pacific Islands. The U.S. National Cancer Institute has contracted the Coral Reef Research Foundation, a non-profit organization based in the Republic of Belau, to collect and identify coral reef and other marine organisms for anti-cancer and anti-AIDS screening tests (CRRF 2000). In addition, the University of Guam Marine Laboratory is seeking new examples of the chemical deterrents that coral reef organisms possess to deter predators. They are collaborating with researchers at the University of Hawaii, who are also examining the properties of these chemical deterrents. Some of these substances could have biomedical uses: they might kill cancer cells; halt inflammatory responses; or deter microbes and viruses. Other substances may be effective insecticides for use in agriculture.

Since its founding in 1999, the Marine Biotechnology Engineering Center in the Department of Oceanography at the University of Hawaii has been actively screening organisms from the marine environment. This multi-disciplinary group connects researchers from many University departments with industry sponsors. In addition, the Governor of Hawaii has made biotechnology industry development a priority for State economic development; and the most prestigious biotechnology conference in the world is scheduled to take place in Hawaii in 2004. Bioprospecting in the EEZ around U.S. Pacific Islands can be socially beneficial, with minimal adverse effects, if it is carefully monitored and managed. The take of potentially-harvested coral reef resources can be maintained at safe levels while new resource information is gathered to estimate biological reference points, assess sustainable yields, and learn how to improve management of new fisheries.

Marine Ornamentals Collection

With dramatic improvements in husbandry techniques and distribution abilities, the private sector marine aquarium trade has expanded considerably in the past decade. This trade, encompassing both public and private aquaria and including pet shop retailing, imports hundreds of species of reef-dwelling fish, corals, and other invertebrates.

Coral reef organisms for the marine aquarium trade are predominantly collected in the Indo-Pacific region. This trade involves numerous species of reef fish (especially angelfish, butterflyfish, and damselfish), and a widening spectrum of invertebrates, including corals, anemones, crustaceans, molluscs, polychaetes, echinoderms, and sponges. Endemic coral reef resources could become locally extinct if heavily collected in their limited range of distribution. In order to address some of their impacts, the aquarium trade is developing education and conservation projects meant to improve fish survivability. These projects include captive breeding of fishes, propagation of corals, and education about advanced husbandry techniques. The goal of these efforts is to significantly decrease the number of species harvested from the wild. So far, few marine ornamental products are collected from reef areas in the EEZ around U.S. Pacific Islands. Nevertheless, the rapidly expanding reef ornamentals industry could soon begin harvesting coral reef resources in some areas of the U.S. Pacific Islands' EEZs.

Live Rock Harvest

Harvesting coral reef habitat itself, in the form of "live rock," is rapidly increasing in the marine ornamentals trade. These rocks consist of stony corals, soft corals, and other attractive reef substrates. Their removal is harmful because many extracted coral species grow so slowly that, in human terms at least, they can be considered non-renewable resources. In addition to a direct loss of valuable habitat, the harvest of live rock substratum unavoidably includes an incidental harvest of commensal and infaunal organisms, which are removed with the rock.

The harvest and possession of live rock and certain coral species are prohibited, with limited exceptions, by island governments in the U.S. Pacific Islands. Collection of live rock and hard coral in the EEZ is completely unregulated, however. Both Hawaii and Guam have recently faced cases in which live rock or coral was being exported, but prosecution was impeded by claims that the collection took place outside territorial waters in the EEZ. This demonstrates that management and enforcement is currently inadequate and cannot effectively control this threat in the EEZ around the U.S. Pacific Islands.

Improvements in Underwater Harvesting Technology

Long established reef-related fisheries in the U.S. Pacific Islands employ conventional types of gear, subject to regulation by the island governments and through FMPs. Advances in scuba technology (e.g., mixed gas, rebreather) and manned and unmanned submersibles are providing greater access to deep-water coral reef resources. As this technology becomes more affordable, fishing pressure will increase on high-value species that are already heavily exploited at shallower depths. Unless new harvesting technologies are monitored and controlled, they could harm the reproductive capacity of species that have slow population turnover or those with few reproductive-size adults because of heavy fishing in shallow habitats.

Recently, the demand for small, immature black coral colonies has increased because of the growing popularity of household marine aquaria. To date, black coral in Hawaii has been hand harvested by a small group of divers using conventional compressed air scuba gear. Divers using this gear can safely descend to a maximum depth of less than 75 m. However, it is likely that in the near future black coral divers will start using mixed-gas diving methods or re-breathers that enable divers to increase both their safe diving depth and their bottom time. Already, some harvesters are experimenting with towed underwater camera systems and other devices that may increase the output from old harvest areas and lead to the discovery of new beds (URS Corp. in prep).

Manned submersibles and remotely-operated vehicles are still very expensive, but during the past two decades innovations in submersible technology in the petroleum and defense industries have significantly reduced their capital and operating costs (URS Corp. in prep).

1.3.3 Need for Comprehensive Ecosystem-Based Management, Monitoring, and Enforcement

Reefs extend across jurisdictional boundaries, and mechanisms for coordinated management among different government agencies are largely *ad hoc*. Reefs in nearshore areas are under the jurisdiction of the island governments. Other reefs are in national parks, marine sanctuaries, national wildlife refuges, or naval defense areas, which are managed by various federal agencies other than NMFS. Fisheries throughout the U.S. EEZ—including coral reef fisheries—are managed under the authority of the Magnuson Fishery and Conservation Act of 1997, as amended (MSFCMA). This legislation delegates much of the responsibility to regional councils. The reef-related bottomfish and lobster fisheries conducted in the EEZ around the NWHI have been actively managed by the Council for more than a decade.

The management objectives of the various agencies are not consistent. Even when effective regulations are in place enforcement is difficult, labor intensive, and often inadequate. Fragmented jurisdicrion and management authority complicate prosecution of violators. Coral reefs represent an extreme in biological diversity, habitat complexity, and competing demands for resource use. Only holistic management is likely to be effective.

1.3.4 Need for Consensual and Adaptive Management

A wide range of consumptive and non-consumptive acrivities, commercial and non-commercial uses, and resident and non-resident populations compete for coral reef resources. Residents of the U.S. Pacific Islands include significant numbers of indigenous people whose cultures are dependent on frshing and seafood. Increased tourism-related ocean recreation in Hawaii, CNMI, and Guam means more island visitors who place a premium on non-consumptive uses of nearshore coral reef resources (Pooley 1993b).

There is almost universal agreement about the need for sustainable resoarce use, but users are divided by fundamentally different views on marine resources: how to study them, analyze them, and manage them. It is difficult, therefore, to define management objectives and "preferred" ecosystem outcomes that are clearly desirable and recognizable by all interests.

The council system, creuted by the MSFCMA, is more decentralized than other forms of living resource management by U.S. government agencies (e.g., national parks, forests and wildlife refuges, endangered species). Under the council process management policies for EEZ fisheries evolve during the preparation and amendment of FMPs. Participants in plan development are diverse—they include regulators, scientists, and resource users. The process is also very open: public participation—through advisory panels and at meetings—is early, systematic, and meaningful. The process encourages participation by stakeholders representing different views and cultures, facilitating dialogue even in an adversarial environment. Decision-making relies heavily on consensual agreement. Typically, the technical data available for management decisions are uncertain and incomplete. The Council, therefore, follows an adaptive management strategy that allows for improvement of FMPs as new information becomes available. An adaptive management process is well suited to coral reef fisheries management because of the diverse stakeholders and poor biological and ecological understanding of the resource base.

1.3.5 Consideration Given to Indigenous People in Plan Development

The indigenous people of the U.S. Pacific Islands have centuries-old connections to coral reefs that pre-date European contact and Western concepts of coral reef management. Beginning when the islands were first settled, indigenous cultures evolved a physical, economic, and spiritual life defined by dependence on marine fisheries for food security. Indigenous cultures believe that the ocean and land environments are inextricably connected. Because of this holistic perspective, Pacific Islanders see themselves as an integral part of the ecosystem. And because of their intimacy with local inshore marine environments, indigenous communities developed a far more detailed understanding of coral reefs than that of modern-day resource users and managers. This fostered the development of relatively sophisticated social controls over fishing, in order to ensure sustainable harvests. For example, islanders recognized that fishing should not disrupt crucial life history bottlenecks like spawning aggregations, and they often imposed corresponding restrictions on fishing times and places. Because of the precision of these controls, traditional conservation measures can be likened to a "rifle" as opposed to a "shotgun."

In developing this FMP, the Council has been ever appreciative of these accomplishments. As important, when preparing FMPs the Council is required to take into account the various traditional fishing practices of indigenous island residents. For example, marine protected areas, one of the management measures outlined in this FMP, could be construed as a limited access system. In this case the MSFCMA dictates that the Council must take into account "historical fishing practices in, and dependence on the fishery" and "the cultural and social framework relevant to the fishery" (§303 (b)(6)).

Apart from considerations of historical participation and cultural dependence on coral reef fisheries, the Council is concerned that communities consisting of descendants of indigenous Pacific Islanders have not sufficiently benefitted from the region's fisheries. The MSFCMA provides for the establishment of a community development program for Western Pacific fisheries. This provision is intended to increase opportunities for indigenous communities to participate in and benefit from fisheries in the Council's jurisdiction.

It is also important to note that in numerous statutes the U.S. Congress has specially considered aboriginal Hawaiians because they are socio-economically disadvantaged and there is a federal trust obligation stemming from Section 5 of the Admissions Act. In addition, the way that the U.S. gained control of Hawaii should be taken into account. As a result, in 1993 Congress passed the Apology Bill, which states that "...the indigenous Hawaiian people never directly relinquished their claims to their inherent sovereignty as a people or over their national lands to the United States, either through their monarchy or through a plebiscite or referendum." In the absence of any treaty or voluntary relinquishment, the lingering sovereignty claim by Hawaiians may dictate caution in establishing regulations that restrict the right of Hawaiians to harvest coral reef marine resources, particularly in areas held by the State of Hawaii as part of the Ceded Lands Trust for the benefit of Native Hawaiians. Many of the submerged lands surrounding the NWHI are part of the Ceded Lands Trust.

1.4 Management Plan Objectives

The MSFCMA mandates fishery management measures that achieve optimum yield from fisheries resources of the U.S., while preventing overfishing. However, in 1999 the Ecosystems Principles Advisory Panel (EPAP) submitted a report to Congress arguing for management that—while not abandoning optimum yield and overfishing principles—takes an ecosystem-based approach (EPAP 1999). Heeding the basic principles, goals, and policies for ecosystem-based management outlined by EPAP, the Council plans to develop "Fisheries Ecosystem Plans" for each major ecosystem under its jurisdiction. This Coral Reef Ecosystem FMP represents the first of these plans. While outlining several new and important coral-reef-specific management measures, it also serves as a framework for incorporating ecosystem approaches into the regulatory structure created by the already-implemented Bottomfish, Crustaceans, Precious Corals, and Pelagics FMPs.

The overall goal of this management program is to establish a management regime for the entire Western Pacific Region that will maintain sustainable coral reef fisheries while preventing any adverse impacts to stocks, habitat, protected species, or the ecosystem. To further this goal the Council established eight objectives for the CRE-FMP. The objectives promote: (1) sustainable use of coral reef resources, especially by fishing communities and indigenous fishermen in the region; (2) an adaptive management approach based on fishery-dependent and fishery-independent research; (3) marine protected areas and habitat conservation; (4) cooperative and coordinated management by the various agencies concerned with the conservation of coral reef resources; and (5) education to foster public support for management.

Objective 1: To foster sustainable use of multi-species resources in an ecologically and culturally sensitive manner, through the use of the precautionary approach and ecosystem-based resource management.

Objective 2: To provide a flexible and responsive management system for coral reef resources that can rapidly adapt to changes in resource abundance, new scientific information, and changes in fishing patterns among user groups or by area.

Objective 3: To establish integrated resource data collection and permitting systems, establish a research and monitoring program to collect fishery and other ecological information, and to collect scientific data necessary to make informed management decisions about coral reef ecosystems in the EEZ.

Objective 4: To minimize adverse human impacts on coral reef resources by establishing new—and improving existing—marine protected areas, managing fishing pressure, controlling wasteful harvest practices, reducing other anthropogenic stressors directly affecting coral reef resources, and allowing the recovery of naturally-balanced reef systems. This objective includes the conservation and protection of essential fish habitats.

Objective 5: To improve public and government awareness and understanding of coral reef ecosystems and their vulnerability and resource potential in order to reduce adverse human impacts and foster support for management.

Objective 6: To collaborate with other agencies and organizations concerned with the conservation of coral reefs, in order to share in decision-making and to obtain and share data and resources needed to effectively monitor this vast and complex ecosystem.

Objective 7: To encourage and promote improved surveillance and enforcement to support the plan's management measures.

Objective 8: Provide for sustainable participation by fishing communities in coral reef fisheries and, to the extent practicable, minimize the adverse economic impacts on such communities.

1.5 Management Plan Approach

Coral reefs are complex, multi-resource marine ecosystems comprising thousands of species, few of which are targeted by existing fisheries. They represent an extreme in biological diversity, ecological complexity and competing demands for resource use. Therefore, only holistic management is likely to be effective. However, the basics, much less the intricacies, of coral reef ecosystems are poorly understood. Furthermore, it is doubtful that there will ever be enough data available to calculate total removals, including incidental mortality, and show how they relate to standing biomass, production, optimum yields, natural mortality, and trophic structure. Ecosystem-based management of coral reefs, therefore, is a long-term goal that can only be achieved as new information allows for improved understanding and decision-making. EPAP (1999) made recommendations to guide the further development of ecosystem management for fisheries, built around the following policies:

- Change the burden of proof.
- Apply the precautionary approach.
- Purchase "insurance" against unforseen, adverse ecosystem impacts.
- Learn from management experience.
- Make local incentives compatible with global goals.
- Promote participation, fairness, and equity in policy and management.

To the extent possible, the CRE-FMP attempts to incorporate these concepts. According to EPAP, a fishery ecosystem plan should incorporate eight actions (EPAP 1999, pp. 27-32). The way in which this FMP incorporates each of these action items is outlined below.

1. *Delineate the geographic extent of the ecosystem(s) that occur(s) within Council authority, including characterization of the biological, chemical, and physical dynamics of those ecosystems.*

   The geographic extent and ecological characterization of coral reef ecosystems around the U.S. Pacific Islands are described in Chapter 2 of this FMP. High biological and environmental variability is a natural characteristic of these ecosystems, with or without fishing. Irregular pulses of new recruits cause cycles in the abundance and harvest potential of individual reef species. Environmental variability is both spatial—related to differences in the quality of habitat—and temporal—related to monthly moon phase, and seasonal and longer-term environmental changes. Coral reef resources are also affected by large-scale climatic shifts. Natural disturbance cycles in areas exposed to large storm waves can dramatically alter coral cover and resulting habitat quality.

2. *Develop a conceptual model of the food web.*

   The ECOPATH model, as applied to coral reef ecosystems, is described in Section 2.4 of this FMP. ECOPATH is a simple mathematical model that estimates mean annual biomass, production, and food consumption for major components (species groups) of an ecosystem. Application of ECOPATH to French Frigate Shoals found that the coral reef ecosystem is controlled mainly by predation from the top down and primary production is controlled mainly by nutrients, photosynthetic rate limits, and habitat space.

3. *Describe the habitat needs of different life history stages for all plants and animals that represent the "significant food web."*

   In addition to Chapter 2, Chapter 6 and Volume III of this FMP, which describe and discuss essential fish habitat, detail the habitat needs of different life history stages for all species managed under this FMP, based on available scientific information.

4. *Calculate total removals—including incidental mortality—and show how they relate to standing biomass, production, optimum yield, natural mortality and trophic structure.*

   Because available biological and fishery data are poor for all species and areas covered by the CRE-FMP, it is not possible to address this action item.

5. *Assess how uncertainty is characterized and what kind of buffers against uncertainty are included in conservation and management actions.*

   The FMP acknowledges that there is uncertainty regarding the impacts of fishing and other human activities on coral reef ecosystems. As a buffer against uncertainty, the FMP establishes marine protected areas as insurance against this risk, and reporting requirements to monitor changes in the fisheries, as described in Chapter 5.

6. *Describe available long-term monitoring data and how they are used.*

   Section 3.3 includes an overview of available long-term monitoring data while Chapter 7 describes research needs. Fishery monitoring and fishery-independent research activities will generate information that may be used for future adjustments to the CRE-FMP under a framework procedure that allows for timely action.

7. *Develop indices of ecosystem health as targets for management.*

   What constitutes a "healthy" reef in the U.S. Pacific Islands is difficult to define, but should be considered within a specific geographic and temporal context, considering the quality of natural habitat, environmental variability, natural disturbance cycles, and also the history of human impacts. Measuring changes and differentiating natural rhythms from fisheries' effects, even in specific localities, present major challenges because of the highly dynamic ecosystem. Because of these factors, no indices of ecosystem health have yet been established under this FMP beyond the MSY, OY and overfishing reference points, as discussed in Chapter 4.

8. *Assess the ecological, human, and institutional elements of the ecosystem which most significantly affect fisheries, and are outside Council/Department of Commerce authority. Included should be a strategy to address those influences in order to achieve both FMP and FEP objectives.*

Much of the previous damage to coral reefs around U.S. Pacific Islands has occurred as a result of non-fishing activities such as coastal and harbor development, watershed land use practices and runoff, industrial discharges, non-fishing vessel operation, and military and tourist use. The most severe impacts have occurred on nearshore reefs under island government jurisdiction. Few reefs in the EEZ are close enough to inhabited land areas to be significantly affected by tourism, coastal development, upland runoff, beach erosion, and other terrestrial impacts. Some impacts occur at a scale too large to be mitigated by unilateral management actions for the Western Pacific Region. These include: overpopulation, ocean warming and increased ultraviolet radiation, introduction of invasive exotic marine species, and accumulation of marine debris.

Reefs extend across jurisdictional boundaries, and mechanisms for coordinated management among different government agencies are largely *ad hoc*. Inter-regional and international management will be necessary to find solutions to this problem. Reef areas in near-shore areas are under the jurisdiction of the island governments. Other reefs are in areas managed by various federal agencies (e.g., national parks, marine sanctuaries, national wildlife refuges). The management objectives of the various agencies are not consistent. Even when effective regulations are in place, enforcement is difficult, labor intensive and often inadequate. Fragmented jurisdiction and management authority complicate prosecution of violators.

To address these problems, several steps could be taken. The Council could negotiate a memorandum of understanding with states to increase the extent of marine protected areas. Reliance on island government permit and reporting for the EEZ adjacent to populated islands, as described in this FMP could be enhanced. Through an amendment to the MSFCMA, the Council's and NMFS's authority could be expanded to address non-fishing vessel impacts on habitat. Finally, the essential fish habitat consultation process, mandated by the 1996 Sustainable Fisheries Act amendment to the MSFCMA, could be actively pursued and enhanced. These possible measures are described in more detail in Chapters 5 and 6 of the FMP.

1.6 Management Unit

1.6.1 Management Area

The Coral Reef Ecosystems Management Area (CRE management area, or management area) includes the EEZ surrounding Hawaii, Guam, Samoa, CNMI and Pacific Remote Island Areas.[1] (The Pacific Remote Island Areas, hereafter PRIAs, consist of Palmyra Atoll,

[1] Generally, EEZ waters are outside of territorial waters, which extend from the shore to 3 miles, and within 200 miles from shore. However, jurisdictional issues in the CNMI are complicated because the federal government claims jurisdiction to the shoreline while the CNMI claims jurisdiction over the whole EEZ. For purposes of the CRE-FMP, waters from shore to 3 miles offshore are the management responsibility of CNMI. Management of inshore waters around CNMI remains with the regional authorities because (1) cooperation between the

Kingman Reef, and Howland and Baker Islands in the central south Pacific; Midway Island at the northwest end of the Hawaiian archipelago; Johnston Atoll southwest of the main Hawaiian Islands; and Wake Island in the Marshall Islands Archipelago.) The management area for this FMP includes at least 11,382 km^2 of reef area, summarized in Table 1.1. Approximately 80% of the coral reef area that would be managed under the CRE-FMP is in the NWHI. The nature and extent of coral reefs in EEZ waters around each Western Pacific Region jurisdiction[2] are briefly described below.

American Samoa

American Samoa is composed of seven islands in the eastern part of the Samoan Archipelago (14° S, 168-173° W). The islands are small, ranging in size from the densely populated high island of Tutuila (145 km^2) to the remote and uninhabited Rose Atoll (4 km^2). Mean air and sea surface temperatures (27.0° C and 28.3° C, respectively) vary little seasonally, although average air temperatures rose sharply, by 2° C, in the 1990s. The high islands receive heavy annual rainfall (300-500 cm on Tutuila) (Craig *et al.* in press).

As shown in Table 1.1, coral reefs are limited in area and only 8.4% of them are located within the EEZ, mostly on offshore banks (Green 1997). The main islands are volcanic mountains that descend steeply below sea level. They are fringed by narrow reef flats (50-500 m wide) that drop steeply to a depth of 3-6 m and descend gradually to 40 m. From this depth, the ocean bottom drops rapidly, reaching depths of 1,000 m within 1-3 km from shore (Craig *et al.* in press). Almost 300 coral species occur in American Samoa (Green 1997). The reefs also support a diverse assemblage of nearly 900 fish species. Dominant families are damselfish, surgeonfish, wrasse, and parrotfish. Spawning for some, and perhaps most, species occurs year-round, although peak spawning may be seasonal (Craig *et al.* in press).

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regional government and the Council relies on recognition of local management authority of the state waters, (2) the CNMI-based small vessel fishermen are best managed by local hands-on interaction and knowledge of the issues, and (3) this regime retains consistency with the other areas under Council jurisdiction.

[2]Recognizing that the region comprises several different political entities—a state, a commonwealth, two territories, and unincorporated federal territory—hereafter, as shorthand, these constituent parts (excluding federal territory) will be generically referred to as states.

Table 1.1: Coral reef area (in km^2 <100m deep) in nearshore waters (0-3 nmi from shore) and offshore waters (3-200 nmi from shore) in each location in the Western Pacific Region (Hunter 1995).

Location	0-3 nmi	3-200 nmi	Total Coral Reef Area
American Samoa	271	25	296
Guam	69	110	179
Hawaii			
Main Hawaiian Islands	1,655	880	2,535
Northwestern Hawaiian Islands	2,227	9,104	11,331
CNMI	45	534	579
PRIAs	620	89	709
Midway*	203	20	223
TOTAL	5,090	10,762	15,852

*Midway is a PRIA located in the Hawaiian Archipelago.

Little is known about the biological assemblages on offshore banks in the EEZ around American Samoa. Species composition on the offshore reefs may be similar to that on the outer reef slopes, although species diversity may be less because of the absence of estuarine, reef flat and shallow lagoon habitats (Green 1997).

Guam

Situated at 13° N latitude and 144° E longitude, Guam is the southernmost and largest island (550 km^2) in the Mariana Islands Archipelago. Guam's climate is warm and humid year round. Annual rainfall ranges from approximately 200 cm along the coast to 220 cm at higher elevations. The rainy season is generally from July through November. Sea surface temperatures range from a monthly mean of 27-28° C in February to 30° C in August. Guam regularly experiences typhoons, with winds greater than 65 knots. Typhoons are possible throughout the year, but their likelihood is greatest from July through December.

Guam is largely a raised limestone island on a volcanic base. Approximately half of the shoreline is bordered by well-developed coral reefs with reef flats as wide as 600 m. A broad barrier reef encloses Cocos Lagoon at the southwest tip of the island. A raised barrier reef, a greatly disturbed barrier reef, and a coral bank enclose the deep lagoon of Apra Harbor. The 110 km^2 of coral reefs on offshore banks in the EEZ account for about 60% of the total reef area in Guam (Green 1997).

Over 250 stony coral species have been recorded in the southern Mariana Islands (Birkeland 1997c). Guam's reefs also support a diverse assemblage of about 800 fish species. The fish families most important to coral reef fisheries—based on the number of fished species they contain—are the wrasses, groupers, surgeonfish, jacks, squirrelfish, snappers, parrotfish, emperors, and goatfish (Green 1997).

Little is known about the biological assemblages on offshore banks in the EEZ around Guam. The tops of these banks are relatively deep (20-40 m) (Green 1997). Myers (1997) has suggested species composition on these banks may be similar to that on the outer reef slope around the island of Guam, although the relative abundance of species would probably be different because of the isolation of the banks from continuous reef tracts and from heavy fishing pressure.

Hawaii

The Hawaiian Islands are the exposed parts of an elongated submarine ridge that extends for a length of nearly 2,400 km, between 19°-28° N latitude and longitudes 155°-178° W. Based on geologic age, the Hawaiian chain is divisible into three sections: eight major volcanic islands, most of which are inhabited, make up the southeastern part; several small islets and pinnacles constitute the middle section; finally, low atolls, sand islets, and shoals compose the most northwesterly part of the chain. The islands have a combined land area of over 16,600 km^2.

The northernmost atolls of Midway and Kure are exposed to cool temperatures during the winter months, but the rest of the chain is subtropical. The climate is determined by prevailing northeast trade winds.

With 89% of the total, Hawaii's coral reefs constitute the vast majority of coral reef area in the U.S. Pacific Islands. By the same token, this 10,004 km^2 of coral reefs is by far the largest area in the Council Region, and 90%, or 9,124 $km^2$of these reefs, is in the NWHI. Almost all sizeable coral reef area (880 km^2) in the EEZ surrounding the main Hawaiian Islands (MHI) is located on Penguin Bank between the islands of Molokai and Oahu.

The islets and atolls between Nihoa Island and Kure Atoll (excluding Midway Atoll), are known as the Northwestern Hawaiian Islands. Except for Kure, these islands are national wildlife refuges, providing habitat for several protected species, inclnding the green seu turtle and the Hawaiian monk seal.

The main Hawaiian Islands represent the young part of the Hawaiian Archipelago; consequently, they have less well-developed fringing reefs, which have not subsided as far below sea level as those in the NWHI (Green 1997). The coral reefs of the MHI were mapped extensively in the 1970s and 1980s, and have since been surveyed only intermittently. Grigg (1997) summarized the condition of MHI reefs in 1996-97, based on a statewide survey of knowledgeable individuals and agencies. He reports, based on that survey, that 90% of the reefs in Hawaii are healthy. The best reef development and highest live coral cover in the MHI are found in areas sheltered, or partially sheltered from, open ocean swell.

Coral reef resources in Hawaii are characterized by relatively low biological diversity, but a high degree of endemism. Hawaii's isolation has produced a large proportion of endemic coral reef species. It is estimated that 20-30% of the fish, 18% of the algae, and 20% of the molluscs are endemic to Hawaii. Hawaii's coral reefs are also unique because some species that are relatively uncommon in other areas of the Pacific are quite abundant in Hawaii (Fielding and Robinson 1987). Only 47 species of reef-building corals have been recorded. Coral species richness tends to be higher in the NWHI, where the genus *Acropora*, not found in the MHI, is present. Many reefs in the NWHI are comprised of calcareous algae (Green 1997). Black corals are found off promontories at depths of 30-100 m in both state and federal waters around the MHI (URS Corp. in prep).

A total of 557 marine reef fish species have been identified from the Hawaiian Islands, and about 24% of these are considered endemic. Reef and coastal pelagic fish families with species valued for food include surgeonfish, goatfish, parrotfish, jacks, bigeye scad, mackerel scad, and soldier fish. Coral reefs in Hawaii also provide habitat for over 1,000 mollusks, 1,350 other macroinvertebrates, and 400 seaweeds.

In general, fish species diversity appears to be lower in the NWHI than in the MHI. Although the inshore fish assemblages of the two regions are similar, fish size, density, and biomass are higher in the NWHI. Fish communities in the NWHI are dominated by apex predators, such as sharks and jacks, while communities in the MHI are not. Some fish species are common in parts of the NWHI that are rare elsewhere in the archipelago (Green 1997).

Perhaps the most important factor in the population dynamics of many coral reef species in the NWHI, and the ecosystem as a whole, are cyclical oceanographic events, which affect productivity over large areas and may account for large fluctuations in population abundance. In a comprehensive study of recent climatic and oceanographic events and their effect on productivity in the NWHI, Polovina *et al.* (1994) found that declines of 30-50% in a number of species from various trophic levels, from the early 1980s to present, could be explained by a shift in oceanographic conditions. Before this, oceanographic conditions lasting from the late 1970s until the early 1980s moved nutrient-rich deep ocean water into the euphotic zone, resulting in higher survival of reef fish, crustaceans, monk seals, and sea birds. The researchers caution that "resource managers need to be aware that target levels of productivity (in the NWHI), for protected species, or sustainable yield for fishery resources, may vary with interdecadal climate events."

The new NWHI Coral Reef Ecosystem Reserve is a related management issue. Executive Orders (EO) 13178 (December 4, 2000) and 13196 (January 18, 2001), issued by President Clinton, established the Reserve which spans the 1,200 mile length of the NWHI by a 100 mile corridor. Conservation measures listed in these EOs include:

- A cap on commercial and recreational fishing at the "previous year's" (from December 4, 2000) level of effort and take. (The bottomfish level would be based on an individual's average over the previous five years.)

- Establishing Reserve Preservation Areas that prohibit almost all activities to 100 fm around most islands. (But bottomfishing and recreational trolling would be allowed in waters deeper than 25 or 50 fm around some islands.)
- Prohibiting anchoring on live or dead coral, where the bottom can be seen.
- Prohibiting anchoring where buoys are available or outside a yet-to-be-determined designated area.
- Prohibiting removal of living/non-living resources.
- Prohibiting taking or touching of living or dead coral.
- Prohibiting discharging or depositing any material, except cooling water or engine exhaust.
- Additional restrictions on non-fishing activities.
- Certain Native Hawaiian uses are allowed in yet-to-be-identified sub-areas. Activities allowed in both the Reserve and Preservation Area would be restricted to subsistence, cultural, and religious purposes.

The Reserve is intended to serve as a temporary management regime until completion of the process to designate the NWHI as a National Marine Sanctuary. On January 19, 2001, the NOAA/NOS Office of National Marine Sanctuaries announced its intent to initiate the Sanctuary designation process for the Reserve pursuant to sections 303 and 304 of the National Marine Sanctuaries Act (16 U.S.C.1433, 1434). During this process, NOAA will prepare an environmental impact statement and management plan, which will examine the management, boundary, and regulatory alternatives associated with sanctuary designation. As required, NOAA must also initiate public scoping meetings to solicit information and comments on the range and significance of issues related to sanctuary designation and management.

In designating the sanctuary, the EOs direct the Secretary of Commerce to supplement or complement the existing Reserve, and in consultation with the Governor of the State of Hawaii, determine whether State submerged lands and waters should be included as part of the Sanctuary. The effect of the reserve on the CRE-FMP, and existing FMPs, cannot be fully assessed until an ongoing review of the EOs by the new Administration is completed. Still ambiguous conservation measures also need to be clarified before the relation between measures in this FMP and Reserve regulations can be resolved.

Commonwealth of the Northern Mariana Islands

The Commonwealth of the Northern Mariana Islands is a subset of the Mariana Archipelago. It encompasses 14 islands (15-21° N latitude, 144-146° E longitude) oriented along a north-south axis stretching over a distance of 740 km. The islands can be divided into two sections based on age and geology. Saipan, Tinian, Rota, Aguijan, and Farallon de Medinilla, in the southern part of the chain, are old, raised limestone islands. In contrast, the northern islands—Anatahan, Sarigan, Guguan, Alamagan, Pagan, Agrihan, Asuncion, Maug, and Uracas—are geologically young volcanic islands with steep seaward slopes.

The CNMI's 579 km^2 of coral reefs represent the second largest reef area in the U.S. Pacific Islands. The 534 km^2 of reefs in the 3-200 nm offshore zone (see footnote 1) account for the majority of this area. The largest single tract is off Farallon de Medinilla (311 km^2). Saipan's best developed reefs occur in the 0-3 nm nearshore zone. These include fringing reefs, inshore and offshore patch reefs, and a well-developed barrier reef-lagoon system along most of the western leeward coast. In the northern islands in general, reef development is poor to non-existent. In addition, there are numerous shoals along the island chain (Green 1997). A chain of small, shallow banks topped with coral reefs lie in a parallel arc 240 to 320 km to the west of the Mariana Islands (Myers 1997).

The number of stony coral and reef fish in the southern part of the CNMI is similar to that of Guam. Diversity drops markedly off the northern volcanic islands, where only 159 species of stony coral and only about 360 species of reef fish have been recorded (Birkeland 1997c). Dominant fish families are the same as in Guam.

Pacific Remote Island Areas

Howland, Jarvis, and Baker are arid coral islands located close to the equator in the southern Line Island group. Kingman Reef is a coral reef shoal in the central Pacific in the northern Line Islands. Palmyra Atoll is a wet atoll located. It is composed of three sub-lagoons and over 50 separate islets that have been modified by construction activity. Johnston Atoll is an open atoll in the north Central Pacific. Until the 1940s, there were only two islands, but by 1964 massive dredge-and-fill operations significantly expanded the original area of Johnston Island. Wake Island is an isolated island north of the Marshall Islands, and consists of three islets and a reef enclosing a sheltered lagoon.

The total reef area around remote U.S. Pacific Islands (not including Midway) is 709 km^2, of which 89 km^2 is offshore (3-200 nmi). The remote U.S. Pacific Island possessions range in location from less than 1° S latitude to 20° N latitude and from 162° W to 167° E longitude. The climate regimes range from arid to wet and equatorial to sub-tropical. Marine resources are similarly varied. Several of these islands are of extreme scientific interest because of their age, with origins in the Mesozoic era, and the majority are designated or proposed as national wildlife refuges. The biological diversity of coral reef ecosystems in these areas varies considerably from island to island. Fish densities and biomass are higher than around the populated islands in the region. Rare species occur in some areas. For example, giant clams are prolific throughout the lagoon at Wake Atoll (Green 1997).

Johnston Atoll has a unique mix of coral reef species not duplicated elsewhere in the Pacific. Invertebrates from both the Western and Central Pacific are present, suggesting that the atoll serves as a bridge connecting distributions of Polynesian and Micronesian invertebrate fauna. The coral fauna has a strong affinity with that of Hawaii, but the appearance of the reef is quite different. This is due to the dominance of *Acropora*, not found in the main Hawaiian Islands, and the lack of the common Hawaiian species *Porites compressa*. Endangered

Hawaiian monk seals occasionally visit the atoll, but are not known to pup there. NMFS has released bachelor male monk seals there to reduce harassment of females in the NWHI. The extremely rare Cuvier's beaked whale is regularly seen offshore and may actually calve in the lagoon (Green 1997).

1.6.2 Management Unit Taxa

As already noted, many different organisms inhabit the coral reef ecosystem. Numerous species are caught in different reef-related fisheries. The biology and population dynamics of many coral reef organisms are poorly understood and it is possible that they may be targeted by commercial fishermen in the future. In developing an FMP, councils must identify management unit species (MUS), which are those species that come under the purview of the management plan. For all the reasons just outlined, this is difficult for coral reef species. The approach taken here is to rely on taxonomically more general designations and to divide these taxa into two groups:

1. Currently Harvested Coral Reef Taxa (CHCRT). Because these organisms are commercially harvested, fishery information for them is available, allowing more effective management. The species in this group have been reported on commercial fishery catch report records for federal EEZ waters but are not MUS under any of the Council's already-implemented FMPs. Membership in this group is based on two criteria: (1) More than 1,000 lbs. annual harvest for all members of a taxon, based on commercial fishery catch reports. These taxa are families or subfamilies. (2) Within these taxa particular genera or species are identified, based on their appearance on catch reports. CHCRT are listed in Table 1.2, grouped by family or subfamily. Table 1.2 also lists Aquarium taxa (discussed below.)

2. Potentially Harvested Coral Reef Taxa (PHCRT). These are coral reef organisms that are not known to be currently caught, or for which very little fishery information is available. However, emerging coral reef fisheries—such as the rapidly expanding marine ornamental products trade and the emerging industries for pharmaceutical and natural products—may target them at some future date. Several family/subfamily taxa in the CHCRT list are also PHCRT. As noted in Table 1.3, which lists PHCRT, all genera or species in these taxa that are not listed as CHCRT are by default PHCRT.

Because fishing for coral reef resources is light to non-existent in the EEZ, the CHCRT list was developed as a functional means to facilitate data collection and monitoring of coral reef ecosystem species that are currently being harvested, both directly and incidentally in commercial fisheries in state/territorial and federal waters. It will also help fishery managers to develop harvest strategies and proxies so that they can begin managing the coral reef ecosystem as a whole. The Currently Harvested Coral Reef Taxa also includes a subgroup of species that aquarium fish collectors presently harvest. With the exception of the nearshore waters of West Hawaii (Big Island), the commercial collection of Aquarium Taxa is minimal throughout the management area. However, the taxa listed in this category represent individual species that have been harvested in the EEZ and will likely continue to be harvested in the EEZ. For this reason they are listed separately at the end of Table 1.2. Their inclusion in the CHCRT list will allow continuing data collection by existing local management programs. As a result, the impacts on resources and habitats by aquarium fish collectors in the EEZ can be better assessed. As discussed in Section 5.3.1, local fishery management agencies will oversee permitting and reporting requirements for harvest of these species.

Subdividing the MUS and limiting the number of species on the CHCRT list makes it easier to establish baseline reference points. These reference points will be used to assess changes in species composition and abundance and will help to manage both currently harvested coral-reef-associated species and those likely to be targeted, should a coral reef fishery in the EEZ develop in the future. This subdivision also encourages cooperation of fishermen by reducing unreasonable permitting requirements, which also reduces unnecessary administrative and regulatory burdens.

The Potentially Harvested Coral Reef Taxa list consists of literally thousands of taxa for which little to no catch or effort data exist. For a great majority of these species scientific knowledge about their life histories, habitat requirements, and other biological information is completely lacking. Therefore, to begin data collection for management purposes, special permits will be required to target the PHCRT listed in Table 1.3 and for any species that is not explicitly listed on the CHCRT list. (Permitting is detailed in Section 5.3.)

The ecosystem concept considers the organisms themselves, grouped by taxa, their interactions, and their relationship to habitats. Taken together, these are the characteristics that structure the ecological relationships. Cooperation by fishermen, coupled with continued data collection and analyses, are all necessary in order to further our understanding of the intricacies of these relationships. Ecosystem-based management of coral reef resources will continually improve as a result. Management Unit Species designation is an important initial step in this effort

Table 1.2: Currently Harvested Coral Reef Taxa.

Acanthuridae (Surgeonfishes)	Orange-spot surgeonfish (*Acanthurus olivaceus*) Yellowfin surgeonfish (*Acanthurus xanthopterus*) Convict tang (*Acanthurus triostegus*) Eye-striped surgeonfish (*Acanthurus dussumieri*) Blue-lined surgeon (*Acanthurus nigroris*) Whitebar surgeonfish (*Acanthurus leucopareius*) Blue-banded surgeonfish (*Acanthurus lineatus*) Blackstreak surgeonfish (*Acanthurus nigricauda*) Whitecheek surgeonfish (*Acanthurus nigricans*) White-spotted surgeonfish (*Acanthurus guttatus*) Ringtail surgeonfish (*Acanthurus blochii*) Brown surgeonfish (*Acanthurus nigrofuscus*) Elongate surgeonfish (*Acanthurus mata*) Mimic surgeonfish (*Acanthurus pyroferus*) Yellow-eyed surgeonfish (*Ctenochaetus strigousus*) Striped bristletooth (*Ctenochaetus striatus*) Twospot bristletooth (*Ctenochaetus binotatus*)
	Bluespine unicornfish (*Naso unicornus*) Orangespine unicornfish (*Naso lituratus*) Humpnose unicornfish (*Naso tuberosus*) Black tongue unicornfish (*Naso hexacanthus*) Bignose unicornfish (*Naso vlamingii*) Whitemargin unicornfish (*Naso annulatus*) Spotted unicornfish (*Naso bravirostris*) Humpback unicornfish (*Naso brachycentron*) Barred unincornfish (*Naso thynnoides*) Gray unicornfish (*Naso caesius*)
Balistidae (Triggerfishes)	Titan triggerfish (*Balistoides viridescens*) Clown triggerfish (*B. conspicillum*) Orangstriped triggerfish (*Balistapus undulatus*) Pinktail triggerfish (*Melichthys vidua*) Black triggerfish (*M. niger*) Blue Triggerfish (*Pseudobalistesfucus*) Picassofish (*Rhinecanthus aculeatus*) Wedged Picassofish (*B. rectangulus*) Bridled triggerfish (*Sufflamen fraenatus*)
Carangidae (Jacks)	Bigeye scad (*Selar crumenophthalmus*) Mackerel scad (*Decapterus macarellus*)
Carcharhinidae (Sharks)	Grey reef shark (*Carcharhinus amblyrhynchos*) Silvertip shark (Carcharhinus albimarginatus) Galapagos shark (*Carcharhinus galapagenis*) Blacktip reef shark (*Carcharhinus melanopterus*) Whitetip reef shark (*Triaenodon obesus*)

Holocentridae (Soldierfish/Squirrelfish)	Bigscale soldierfish (*Myripristis berndti*) Bronze soldierfish (*Myripristis adusta*) Blotcheye soldierfish (*Myripristis murdjan*) Bricksoldierfish (*Myripristis amaena*) Scarlet soldierfish (*Myripristis pralinia*) Violet soldierfish (*Myripristis violacea*) Whitetip soldierfish (*Myripristis vittata*) Yellowfin soldierfish (*Myripristis chryseres*) Pearly soldierfish (*Myripristis kuntee*) (*Myripristis hexagona*) Tailspot squirrelfish (*Sargocentron caudimaculatum*) Blackspot squirrelfish (*Sargocentron melanospilos*) File-lined squirrelfish (*Sargocentron microstoma*) Pink squirrelfish (*Sargocentron tieroides*) Crown squirrelfish (*Sargocentron diadema*) Peppered squirrelfish (*Sargocentron punctatissimum*) Blue-lined squirrelfish (*Sargocentron tiere*) Ala'ihi (*Sargocentron xantherythrum*) (*Sargocentron furcatum*) (*Sargocentron spiniferum*) Spotfin squirrelfish(*Neoniphon spp.*)
Kuhliidae (Flag-tails)	Hawaiian flag-tail (*Kuhlia sandvicensis*) Barred flag-tail (*Kuhlia mugil*)
Kyphosidae (Rudderfish)	Rudderfish (*Kyphosus biggibus*) (*Kyphosus cinerascens*) (*Kyphosus vaigienses*)

Labridae (Wrasses)	Saddleback hogfish (*Bodianus bilunulatus*) Napoleon wrasse (*Cheilinus undulatus*) Triple-tail wrasse (*Cheilinus trilobatus*) Floral wrasse (*Cheilinus chlorourus*) Harlequin tuskfish (*Cheilinus fasciatus*) Ring-tailed wrasse (*Oxycheilinus unifasciatus*) Bandcheek wrasse (*Oxycheilinus diagrammus*) Arenatus wrasse (*Oxycheilinus arenatus*) Razor wrasse (*Xyricthys pavo*) Whitepatch wrasse (*Xyrichtes aneitensis*) Cigar wrass (*Cheilio inermis*) Blackeye thicklip (*Hemigymnus melapterus*) Barred thicklip (*Hemigymnus fasciatus*) Threespot wrasse (*Halichoeres trimaculatus*) Checkerboard wrasse (*Halichoeres hortulanus*) Weedy surge wrasse (*Halichoeres margaritacous*) (*Halichoeres zeylonicus*) Surge wrasee (*Thalassoma purpureum*) Redribbon wrasse (*Thalassoma quinquevittatum*) Sunset wrasse (*Thalassoma lutescens*) Longface wrasse (*Hologynmosus doliatus*) Rockmover wrasee (*Novaculichthys taeniourus*)
Mullidae (Goatfishes)	Yellow goatfish (*Mulloidichthys spp.*) (*Mulloidichthys Pfleugeri*) (*Mulloidichthys vanicolensis*) (*Mulloidichthys flaviolineatus*) Banded goatfish (*Parupeneus spp.*) (*Parupeneus barberinus*) (*Parupeneus bifasciatus*) (*Parupeneus heptacanthus*) (*Parupeneus ciliatus*) (*Parupeneus ciliatus*) (*Parupeneus cyclostomas*) (*Parupeneus pleurostigma*) (*Parupeneus indicus*) (*Parupeneus multifaciatus*) Bantail goatfish (*Upeneus arge*)
Mugilidae (Mullets)	Stripped mullet (*Mulgil cephalus*) Engel's mullet (*Moolgarda engeli*) False mullet (*Neomyxus leuciscus*) Fringelip mullet (*Crenimugil crenilabis*)

Muraenidae (Moray eels)	Yellowmargin moray (*Gymnothorax flavimarginatus*) Giant moray (*Gymnothorax javanicus*) Undulated moray (*Gymnothorax undulatus*)
Ocotpodidae	Octopus (*Octupus cyanea; O. ornatus*)
Polynemidae	Threadfin (*Polydactylus sexfilis*) -Moi
Pricanthidae (Bigeye)	Glasseye (*Heteropriacanthus cruentatus*) Bigeye (*Priacanthus hamrur*)
Scaridae (Parrotfishes)	Humphead parrotfish (*Bulbometapon muracalum*) Parrotfishes (*Scarus spp.*) Pacific longnose parrotfish (*Hipposcarus longiceps*) Stareye parrotfish (*Catolomus carolinus*)
Scombirdae	Dogtooth tuna (*Gymnosarda unicolor*)*
Siganidae (Rabbitfish)	Forktail rabbitfish (*Siganus aregentus*) Golden rabbitfish (*Siganus guttatus*) Gold-spot rabbitfish (*Siganus punctatissimus*) Randall's rabbitfish (*Siganus randalli*) Scribbled rabbitfish (*Siganus spinus*) Vermiculate rabbitfish (*Signaus vermiculatus*)
Sphyraenidae (Barracuda)	Heller's barracuda (*Sphyraena helleri*) Great Barracuda (*Sphyraena barracuda)*
Turbinidae **(turban shells/green snails)**	Green snails (*Turbo spp.*)

*Moved from Pelegic MUS list as part of this FMP.

Aquarium Taxa/Species	**Acanthuridae** Yellow tang (*Zebrasoma flavescens*) Yellow-eyed surgeon fish (*Ctenochaetus strigosus*) Achilles tang (*Acanthurus achilles*) **Muraenidae** Dragon eel (*Enchelycore pardalis*) **Zanclidae** Morrish idol (*Zanclus cornutus*) **Pomacanthidae** Angelfish (*Centropyge shepardi* and *C. flavissimus*) **Cirrhitidae** Flame hawkfish (*Neocirrhitus armatus*) **Chaetodontidae** Butterflyfish (*Chaetodon auriga*, *C. lunula*, *C. melannotus* and *C. ephippium*) **Pomacentridae** Damselfish (*Chromis viridis*, *Dascyllus aruanus* and *D. trimaculatus*) **Sabellidae** Featherduster worm (*Sabellidae*)

Table 1.3: Potentially Harvested Coral Reef Taxa (PHCRT). Several taxa in the CHCRT list appear below. As noted in the table, all species in these taxa that are not listed as CHCRT are by default PHCRT.

Other Labridae spp. (wrasses) *(Those species not listed on CHCRT list)*	Ephippidae (batfish)
Other Carcharhinidae, Sphyrnidae (*Those species not listed on CHCRT list*)	Monodactylidae (mono)
Dasyatididae, Myliobatidae, Mobulidae (rays)	Haemulidae (sweetlips)
Other Serranidae spp. (groupers) *(Those species not managed under the Bottomfish FMP)*	Echineididae (remoras)
Carangidae (jacks/trevallies) (*Those species not listed on CHCRT list or managed under the Bottomfish FMP*)	Malacanthidae (tilefish)
	Acanthoclinidae (spiny basslets)
Other Holocentridae spp. (soldierfish/squirrelfish) (*Those species not listed on CHCRT list*)	Pseudochromidae (dottybacks)
Other Mullidae spp. (goatfish) (*Those species not listed on CHCRT list*)	Plesiopidae (prettyfins)
Other Acanthuridae spp. (surgeonfish/unicornfish) (*Those species not listed on CHCRT list*)	Tetrarogidae (waspfish)
Other Lethrinidae spp. (emperors) *(Those species not managed under the Bottomfish FMP)*	Caracanthidae (coral crouchers)
Chlopsidae, Congridae, Moringuidae, Ophichthidae (eels) Other Muraenidae (morays eels) (*Those species not listed on CHCRT list*)	Grammistidae (soapfish)
Apogonidae (cardinalfish)	*Aulostomus chinensis* (trumpetfish)
Other Zanclidae spp. (moorish idols)	*Fistularia commersoni* (coronetfish)
Other Chaetodontidae spp. (butterflyfish)	Anomalopidae (flashlightfish)

Other Pomacanthidae spp. (angelfish)	Clupeidae (herrings)
Other Pomacentridae spp. (damselfish)	Engraulidae (anchovies)
Scorpaenidae (scorpionfish)	Gobiidae (gobies)
Blenniidae (blennies)	Lutjanidae *(Those species not managed under the Bottomfish FMP)*
Other Sphyraenidae spp. (barracudas)	Other Ballistidae/Monocanthidae spp. (*Those species not listed on CHCRT list*)
Pinguipedidae (sandperches)	Other Siganidae spp. (*Those species not listed on CHCRT list*)
Gymnosarda unicolor	Other Kyphosidae spp.
Bothidae/Soleidae/Pleurnectidae (flounder/sole)	Caesionidae
Ostraciidae (trunkfish)	Cirrhitidae
Tetradontidae/Diodontidae (puffer/porcupinefish)	Antennariidae (frogfishes)
	Syngnathidae (pipefishes/seahorses)
Stony corals	Echinoderms (e.g., sea cucumbers, sea urchins)
Heliopora (blue)	Mollusca
Tubipora (organpipe)	Sea Snails (gastropods)
Azooxanthellates (non-reefbuilders)	Trochus spp.
Fungiidae (mushroom corals)	Opistobranchs (sea slugs)
Sm/Lg Polyped Corals (endemic spp.)	*Pinctada margaritifera* (black lipped pearl oyster)
Millepora (firecorals)	Tridacnidae
Soft corals and Gorgonians	Other Bivalves
Anemones (non-epifaunal)	Cephalopods
Zooanthids	Crustaceans (Lobsters, Shrimps/Mantis, True Crabs and hermit crabs) (*Those species not managed under the Crustacean FMP*)
Sponges (non-epifaunal)	Stylasteridae (lace corals)
Hydrozoans	Solanderidae (hydroid fans)

Bryozoans	Annelids
	Algae
Tunicates (solitary/colonial)	Live rock
All other coral reef ecosystem marine plants, invertebrates and fishes not listed under existing FMPs.	

1.7 Definitions and Acronyms Applicable to the Coral Reef Ecosystem FMP

1.7.1 Definitions

Adaptive Management: A program that adjusts regulations based on changing conditions of the fisheries and stocks.

Bycatch: Any species caught in a fishery, but which are not sold or kept for personal use, and includes economic discards and regulatory discards.

Barrier Net: A small-mesh net used to capture coral reef or coastal pelagic fishes.

Bioprospecting: The search for commercially valuable biochemical and genetic resources in plants, animals and microorganisms for use in food production, the development of new drugs and other biotechnology applications.

Bottomfish Fishery Management Plan: Council's FMP for bottomfish and seamount groundfish of the Western Pacific Region.

Charter Fishing: Fishing from a vessel carrying a passenger for hire (as defined in section 2101(21a) of Title 46, United States Code) who is engaged in recreational fishing.

Commercial Fishing: Fishing in which the fish harvested, either in whole or in part, are intended to enter commerce or enter commerce through sale, barter or trade. For the purposes of this Fishery Management Plan, commercial fishing includes the commercial extraction of biocompounds.

Consensual Management: Decision making process where stakeholders meet and reach consensus on management options to implement.

Coral Reef: All benthic substrata from 0 to 50 fathoms deep.

Coral Reef Ecosystem (CRE): Those species, interactions, processes, habitats and resources of the water column and substrate located within any waters less than or equal to 50 fathoms in total depth.

Coral Reef Ecosystem Management Area *(CRE management area, or management area)*: all Hawaii, PRIA, American Samoa, CNMI and Guam EEZ waters (from surface to ocean floor) that are outside of state or territorial waters and within 200 miles from shore. Because the EEZ of the CNMI currently extends to the shoreline, it is separated into two zones: the inshore zone (0-3 miles from shore) and the offshore zone (3-200 miles from shore), with federal management of the coral reef ecosystem proposed for the offshore zone only. The inshore zone would continue to be managed by local authorities. The CNMI government should manage the inshore zones because (1) cooperation between the local governments and the Council relies on recognition of local management authority of nearshore waters, (2) the CNMI-based small vessel fishermen are best managed by a local regime with hands-on interaction and knowledge of the issues, and (3) this regime retains consistency with the other areas under Council jurisdiction.

Coral Reef Ecosystem Management Unit Species (*CRE MUS or MUS*): an extensive list of coral reef organisms, many included by family. Includes some management unit species from existing FMPs (bottomfish, crustaceans, precious corals) for which primary management would remain under their current FMPs but ecosystem effects would be addressed via the CRE-FMP. CRE MUS are listed in two categories: Currently Harvested Coral Reef Taxa (CHCRT) and Potentially Harvested Coral Reef Taxa (PHCRT).

Coral Reef Ecosystem General Permit (CRE general permit, or general permit): a permit which would be required under some alternatives if deemed necessary by the Council to harvest Currently Harvested Coral Reef Taxa from all non-MPA coral reef management areas. This permit would involve simple application procedures and reporting requirements.

Coral Reef Ecosystem Special Permit (CRE special permit, or special permit): a permit which would be required under some alternatives to (1) fish for any coral reef MUS (both Currently Harvested and Potentially Harvested Taxa) within low-use MPAs (with some exceptions), and (2) fish for any Potentially Harvested Coral Reef Taxa outside of MPAs. This permit would be approved and issued on a case-by-case basis and would have more complex application procedures and reporting requirements.

Coral Reef Resources: The currently or potentially exploitable resources in coral reef ecosystems.

Council: The Western Pacific Regional Fishery Management Council (WPRFMC).

Critical Habitat: Those geographical areas that are essential for bringing an endangered or threatened species to the point where it no longer needs the legal protections of the Endangered Species Act (ESA), and which may require special management considerations or protection. (That is, the critical habitat consists of those areas that must be managed to permit an endangered or threatened species to recover to a level where it is safe, for the foreseeable future, from the danger of extinction.)

Currently Harvested Coral Reef Taxa (CHCRT): A sub-category of management unit species (MUS) including species that have been reported on commercial fishery catch report records for federal EEZ waters but are not MUS under any of the Council's already-implemented FMPs. Membership in this group is based on two criteria: (1) More than 1,000 lbs. annual harvest for all members of a taxon, based on commercial fishery catch reports. These taxa are families or subfamilies. (2) Within these taxa particular genera or species are identified, based on their appearance on catch reports.

Dealer: One who buys and sells species in the fisheries management unit without altering their condition.

Depleted Coral Reef Taxon: Species or taxon that is locally in low abundance but not overfished (by definition).

Dip Net: A hand-held net consisting of a mesh bag suspended from a circular, oval, square or rectangular frame attached to a handle. A portion of the bag may be constructed of material, such as clear plastic, other than mesh.

Ecology: The study of interactions between an organism (or organisms) and its (their) environment (biotic and abiotic).

Ecological Integrity: Maintenance of the standing stock of resources at a level that allows the ecosystem processes to continue. Ecosystem processes include replenishment of resources, maintenance of interactions essential for self-perpetuation and, in the case of coral reefs, rates of accretion that are equal to or exceed rates of erosion. Ecological integrity cannot be directly measured but can be inferred from observed changes in corel reef ecology.

Economic Discards: Coral reef resources that are the target of a fishery but which are not retained because they are of an undesirable size, sex or quality or for other economic reasons.

Ecosystem: The interdependence of species and communities with each other and with their non-living environment.

Ecosystem-Based Fishery Management: Fishery management actions aimed at conserving the structure and function of marine ecosystems, in addition to conserving the fishery resource.

Ecotourism: Observing and experiencing, first hand, natural environments and ecosystems in a manner intended to be sensitive to their conservation.

Environmental Impact Statement (EIS): A document required under the National Environmental Policy Act (NEPA), that assesses alternatives and addresses the impact on the environment of a proposed major federal action.

Essential Fish Habitat (EFH): Those waters and substrate necessary to coral reef resources for spawning, breeding, feeding or growth to maturity.

Exclusive Economic Zone (EEZ): The zone established by Proclamation numbered 5030, dated March 10, 1983. For purposes of application, the inner boundary of that zone is a line coterminous with the seaward boundary of each of the coastal states, commonwealths, territories or possessions of the United States.

Existing CRE Fishery: A fishery targeting organisms that are currently harvested from coral reef areas, but not covered by existing FMPs

Exporter: One who sends species in the fishery management unit to other countries for sale, barter or any other form of exchange (also applies to shipment to other states, territories or islands).

Fish: Finfish, mollusks, crustaceans and all other forms of marine animal and plant life other than marine reptiles, marine mammals and birds.

Fishery: One or more stocks of fish that can be treated as a unit for purposes of conservation and management and that are identified on the basis of geographical, scientific, technical, recreational and economic characteristics; and any fishing for such stocks.

Fishery Management Plan (FMP): A plan prepared by a Regional Fishery Management Council or by NMFS (if a Secretarial plan) to manage fisheries.

Fishery Management Unit Species (MUS): The coral reef resources in the FMP, including fish, corals, certain species associated with live rock, reef-associated invertebrates and plants.

Fishing: The catching, taking or harvesting of fish; the attempted catching, taking or harvesting of fish; any other activity that can reasonably be expected to result in the catching, taking or harvesting of fish; or any operations at sea in support of, or in preparation for, any activity described in this definition. Such term does not include any scientific research activity that is conducted by a scientific research vessel.

Fishing Community: A community that is substantially dependent on or substantially engaged in the harvest or processing of fishery resources to meet social and economic needs and includes fishing vessel owners, operators and crews and United States fish processors that are based in such community. The FMP defines fishing communities as: American Samoa, the Northern Mariana Islands and Guam, and each of the inhabited main Hawaiian Islands.

Food Web: Inter-relationships among species that depend on each other for food (predator-prey pathways).

Framework Measure: Management measure listed in an FMP for future consideration. Implementation can occur through an administratively simpler process than a full FMP amendment.

General Permit: Permit, for possible future implementation under the framework process, to harvest and report take of coral reef taxa in non-MPA areas, issued upon meeting basic minimum requirements.

Ghost Fishing: The chronic and/or inadvertent capture and/or loss of fish by lost or discarded fishing gear.

Habitat: Living place of an organism or community, characterized by its physical or biotic properties.

Habitat Area of Particular Concern (HAPC): Those areas of EFH identified pursuant to Section 600.815(a)(9). In determining whether a type or area of EFH should be designated as a HAPC, one or more of the following criteria must be met: (1) ecological function provided by the habitat is important; (2) habitat is sensitive to human-induced environmental degradation; (3) development activities are, or will be, stressing the habitat type; or (4) the habitat type is rare.

Hand Harvest: Harvesting by handline.

Harvest: The catching or taking of a marine organism or fishery MUS by any means. Marine organisms or MUS that are caught but immediately returned to the water free, alive and undamaged are bycatch.

Hook-and-line: Fishing gear that consists of one or more hooks attached to one or more lines.

Incidental Catch: Any non-targeted species harvested while fishing for the primary purpose of catching a different species.

Large Fishing Vessels: a vessel equal to or greater than 50 ft length overall. (These vessels are prohibited from anchoring on Guam's southern banks.)

Live Rock: Any natural, hard substrate (including dead coral or rock) to which is attached, or which supports, any living marine life-form associated with coral reefs.

Longline: A type of fishing gear consisting of a main line which is deployed horizontally from which branched or dropper lines with hooks are attached.

Low-Use MPA: Marine Protected Area zoned to allow limited fishing activity controlled under special permit.

Main Hawaiian Islands (MHI): The high islands of the State of Hawaii consisting of Niihau, Kauai, Oahu, Molokai, Lanai, Maui, Kahoolawe, Hawaii and all of the smaller associated islets (from 154° W longitude to 161°20' W longitude).

Marine Protected Area (MPA): Designated area within the federal EEZ, which is used as a management measure to allow or prohibit certain fishing activities.

Maximum Sustainable Yield: A management goal specifying the largest long-term average catch or yield (in terms of weight of fish) that can be taken, continuously (sustained) from a stock or stock complex under prevailing ecological and environmental conditions, without reducing the size of the population.

National Marine Fisheries Service (NMFS): The component of the National Oceanic and Atmospheric Administration (NOAA), Department of Commerce, responsible for conservation and management of living marine resources.

No-Take MPA: Marine Protected Area where no fishing or removal of living marine resources is authorized.

Northwestern Hawaiian Islands (NWHI): The EEZ of the Hawaiian islands archipelago lying to the west of 161°20'W longitude.

Optimal Economic Productivity: The greatest long-term net economic benefit from the resources. Economic benefits are defined as both market price-based benefits and non-market benefits.

Optimum Yield (OY): With respect to the yield from a fishery "optimum" means the amount of fish that (a) will provide the greatest overall benefit to the nation, particularly with respect to food production and recreational opportunities and taking into account the protection of marine ecosystems; (b) is prescribed as such on the basis of the MSY from the fishery, as reduced by any relevant economic, social or ecological factor; and

(c) in the case of an overfished fishery, provides for rebuilding to a level consistent with producing the MSY in such fishery.

Overfishing: Fishing at a rate or level that jeopardizes the capacity of a stock or stock complex to produce maximum sustainable yield on a continuing basis.

Pacific Island Area: American Samoa, Guam, Hawaii, the Commonwealth of the Northern Mariana Islands, Baker Island, Howland Island, Jarvis Island, Johnston Atoll, Kingman Reef, Midway Island, Wake Island or Palmyra Atoll, as applicable, and includes all islands and reefs appurtenant to such island, reef or atoll.

Pacific Remote Islands (PRIAs): Baker Island, Howland Island, Jarvis Island, Johnston Atoll, Kingman Reef, Midway Island, Wake Island and Palmyra Atoll and includes all islands and reefs appurtenant to such islands, reefs and atolls.

Passive Fishing Gear: Gear left unattended for a period of time prior to retrieval (e.g., traps, gill nets).

Plan Team (PT): A team appointed by the Council to help prepare an FMP under the direction of the Council. The PT utilizes input from all committees and panels as well as outside sources in developing the FMP and amendments.

Potentially Harvested Coral Reef Taxa (PHCRT): A sub-category of MUS. These are coral reef organisms that are not known to be currently caught, or for which very little fishery information is available. Several Currently Harvested Coral Reef Taxa (listed by family/subfamily) are also PHCRT. All genera or species in these taxa that are not listed as CHCRT are by default PHCRT.

Precautionary Approach: The implementation of conservation measures even in the absence of scientific certainty that fish stocks are being overexploited.

RA: Regional Administrator, NMFS Southwest Region

Recreational Fishing: Fishing primarily for sport or pleasure.

Recruitment: A measure of the weight or number of fish which enter a defined portion of the stock such as fishable stock (those fish above the minimum legal size) or spawning stock (those fish which are sexually mature).

Reef: A ridgelike or moundlike structure built by sedentary calcareous organisms and consisting mostly of their remains. It is wave-resistant and stands above the surrounding sediment. It is characteristically colonized by communities of encrusting and colonial invertebrates and calcareous algae.

Reef-obligate Species: An organism dependent on coral reefs for survival.

Regulatory Discards: Any species caught that fishermen are required by regulation to discard or to retain but not sell.

Regulatory Impact Review (RIR): Assessment of all costs and benefits of available regulatory measures, including the alternative of not regulating (per Executive Order 12866). The emphasis of the analysis is on the changes in the stream of net benefits that will occur as a result of each of the alternative management measures. NOAA requires that this analysis, through a Regulatory Impact Review, be done for all regulatory actions that are of public interest, such as those associated with new fishery management plans.

Resilience: The ability of a population or ecosystem to withstand change and to recover from stress (natural or anthropogenic).

Restoration: The transplanting of live organisms from their natural habitat in one area to another area where losses of, or damage to, those organisms has occurred with the purpose of restoring the damaged or otherwise compromised area to its origiual, or a substantially improved, condition; additionally, the altering of the physical characteristics (e.g., substrate, water quality) of an area that has been changed through human activities to return it as close as possible to its natural state in order to restore habitat for organisms.

Rock: Any consolidated or coherent and relatively hard, naturally formed, mass of mineral matter.

Rod-and-Reel: A hand-held fishing rod with a mannally or electrically operated reel attached.

Scuba-assisted Fishing: Fishing, typically by spear or by hand collection, using assisted breathing apparatus.

Secretary: The Secretary of Commerce or a designee.

Sessile: Attached to a substrate; non-motile for all or part of the life cycle.

Slurp Gun: A self-contained, typically hand-held, tube–shaped suction device that captures organisms by rapidly drawing seawater containing the organisms into a closed chamber.

Small Fishing Vessel: a vessel less than 50 ft length overall. (These vessels are exempt from alternatives prohibiting anchoring on Guam's southern banks.)

Social Acceptability: The acceptance of the suitability of the FMP by stakeholders, taking cultural, traditional, political and individual benefits into account.

Spear: A sharp, pointed, or barbed instrument on a shaft, operated manually or shot from a gun or sling.

Special Permit: Permit with stringent criteria for issuance and operation. Required for fishing for coral reef taxa in low-use MPAs or for potentially harvested coral reef taxa in non-MPA areas. Also required for harvesting live hard coral for aquaculture seed stock, traditional indigenous use, scientific collecting and bioprospecting.

State: Recognizing that the Council Region comprises several different political entities—a state, a commonwealth, two territories, and unincorporated federal territory—hereafter, as shorthand, these constituent parts (excluding federal territory) will be generically referred to as states.

Stock Assessment: An evaluation of a stock in terms of abundance and fishing mortality levels and trends, and relative to fishery management objectives and constraints if they have been specified.

Stock of Fish: A species, subspecies, geographical grouping or other category of fish capable of management as a unit.

Submersible: A manned or unmanned device that functions or operates primarily underwater and is used to harvest fish.

Subsistence Fishing: Fishing primarily to obtain food for personal use rather than for sale or recreation.

Sustainable Use: The use of components of an ecosystem in a way and at a rate that does not lead to the long-term decline of biological diversity, size structure or abundance of any of its components, thereby maintaining their potential to meet the needs and aspirations of present and future generations.

Target Resources: Species or taxa sought after in a directed fishery.

Total Allowable Level of Foreign Fishing (TALFF): The portion of the OY on an annual basis that will not be harvested by U.S. vessels.

Trophic Web: The network that represents the predator/prey interactions of an ecosystem.

Trap: A portable, enclosed, box-like device with one or more entrances used for catching and holding fish or marine organism.

Unincorporated U.S. Island Possessions: Johnston Island, Wake Island, Midway Island, Palmyra Atoll, Kingman Reef, Jarvis Island, and Howland and Baker Islands.

Western Pacific Regional Fishery Management Council (WPRFMC or Council): Representatives from the State of Hawaii, the Territories of American Samoa and Guam and the Commonwealth of the Northern Mariana Islands with authority over the fisheries in the Pacific Island Area EEZ.

1.7.2 List of Acronyms

B:	Stock biomass
B_{FLAG}:	Minimum Biomass Flag
B_{MSY}:	Biomass Maximum Sustainable Yield
B_{OY}:	Biomass Optimum Yield
^0C:	Degrees Celsius
CITES:	Council on International Trade and Endangered Species
cm:	centimeters
CNMI:	Commonwealth of the Northern Mariana Islands
CPUE:	Catch per unit effort
$CPUE_{MSY}$:	Catch per unit effort Maximum Sustainable Yield
$CPUE_{REF}$:	Catch per unit effort
CRAMP:	Coral Reef Assessment and Monitoring Program
CRE:	Coral Reef Ecosystem
CRE-FMP:	Coral Reef Ecosystem Fishery Management Plan
CRTF:	Coral Reef Task Force
CDP:	Community Development Plan
DAR:	Division of Aquatic Resources, Department of Land and Natural Resources, Hawaii
DAWR:	Division of Aquatic and Wildlife Resources, Department of Agriculture, Guam
DBOR:	Division of Boating and Ocean Resources, Department of Land and Natural Resources, Hawaii
DEIS:	Draft Environmental Impact Statement
DFW:	Division of Fish and Wildlife, Department of Land end Natural Resources, CNMI
DLNR:	Department of Land and Natural Resources, Hawaii
DMWR:	Department of Marine and Wildlife Resources, American Samoa
DOC:	Department of Commerce
DOI:	Department of the Interior
E:	Effort
E_{AVG}:	Effort average
EEZ:	Exclusive Economic Zone
EFH:	Essential Fish Habitat

EIS:	Environmental Impact Statement
E_{MSY}:	Effort Maximum Sustainable Yield
ENSO:	El Niño Southern Oscillation
EO:	Executive Order
EPAP:	Ecosystem Principals Advisory Panel
ESA:	Endangered Species Act
F:	Fishing mortality
F_{MSY}:	Fishing mortality Maximum Sustainable Yield
F_{OY}:	Fishing mortality Optimum Yield
FEP:	Fishery Ecosystem Plan
FDM:	Farallon de Medinilla, CNMI
FFS:	French Frigate Shoals, NWHI
FLPMA:	Federal Land Policy Management Act
fm:	fathoms
FMP:	Fisheries Management Plan
g:	grams
GIS:	Geographic information systems
HAPC:	Habitat Areas of Particular Concern
HCRI:	Hawaii Coral Reef Initiative Research Program
HINWR:	Hawaiian Islands National Wildlife Refuge
HIR:	Hawaiian Islands Reservation
ICRI:	International Coral Reef Initiative
IRFA:	Initial Regulatory Flexibility Analysis
km:	kilometers
lbs.	pounds
m:	meters
maxFMT:	maximum fishing mortality threshold
MHI:	Main Hawaiian Islands
min SST:	minimum spawning stock threshold
mm:	millimeters
MMPA:	Marine Mammal Protection Act
MPA:	Marine Protected Area
MSFCMA:	Magnuson-Stevens Fisheries Conservation and Management Act
MSY:	Maximum Sustainable Yield
mt:	metric ton
MUS:	Management Unit Species
NDSA	Naval Defensive Sea Area
NEPA:	National Environmental Policy Act
nm or nmi:	nautical miles
NMFS:	National Marine Fisheries Service
NMFS-HL:	National Marine Fisheries Service - Honolulu Laboratory
NOAA:	National Oceanic and Atmospheric Administration
NWHI:	Northwestern Hawaiian Islands
NWR:	National Wildlife Refuge

NWRAA:	National Wildlife Refuge Administration Act
OY:	Optimum Yield
PIAO:	Pacific Islands Area Office
PRA:	Paperwork Reduction Act
PRIA:	Pacific Remote Island Areas
PT:	Plan Team (for FMP development)
RA:	Regional Administrator, NMFS
RFA:	Regulatory Flexibility Act
RIR:	Regulatory Impact Review
SFA:	Sustainable Fisheries Act
SLA:	Submerged Lands Act
SPR:	Spawning Potential Ratio
SSC:	Scientific and Statistical Committee
TALFF:	Total Allowable Level of Foreign Fishing
TSLA:	Territorial Submerged Lands Act
USFWS:	United States Fish and Wildlife Service
USCG:	United States Coast Guard
VMS:	Vessel Monitoring System
WpacFin:	Western Pacific Fisheries Information Network
WPRFMC:	Western Pacific Regional Fishery Management Council

CHAPTER 2

DESCRIPTION OF THE CORAL REEF ECOSYSTEM

2.1 Coral Reef Ecosystems

Coral reefs are carbonate rock structures at or near sea level that support viable populations of scleractinian or reef-building corals. Apart from a few exceptions, coral reefs are confined to the warm tropical and sub-tropical waters lying between 30° N and 30° S. Coral reef ecosystems are arguably the oldest and certainly the most diverse and complex ecosystems on earth. Their complexity is manifest on all conceptual dimensions, including geological history, growth and structure, biological adaptation, evolution and biogeography, community structure, organism and ecosystem metabolism, physical regimes, and anthropogenic interactions (see sources cited by Hatcher *et al.* 1989). There is a voluminous and expanding literature on coral reefs and coral reef ecosystems (Birkeland 1997a), beginning with Charles Darwin's 1842 volume, *The Structure and Distribution of Coral Reefs*, which remains the seminal volume on reef formation and structure, including reefs in the Western Pacific Region. The symbiotic relationship between the animal coral polyps and algal cells known as zooxanthellae is a key feature of reef building corals. Incorporated into the coral tissue, these photosynthesizing zooxanthellae provide much of the polyp's nutritional needs, primarily in the form of carbohydrates. Most corals supplement this food source by actively feeding on zooplankton or dissolved organic nitrogen, due to the low nitrogen content of the carbohydrates derived from photosynthesis.

The corals and coral reefs of the Pacific are described in Wells and Jenkins (1988) and Veron (1995). The number of corel species declines in an easterly direction across the Western and Central Pacific in common with the distribution of fish and invertebrate species. Over 330 species are contained in 70 genera on the Australian Barrier Reef, compared with only 30 coral genera present in the Society Islands of French Polynesia, and 10 genera in the Marquesa and Pitcairn Islands. Hawaii, by virtue of its isolated position in the Pacific, also has relatively few species of coral (about 50 species in 17 genera) and, more importantly, lacks most of the branching or "tabletop" *Acropora* species that form the majority of reefs elsewhere in the Pacific. The *Acropora* species provide a large amount of complex three-dimensional structure and protected habitat for a wide variety of fishes and invertebrates.

Most forms of coral reef development can be found in the Western Pacific Region, including barrier reefs in Guam and Saipan, fringing reefs in the Samoas and Hawaii, and patch and submerged reefs, banks and shoals throughout the region, but particularly abundant in the NWHI and within the EEZ of the Northern Mariana Islands. Other habitats commonly associated with coral reefs include mangrove forests, particularly in estuarine areas. The natural eastern limit of mangroves in the Pacific is American Samoa, although the red mangrove *Rhizophora mangle*, was introduced into Hawaii in 1902 and has become the dominant plant within a number of large protected bays and coastlines on both Oahu and Molokai (Gulko 1998). Apart from the usefulness of the wood for building, charcoal, and tannin, mangrove forests stabilize areas where sedimentation is occurring and, from a fisheries perspective, are important as nursery grounds for peneaeid shrimps and some inshore fish species, and form the habitat for some commercially valuable crustaceans.

Sea grasses are common in all marine ecosystems and are a regular feature of most of the inshore areas adjacent to coral reefs in the Pacific Islands. According to Hatcher *et al.* (1989), sea grasses stabilize sediments because leaves slow current flow, thus increasing sedimentation of particles. The roots and rhizomes form a complex matrix that binds sediments and stops erosion. Sea grass beds are the habitat of certain commercially valuable shrimps, and provide food for reef-associated species such as surgeonfishes (Acanthuridae) and rabbitfishes (Sigaridae). Sea grasses are also important sources of nutrition for higher vertebrates such as dugongs and green turtles. A concise summary of the seagrass species found in the western tropical South Pacific is given by Coles and Kuo (1995). From the fisheries perspective, the fishes and other organisms harvested from the reef coral and associated habitats such as mangroves, seagrass beds, shallow lagoons, bays, inlets, and harbors, and the reef slope beyond the limit of coral reef growth, contribute to the total yield from coral reef-associated fisheries. Unlike other Council FMPs, which are broadly species-based, this FMP is ecosystem-based. It is concerned not only with the health of target stocks, but also with the preservation of the coral reef ecosystems within the Western Pacific Region. To do this requires an understanding of the ecosystem components and how these various components interact.

2.1.1 Reef Productivity

Coral reefs are among the most biologically productive ecosystems in the world. The global potential for coral reef fisheries has been estimated at 9 million mt per year, which is impressive given the small area of reefs compared to the extent of other marine ecosystems, which collectively produce between 70 - 100 million mt per year (Munro 1984; Smith 1978). An apparent paradox of coral reefs, however, are their location in the nutrient deserts of the tropical oceans. In these areas the water is very clear because gross primary productivity is low, generally ranging between 20 to 50 $gCm^{-2}yr^{-1}$. Coral reefs themselves are characterized by the highest gross primary production in the sea, with reef flats and margins sustaining primary production rates of between 1,800-3,700 $gCm^{-2}yr^{-1}$, and sand and rubble zones about 370 $gCm^{-2}yr^{-1}$. The main primary producers on reefs are the benthic microalgae, macroalgae, symbiotic microalgae of corals, and other symbiont-bearing invertebrates. Zooxanthellae living in the tissues of hard corals make a substantial contribution to primary productivity in zones rich in corals due to their density—greater than 10^6 cells cm^{-2} of live coral surface—and the high rugosity of the surfaces on which they live, as well as their own photosynthetic potential. However, zones of high coral cover make up only a small part of entire coral reef ecosystems, and so their contribution to total reef gross primary productivity is small.

Although the ocean's surface waters in the tropics generally have low productivity, these unproductive waters, which bathe coral reefs, are continually moving. Reefs therefore have access to substantial open-water productivity. Thus, particularly in inshore continental waters, shallow benthic habitats such as reefs must not always be considered the dominant sources of carbon for fisheries. Outside sources may be important for reefs, and while this significance is rarely estimated, its input may be in living (plankton) or dead (detrital) forms. In coastal waters detrital matter from land, plankton, and fringing marine plant communities are particularly abundant. There may be passive advection of particulate and dissolved detrital carbon onto reefs, and active transport onto reefs via fishes that shelter on reefs but feed in adjacent habitats. There is, therefore, greater potential for nourishment of inshore reefs than offshore reefs by external carbon sources, and this inshore nourishment will be enhanced by large land masses.

For most of the Pacific Islands, rainfall typically ranges from 2,000 to 3,500 mm per year. Low islands, such as *makateas* and atolls, tend to have less rainfall and may suffer prolonged droughts. Further, when rain does fall on coral islands and *makateas* that have no major catchment area, there is little allochthonous nutrient input into surrounding coastal waters and lagoons. Lagoons and embayments around high islands are therefore likely to be more productive than atoll lagoons. There are however, some exceptions. Both Palmyra Atoll and Rose Atoll are unique in that they may receive up to 4,300 mm of rain per year. These atolls are among the few wet atolls in the world. The productivity of high island coastal waters, particularly where there are lagoons and sheltered waters, is possibly reflected in the greater abundance of small pelagic fishes such as anchovies, sprats, sardines, scads, mackerels, and fusiliers. Furthermore, the range of different environments that can be found in the immediate vicinity of the coasts of high islands also contributes to the greater range of bio-diversity found in such locations.

Studies on coral reef fisheries are relatively recent, commencing with the major study by Munro and his co-workers during the late 1960s in the Caribbean (Munro 1983). Even today, only a relatively few examples are available of in-depth studies on reef fisheries. It was initially thought that the maximum sustainable yields for coral reef fisheries were in the range of 0.5-5 $t/km^{-2}yr^{-1}$, based on limited data (Marten and Polovina 1982; Stevenson and Marshall 1974). Much higher yields of around 20 $t/km^{-2}yr^{-1}$, for reefs in the Philippines (Alcala 1981; Alcala and Luchavez 1981) and American Samoa (Wass 1982), were thought to be unrepresentative (Marshall 1980), but high yields of this order have now been independently estimated for a number of sites in the South Pacific and Southeast Asia (Dalzell and Adams 1997; Dalzell *et al.* 1996). These higher estimates are closer to the maximum levels of fish production predicted by trophic and other models of ecosystems (Polunin and Roberts 1996). Dalzell & Adams (1997) suggest that the average MSY for Pacific reefs is in the region of 16 $t/km^{-2}yr^{-1}$ based on 43 yield estimates where the proxy for fishing effort was population density.

However, Birkeland (1997a) has expressed some scepticism abont the sustainability of the high yields reported for Pacific and sonth east Asian reefs. Among other examples, he notes that the high values for American Samoa reported by Wass (1982) during the early 1970s were followed by a 70% drop in coral reef fishery catch rates between 1979 and 1994. Saucerman (1995) ascribed much of this decline to a series of catastrophic events over the same period. This began with a crown of thorns infestation in 1978, followed by hurricanes in 1990 and 1991, which reduced the reefs to rubble, and a coral bleaching event in 1994, probably associated with the El Niño phenomenon. These various factors reduced live coral cover in American Samoa from a mean of 60% in 1979, to between 3-13% in 1993.

Further, problems still remain in rigorously quantifying the effects on yield estimates of factors, such as primary productivity, depth, sampling area, or coral cover. Polunin *et al.* (1996) noted that there was an inverse correlation between estimated reef fishery yield and the size of the reef area surveyed, based on a number of studies reported by Dalzell (1996). Arias-Gonzales *et al.* (1994) have also examined this feature of reef fisheries yield estimates and noted that this was a problem when comparing reef fishery yields. The study noted that estimated yields are based on the investigator's perception of the maximum depth at which true reef fishes occur. Small pelagic fishes, such as scads and fusiliers, may make up large fractions of the inshore catch from a particular reef and lagoon system, and if included in the total catch can greatly inflate the yield estimate. The great variation in reef yields summarized by authors such as Arias-Gonzales et al (1994), Dalzell (1996) and Dalzell and Adams (1997) may also be due in part to the different size and trophic levels included in catches.

Another important aspect of the yield question is the resilience of reefs to fishing and recovery potential when overfishing or high levels of fishing effort have been conducted on coral reefs. Evidence from a Pacific atoll where reefs are regularly fished by community fishing methods, such as leaf sweeps and spearfishing, indicated that depleted biomass levels may recover to pre-exploitation levels within one to two years. In the Philippines, abundances of several reef fishes have increased in small reserves within a few years of their establishment (Russ and Alcala 1994; White 1988), although recovery in numbers of fish is much faster than recovery of biomass, especially in larger species such as groupers. Other studies in the Caribbean and South East Asia (Polunin *et al.* 1996) indicate that reef fish populations in relatively small areas have the potential to recover rapidly from depletion in the absence of further fishing. Conversely, Birkeland (1997a) cites the example of a pinnacle reef off Guam fished down over a period of six months in 1967 that has still not recovered thirty years later.

Estimating the recovery from, and reversibility of fishing effects over large reef areas appears more difficult. Where growth overfishing predominates, recovery following effort reduction may be rapid if the fish in question are fast growing, as in the case of goatfish (Garcia and Demetropolous 1986). However, recovery may be slower if biomass reduction was due to recruitment overfishing because it takes time to rebuild adult spawning biomasses and high fecundities (Polunin and Morton 1992). Further, many coral reef species have limited distributions; they may be confined to a single island or a cluster of proximate islands.

Widespread heavy fishing could cause regional extinctions of some such species, particularly if there is also associated habitat damage. Unfortunately, the majority of species with a limited range are also valuable to the aquarium trade, and in the future restrictions on capture, possibly through CITES listiug, may be appropriate to prevent overfishing.

2.1.2 Extent and Distribution of Coral Reefs

Roughly 70% of the world's coral reefs, or 420,000 km^2 are located in the Pacific Ocean (Bryant *et al.* 1998). Of all reefs under U.S. jurisdiction, 94%, or an estimated 15,852 km^2 of reef area, are associated with U.S. Pacific Islands (Clark and Gulko 1999; Hunter 1995). Table 1.1 shows their geographical distribution. Note that many of these coral reefs are located in areas where there is no human population, like the NWHI and the PRIAs, or in island archipelagos, like American Samoa and the CNMI, where population is concentrated on one or two islands.

2.2 Coral Reef Ecological Characteristics snd Resource Dynamics

Coral reefs and reef-building organisms are confined to the shallow upper photic zone. Maximum reef growth and productivity occurs between 5-15 m (Hopley and Kinsey 1988) and maximum diversity of reef species occurs at 10-30 m (Huston 1985). Thirty meters has been described as a critical depth below which rates of growth (accretion) of coral reefs are often too slow to keep up with changes in sea level. This was true during the Holocene transgression over the last 10,000 years, and many reefs below this depth drowned during this period. Coral reef habitat does extend deeper than 30 m, but few well developed reefs are found below 50 m. Many reefs in the world are bordered by broad areas of shelf habitat between 50-100 m. Many of these shelf habitats were formed by wave erosion during periods of lower sea level during the Pleistocene period. Today, extensive areas of shelf habitat exist in the NWHI. These habitats consist primarily of carbonate rubble, algae and micro-invertebrate communities, some of which may be important nursery grounds for some coral reef fish, as well as habitat for several species of lobster. However, the ecology of this habitat is poorly known and much more research is needed in this zone. This will help in defining the lower depth limits of the coral reef ecosystem, which by inclusion of shelf habitat, could be viewed as extending to 100 m.

Available biological and fishery data are poor for all species and areas covered by the CRE-FMP; therefore, it is not possible to implement the Fishery Ecosystem Plan action item 4, elaborated by EPAP.[2] Furthermore, high biological and environmental variability is a natural characteristic of coral reef ecosystems around the U.S. Pacific Islands, with or without fishing. Irregular pulses of new recruits (Walsh 1987) cause cycles in the abundance and

[2]As discussed on page 14 in this FMP, FEP action item four states "Calculate total removals—including incidental mortality—and show how they relate to standing biomass, production, optimum yields, natural mortality, and trophic structure."

harvest potential of individual reef species. Environmental variability is both spatial, related to differences in the quality of habitat (Friedlander and Parrish 1998a), and temporal, related to monthly moon phase, seasonal and longer-term environmental changes (Friedlander and Parrish 1998b).

Polovina *et al.* (1994) examined a large-scale climatic shift that affected coral reef resources in the NWHI from the mid-1970s to the late 1980s. During this period, the central North Pacific experienced increased vertical mixing, with a deepening of the wind-stirred surface layer into nutrient-rich lower waters and probable increased injection of nutrients into the upper ocean. Resulting increased primary productivity likely provided a larger food base for fish and animals at higher tropic levels. In the NWHI, changes of 60-100% over baseline levels in productivity for lobsters, sea birds, reef fish, and monk seals were observed and attributed to deeper mixing during 1977-1988.

The highest quality habitat on a coral reef is often where abundant living coral has created high bottom relief. Natural disturbance cycles in areas exposed to large storm waves can dramatically alter habitat quality. For example, periodic storms in the NWHI reduce live coral cover to 10% in some areas. Coral cover eventually returns to 50% or more, depending on how protected the area is (R. Grigg, 104th Council meeting, June 2000).

Unlike pelagic ecosystems, which are driven primarily by oceanographic forces operating on a large scale, coral reef ecosystems are strongly influenced by biological processes, habitat utilization, and environmental conditions at a relatively small scale. Innumerable animals and plants shelter, attach, or burrow into the reef structure, creating some of the most biologically diverse and complex ecosystems on earth.

2.2.1 Ecological Relationships

Coral reef ecosystems have existed in geological terms for nearly twice as long as flowering plants, and some of the coral genera are more ancient than any grasslands. Therefore, the ecological relationships have had more time to develop complexity in coral reefs. A major portion of the primary production of the coral reef ecosystem comes from complex inter-kingdom relationships of animal/plant photo-symbioses hosted by animals of many taxa, most notably stony corals. Most of the geological structure of reefs and habitat is produced by these complex symbiotic relationships.

Complex symbiotic relationships for defense from predation, removal of parasites, building of domiciles, and other functions are also prevalent. About 32 of the 33 animal phyla are represented on coral reefs (only 17 are represented in terrestrial environments) and this diversity produces complex patterns of competition. The diversity also produces a disproportionate representation of predators, which have strong influences on lower levels of the food web in the coral reef ecosystem (Birkeland 1997c). Figure 2.1 shows, in a schematic fashion, inter-relationships between reef fishes and with the surrounding environment, and how these relationships can affect population dynamics during different life phases.

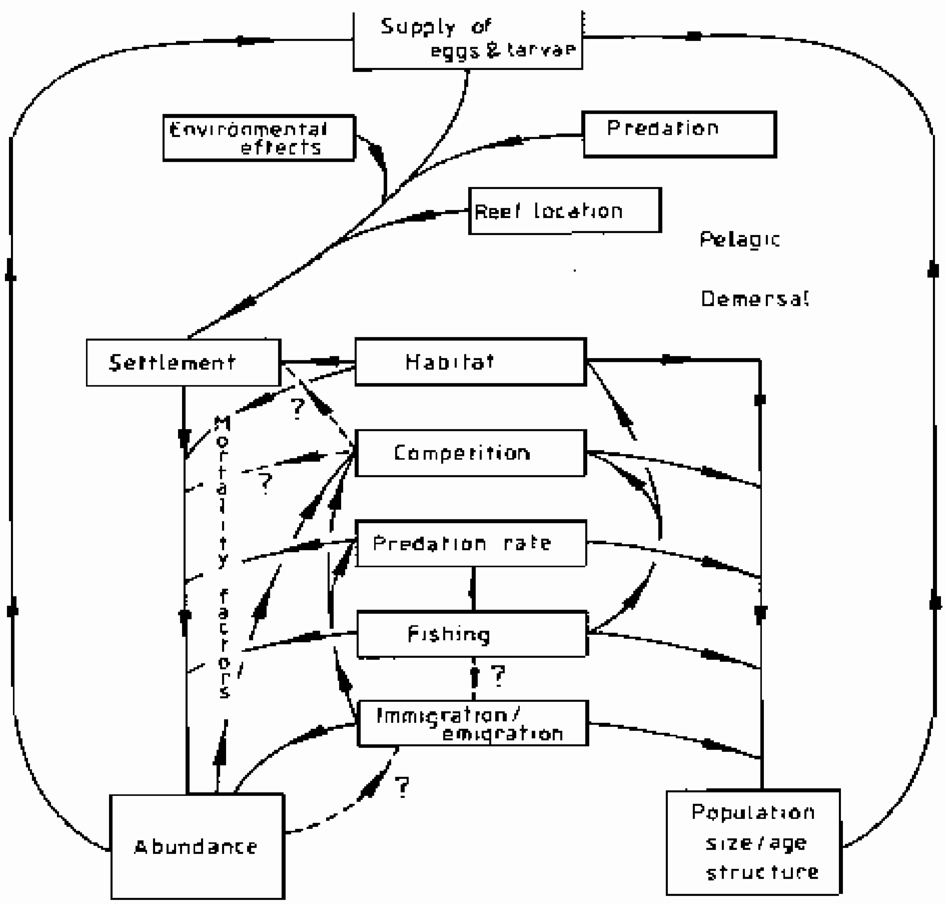

Figure 2.1: Interrelationships within the coral reef ecosystem. Flow diagram illustrating factors determining the abundance and size/age structure of populations. Arrows show direction of effects. Dashed lines with ? indicated expected relationships but without supporting evidence. (Source: Polunin and Roberts 1991.)

In areas with high gross primary production but low net primary production or yield—such as rain forests and coral reefs—animals and plants tend to have a higher variety and concentration of natural chemicals as defenses against herbivores, carnivores, competitors, and microbes. Because of this tendency, and the greater number of phyla in the system, coral reefs are now a major focus for bioprospecting, especially in the southwest tropical Pacific (Birkeland 1997c).

2.2.2 Coral Reef Habitat

Even within a thriving coral reef habitat, not all space is occupied by corals or coralline algae. Reefs are typically patchworks of hard and sediment bottoms. A reef provides a variety of environmental niches, or combination of resources. The wide variety of survival strategies employed by coral reef organisms allows different species to exploit some combination of resources better than their competitors. The ecosystem is dynamic, however. If conditions change, a very specialized species may not be able to survive the rigors of the new environment or may be forced out by another species more adept at using the available resources, including space, food, light, water motion, and temperature.

2.2.3 Long-term Ecosystem Variability

Climate and ecosystem shifts may occur over decadal scale cycles or longer, meaning that resources management decisions need to consider changes in target level productivity over the long-term as well as short-term inter-annual variation. For example, the climatic shift that occurred in the central North Pacific in the late 1980s (see Section 2.20 produced an ecosystem shift in the NWHI to a lower carrying capacity, with a 30-50% decline in productivity (Polovina *et al.* 1994). This in turn reduced recruitment and survival of monk seals, reef fish, albatross, and lobsters. Under lower carrying capacity regime, fishing alters the age-structure of the population and may also lead to stock depletion.

At Laysan Island, where lobster fishing is prohibited, spawning biomass of lobsters was also depleted by natural mortality. This suggests that marine reserves may not guarantee the protection that is typically assumed (Polovina and Haight 1999). In response to this natural variability, the Council adjusted its management measures (e.g., limited entry, annual quota) to reduce catch and effort to about 25% of its 1980's level.

The destruction of coral reefs around Tutuila, the principal island in American Samou, forced fishermen to move into predominantly pelagic fishing, initially trolling, and later, small-scale longline fishing. As a result, much of the reef fish consnmed in American Samoa now comes from Western Sunoa. The reduction of fishing on coral reefs may also aid in the recovery of live coral cover, but the long-term recovery of the reefs around Tutuila will principally depend on a benign climate and marine environment over the next decade. Furthermore, these destructive events occurred during a long-term shift in the physical environment of the equatorial Pacific Ocean, which began in 1977 (Miller *et al.* 1994). Conditions included more clouds, more rainfall, warmer sea surface temperatures, and weaker trade winds, similar to a weak decadal El-Niño state. They were most pronounced in the central equatorial Pacific, so American Samoa was close to the center of this shift, which persisted until 1999, when conditions began to change. Whether 1999 marks another regime shift will not be known for several years (Polovina pers. comm.).

The destruction of American Samoan coral reefs included, in 1994, a coral bleaching episode. This phenomenon also affected reefs in the Cook Islands and French Polynesia, and was due to unseasonably high sea water temperatures. Coral bleaching occurs when corals lose or expel their zooxanthellae in large numbers, usually due to some trauma such as high or low temperatures or lower than usual salinities (Brown 1997). The corals that lose zooxanthellae also lose their color, becoming white and hence the term 'bleaching.' Although first described in the 1900s, interest in this phenomenon was heightened in the 1980s and 1990s after a series of major bleaching events in the Atlantic and Pacific Oceans. Some of these episodes were linked to the El-Niño Southern Oscillation or ENSO events (Gulko 1998).

When bleaching occurs, some corals are able to regain zooxanthellae by slowly re-infecting themselves with the algae, or through the reproduction of remaining zooxanthellae within the colony. Frequently, the loss of large amounts of symbiotic algae results in the colony becoming energy deficient; it expends more energy than it is consuming. If this occurs over the long term the colony dies (Brown 1997; Gulko 1998). Coral bleaching events require only a 1-2° C increase in water temperature. Thus, due to global warming, bleaching may become more common. According to Goreau *et al.* (1997), similar events in the Atlantic and the Indian Oceans suggest that worldwide corals are acclimated close to their upper temperature limits. As a result, they are unable to adapt rapidly to an anomalons warming (Goreau *et al.* 1997). Consequently, global warming represents a very serious threat to the survival of coml reefs.

Other physical phenomena that may bring long-term change to coral reef systems include the impact of hurricanes and tectonic uplift. Bayliss-Smith (1988) describes the changes in reef islands at Ontong-Java Atoll over a 20-year period following a severe hurricane. Most atoll islands are on reef flats in what are frequently high wave-energy locations near to seaward reef margins. Unless composed of coarse shingle and rubble, these islands are unstable. Hurricanes will destroy such small cays and scour *motu* beaches, and strip small or narrow islands of fine sediment during over-wash periods. Bayliss Smith (1988) notes that while hurricanes tend to erode islands, they also prodnce the material for their reconstruction. More frequent, lower magnitude storms contribute to the process by transporting the rubble ramparts thrown up by hurricanes. This reconstructs scoured beaches and eroded shorelines. Clearly, such destructiou and reconstruction activity on reef flats will have an effect on reef organisms, including fish aud invertebrates, particularly where large areas of reef are smothered by sand and silt following a hurricane.

The process of tectonic uplift can profoundly influence coral reef systems. It is a much slower process, however, taking several centuries or even millennia to significantly change coral reefs. Tectonic uplift can push a productive reef flat above the water's surface, producing an exposed limestone terrace. This rednces the amount of reef area available for fishing, as occurred at Niuatopntapu and in the Tonga archipelago (Kirch and Dye 1979). Tectonic nplift was also partially responsible for changing Tongatapu Island's central lagoon from a marine to a brackish water environment. This resulted in the loss of an important reef mollusc resouree, *Anadara antiquata,* which could not survive the reduced salinity. A similar event occurred at Tikopia in the Solomon Islands. There, a circular bay with a narrow entrance became a brackish coastal lake as the bay entrance was sealed through a combination of tectonic uplifl and increased sedimentation cansed by agricultural runoff from neighboring slopes. Again, this major habitat change wiped ont reef- and lagoon-associated mollnscs, a major food source for the indigenous people (see sourees cited in Dalzell 1998).

2.3 Coral Reef Communities

Coral reef communities are among the most diverse and ecologically complex systems known. The structure of reef communities is usually defined iu terms of the diversity and relative abundances of species characteristic of a habitat type. Commonly, only a few species compose over half the abundance, while hundreds of others are present in low numbers.

2.3.1 Life History

The literature on coral reef fish life histories is voluminous, but convenient entries into the literature are provided by Sale (1991), Polunin and Roberts (1996), and Birkeland (1997b). The life of a coral reef fish includes several stages. Typically, spawning occurs in the vicinity of the reef and is characterized by frequent repetition throughout a protracted time of the year, a diverse array of behavioral patterns, and extremely high fecundity. The eggs of many species are fertilized externally and dispersed directly into the pelagic environment as plankton. Other species have demersal eggs, which upon hatching disperse larvae into the pelagic realm. Planktonic mortality is very high and unpredictable. Recruitment is the transition stage from the planktonic larval life to demersal existence on a coral reef. Recruitment is both spatially and temporally highly variable. This is when post-larval juveniles begin their residence on reefs where many remain for life. Highest predation mortality occurs in the first few days or weeks, thus rapid growth out of the juvenile stage is a common strategy.

Terrestrial animal populations are usually dispersed by adults, who deposit eggs or build nests in selected locations. In contrast, the most frequent pattern for coral reef organisms is dispersion of eggs and larvae in water currents, which determines the final locations of adults. The adults are often sedentary or territorial. The differences in factors that bring about success in these two life history phases complicate fisheries management (Birkeland 1997c).

2.3.2 Species Distribution and Abundance

Species diversity declines eastwards across the Pacific from the locus of maximum species richness in Southeast Asia (especially in the Philippines and Indonesia), and is related in part to the position of land masses in relation to the Pacific Plate, the earth's largest lithospheric plate (Springer 1982). In general, species richness is greatest along the plate margin and declines markedly on the plate itself. As a result, islands in the Central Pacific generally have a lower reef organism diversity, but also a high degree of endemism. For example, Guam has about 269 species of zooxanthellate Scleractinian corals, about 40 Alcyonacea and just under a thousand species of fishes; Hawaii has far fewer in comparison. The proportion of endemic species increases in the opposite direction. For example, the Hawaiian Islands have about 18% endemic zooxanthellate corals, 60% endemic Alcyonacea and 25% endemic reef fishes. The proportion of alien species in Hawaiian waters is also greater, and it is increasing (Birkeland 1997c).

As noted above, among the diverse array of species in each taxa on coral reefs, there are usually only a few that are consistently abundant, with the relative abundance of species within a taxa possibly approximating a log-uonnal distribution. The majority of species are relatively uncommon or only episodically abundant, following unusually successful recruitment (Birkeland 1997c).

Individual sub-populations of larger stocks of reef species may increase, decrease, or cease to exist locally without adversely affecting the overall popnlation. The condition of the overall populations of particular species is linked to the variability among sub-populations: the ratio of sources and sinks, their degrees of recruitment connection, and the proportion of the sub-populations with high variability in reproductive capacity. Recruitment to populations of coral reef organisms depends largely on the pathways of larval dispersal and "downstream" links. In considering recruitment mechanisms one must ask: Are the connections sufficient to actually restock distant snb-populations or only enough to maintain a homogenons genetic stock?

2.3.3 Reproduction and Recruitment

The majority of coral reef animals are very fecund, but temporal variations in recruitment success have been recorded for some species and locations. Many of the large, commercially-targeted coral reef animals are long-lived and reproduce for a number of years. This is in contrast to the majority of commercially-targeted species in the tropical pelagic ecosystem. Long-lived species adapted to coral reef systems are often characterized by complex reproductive patterns like sequential hermaphroditism, sexual maturity delayed by social hierarchy, multi-species mass spawnings, and spawning aggregations in predictable locations (Birkeland 1997c).

2.3.4 Growth and Mortality Rates

Recruitment of coral reef species is limited by high mortality of eggs and larvae, and also by competition for space to settle out on coral reefs. Predation intensity is due to a disproportionate number of predators, which limits jnvenile survival (Birkeland 1997c). In response some fishes—such as scarids (parrotfish) and labrids (wrasses)—grow rapidly compared with most coral reef fishes. Bnt they still grow relatively slowly compared to pelagic species. In addition, scarids and labrids may have complex haremic territorial social structures that contribute to the overall effect of harvesting these resources. It appears that many tropical reef fishes grow rapidly to near-adult size, and then often grow relatively little over a protracted adult life span; they are thus relatively long-lived. In some groups of fishes, such as damselfish, individuals of the species are capable of rapid growth to adult size, but sexual maturity is still delayed by social pressure. This complex relationship between size and maturity makes resource manugement more difficult (Birkeland 1997c).

2.3.5 Community Variability

High temporal and spatial variability is characteristic of reef communities. At large spatial scales, variation in species assemblages may be due to major differences in habitat types or biotopes. Seagrass beds, reef flats, lagoonal patch reefs, reef crests, and seaward reef slopes may occur in relatively close proximity, for example, but represent notably different habitats.

As suggested in Section 2.2.3, reef fish communities from the geographically isolated Hawaiian Islands are characterized by low species richness, high endemism, and exposure to large semiannual current gyres, which may help retain planktonic larvae. The NWHI is further characterized by: (1) high latitude coral atolls; (2) a mild temperate to subtropical climate, where inshore water temperatures can drop below 18° C in late winter; (3) species that are common on shallow reefs and attain large sizes, which to the southeast occur only rarely or in deep water; and 4) inshore shallow reefs that are largely free of fishing pressure.

2.4 Ecosystem Models

Several approaches to model multi-species fisheries have been used by coral reef fishery scientists with varying levels of success. The simplest approach has been to treat a community as the sum of its species. These general multi-species models have been applied by several researchers to estimate yields in coral reef fisheries. They are based on simultaneous Lotka-Volterra equations, which incorporate the impact of each species' population size on every other species through use of shared resources. Researchers have also incorporated predation and harvesting effects into these models. Unfortunately, with highly diverse systems such as coral reefs, this leads to an extremely complex model with potentially hundreds of parameters. Nonetheless, these approaches are mentioned as possible avenues for future assessment methodologies, although at present the lack of data limits confidence in their results.

An alternative is to divide the assemblage into separate trophic levels and model the energy flow through the system to estimate potential yields. The two linked models described in more detail below take this approach.

2.4.1 ECOPATH

ECOPATH is a simple mathematical model that estimates mean annual biomass, production, and food consumption for major components—defined in terms of species groups—of a coral reef ecosystem (Polovina 1984). Polovina used the following species groups to model the ecosystem at French Frigate Shoals in the NWHI: tiger sharks, monk seals, seabirds, reef sharks, sea turtles, small pelagics, jacks, reef fish (and octopus), lobsters and crabs, deepwater bottomfish, nearshore scombrids, zooplankton, phytoplankton, heterotrophic benthos, and benthic algae. A box model illustrates a biomass budget schematic for major predator-prey pathways and lists annual production and annual biomass for each group. The model shows a high percent of internal predation, which partially explains why fishery yields from coral reefs are generally low despite high primary productivity. The allocation of species to trophic compartments constrains the ECOPATH approach because it imposes an artificial structure that may not coincide with actual community structure. This approach is also data intensive and requires information on each species' diet, mortality, and growth rates.

Extensive field work from French Frigate Shoals provided estimates of parameters used to validate the model. Application of ECOPATH to French Frigate Shoals found that the coral reef ecosystem is controlled mainly by predation from the top down and primary production is controlled mainly by nutrients, photosynthetic rate limits, and habitat space (Grigg *et al.* 1984). Fishery yields can be maximized by targeting lower trophic levels and cropping top predators to release pressure on prey. Thus, a fishery targeting tiger sharks at French Frigate Shoals should help ease predation pressure on endangered Hawaiian monk seals and threatened green turtles. Coral reef ecosystems are susceptible to overfishing due to high levels of natural mortality and low net annual production. A study of coral reef fish communities on patch reefs at Midway Atoll found that they were relatively resilient to several years of fishing pressure on top predators, while some control by predation was detected (Schroeder 1989).

2.4.2 ECOSIM

ECOSIM is a computer model that uses the output of the ECOPATH model. Input parameters by species (or species group) include natural and fishing mortality, diet composition, and production to biomass ratio. The vulnerability level of prey to predators can be adjusted and gear selectivity levels can also be set. Predation levels are then determined. In order to determine qualitative changes in the structure of the resource community, the model can be run for several decades. Applying various levels of fishing pressure can reveal which target and non-target species increase and which decrease in abundance, considering predator-prey interactions (Kitchell *et al.* 1999).

2.5 Ecosystem Overfishing

The special vulnerability of targeted coral-reef resources comes from life-history traits of these economically valuable species, which live in diverse communities with strong predatory and competitive forces. Coral reef species are adapted to reproduce often because so few of their progeny are likely to survive. Therefore, they grow slowly, delay first reproduction, and are more territorial than pelagic species. These life history traits make recovery from overfishing very uncertain. Some coral reef ecosystems, driven by biological interactions, have not recovered for decades following intensive harvest, and there are no indications that they will recover. In contrast, pelagic fisheries, driven by oceanographic processes, usually do recover. For example, black-lipped pearl oysters at Pearl and Hermes Atoll in the NWHI were over-harvested to commercial extinction in the late 1920s; according to recent surveys, stocks have still not recovered after 70 years. Holothuroids (sea cucumbers) were over-harvested in the late 1930s in Chuuk, Eastern Caroline Islands, and recent surveys there also show no recovery after 60 years. Dalzell *et al.* (1996) cite several other examples from the Pacific Islands where pearl oyster and sea cucumber populations have failed to recover from over-harvesting, even after several decades of no fishing.

Some fishing activities, such as overfishing, may degrade coral reef ecosystems and ultimately affect ecosystem processes. For example, the removal of herbivorous fishes can lead to the overgrowth of coral by algae, eventually destroying some coral reef resources. Munro (1983; 1999) has suggested that overfishing of predatory reef species may lead to a decline in the natural mortality of herbivores; in response, their biomass increases. When the herbivores are in turn overfished, algal production is uncontrolled. Most of the resulting increase in algae and sea-grass biomass then turns to detritus. However, there are few well documented examples of such effects cascading through ecosystems.

Munro (1999), cites the north coast of Jamaica as an example of reefs almost entirely overgrown by macro-algae and where the cover of live coral is extremely low. Although scientists do not fully agree, it appears that this can be attributed to the long-term effects of overfishing. The very narrow island shelf (less than one kilometer wide) was covered by flourishing coral reefs until 1984. Then several events combined to change the situation. First, the herbivorous long-spined sea urchin, *Diadema antillarum,* spread rapidly throughout the Caribbean. Then the north coast of Jamaica took a direct hit from a major hurricane. The reefs were pulverized by heavy seas and large corals were stripped of tissue. Macro-algae colonized all these newly exposed surfaces. In the absence of sea urchins and herbivorous fish, the macro-algae have remained dominant (Hughes 1994). Other parts of the Caribbean with less heavily exploited fish stocks also lost their urchin populations and suffered hurricanes, but these reefs were not massively overgrown with algae. While it cannot be proven that overfishing was the cause of this catastrophe, the evidence points in that direction.

The MSFCMA requires managers to identify the individual species composing a fishery management unit and calculate Maximum Sustainable Yield (MSY) for each. But on coral reefs, although there are thought to be thousands of economically valuable species, many of them have not been named or described by scientists. However, bio-prospectors—the major near-term users of reef resources—will try to find as many pharmaceutically useful species as possible, whether or not they have been officially described by scientists. If managers have to name each species, and estimate their MSY, it will be many decades before an FMP can be completed and these kinds of economic uses can begin. Thus, the sort of ecosystem-level approach espoused by EPAP is well suited to the complex multi-species coral reef ecosystem.

In concert with the ecosystem approach, an alternative overfishing definition seems most appropriate for the CRE-FMP. In contrast to the single-species approach, the ecosystem overfishing concept considers how fishing pressure can cause changes to species composition in a multi-species setting, often resulting in changes in ecosystem function (DeMartini *et al.* 1999). This can be detected by shifts in species composition or trophic web dynamics. Using this concept can also guard against single-stock recruitment overfishing, where applicable.

There are other reasons for adopting this approach. First, the loss of some species in the multi-species coral reef ecosystem—due to overfishing or other human impacts—could allow often less valuable generalist species to predominate. As in the example cited above, these types of changes to heavily fished reefs have been reported for a number of tropical stocks from various areas around the world. Second, multi-species systems become more vulnerable to environmental fluctuations as exploitation increases.

CHAPTER 3

DESCRIPTION OF THE FISHERY AND FISHING COMMUNITIES

3.1 Introduction

Chapter 2 of this FMP outlined the biology and ecology of coral reefs. This chapter describes how people use and depend on those resources. The discussion is divided into two parts. The first part, Sections 3.2 though 3.5, describe various aspects of regional fisheries as they relate to coral reef resources. The next section provides an overview of the many uses of coral reefs in the region and identifies those uses—defined as "sectors"—that the management measures in this plan will directly affect. Section 3.3 summarizes the available data that can be used to characterize regional fisheries, and using these data briefly describes two important fisheries sectors. Section 3.4 reviews the ex-vessel value of regional fisheries under Council management and Section 3.5 describes bycatch by coral reef fisheries with special attention to the main gear types employed in these fisheries. The second part of this section, comprising Sections 3.6 and 3.7 describes fishing communities in the region and how they depend on coral reef resources. This discussion, in Section 3.6, provides a regional overview and descriptions specific to each of the jurisdictional areas in the Council region. Section 3.7 contains a brief statement about the definition of communities, as required by the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), and their dependence on coral reef resources.

3.2 Description of Coral Reef Uses

Ecosystem-based fisheries management—the principle that informs this FMP—recognizes that fisheries and other forms of resource harvest affect more than just the target species. Because of ecological linkages, other species and their habitats are affected too, and these effects may be felt in other reef-related fisheries. An ecosystem approach should also take into account value that accrues from not extracting resources, such as scenic or recreational use. In the summary that follows, current and potential uses of coral reef resources are called "sectors." Since the Council only manages fisheries, and this FMP covers the coral reef ecosystem, management measures in this FMP only apply to the fishery sectors summarized in the first category below. (These fisheries are defined as those that take coral reef MUS in depths between 0 and 50 fathoms. When coral reef fisheries are discussed in the remainder of this section this definition bounds the resources under consideration.) This includes coral reef MUS caught incidentally by other FMP-managed fisheries. The first two sectors, food and sport, are briefly described in the next section. (The remaining three coral reef fishery sectors—ornamentals, natural products, and mariculture—have not yet developed in the EEZ.) Non-fishery sectors are described elsewhere, as indicated in the descriptions below.

Coral Reef Fishery Sectors

Food	All commercial, subsistence, and recreational coral reef resource harvests generally for food production.
Sport	Fishing for coral reef resources mainly motivated by recreation.
Ornamentals	Harvest of coral reef resources, including fishes, invertebrates, and live rock for use as ornamentals, for home and local use and commercial trade.
Natural products	Harvest of coral reef resources for all other purposes, such as coral for bone grafts and production of pharmaceuticals.
Mariculture	At-sea mariculture of coral reef resources, and harvest of coral reef resource broodstock for land-based mariculture.

Non-coral Reef Fishery Sectors

Deep-water bottom fisheries	Fisheries for finfish, crustaceans and precious corals, in benthic environments deeper than 50 fathoms, including for food, sport, and ornamentals, as described above for coral reef fisheries.
Pelagic fisheries	Fisheries for finfish in pelagic ecosystems, including for food and sport. In general, the pelagic fisheries are not directly related to the coral reef ecosystem.

Non-fishery Sectors

Tourism (non-fishing)	Visitors engaging in scuba diving, snorkeling, boating, swimming, viewing of coral reefs, and other coral reef-related activities, including eco-tourism. The economic value of tourism to different island areas is discussed in Section 3.6, which details fishery-related economic and social conditions in each of the Council's member jurisdictions.
Recreation (non-fishing)	Residents engaging in scuba diving, snorkeling, boating, swimming, viewing of coral reefs and other coral reef-related activities. Non-consumptive values and uses are discussed in Section 5.11 of the Environmental Impact Statement.

Mining	Extraction of fossil coral and sand from the coral reef ecosystem. The effects of dredging, mining and filling is discussed in Section 6.4 of the FMP.
Breakwater	Coral reef ecosystems functioning to protect shorelines from erosion and to provide shelter for navigation and mooring, and other activities. The value of coral reef ecosystems functioning to protect shorelines from erosion is not discussed in the FMP.
Ecological support	Coral reef ecosystems functioning as nursery areas, spawning areas, or otherwise in support of resources, protected species, essential fish habitat, fisheries, and ecological services in other ecosystems. Ecosystem effects on MUS are discussed in Sections 3.0 and 5.2 of the EIS.
Information	Coral reef ecosystems providing values associated with gaining and sharing information, or the non-extractive, "discovery" aspects of research and education, and the values associated with the consequential development and production of marine natural products.
Biodiversity	Coral reef ecosystems providing values associated with varied genetic resources. The biodiversity of coral reef ecosystems is discussed in section 3.1.2. of the EIS.

3.3 Summary of Data Describing Fisheries in the Council Region

3.3.1 Available Data

The ability to describe, assess, and manage fisheries depends on the amount and quality of available fisheries data. Local jurisdictions in the Council Region collect much of the data used for management. Table 3.1 summarizes data availability, which is detailed for each area below. The State of Hawaii requires fishermen who sell any portion of their catch to hold a commercial marine license and to complete and submit a monthly Division of Aquatic Resources' Fish Catch Report for every trip conducted during that period. The licensee must report the type of fishing gear used (e.g., trap, diving, net), area fished, and number and/or weight of each species caught.

Hawaii is one of the few coastal states that does not require a marine recreational fishing license and associated reporting. Therefore, obtaining estimates of the recreational catch or effort in the coral reef fisheries is very difficult. However, there is some information available on the nearshore recreational catch from past creel surveys. Several of these surveys have shown the recreational catch to be the equivalent or greater than that reported in the commercial fisheries landing data (Friedlander 1996).

In American Samoa, the Offshore Creel Survey administered by the Department of Marine and Wildlife Resources (DMWR) collects fishery information from both commercial and recreational fishermen on the number and weight of each species, method of fishing, time fished, and area fished. In addition, the survey includes information on the disposition of the catch. DMWR applies a set of algorithms to estimate the commercial landings based on the estimate of total landings and catch disposition information derived from the survey. DMWR also directly monitors the commercial fishery by collecting "trip-ticket" receipts from fish sales to local fish markets, stores, hotels, and restaurants.

In Guam, the Division of Aquatic and Wildlife Resources (DAWR) administers both the Offshore and Inshore Creel Surveys. The surveyors interview fishermen to collect information on the length and weight of each species caught during fishing trips, method of fishing, number of gear used, time fished, area fished, and weather conditions. The disposition of the catch is only recorded as part of the Offshore Creel Survey; therefore, differentiating commercial and recreational landings in the inshore fishery is almost impossible. Total landings are estimated from survey data by applying fairly complex stratum-based expansion factors, which are calculated by integrating data collected from participation surveys with the creel intercept and interview data. DAWR also collects information on commercial landings through a voluntary trip ticket receipt program with major fish dealers. Estimates of total commercial landings are calculated by applying expansion factors to the receipt book data.

In the Commonwealth of the Northern Mariana Islands, data on commercial landings are collected by the Division of Fish and Wildlife (DFW) through the Commercial Sales Receipt or "Trip ticket" Program, which, like Guam and American Samoa, documents local fish sales to commercial establishments. Landings, species composition, revenue, and the number of fishermen or boats selling catch are estimated from information provided on the forms. The Offshore and Inshore Creel Surveys administered by DFW were suspended in 1996. The information collected from surveys included the number and weight of each species caught during commercial and recreational fishing trips, fishing method used, number of gear used, area fished, fishing time, weather conditions and percentage of the total catch that is sold. In 2000, the boat-based Offshore Creel Survey was reimplemented and redesigned to include charter boats in addition to recreational and commercial vessels. The Council supports DFW's efforts to reestablish the inshore survey to collect information on coral reef fisheries.

No other recreational fishing surveys have been conducted recently in U.S. Pacific to supplement information collected by local creel survey programs. The Council fully supports proposals by NMFS to conduct such marine recreational fishing surveys. For the time being, the portion of the catch reported as sold in creel surveys is considered the commercial component, whereas the unsold portion represents the recreational/subsistence component. According to the MSFCMA, unsold fish should be classified as commercial if traded or bartered. It is not practical or appropriate for data collection systems in the region to make this distinction. The customary exchange of fish with no immediate expectation of return is not regarded in Pacific Island societies as a commercial activity, but represents a traditional use.

This FMP will require detailed reporting in a logbook as a condition for holding a permit to harvest coral reef resources in the EEZ. The Council recommends that no exception be granted for subsistence fishermen from permitting or reporting. This revision should not greatly affect exclusive subsistence fishermen since they generally do not fish in federal waters. The logbook would report types and quantities of gear used, numbers and weights of species kept, number released alive, number released unknown, area fished, length of trip, specific effort information and other information required as a condition of holding the permit. The annual report required under the CRE-FMP would summarize and analyze the information collected.

Table 3.1: Summary of data availability for major fishing sectors in the Western Pacific Region

	Commercial	Recreational/subsistence	Charter
American Samoa	Yes	Yes	N/A
Guam	Yes	Yes	Yes
Hawaii	Yes	Limited**	Yes, needs improvement*
CNMI	Yes	Limited***	Yes, under improvement

* Data collected through reporting forms but no separated from commercial information
** Some recreational information available from past creel surveys
***Data only available from boat-based fishing activity. Current survey program does not collect information from shore based fishers.

3.3.2 Food Sector

Pooley (1993b) noted that "the distinction between 'commercial' and 'recreational and subsistence' fishing in Hawaii is a weak distinction." The same is true of other U.S. Pacific Islands. The coastal fisheries of the region are dominated, at least in terms of numbers, by small-scale part-time fishermen who have variously mixed motivations to fish. They derive benefits as both producers and consumers—that is, consumers of both seafood and enjoyment. For example, the category of small-boat fishermen in Hawaii termed expense fishermen by Hamilton and Huffman (1997) sell at least part of their catch to offset their fishing expenses, but their expenses still outweigh their revenues. These fishermen are undoubtedly receiving enough consumer surplus (i.e., enjoyment) to monetary losses.

In each of the island areas it is almost impossible to label the majority of these fishermen or fishing vessels as commercial or recreational. It is more appropriate to categorize the fish caught as commercial or recreational/subsistence during a particular trip. Most of the fish caught in 'recreational fisheries' are not released alive. Although some harvest occurs in the EEZ, existing fisheries for coral reef resources are concentrated in the nearshore waters (0-3 miles) around American Samoa, Guam, Hawaii and CNMI. Harvesting of inshore resources is frequently shore-based, whereas fishing offshore reefs is small boat-based.

Recreational fishermen tend to harvest a greater variety of species than do commercial fishermen, so the diversity of the recreational catch is underestimated in commercial databases. For example, the Hawaii DAR database contained only 28 commercial taxa for Hanalei Bay, whereas a creel survey of the area included 95 taxa, although the catches of many taxa were trivial (Friedlander 1996).

Commercial and recreational components employ the same fishing methods, although the recreational fishery typically utilizes a wider range of harvesting methods than the commercial fishery (Friedlander 1996). Inshore gear types with the highest proportion of commercially sold catch (more than 50%) are fish traps, crab nets, surround nets, and gill nets. Spearing and mid-depth handline are less important for commercial harvest (30–35% of catch sold) and casting is almost exclusively for recreation (less than 6% of commercial catch) (Friedlander 1996 after (Hamm and Lum 1992). Creel surveys show that gear types used primarily for recreational/subsistence purposes contribute much more to the total catch than the gear types used for commercial purposes (Green 1997).

3.3.3 Sport Sector

Of the five regions within the Council region, American Samoa is the only area without a real charter boat fleet. Infrequently, private vessels are used for "charter" trips, but to a very limited extent. Recently, in addition to the traditional trolling charters, a bottomfishing charter fishery developed in Guam to target the deep and shallow-water emperors, groupers and snappers, as well as wrasses, squirrel fish, triggerfish, and other coral reef species. The size of the vessels range from typical charter boats carrying three to six anglers to larger party boats accommodating up to 30 persons. During the tourist season, boats make one to three trips per day at two to six hours each trip. Fish are frequently released on shallow-water bottomfishing charters. DAWR estimates 1,700 charter trips in 1999 totaling 4,000 hours bottomfishing. From an effort of 35,000 gear-hours and a total catch of 13,000 lbs., the catch rate was estimated at 0.38 lbs. per gear-hour.

Of the dozen or so charter vessels in the CNMI, several are targeting bottomfish. DFW reports that shallow-water charters generally last two hours and are conducted up to four times per day that could include occasional night trips. Charters generally fish outside the barrier reef in 80-200 feet of water from Chalan Kanoa in the south, up to areas off Nikko Hotel in the north. In 2000 there were two vessels that strictly charter for shallow-water bottom/reef fish. With the re-implementation of the offshore creel survey, routine sampling of the charter fleet includes detailed interviews for bottomfish charters, including numerating and measuring all retained catch.

Shallow-water bottomfish charters have also recently begun in Hawaii. Charter vessels range from smaller boats accommodating four to six passengers to larger party boats of 30 or more. Trips are generally four hours long and conducted twice daily. Vessels routinely operate within three miles of their port. Average depth of operation is from 80 to 200 feet. It is estimated that less than a dozen bottomfish charters operate in Hawaii.

Catch and effort information from bottomfish charter operators are collected through the HDAR Commercial Marine Licenses or sales reporting forms (C-3 forms). However, because bottomfish chartering is relatively new in Hawaii, HDAR cannot tell whether reported bottomfish landings are taken during a charter trip or commercial trip. Fish sold from a bottomfish charter operation would be included on a C-3 form and probably credited toward a normal commercial trip. The C-3 form does not require bottomfish charter operators to indicate if the fish was taken during a charter trip. Fish that are released or consumed may not be reported under the current system. A new form may need to be specifically developed to ensure catch and effort data is collected from the Hawaii bottomfish charter sector. HDAR has developed and will soon implement a new charter troll report form.

Low levels of recreational and/or subsistence fishing occur at Palmyra, Johnston, Wake, and Midway Atolls. Sportfishing is a major attraction at Midway for ecotourists. The no-take zone MPAs proposed for the other Pacific Remote Island Areas (see Section 5.2.) will deter future tourism development at these remote locations.

Most coral reef ecosystem resources in the EEZ are beyond the reach of the average recreational fisherman. Recreational fishing is limited and generally confined to shallow and deep-reef slope species which generally occur in state or territorial waters. The U.S. EEZ starts at the base of the CNMI shoreline from which recreational harvest of coral reef species occurs. However, under this FMP, lead management of these resources within three miles of shore has been given to the local governments.

3.4 Ex-vessel Value of Coral Reef Resources

Tables 3.2 and 3.3a-3.3f summarize the recent approximate total annual ex-vessel value for each of the domestic marine fisheries of the Western Pacific Region's island groups. They focus on fisheries for coral reef resources. But rough estimates of the crustacean and precious coral fisheries (categorized as deep-bottom), and pelagic fisheries, also appear. This allows these fisheries to be compared to coral reef fisheries. It also highlights the potential follow-on effects of the management measures in this FMP. Table 3.2 is a regional summary, while tables 3.3a-3.3f break down the information by island area. Monetary value is expressed in 1999 dollars. Ex-vessel values are the estimated total annual gross value of landings from each fishery, whether sold or not. The ex-vessel values for the sport sector represents charter fees. The landings value for these fisheries are included in the food sector. It should be noted that there is a variable, and in some cases quite high, level of uncertainty as to the accuracy of values in Tables 3.3a-3.3f.

The total annual ex-vessel value of the region's fisheries for coral reef resources in recent years has been about $15 million, $14 million of this derived from food fisheries (mostly bottomfish and lobsters), $1 million from ornamentals (from 0.5 million pieces) and $0.6 million from sport fisheries (from 12,000 angler-trips). The deep bottom fisheries (mostly bottomfish and lobsters harvested from greater than 50 fathoms) realized an approximate annual ex-vessel value of $4 million annually. The value of the natural products and mariculture sectors are assumed to be minimal, but more in-depth investigation might reveal otherwise.

Hawaii's share of total coral reef resource harvests is about 77 %, or $12 million, of which 88% comes from the main islands and 12% from the Northwestern Hawaiian Islands. The ex-vessel value of Guam's harvested coral reef resources is about $1.6 million, the CNMI's about $1.3 million, and American Samoa's about $0.7 million.

Overall, it is very roughly estimated that 10% of the total ex-vessel value of harvested coral reef resources is taken in federal waters (or the "management zone" of the CNMI). The estimated percentages of total ex-vessel value caught in the FMP area are 1% in American Samoa, 4% in the CNMI, 8% in Guam, and 11% in Hawaii.

Table 3.2: Summary of annual ex-vessel value for Western Pacific Region fisheries ($1,000/year).

	Am. Samoa		CNMI		Guam		MHI		NWHI		Other islands		All islands	
	Total	FMP	Total	FMP	Total	FMP	Total	FMP	Total	FMP	Total	FMP	Total	FMP
Coral reef:														
Food	671	8	1,217	54	1,214	118	9,391	1,075	1,295	12	22	21	**13,80**	**1,287**
Sport	m	0	80	4	306	15	71	7	159	159	0	0	**616**	**186**
Ornamentals	10	0	m	0	48	0	1,004	0	0	0	m	m	**1,062**	**m**
Natural	0	0	0	0	0	0	?	?	0	0	0	0	**?**	**?**
Mariculture	m	0	0	0	0	0	?	0	0	0	0	0	**m**	**0**
Total coral reef	**681**	**8**	**1,297**	**58**	**1,567**	**133**	**10,465**	**1,082**	**1,454**	**171**	**22**	**21**	**15,48**	**1,472**
Deep bottom														
Food	64	0	166	0	158	0	1,455	0	1,161	0	0	0	**3,004**	
Sport	m	0	30	0	306	0	707	0	m	0	0	0	**1,043**	
Ornamentals	0	0	0	0	0	0	0	0	0	0	0	0	**0**	
Total deep	**64**	**0**	**196**	**0**	**463**	**0**	**2,162**	**0**	**1,161**	**0**	**0**	**0**	**4,047**	
Pelagic:														
Food	444	0	950	0	858	0	48,200	0	8,764	0	10	0	**59,22**	
Sport	10	0	900	0	1,238	0	14,000	0	159	0	0	0	**16,30**	
Total pelagic	**454**	**0**	**1,850**	**0**	**2,096**	**0**	**62,200**	**0**	**8,923**	**0**	**10**	**0**	**75,53**	
TOTAL	1,199	8	3,343	58	4,127	133	74,827	1,082	11,538	171	32	21	**95,06**	**1,472**

Values are approximate, recent, annual gross values of the production side of these fisheries, expressed in 1999 dollars (x 1,000).
"m" means minimal and unquantifiable.

Table 3.3a: American Samoa fisheries by area, annual volume, and ex-vessel value.

	Annual Total		% of harvest from FMP area	FMP portion	
	Volume (lbs)	Value ($1,000)		Volume (lbs)	Value ($1,000)
Coral reef area harvests:					
Food					
Finfish:					
live	0	0	0	0	0
dead	216,000	393	2	4,000	8
Crustaceans:	7,000	26	0	0	0
lobster					
other crustaceans					
Echinoderms	43,000	87	0	0	0
Molluscs:	73,000	146	0	0	0
mother-of-pearl					
other molluscs					
Other invertebrates	2,000	20	0	0	0
Seaweeds	min	min	0	0	0
Sport	min	min	0	0	0
Ornamentals					
Fishes and other	5,000	10	0	0	0
Hermatypic coral/live	min	min	0	0	0
Black coral	0	0		0	0
Marine natural products	0	0		0	0
Mariculture	min	min	0	0	0
Total coral reef area		**681**			**8**
Deep bottom area harvests:					
Food	27,000	64	0	0	0
Sport	min	min	0	0	0
Ornamentals	0	0	0	0	0
Total deep bottom		**64**			**0**
Pelagic fisheries:					
Food	400,000	444	0	0	0
Sport	120	10	0	0	0
Total pelagic harvests		**454**			**0**
Total all fisheries		**1,199**			**8**

All volume figures are in pounds per year, except the sportfishing sectors, which are in number of angler-trips per year, and ornamentals (except black coral), which are in number of pieces or organisms per year. "min" means minimal.

Table 3.3b: Northern Mariana Islands fisheries by area, annual volume and ex-vessel value.

	Annual Total		% of harvest from FMP area	FMP portion	
	Volume (lbs)	Value ($1,000)		Volume (lbs)	Value ($1,000)
Coral reef:					
Food					
Finfish:					
live	0	0		0	0
dead	446,000	1,070	5	22,000	54
Crustaceans:					
lobster	4,000	19	0	0	0
other crustaceans					
Echinoderms	25,000	68	0	0	0
Molluscs:					
mother-of-pearl	20,000	60	0	0	0
other molluscs					
Other invertebrates					
Seaweeds	min	min	0	0	0
Sport	1,600	80	5	80	4
Ornamentals					
Fishes and other inverts	min	min	0	0	0
Hermatypic coral/live	min	min	0	0	0
Black coral	0	0		0	0
Marine natural products	0	0		0	0
Mariculture	0	0		0	0
Total coral reef		1,297			58
Deep bottom:					
Food	50,000	166	0	0	0
Sport	300	30	0	0	0
Ornamentals	0	0		0	0
Total deep bottom		196			0
Pelagic:					
Food	500,000	950	0	0	0
Sport	9,000	900	0	0	0
Total pelagic		1,850			0
Total all fisheries		3,343			

All volume figures are in pounds per year, except the sportfishing sectors, which are in number of angler-trips per year, and ornamentals (except black coral), which are in number of pieces or organisms per year "min" means minimal.

Table 3.3c: Guam fisheries by area, annual volume and ex-vessel value.

	Annual Total		% of harvest from FMP area	FMP portion	
	Volume (lbs)	Value ($1,000)		Volume (lbs)	Value ($1,000)
Coral reef:					
Food					
Finfish:					
live	0	0		0	0
dead	400,000	1,176	10	40,000	118
Crustaceans:					
lobster	5,000	19	0	0	0
other crustaceans					
Echinoderms					
Molluscs:					
mother-of-pearl	3,000	6	0	0	0
other molluscs	4,000	9	0	0	0
Other invertebrates	1,000	2	0	0	0
Seaweeds	some	unknown	0	0	0
Sport	10,000	306	5	510	15
Ornamentals					
Fishes and other inverts	24,000	48	0	0	0
Hermatypic coral/live	min	min	0	0	0
Black coral	0	0		0	0
Marine natural products	0	0		0	0
Mariculture	0	0		0	0
Total coral reef		**1,567**			**133**
Deep bottom:					
Food	45,000	158	0	0	0
Sport	10,000	306	0	0	0
Ornamentals	0	0			0
Total deep bottom		**463**			
Pelagic:					
Food	660,000	858	0	0	0
Sport	21,000	1,238	0	0	0
Total pelagic		**2,096**			**0**
Total all fisheries		**4,127**			**133**

All volume figures are in pounds per year, except the sportfishing sectors, which are in number of angler-trips per year, and ornamentals (except black coral), which are in number of pieces or organisms per year. "min" means minimal.

Table 3.3d: Main Hawaiian Islands fisheries by area, annual volume and ex-vessel value.

	Annual Total		% of harvest from FMP area	FMP portion	
	Volume (lbs)	Value ($1,000		Volume (lbs)	Value ($1,000
Coral reef:					
Food	1,004,900	9,391		540,001	1,076
Finfish:					
live					
dead	443,900	7,571	10	439,000	750
Crustaceans:					
lobster	10,000	128	0	0	0
other crustaceans	100,000	417	41	41,000	173
Echinoderms	1,000	11	3	0	0
Molluscs:					
mother-of-pearl					
other molluscs	369,000	925	16	60,000	150
Other invertebrates					
Seaweeds	81,000	339	1	1	3
Sport	500	71	10	50	7
Ornamentals					
Fishes and other	430,000	937	0	0	0
Hermatypic coral/live	min	min	0	0	0
Black coral	3,000	66	0	0	0
Marine natural products	unknown	unknown	unknown	unknown	unknown
Mariculture	unknown	unknown	0	0	0
Total coral reef		**10,465**			**1,082**
Deep bottom:					
Food	418,000	1,455	0	0	0
Sport	5,000	707	0	0	0
Ornamentals	0	0		0	0
Total deep bottom		**2,162**			**0**
Pelagic:					
Food	22,000,00	48,200	0	0	0
Sport	99,000	14,000	0	0	0
Total pelagic		**62,200**			**0**
Total all fisheries		**74,827**			**1,082**

All volume figures are in pounds per year, except the sportfishing sectors, which are in number of angler-trips per year, and ornamentals (except black coral), which are in number of pieces or organisms per year.

Table 3.3e: Northwestern Hawaiian Islands fisheries by area, volume and ex-vessel value.

	Annual Total		% of harvest from FMP area	FMP portion	
	Volume (lbs)	Value ($1,000)		Volume (lbs)	Value ($1,000)
Food					
Finfish:					
live	0	0		0	0
dead	19,000	14	82	16,000	11
Crustaceans:					
lobster	246,000	1,280	0	0	0
other crustaceans	min	1	51	min	min
Echinoderms	0	0		0	0
Molluscs:					
mother-of-pearl					
other molluscs	0	0		0	0
Other invertebrates	0	0		0	0
Seaweeds	0	0		0	0
Sport	375	159	100	375	159
Ornamentals					
Fishes and other inverts	0	0		0	0
Hermatypic coral/live rock	0	0		0	0
Black coral	0	0		0	0
Marine natural products	0	0		0	0
Mariculture	0	0		0	0
Total coral reef		**1,454**			**171**
Deep bottom:					
Food	371,000	1,161	0	0	0
Sport	min	min	0	0	0
Ornamentals	0	0		0	0
Total deep bottom		**1,161**			**0**
Pelagic:					
Food	4,000,00	8,764	0	0	0
Sport	375	159	0	0	0
Total pelagic		**8,923**			**0**
Total all fisheries		**11,538**			**171**

All volume figures are in pounds per year, except the sportfishing sectors, which are in number of angler-trips per year, and ornamentals (except black coral), which are in number of pieces or organisms per year. "min" means minimal.

Table 3.3f: Other Islands fisheries by area, annual volume and ex-vessel value.

	Annual Total		% of harvest from FMP area	FMP portion	
	Volume (lbs)	Value ($1,000)		Volume (lbs)	Value ($1,000)
Coral reef:					
Food					
Finfish:					
live	0	0		0	0
dead	10,000	20	100	10,000	20
Crustaceans:					
lobster	200	1	0	0	0
other crustaceans	200	min	100	200	min
Echinoderms	0	0		0	0
Molluscs:					
mother-of-pearl					
other molluscs	100	min	100	100	min
Other invertebrates	0	0		0	0
Seaweeds	0	0		0	0
Sport	0	0		0	0
Ornamentals					
Fishes and other inverts	min	min	100	min	min
Hermatypic coral/live rock	min	min	100	min	min
Black coral	0	0		0	0
Marine natural products	0	0		0	0
Mariculture	0	0		0	0
Total coral reef		**22**			**21**
Deep bottom:					
Food	min	min	0	0	0
Sport	0	0		0	0
Ornamentals	0	0		0	0
Total deep bottom		**0**			**0**
Pelagic:					
Food	5,000	10	0	0	0
Sport	0	0		0	0
Total pelagic		**10**			**0**
Total all fisheries		**32**			**21**

All volume figures are in pounds per year, except the sportfishing sectors, which are in number of angler-trips per year, and ornamentals (except black coral), which are in number of pieces or organisms per year "min" means minimal.

3.5 Description of Fishing Gear Used and Associated Bycatch

3.5.1 Existing Bycatch Management Measures

Although the Council's existing FMPs do not specifically address coral reef fisheries, there are aspects of these plans and their amendments that may have an influence on coral reef fishery bycatch and on the potential for reporting bycatch. Measures in the Council's Bottomfish, Crustaceans, and Pelagic FMPs are summarized below.

The Bottomfish FMP prohibits certain destructive fishing techniques—including explosives, poisons, trawl nets, and bottom-set gillnets—all of which have the capacity to generate high levels of bycatch, especially the use of trawl nets. Bottomfishing, and hence the volume of resulting bycatch, is regulated by the Bottomfish FMP. The permit and reporting system for bottomfish fisheries in the NWHI allows the reporting of catch and discards.

The Crustaceans FMP, adopted in 1983, included a minimum size limit for spiny lobster in the NWHI trap fishery. A minimum size for slipper lobsters was implemented later under Amendment 5. The amendment banned the taking of egg-bearing females and established a mandatory logbook program. Bycatch from the NWHI fishery initially included regulatory discards of undersized or egg-bearing females, while the logbook program provided a means to monitor the bycatch of target species. Amendment 9 to the FMP implemented a retain-all fishery, thus minimizing the volume of undersized or egg-bearing female discards. Some discarding was believed to take place through high-grading, but subsequent observer records from the fishery showed that this was minimal. Potentially, a large range of coral reef fishes and invertebrates can be taken in lobster traps, but the use of escapement panels in these traps minimizes the retention of other non-target species. A limited entry program implemented through Amendment 7 to the FMP, and a more recently established annual harvest guideline for the NWHI fishery, limit total catch volume and therefore the associated bycatch.

Fishing activity targeting highly migratory species rarely interacts with reef fishes. However, some of the provisions of the Pelagics FMP and amendments have tangentially influenced potential bycatch from coral reefs. Currently, the FMP management unit contains four shark families—Alopiidae, Lamnidae, Sphyrnidae, and Carcharhinidae—which include many inshore shark species found on and around coral reefs. The FMP contains a ban on the use of drift gillnets, which can take large numbers of sharks. Some of the species caught by drift gillnets—such as tiger sharks, Galapagos sharks, and hammerheads—are commonly found on and around coral reefs. The FMP also established a 50 nm longline closed area around the NWHI and a 50-75 nm closed area around the MHI, which also reduce the likelihood that longliners will catch sharks common to nearshore areas and coral reefs. Lastly, one of the measures in Amendment 9 to the FMP, although pending implementation, would ban bottom set longline fishing in federal waters which in the past has targeted coastal shark species. Many of these species are also part of the CRE-FMP management unit. Amendment 2 of the FMP implemented a logbook program, which includes a provision to record catch and discards, including shark species.

As part of CRE-FMP implementation, it is recommended that the Pelagics FMP be amended so that nine coastal shark species—currently classified as Pelagic MUS because of their membership in the four shark families identified in that FMP—be reclassified coral reef ecosystem MUS, managed under this FMP. As coral reef ecosystem MUS they should be identified by species.

3.5.2 Coral Reef Fisheries Bycatch

All gears used to catch coral reef species are essentially artisanal in nature. Catch rates are minimal, usually only a few pounds per man-hour or other unit of effort. Large catches thus depend on fishing methods employing a lot of people, such as driven-in-net fishing or group spear fishing. Because of the characteristics of gear and methods, in most cases coral reef fishing generates very little bycatch. Bycatch is further reduced because almost all reef fish taken are eaten. For more detailed information consult Appendix A, which catalogs fishing gears and their impact on essential fish habitat.

In the Pacific Islands, discards, where they occur, are usually due to cultural or practical reasons. In some cultures customary taboos may still adhere. For example, people may avoid nearshore copraphageous scavengers, such as surf perches (Theraponidae) for this reason. Taboos may also stem from the association between a species and gender, as is the case with moorish idols (Zanclidae).

Reef fish preference is also strongly influenced by urbanization: many city dwellers eat a narrower range of reef fish than their brethren in traditional villages on the same island or of the same culture. For example, in Guam triggerfish, butterflyfish, angelfish, and damselfish are typically rejected because they are considered too boney and lacking sufficient meat, while in rural areas in Micronesia these species are readily consumed. Some reef fish in Hawaii state waters are also subject to minimum size and weight restrictions for sale or for capture by spearfishing. These include species of parrotfish, goatfish, jacks, surgeonfish, mullet, milkfish, and threadfins.

In other cases, fish may be avoided due to toxicity. Puffers, toad fish, and porcupine fish (Tetraodontidae, Diodontidae) carry ichthyotoxins, while ichthyosarcotoxicity due to ciguatoxins and related toxins cause people to avoid a wide range of species, including the snapper *Lutjanus bohar*, surgeon fish *Ctenochaetus* spp., moray eels (Muraenidae), groupers (Serranidae), amberjack (*Seriola dumerilli*), and barracuda (Sphyraenidae). Trianni (pers. comm.) suggests that in the Mariana Islands, the red snapper *Lutjanus bohar*, groupers of the genus *Variola* and *Cephalopholis*, jacks, and large barracuda are avoided due to ciguatera. More or less the same species are avoided for the same reason in American Samoa.

People in the Western Pacific Region consume a wide range of invertebrates. Titcomb (1972) catalogs an extensive list of invertebrates used by Native Hawaiians, including many types of crustaceans, sea cucumbers, sea urchins sponges, corals, and various marine worms. In the Samoan Islands, the annual appearance of the gonadal stage of the marine polychaete worm, or *palolo*, is eagerly anticipated because it is regarded as a delicacy (Itano and Buckley 1988). Some traditionally-consumed marine invertebrates may be avoided by some people in the Western Pacific, particularly as dietary habits become more Westernized. Also, some religions, like the Seventh Day Adventist faith, follow dietary rules similar to the kosher dietary restrictions and avoid pork and shellfish. Inadvertent catches of shellfish would likely be discarded by Adventists and may be included as bycatch.

Three fishing gears predominate in Pacific Island coral reefs and lagoons: hook-and-line or handline, spearguns and gillnets. The bycatch characteristics of each of these gear types is summarized below.

Hook-and-Line Catches

Hook-and-line catches generally target carnivorous species of fish, although herbivores can be enticed to take baited hooks. Catch and selectivity of hook-and-line gear is a function of hook size, bait used, and the depth fished. Hook size and bait can select for size, with larger hooks and harder baits tending to catch larger fish. Similarly, fish size tends to increase with depth on the reef slope, although species diversity tends to decrease. Fishermen may use combinations of these factors to sharpen the focus of their fishing, particularly targeting bottomfish on the deep reef slope.

The amberjack *Seriola dumerilii*, frequently a part of deep-slope bottomfish catches in the NWHI, are discarded because they are thought to carry worms and the ciguatera toxin which makes marketing this species difficult. This is reinforced by the selectivity of fish by the fish auction at Honolulu which do not accept these fish. However, small amount of amberjack may be retained for use as bait in crab pots. The other major discard in this fishery is the thick-lipped trevally or *butaguchi* (*Pseudocaranx dentex*), which has a fairly short shelf life and commands a low price in local markets. Therefore, it is often discarded in the early days of a trip to avoid losing room for more valuable fishes, but are retained in the later days to fill fish holds if necessary.

Spearfishing

Underwater fishing with spearguns—either with scuba or snorkels—is extremely selective, since the act of capture involves a deliberate choice of target. Bycatch is likely restricted to speared fish that escape with minor wounds. Spearfishing tends to select by size, with a bias towards larger size fish and larger sizes of a given species (Dalzell 1996). Catch composition may also be different between day and night when different groups of fish are active or sedentary. Night divers can take advantage of the sleeping habits of some parrotfish to cluster in "dormitories" on the reef and therefore be especially vulnerable to spearing.

Hawaiian spearfish catches are dominated by parrotfish, sargeonfish, octopus, and squirrelfish. In areas with greater reef fish diversity, such as Guam, spearfish catches are still mainly dominated by surgeonfish, and parrotfish. Other common families—such as rabbitfish, emperors, snappers, and jacks—also contribute to catches.

Fish Traps

Fish trapping for finfish is not widely practiced in the Western Pacific Region, and is only conducted with any frequency in Hawaii. Traps, like nets, take a large random assortment of different species that probably reflects the proportions of different species groups on coral reefs. Surgeonfish dominate catches in Hawaii, making up 31% of commercial landings, and are comparable to reef fish catches in traps elsewhere in the Pacific (Dalzell 1996).

The main commercial trap fishery on Hawaii's coral reefs is in NWHI. It targets spiny lobster and slipper lobster, rather than reef fish. The fortunes of this fishery have waxed and waned over two decades, with catches in excess of a million lobsters annually in the 1980's, but with much more modest catches of between 100,000 and 300,000 lobsters in the late 1990's. The lobster traps also catch a wide range of other coral reef species, mainly reef fish and reef crustaceans. In the initial years of the fishery, many octopus were also caught and kept, but octopus catches dropped off to negligible amounts by the 1990's because of the use of escape vents. The lobster traps are two-piece plastic halves joined with pins that dissolve in seawater, preventing ghost-fishing by lost traps. They also have a series of small holes in the trap walls to allow undersized lobster and other small bycatch species to escape. Polovina (1993) reports that an estimated 2,000 traps are lost annually in the NWHI. Parrish and Kazama (1992) found that while lobsters may enter these traps, they were also able to exit and there were no observed mortalities associated with ghost fishing. These researchers concluded that lobsters utilized the traps as shelter.

Selection effects in traps are a function of the soak time, mesh size, materials used to construct the traps, trap design, and the depth and position of the set. Traps set in relatively shallow water with little or no bait will generally maximize catches within 4-5 days. Traps baited with fish such as *aku* (skipjack tuna) or sardines and set on deep reef slopes may catch sizeable quantities of fish in a matter of hours rather than days, but the composition is very different, reflecting the generally large highly mobile carnivore complex of the deep reef slope. Lost traps may become a problem through ghost fishing, although eventually ingress and egress from the traps reaches an equilibrium. As with the lobster traps, seawater-degradable pins or panels can be built into traps so that they lose their ability to hold fish.

Nets

In Hawaii, gillnets mostly catch the bigeye scad or *akule*. Other dominant species include surgeonfish, snappers, goatfish, and rudderfish. Goatfish, surgeonfish, parrotfish, and siganids are dominant features of gillnet catches in Guam. There are differences between night and day gillnet catches, with some nocturnally active species such as slipmouths composing part of night gillnet sets.

For smooth fusiform—or cigar-shaped—fish, gillnets tend to select a normally distributed size range, with the lower and upper size limits dependant on mesh size. Spiny fishes may be very vulnerable to gillnet catches, regardless of mesh size, because of tangling. Seasonality can also influence gillnet catches. Fish become more vulnerable during spawning season because gonad development increases their girth and spawning changes behavior (Ehrhardt and Die 1988). The selection effects of gillnets are further complicated by the type of material used, the hanging ratio or measure of meshes per unit of length, the way the net is deployed on a reef, the time of day set, and length of soak. If gillnets are not checked regularly, bycatch may increase. Entangled fish build up in the net; if they are not removed, they are either preyed on or rot and become unsaleable.

Seine nets are actively deployed around schools of fish, as opposed to gillnets, which—like fish traps—are a passive gear. Beach seines, as the name implies, are set in an arc from the beach. Both wings are drawn together on the beach and hauled to concentrate the fish in the head of the net, from where they can be bucketed ashore. Seine nets can also be used for drive-in-net, or muro-ami, fishing. A barrier net is set in the lagoon or on a reef, and fish are driven with scare lines into the apex of the net, which is then closed to catch the fish. The amount of bycatch from this type of fishing depends on whether people are largely urbanized and used to eating a narrow range of reef fish, or whether they mainly rely on fishing for subsistence and eat a broader range of fish.

Surround seines can also be set on open schools in a lagoon in the same manner as a beach seine. This fishing method is employed in Hawaii to catch schools of big-eye scad or *akule*, which are located by spotting from light aircraft. This method of fishing is extremely selective, bycatch results when not all the captured school is kept and excess fish will be released. In such cases the release of fish is commendable since they are not wasted as dead bycatch.

Lastly, cast or throw nets are also common in parts of the Pacific, where fishermen want to make modest catches, usually of small nearshore schooling reef species. These catches are taken mainly for subsistence, and fishermen will select and stalk on foot schools of fish such as surgeonfish, herrings, rabbitfish, and mullets in the hope of obtaining a catch (Dalzell *et al.* 1996). As with spearfishing, there is a high degree of selectivity in the target catch, so bycatch is negligible.

3.5.3 Bycatch Reduction

It is important to understand that virtually all coral reef fisheries production in the western Pacific comes from state waters and not from waters under federal control. Consequently, it might be argued that there is no bycatch problem for coral reef fisheries under federal control. However, under the MSFCMA there is no minimum acceptable threshold for bycatch. Whatever the bycatch, the Council must try to reduce it, where practicable. However, using the simple gears deployed on coral reefs in a way that catches only the target species is difficult, if not impossible. Specialized gears, such as kites and spider-web lures that catch garfish, are used in the Pacific Islands, but many of the other universally employed gears will invariably take species that people generally refuse to eat.

Incentives to reduce bycatch are limited. People will not eat suspected ciguatoxic fish and may regard any attempts to subvert taboos on other species as culturally insensitive. Coral reef fisheries are composed of many fishermen and small vessels without observer programs. This makes it difficult to enforce regulations mandating a "take-all fishery" to eliminate bycatch. Further, where fish are suspected of being ciguatoxic, prudence dictates that catches should continue to be discarded. Ciguatera test kits exist, but these are relatively expensive and are designed for amateur fishermen who want to test individual fish. It is not a test that can be applied wholesale on a cost-effective basis to even a modest commercial reef fish catch.

It probably makes the most sense to focus regulations and incentives on those gears that usually produce the most bycatch, especially on passive gears, such as traps and gillnets. Fish traps may be regulated by varying mesh size to exclude undersize fish and non-target species, or requiring escape vents for the same purpose. As mentioned earlier, some kind of degradable panel or fastening can be employed to open traps after a given amount of time, thus minimizing ghost-fishing by lost traps. The number of traps that a person is allowed to set could also be limited. Specifying the maximum soak time could also reduce the number of fish unnecessarily lost or killed due to a long set time. By the same token, not only could gillnet mesh size be regulated, but also the length of the net and the duration of soak time.

Education campaigns might be run to alert fishermen to the bycatch issue and encourage them to avoid damaging fish that must be returned to the sea. Where fish have suffered as a result of raising them from depth, fishermen may be convinced to return fish by first deflating distended swim bladders. Similarly, greater care and attention to releasing fish from the common gears may minimize release mortality. Circle hooks, for example, because they hook in the mouth instead of the stomach or gills, could effectively reduce bycatch mortality of discarded handline-caught fish. Trap-caught reef fishes can also be returned to the sea in good condition, if handled appropriately, with gloves, and rapidly removed from traps with minimal trauma.

It is difficult, however, to conceive of ways in which speared fish can be safely released without trauma, although release has been successful in some reef fish tagging experiments. But the selection by fishermen of fish to spear should minimize most spearfishing bycatch. It is more difficult to release fish from gillnets and other seines in good condition if fish are gilled or tangled. Aside from the measures outlined above, there is very little direct regulatory action that will minimize bycatch. Instead, making fishermen more aware of the need to minimize discard volume and mortality might be more effective. Fortunately, traditional Pacific Island societies usually abide by this ethic already.

3.5.4 Reef Fish Bycatch Data

The WPacFIN program has recently begun to collect data on bycatch in American Samoa, Guam and the CNMI as part of the routine creel surveys carried out by local agencies. Members agreed at recent Council Plan Team meetings that the most critical and plausible information to collect on bycatch during creel surveys was the species name, the number of fish discarded, and whether they were discarded alive or dead/injured. The overall coverage rates of these surveys and the experience of the personnel involved is sufficient to achieve good estimates of bycatch species and bycatch rates in most fisheries. Voluntary observer programs are also being discussed to obtain more reliable estimates from certain sectors, such as the charter bottomfish fishery.

In Hawaii, the main commercial catch database does not, in general, contain discard data, except for the NWHI bottomfish catch. This fishery has also been monitored in the past by observers. However, creel surveys—initially focused on shoreline catches on the Big Island of Hawaii—are being expanded to Maui and will also include boat landings. The surveys will include questions on discards in common with those in the CNMI and the territories, and there are plans to seek funding to expand the surveys to all the MHI archipelago.

3.6 Description of Island Areas in the Council Region: Economy, Fishing Communities, and Use of Reef Resources

This section describes fishery-related economic and cultural characteristics of each of the five jurisdictions in Council region. Section 3.6.1 provides a regional overview, describing the nature of contemporary island communities, how they depend on coral reef resources, and how they used these resources in the past and continue using them today. Section 3.6.2 generally repeats this format for each of the five jurisdictions in the Council Region: American Samoa, the CNMI, Guam, Hawaii, and the PRIAs.

The whole of Section 3.6, then, concerns the socio-cultural aspects of the fishery, which includes shared technology, customs, terminology, attitudes, and values. Fishermen may be the most direct beneficiaries of the fishing lifestyle, but the broader social context also needs to be considered. Those who participate in the marketing or consumption of fish, or in the provision of fishing supplies, may also share in the fishing culture. An integral part of this web of interactions is the broad network of interpersonal social and economic relations through which the cultural attributes of a fishery are transmitted and perpetuated. The relations that originate from a shared dependence on fishing and fishing-related activities to meet economic and social needs can have far-reaching effects in the daily lives of those involved.

Island cultures are maintained by systems of interdependence and social reciprocity, including sharing of seafood gathered by fishing. Beyond their dietary importance, fish have value for exchange and gift-giving that promotes social harmony, community cohesion, and cultural identity. Various types of seafood served on holidays or during celebrations may become imbued with specific symbolic meanings.

Finally, the socio-cultural context of fishing may include the contribution fishing makes to the cultural identity and continuity of the broader community or region. As a result of this contribution, the activity of fishing may have existence value for some members of the general public. Individuals who do not fish themselves, and are never likely to, may derive satisfaction and enjoyment from knowing that this activity continues to exist. They may value the knowledge that the traditions, customs and life ways of fishing are being preserved (URS Corp. in press).

3.6.1 Regional Overview

Island Communities in the U.S. Pacific

The Contemporary Socio-economic Context

The social and economic histories of the populated U.S. Pacific Islands differ considerably from that of the continental US. The Samoan, Hawaiian, and Mariana Islands were originally settled in ancient times by seafaring peoples. In most areas, the dearth of terrestrial resources led to great dependence on fishing for food security. This dependence shaped the social organization, cultural values and spiritual beliefs of the indigenous populations.

The era of European discovery brought the island cultures in direct conflict with western traditions of proprietorship. Repeated contact with western culture eroded the stability of the social structures and subsistence economies created by indigenous people. The beginning of the twentieth century brought American administrators to the Pacific and accelerated the process of westernization.

World War II caused dramatic changes in all of the populated U.S. Pacific Island groups. It also caused an influx of Caucasians into Hawaii. New harbors, airports, and other infrastructure tied the islands closer to the U.S. mainstream. This increased the imports of goods, and exposure to American laws, education, media, and technology. The islands moved rapidly away from subsistence and toward cash economies.

Table 3.4a: Major demographic and economic characteristics of American Samoa, Guam, Hawaii, and the CNMI.

	American Samoa	CNMI	Guam	Hawaii
Population	57,281	69,221	154,805	1,193,001
Indigenous Population (%)	89%	29%	47%	19%
Land Area (sq. mi.)	77	179	212	6,423
Reef Area (sq. mi.)	296	579	179	(MHI) 2.535 (NWHI) 11,535
GDP (U.S.$ million)	253.00	664.60	3,065.80	35,146.40
GDP Per Capita ($)	4,295	8,367	18,766	29,164
Major Income Sources	Tuna canneries, government services, remittances from Samoans overseas.	Tourism, garment manufacturing, trade and services.	Tourism, military, trade and services.	Tourism, services, trade, Government, military.
Political Status	U.S. territory since 1899, Samoans are U.S. citizens but do not vote in U.S. national elections.	After WWI under Japanese Mandate. 1947-became part of UN TTPI (U.S. administered). 1978-Commonwealth. Islanders are U.S. citizens but do not vote in U.S. elections.	U.S. territory since 1898, 1950-Guam Organic Act conferred citizenship but no voting privileges in U.S. national elections. Organic Act never ratified by Guam referendum.	Kingdom overthrown by American businessmen,1893. Annexed in 1898 by "Newlands Resolution." Organic Act in 1900 creates U.S. Territory. 1959-Admissions Act creates State of Hawaii.
Major Investment Sources	U.S.	Japan, Korea, Hong Kong. U.S.	U.S., Japan, Korea	U.S., Japan. Australia.

Table 3.4b: Statute mile distances between population centers in the Region, and to Washington, D.C.

	Garapan, CNMI	Pago Pago, American Samoa	Honolulu, Hawaii	Washington, D.C.
Agana, Guam	136	3,598	3,812	7,396
Garapan, CNMI		3,604	3,717	7,802
Pago Pago, American Samoa			2,598	7,028
Honolulu, Hawaii				4,835

With the exception of American Samoa—and small enclaves in Guam, Hawaii, and the CNMI—the contemporary descendants of indigenous Pacific Islanders are dispersed as part of cosmopolitan populations. Island societies have become pluralistic, and many aspects of their economies and cultures have evolved in modern times. Yet, the vast majority of contemporary island inhabitants continue to depend on coral reef resources for consumptive and non-consumptive uses. Most are consumers of seafood and many are at least part-time fishermen. In addition to providing food and recreation, the harvest of coral reef resources is also important as a means of preserving and perpetuating indigenous cultural identities and values. Table 3.4a-b provide general socio-economic and geographic data for the four populated jurisdictions in the Council Region.

Fishing Communities in the U.S. Pacific

The U.S. Pacific islands vary significantly in land area, population levels, and the size of their associated EEZs. They have had significantly different courses of political development and historical relationships with the U.S., but they share a common economic and social dependence on marine fisheries, especially coral reef resources. This dependence traces back thousands of years, when the islands were first settled by sea-faring peoples. Their dependence on fishing for food security shaped the social organization, cultural values and spiritual beliefs of the indigenous cultures. Contemporary island societies are pluralistic in population and culture and few people depend solely on fish catches for protein.

Contemporary communities result from webs of social interaction that people create by taking advantage of shared cultural understanding and identity. Fishing communities in the U.S. Pacific Islands are based on shared participation in fishing-related activities that occur over larger geographical scales than single villages or towns. At least one-third of the resident population of the U.S. Pacific Islands participates in some level of fishing, and all towns and villages include some proportion of residents who are part-time fishermen. Fishermen from one town travel to other parts of the island and between islands to visit family and friends. Fishing is one of the most common shared activities at such gatherings. Fishermen frequently trailer small boats from one side of an island to the other to take advantage of seasonal fish availability and weather conditions. Fishing cooperatives in the U.S. Pacific Islands have island-wide memberships and seafood markets are supplied by widespread on-and off-island harvesters.

Community Participation in Coral Reef Fisheries

Contemporary participation in coral reef fisheries in the U.S. Pacific Islands has grown out of ancient traditions. Near the more popnlated islands, however, the impacts of fishing have been magnified by population growth and the introduction of modern, manufactured gear (e.g., monofilament nets, scuba).

Coral reef products that enter commercial markets typically undergo very little processing and the chain of sale is very short, from harvesters to retailers to consumers. There are no known participants whose primary business is processing coral reef products. Wholesalers of coml reef products are also rare. The predominant use of coral reef resources is for subsistence, where the product moves directly from harvester to consumer, often within the same family or village.

The harvest and consumption of coral reef resources has beeu a part of the way of life since the islands were first settled several thousand years ago. Pacific Islanders of old were considered masters in their knowledge of fish, their habits, and the means of capturing them. Through oral tradition, one generation taught the next about the dynamics of inshore marine resources and passed on the skills needed to harvest them. Based on their familiarity with specific places and through trial and error, the Pacific Islanders were able to devise social controls to foster, in modern terminology, "sustainable use" of marine resources in localized areas. Periods of scarcity brought about an early awareness that marine resources were limited. This reinforeed a shared social obligation to exercise self-restraint in resource exploitation. Irresponsible resouree nse was tantamount to denying future generations their birthright and means of survival. Virtually every method utilized in modern fisheries management was in use in the Pacific Islands centuries ago. Many of the ancient fishing techniques survived into the twentieth century, but today these traditional management measures are rarely applied in the U.S. Pacific Islands.

The methods and patterns of coral reef fisheries that have evolved over the years in the U.S. Pacific Islands grew out of these traditions. Fishing for pelagic fish in offshore waters is constrained by the need for seaworthy vessels, distance to fishing grouuds and weather. In contrast, nearshore coral reef resources can be harvested with low capital outlay, and less time and risk. Relative to other fisheries resources in theU.S.Pacific Islands, coral reefs are more accessible and are used by a larger and more diverse population of fishermen, which employs a wider variety of gear. Table 3.5 lists a broad spectrum of coral reef taxa, which are harvested for many purposes.

Table 3.5: Coral reef taxa harvested by indigenous and contemporary fishermen in the U.S. Pacific islands.

Taxa	Harvested by:	
	Indigenous People	Contemporary Fishermen
Acanthuridae (Surgeonfish)	F, C, M, (1)	F, A
Algae (Seaweeds)	C, F, M, B	F, A
Annelid (Seaworms)	M	B, A
Antipathes spp. (Black coral)	M	A
Apogonidae (Cardinal fishes)	F	F, A
Architeconicidae (Sundial shells, Sea hares)	F, C	A
Aulostomidae (Trumpetfish)	F	A
Balistidae (Triggerfish)	F	A
Blennidae (Blennies)	B	B, A
Carangidae (Jacks, Trevally)	F	F, A
Carcharhinidae (Sharks)	F, C, (1)	F, M, (1)
Cassididae (Helmet Shell)	F, T	F, A
Chaetodontidae (Butterflyfish)		A
Cheloniidae (Sea turtles)	F, M, T	F, A
Cirrhilidae (Hawkfish)	F	A
Clupeidae (Herrings)		B
Cnidara (Sea anemones)	F	A
Conidae (Cone shells)	F, A, T	A
Crustacea (Crabs, shrimps, lobsters)	B, F, M	B, F, A
Cypraeidae (Cowries)	F, A, T, M	A, T

(1) Skins of some species used for drums

A. Aquaria or ornamental uses
B. Used for bait
C. Ceremonial Uses
F. Used for Food
M. Medicinal Uses
T. Tool Uses

Table 3.5 (cont.)

Taxa	Harvested by: Indigenous People	Contemporary Fishermen
Dasyatididae,		
Myliobatidae,		F, A
Mobulidae (Rays)		
Decapterus/Selar spp (Scads)	B, F	B, F
Echinoderms (Sea cucmbers,sea Urchins)	B, F, T,	F, A
Engraulidae (Anchovies)		B
Fasciolariidae (Spindleshell)	T	A
Fistularidae (Cornetfish)		A
Gobiidae (Gobies)	B, F, C	B, A
Holocentridae (Soldierfish)	F	F
Kuhliidae (Flagtail)	C, F	F
Kyphosidae (Rudderfish)	F, M,	F
Labridae (Wrasses)	F, C	F
Lethrinidae (Emperor fish)	F	F
Littorinidae (Kukae kolea)	F	
Lutjanidae (Snappers)	F	F
Melampidae (Oe)	F	
Moringidae		
Muraenidae		
Chlopsidae		

(1) Skins of some species used for drums

A. Aquaria or ornamental uses
B. Used for bait
C. Ceremonial Uses
F. Used for Food
M. Medicinal Uses
T. Tool Uses

Table 3.5 (cont.)

Taxa	Harvested by	
	Indigenous Fishermen	Contemporary Fishermen
Congridae,		
Ophichthidae (Eels)	F	F, A, B
Mullidae (Goatfishes)	F	F
Neritidae (Snails)	F, A, T	F, A
Octopodidae (Octopus)	F	F
Patellids (Opihi)	F, M, C, T	F
Polynemidae (Threadfin)	F	F
Pomacanthidae spp (Angelfish)		A
Pomacentridae spp (damselfish)		A
Priacanthidae (Bigeye)	F	F
Pteridae (Oysters)	F, T	F, A
Scaridae (Parrotfish)	F	F
Scorpaenidae (Scorpion fishes)	F	F, A
Serranidae (Grouper, Sea bass)	F	F, A
Siganidae (Rabbitfish)	F	F
Sphyraenidae (Barracuda)	F	F
Terebridae (Auger shells)	T	
Verenidae (Clams)	F, T	F
Zanclidae (Moorish Idol)		A
Zooanthids (Soft Corals)	M	A

(1) Skins of some species used for drums

A. Aquaria or ornamental uses
B. Used for bait
C. Ceremonial Uses
F. Used for Food
M. Medicinal Uses
T. Tool Uses

Historical and Contemporary Coral Reef Uses

Coral reef resources sustained indigenous populations in the U.S. Pacific Islands for hundreds to thousands of years before European contact. More recently, coral reef resources have been harvested for recreational and commercial purposes as well. Reef species have been harvested for food, the aquarium trade, construction materials, curios, jewelry, pharmaceuticals and traditional medicines.

In modern times, some reefs have been degraded by a range of human activities. Comprehensive lists of human threats to coral reefs in the U.S. Pacific Islands are provided by Maragos *et al.* (1996), Birkeland (1997b), Grigg (1997), Jokiel *et al.* (1999), and Clark and Gulko (1999). In general, reefs closest to human population centers are more heavily used and are in worse condition than those in remote locations (Green 1997). Table 3.6 summarize coral reef use in the various jurisdictions in the Council region.

Table 3.6: Summary of coral reef resource use levels in nearshore areas (0-3 nmi from shore) and offshore areas (3-200 nmi from shore) in sub-areas of the U.S. Pacific Islands (modified from Green, 1997).

Location	0-3 nmi	3-200 nmi
American Samoa	Nil-Moderate	Nil-Light
CNMI	Nil-Heavy	Nil-Heavy
Guam	Light-Heavy	Nil-Heavy
Hawaii		
Main Hawaiian Islands	Light-Heavy	Nil-Heavy
Northwestern Hawaiian Islands	Mostly Nil	Nil-Moderate
Remote Islands	Nil-Light	Mostly Nil
Overall	Nil-Heavy	Nil-Moderate

3.6.2 Island Area Descriptions

American Samoa

Socio-economic Overview

American Samoa is an unincorporated territory of the U.S. comprising seven islands with a total land area of only 77 square miles. Because most of the islands are mountainous, there is very little area suitable for a agriculture. The Territory's population is about 60,000, and is growing rapidly, with a doubling time of only 20 years (Craig *et al.* in press). (Table 3.7 provides basic demographic data for the Territory.) Of all the U.S. Pacific Islands, American Samoa has the lowest gross domestic product and highest donor aid per capita (Adams *et al.* 1999).

Table 3.7: 2000 U.S. Bureau of Census Data for American Samoa.

	Population (n)	Population (%)	Land Area (sq. miles)	Land Area (%)
American Samoa Total	57,291	100.0	77.4	100.0
Tutuila Island and Aunu'u Island	55,876	97.5	54.8	70.8
(Eastern District)	23,441	40.9	25.9	33.5
(Western District)	32,435	56.6	28.9	37.4
Manu'a Islands	1378	2.4	21.9	28.3
(Ofu and Nu'u Islands)	289	0.5	2.8	3.6
(Olosega Island)	216	0.3	2	2.6
(Ta'u Island)	873	1.5	17.1	22.1
Rose Island	0	0	0.1	0.1
Swains Island	37	<0.06	0.6	0.8

American Samoa has a small developing economy, dependent mainly on two primary income sources: the American Samoa government, which receives income and capital subsidies from the federal government, and two tuna canneries on the island of Tutuila. These two income sources have given rise to a third: a services sector that derives from and complements the first two. In 1993, the latest year for which American Samoa government has compiled detailed labor force and employment data, the local government employed 4,355 people, or 32.2% of total employment, followed by the two canneries with 3,977 people (29.9%) and the rest of the services economy with 5,211 workers (38.4%). Altogether, the three segments employed 13,543 workers, while 2,718 people were registered as unemployed (that is, actively seeking employment). This gives a total labor force of 16,621 and an unemployment rate of 16.7%. A large proportion of the territory's workers are from Samoa, formerly Western Samoa. While Samoans working in the territory are legally alien workers under U.S. law, they share a common culture, history, and family ties.

Because of its tuna canneries, Pago Pago is the leading U.S. port in terms of dollar value of fish landings. Star-Kist Samoa has become the largest tuna cannery in the world. Ancillary businesses associated with the tuna processing industry also contribute significantly to American Samoa's economy. Pago Pago Harbor supports mostly large fishing vessels, tankers, and container ships. Shoreside infrastructure for small domestic fishing vessels is minimal. Commercial fisheries for bottomfish and reef fish make a minor contribution to the Territory's overall economy. The social and cultural importance of coral reef resources in American Samoa dwarfs their commercial value.

With a total population estimated in 1993 at 52,900, the labor force represented 30.7% of the population, which is very low when compared with the overall U.S. labor force ratio (well over 50 percent) but typical of the smaller developing Pacific Island economies. Of the 31,822 residents 16 years or older, the total labor force was equivalent to 51.1%. That half of the 16 years-plus population is not in the labor force is explained by American Samoa's lack of major industry other than government and fish canning. Work opportunities are certainly limited, but not having a job in the money economy does not necessarily equate with unemployment because subsistence activity contributes to the extended family's total well-being.

Official data notwithstanding, by many measures American Samoa is not a poor economy. Its estimated per capita income of $5,000 is almost twice the average for all the Pacific Island economies (at $2,700) (Bank of Hawaii 1997a). Per capita income in American Samoa does not represent the same market basket and value as it would, for example, in Honolulu. There are aspects of work and the creation of value in communal societies of the Pacific Islands that are not captured by market measures. For instance, American Samoa's tightly organized *aiga* (extended family) system helps to keep young people from becoming economically unproductive and socially disruptive. Unlike the vast majority of youth in the Pacific Islands, American Samoan youth can emigrate to the United States, where an estimated 70,000 Samoans live, 20,000 of them in Hawaii.

The policy of the American Samoa government, as expressed in the Revised Constitution (1966), is "... to protect persons of Samoan ancestry against ... the destruction of the Samoan way of life ... [and] to protect the lands, customs, culture, and traditional Samoan family organization of persons of Samoan ancestry, and to encourage business enterprises by such persons...."

Community Participation in Coral Reef Fisheries

The majority of fishermen in American Samoa harvest coral reef resources for subsistence and do not sell their catches. Samoans have cultural obligations to extended families, traditional leaders, and village ministers that require the exchange of food and other resources. Undertaking fishing on a part-time basis, rather than as a full-time business, provides residents with the flexibility to fulfill these obligations, which are an integral part of *fa`a Samoa* (the Samoan way of life).

There are no data on the proportion of the population that engages in fishing, but the number must be greater than 50%. Interviews with men and women in 42 villages of Tutuila, revealed that most men and women fished in the reef environment between one and four times per week and that they ate meals of those fish between one and six times per week (Des Rochers and Tuilagi 1993). The number of sometime food fishermen probably ranges from 10,000 to 30,000, with less than 1% of these involved in commercial harvesting.

Fishing has been interwoven with all aspects of Samoan community life and cultural identity since the islands were first settled 3,500 years ago. It shaped the traditional Samoan religion, diet, material culture, oral traditions and calendar (Severance and Franco 1989). Fishing and its products also played a fundamental role in the social structure. Ceremonial and cultural demands involve exchange of food and other resources to support extended families and traditional leaders. Participation in commercial activities, wage labor, and a cash economy has not weakened this network of social obligations as much as provided new opportunities for customary exchange of goods and services within American Samoa's tightly held *aiga* (extended family) system.

Fishing contributes not only to the extended family's welfare, but also to social cohesion within the broader island community. It offers individuals an occupation that is consistent with Samoan cultural values and the island lifestyle. Furthermore, to the extent that unemployment among the younger population can cause both economic and social ills, commercial fishing provides an additional opportunity for young people to be economically productive and socially responsible.

In contemporary Samoa, seafood harvested from inshore coral reefs continues to be a major component of the local diet. Wass (1982) reported that annual per capita consumption of seafood in American Samoa is 148 lbs., which is several times higher than the U.S. national average. Local catches are insufficient to meet such high demand, and they are supplemented by imports of reef fish and bottomfish from neighboring Samoa.

Despite increasing commercialization, fishing continues to contribute to the perpetuation of Samoan culture and social cohesion of American Samoa communities. The role of fishing in cultural continuity is at least as important as the contributions made to the nutritional and economic well-being of island residents. Continuing access to fish is important for the perpetuation of *fa`a Samoa* (the Samoan way of life), as well as for food.

Traditional Samoan values still exert a strong influence on when and why people fish, how they distribute their catch, and the meaning of fish within the culture. Fishing has become increasingly commercialized, but fish, whether caught or purchased, remains a significant component of the customary exchange system. Fish catches are distributed according to a strict protocol. Even the fish that is sold may be fulfilling obligations to friends and members of the extended family. A recent survey of American Samoan fishermen revealed that a significant portion of the catch that is sold is done so at a reduced price to friends and kinsmen as an expression of a established social relationship (Severance et. al. 1998). When distributed, fish and other resources move through a complex and culturally embedded exchange system that supports the food needs of the *aiga*, and enhances the status of the *matai* and village ministers. (The *matai* is the authority, chief, or specialist on land, while the *tautai* is the authority, chief, or specialist on the sea (Severance *et al.* 1998). A range of separately named types of customary exchange have been documented.

Meyer (1987) emphasizes that reef-associated fish are not important just as food resources but that "fish and fishing are embedded in Samoan culture and wisdom." Both Severance and Franco (1989) and Meyer (1987) illustrate the importance of fish in Samoan culture through long lists of proverbs that feature fish and fishing gear. An important community event, and one of the few remaining group fishing activities, is the harvest of *palolo* worms (*Eunice viridis*).

During just a few nights each year, the reef-burrowing polychaete releases egg- and sperm-filled body segments that are delicacies in Samoa (Des Rochers and Tuilagi 1993).

Historical and Present Coral Reef Uses

Coral reef fishes and invertebrates are harvested in subsistence and small-scale commercial fisheries. In 1994, the only year when both components of this fishery were measured, catches were 86 mt and 76 mt, respectively, and consisted primarily of surgeonfish, parrotfish, groupers, octopus and sea urchins (Craig *et al.* in press). Sixty-nine different taxa were harvested in 1991. The migratory *atule* (*Selar crumenophthalmus*, or bigeye scad) is an important catch component (Green 1997).

As recently as 20 years ago, the harvest of reef fish and invertebrates from reef flats fronting the most densely populated section of coast on Tutuila was as high as 26.6 mt/km^2 per year (Wass 1982). A decreasing trend in reef-related fish catches was observed in the early 1990's. Giant clams, and perhaps other favored invertebrates, have been overfished in most areas, except Rose Atoll (Craig *et al.* in press). In general, the reefs adjacent to population centers on Tutuila Island appear to be in worse condition than those near less populated or unpopulated islands (Green and Craig 1996).

Most of the coral reef fisheries in American Samoa occur in nearshore waters. Much of the bottomfishing activity by small boats is conducted on banks in the EEZ, and some of the shallow-water snappers and emperors they catch can be considered reef fish species. At present, the catch from this fishery is minor (Green 1997). Ornamental fish collection has occurred on a small scale in recent years. Live rock taken from shallow reef areas was exported during 1999, but this fishery has since been prohibited by the *fono* (American Samoa Legislature).

Fisheries statistics show that in recent years coral reef fisheries have accounted for 62% of the annual catch of 154 mt and 70% of the $619,000 annual catch value. This estimate is low because it does not include the shoreline subsistence harvest, which is assumed to be substantial. Nor does the estimate include shallow-water species of bottomfish, which are taken in a commercial small-boat fishery. The annual harvest of the latter fishery has been small in recent years (11 mt valued at $46,000), so the contribution to the total reef fish harvest is insubstantial.

Most of the landings in the known reef-related fisheries in American Samoa are fish (98 mt/year), molluscs (33 mt/year) and echinoderms (19 mt/year), but small amounts of crustaceans (3 mt/year) are also reported (Green 1997). A much smaller commercial fishery, using ten-meter boats, catches bottomfish (principally emperors and snappers) around the islands and offshore banks, using hook-and-line. In 1997, this fishery harvested 12 mt (Craig et. al. 1999). Chambered nautilus has occasionally been taken by researchers and public aquaria at depths of about 200 m on offshore reef slopes (Itano pers. comm.). Virtually nothing is known about the reefs on these offshore banks because they are relatively inaccessible. It is assumed, however, that they are in better condition than the nearshore reefs because they are deep and remote from most human activities.

Coral reefs around American Samoa are recovering from a series of natural disturbances that occurred over the past two decades: a crown-of-thorns invasion (1978), three hurricanes (1986, 1990, 1991), and mass coral bleaching (1994), as well as chronic human-induced impacts along the populated coasts. Beaches, wetlands, and coral reefs have been extensively altered due to highway construction and urban expansion, particularly along the south shore of Tutuila. Coastal erosion is amplified by the removal of large quantities of beach sand and coral rubble from the shoreline for use around homes. Together, these shoreline alterations have largely eliminated the use of the central south coast by nesting sea turtles. Direct losses of coral reef habitats are related to dredging for harbors and filling to build the international airport runway.

Possible degradation of reefs has also occurred due to chronic water quality and sedimentation problems. Because of the main islands' steep terrain and high rainfall, hillside runoff causes heavy sedimentation in adjacent coastal waters. Landfills, sewage disposal, and—in Pago Pago Harbor—discharges from shoreside industries and spills from vessels in port have also had a major impact on the reef environment (Craig *et al.* in press). Remote Rose Atoll, protected as a National Wildlife Refuge (established through a cooperative agreement between the Territory of American Samoa and the U.S. Fish and Wildlife Service in 1973), was damaged in 1993 by a ship grounding and related oil spill.

The condition of nearshore reefs around American Samoa varies according to location. Reefs on the main island of Tutuila are in the worst condition because of a combination of natural and human effects (hurricanes, coral bleaching, pollution, sedimentution), whereas the reefs on the more remote and less populated islands tend to be in good condition (Green 1997). Evidence from recent fisheries statistics, scientific resource surveys, and interviews with village elders and fishermen suggests that the more accessible coral reefs are seriously overfished. Scuba-assisted fishing is a major contributor to this problem, especially at night. Green sea and hawksbill turtle populations have seriously declined due to harvesting of turtles and eggs and degradntion of nesting and inshore habitats.

Commonwealth of the Northern Mariena Islands

Socio-economic Overview

The Northern Mariann Islands was part of the former Trust Territory of the Pacific Islands, administered by the U.S., before becoming a commonwealth by plebiscite in 1998. It has a total land area of 179 square miles spread over 264,000 square miles of ocean and consists of three main islands, Saipan, Tinian, and Rota, and several small islands and atolls. The southernmost island, Rota, lies some 50 miles northeast of Guam and 430 miles south of CNMI's northernmost island, Uracus. The small islands of the northern part of the chain are lightly populated. In 1990, the population of the northern islands was 36, but has dwindled down to only 6 according to 2000 Census Bureau Data. The main islands are grouped together in the southern part of the chain. The Commonwealth's capital is Saipan, but no locality on that island is recognized specifically as the capital; several government offices are located in the CDP of Capital Hill, but the legislature meets in Susupe. Ninety percent of its of 69,221 residents live on the island of

Saipan and almost al the rest on Tinian and Rota. (Table 3.8 provides basic demographic data for the Commonwealth.) Chamorro is the most commonly spoken native language.

Table 3.8: 2000 Bureau of Census Data for the Northern Mariana Islands and Guam.

	Population (n)	Population (%)	Land Area (sq. Miles)	Land Area (%)
CNMI Total	69,221	100.0	179	100.0
Northern Islands	6	<0.01	59.8	33.4
Rota Island	3,283	4.8	33	18.4
Saipan Island	62,392	90.1	44.6	24.9
Tinian Island	3,540	5.1	41.7	23.3
Guam total	154,805	100	212	100

The Bureau of the Census estimates that the population of the Northern Mariana Islands grew by 25,867 persons between the 1990 census and 2000 to an estimated 69,221 persons. It is estimated that approximately 59% of this increase is a result from migration to the islands, principally from Asian countries. The Chamorro and Carolinan ethnic groups native to the islands represented some 29% of the CNMI's population (Bureuu of Census, International Data Base, 12/29/99).

The early history of the Northern Mariana Islands parallels that of Guam. Spanish and other explorers first visited the islands in the sixteenth century, and they were colonized by Spain in the seventeenth century. Spain sold the islands in 1899 to Germany, following the end of the Spanish-American War. In 1914, Japan entered World War I on the side of the Allies and took possession of the islands. After the war, Japan retained the islands under a League of Nations Mandate. In 1944, the United States gained control of the islands from Japan and in 1947, along with other parts of U.S.-controlled Micronesia, these islands became a United Nations Trust Territory under U.S, administration. The islands were administered by the Defense Department until 1961. However, administrative authority was vested in the Department of the Interior in 1951. In 1978, a separate government for the Northern Mariana Islands was established and Commonwealth status was granted in 1986.

The main islands are each organized as a single municipality, with its own elected mayor and municipal council. Saipan's municipal council also serves the Northern Islands municipality. In 1990, there were 16 CDP's identified at the time of the Census. Each of these communities had locally recognized boundaries, a population of more than 300 people, and was enumerated in the decennial and economic censuses.

The aboriginal people of the CNMI include the indigenous Chamorros, original inhabitants of the islands, and the Carolinians, who are Micronesians that resettled on Saipan during the 1840s. Carolinians are a small minority of the population, but they are known for their seafaring and fishing skill. Their fishing activity largely centered on the harvest of lagoon and reef species, but small paddling canoes were sometimes used to fish a short distance outside the reef (Amesbury and Hunter-Anderson 1989). In the two decades since these islands achieved commonwealth status their demographic, economic, and social structure has changed dramatically. When the CNMI opened to foreign capital and labor, it was transformed from a small economy supported largely by subsistence and government to a large regional tourist destination and a garment-manufacturing haven. Although tourism has been CNMI's largest income source, the Asian financial crisis of the late 1990s caused visitor arrivals from Japan and Korea to drop by one-third. At present, garment production is CNMI's fastest growing industry and is credited with preventing an economic depression following the decline of the tourist industry.

The development of tourist and garment industries based on foreign labor has had a dramatic impact on CNMI's population growth, which increased from 16,780 in 1980, to 79,429 in early 1999 (Bank of Hawaii 1997b). The majority of the current population are non-resident workers from the Philippines and other parts of Asia. There are also workers from Republic of Belau and the Federated States of Micronesia. Early 1999 data reveal that on Saipan only 28% of the population, and 22.6% of the labor force, are U.S. citizens. In addition to the garment industry, foreign workers hold most jobs in the construction, hotel, and retail sectors. The government provides approximately 12% of the jobs, and U.S. citizens make up most of this work force. They also make up 55% of the unemployed. The unemployment rate among Saipan's U.S. citizen labor force in early 1999 was 13.4%, compared to 3.2% among foreign workers (Bank of Hawaii 1997b). With the exception of a now defunct purse seine support base on the island of Tinian, CNMI has never had very much infrastructure dedicated to commercial fishing. Commercial domestic fisheries for reef fish and bottomfish make a minor contribution to the overall economy. The social and cultural importance of coral reef resources in the CNMI dwarfs their commercial value.

Community Participation in Coral Reef Fisheries

Under Japanese rule, the Northern Mariana Islands became a major fishing base, primarily for the harvest of skipjack tuna. However, the Chamorros or Carolinians of the Northern Marianas had little or no involvement in these industrial-scale fish harvesting or processing operations. According to Joseph and Murray (1951), Japanese colonial policy prohibited commercial fishing—and most other remunerative enterprises—by Chamorros and Carolinians. Presumably, during this period the Chamorros and Carolinians relied heavily on subsistence use of inshore marine resources (Amesbury and Hunter-Anderson 1989). When the Americans assumed control of the islands at the end of World War II, the fishing industry was left in the hands of Japanese civilian prisoners, until their repatriation in 1946.

The post-World War II years saw a gradual involvement of the Chamorros and Carolinians of the Northern Mariana Islands in commercial fishing. According to Orbach (1980), the Carolinians were the leaders in forming crews for fishing enterprises involving larger craft and offshore fishing. Orbach attributed the predominance of Carolinians in these initial offshore fishing ventures to the importance of fishing in traditional Carolinian culture. The closely-knit family and community structures within Carolinian settlements on Saipan facilitated cooperative fishing effort.

By 1980, several boats over 25 ft in length were actively engaged in commercial fishing for bottomfish and pelagic species (Orbach 1980). One vessel was operated by a Carolinian company; one was owned and operated by the Tinian Fishing Cooperative, whose membership was Chamorro; and two other boats were skippered and crewed mainly by Japanese fishermen. In addition, some of the charter vessels that had been operating in the CNMI since 1978, catering to the Japanese tourists, were also being used to catch fish for sale to hotels and restaurants on Saipan (Orbach 1980).

Many of the early offshore commercial fishing ventures involving large vessels received support from the CNMI government in the form of loans and fishing supplies (Orbach 1980). However, all of the fishing enterprises failed within a few years because of inadequate markets, lack of management expertise, and other factors. After some time, a number of other large vessels entered the bottomfish fishery, but they too eventually dropped out. This considerable turnover pattern of entry and exit has continued over the past two decades. In 1999, there were two major bottomfish fishing operations. One of the owners suspended his entire operation toward the end of the year because of financial problems. The downturn in the Asian economy has had a severe impact on the tourism industry in the CNMI, and the demand for bottomfish by local hotels has declined. However, another company has started its own fishing operation with two multi-purpose vessels. In addition, another individual is considering converting a deep-sea shrimp boat to bottomfish fishing (Trianni pers. comm.).

The CNMI bottomfish fishery consists mainly of small (less than 24 ft) boats engaged in commercial and subsistence fishing within a 20-mile radius around the islands of Saipan, Tinian, and Rota. However, larger vessels that are capable of traveling to the northern islands have periodically entered the fishery. The larger vessels fish primarily for commercial purposes and target both deep-water and shallow-water bottomfish species, the latter primarily on the extensive banks and reefs surrounding Farallon de Medinilla (WPRFMC 1999). The smaller vessels fish both commercially and for subsistence and target shallow-water species.

The number of sometime food fishermen in the NMI may be from10,000 to as many as 30,000, depending on how actively the large population of non-resident Asian workers is engaged in fishing. Few depend on fishing for all of their income. The primary motivation for fishing is to provide food for home consumption and gifts to family and friends. According to Hamnett *et al.* (In press), each fishing trip had multiple purposes and the catch was used in a variety of ways, even though the primary reason for the fishing trip may have been associated with a specific event. Sixty-five percent of those surveyed contributed fish to a family or church fiesta. All of those who contributed fish to an event also took some of their catch home, gave fish to extended relatives, or sold some of their catch. Interviews with those surveyed revealed that fishermen who fished with the primary intent of making a contribution to an event, rarely sold part of their catch and usually took home fish for consumption.

Orbach (1980) notes that the fisheries in CNMI are inextricably involved with the lifestyles and plural-occupational patterns of the participants. Part-time fishing performed in conjunction with other activities has a prominent place in the socio-economic adaptations of local residents. People fish for bottomfish and pelagic species to supplement their family subsistence, which is gained by a combination of small-scale gardening and wage work (Amesbury and al 1989). Orbach suggests that the availability of economic activities like part-time fishing is among the major reasons that CNMI has not experienced more of the problems of other island entities such as out-migration or high rates of crime and juvenile delinquency.

Because they are acculturated to fishing and seafood consumption practices in their home countries, Asians are likely to harvest a wider spectrum of coral reef resources for food and are less discouraged by declining catch rates. These attitudes are different from those of the indigenous islanders.

Fishing in Guam and the CNMI is still important, because it both contributes to the Chamorros' and Carolinians' subsistence needs and helps them to preserve their history and identity. Many aspects of traditional Chamorto and Carolinian culture have been lost. But fishing has helped Chamorros and Carolinians to keep alive what remains of their maritime tradition and maintain their connection to the sea and its resources.

The social obligation to share one's fish catch extends to part-time and full-time commercial fishermen. In Guam and the CNMI locally caught fish are often sold informally (Amesbury and al 1989; Amesbury and Hunter-Anderson 1989). The buyers are mainly friends, neighbors, and relatives, especially in the CNMI. This non-anonymous, very personal "market" tends to restrain the price asked and paid.

In 1980, an observer wrote that "although subsistence fishing is clearly not as prevalent as it has been in the past, subsistence and mixed economy fishing are important to all segments of the population as income and nutrition sources, as recreation, and as an integral part of family and community life and reinforcement of cultural traditions" (Orbach 1980).

The CNMI is well-known for its community celebrations known as fiestas, which are held on such occasions as birthdays, baptisms, marriages and village patron saints' days. The fiesta serves several social functions, one of which is to promote and cement social cohesion. A large assortment of food, including locally-caught reef fish, is served in prodigious quantities (McCoy 1997).

There continues to be high demand for coral reef resources as seafood in the CNMI because of the indigenous cultures and the presence of a large population of non-resident workers from Asia. Total seafood consumption in the CNMI has been estimated at about 56 lbs. per person (including tourists). Locally-harvested products accounted for slightly less than half of the total supply. Reef fish landings, by weight, are a more important component of the local catch than bottomfish or pelagic fish. Estimates of the annual catch of reef fish in the CNMI are about 150,000 lbs. for sale and 280,000 lbs. for subsistence. The major commercial outlets for locally-caught reef fish are small retail markets, hotels, and restaurants on Saipan. Chamorro and Carolinian consumers are the most important retail fish buyers (Radke and Davis 1995).

Historical and Present Coral Reef Uses

Before World War II, the Japanese exploited sea cucumbers, trochus (topshell), precious corals and many other coral reef resources in the Japanese Mandated Islands, which included the present Commonwealth of the Northern Mariana Islands. Commercial fisheries for trochus and sea cucumbers were re-opened during the mid-1990s for the first time in recent history. Over an 18-month period in 1995-1996, 268,000 sea cucumbers were collected (Green 1997).

It is difficult to assess the total harvest of present-day coral reef fisheries in the CNMI because of shortcomings in fisheries statistics. Virtually no recent information is available for inshore subsistence and recreational catches of coral reef resources. This harvest is assumed to be substantial, especially in the more accessible areas like Saipan Lagoon. Coral reef fisheries in the CNMI are mostly limited to nearshore areas, especially off the islands of Saipan, Rota, and Tinian. Finfish and invertebrates are the primary targets but small quantities of seaweed are also taken. All of the recent data are for commercial landings: 62 - 80mt/year of reef fish and 1 -1.5 mt/year of spiny lobster. An unknown proportion of the bottomfish landings in the CNMI are shallow-water snappers, emperors, and groupers, which may be considered part of the coral reef fishery (Green 1997).

Little is known of the coral reef fisheries in the northern islands of CNMI, but the catch by domestic fishermen is believed to be minor. The exception was in 1995, when the nearshore reefs around six of the northern islands (especially Anatahan and Sarigan) were fished commercially for several months. During that time, these areas yielded a harvest of 15 mt of reef fish and 380 pieces of spiny lobster. Poaching by foreign fishing boats may occur in some places (Green 1997).

Coral reefs near some heavily populated areas in the southern islands of the CNMI have been degraded by heavy fishing, sedimentation, and tourist recreation (Green 1997). Limited information suggests that most of the nearshore reefs elsewhere in the CNMI are in good condition. Reefs off the southern islands experienced a massive starfish outbreak in late 1960s, but corals recovered rapidly from this disturbance. Reefs around the northern islands are in good condition because of their isolation from human activities. Local damage, on Pagan and Farallon De Medinilla for example, may have been caused by storm waves, volcanic eruptions, or military activities (Birkeland 1997c; Green 1997).

Virtually nothing is known about the condition of offshore reefs, but they are assumed to be in good condition because of their isolation. Offshore reefs generally receive little fishing pressure because of the limited range of the small boat fishery. The exceptions are banks that are relatively close to the main islands, like Esmeralda, and the extensive bank off Farallon de Medinilla, where a fishery for shallow water bottomfish is conducted by small boats.

Guam

Socio-economic Overview

Guam and the Mariana Islands were first settled about 3,000 years ago, but their present social and demographic structure is largely the result of colonial experiences of the last 300 years. Guam's total population is estimated to have reached 154,000 in 1999, nearly doubling the 1970 total of 85,000. Of the total reported labor force of 72,700 (June 1999), 61,460 were employed and 11,060 were unemployed, for an official jobless rate of 15.2%. In September 1997, at the beginning of the current economic and employment downturn on Guam, the unemployment rate was only 9.2% (Bank of Hawaii 1997c).

Guam's economy has become so dependent on tourists from East Asia, particularly Japan, that any significant economic, financial and foreign exchange development in the region has had an immediate impact on the territory. During the mid- to late-1990's, as Japan experienced a period of economic stagnation and cautious consumer spending, visitor arrivals from Japan dropped, and the impact was felt as much on Guam as in Japan. The U.S. military presence on Guam has diminished to the lowest level in decades. Nevertheless, the military remains a vital stabilizing economic factor for Guam, particularly in times of regional economic crises. The Government of Guam currently supplies more than 20% of all civilian jobs in the territory. Recent deficits have resulted from a steady rise in government spending without a concomitant increase in tax revenues due to a stagnant tax base (Bank of Hawaii 1997c).

Guam's most significant commercial fishing attribute is its status as a regional tuna transshipment center and re-supply base for foreign tuna fleets (Hamnett and Pintz 1996). Guam is the fourth leading U.S. port in terms the dollar value of fish landings, which are mostly for transshipment to tuna markets in Japan. Commercial domestic fisheries for reef fish and bottomfish make a relatively minor contribution to the Guam economy. The social and cultural importance of coral reef resources in Guam dwarfs their commercial value. (Table 3.8 provides basic demographic data for Guam.)

Community Participation in Coral Reef Fisheries

Prior to the arrival of Europeans in Guam and the other Mariana Islands in the sixteenth century, the Chamorros, as the original inhabitants of these islands were called, possessed large sailing canoes that enabled them to fish on offshore banks and seamounts (Amesbury and Hunter-Anderson 1989). However, during the 1700's these large oceangoing canoes were systematically destroyed by the Spanish colonizers in order to concentrate the indigenous population in a few settlements, thereby facilitating colonial rule as well as religious conversion (Amesbury and Hunter-Anderson 1989). After the enforced demise of the sailing canoes, fishing for offshore species was no longer possible. By the mid-nineteenth century, there were only 24 outrigger canoes on Guam, all of which were used only for fishing inside the reef (Myers 1993). Another far-reaching effect of European colonization of Guam and other areas of the Mariana archipelago was a disastrous decline in the number of Chamorros, from an estimated 40,000 persons in the late seventeenth century to approximately 1,500 persons a hundred years later (Amesbury and Hunter-Anderson 1989).

After the U.S. acquired Guam in 1898, following the Spanish-American War, the U.S. colonial government held training programs to encourage local residents to participate in offshore commercial fishing (Amesbury and Hunter-Anderson 1989). However, because they lacked the capital necessary to purchase and maintain large enough boats, most couldn't participate. They were also largely unwilling to stay at sea for more than a day or so. Shortly after the end of World War II, the U.S. military assisted several villages in developing an inshore commercial fishery using nets and traps. Post-World War II wage work enabled some fishermen to acquire small boats with outboard engines and other equipment for offshore fishing (Amesbury and Hunter-Anderson 1989). However, even as late as the 1970's, relatively few people in Guam fished offshore, even on the protected leeward side of the island, because boats and deep-sea fishing equipment were too expensive for most people (Jennison-Nolan 1979).

In the decades following the end of World War II, the ethnic composition of Guam's population changed markedly. By 1980, less than half of the inhabitants were Chamorros (Amesbury and al 1989). In the late 1970's, a group of Vietnamese refugees living on Guam fished commercially on a large scale, verifying the market potential for locally-caught reef fish, bottomfish, tuna, and mackerel (AECOS 1983). The Guam Fishermen's Cooperative Association began operations during that time. Until the co-op established a small marketing facility at the Public Market in Agana, fishermen were forced to make their own individual marketing arrangements after returning from fishing trips (AECOS 1983). In 1980, the co-op acquired a chill box and ice machine, and emphasized wholesaling. Today, the co-op's membership includes over 160 full-time and part-time fishermen, and it processes and markets (retail and wholesale) an estimated 80% of the local commercial catch (Duenas pers. comm.).

As Guam's tourism industry grew in the1980's, a fleet of marina-berthed charter vessels developed, which were used by tourists and residents for bottomfish fishing (Myers 1993). The charter boats made multiple two-hour to four-hour trips daily. Two types of charter bottomfish fishing trips were organized. The more typical charter boats involved three to six patrons, while the larger "party-boat" vessels carried as many as 30 patrons on a single trip. Most of these bottomfish charters operate out of the Agat Marina and primarily target the shallow-water bottomfish complex. Since most of the charter fishing trips are short, it is unlikely that many of these trips enter federal waters (WPRFMC 1999).

Participants in inshore reef fisheries are predominantly of indigenous Chamorro ancestry. Their harvest accounts for 79% of the non-commercial component of the inshore catch. One study concludes that "probably no one was supported full-time by this fishery, but probably a great many people added a useful income for themselves and their families through it" (Knudson 1987). In characterizing Guam's fisheries, Knudson (1987) concludes that "the commercial fishery on Guam is the product of many relatively small sales by a large number of 'semi-commercial' fishermen and that the non-commercial fishery is the product of a considerable pool of subsistence fishermen plus another sizeable pool of recreational fishermen," and that, "on the whole, catches in the Guam fishery are small, but that the number of participants is quite large." The number of sometime food-fishermen who harvest coral reef resources in Guam may be on the order of 20,000, with less than 1% engaged in commercial harvesting.

For the past two decades bottomfish fishing around Guam has been a highly seasonal small-scale commercial, subsistence, and recreational fishery. The majority of the participants in the bottomfish fishery operate vessels less than 25-ft long and primarily target the shallow-water bottomfish complex (WPRFMC 1999). The shallow-water component is the larger of the two in terms of participation because of the lower expenditure and relative ease of fishing close to shore (Myers 1993). Participants in the shallow-water component seldom sell their catch because they fish mainly for recreational or subsistence purposes (WPRFMC 1999). The commercially-oriented highliner vessels tend to be longer than 25 ft, and their effort is usually concentrated on the deep-water bottomfish complex.

Fishing for coral reef resources has occurred throughout the island's history. Archaeological evidence reviewed by Amesbury *et al.* (1989) suggested "... an apparent tendency throughout prehistory and historic times for Mariana Island native groups to have relied more on inshore fish species than offshore ones ...."

In the late 1880s, the Spanish governor of the Mariana Islands wrote of Guam that "inside the reef (indigenous people) catch different varieties (of fish) all year long." Whether the preference for reef fishing had anything to do with restrictions on the use of ocean-going canoes is not clear. The Governor also noted the importance of the seasonal arrival of rabbitfish (*manahak*) in inshore areas ("the populace then appears en masse to fish"), which is still an important event in Guam's reef fishery in modern times. Hensley and Sherwood (1993) note that the traditional practice of sharing the catch of *atulai* (*Selar crumenophthalmus*) from a surround net continues today, with equal portions given to the owner of the net, the village where the fish were caught, and the group that participated in the harvest.

Amesbury *et al.* (1989) concluded that "in the decades prior to the Second World War, inshore but not offshore fishing was part of the subsistence base of the native people." One document they reviewed was a list of the "principal fishes of Guam" written by a scientifically trained naval officer. Nearly all the fishes listed were reef-associated. The first year that a pelagic fish species was included in the catch reports of the post-war Guam civilian government was 1956. Until then, all catch reports were of reef-associated species (Amesbury *et al.* 1989).

Based on creel surveys of fishermen, only about one-quarter to one-third of the inshore catch is sold. The remainder enters non-commercial channels (Knudson 1987). Reef fish continues to be important for social obligations, such as fiestas and food exchange with friends and families. One study found a preference for inshore fish species in non-commercial exchanges of food (Amesbury *et al.* 1989). The local harvest of reef fish is insufficient to meet commercial demand, and there are substantial imports from the Federated States of Micronesia and the Philippines. Annual seafood consumption in Guam is on the same order as that in the CNMI—56 lbs. per capita.

Over the centuries of acculturation, beginning with the Spanish conquest in the late seventeenth century, many elements of traditional Chamorro and Carolinian culture in Guam and the Northern Mariana Islands were lost. But certain traditional values and attitudes were retained and have been melded with elements of Western culture that are now a part of local life and custom. High value is placed on sharing one's fish catch with relatives and friends. Sometimes fish are sold in order to earn money to buy gifts for friends and relatives on important Catholic religious occasions such as novenas, births and christenings, and other holidays (Amesbury *et al.* 1989).

In addition, the people of Guam and the CNMI participate in many banquets throughout the year associated with neighborhood parties, wedding and baptismal parties, and especially the village fiestas that follow the religious celebrations of village patron saints. All of these occasions require large quantities of fish and other traditional foods (Orbach 1980).

Historical and Present Coral Reef Uses

Since World War II, Guam's coral reef fisheries have shifted from an exclusively subsistence focus to an artisanal fishery that blends subsistence, recreational, and commercial purposes (Hensley and Sherwood 1993). The more accessible reefs are considered overfished because of declining catch rates, declining size of target fish species, and greater prevalence of less desirable species (Birkeland 1997c; Green 1997; Katnik 1982).

Prior to World War II, trochus was taken in large quantities for food and jewelry work. By the 1970's, the trochus population had recovered sufficiently to allow a limited fishery that is currently regulated by size restrictions. Stony and precious corals have been harvested in the past for ornamental use and jewelry work. Residents and visitors, including foreign fishing crews, collect stony corals and mollusks as curios. Coral harvesting is illegal on Guam without a permit and several violators have been convicted (Green 1997).

Since the late 1970's, the percentage of live coral cover on Guam's reefs and the recruitment of small corals have decreased. This trend has been attributed to poor recruitment by coral larvae, increased sedimentation of reef habitat, and domination of reef habitat by fleshy algae. Corals have also been affected by natural disturbances (Birkeland 1997c). Pervasive events include starfish predation between 1968 and 1970 and exposure of corals due to extreme tides during El Niño events. Heavy wave action, associated with typhoons, has had more localized effects.

Shore-based fishing accounts for most of the fish and invertebrate harvest from coral reefs around Guam. In recent years, the estimated inshore harvest has ranged from 38 to 108 mt. This estimate excludes highly variable catches of juvenile rabbitfish and bigeye scad by traditional fisheries that are still practiced seasonally (Myers 1993). While spearfishing is the principal method of harvesting, it is highly seasonal because of weather conditions. In the fiscal years from 1985 to 1991, spearfishers mostly landed parrotfishes (36%), surgeonfishes (17%), and wrasses (7%) (Myers 1993).

The coral reef fishery harvests more than 100 species of fish, including the families *Acanthuridae, Carangidae, Gerreidae, Holocentridae, Kyphosidae, Labridae, Lethrinidae, Lutjanidae, Mugilidae, Mullidae, Scaridae*, and *Siganidae* (Hensley and Sherwood 1993). Myers (1997) noted that seven families (*Acanthuridae, Mullidae, Siganidae, Carangidae, Mugilidae, Lethrinidae, and Scaridae*) were consistently among the top ten species in any given year from FY91 to FY95 and accounted for 45% of the annual fish harvest. Approximately 40 taxa of invertebrates are harvested by the nearshore fishery, including 12 crustacean taxa, 24 mollusc taxa, and 4 echinoderm taxa (Hensley and Sherwood 1993; Myers 1997). Species that became rare on shallow reefs due to heavy fishing include bumphead parrotfish (*Bolbometapon muricatum*), humphead wrasse (*Cheilinus undulatus*), stingrays, parrotfish, jacks, emperors, and groupers (Green 1997).

Many of the nearshore reefs around Guam appear to have been badly degraded by a combination of natural and human impacts, especially sedimentation, tourist overuse and overharvesting. In the last few years, there has been an increase in commercial spearfishing using scuba at night. Catch rates have increased because of improved technology (high capacity tanks, high tech lights, and bang sticks) that allows spearing in deeper water (30-42 m). As a result, many larger species that have already been heavily fished in shallow water—such as bumphead parrotfish, humphead wrasse, stingrays, and larger scarid species—are now reappearing in the fishery catch statistics (Green 1997).

Virtually no information exists on the condition of the reefs on offshore banks. On the basis of anecdotal information, most of the offshore banks are in good condition because of their isolation. Observations by divers suggest that anchor damage is having a major impact on branching coral formations on some of the offshore banks. Anchors dragged by small boats dig small furrows, but anchors from large fishing vessels leave large craters.

According to Myers (1997), less than 20% of the total coral reef resources harvested in Guam are taken from the EEZ, primarily because they are associated with less accessible offshore banks. Finfish make up most of the catch in the EEZ. Most offshore banks are deep, remote, shark infested, and subject to strong currents. Generally, these banks are only accessible during calm weather in the summer months (May to August/September). Galvez Bank is the closest and most accessible and, consequently, fished most often. In contrast, the other banks (White Tuna, Santa Rose, and Rota) are remote and can only be fished during exceptionally good weather conditions (Green 1997). Local fishermen report that up to ten commercial boats, with two to three people per boat, and some recreational boats, use the banks when the weather is good (Green 1997).

At present, the banks are fished using two methods: bottomfishing by hook-and-line and jigging at night for bigeye scad (*Selar crumenophthalmus*) (Myers 1997). In recent years, the estimated annual catch in these fisheries has ranged from 14 to 22 mt of shallow bottomfish and 3 to 11 mt of bigeye scad (Green 1997). The shallow-water component accounted for almost 68% (35,002 to 65,162 lbs.) of the aggregate bottomfish landings in FY92–94 (Myers 1997). Catch composition of the shallow-bottomfish complex (or coral reef species) is dominated by lethrinids, with a single species (*Lethrinus rubrioperculatus*) alone accounting for 36% of the total catch. Other important components of the bottomfish catch include lutjanids, carangids, serranids, and sharks. Holocentrids, mullids, labrids, scombrids, and balistids are minor components. It should be noted that at least two of these species (*Aprion virescens* and *Caranx lugubris*) also range into deeper water and some of the catch of these species occurs in the deepwater fishery.

The majority of bigeye scad fishing occurs in territorial waters, but also occasionally takes place in federal waters. Estimated annual offshore landings for this species since 1985 have ranged from 6,393 to 44,500 lbs., with no apparent trend (Myers 1997). It is unclear how much of this offshore bigeye scad fishery has occurred in the EEZ

Hawaii

Socio-economic Overview

Ocean resources are very important to Hawaii's economy. For example, tourism, the largest industry in Hawaii, is heavily dependent on oceanic resources. As important, both the indigenous and non-indigenous population depend upon the ocean and oceanic resources for recreation and social interactions. As a result, the State of Hawaii is broadly engaged in management of the ocean and ocean resources. However, Hawaii's economic situation changed dramatically in the 1990s. Several major economic sectors—such as plantation agriculture, tourism, and the military—suffered downturns. As a consequence, Hawaii never entered the period of economic prosperity that many U.S. mainland states experienced. Since 1998, Hawaii's tourism industry has recovered substantially, mainly because the strength of the national economy promoted growth in visitor arrivals from the continental US. Efforts to diversify the economy, and thereby render it less vulnerable to future economic downturns, have met with little success to date (Bank of Hawaii 1998). Commercial fishing has historically represented a small share of Hawaii's total economic activity. In contrast to the sharp decline in some industries of long-standing importance in Hawaii, however, the fishing industry has been fairly stable during the past decade. More importantly, fishery resources, especially coral reef resources, represent an important source of subsistence, providing food, income, opportunity for social interaction, and cultural exchange for Hawaii's residents during periods of economic recession. As a result of the rise in tourism-related ocean recreation in Hawaii, a premium has been placed on non-consumptive uses of nearshore marine resources (Pooley 1993b).

In 1998, Hawaii's ethnic makeup was 22% Caucasian, 21% Hawaiian or part Hawaiian, 18% Japanese, 13% Filipino, 7.3% Hispanic (1990), 3% Chinese, and 1% African-American; other ethnicities made up the balance (DBEDT 1999). (However, Office of Hawaiian Affairs data reveals that a significant part of the population lists their ethnicity as "other/unknown.") Hawaii's population has been growing at the rate of 7% during the past decade, and was estimated to be 1,193,001 in 1998. Table 3.9 provides additional demographic information.

By most statistical measures, people of Native Hawaiian ancestry have the lowest incomes and poorest health of any ethnic group in the State (OHA 1998). Federal, state, and private programs have been established to benefit Hawaiians. There is also an active cultural renaissance among Native Hawaiians, with efforts to restore the language, arts, and subsistence activities, including traditional fishing practices. As part of this renaissance, Native Hawaiians continue to assert their rights of access to oceanic resources. In Hawaii, all shoreline to the highwater mark and undeveloped areas *mauka* (inland, toward the mountains) are public areas that can be accessed for cultural and traditional practices, a holdover from the days of the kingdom. These Native Hawaiian gathering rights, including shoreline access, have been reaffirmed in court decisions.

The islands of the State of Hawaii were discovered and settled by Polynesians between the third and seventh centuries A.D. Captain James Cook, the first European to reach Hawaii, arrived in 1778. Europeans and Asians began to settle on the islands in the nineteenth century with the development of pineapple and sugar plantations. In 1898 the islands were ceded to the United States and Hawaii became the fiftieth state in 1959.

Table 3.9: 1998 DBEDT estimates of population, employment and unemployment in Hawaii.

	Population	Population (%)	Civilian Labor Force	Unemployment (%)
State of Hawaii	1,193,001	100	597,800	6.2
City & County of Honolulu	872,478	73.13	427,650	5.4
Hawaii County	143,135	12.00	68,650	9.7
Maui County	120,785	10.12	71,650	6.6
Maui Island	105,336	8.83	66,850	n/a
Kauai County	56,603	4.74	28,700	9.8
Kauai Island	50,947	4.27	n/a	n/a
Molokai Island	6,838	0.57	3,050	n/a
Lanai Island	2,989	0.25	1,750	n/a
Niihau Island	230	0.02	n/a	n/a

Hawaii is a string of 137 islands extending in an arc across the Pacific Ocean from the northwest to the southeast. The eight largest islands—measured by size, population, and economic activity—are at the southeastern end of the arc, some 2,400 miles from the United States. They are divided into four municipal counties: Hawaii County, Maui County, City and County of Honolulu and Kauai County. The land area of the island chain is estimated to be 6,423 square miles.

Community Participation in Coral Reef Fisheries

Archaeological evidence reveals that seafood, particularly coral reef species, was part of the customary diet of the earliest human inhabitants of the Hawaiian Islands (Goto 1986). Fishing and related activities in traditional Hawaii were also often highly ritualized and important in religious beliefs and practices. The *Kumulipo*, or Hawaiian creation legend, says that fish were created after corals and mollusks, but before insects and birds (Beckwith 1951). Certain species of fish were venerated as personal, family or professional gods, called *aumakua*. Like the Native Hawaiians, nineteenth century Asian immigrants imbued fish with symbolic meaning, extending their cultural significance beyond their value as a dietary staple. Although no longer the only source of protein, seafood consumption in Hawaii is still at least twice as high as the U.S. national average (URS Corp., in prep).

The social and symbolic value of fish, reflected early Native Hawaiian traditions, is related to the sharing of fish in the extended family and community. This social responsibility remains an important in the lives of many Native Hawaiians. It is regularly reenacted during weddings, communions, school graduations, funerals, or a child's first birthday (baby luau), where fish is considered an important customary food item (Glazier 1999). The importance of sharing fish is also found in other ethnic groups in Hawaii. For example, Japanese tradition dictates reciprocal exchanges of gifts according to an intricate pattern of established norms and procedures (Ogawa 1973). Those who neglect the obligation to reciprocate risk losing the trust of others, and eventually their support.

Commercial fishing has been part of Hawaii's economy for nearly two centuries and the socio-cultural context of fishing in Hawaii has been shaped by the multi-ethnicity of local fisheries. Although certain ethnic groups have predominated in Hawaii's fisheries in the past, and ethnic enclaves continue to exist in certain fisheries, the fishing tradition in Hawaii is generally characterized by a partial amalgamation of cultures. The remnants of the varied technology, customs, and values of Native Hawaiians and immigrant groups from Japan, China, Europe, America, the Philippines, and elsewhere appear in the methods used by contemporary Hawaii residents to harvest, distribute, and consume seafood.

A history of commercial fishing in Hawaii begins with the arrival of British and American whaling fleets during the early nineteenth century. Along with the introduction of a cash economy and the growth of the foreign—or non-Native Hawaiian—community, whalers fostered its development. Initially, commercial fishing in Hawaii was monopolized by Native Hawaiians, who supplied the local market with fish, using canoes, nets, traps, spears, and other traditional fishing devices (Cobb 1902; Jordan and Evermann 1902; Konishi 1930). However, the role that Native Hawaiians played in Hawaii's fishing industry gradually diminished through the latter half of the nineteenth century. During this period, successive waves of immigrants of various races and nationalities arrived in Hawaii, increasing the non-indigenous population from 5,366 in 1872 to 114,345 in 1900 (OHA 1998). The new arrivals included Americans, Chinese, Portuguese, and Filipinos.

The arrival of a large number of Japanese, in particular, had a long-term impact on the fishing industry. Like the majority of the early immigrants, they were contracted to work on Hawaii's sugar cane plantations. But many of these Japanese immigrants were also skilled commercial fishermen from the coastal areas of Wakayama, Shizuoka and Yamaguchi Prefectures in Japan. When their contract terms expired on the plantations, they turned to the sea for a living (Okahata 1971). Later, experienced Japanese fishermen came to Hawaii specifically to fish commercially. During much of the twentieth century Japanese immigrants to Hawaii and their descendants were preeminent in Hawaii's commercial fishing industry. Although these fishermen of Japanese ancestry became more Americanized, many Japanese fishing traditions persisted. As late as the 1970s, the full-time professional fishermen in Hawaii were predominately of Japanese descent (Garrod and Chong 1978). However, by then hundreds of local residents of various ethnicities were also participating in Hawaii's offshore fisheries as part-time commercial and recreational fishermen.

During the early years of the commercial bottomfish fishery, vessels restricted their effort to areas around the MHI. The fishing range of the sampan fleet increased substantially after the introduction of motor powered vessels in 1905. Fishing activity around the NWHI began at least as early as 1913, when one commentator recorded: "Fishing for *ulua* and *kahala* is most popular, using bonito for bait, fishermen seek this (sic) species in a 500 mile range toward Tori-Jima (NWHI)" (Yamamoto 1970, p. 107). Within a few years, more than a dozen sampans were fishing for bottomfish around the NWHI (Konishi 1930). Fishing trips to the NWHI typically lasted 15 days or more, and the vessels carried seven to eight tons of ice to preserve their catch (Nakashima 1934). The number of sampans traveling to the more distant islands gradually declined due to the limited shelter the islands offered during rough weather, and the difficulty of maintaining the quality of the catch during extended trips (Konishi 1930). However, during the 1930's, at least five bottomfish fishing vessels, ranging in size from 65 to 70 ft, continued to operate in the waters around the NWHI (Hau 1984). These sampans harvested lobster, reef fish, turtles, and other marine animals in addition to bottomfish (Iverson et. al. 1989). During World War II the bottomfish fishery in Hawaii virtually ceased operations, but it recommenced shortly after the war ended (Haight *et al.* 1993). The late 1940s saw as many as nine vessels fishing around the NWHI, but by the mid-1950s, vessel losses and depressed fish prices, resulting from large catches, had reduced the number of fishery participants. But in 1948, the Pacific Ocean Fishery Investigation began researching potential commercial fisheries in the NWHI. In 1950, Leo Ohai, owner and captain of the Sea Queen, transported a small aircraft to French Frigate Shoals to support *akule* fishing and Buzzy Agard, using a DC3 cargo aircraft, flew catches of *akule* from French Frigate Shoals to Honolulu. He also captained the Koyo Maru to catch *akule* at Nihoa. During the 1960s, only one or two vessels were operating around the NWHI.

Commercial fisheries saw a rise and subsequent fall in both participation and landings during the first half of the twentieth century. There were 2,000 to 2,500 commercial fishermen in 1900 (Cobb 1902). In 1947, the number was about 3,500 (Hida and Skillman 1983), but by 1985 the number fell to about 2,600 (Shomura 1987). Thus, while Hawaii's motorized fleet grew remarkably during the twentieth century, participation in the commercial fisheries did not. Landings saw a similar rise and fall during this period. Hawaii's commercial catch statistics show an increase from about 6 million lbs. in 1900, to about 19 million lbs. in 1953, and a subsequent decrease to 11 million lbs. in 1986. Not surprisingly, most of the increase was in the pelagic fishery. The reported commercial catch of the "coastal" fishery—reef, bays, and nearshore habitats—in fact declined from about 3.6 million to 0.6 million lbs. from 1900 to 1986 (Shomura 1987).

There was renewed interest in harvesting the bottomfish resources of the NWHI in the late-1970s, following a collaborative study of the marine resources of the region by state and federal agencies (Haight *et al.* 1993). Several modern boats entered the NWHI fishery. As a result, the supply of high-valued bottomfish—such as *opakpaka* and *onaga*—increased. This regular and consistent supply of relatively fresh fish allowed the tourism-linked restaurant market to expand (Pooley 1993b). Markets for Hawaii bottomfish further expanded after wholesale seafood dealers began sending fish to the U.S. mainland. By 1987, 28 vessels were active in the NWHI bottomfish fishery, although only 12 were fishing for bottomfish full-time. Some of the part-time bottomfishing vessels also engaged in the pelagic or lobster fisheries (Iverson *et al.* 1989). In 1989, the WPRFMC developed regulations that divided the fishing grounds of the NWHI bottomfish fishery into the Ho'omalu Zone and Mau Zone. The Council established limited entry programs for the Ho'omalu Zone and Mau Zone in 1989 and 1999, respectively, to avoid economic overfishing (Pooley 1993a). Since 1995, the number of vessels allowed to fish in the Ho'omalu Zone has been capped at seven. Currently, only ten vessels are allowed to bottomfish in the Mau zone (URS Corp. in press). The NWHI lobster fishery, centered around Necker Island, underwent a similar evolution. It developed in the late 1970s, reached a peak of 16 vessels in 1985 and 1986, and subsequently declined, with nine vessels active in 1997 (of 15 allowed under the limited access system) (Pooley and Kawamoto 1998).

The 1970's also saw major changes in the composition and operations of the bottomfish fishery around the main Hawaiian Islands. The fishery changed from one dominated, in terms of catch and effort, by a relatively small number of full-time professional fishermen to one dominated by hundreds of part-time commercial and recreational fishermen. This change was due to a number of factors. The popularity of offshore fishing increased in Hawaii with the increase in the availability of locally-built and imported small fiberglass boats. In addition, the rise in fuel prices during the 1970s made fishing for bottomfish particularly attractive to fishermen because it consumed less fuel than trolling and generated higher-value fish catches to offset fuel costs. Finally, as navigation systems, bottom-sounders, and hydraulic or electric powered reels became more affordable, the skill level aud experience necessary to successfully fish for bottomfish were reduced and the labor associated with hauling up the long lines was considerably lightened.

The development of a much larger market for bottomfish in the early 1980s resulted in premium prices. This motivated fishermen on the main Hawaiian Islands fishing grounds to increase their landings (Pooley 1993b). However, the number of vessels participating in the MHI fishery declined after reaching a peak of 583 in 1985. This decrease in fishing effort suggests that some bottomfish fishermen perceived a growing shortage of bottomfish in the MHI fishery and switched to other fisheries. In 1998, concerns about decreasing catch rates led the State of Hawaii to close certain areas around the MHI to bottomfish fishing, including parts of Penguin Bank in the EEZ. In addition, new state rules established a recreational bag limit of five *onaga* or *ehu*, or a mix of both, per person.

In addition to these food fisheries, Hawaii is the only area of the U.S. Pacific Islands where a significant ornamental reef fish fishery has developed. The State of Hawaii regulates ornamental collecting by permit. Most of the commercial collecting occurs around the island of Hawaii (Miyasaka 1997). At least 60 businesses, employing at least 255 people, are involved in collecting, wholesaling, retailing, importing, and exporting ornamental reef products in Hawaii (Miyasaka 1991).

Hawaii also has a large and apparently still growing recreational fishery, which overlaps considerably with the commercial and subsistence components. A 1996 national snrvey of recreational fishing (in which "recreation" included charter fishing) estimated that 244,000 recreational marine anglers, about half of them residents of Hawaii, made 2.3 million angler-trips (2.9 million angler-days) in Hawaii (U.S. Fish and Wildlife Service and Bureau of the Census 1998).

The cultural significance of this history of commercial development is underlined by its significance in the collective memory of some of Hawaii's major ethnic groups—the Japanese and Native Hawaiians in particular. In 1999, for example, the Japanese Cultural Center of Honolulu organized an exhibition commemorating the past involvement of Japanese in Hawaii's commercial fishing industry. Some Hawaii fishermen feel a sense of continuity with previous generations of fishermen and want to perpetuate the fishing lifestyle. A 1993 survey of participants in the NWHI bottomfish fishery found that half of the respondents who fish in the Ho'omalu Zone were motivated to fish by a long-term family tradition (Hamilton 1994). This sense of continuity is also reflected in the importance placed on the process of learning about fishing from "old timers," and transmitting that knowledge to the next generation.

The importance of seafood, and the discriminating tastes of Hawaii's consumers, have made quality—and quantity and variety too—hallmarks of Hawaii's seafood markets. As a result, fish markets have became important institutions in Hawaii society. Long-established fishing-related infrastructure in Honolulu, such as the fish market and the Kewalo Basin mooring area, have helped define the character of the city. Consequently, even though much fish retailing now occurs through self-service supermarkets, Honolulu's fish market has endured and continues to be a center of social interaction for some island residents. The retail market is mainly composed of single proprietorship-family type operations. Close social connections have developed between retailers and consumers. This stems from the need for successful fish dealers to maintain good relations with their customers and thus keep a stable clientele (Garrod and Chong 1978). The large variety of seafood typically offered in Hawaii's seafood markets reflects Hawaii's ethnic diversity and each ethnic group's preferences, traditions, holidays, and celebrations (URS Corp. in prep).

Given the historical significance of commercial fishing in Hawaii, it is likely that some residents consider the fishing industry an important part of the cultural identity and heritage of the islands. Even people who have never fished, and do not intend to, may nonetheless wish that others continue to fish because of its contribution to Hawaii's social, cultural, and economic diversity. This existence value may be expressed in various ways. For example, some people may engage in vicarious fishing through the consumption of books, magazines, and television programs describing the fishing activities that others are pursuing in the waters around Hawaii.

Just as Hawaii's fishing tradition is an integral part of the islands' heritage and character, Hawaii's image has become linked with some types of locally caught consumed seafood. Among the fish species that have become closely identified with Hawaii are *opakapaka* and *onoga*. As noted by a national seafood marketing publication, this symbolic association has an important economic aspect:

> "When it comes to selling seafood the Hawaiians have a distinct advantage. Their product comes with built-in aloha mystique, and while they've emphasized the high quality of the fish taken from their waters, they've also taken full advantage of the aura of exotic Hawaii itself in promotion on the mainland and, now, in Europe" (Marris 1992, p. 75).

The availability of seafood is also important to Hawaii's tourist industry, the mainstay of the state economy. Japanese tourists visiting Hawaii often want to enjoy the traditional foods and symbols of Japan while they vacation in Hawaii, including various types of high quality fresh fish (Peterson 1973). Hawaii tourists from the U.S. mainland, and other areas where fish is not an integral part of the customary diet, typically want to eat seafood because it is part of the unique experience of a Hawaii vacation. Consuming fish that is actually caught in the waters around Hawaii further enhances that experience (WPRFMC 2000).

Today, the people who participate in Hawaii's reef-related fisheries constitute an ethnically mixed and spatially dispersed community numbering thousands of individuals. A large percentage of the population harvests coral reef resources for subsistence and customary exchange of food with friends and family. Although it is hard to tell how many people this segment of the population represents, it has been estimated that some-time food fishermen range between 100,000 to 400,000 individuals.

There are a few rural villages in the state where most residents are at least partly dependent on fishing for their livelihood (Glazier 1999). But generally there are not particular towns or cities where the balance of the residents depend on or engage in fishing to make a living. Instead, fishing communities—in the sense of social groups whose members share similar lifestyles associated with fishing—are sub-populations within metropolitan areas or towns.

Today, Hawaii fishermen fish for a variety of reasons. In fact, the same person can cite a range of motivations (Glazier 1999). In the small boat fishery around the MHI the distinction between "recreational" and "commercial" fishermen is extremely tenuous (Pooley 1993b). Hawaii's seafood market is not as centralized and industrialized as U.S. mainland fisheries. Thus, it is has always been feasible for small-scale fishermen to sell any or all of their catch for a respectable price. Money earned from part-time commercial fishing is an important supplement to the basic incomes of many Hawaii families. Even full-time commercial fishermen cite other reasons, besides money, for why they fish. For example, a 1993 survey of owner-operators and hired captains who participate in the NWHI bottomfish fishery found that enjoyment of the lifestyle or work itself are important motivations for participants (Hamilton 1994).

Historical and Present Coral Reef Uses

In recent decades, there has been a notable decline in nearshore fishery resources in the main Hawaiian Islands (Shomura 1987). Overfishing is considered to be one of the major causes of this decline (Grigg 1997; Harman and Katekaru 1988), but coastal construction, sedimentation, and other effects of urbanization have caused extensive damage to coral reefs and benthic habitat in localized areas near the populated islands.

Fishing gear types that mainly target inshore and coastal pelagic species accounted for about 10% (or 1.5 million lbs.) of the mean annual commercial fish catch in the State of Hawaii from 1990 to 1995. Recreational and subsistence catches are not reported in Hawaii, but creel surveys at Kaneohe, Hanalei, and Hilo Bays suggest that the total inshore catch from reef areas is at least equivalent to the reported commercial catch, and may be two or three times greater than that (Friedlander 1996).

The majority of the total commercial catch of inshore fishes, invertebrates, and seaweed comes from nearshore reef areas around the MHI. The exceptions are crustaceans: over 90% of the spiny lobster landings come from the NWHI and over 50% of Kona crab landings from Penguin Bank. Nearshore reefs in the MHI are the focus for commercial reef ornamentals harvesting and black coral collecting (Friedlander 1996).

The collection of black coral from depths of 30 to 100 m by scuba divers has continued in Hawaii since black coral beds were discovered off Lahaina, Maui, in the late 1950's, although harvest levels have fluctuated with changes in demand. Since 1980, virtually all of the black coral harvested around the Hawaiian Islands has been taken from a bed located in the Auau Channel. Most of the harvest has come from State of Hawaii waters and no black coral diver has ever received a federal permit to harvest precious coral in the EEZ. However, a substantial portion of the black coral bed in the Auau Channel is located in the EEZ. Recently, with the growing popularity of household marine aquaria, the demand for small, immature black coral colonies has increased. In 1999, concern about the potential for greater harvesting pressure on the black coral resources led the State of Hawaii to prohibit taking from state waters black coral with a base diameter less than 3/4 inches. The Council has recommended that a minimum size limit also be established for black coral harvested in the EEZ (WPRFMC 1999).

Table 3.10: Mean actual catch (lbs) by gear type from Penguin Bank (2-200 nm), based on data from DAR reported commercial fishery catch statistics from 1991-1995 (modified from Friedlander 1996).

Gear Type	Catch (lbs/yr)
Offshore gear	
Aku pole & line	67,486
Trolling	26,607
Tuna handline	1,295
Subtotal	**95,388**
Inshore gear	
Deep handline	83,517
Net	14,191
Inshore handline	2,465
Other	573
Trap	493
Diving	22
Subtotal	**101,261**
Total	**196,670**

After two decades of minimal activity, the domestic fishery for pink, gold and bamboo precious corals in the EEZ of Hawaii resumed in December 1999. One company uses two one-man submersibles to survey and harvest the resource at depths between 400-500 m. These technologically advanced devices are capable of diving to 700 m, with a maximum bottom time of six hours. To date, they have only surveyed and begun harvesting in areas around two of the seven known beds between the islands of Oahu and Hawaii. The company has plans to search for additional beds in both the MHI and NWHI.

Table 3.11: Mean annual catch (lbs) of the most common reported inshore fish species from Penguin Bank (2-200 nm) based on reported DAR commercial fisheries catch statistics from 1991-1995 (modified from Friedlander 1996) and from 1996-2000 (D. Hamm, pers. comm.).

Species/Taxa	1991-1995	1996-2000
Bigeye scad (*Selar crumenophthalums*)	537	474
Goatfish (*Mulloidichthys vanicolensis*)	264	165
Surgeonfish (*Acanthurus xanthopterus*)	204	65
Scad (*Decapterus* spp.)	152	41
Wrasse (*Bodianus bilunulatus*)	149	62
Barracuda (*Sphyraena helleri*)	111	56
Wrasse (*Xyrichthys pavo*)	111	176
Sharks (misc.)	65	3,605
Other goatfish (*Parupeneus* spp.)	37	6
Big-eye-fish (*Priacanthus* spp.)	28	30
Parrotfish (*Scarid* spp.)	22	-
Trumpetfish (*Aulustoma chinensis*)	14	1
Soldierfish (*Myripristis* spp.)	12	31
Leatherback (*Scomberoides lysan*)	5	6
Surgeonfish (*Acanthurus dussumieri*)	4	1
Surgeonfish (*A. olivaceus*)	4	-
Goatfish (*Parupeneus porphyreus*)	2	1
Unicornfish (*Naso* spp.)	1	1
Threadfin (*Polydactylus sexfilis*)	1	-
Wrasse (*Coris* spp.)	1	3
Flyingfish (*Exocoetus* spp.)	-	1

The deep-slope bottomfish fishery in Hawaii concentrates on species of eteline snappers, carangids, and a single species of grouper concentrated at depths of 30-150 fm. The fishery can be divided into two geographical areas: the inhabited main Hawaiian Islands, with their surrounding reefs and offshore banks, and the NWHI. In the MHI about 80% of the bottomfish habitat lies in state waters. Bottomfish fishing grounds within federal waters include Middle Bank, most of Penguin Bank, and approximately 45 nm of 100-fathom bottomfish habitat in the Maui-Lanai-Molokai complex.

Historically, Penguin Bank has also been one of the most important bottomfish fishing grounds in the MHI, because it is the most extensive shallow shelf area in the MHI, and it is within easy reach of major population centers. Penguin Bank is particularly important for the MHI catch of *uku* (Aprion virescens, or gray snapper), one of the few bottomfish species available in substantial quantities to Hawaii consumers during summer mouths. Table 3.12 compares bottomfish landings at Penguin Bank during two periods as a percentage of total MHI commercial landings, for five major bottomfish species. It shows that the bank has increased in importance over the years.

For the period 1991 to 1995, 8% of the licensed commercial fishermen who participated in the MHI bottomfish fishery reported catches from Penguin Bank (WPRFMC 1996). Penguin Bank has long been known to support a productive bottom "handline" fishery for snappers and groupers. It is also a popular bottomfish fishing ground for recreational anglers. However, the magnitude and value of the recreational landings, while significant, are poorly documented (Friedlander 1996). However, Holland (1985 in Friedlander 1996) noted that the Kewalo Basin charter fishing fleet uses Penguin Bank as one of its major fishing areas. Offshore and inshore fishing gear are used on Penguin Bank in about equal importance. Table 3.10 lists, in decreasing order of catch, offshore gear and inshore gear. Table 3.11 lists the most common reef/inshore fish species reported in commercial landings from Penguin Bank over the past decade, by five-year periods. Catches for most species are generally comparable for both periods with slightly less taken in the last period (1995-2000). Sharks appear to have been under-reported in the earlier period (1991-1995).

Table 3.12: Average percentage of total MHI commercial catch and average commercial catch of major bottomfish species harvested from Penguin Bank. Sources: WPRFMC (1996) and unpublished data from HDAR.

	Average annual percent of total MHI catch		Average annual catch (lbs)
	1980-1984	1991-1995	1997-1999
Opakapaka	9.63	16.11	20,609
Uku	12.06	44.04	28,785
Onaga	14.87	20.24	9,277
Ehu	12.15	17.60	3,380
Hapuupuu	4.31	6.64	905

Limited information is available on coral reef fish community structure at Penguin Bank. An investigation of deepwater artificial reefs on the bank, using manned submersibles, recorded 62 taxa (25 families), of which 32 were considered resident, 25 transient, and five incidental (Friedlander 1996). Estimates of mean biomass ranged from 3-290 mt/km^2 for resident species to 90-2,460 mt/km^2 for transient species. However, these estimates are considered high for the area, since several studies have shown that artificial reefs tend to support u higher biomass than natural reefs under similar circumstances.

An investigation of the deepwater macroalgal community, using a manned submersible, provides information on algae at Penguin Bank (Agegian and Abbott 1985). The bank consists of a broad carbonate platform (~60m deep) covered with loose carbonate rubble and coarse sediments from the calcareous green alga, *Halimeda*. The algal community, comprising 54 species, is characterized by two deepwater species and many species that occur in shallow water. The deeper areas of the bank (182 m) are dominated by crustose coralline algae.

When reef-associated species that are presently managed under other Council FMPs are excluded from the analysis, almost all of the coral reef fisheries in Hawaii take place in inshore (state) waters in the MHI (Friedlander 1996). For example, in Hawaii less than 12% of the inshore fishes are caught in federal waters, based on reported commercial catch from 1991-1995. Similarly, only 18% of molluscs, 1% of seaweeds, and no echinoderms are harvested in federal waters. Of the crustaceans, less than 50% of the reported commercial catch of kona crab—or 14,191 lbs. valued at $57,436—were taken in federal waters on Penguin Bank. Overall, only 1% of total catch, measured either by weight or value, comes from EEZ waters.

The top species by weight and value in the DAR inshore fish category were soldierfishes (*Myripristis* spp.), parrotfish (*Scarid* spp.), surgeonfishes (inclnding *Acanthurus dussumieri, A. trostegus* and *Naso* spp.) and goatfishes (including *Mulloidichthys* spp.). Inshore fishermen target some of these species (especially the goatfishes *Parupeneus porphyreus* and *P. cyclostomus*), since they can fetch a high price in some seasons (Friedlander 1996). *Tilapia* spp. ranked high in terms of catch, but because it sells for a low price, it does not rank very high in terms of value. In the MHI, 89% of the catch of these species came from state waters.

Crabs are also an important gronp for commercial, recreational, and subsistence fishermen in Hawaii, with a mean annual commercial value of $182,182 (Friedlander 1996). The dominant species in the catch is kona erab (*Ranina ranina*) with more than 28,000 lbs. caught annually. By weight, 51% of kona crab are caught on Penguin Bank, which has long been an important location for kona crab net harvests of (Onizuka 1972). In contrast, almost all of the other erabs species were caught less than 2 nm from shore in the MHI.

Surveys of the NWHI demonstrate that coral reefs are in good condition with high standing stocks of many reef fish. Nearshore coral reefs receive little human use because of their remoteness, exposure to harsh seasonal ocean conditions, and their protected status as part of a national wildlife refuge. Most of the shallow reefs of the NWHI lie within the boundaries of the State of Hawaii, where access and resource use controlled by special permit.

There is a long history of fishing in the NWHI. Iverson *et al.* (1989) found ample evidence of fishing by the ancient Hawaiians as far northwest as Necker Island. Starting in the 1920's, a handful of commercial boats ventured into the NWHI to fish for shallow and deepwater bottomfish, spiny lobsters, and other reef and inshore species. Black-lipped pearl oysters at Pearl and Hermes Reef in the NWHI were overfished in the late 1920's and recent surveys indicate that stocks have still not recovered, due to lack of suitable oyster shell habitat (Green 1997). As discussed in the previous section, from the late 1940s to the late 1950s, there was a fishery for *akule* and reef fish around French Frigate Shoals and Nihoa Island.

During the 1960's, and as recently as 1978, Asian fleets harvested tuna, billfish, precious corals, and groundfish in and around the NWHI using longliners, pole-and-line vessels, draggers, and trawlers. Foreign fleets were not excluded from the 200-mile EEZ surrounding the islands until after the Fishery Conservation and Management Act was signed into law in 1976, and the Council began developing management plans for domestic fisheries in 1978. Even so, over the two decades from 1965 to the late 1980's, dozens of foreign vessels intermittently and illegally harvested precious corals in the waters around the NWHI. Because they used tangle-net bottom dredges, much deepwater habitat was destroyed (Grigg 1993).

As discussed in the previous section, both the deep-slope bottomfish and lobster fisheries grew rapidly, beginning in the early 1980s. Both fisheries have declined from peaks late in that decade. They are now managed by the Council under limited access programs that fix the number of permits. The lobster trap fishery is also subject to a harvest quota, set annually at 13% of MSY, and it is one of the most intensively managed U.S. EEZ fisheries. Conservative management measures reduce the risk of overfishing and help prevent protected species interactions. The lobster fishery is managed for low fishing mortality, which is spread across a wide geographic region. However, the population structure of the lobster population in the region as a whole and the magnitude of oceanographic changes on the recruitment dynamics of the population are not fully understood. Spiny and slipper lobsters are harvested at many banks and on reefs deeper than 10 fathoms. The lobster trap fishery catches octopus and hermit crabs incidentally. But the incidental catch of reef fish is minimal because the lobster traps have escape vents. Bank-by-bank allocation of the 1999 harvest guideline caused permit holders in the lobster trap fishery to distribute effort into new trapping sites, inuluding some areas where retrieval of trap lines may damage live coral.

Currently, there are no other major fisheries in the NWHI. Commercial trolling for *ono* occurs seasonally in some areas of the NWHI. For a short time in 1999, experimental fishing for coastal sharks was permitted. Many of the shallow reefs are in the NWHI are within the National Wildlife Refuge and will likely remain off limits to fishing. Chapter 5 of the EIS discusses documented and potential fisheries interactions with protected species in the NWHI. Occasional visitors, including federal government personnel and contract workers at Midway, sometimes fish recreationally in the NWHI. However, Midway is considered part of the PRIAs and recreational development is discussed in that section.

The most serious problems in the NWHI at present are accumulation of marine debris, vessel groundings, and oil spills. Most of the debris is derelict gear lost from North Pacific fisheries. In addition to the physical damage to coral reefs, the debris entangles protected species, ghost fishes, and may introduce alien marine species (Green 1997). Prior military occupation has resulted in significant impacts at Kure Atoll, Midway Islands, and French Frigate Shoals due to dredging, filling, and contamination by the release of toxins from dumped transformers (Green 1997).

Pacific Remote Island Areas

Socio-economic Overview

During the nineteenth century, the United States and Britain actively mined guano deposits on Howland, Jarvis, and Baker Islands. They became possessions of the U.S. in 1936, and have been under the jurisdiction of the Department of the Interior since that time. From 1935 to 1942, the three islands were occupied by Hawaiians, sent to consolidate U.S. claims. They were used as weather stations and military outposts during World Was II, and debris from that period remains. The three atolls are presently National Wildlife Refuges administered by the U.S. Fish and Wildlife Service. They are uninhabited but visited periodically by scientists, researchers and, occasionally, expeditions of ham radio operators. Entry is controlled by special permit.

Palmyra was claimed by the American Guano Company in 1859. It was annexed to the Kingdom of Hawaii in 1862, but became privately owned in 1911. In 1922, the Fullard-Leo family purchased it. It was later annexed to the United States, but specifically excluded from the Territory and State of Hawaii. In the late 1930's, in preparation for World War II, a seaplane base and other defense facilities were constructed on Palmyra. The U.S. Navy or other federal installations continuously occupied the atoll until 1949. It was also used for nuclear testing programs in 1962. The Navy's attempt to regain control of Palmyra after World War II ended with a U.S. Supreme Court decision to return the atoll to the private owners, the Fullard-Leo family, who also claim ownership of Kingman Reef. In January 2001, The Nature Conservancy negotiated exclusive purchasing rights to Palmyra Island with the Fullard-Leo family. They report that two-thirds of the island will eventually be designated a National Wildlife Refuge, run by the USFWS, and one-third will be used for ecotourism. On January 18, 2001, the Secretary of the Interior, through Secreturial Order 3223, declared Kingman Reef and the surrounding submerged lands and waters as a National Wildlife Refuge out to a distance of 12 nm. Secretarial Order 3224, issued the same day, declared the waters of Palmyra Atoll as a national wildlife refuge out to a distance of 12 nm. However, tidal waters, submerged lands, and emergent lands were excluded from this Order. The MSFCMA establishes the Council's jurisdiction over EEZ waters surrounding Palmyra to the mean high water mark, including the waters of the lagoon and the area within the 12 nm refuge boundaries.

The written historical record provides no evidence of prehistoric populations on Wake Island, but Marshall Islanders occasionally visited Wake, giving it the name Enenkio. The island was annexed by the United States in 1899. Before the 1930's the only visitors were scientists and survivors of shipwrecks. The Navy received administrative control of Wake in 1934, and established an air base on the atoll in January 1941. Wake Island figured prominently in World War II. The U.S. re-occupied the atoll after the war, and administrative authority was held by the Federal Aviation Administration until 1962, when it was transferred to the Department of the Interior, which in turn assigned authority to the U.S. Air Force. Since 1994, the Department of the Army has maintained Administrative use of Wake Island.

In 1858, both Hawaii and the U.S. claimed Johnston Atoll. Guano deposits found on the island were exploited for a short period in the nineteenth century. Johnston Atoll is still controlled by the U.S. military. Starting in the late 1940's, Johnston Atoll played an important role in the U.S. nuclear testing program. In 1962, three rockets accidentally exploded on or above Johnston Island. Chemical munitions have been stockpiled on Johnston Atoll for storage and destruction by means of a specially designed chemical munitions incinerator.

A recently established eco-tourism operation in the Midway Atoll National Wildlife Refuge has improved public access to the NWHI. An agreement between Midway Phoenix Corporation and the USFWS allows up to 100 people to visit the atoll each week. These visitors normally get to Midway by air, on charter flights from Honolulu. Typical activities include charter fishing, diving, and wildlife observation. The company emphasizes this last activity in its promotional material, promoting wildlife tours that let visitors "gain first hand knowledge of the albatross, resident seabirds, migrant shorebirds, threatened green turtles and endangered Hawaiian monk seals." The Public Use Plan for the Refuge outlines other outdoor recreational activities—including shoreline fishing, lobstering, night diving, night fishing, kayaking tours, and glass-bottom boat excursions—that could be offered to visitors in the future (USFWS 1997). These activities should result in increased recreational use of NWHI marine resources. Because of their location and history, no genuine community participation in coral reef fisheries can be identified for the PRIAs. The next section discusses coral reef resource use by part-time residents on these islands and atolls.

Historical and Present Coral Reef Uses

Little is known about the present status of coral reefs in most of the remote U.S. island possessions, although anecdotal reports suggest that they are mostly in good condition. Localized impacts on coral reefs have occurred due to coastal construction and pollution on some islands occupied by the U.S. military. Hurricanes and starfish infestations have occasionally affected some areas.

Fishing is light in most areas. Hawaii-based vessels have been reported to make sporadic commercial fishing trips to Palmyra and Kingman Reef for bottom fishing, harvesting coastal sharks for finning,. The past extent of harvesting by passing yachts or poaching by foreign fishing vessels is unknown (Green 1997). Since May 2000, the Nature Conservancy has been conducting small scale experimental ecotourism activities, including, diving, snorkeling, kayaking, fishing, and wildlife photography. The Nature Conservancy has also proposed establishing an inshore/offshore sportfishing operation. It would include a catch-and-release program for pelagic species, bonefish (*Albula* spp.), and other reef fish, particularly the giant trevally (*Caranx ignoblis*). The proposal also includes monitoring of fish stocks, and conducting biological investigations on the migratory, reproductive, and recruitment patterns of those stocks (Chuck Cook pers. comm. 2001). Data on catch and effort from the recreational fishing will also be recorded. In addition, pursuant to a license agreement with the Nature Conservancy, Palmyra Pacific Seafoods, LLC has established and is currently operating a commercial fishing operation on Palmyra Atoll. Palmyra Pacific Seafoods, LLC is operating under rights granted to it by the

Fullard-Leo family, and its existing fishing areas and business interests include the resources in the vicinity of Kingman Reef (F. Sorba, pers. comm 2001).

There are no permanent residents on any of these islands, although on Wake and Johnston there are temporary work forces who have a long history of recreational fishing and shell collecting. The fishery at Johnston Atoll was described over a six-year period (1985–1990), based on the results of a creel census by Irons *et al.* (1990). They found that long-term 'residents' —almost all employees of the prime contractor for Johnston Atoll operations—did most of the fishing and thus produced a large proportion of the catch. These residents fished for enjoyment, to add fresh fish to their diet, and to accumulate fish to take home on leave. The remainder of the catch was harvested by 'transients,' military personnel and contractors stationed on the island for one or two years. However, through cooperative management between the USFWS and the military, the practice of shipping coolers of fish back to Hawaii by workers stationed on the atolls was stopped. Likewise, the collection and shipment of live corals by recreational divers were also stopped.

Irons *et al.* (1990) reported that the soldierfish (*Myrispristis amaenus*) composed the largest proportion of reef fish catch at Johnston (see Table 72 in Green 1997). Other important fish species included bigeyes (*Priacanthus cruentatus*), flagtails (*Kuhlia marginata*), mullet (*Chaenomugil leuciscus*), goatfishes (*Mulloides flavolineatus, Pseudupeneus bifasciatus, P. cyclostomus*, and *P. multifasciatus*), jacks (*Caranx melampygus* and *Carangoides orthogrammus*), parrotfish (*Scarus perspicillatus*), surgeonfishes (*Acanthurus triostegus* and *Ctenochaetus strigosus*), and bigeye scad (*Selar crumenophthalmus*). Gear types varied with the target species and included hook-and-line fishing, spearfishing and throw nets. All of the more heavily fished areas at Johnston are located in nearshore waters. Irons *et al.* (1990) also noted that recreational divers at Johnston collected pieces of coral for souvenirs. *Acropora cytherea* and the hydrocoral *Distichopora violacea* were the two main species collected, although smaller quantities of *Acropora valida, Millepora* and *Fungia* were also collected.

The original Johnston Atoll has been extensively modified by dredging and filling. An estimated 4 million square meters of coral were destroyed by construction, and an additional 25 million square meters were damaged by the resulting sedimentation. By 1964, dredge and fill operations had enlarged the original island by over tenfold and had added two manmade islands. Fishing regulations have changed at Johnston Atoll in recent years because of concerns that fish were being exported and that coral collecting had become excessive and was incompatible with the philosophy of the refuge (Green 1997). Current DOI policy prohibit coral collecting and the export of any reef fish or invertebrates from the island. However, collection of selected organisms and shells is permitted in restricted areas by recreational divers. Since Johnston is a closed military base, only local residents engage in such activities. No recent fisheries statistics are available for the area.

National Wildlife Refuges have been established at Baker, Howland and Jarvis Islands, Palmyra Atoll Kingman Reef and Johnston Atoll. Natural resources are managed by the USFWS and access is by special use permit only. Wake Atoll is also a candidate for National Wildlife Refuge status.

3.7 Magnuson-Stevens Fishery Conservation and Management Act Definition of Communities

The MSFCMA requires that FMPs take into account the importance of fishery resources to fishing communities, in order to provide for the sustained participation of such communities and to the extent practicable, minimize adverse economic impacts on them. For the purposes of the Coral Reef Ecosystems FMP there are no communities substantially engaged in, or substantially dependent, on the harvesting and processing of coral reef resources from the EEZ, as defined by the MSFCMA.

CHAPTER 4

SPECIFICATION OF MSY, OY AND OVERFISHING, AND DOMESTIC HARVESTING AND PROCESSING CAPACITY

4.1 Introduction

Sections 301, listing National Standards, and 303 of the Magnuson-Stevens Fishery Conservation and Management Act specify required provisions of fishery management plans. First and foremost, an FMP must describe how management measures will prevent overfishing and achieve optimum yield for managed stocks (§301(a)(1) and §303(a)(1)(A)). It must also describe how much of the optimum yield can be harvested by domestic vessels and how much can be processed domestically (§303(a)(4)). Since it is usually impossible to measure stock size directly, managers must identify various indirect measures, or indicators, that they can use to determine stock status, the impact of fishing, and the degree to which the stock is being fished at optimum yield. They must then develop a set of control rules that specify how management action should respond to any given indicator value. Most importantly, if the indicators suggest that a stock is being overfished, managers need to take action to reduce fishing pressure and begin rebuilding stocks. This chapter discusses how measures of stock condition—maximum sustainable yield (MSY), optimum yield (OY), and overfishing—have been developed, and the indicators that will be used to determine these levels. It also specifies how much of the optimum yield domestic fishermen are capable of harvesting and how much can be processed domestically.

As detailed in Chapter 2 of this FMP, the coral reef ecosystem consists of thousands of species; regulation of the enormous number of species with individual harvest control rules would prove unwieldy, and it is unnecessary. One strategy taken in this FMP, described in Section 1.6.2, is to divide the coral reef ecosystem management unit into two groups, Currently Harvested Coral Reef Taxa (CHCRT) and Potentially Harvested Coral-Reef Taxa (PHCRT). This division of the management unit focuses attention on and helps to prevent overfishing of currently harvested taxa. For those taxa for which scientists have limited data, it will make it easier to get the scientific data needed to estimate biological reference points. For CHCRT, available catch and effort data will be used to estimate reference points. If insufficient data exist for a given species, data from similar areas or species will be used instead to estimate reference points. If there is absolutely no information that can be brought to bear, then reference points may be estimated by proxy using data collected from the developing fishery. As fisheries for PHCRT develop, those taxa will be moved to the CHCRT category.

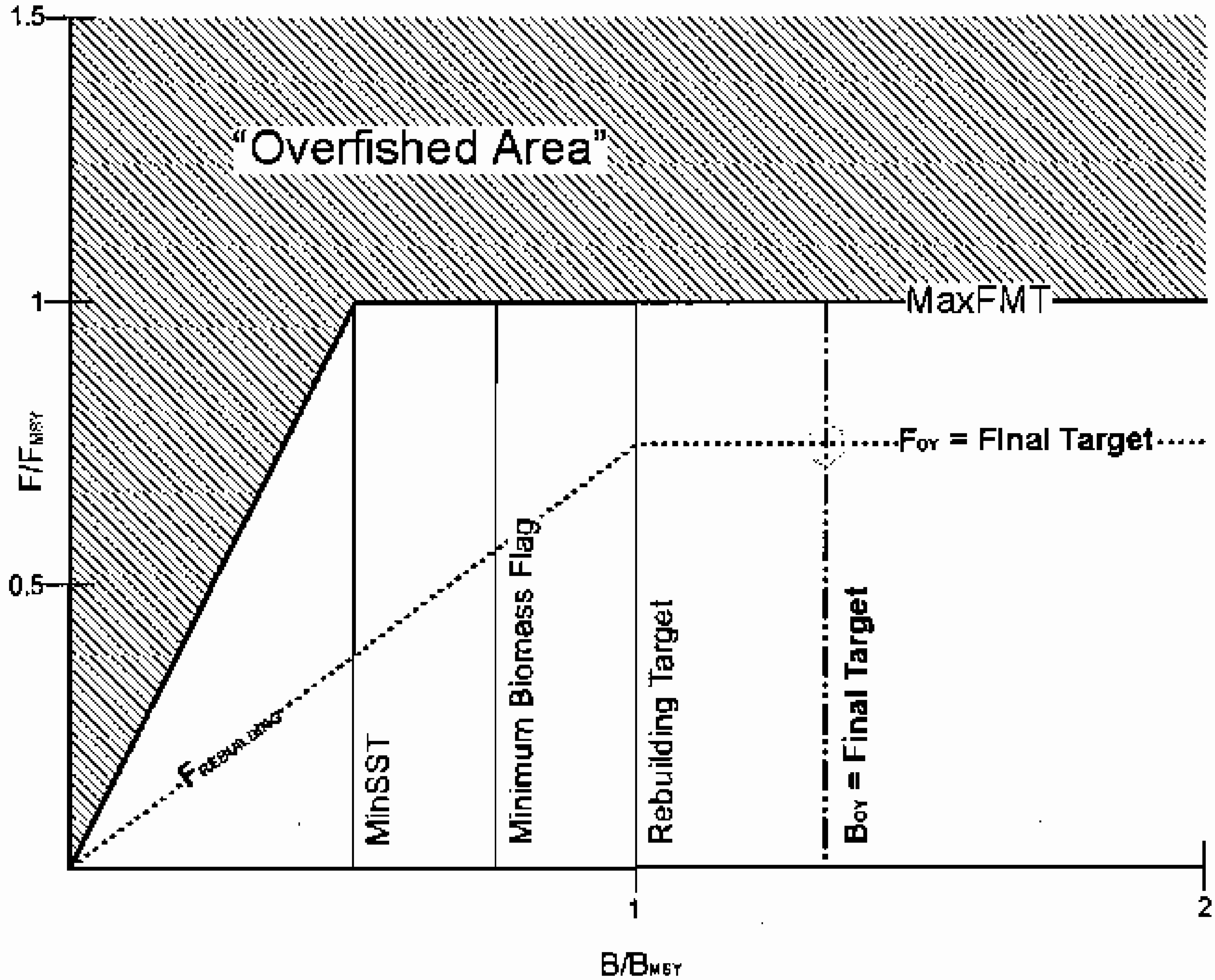

Figure 4.1: Representation of MSY, OY, and overfishing.

4.2 MSY, OY, and Overfishing

The goal of the MSFCMA is to ensure long-term fishery sustainability by halting or preventing overfishing, and by rebuilding any overfished stocks. By definition, overfishing occurs when fishing mortality (F) is higher than the level at which fishing produces maximum sustainable yield (MSY). MSY is the maximum long-term average yield that can be produced by a stock on a continuing basis. A stock is overfished when stock biomass (B) has fallen to a level substantially below what is necessary to prodnce MSY. So there are two aspects that managers must monitor to determine the status of a fishery: the level of F in relation to F at MSY (F_{MSY}), and the level of B in relation to B at MSY (B_{MSY}).

The technical guidance document for National Standard 1 (Restrepo *et al.* 1998) requires that "control rules" be developed that identify "good" versns "bad" stock conditions. It also requires that control rules describe management action that will influence a control variable (e.g., F) as a function of some stock size variable (e.g., B), to achieve "good" stock conditions. Each control rule must identify reference points called "status determination criteria": one for F that identifies when overfishing is occurring, and one for B that indicates when the stock is overfished. The status determination criterion for F is the maximum fishing mortality threshold (MaxFMT). Minimum stock size threshold (MinSST) is the status determination criterion for B. When F/F_{MSY} exceeds the MaxFMT, overfishing is occurring, and when B/B_{MSY} falls below MinSST the stock is overfished. When either of these two conditions occur, NMFS must notify Congress that the stock is overfished, and fishery managers must take action to halt overfishing, and rebuild the stock. A reasonable MSY control rule template for application to western Pacific coral reef ecosystems may be derived from the default MSY control rule suggested by Restrepo *et al.* (1998).

Managers must exert some control over F/F_{MSY}, the y-axis labeled in Figure 4.1, which is a function of B/B_{MSY} on the x-axis. The default MaxFMT recommended by the technical guideline document cited above is an upper limit set at F_{MSY}, shown as a horizontal line at 1 = MaxFMT = F/F_{MSY}. In applying the MSY control rule, fishing effort—expressed as the ratio F/F_{MSY}—must not be allowed to exceed the MaxFMT, although a stock with a biomass well above B_{MSY} can support larger F values for a limited time, while B declines towards B_{MSY}. Other types of control rules would allow higher F levels under specified conditions, but such rules require reliable measures of B and a very good understanding of stock dynamics.

The MinSST is shown in Figure 4.1 by a vertical line at a biomass level substantially below B_{MSY}. This allows for some natural fluctuation of biomass around B_{MSY} under an MSY harvest policy. When B falls below MinSST, however, the stock is considered to be overfished and then F must be reduced below the MaxFMT by an amount that depends on the severity of the stock depletion, the stock's capacity to rebuild, and the desired recovery time for the stock. A minimum biomass flag (see Figure 4.1) should also be defined so that if B drops below it, managers are prompted to implement remedial action before biomass reaches the MinSST.

When stock biomass falls below the MinSST, fishery councils are required to develop stock rebuilding plans. Different control rules may be used in rebuilding plans. A precautionary approach dictates that managers follow an "optimal yield" (OY) control rule, as illustrated by the line labeled $F_{REBUILDING}$ in Figure 4.1. OY is MSY as reduced by relevant socioeconomic factors, ecological considerations, and fishery biological constraints to provide the greatest long-term benefits to the nation. Under the suggested OY control rule (adapted from the Restrepo *et al.* 1998 default guidelines), when B is below B_{MSY}, F is controlled as a linear function of B, until a rebuilding target of B_{MSY} is reached at F_{OY}. A final OY target (B_{OY}) somewhat greater than B_{MSY} is achieved by keeping fishing effort at F_{OY} (see Figure 4.1). Simulation results show that when fisheries are managed at F_{OY}, equilibrium biomass will be maintained at about 1.30 B_{MSY} and resulting equilibrium yield (OY) will be at about 95% of MSY (Mace 1994).

4.3 Application of the MSY Control Rule to the Coral Reef Ecosystem

4.3.1 Overfishing Criteria in Coral Reef Ecosystems

It is difficult to determine overfishing criteria for coral reef fisheries because the coral reef ecosystem contains many species and this produces a complex web of ecological interrelationships. Russ (1991) defines four non-mutually-exclusive overfishing categories:

- growth overfishing, which occurs when fishing intensity prevents fish from reaching older age classes;
- recruitment overfishing, which occurs when the spawning stock of a population is reduced below the level at which adequate reproduction can maintain the population;
- economic overfishing, which occurs when a fishery is no longer cost-effective; and,
- ecosystem overfishing, which occurs when fishing pressure causes changes to the species composition in a multi-species setting, often resulting in changes in ecosystem function (DeMartini *et al.* 1996).

The Council manages most other EEZ fisheries through its four implemented FMPs. These FMPs have used either the recruitment overfishing model to identify overfishing criteria—such as spawning potential ratio, or SPR—or the growth overfishing model, using MSY methods. However, the ecosystem overfishing concept, detected by shifts in species composition or trophic web dynamics, may be most appropriate for the CRE-FMP. This approach can guard against single-stock recruitment overfishing, where applicable. Because the coral reef ecosystem is a multi-species community with a long coevolutionary history, removing certain species—if it reduces species diversity—could lead to the unwanted predominance of often less valuable generalist species. Changes in species dominance patterns in coral reefs experiencing fishing pressure have been reported for a number of tropical stocks from various areas around the world. It is also well known that the sensitivity of multi-species systems to environmental fluctuations increases as the level of exploitation increases.

4.3.2 Estimating Reference Points With Limited Data

Available biological and fishery data are poor for all species and island areas covered by the CRE-FMP. Data collection systems are managed by the local island governments, and they vary widely in format and coverage. Data are generally restricted to commercial landings records for a handful of species. Total effort cannot be adequately partitioned between the various management unit species (MUS) for any fishery or area. Biomass, maximum sustainable yield, and fishing mortality estimates are not available for any single MUS. Even though it seems likely that fisheries targeting coral reef ecosystem resources will continue to expand, possibly into the EEZ, there is scant information on the life histories, ecosystem dynamics, fishery impact, community structure changes, yield potential, and management reference points for many coral reef ecosystem species.

Once these data are available, fishery managers will then be able to establish limits and reference points based on the multi-species coral reef ecosystem as a whole. In accordance with the National Standard guidelines cited above, whenever possible, the MSY control rule should be applied to the individual species in a multi-species stock. When this is not possible, MSY may be specified for one or more species; these values can then be used as indicators for the multi-species stock's MSY. Clearly, any given species that is part of a multi-species complex will respond differently to an OY-determined level of fishing effort (F_{OY}). Thus, for a species complex that is fished at F_{OY}, managers still must track individual species' mortality rates in order to prevent species-specific population declines that would lead to strict protection, as required by the Endangered Species Act. For the fisheries encompassed by the CRE-FMP, the multi-species complex as a whole will be used to establish limits and reference points for each area. Where possible, available data for a particular species will be used to evaluate the status of individual MUS stocks in order to prevent recruitment overfishing. When better data and the appropriate multi-species stock assessment methodologies become available, all stocks will be evaluated independently, without proxy. Spatial bounds will initially follow the five island groups that are part of the management area,[1] but will be refined as stock bounds and ecosystem structure become better understood.

Coral reef fishery scientists have used several approaches to model multi-species fisheries with varying levels of success. These have been discussed in Section 2.4. Briefly, the simplest approach has been to consider a community to be the sum of its species. But the coral reef ecosystem is too complex to use these methods. Instead, the system can be divided into separate trophic levels to model energy flow and estimate potential yields. The ECOPATH model, discussed in Section 2.4, is based on this approach (Polovina 1984). When coupled with another computer model, ECOSIM, which uses output from ECOPATH, abundance of both target and non-target species can be estimated when different levels of fishing pressure are applied to the system (Kitchell *et al.* 1999). It may be possible to use these models in the future, but right now there is not enough data on coral reef species and fisheries to use them.

4.3.3 Establishing Reference Point Values

Standardized values of catch per unit effort (CPUE) and effort (E) will be used to establish limit and reference point values, which will act as proxies for relative biomass and fishing mortality, respectively. Limits and reference points will be calculated in terms of $CPUE_{MSY}$ and E_{MSY} included in Table 4.1.

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[1]American Samoa, CNMI, Guam, Hawaii, and the PRIAs. See Section 1.6.1 for a description of the management area.

Table 4.1. CPUE-based overfishing limits and reference points for coral reef species.

Value	Proxy	Explanation
MaxFMT (F_{MSY})	E_{MSY}	0.91 $CPUE_{MSY}$
F_{OY}	0.75 E_{MSY}	suggested default scaling for target
B_{MSY}	$CPUE_{MSY}$	operational counterpart
B_{OY}	1.3 $CPUE_{MSY}$	simulation results from Mace (1994)
MinSST	0.7 $CPUE_{MSY}$	suggested default (1-M)B_{MSY} with M=0.3*
B_{FLAG}	0.91 $CPUE_{MSY}$	suggested default (1-M)B_{OY} with M=0.3*

*interim value of M=0.3 is applied.

When reliable estimates of E_{MSY} and $CPUE_{MSY}$ are not available, they will be estimated from the available time series of catch and effort values, standardized for all identifiable biases using the best available analytical tools. $CPUE_{MSY}$ will be calculated as one-half a multi-year moving average reference CPUE ($CPUE_{REF}$). This value has not been finalized yet; however, preliminary values from the types of data presently available for Hawaii are shown in Figures 4.2a-c. These are time series of data from the State of Hawaii commercial catch reports, screened to include only CHCRT from all gear types for the entire area of the MHI. CPUE is estimated as the aggregate weight reported for that year, divided by the number of records for that year. A twenty-year time window is used for the multi-year average. Figure 4.2a presents all CHCRT in aggregate. Figure 4.2b is for *menpachi* (*Myripristis* spp.) while 4.2c is for *weke* (*Mulloidichthys* spp.). These two latter examples were chosen because they are well-represented in the catch report database. $CPUE_{REF}$ and E_{MSY} could be estimated directly from this, as shown in the figures. Alternatively, following Restrepo *et al.* (1998), they could be estimated as $E_{MSY} = E_{AVE}$, where E_{AVE} represents the long-term average effort prior to declines in CPUE. When multiple estimates are available, the more precautionary value will be used. All values will be calculated using the best available data. When new data become available, reference point values will be recalculated.

Figure 4.2a: Time series of aggregate CHCRT CPUE from HDAR data.

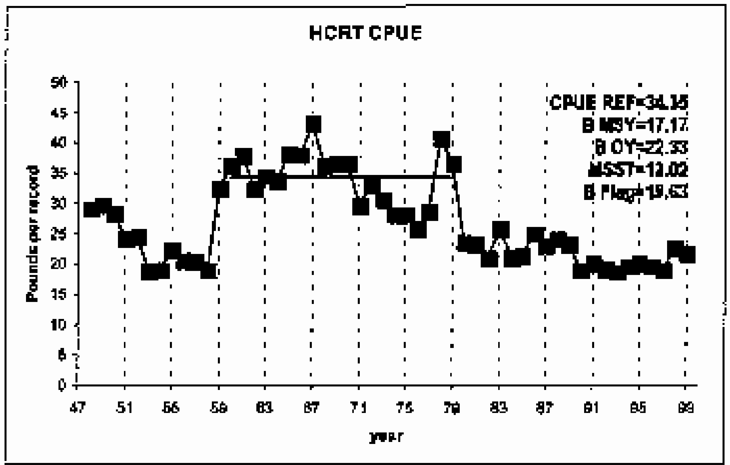


Figure 4.2b: Time series of menpachi (*Myripristis* spp.) CPUE from HDAR data.

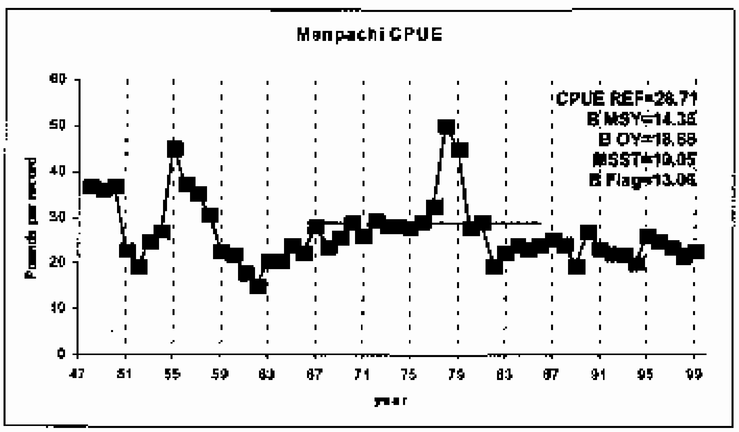
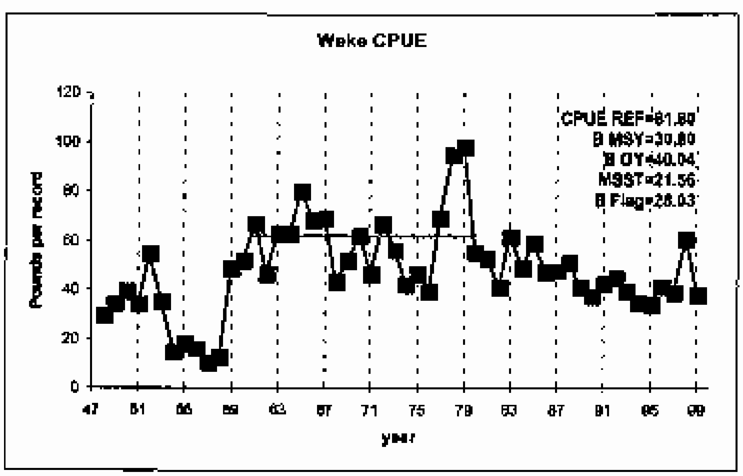


Figure 4.2c: Time series of weke (*Mulloidichthys* spp.) CPUE from HDAR data.



4.3.4 Preventing Recruitment Overfishing

The limits and reference points illustrated in Figure 4.2 can be applied to both multi-species stocks and to individual component species stocks, realizing however, that much of the data in the State of Hawaii commercial catch reports are often at the genus or family level. As stated earlier, while managing the multi-species stock to provide maximum benefit, fishery managers must also ensure that the resulting fishing mortality rate does not reduce any individual species stock to a level requiring protection under the Endangered Species Act. Preventing recrcitment overfishing on any component stock will satisfy this need in a precautionary manner. Best available data will be used for each fishery to estimate these values. These reference points will be related primarily to recruitment overfishing and will be expressed in units such as spawning potential ratio or spawning stock biomass. However, no examples can be provided at present. Species for which managers have collected extensive survey data and know their life history parameters, such as growth rate and size at reproduction, will be the best candidates for determining these values.

4.3.5 Preventing Ecosystem Overfishing

Using the best available data, managers will monitor changes in species abnndance and/or composition. They will pay special attention to those species they consider important because of their trophic level or other ecological importance to the larger community. For Hawaii, a preliminary approach aggregates HDAR data into two five-year bins for comparison, an early bin comprising 1948-1952 and a recent bin comprising 1995-1999. Table 4.2, which may be found at the end of this chapter, ranks CHCRT based on their proportion of total landings in the 1948-1952 data bin. Although it is difficult to draw conclusions from this exercise, it does show, in a preliminary way, how in an exploited ecosystem species composition has changed over time.

4.4 Specification of Harvesting and Processing Capacity

Section 303(a)(4) of the MSFCMA requires that all FMPs "assess and specify– (A) the capacity and the extent to which fishing vessels of the United States, on an annual basis, will harvest the optimum yield..., (B) the portion of such optimum yield which, on an annual basis, will not be harvested by fishing vessels of the United States and can be made available for foreign fishing, and (C) the capacity and extent to which United States fish processors, on an annual basis, will process that portion of such optimum yield that will be harvested by fishing vessels of the United States."

Information used to compile this FMP, together with infonnation in the other Western Pacific Council's FMPs and related documents, was examined to assess and specify the U.S. fishing and processing capacity in this region. FMPs from other regions and related documents, inclnding *Our Living Oceans* (NMFS 1999) (available online at http://spo.nwr.noaa.gov/olo99.htm) provided additional infonnation on U.S. harvesting and processing capacity. This information clearly indicates that fishing vessels of the U.S. currently have the capacity to harvest the optimum yield on an annual basis. As such, no part of the optimum yield will be made available for foreign fishing. Similarly, the capacity of U.S. fish processors is of sufficient size to process the entire optimum yield.

Table 4.2: Change in landings for selected Hawaii CHCRT, 1948-1952 compared to 1995-1999. Species are ranked based on 1948-1952 landings.

Hawaiian, English & Latin names	1948-1952 aggregate			1995-1999 aggregate		
	Pounds	%	Rank	Pounds	%	Rank
Menpachi, soldierfish (*Myripristis* spp.)	415,252	18.54	1	218,781	15.04	1
Amaama, striped mullet (*Mugil cephalus*)	321,480	14.35	2	27,285	1.88	12
Weke, yellow goatfish (*Mulloidichthys* spp.)	305,108	13.62	3	148,149	10.18	4
Moano, banded goatfish (*Parupeneus spp.*)	172,493	7.70	4	20,656	1.42	19
Wekeula, Pflugers goatfish (*Mulloidichthys* spp.)	101,189	4.52	5	104,909	7.21	5
Moi, threadfin (*Polydactylus sexfilis*)	96,385	4.30	6	5,126	0.35	28
Manini, convict tang (*Acanthurus triostegus*)	88,335	3.94	7	70,448	4.84	7
Kumu, whitesaddle goatfish (*Parupeneus porphyreus*)	86,445	3.86	8	23,620	1.62	13
Kawelea, Hellers barracuda (*Sphyraena helleri*)	84,075	3.75	9	15,589	1.07	21
Kaku, great barracuda (*Sphyraena barracuda*)	82,062	3.66	10	14,847	1.02	22
Tako, octopus (*Octopus* spp.)	80,950	3.61	11	98,016	6.74	6
Uhu, parrotfish (*Scaridae*)	49,795	2.22	12	159,252	10.95	3
Pualu, yellowfin surgeonfish (*Acanthurus xanthopterus, A. blochii*)	46,338	2.07	13	28,020	1.93	11
Palani, eyestriped surgeonfish (*Acanthurus dussumieri*)	43,054	1.92	14	165,164	11.35	2
Aweoweo, bigeye (Priacanthidae)	32,058	1.43	15	22,133	1.52	14

Table 4.2 (cont.)

Hawaiian, English & Latin names	1948-1952 aggregate			1995-1999 aggregate		
	Pounds	%	Rank	Pounds	%	Rank
Aholehole, flagtail (*Kuhlia sandvicensis*)	31,637	1.41	16	21,627	1.49	16
Kala, unicornfish (*Naso* spp.)	27,727	1.24	17	66,686	4.58	8
Nenue, rudderfish (*Kyphosus* spp.)	27,156	1.21	18	56,628	3.89	9
Puhiuha, conger eel (*Conger cinereus*)	20,616	0.92	19	1,378	0.09	33
Aawa, hogfish (*Bodianus bilunulatus*)	20,173	0.90	20	13,576	0.93	25
Nabeta, razorfish (*Xyrichthys* spp., *Cymolutes lecluse*)	17,559	0.78	21	22,014	1.51	15
Mu, porgy (*Monotaxis grandoculis*)	15,937	0.71	22	11,479	0.79	26
Uouoa, false mullet (*Neomyxus leuciscus*)	15,873	0.71	23	2,658	0.18	30
Humuhumu, triggerfish (Balistidae)	14,460	0.65	24	873	0.06	36
Kamanu, rainbow runner (*Elagatis bipinnulatus*)	10,540	0.47	25	21,867	1.50	17
Maiko, bluelined surgeonfish (*Acanthurus nigroris*)	10,067	0.45	26	17,953	1.23	20
Alaihe, squirrelfish (*Neoniphon* spp., *Sargocentron* spp.)	9,718	0.43	27	1,376	0.09	34
Panuhunuhu, parrotfish (*Calotomus* spp.)	8,117	0.36	28	5,316	0.37	27
Kupoupou, cigar wrasse (*Cheilio inermis*)	2,035	0.09	29	227	0.02	39
Kihikhi, Moorish idol (*Zanclus cornutus*)	1,768	0.08	30	0	0.00	43

Table 4.2 (cont.)

Hawaiian, English & Latin names	1948-1952 aggregate			1995-1999 aggregate		
	Pounds	%	Rank	Pounds	%	Rank
Naenae, orangespot surgeonfish (*Acanthurus olivaceus*)	945	0.04	31	28,590	1.97	10
Amaama, summer mullet (*Moolgarda engeli*)	376	0.02	32	421	0.03	38
Pakuikui, Achilles tang (*Acanthurus achilles*)	253	0.01	33	2,233	0.15	32
Kole, goldring surgeonfish (*Ctenochaetus strigosus*)	65	0.00	34	13,882	0.95	23
Maikoiko, whitebar surgeonfish (*Acanthurus leucopareius*)	44	0.00	35	0	0.00	44
Uukanipou, squirrelfish (*Sargocentron spiniferum*)	32	0.00	36	873	0.06	37
Pala, Yellow tang (*Zebrasoma flavescens*)	23	0.00	37	47	0.00	41
Lauwiliwili, longnose butterflyfish (*Forcipiger* spp.)	11	0.00	38	1	0.00	42
Wekepueo, bandtail goatfish (*Upeneus arge*)	8	0.00	39	60	0.00	40
Opelu kala, unicornfish (*Naso hexacanthus*)	0	0.00	40	22,001	1.51	16
Munu, striped goatfish (*Parupeneus bifasciatus*)	0	0.00	41	1072	0.07	35
Moanokea, blue goatfish (*Parupeneus cyclostomus*)	0	0.00	42	13,821	0.95	24
Roi, seabass (*Cephalopholis* argus)	0	0.00	43	2,304	0.16	31
Poopaa, hawkfish (Cirrhitidae)	0	0.00	44	3,744	0.26	29

CHAPTER 5

MANAGEMENT REGIME

5.1 Introduction

The preceding chapters have mainly described the setting for management: what areas and taxa will come under the FMP, the nature of the coral reef ecosystem, the way that resources within that ecosystem are used by people in various communities in the region, and the criteria that will be used to assess the status of managed species. This chapter outlines the actions that the Council is implementing to manage fisheries on coral reefs under Council jurisdiction. The overall goal of this management program is to establish a management regime for the entire Western Pacific Region that will maintain sustainable coral reef fisheries while preventing any adverse impacts to stocks, habitat, protected species, or the ecosystem. Developing management objectives that support this goal was an important starting point in determining the kinds of measures that should be implemented. The reader is encouraged to review Section 1.4, which lists and describes these objectives. Just as this whole plan has been shaped by the ecosystem approach advocated by the Ecosystem Principles Advisory Panel (EPAP 1999), the management regime outlined here has been developed with these principles in mind. Section 1.5, describes how this FMP conforms to the eight actions that the Ecosystem Principles Advisory Panel argues should be included in any "fishery ecosystem plan."

Presently, there is little or no fishing or harvesting of coral reef ecosystem species in federal waters of the Western Pacific Region. This is due partly to access restrictions imposed in some coral reef habitat areas by various federal agencies. Within these areas, certain activities may also be restricted through regulations that in effect serve as a *de facto* management program. The management program described here will not supersede any of the valid restrictions imposed by these federal authorities. However, these areas encompass only a small portion of the total coral reef habitat in the region. Thus, most of the coral reef ecosystem in the region is currently not managed. This FMP management regime will strengthen and extend protection and management of the ecosystem to all areas within the region's EEZ.

The coral reef management area includes all EEZ waters (from the surface to the ocean floor) that are outside of state or territorial waters (0-3 nmi) and within 200 nmi from shore. (See Section 1.6.1 for a detailed description of the management area.) The management area includes some areas where the Council shares jurisdiction with other federal agencies, such as National Wildlife Refuges. State waters have also been considered, although the management measures described here will only apply to waters within federal jurisdiction. CRE-FMP management measures are meant to simplify regulations for coral reef areas by developing consistency between the management regimes of these various state and federal entities.

The remainder of this chapter describes the management measures, which fall in four categories. Section 5.2 describes marine protected areas, which would restrict fishing in certain areas. Section 5.3 outlines permitting regimes. This FMP would implement a special permit and reporting regime for certain activities. A less restrictive general permit may be implemented at a later date. Section 5.4 describes gear restrictions that would be imposed on coral reef fisheries. Section 5.5 enumerates several other components of the management regime that are not regulatory measures. These include measures to adapt the management regime to changing conditions, the enforcement program that will support the regime, and non-regulatory measures to facilitate coordination between the various groups and agencies involved in managing EEZ marine resources.

5.2 Marine Protected Areas

Marine protected areas (MPAs) are an attractive option for ecosystem-based fisheries management. The selection of an MPA does not require detailed knowledge of the management unit species in order to holistically conserve multi-species resources and the functional attributes of marine ecosystems. They can also provide "insurance" against periods of poor recruitment of individual stocks.

MPAs can also vary in scope and extent. They can be areas designated for limited use, seasonal use, or areas that are completely restricted from consumptive use (no-take). Although completely restricted areas are thought to provide the highest degree of protection to marine ecosystems, less restrictive areas also provide some protection with fewer economic and social impacts.

The optimum size of an MPA depends on many factors, including the resources managed, management goals, enforcement capabilities, and social and economic constraints. However, researchers do not yet fully understand the relation between the area covered by an MPA and resulting benefits in the form of ecologically complete coral reef ecosystem protection. To be useful to fisheries and to promote the conservation of coral reef resources on a broader scale, MPAs should serve as sources of reproductive output to replenish larger surrounding or down-current areas. The present approach of establishing small and isolated MPAs is inadequate for this purpose.

Few, if any, studies have sought to verify whether MPAs established in the U.S. Pacific Islands do actually benefit nearby fisheries. It is clear that fish populations that build up in small areas temporarily closed to fishing are quickly reduced when fishing is resumed, as evidenced by studies in Hawaii and the Philippines. Existing MPAs in the U.S. Pacific Islands have been criticized for being either too small and fragmented or for not encompassing sufficient depth range and high quality habitat to provide broad coral reef ecosystem protection or recruitment benefits to fisheries.

It has been suggested that linking the populations in different MPAs over a broad area is necessary to assure long-term sustainability of coral reef fisheries. Some argue for complete protection from fishing, whereas others believe MPAs are more valuable when they can serve as natural laboratories for fishing experiments and to test adaptive management strategies.

In determining the locations in the CRE-FMP, the Council considered the following criteria:

- Natural resource values- biogeographical representation, biodiversity, ecosystem integrity, ecological significance, species maintenance, habitat structure/features, and other special elements;
- Human use and historical values- renewable resources of importance for sustainable uses, recreational resources, research and monitoring, educational and interpretive opportunity, historical and cultural resources, and aesthetic resources;
- Impacts of human activities- observed environmental impacts and projected impacts; and,
- Management concerns- coordination with other programs, size and boundary considerations, accessibility, surveillance and enforcement, economic considerations, network-wide activities, and urgency of threats.

Two types of MPAs will be used to manage coral reef ecosystem fisheries. The first type is the no-take MPA, where all extractive activities, with a few carefully monitored exceptions, will be prohibited. Certain carefully managed fisheries will be allowed in the second type, the low-use MPA. However, as new information is acquired through resource monitoring, the initial MPA designations could be adjusted and additional MPAs added in the future through the adaptive management process.

5.2.1 No-take Marine Protected Areas

Under this plan, no-take MPAs will encompass federal waters shallower than 10 fathoms in the NWHI and waters shallower than 50 fathoms around Jarvis, Howland, Baker, Kingman, Laysan, French Frigate Shoals, the northern half of Midway Atoll, and Rose Atoll in American Samoa. (The Council recognizes the co-management agreement between the Territory of American Samoa and Department of the Interior for the Rose Atoll National Wildlife Refuge (0-3 nm), together with Department of Commerce's jurisdiction to the shoreline.) Figures 5.1 - 5.13 show the locations of the MPAs implemented by this FMP. Detailed maps of each MPA may be found at the end of this chapter. The Crustacean FMP provides additional protection by prohibiting fishing for lobster within 20 miles around Laysan island. Moreover, other restrictions may also apply inside areas managed and regulated by other federal authorities. The locations of no-take MPAs are described in the draft regulations of this FMP (see Section 8.1).

Amendments to Already-implemented FMPs

The CRE-FMP designates no-take marine protected areas within the management area. Commercial, recreational, subsistence, or cultural take of any marine species within these areas is prohibited. No described or undescribed gear is exempt from this designation. Fisheries managed under the Council's four already-implemented FMPs[1] are mostly exempt from the regulations outlined in this CRE-FMP, and will observe the management regime of their respective FMPs. No-take marine protected areas are the main exception: they will apply to all Council-managed fisheries. Chapter 5 of the EIS accompanying this plan analyzes the impacts of these area closures on these four already-implemented FMPs. To ensure designated no-take MPAs effectively apply to all of the fisheries managed under Council FMPs, each of the four already-implemented FMPs must be amended to ensure the no-take status of these areas. The following four subsections serve as amendments to those FMPs.

Amendment 7 to the Bottomfish and Seamount Groundfish FMP

It is prohibited to harvest the bottomfish management unit species listed in Table 5.1, and all future additions to the bottomfish MUS list, in no-take marine protected areas designated in the Coral Reef Ecosystem FMP, and in any marine protected areas that may be designated by amendment to the Coral Reef Ecosystem FMP. The locations of the no-take MPAs are:

(1) federal waters shallower than 10 fathoms in the Northwestern Hawaiian Islands; and,

(2) federal waters shallower than 50 fathoms around Jarvis Island (0°23' S, 160°01' W), Howland Island (0°48' N, 176° 38' W), Baker Island (0° 13' N, 176°38' W), Kingman Reef (6°23' N, 162°24' W), Laysan Island (25° 45' N, 171°45' W), French Frigate Shoals (23° 45' N, 166°15' W), the Northern half of Midway Atoll (28° 14' N, 177° 22' W), and Rose Atoll (14° 33' S, 168° 09' W).

Table 5.1: Bottomfish management unit species list.

Scientific Name	English Common Name	Scientific Name	English Common Name
Aphareus rutilans	red snapper/silvermouth	*Pristipomoides auricilla*	yellowtail snapper
Aprion virescens	gray snapper/jobfish	*P. filamentosus*	pink snapper
Caranx ignobilis	giant trevally/jack	*P. flavipinnis*	yelloweye snapper
C. lugubris	black trevally/jack	*P. seiboldi*	pink snapper
Epinephelus fasciatus	blacktip grouper	*P. zonatus*	snapper
E. quernus	sea bass	*Pseudocaranx dentex*	thicklip trevally
Etelis carbunculus	red snapper	*Seriola dumerili*	amberjack
E. coruscans	red snapper	*Variola louti*	lunartail grouper
Lethrinus amboinensis	ambon emperor	*Beryx splendens*	alfonsin
L. rubrioperculatus	redgill emperor	*Hyperoglyphe japonica*	ratfish/butterfish
Lutjenus kasmira	blueline snapper	*Pseudopentaceros richardsoni*	armorhead

[1]The Bottomfish and Seamount Groundfish, Crustaceans, Pelagics, and Precious Corals FMPs. Additionally, the Council is currently developing an amendment to the to include the CNMI and the PRIA under Council-developed FMPs and designates 26 additional bottomfish MUS. These FMPs and their fisheries are summarized in Chapter 3 of the EIS that accompanies this CRE-FMP.

Amendment 11 to the Crustaceans FMP

It is prohibited to harvest the crustacean management unit species listed in Table 5.2, and all future additions to the crustacean MUS list, in no-take marine protected areas designated in the Coral Reef Ecosystem FMP, and in any marine protected areas that may be designated by amendment to the Coral Reef Ecosystem FMP. The locations of the no-take MPAs are:

(1) federal waters shallower than 10 fathoms in the Northwestern Hawaiian Islands; and,

(2) federal waters shallower than 50 fathoms around Jarvis Island (0°23' S, 160°01' W), Howland Island (0°48' N, 176° 38' W), Baker Island (0° 13' N, 176°38' W), Kingman Reef (6°23' N, 162°24' W), Laysan Island (25° 45' N, 171°45' W), French Frigate Shoals (23° 45' N, 166°15' W), the Northern half of Midway Atoll (28° 14' N, 177° 22' W), and Rose Atoll (14° 33' S, 168° 09' W).

Table 5.2: Crustacean management unit species list.

Scientific Name	English Common Name
Panulirus marginatus	Spiny lobster
Panulirus penicillatus	Spiny lobster
Family Scyllaridae	Slipper lobster
Ranina ranina	Kona crab

Amendment 10 to the Pelagic FMP

It is prohibited to harvest the pelagic management unit species listed in Table 5.3, and all future additions to the pelagic MUS list, in no-take marine protected areas designated in the Coral Reef Ecosystem FMP, and in any marine protected areas that may be designated by amendment to the Coral Reef Ecosystem FMP. The locations of the no-take MPAs are:

(1) federal waters shallower than 10 fathoms in the Northwestern Hawaiian Islands; and,

(2) federal waters shallower than 50 fathoms around Jarvis Island (0°23' S, 160°01' W), Howland Island (0°48' N, 176° 38' W), Baker Island (0° 13' N, 176°38' W), Kingman Reef (6°23' N, 162°24' W), Laysan Island (25° 45' N, 171°45' W), French Frigate Shoals (23° 45' N, 166°15' W), the Northern half of Midway Atoll (28° 14' N, 177° 22' W), and Rose Atoll (14° 33' S, 168° 09' W).

The Council also recommends that the Pelagic FMP be amended to specifically identify only the nine pelagic shark species that are to remain as Pelagic MUS. In doing so, all other oceanic sharks belonging to the families Alopiidae, Carcharhinidae, Sphyrnidae, and Lamnidae will be removed from the Pelagic MUS list at that time. The Council further recommends that all coastal shark species belonging to these families are to be managed under the CRE-FMP. Therefore, the Pelagic FMP is amended to:

(1) Remove all species of shark belonging to the families Alopiidae, Carcharhinidae, Sphyrnidae, and Lamnidae from the Pelagic MUS list except for the nine shark species listed in Table 5.3.

(2) Remove dogtooth tuna (*Gymnosarda unicolor*) from the Pelagic MUS list. (*Gymnosarda unicolor* is to be managed under the CRE-FMP.)

Table 5.3: Pacific Pelagic management unit species list, as amended.

Scientific Name	English Common Name	Scientific Name	English Common Name
Coryphaena spp.	Mahimahi (dolphinfishes)	*Isurus oxyrinchus*	Shortfin mako shark
Acanthocybium solandri	Wahoo	*Isurus paucus*	Longfin mako shark
Makaira mazara; *M. indica*	Indo-Pacific blue marlin Black marlin	*Lamna ditropis*	salmon shark
Tetrapturus audax	Striped marlin	*Thunnus alalunga*	Albacore
T. angustirostris	Shortbill spearfish	*T. obesus*	Bigeye tuna
Xiphias gladius	Swordfish	*T. albacares*	Yellowfin tuna
Istiophorus platypterus	Sailfish	*T. thynnus*	Northern bluefin tuna
Alopias pelagicus	Pelagic thresher shark	*Katsuwonus pelamis*	Skipjack tuna
Alopias superciliousus	Bigeye thresher shark	*Euthynnus affinis*	Kawakawa
Alopias vulpinus	Common thresher shark	*Lampris* spp	Moonfish
Carcharhinus falciformis	Silky shark	Gempylidae	Oilfish family
Carcharhinus longimanus	Oceanic whitetip shark	family Bramidae	Pomfret
Prionace glauca	Blue shark	*Auxis* spp, *Scomber* spp; *Allothunus* spp	Other tuna relatives

Amendment 5 to the Precious Corals FMP

It is prohibited to harvest the precious corals management unit species listed in Table 5.4, and all future additions to the precious corals MUS list, in no-take marine protected areas designated in the Coral Reef Ecosystem FMP, and in any marine protected areas that may be designated by amendment to the Coral Reef Ecosystem FMP. The locations of the no-take MPAs are:

(1) federal waters shallower than 10 fathoms in the Northwestern Hawaiian Islands; and,

(2) federal waters shallower than 50 fathoms around Jarvis Island (0°23' S, 160°01' W), Howland Island (0°48' N, 176° 38' W), Baker Island (0° 13' N, 176°38' W), Kingman Reef (6°23' N, 162°24' W), Laysan Island (25° 45' N, 171°45' W), French Frigate Shoals (23° 45' N, 166°15' W), the Northern half of Midway Atoll (28° 14' N, 177° 22' W), and Rose Atoll (14° 33' S, 168° 09' W).

Table 5.4: Precious Corals management unit species list.

Scientific Name	English Common Name	Scientific Name	English Common Name
Corallium secundum	Pink coral (also known as red coral)	*Lepidisis olapa*	Bamboo coral
Corallium regale	Pink coral (also known as red coral)	*Acanella* spp.	Bamboo coral
Corallium laauense	Pink coral (also known as red coral)	*Antipathes dichotoma*	Black coral
Gerardia spp.	Gold coral	*Antipathes grandis*	Black coral
Narella spp.	Gold coral	*Antipathes ulex*	Black coral
Calyptrophora spp.	Gold coral		

5.2.2 Low-use Marine Protected Areas

MPAs that allow for limited consumptive activities are becoming a popular tool for conservation of marine resources. Low-use MPAs—while effectively protecting coral reefs—have fewer social and economic impacts than no-take areas. Low-use MPAs may also serve as natural laboratories to conduct research and fishing experiments, and to test adaptive management measures. At the same time, through carefully managed exploitation they can provide for food, medicine, and other benefits.

This FMP establishes low-use MPAs in federal waters between 10 and 50 fathoms deep in the NWHI, and around Palmyra Atoll, Wake Island, Johnston Atoll, and the southern half of Midway Atoll in federal waters shallower than 50 fathoms. The draft regulations of this FMP (see Section 8.1) provide detailed descriptions of the location and extent of these low-use MPAs. Fishing for coral reef ecosystem MUS will be carefully regulated and monitored in the low-use MPAs established under this FMP through a special permit regime described in Section 5.3.

Any vessel operator[2] intending to fish in a low-use MPA must notify the NMFS Regional Administrator (RA) at least 72 hours before the vessel leaves port (not including weekends and federal holidays). The notice must be transmitted directly to the RA's office or via a telephone number designated by the RA. It must provide the official number of the vessel; the name of the vessel; the intended departure date, time, and location of the name of the operator of the vessel; and the name and telephone number of the agent designated by the permit holder that NMFS can contact on any weekday 8:00 a.m. to 5:00 p.m. (Hawaii Standard Time).

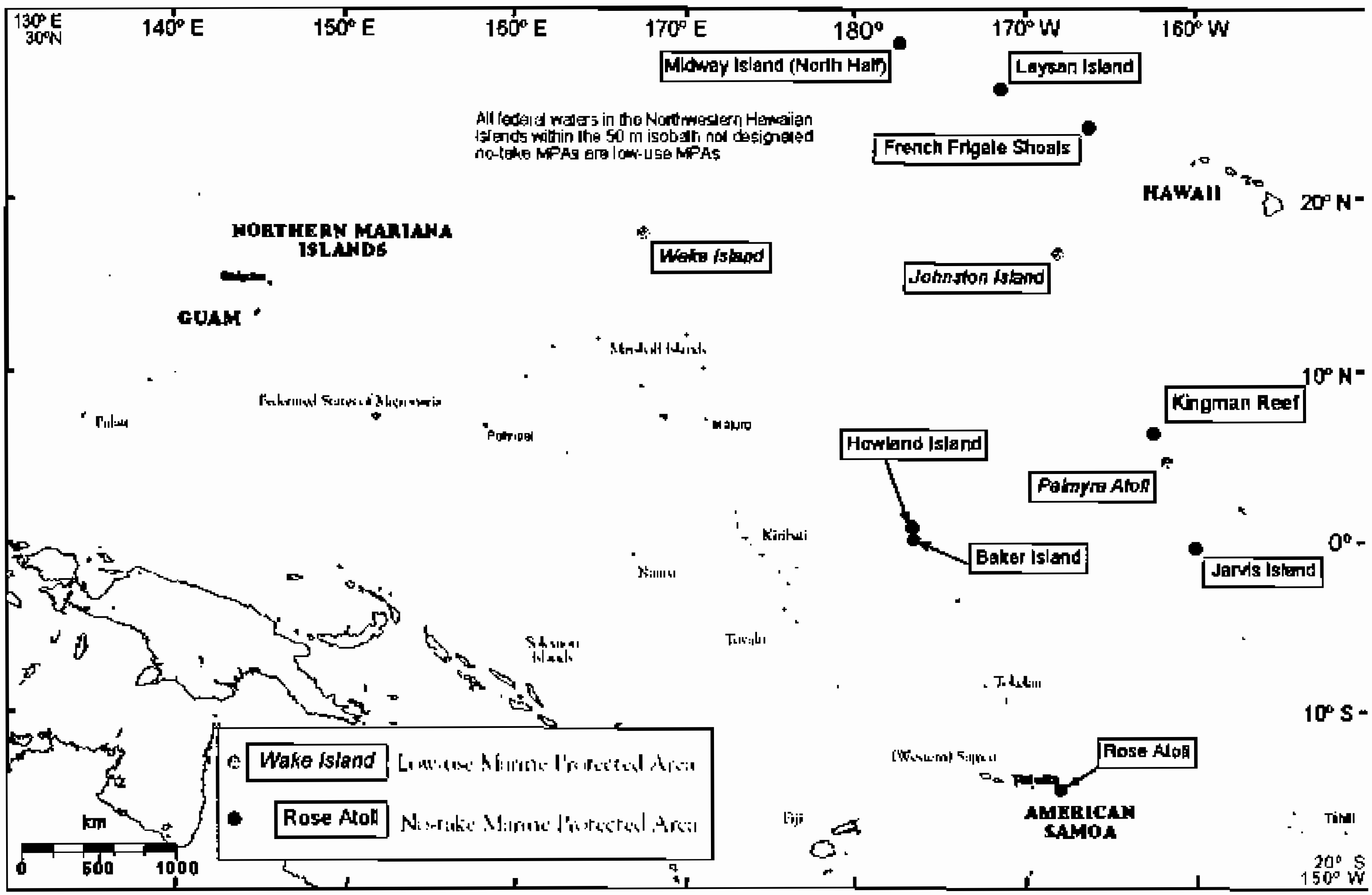
[2]The vessel operator will be presumed to be an agent designated by the permit holder unless the NMFS Regional Administrator is otherwise notified by the permit holder.

5.2.3 Operational Restrictions in MPAs

Most of the operational restrictions are inherent in MPA designation, as is the case with no-take MPAs, or stem from the permit regime described in the next section. (Other restrictions result from the gear restrictions outlined in Section 5.4.) However, there are two more general measures. First, all fishing vessels, including those regulated by existing FMPs, operating in or transiting an MPA must carry insurance to cover the cost of vessel removal and pollution liability in the event of a grounding. The insurance liability so required will be based on vessel category, permit type, and fishing area. Additionally, the Council will work with the relevant authorities to prohibit cruise ships from operating within established no-take and low-use MPAs. The Council will also work with the relevant authorities to authorize other vessels operating within MPAs to carry insurance similar to that which will be required for fishing vessels, as just described. Second, anchoring will not be permitted by vessels larger than 50 feet on Guam's Southern Banks. (It should be noted that the Southern Banks are not designated an MPA under this FMP, so none of the other MPA-related restrictions apply to that area.) In the event of an emergency caused by ocean conditions or vessel malfunction, vessels would be exempted from this prohibition. But they must be able to document the condition or malfunction after the fact.

The Council considered designating sub-zones within low-use MPAs that would be reserved for use by indigenous people on populated islands adjacent to the MPAs. However, the size, location, and specific rights of use have not been determined in any detail. Therefore, indigenous use sub-zones will not be implemented as part of this FMP, but could be a proposed measure for future framework action.

Figure 5.1: Location of MPAs proposed in this FMP.



5.3 Fishing Permits and Reporting Requirements

Permits are a fundamental management tool, and are used as a basis for participation in many U.S. domestic fisheries. Permits establish the legal rights, privileges, and obligations of fishermen. They are thus a vehicle for specifying the conditions under which fishing occurs. For example, performance standards can be set as qualifying criteria for obtaining and renewing permits. Permits can also specify that fishermen provide basic data for fishery monitoring and management. This monitoring can extend to permit holders' success in complying with permit requirements; by evaluating their records, managers can maintain a register of those permit holders in good standing. Permits will be issued only to U.S. citizens or nationals. Permits are not assigned to specific vessels, although the vessel being used during fishing operations will be identified on the permit application.

A permit process that allows managers to monitor participation, effort, and catch contributes to seven of the eight FMP objectives outlined in Section 1.4. Objective 4, which calls for measures to minimize adverse human impacts, is particularly addressed by permitting. More specifically, special permit conditions will allow managers to carefully monitor emerging coral reef fisheries and fisheries in low-use MPAs. Permits focus management attention on the specific reef resources and areas to be exploited and the harvest methods to be used. Periodic analysis of catch/effort data collected through permit reporting facilitates adaptive management. Finally, special permits can encourage applicants to more carefully consider their proposed activities and the potential impacts.

Table 5.5: Summary of CRE reporting requirements.

Fishery Type	Fishery Allowed In:	Permit Type Required	Reporting Requirement
All fisheries (except existing FMP fisheries)	All low-use MPAs	**Special permit** *Framework for general permit*	via special permit
Currently harvested CRE taxa (existing fisheries)	Outside no-take areas	*Framework for general or special permit*	via local monitoring/ coordination
Potentially harvested CRE taxa (new fisheries)	Outside no-take areas	**Special permit** *Framework for general permit*	via special permit
Exemptions to ban on take of wild live rock and coral (bioprospecting, indigenous)	Outside no-take areas	**Special permit**	via special permit
Existing FMP fisheries (bottomfish, crustaceans, precious corals, pelagics)	Outside no-take areas	Follow permit requirements in respective FMP	Report incidental take of CRE taxa via respective FMP requirements

The permit regime adopted through this FMP will regulate the harvest of coral reef ecosystem management unit species (described in Section 1.6.1) under Council jurisdiction. As already noted, the management area covers EEZ coral reef resources in the Council region, including the remote U.S. island possessions directly under federal control, where permits would apply to fishing from the shoreline to the outer edge of the EEZ. (In no-take MPAs, of course, marine resources harvesting is prohibited).

5.3.1 Permit and Reporting Regimes

Two types of permits will be used to manage coral reef fisheries. First, a special permit will be required to fish in low-use MPAs and to harvest Potentially Harvested Coral Reef Taxa (PHCRT). A second permit type, the general permit, may be implemented at a later date, using the framework process described in Section 5.5. General permits, if implemented, would be required to fish for Currently Harvested Coral Reef Taxa (CHCRT) in the EEZ outside of MPAs. In the meantime, existing permit regimes in the region will be used to manage CHCRT harvests outside MPAs. For the most part, these permit regimes, administered by local agencies in the various jurisdictions in the Council region, effectively manage current coral reef fisheries, to the degree that these fisheries are active. Hawaii and American Samoa have these locally-administered permitting systems. In Hawaii, any person who sells their catch is required to have a commercial fishing licence granted by the Department of Land and Natural Resources. In American Samoa, the Department of Marine and Wildlife Resources issues a variety of fishing permits and commercial licences via a regional general form. Fishing for CHCRT in CNMI and Guam does not require a permit. Nevertheless, information on numbers of vessels fishing, fishing effort, and catch data are collected through standardized sales receipts and creel censuses. If, in the future, these locally-administered permit regimes are deemed inadequate, a federal permit, such as the general permit mentioned above, could be implemented by the framework procedure.

Anyone wishing to fish in the EEZ must contact their local marine fisheries office to confirm if a permit is needed, based on the specific target resources sought and the area to be fished. Local marine fisheries offices will handle requests for participation in all existing fisheries in coordination with the NMFS Pacific Islanda Area Office (PIAO), unless by means of a framework measure the Council has specified some other process. If appropriate, the PIAO will explain the proper procedure to the fisherman and make available permit and logbook forms as needed.

The Special Permit and Reporting Regime

Special permits will be required for:

(1) fishing for coral reef taxa in a low-use MPA;

(2) targeting all PHCRT anywhere fishing is allowed in the EEZ; and,

(3) bioprospecting.

The Council thinks that, in general, harvesting significant quantities of wild live rock and live coral should be prohibited because of the harm it could do to the coral reef ecosystem. However, they recognized that limited harvests could be allowed by special permit in two circumstances:

(1) collection of seed stock by aquaculture operations; and, (2) collection by indigenous people for traditional and ceremonial uses.

Once enough data has been acquired from fisheries targeting PHCRT, the framework process could be used to classify the taxon as a CHCRT. A special permit would then no longer be required to harvest the taxon. In addition, in order to use fishing gear that is not one of the allowable gear types listed in Section 5.4, a person will have to apply for a special permit. The applicant must fully describe the gear and its mode of deployment on the permit application. These applications will be reviewed using the same process as would be used for any other special permit application.

Currently, residents on and visitors to Palmyra, Johnston and Wake Islands and Midway Atoll—which under this FMP will be surrounded by low-use MPAs—are allowed to fish recreationally, in some cases using catch-and-release. Although these fisheries are regulated by the USFWS, they are not regulated by any of the Council's already-implemented FMPs. Therefore, under this FMP people who want to take coral reef resources for recreation and personal on-island consumption will have to obtain a special permit for this purpose. They will have to provide an estimate of their total take (in pounds) and this must be approved by the local authority. Any local fishing regulations in effect should also be followed. If these procedures are followed, the NMFS PIAO may allow the on-site resource manager to issue these permits. Since the USFWS already regulates and monitors these activities, their programs will be taken into consideration as part of the permit application process.

Special Permit Application and Review Process

Anyone who wants to fish in the EEZ and meets any of the criteria listed above for the special permit requirement must contact the PIAO in order to obtain an application. They may contact the office directly, or they may be directed to the PIAO by the fishery management agency in their jurisdiction. A completed application must be submitted along with any specified fees at least 60 days prior to the desired date of permit action. The fee will be calculated based on administrative cost, in accordance with procedures in the NOAA Finance Handbook. (A sample application form with directions may be found in Section 8.2.) The applicant must provide the following information:

1. the species or taxa to be targeted by the fishery;
2. the estimated amount of catch (in pounds);
3. the general areas/banks that will be fished; and,
4. the gear that will be used and methods of collection.

Within 10 business days after they receive the application the PIAO will notify applicants if they need to submit additional information in order to process their application. Incomplete applications will not be processed until corrected in writing.

After receiving a completed application, the PIAO Administrator will consult with the Council and the director of the affected state fishery management agency. The Council will then inform PIAO of its decision to approve or deny the application. At the discretion of the Council, it may invite the applicant to appear in support of the application at the next Council meeting. In its review, the Council will consider anticipated cumulative effects of fishing and other activities in the proposed area, environmental factors which could compound effects of fishing pressure, and other relevant scientific information before making recommendations. After reviewing the Council's decision and supporting material, the PIAO Administrator will notify the applicant in writing whether the application has been approved or denied. If the application is denied, reasons for denial will be sent to the applicant in writing within 60 days. Permits can be denied for a number of reasons. Reasons include but are not limited to:

- The applicant has failed to disclose material information required, or has made false statements as to any material fact, in connection with his application;
- According to the best scientific information available, the harvest to be conducted under the permit would be significantly detrimental to the population of any species of fish or fish habitat;
- Activities to be conducted would be inconsistent with the intent of the special permit program or the management objectives of the FMP; and,
- The activity proposed under the special permit would create a significant enforcement problem.

Appeals for denied permits are outlined in Section 5.3.3.

Special Permit Logbooks

Catch reporting is an essential part of the permitting regime. Special permit holders will have to maintain a logbook to record and report their fishing activity. Logbook format and data reporting methods will be determined during the special permit approval process. However, any permit-specific requirements are in addition to the following basic requirements. The permittee must:

1. Report catch, effort and discards by species, location, time, and other factors as specified by the Council;
2. Report protected species observations;
3. Report any lost gear or damage to the coral reef (with no penalty to permittee);
4. Complete a daily logsheet within 24 hours after completion of the fishing day; and,
5. Submit reports within 30 days of returning to port.

For a more complete description, an example special permit daily catch report, and the directions to fill out the form see Section 8.2.

The operator of a vessel harvesting coral reef resources in a low-use marine protected area must contact the USCG, by radio or otherwise, at the 14th District, Honolulu, HI; Pacific Area, San

Francisco, CA; or 17th District, Juneau, AK, at least 24 hours before landing, and report the port and the approximate date and time at which the coral reef resources harvested on the trip will be landed.

As noted above, only recreational and on-island consumption fishing is allowed on Palmyra, Wake and Johnston Islands and Midway Atoll. The USFWS has programs in place to monitor these fisheries. If, after applying for a special permit through PIAO, the Council determines this reporting is adequate for the MSFCMA, and data are properly processed and provided to the appropriate Council advisory bodies, no further data collection will be required.

The General Permit and Reporting Regime

As mentioned above, general permits could be required to harvest CHCRT in any area of the EEZ not designated an MPA. If the Council determines that any extant locally administered permitting and reporting system is inadequate, because it is inconsistent with the objectives of this FMP, the general permit regime could be implemented by means of a framework measure (see Section 5.5.1). This framework procedure can be initiated in one of three ways:

1. If after reviewing the Coral Reef Ecosystem annual report the Council finds that data collection is inadequate, overfishing is occurring or there is the potential for overfishing, or other relevant scientific data show that there is a need for additional management measures;
2. If the Coral Reef Ecosystem Plan Team issues a report to the Council outlining concerns that need to be addressed at the next scheduled Council meeting; and,
3. If at any time regional management authorities bring concerns to the attention of the Council.

General permits can only be issued if the applicant meets certain minimum requirements, such as he or she is at least eighteen years old, a U.S. citizen or national, has no criminal record, and has completed the application form. Applications will be denied if the applicant does not meet any one of the minimum requirements or if in the past the applicant has been cited for not complying with regulations or reporting requirements. A general permit and reporting requirement would allow fishery managers to assess individual fishing effort and methods for a given target species, and associated bycatch. Implementing a general permit would result in more effective and adaptive management because consequent mandatory reporting would allow more specific data to be collected. The general permit application and review process would be administered by the PIAO in a manner similar to that described above for the special permit. Also like the special permit, a denied permit application may be appealed, as described in Section 5.3.3.

<u>General Permit Logbooks</u>

For existing coral reef fisheries that harvest CHCRT outside of MPAs—typically in EEZ waters around the main Hawaiian Islands, Guam, CNMI, and American Samoa—data reporting will be coordinated through the fishery management agencies in local jurisdictions. As with locally administered permitting, these reporting regimes—covering subsistence, recreational, and commercial fishers—currently provide sufficient information for management. Mechanisms currently in effect include dockside creel surveys, logbooks, and/or sales reports in American Samoa, Guam, and the CNMI. Since these methods are adequate, no changes are recommended. Fishery management agencies in these jurisdictions, and in Hawaii, also collect data through commercial purchases from buyers and wholesalers. The CNMI government has requested all fish buyers to fill out data forms since 1983. While commercial fish catch reporting is also still voluntary in Guam, a relatively high percent coverage has been maintained since 1982 through cooperation of the major fish dealers there. In American Samoa, the Department of Marine and Wildlife Resources requires fish buyers to fill out a form that includes the date, species, weight of fish purchased, and additional economic information. Fishermen who land their catch in Hawaii are required to fill out a fish catch report; it includes area fished, type of gear, and weight and numbers of fish caught by species.

If the Council determines data collection to be inadequate for the given fishery, the general permit could be implemented through the framework process. In addition to the permit, this regime would also require a "general coral reef taxa daily catch report," which will be provided by NMFS. NMFS can coordinate with local fisheries agencies to facilitate the collection, distribution, and processing of data via established WPacFIN protocols. Section 8.2 contains an example of this form and associated directions. Catch report or general permit logbook format and data reporting methods will be determined during the framework implementation process. However, any permit-specific requirements are in addition to the same five basic requirements listed below for the special permit logbook. The permittee must:

1. Report catch, effort and discards by species, location, time and other factors as specified by the Council;
2. Report protected species observations;
3. Report any lost gear or damage to the coral reef (with no penalty to permittee);
4. Complete daily logsheet within 24 hours after completion of the fishing day; and,
5. Submit reports within 30 days of returning to port.

It should be noted that the PIAO Administrator may, after consultation with the Council, initiate rule-making to modify these or any fishing record forms.

5.3.2 Federal Permit Exemptions

Two activities are exempted from the special permit and any future general permit requirement:

<u>Scientific Research</u>: Scientific research is permitted in all areas of the EEZ, including both no-take and low-use MPAs, if approved by the NMFS-Southwest Regional Administrator (RA), Science Center Director, or designee. The RA will, upon a formal request for a scientific permit for a given project in a designated area, contact the regional authority and consult with both the Council and the regional management agency at a subsequent Council meeting and prior to issuing a scientific permit. Foreign scientists who want to conduct research in the EEZ of the

Western Pacific Region must also contact the RA with a formal request. The RA will also contact the appropriate regional authority and then consult with the Council in the same manner as for domestic scientific permits.

Fishing permitted by other Council FMPs: Fishing for species managed under one of the Council's implemented FMPs already requires a permit, as specified by the relevant FMP. Therefore, participants in those fisheries will not be required to get a second CRE permit to fish in the CRE management area. They are already required to report any incidental catch of coral reef taxa under the relevant FMP permit and reporting regime. This information will be shared among managers through formal and informal coordination (see Section 5.5.3).

5.3.3 Appealing a Denied Permit

Within 30 days of receiving reasons for denial of a special or general permit from the PIAO Administrator, the applicant must submit in writing to the NMFS Southwest Regional Administrator an explanation of why he or she is appealing the decision, including supporting material for the appeal, and copies of the original application and reasons for denial. The applicant may also request an informal hearing.

Appeals to decisions will be heard by the RA, who will consult with the Council prior to making a determination. The RA has the discretion to grant the informal hearing. If no hearing is granted, the RA will notify the applicant and other interested parties in writing of the decision within 30 days.

If the RA determines that a hearing is necessary, a notice of the time, place, and subject will be published in the Federal Register. The hearing shall be held before a hearing officer within 30 days of the FR notice. The appellant and all interested parties are invited to give testimony. Within 30 days of the close of the hearing, the hearing officer will make a written recommendation to the RA on his decision. Within 30 days of receiving this recommendation, the RA will notify the appellant and other interested parties about the final action. Time limits may be extended for a period no longer than 30 days by either the RA or through a request from the appellant, based upon a written request stating good cause.

5.3.4 Data Processing and Annual Reports

For other FMP fisheries, data processing procedures have been established for Hawaii, Guam, CNMI, and American Samoa. The CRE-FMP will follow these established procedures. Creel survey, logbook, and/or commercial buyer's data will be collected and processed by the relevant local agencies in each jurisdiction. A cooperative program, funded in part by NMFS, augments existing fisheries monitoring efforts so that they more effectively support FMP objectives. As part of this cooperative agreement, NMFS staff make regular visits to the insular areas to coordinate data programs and to help produce the other FMPs' annual report modules. This cooperative program can support CRE data analysis in the same fashion, including NMFS staff visits. Island-specific annual report modules will be produced by CRE Plan Team members from each respective island jurisdiction. Additional data come from federal logbooks, which are submitted directly to the NMFS-Honolulu Laboratory. Once all this information is given to the Council, it will be combined with other required material to produce the CRE-FMP Annual Report, which must be published by July 31 of each year. Annual reports are divided into six regions: MHI, NWHI, PRIAs, American Samoa, Guam, and CNMI. They include summaries of the status of the fisheries, the health of the ecosystem, status of current research, economics of the fisheries, and potential or emerging issues. They also include a section detailing fishing and non-fishing impacts to Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC) for both nearshore and EEZ waters throughout the Council region. Finally, these reports include actions taken in the past year by the Council; recommendations from the Plan Team, Advisory Panels, and the Scientific and Statistical Committee; reports from enforcement; and a report on the status of protected species.

5.3.5 Other Permit-related Matters

Fishing Regulations

Upon receipt of a special permit (or general permit if implemented), the user must affix the permit to the vessel for which the permit was issued in the manner outlined in regulations pursuant to this FMP. Regulations that will affect fishing operations include, among others, gear and area restrictions.

Transshipment Logbooks

Any vessel engaged in transshipment of coral reef ecosystem resources in the EEZ must have a permit issued for such activity as outlined in regulations pursuant to this FMP. These vessels must have an accurate and complete NMFS transshipment logbook. Section 8.2 contains an example form and directions. All required information must be recorded on the form within 24 hours after transshipment is completed. This information must be submitted to NMFS within seven days of landing transshipped coral reef ecosystem resources in port.

State Reporting

Vessels required to complete a federal logbook must still follow any state laws and regulations regarding reporting and submit those forms to the appropriate state agency. These records shall be made available for federal inspection and copying if an authorized officer so requests.

5.4 Fishing Gears and Methods

Pacific Islanders have fished on coral reefs for several thousand years. Sustainability resulted in part from the inefficiency and selectivity of the gear that they used. Many of these traditional methods are still used in contemporary fisheries, although the introduction of manufactured gear and population growth have increased the impacts. Today's fishermen employ a wide variety of gear and methods to harvest extremely diverse resources numbering hundreds of species. Most of these methods are very inefficient when compared to industrial fishing technology, such as bottom trawls, all-terrain trawls, bottom dredges, or industrial netting—used in U.S. continental shelf fisheries but prohibited in many benthic fisheries around the Pacific. However, several potential threats to coral reef resources in the EEZ around U.S. Pacific Islands remain, due to the use of destructive fishing methods.

Unregulated live reef fish harvests for food and ornamental markets are already a problem in Southeast Asia, and could find their way to U.S. EEZ waters, especially in remote, difficult to monitor areas. Controls are needed to prevent the possession or use of destructive gear such as poisons, explosives, and intoxicating substances. Gillnets also need to be controlled because they can be very unselective, if left unattended. Along with other non-selective gears and methods, they result in substantial incidental catch or bycatch. Scuba-assisted spearfishing at night can be very efficient because highly-prized fish, which sleep among coral heads and in reef crevices, can be sought out and easily speared. Bioprospecters may also wish to harvest reef resources. Despite the potential benefits to society, any harvesting must be carried out in a controlled manner. The collection of these organisms, many of which are still unknown, will utilize novel techniques that are difficult to anticipate.

Because certain gear types can damage habitat and result in high levels of bycatch, FMPs are required to list allowable gear types. In addition to meeting this requirement, specifying allowable gear types addresses several FMP objectives including Objective 1- sustainable use of resources, Objective 4- minimizing adverse human impacts, and Objective 7- effective surveillance and enforcement.

Three criteria have been used to rate fishing gear that has been or may be used in the coral reef ecosystem environment. First, how selective is the gear, or how well does it catch the target species and not other organisms? Second, does the gear damage essential fish habitat? And third, to what degree does the gear or method of use allow species to find refuge from capture?

5.4.1 Restricted Gear

The use of poisons, explosives and intoxicating substances are specifically banned in all areas of the EEZ. Scuba-assisted spearfishing at night is prohibited in the PRIAs and NWHI, and in other areas, scuba-assisted spearfishing could be prohibited via future framework action so as to be consistent with local regulations.

5.4.2 Allowable Gear

Existing FMP fisheries shall follow the allowable gear and methods outlined in their respective plans. For coral reef fisheries, only the following 11 selective, non-destructive fishing gears are allowed: (1) hand harvest; (2) spear; (3) slurp gun; (4) hand net/dip; (5) hoop net (for kona crab) net; (6) throw net; (7) barrier net (for aquarium fish); (8) surround/purse nets for targeted schools (e.g., *akule*, baitfish, *weke*) with a minimum of bycatch; (9) hook-and-line (includes powered and unpowered handlines, rod-and-reel, and trolling); (10) traps (with conditions); and (11) remote-operating vehicles/submersibles.

Anyone who wants to fish with gear that is not on this list must describe the gear and its method of deployment in the special permit application. The PIAO Administrator will rule on the acceptability of a proposed gear type after consulting with the Council and the director of the affected state fishery management agency. While fishing for coral reef resources in the EEZ, it is prohibited to possess any gear not approved under 50 CFR 660.108 (a) or not approved by the PIAO Administrator as part of the permit approval process.

5.4.3 Unattended Gear and Gear Identification

Because any allowable gear type, if improperly used, has the potential to cause damage, specific conditions of operation are outlined in the gear catalogue (Appendix B). In summary, nets must be tended at all times (except hoop nets for Kona crabs) and traps must only be used in appropriate areas and only operated under appropriate conditions. These conditions are meant to minimize bycatch mortality, produce negligible habitat impact, and minimize the possibility of ghost fishing. In addition, all traps on board a vessel possessing a CRE-FMP permit or deployed by this vessel in the EEZ must be permanently and legibly marked to identify the owner. NMFS personnel, or an authorized officer, may seize and dispose of traps found that do not comply with CRE-FMP regulations and are unattended in EEZ waters. By the same token, they may dispose of unattended surround nets or bait seine nets. The U.S. Coast Guard has authority to board any vessel in the EEZ to check for violations, including gear compliance.

5.5 Other Components of the Management Regime

This section describes three parts of the management regime that are not immediately implemented as regulatory measures. Section 5.5.1 describes procedures to adapt the management regime to changing environmental and fishery conditions. These are the framework and amendment processes for implementing new management measures. Section 5.5.2 outlines how management measures will be enforced. Finally, Section 5.5.3 list non-regulatory measures that will improve inter-agency coordination, and highlights education programs to raise public awareness.

5.5.1 Adapting the Management Regime to Changes in the Environment and Fishery

Since the status of coral resources and their exploitation can change over time, any management regime must be able to adapt to those changing conditions. Flexibility is also needed to change management measures in response to new information on ecosystem function, including how it responds to alteration, and on productivity limits. Implementation is also a learning process and regulations sometimes need to be changed if, for example, they do not work as intended. Generally, the process of changing the management regime begins with recommendations made in the annual report and/or at Council or other advisory body meetings. There are two ways to implement new management measures, by the framework procedure, for established measures, and by FMP amendment, for new measures.

Framework Actions for Established Measures

Established management measures can be changed in an administratively simpler and more timely fashion through the framework process. Framework measures are measures that have been evaluated in this FMP or one of its amendments. These changes, or "adjustments," must be consistent with the original intent of the measure and within the scope of analysis in any previous documents supporting the existing measures. All adjustments must address the objectives of this FMP, which taken together promote sustainable resource management of coral reef ecosystems. Provided that a proposed adjustment meets these criteria, a draft document is prepared. It outlines the need for actiou, analyzes alternatives, provides supporting material, and describes how other federal laws may be applicable. A notice is then placed in the Federal Register and the document is made available for public comment. A public hearing may also be required. After receiving and addressing all public comments, the document is revised prior to the next Council meeting, when the Council votes on it. If the measure is approved, the RA is asked to begin rule-making.

This section identifies five such measures, which could be implemented at a later date using this procedure. These are: (1) mooring buoy installation and an anchoring prohibition, (2) a vessel monitoring system (VMS) reqnirement for vessels operating in specific coral reef areas, (3) implementation of the general pennit and reporting regime, (4) moving MUS on the PHCRT list to the CHRCT list, and (5) designating indigenous sub-zones within low-use MPAs. Additional measures could be implemented through the framework process too, if their impacts are evaluated in a subsequent amendment to this FMP; otherwise a full FMP amendment is required.

These five measures are not slated for immediate implementation for several reasons. Details for actions 1, 2 and 5 still need to be worked out. For action 1, mooring bnoy locations have not yet been determined, although all parties agree on their importance. For action 2, a closer look at the needs of vessels operating in MPAs and a better understanding of EFH and HAPC will be required. It has not yet been determined whether the federal government will pay for the installation and operation of VMS in this fishery. For action 5, the size and location of indigenous sub-zones have not been decided and legal issues were not fully explored. Although the management aspects of framework measures 3 and 4 have been explored in this FMP, their implementation depends on the availability of new information on the fishery and its environment.

1. **Designate zones in the EEZ where mooring buoys will be installed in order to protect EFH from anchor damage. In areas with approved mooring buoys, probibit anchoring of fishing vessels within a radins indicated on the bnoy.**

Rationale: "No anchor zones" in specific habitat areas wonld protect coral reefs from devastating anchor damage. Mooring buoys have been used successfully in Hawaii and elsewhere in the Pacific as an alternative to anchoring, particularly in high use areas. The buoys would be nsed on a first-come-first-served basis and allowed time limits would be specified so that no one boat monopolizes a buoy. This process would ensure that the use of these buoys and the concomitant access to the resources would be fair and equitable to all fishermen, consistent with National Standard 4. Only one boat would be allowed to moor at a time at each buoy. The prohibition of anchoring would limit the number of secured boats fishing an area to the number of mooring buoys at the site. While this may concentrate fishing effort around the buoys, it would also limit the number of vessels fishing at one time, increasing vessel safety and minimizing fishing pressure on coral reef resources.

Beneficial Impacts:

- Prevents anchor damage to reef habitats and allows anchoring for safety reasons in EFH and/or HAPC.
- Limits number of vessels fishing on the banks at one time, increasing vessel safety and minimizing fishing pressure on coral reef resources.
- Increases safety of fishermen by making anchoring (and its hazards) unnecessary and reducing risk of anchor dragging.
- Is consistent with requirements of the Sustainable Fisheries Act by minimizing degradation of coral reef habitats.

Adverse Impacts:

- Limits number of vessels able to fish in a designated mooring zone at one time.
- Mooring buoy maintenance may be difficult.
- May concentrate fishing effort in areas with buoys.
- Includes a cost for installation and maintenance of buoys.
- May encourage "rafting" of vessels at each mooring buoy (even though it would be prohibited under the measure), which is a safety concern.

2. **Require fishing vessels to carry remote electronic vessel monitoring systems (VMS) as part of an effective monitoring and enforcement system for state and federal agencies. This requirement could be applied to coral reef fisheries in specific geographical areas (e.g., the NWHI). This measure will only be enacted if the cost of such a system is fully subsidized with federal funding.**

Rationale: VMS is an effective system for managing vessels operating in areas with different use zones, such as the MPAs, and with different licenses/permits, and for encouraging and documenting compliance with permit conditions. The vessel's precise location would be transmitted via satellite to a Land Earth Station and from there to a computerized monitoring station where the information would be kept in a secure and confidential database. If the vessel enters a designated buffer zone or MPA, an automatic signal is sent to both the ship's captain and the appropriate management agency. Such a system may prove to be a cost-effective compliance tool for real time and accurate positioning of vessels and instant recognition of a breach of permitted activities, as well as a tool to locate vessels in distress. VMS also has been shown to be an effective tool for monitoring vessels' locations in relation to navigational hazards and, when used in conjunction with automated buffer zones, may serve as an additional warning mechanism to prevent vessel groundings.

Beneficial Impacts:

- Protects coral reef resources by providing early warning of a vessel approaching too close to a reef slope, thereby protecting both the reef and the vessel from grounding damage.
- Protects coral reef resources by providing a tool that can dramatically improve compliance with FMPs.
- Is consistent with the requirements of the Sustainable Fisheries Act.
- Provides precise location information to assist in emergencies and rescues.
- Provides documentation on vessel movements, which can be used to clear up misunderstandings regarding liability or accusations of responsibility for environmental damage.
- Requires no input by captain or crew to run the automatic system.
- Can make enforcement easier and potentially much less costly.

Adverse Impacts:

- Cost of implementation may be burdensome to federal government.
- Implementation will require fiscal and personnel resources.
- Fishermen are concerned over the use of VMS information (security and confidentiality of data).

3. **Require general permits to fish for CHCRT MUS outside of MPAs in the EEZ, in the event that regional management is determined inadequate to protect the species and/or ecosystem.**

Rationale: This framework measure is described in Section 5.3.1 in the subsection outlining the general permit and reporting regime. Initially, general permits will not be required for existing CRE fisheries. This option to implement a general permit requirement would allow fishery managers to assess individual fishing effort and methods for a given target species and associated bycatch before any vessel begins fishing. This more detailed data collection and mandatory reporting would facilitate more effective and adaptive management. This framework measure can be enacted if the Council determines that a locally administered permit and reporting regime does not adequately address CRE-FMP objectives. A general permit, issued by NMFS-PIAO, would then be required to harvest CHCRT MUS in the EEZ outside of MPAs.

A number of methods could be used to instigate this framework procedure: (1) as a result of the Council reviewing the Coral Reef Ecosystem Annual Report for adequate data collection, overfishing or potential for overfishing, and other relevant scientific data which reflect the need for additional management measures, (2) the Coral Reef Plan Team issuing a report outlining concerns to the Council to be addressed at the following scheduled Council meeting, or (3) regional management authorities bringing their concerns to the attention of the Council at any time.

American Samoa can be used as an example of how a general permit and reporting regime could be implemented and applied, using framework procedures. This example is particularly apposite because reef fisheries occur both in territorial and federal waters. The American Samoa Department of Aquatic and Wildlife Resources issues permits to fish for coral reef species and collects data through both creel surveys and commercial purchases. These reef fisheries are small-scale operations, with individuals catching a few to a couple hundred pounds of fish on a given day. If one or more large-scale operations began efficiently targeting these species in the EEZ, increasing the total catch substantially, regional management might not be sufficient to address this development. The Council could then initiate the framework process to require a general permit for reef fisheries in the EEZ of American Samoa.

While details about who would be affected and how the measure would affect fishing are unique and unforeseeable, general procedures can be outlined here. Federal regulation 50 CFR 660.13 details current permitting procedures, which would also apply to this CRE general permit. Permits would be valid only for the fishery management subarea specified on the permit and remain valid for the period specified unless transferred, revoked, suspended, or modified. A permittee first requests an official Southwest Region Federal Fisheries permit application form. After filling out all required information and attaching necessary documents (see example form in Section 8.2), the permittee returns the application along with any fees, as specified. The PIAO will review and process all completed applications within 15 business days. Permittees will be notified of incomplete or incorrect applications. If deficiencies are not corrected within 30 days following notification, the application will be considered abandoned. Within 15 business days after receiving a completed application, the administrator of the PIAO will issue a permit to the applicant under the CRE-FMP or send a written notification of denial, which will include the reasons for the denied application.

Beneficial Impacts:

- Requires specific data reporting of catch, effort, area, and method of fishing.
- Allows for a thorough understanding of the total fishing effort for given areas and given target species.
- Provides information on bycatch and protected species.
- Allows for standardization of reporting, assisting fishery managers assessment of impacts
- Makes fishermen more aware of concerns of impacts from fishing through completing both permit form and logbooks.
- Assists adaptive management with crucial data on fishery.

Adverse Impacts:

- Increases administrative burdens (time and costs) due to the permit process.
- Increases burdens to fishermen not used to completing this type of paperwork.

- Removes management from regional authority which had traditionally managed these fisheries.

4. Allow particular MUS on the PHCRT list to be moved to the CHCRT list when sufficient information has been gathered for less restrictive management.

Rationale: If a market develops for potentially-harvested species, fishermen will request to fish those species under a special permit. The special permit embodies the precautionary approach. Permit approval requires a thorough description and evaluation of all aspects of the fishing method for each applicant. Additionally, permittees will be subject to strict reporting requirements, including submittal of bycatch and discards information. The data gathered from the vessels will help managers determine MSY, OY, and potential for overfishing. When enough data has been gathered for a given species or species complex and its associated bycatch to understand cumulative impacts on the species and the ecosystem, the Council can determine whether to lessen the stringent requirements by moving such species to the currently harvested list. This reduces administrative and regulatory burdens at the appropriate time without causing risk to the resource.

Beneficial Impacts:

- Relieves unnecessary administrative burdens associated with fishing for species for which management is better understood.
- Reduces burden to the Council and the PIAO Administrator for permit approval.
- Eases burdens on fishermen who have complied with regulations, allowing for given species to be re-listed as CHCRT.
- Procedure to re-list MUS prompts fishery managers to better understand species and the ecosystem to facilitate effective management.

Adverse Impacts

- Has the potential to put species at risk, which could require more stringent management measures.
- Could facilitate additional fishing pressure for given species due to less stringent permit requirements for allowed harvesting.

5. Designate a set percentage of the area within low-use MPAs for sole use by indigenous people, with the percentage based upon the percentage of indigenous population in the area around the low-use MPA.

Rationale: Discussions during the planning process centered around access for Native Hawaiians to the NWHI for traditional and ceremonial purposes. Later on, other island cultures were included in these discussions, with details to be worked out in the future as new MPAs were designated in their EEZs. At this time, however, details are lacking even for the NWHI. Details include where the areas would be, the exact percentage of low-use MPA that would be set aside, and also the legal issues surrounding the proposal. Nevertheless, the CRE Plan Team and other groups strongly believe in the premise. As discussed in Section 1.3.5, the indigenous people of the Samoan, Hawaiian and Mariana islands have close historical and cultural relationships with the marine environment and coral reef resources. Increasing restrictions on customary and traditional uses of marine resources are jeopardizing cultural continuity in many areas of the U.S. Pacific. The designation of no-take zones in the NWHI could result in some negative impact on the Hawaii fishing community by causing a loss of earning potential, investment value, and lifestyle for some bottomfish and lobster fisheries participants.

A 1993 survey of participants in the NWHI bottomfish fishery found that half of the respondents who fish in the Ho'omalu Zone were motivated to fish by a long-term family tradition (Hamilton 1994). This sense of continuity is also reflected in the importance placed on the process of learning about fishing from "old timers" and transmitting that knowledge to the next generation. Hawaii's commercial fishing industry dates back nearly 200 years and closure of some fishing grounds in the NWHI would also likely have a negative impact on those who value the continued existence of Hawaii's maritime tradition and culture. In view of the historic and cultural importance of fishing over the last 2,000 years for Native Hawaiians, this deprivation of the right to make a living at *koa* (see Kahuulelio 1902, pp. 22, 24), which they have been accustomed to frequent in the NWHI, is an especially onerous penalty. Two events have exacerbated this situation. First, annexation of Hawaii by the U.S. opened access to fishery resources to any U.S. citizen (Kosaki 1954). Second, this action increased fishing pressure on resources customarily used by Native Hawaiians and weakened cultural norms that controlled the proper conduct of fishing.

Beneficial Impacts

- Helps preserve and reestablish island cultures and families whose history of traditional and ceremonial use of coral reef resourees dates back thousands of years.
- Adds additional protection within low-use MPAs, by effectively limiting the amount of users in the area.
- Will make the permitting process for certain activities simpler because usage in these areas can be expected to be uniform across these select user groups.
- Potentially supports subsistence fishing.

Adverse Impacts

- Could be challenged legally on grounds of discrimination.
- Locations and size of the sub-zones could cause contention between user groups.
- Concerns have been expressed regarding what constitutes cultural take. For example, modern gear and techniques could alter the purpose of the sub-zone.

Procedure for New Measures (Amendments)

These procedures apply to regulatory measures that have not been included in previous regulations and/or whose impacts have not been analyzed previously in the FMP. These new measures include, but are not limited to, catch limits, resource size limits, closures, and effort limitations. New regulatory measures will follow the procedure outlined for amendments in NMFS' *Operational Guidelines, Fishery Management Plans* (May 1, 1997 revision).

A Federal Register notice will be published describing any proposed new management measure. The notice will solicit public comment. At the subsequent Council meeting, the Council will formally address the specific measure for which they will consider recommendations. A Federal Register notice will be prepared summarizing the Council's deliberations, rationale, and analysis for the preferred action, and include the time and place for any other Council meetings to consider the measure. At subsequent meetings, the Council will consider public comments and other information received and will draft a document with a recommendation to the Regional Administrator.

Within two weeks of the decision, the RA will propose regulations to carry out the action or offer a written explanation supporting the denial of the recommendation. The Council may appeal a denial by writing to the Assistant Administrator. The Assistant Administrator must respond to the Council within 30 days. If the RA agrees with the recommendation, the RA and the Assistant Administrator will make their decision in accordance with the MSFCMA and other applicable laws. Finally, NMFS may implement any recommendation made by the Council by rule-making, if approved by the Regional Administrator.

5.5.2 Enforcement

Enforcement burdens and costs have been analyzed in the draft Regulatory Impact Review (RIR) and Initial Regulatory Flexibility Act (IRFA) analysis found in Appendix B. Enforcement can occur either at sea with use of air and/or boat patrols or dockside through vessel and logbook inspection.

At-Sea Enforcement

The major additional enforcement burden required by this FMP is directly related to the designation of no-take and low-use MPAs. In the NWHI, these areas follow the 10 or 50 fathom depth contour in the EEZ. Due to the irregular shape of the bathymetric contours that define MPAs, it may be difficult for enforcement officials to determine whether a vessel is inside or outside an MPA. Large-scale maps of the MPA with boundary coordinates will help determine whether a vessel is in violation of MPA provisions. Improving the accuracy and detail of maps of coral reef ecosystems and associated habitat is a priority for both the Council and NOAA.

Prior to implementation of framework action 2, mandating VMS for every vessel operating in any MPA, the only method to enforce MPA regulations is through direct at-sea monitoring with either aerial or vessel patrols. The cost and time needed to patrol the coral reef ecosystem of the

NWHI, the PRIAs, and the other insular areas is analyzed in the associated RIR and EIS. Mandatory installation and use of VMS for every vessel operating in MPAs would greatly reduce the need for at-sea patrols, simplify the process of determining whether vessels are operating within or outside an MPA, and greatly reduce the cost while increasing overall coverage.

Enforcement agencies may, if deemed necessary, board any vessel and request to conduct an at-sea inspection of the catch, gear, and logbooks. Retained catch should be recorded in the logbook entries. Fishing data forms should be filled out within 24 hours of completing fishing. If on-board gear should be specifically identified (e.g., traps), compliance can be checked.

Unattended surround nets or bait seine nets or traps without owner identification, as described in the CRE-FMP regulations, and found deployed in the EEZ, will be considered unclaimed or abandoned property. Enforcement officers may dispose of these in any manner considered appropriate.

Dockside Inspection

While many of the activities stated above could occur at sea, it is much more effective to inspect gear compliance, validity of permits, and logbooks and reporting of catch when a boat returns from a fishing trip. Vessels that have fished in low-use MPAs are supposed to notify the Coast Guard at least 24 hours prior to returning to port. This makes dockside inspection much easier than at-sea inspection.

5.5.3 Non-regulatory Actions

Strengthen Inter-agency Cooperation

Coherent management of coral reefs and better enforcement of island government fishing regulations, which presupposes regulatory consistency in state and federal waters, can be achieved through cooperative agreements between federal and island government natural resource management and enforcement agencies. The enforcement agreements between NMFS Southwest Law Enforcement and enforcement agencies in American Samoa, Guam, and Hawaii are good examples of such cooperation. Such agreements may vary from area to area. They are manpower intensive and require a substantial commitment to training. With joint enforcement by island government and federal agencies, local regulations might be enforced as landing laws to control the harvest of coral reef resources in areas outside state waters. Coral reef areas where fishing is prohibited or restricted and which function as *de facto* MPAs could be expanded by island governments and federal agency designations.

Process to Facilitate Interagency Coordination to Assess Non-fishing Impacts and Threats to Coral Reef Habitat

This document identifies and describes MPAs, Essential Fish Habitat (EFH), and Habitat Areas of Particular Concern (HAPC). Many of these areas fall under state or territorial jurisdiction (i.e., within 3 nm from shore), while others are under partial jurisdiction of the Department of Interior and the Department of Defense (e.g., National Wildlife Refuges or Defensive Seas around some parts of the NWHI and the PRIAs). Under the EFH provision of the MSFMCA, federal agencies are required to consult with NMFS for any action that may affect EFH. The EFH provision also allows for NMFS and the Council to comment on any federal or state agency action that may impact EFH. Therefore, designation of these specific areas within the whole management area will help to provide additional focus for conservation and management efforts.

In the populated areas, much of the non-fishing impacts are land-derived and the potential impacts from these activities will not initially affect the EEZ waters under Council jurisdiction. But these spillover effects may eventually impact resources under the Council's jurisdiction. Therefore, efficient inter-agency coordination is vital to effective conservation and resource management.

In order to facilitate interagency coordination to assess the impacts of non-fishing activities on the marine environment, specific concerns that would initiate inter-agency coordination must be identified. These issues include, but are not limited to the following:

- Significant damage to habitat or high likelihood of significant damage;
- Size of a coastal construction project (dredging, likelihood of erosion);
- Large-scale agricultural activity (pesticides, herbicides, nutrient loading);
- Increased marine tourism (anchoring, shell collecting, cruise ships);
- Military activities (bombing and training operations, construction);
- Boat activity (oil / fuel spills, vessel grounding);
- Offshore mining (sand, coral, manganese);
- Power plant and water treatment plant discharge;
- Scientific projects;
- Marine debris (fishing gear); and,
- Introduction of exotic species (ballast/bilge waters, aquaculture).

The National Environmental Policy Act requires that an environmental impact statement be prepared for any major federal action that significantly affects the environment. Similarly, the EFH provisions require that any federal agency must consult with NMFS and the Council if the action they propose is conducted or may impact an area designated as EFH or HAPC. After this consultation, the permitting agency must make an initial assessment of how the proposed activity may affect EFH and must respond to any recommendations provided by NMFS or the Council. This consultation merges the requirements of other environmental laws (e.g., Clean Water Act, Endangered Species Act) so as not to cause undue burden on the permittee, the permitting agency, NMFS, or the Council. If an action or project is proposed by any state or territorial agency that may impact an area designated as EFH or HAPC, NMFS and the Council may provide recommendations to minimize or eliminate the impacts to those areas.

Formal Process for Coordination among Plan Teams to Identify and Address Impacts to Coral Reef Ecosystems

A formal process will be established (under the Council's Standard Operating Procedures and Practices) to ensure coordination of the CRE-FMP with the existing Bottomfish, Crustaceans, Pelagics and Precious Corals FMPs. The plan team coordination procedure is described here. The CRE Plan Team (CRE-PT) identifies an ecosystem issue pertinent to the activities of another Council FMP. Conversely, ecosystem issues may also be brought to the attention of the CRE-PT by other plan teams, the Scientific and Statistical Committee, the Council, fishermen, government agencies, NGOs, or the public. The CRE-PT then prepares a written description of the issue, together with various options or measures to minimize the identified fishery-related impacts to the coral reef ecosystem, and submits it to the respective FMP plan teams for review. The other FMP plan teams then prepare a summary of proposed alternatives to mitigate the impacts, including pros and cons, in consultation with the CRE-PT. The plan teams, at their next regularly scheduled meeting, then formalize their proposed mitigation measures in their meeting reports and recommend a preferred alternative to the Council. The Council reviews these alternatives at its next regularly scheduled meeting and directs an appropriate course of action. The Council's program planning "milestones" document, which is regularly updated, also describes cross-FMP activities and needs, including research.

Education

The Council has established an education and public outreach program for FMP-managed fisheries. The program will be expanded to include a strong educational outreach component to raise public awareness of coral reef ecosystems and to improve compliance with regulations controlling the harvest of coral reef resources.

Figure 5.2: NWHI Marine Protected Area (MPA) Map legend.

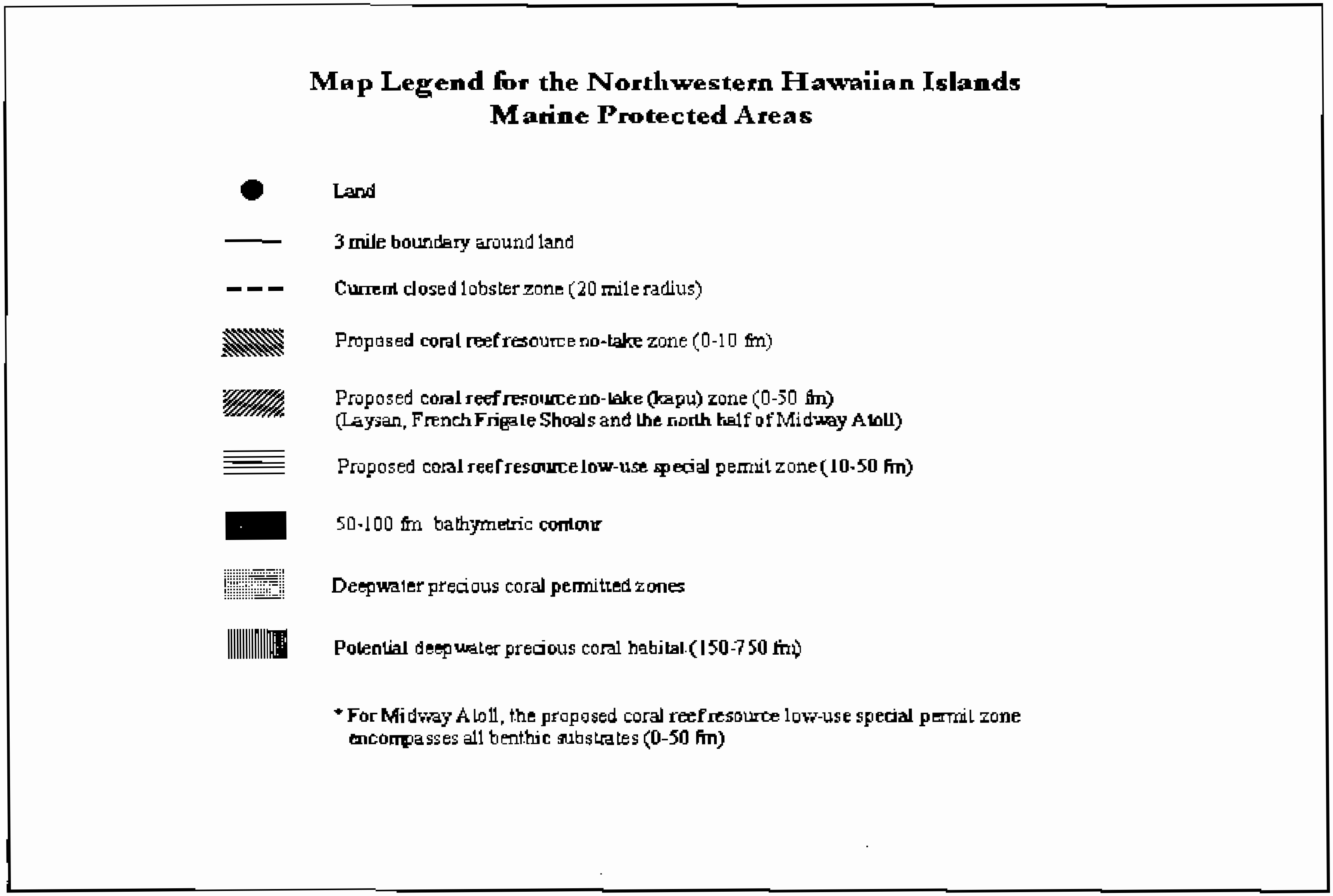


Figure 5.3 : Nihoa to Necker Island Marine Protected Area.

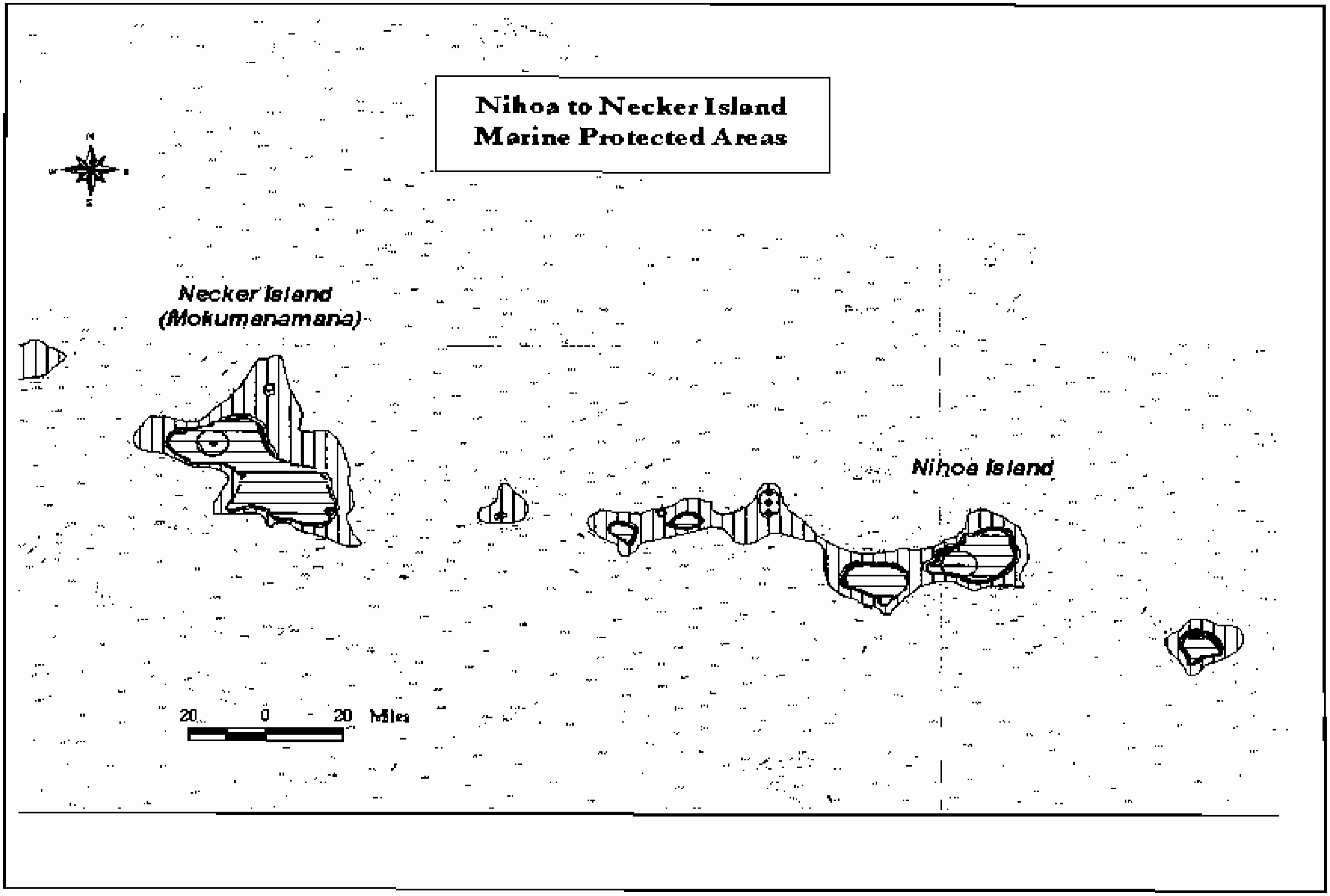


Figure 5.4: French Frigate Shoals to Raita Bank Marine Protected Area.

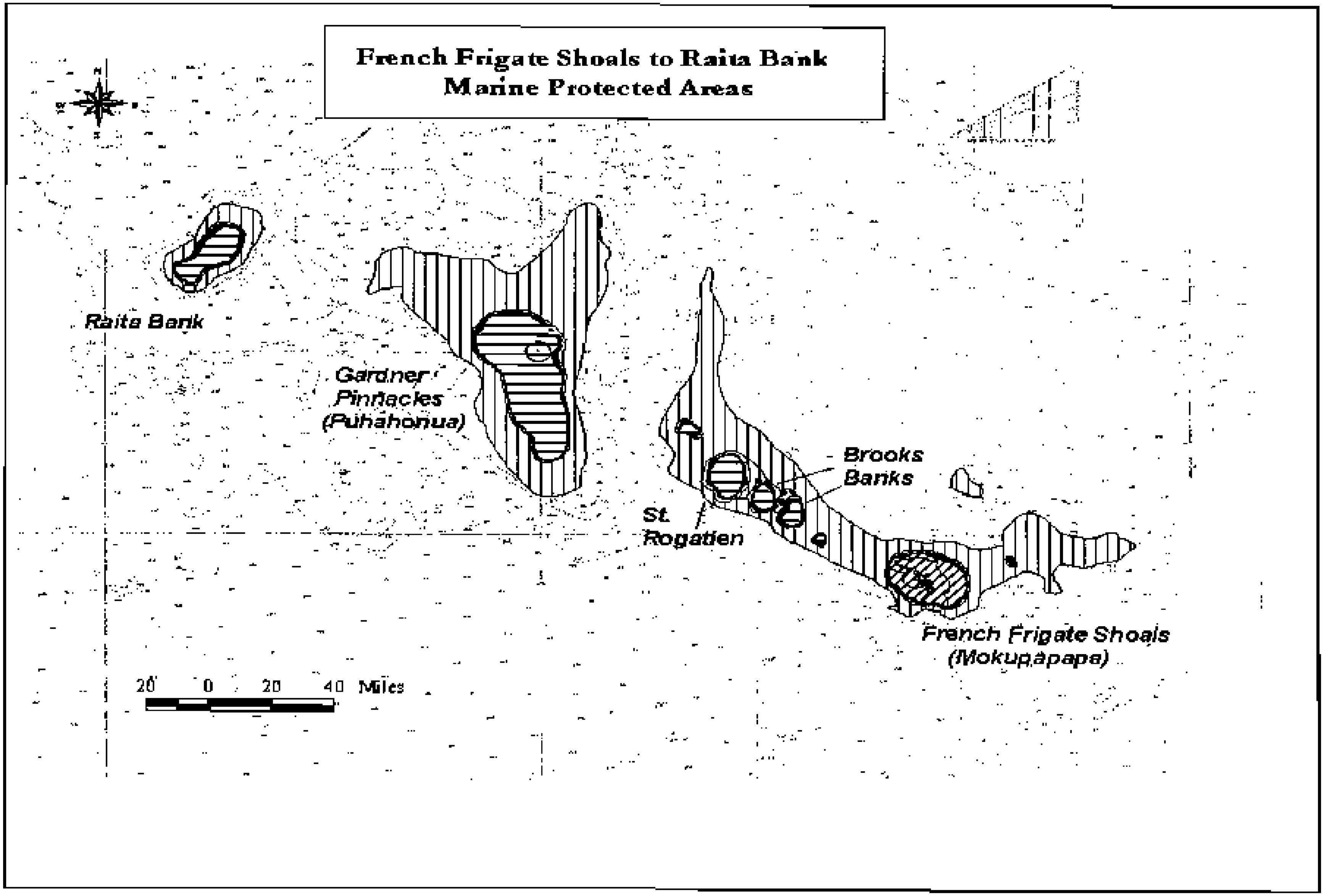


Figure 5.5: Maro Reef to Lisianski Island Marine Protected Area.

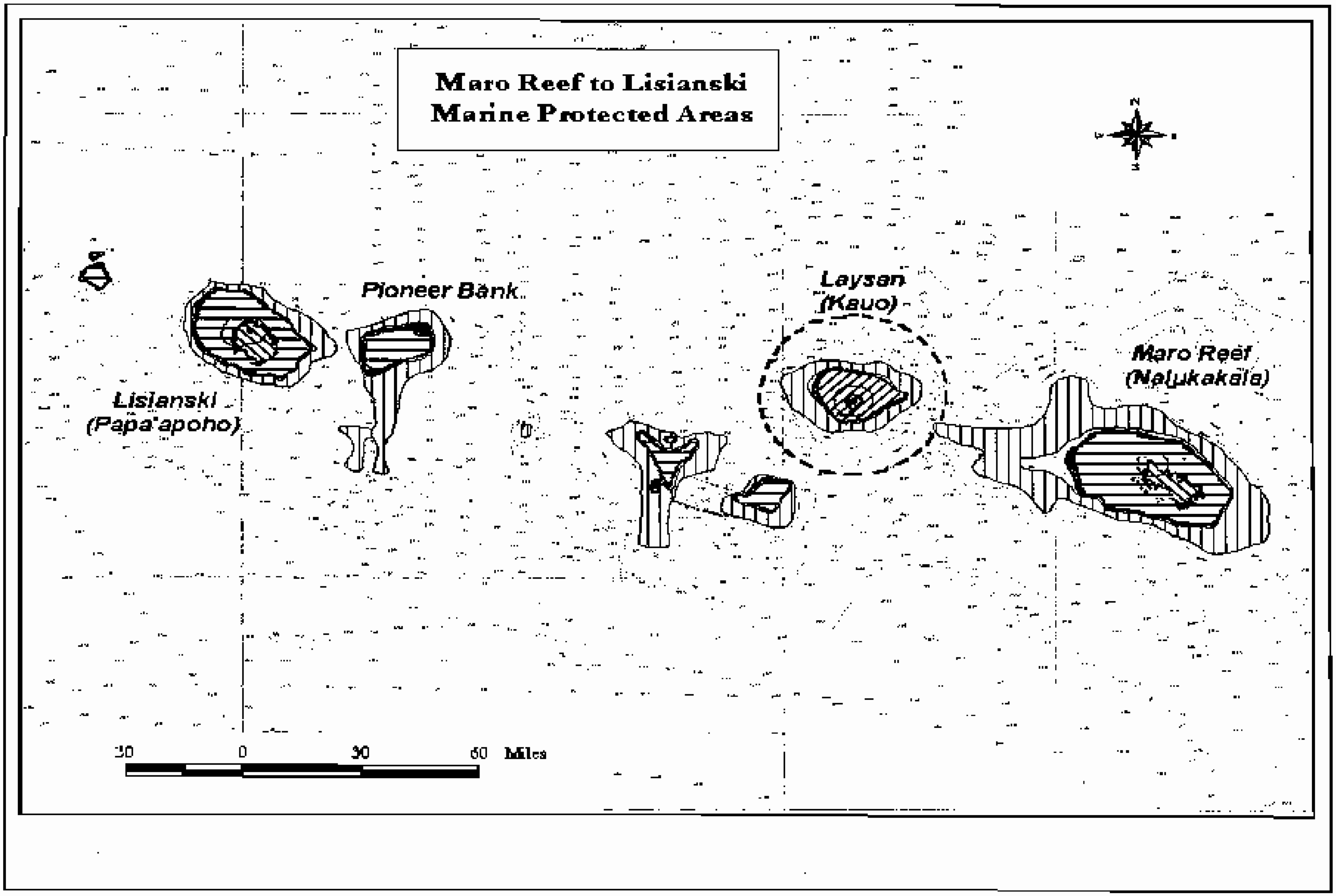


Figure 5.6: Pearl and Hermes Reef to Midway Atoll Marine Protected Area.

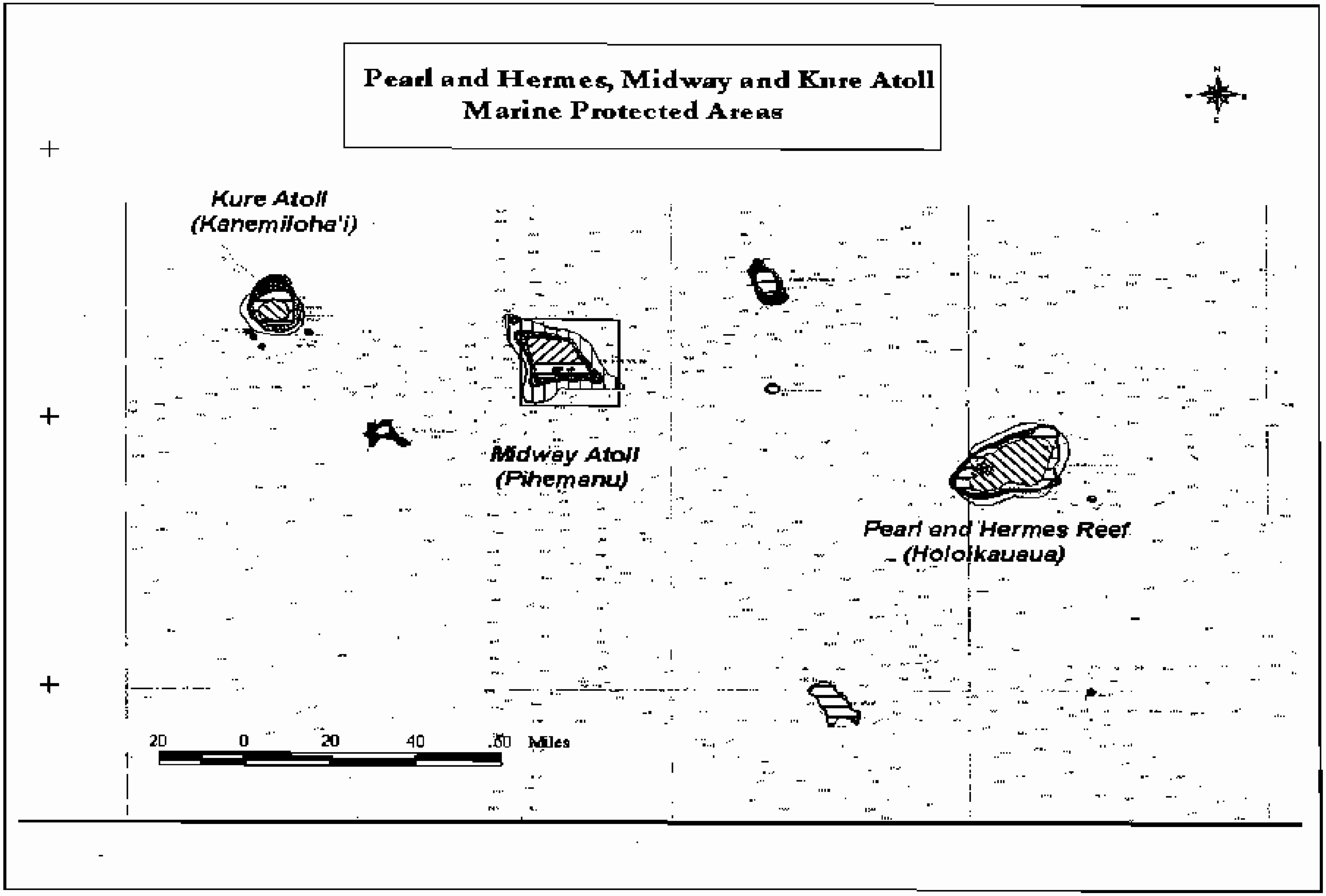


Figure 5.7: Rose Atoll Marine Protected Area.

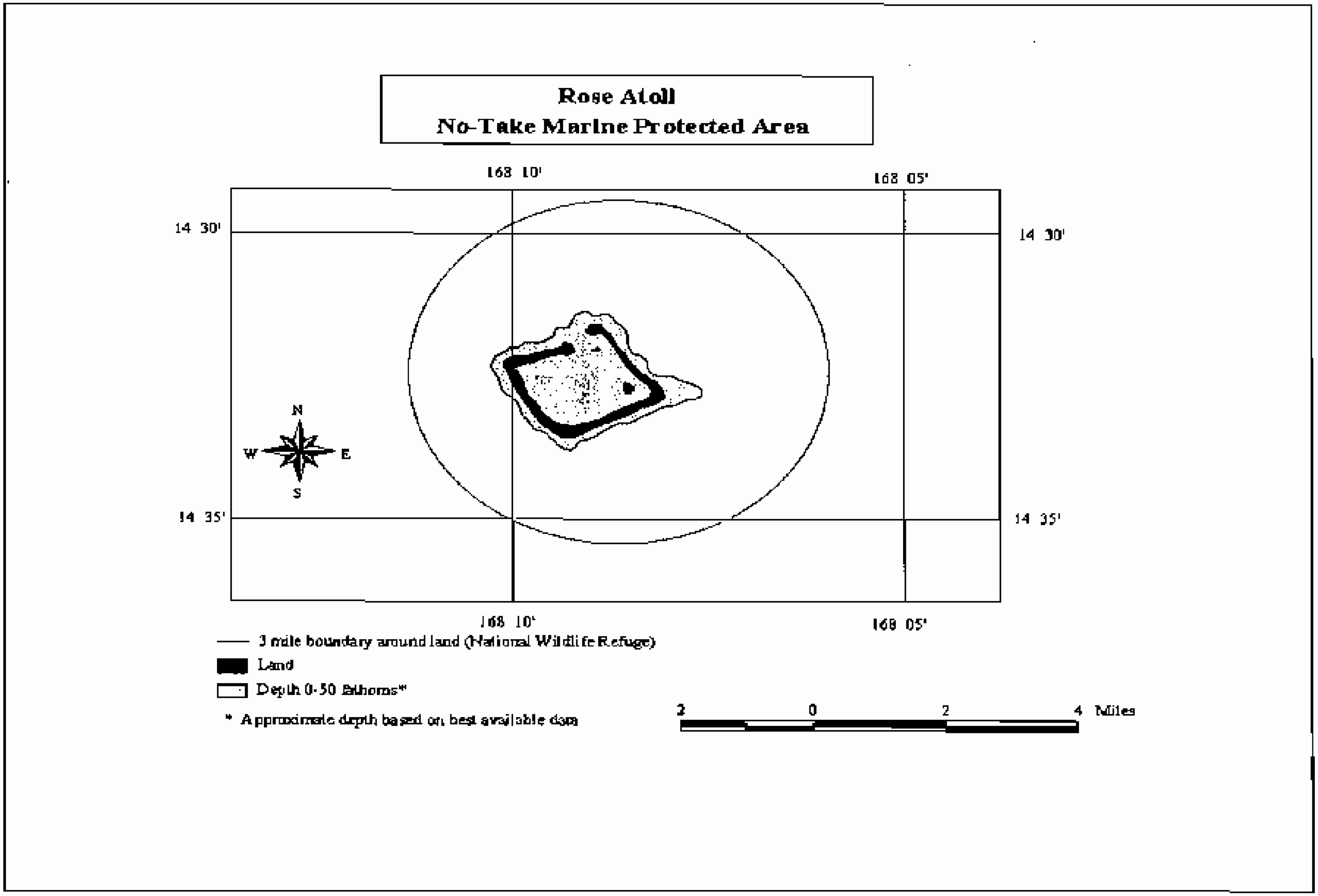


Figure 5.8: Howland Island Marine Protected Area.

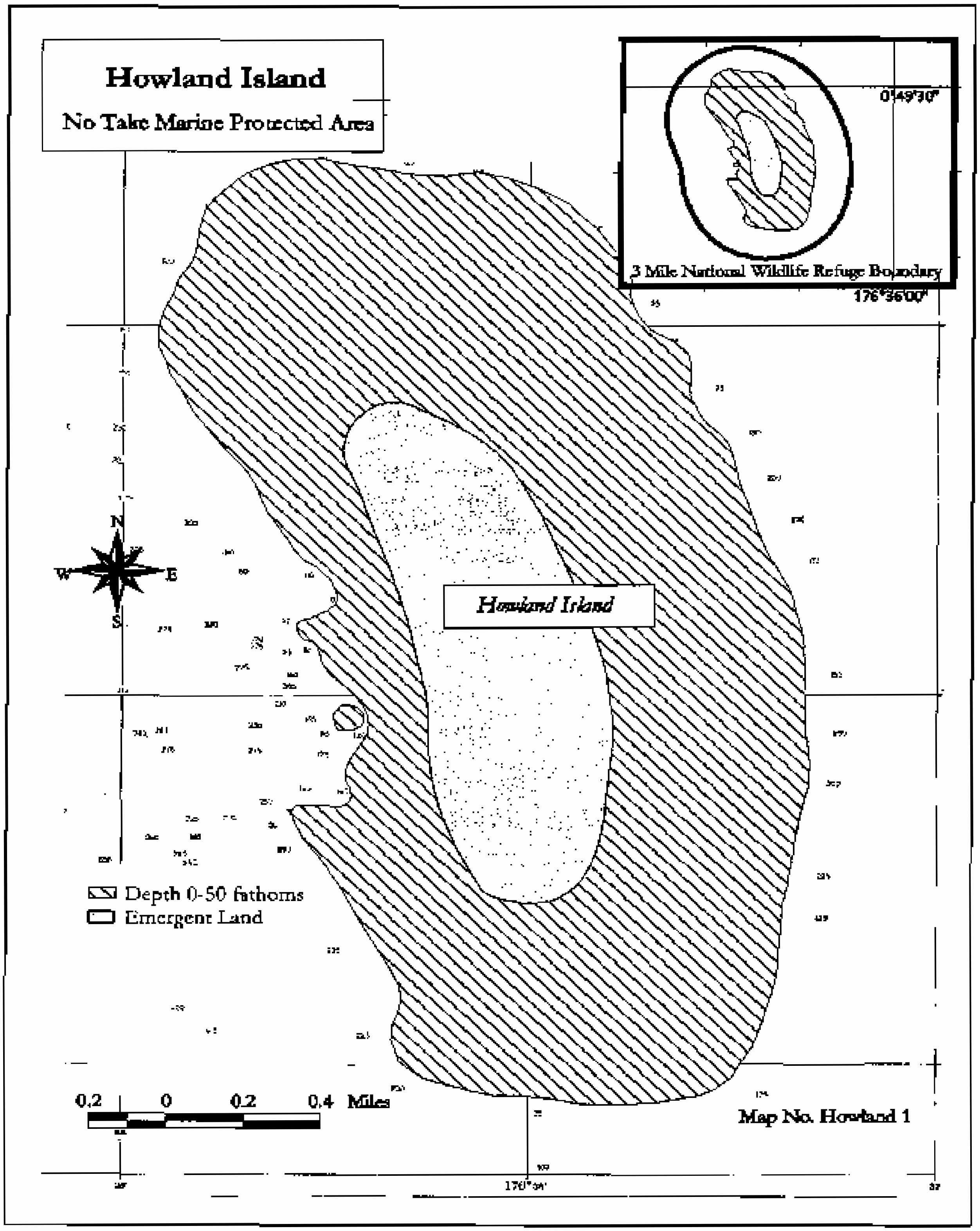


Figure 5.9: Baker Island Marine Protected Area.

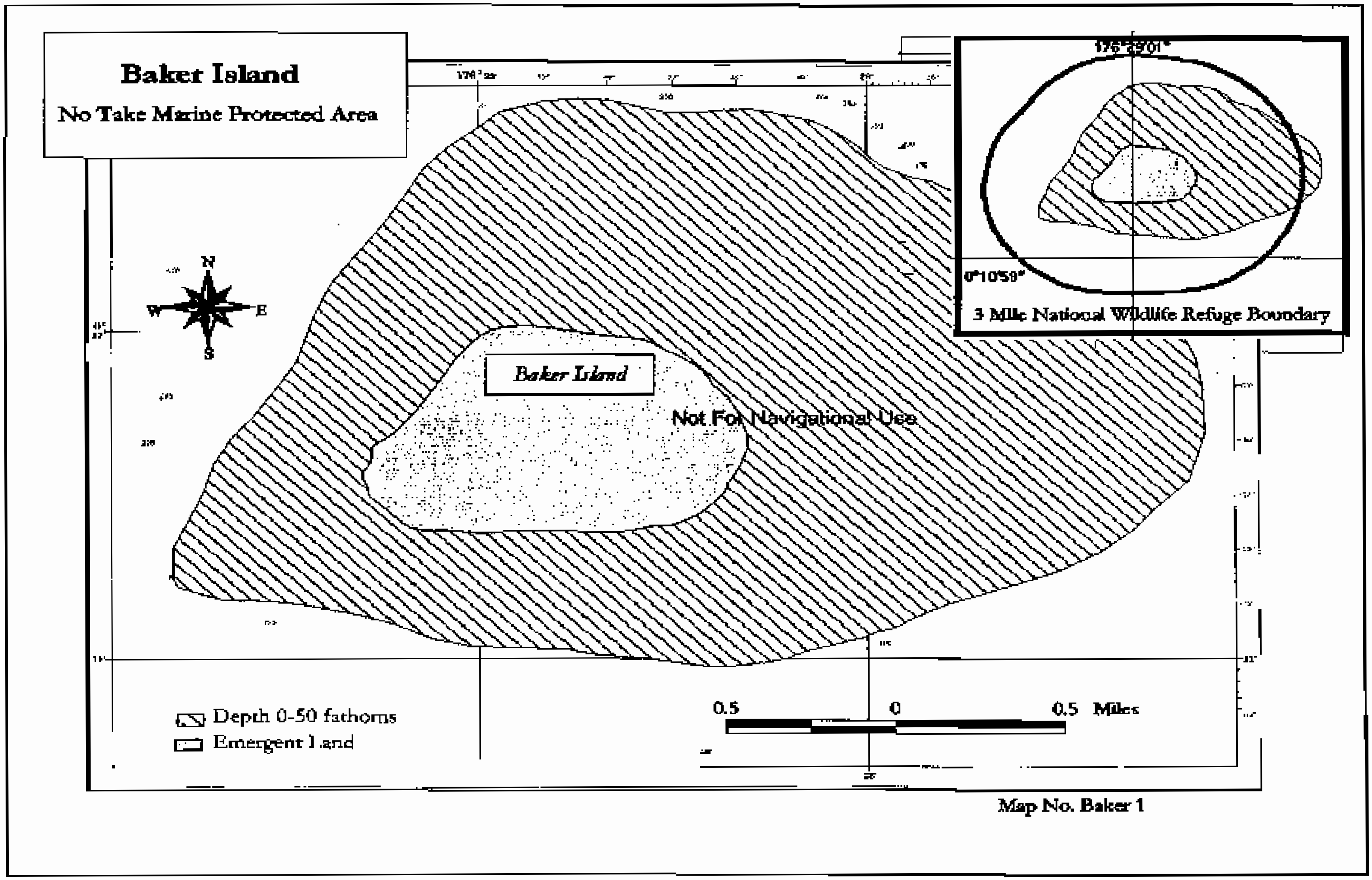


Figure 5.10: Jarvis Island Marine Protected Area.

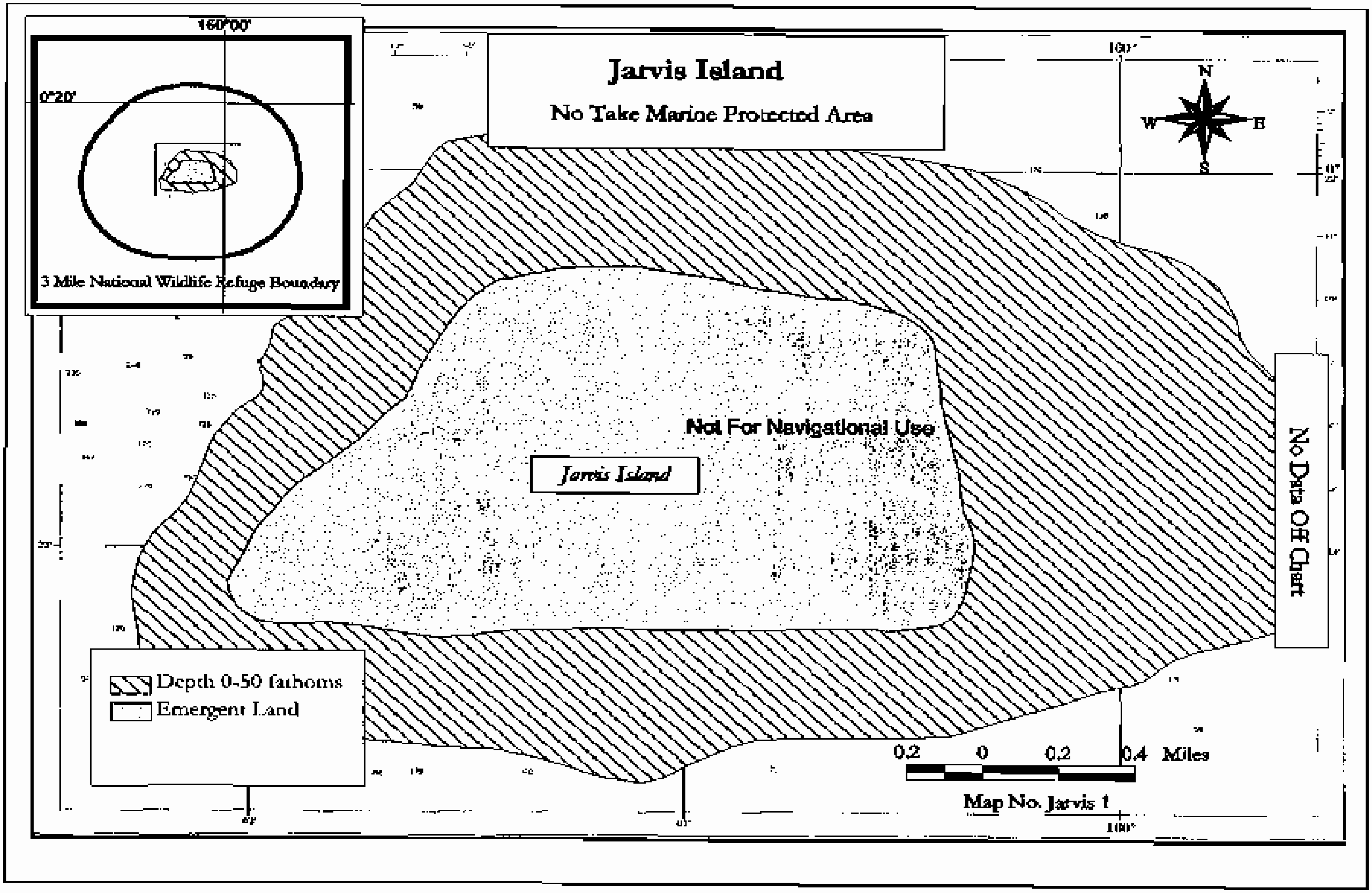


Figure 5.11: Kingman Reef Marine Protected Area.

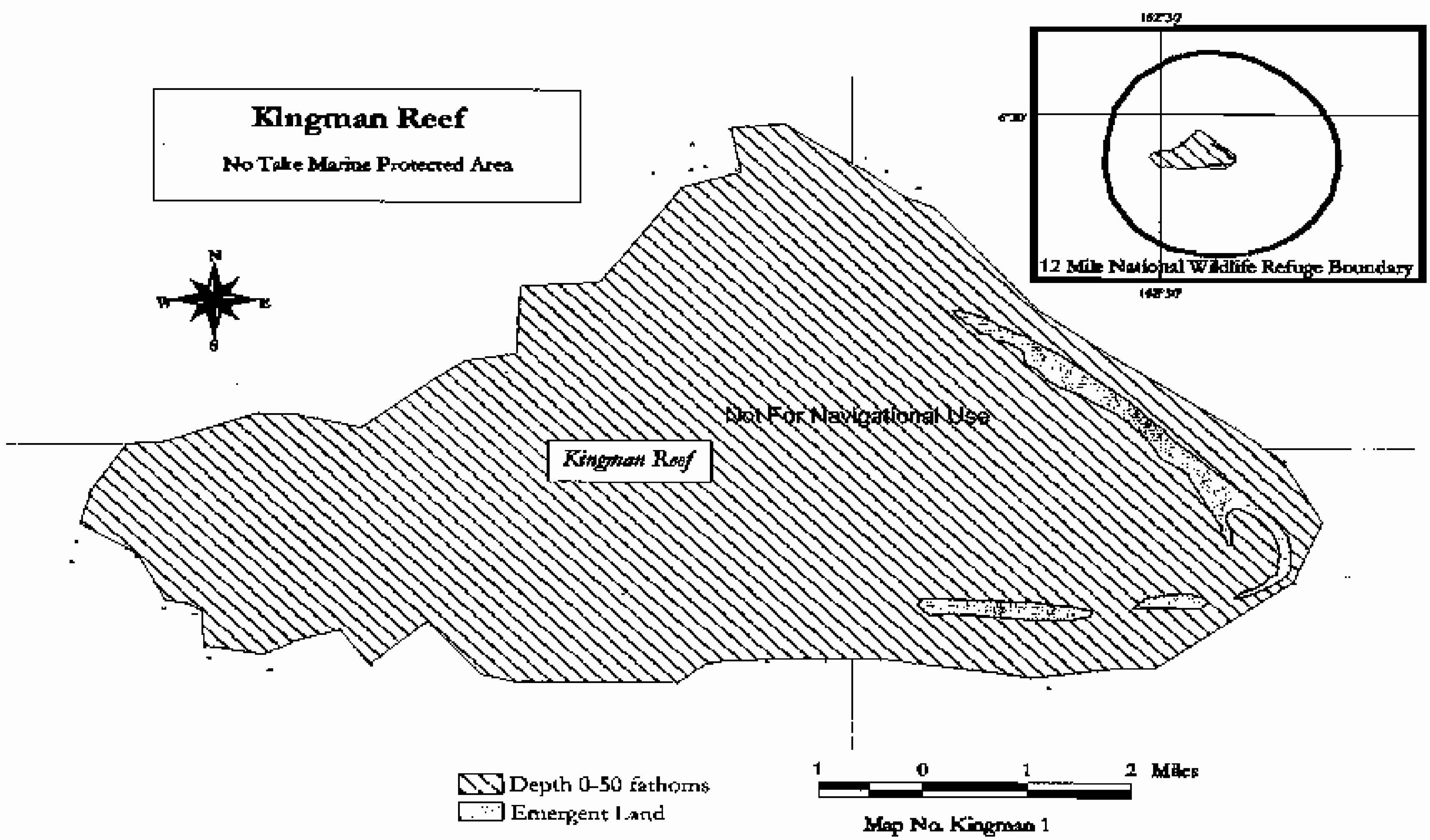


Figure 5.12: Palmyra Atoll Marine Protected Area.

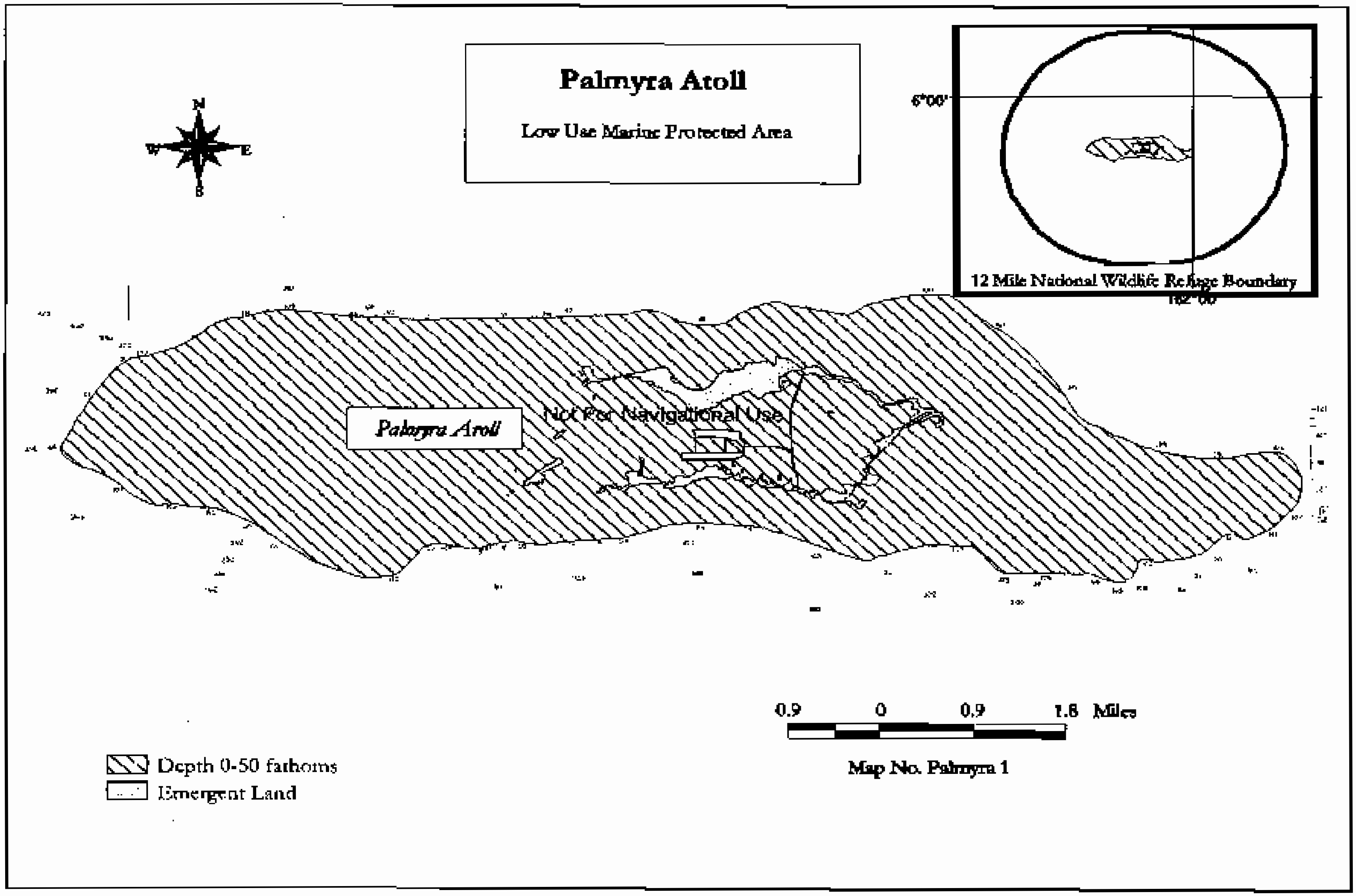


Figure 5.13: Wake Island Marine Protected Area.

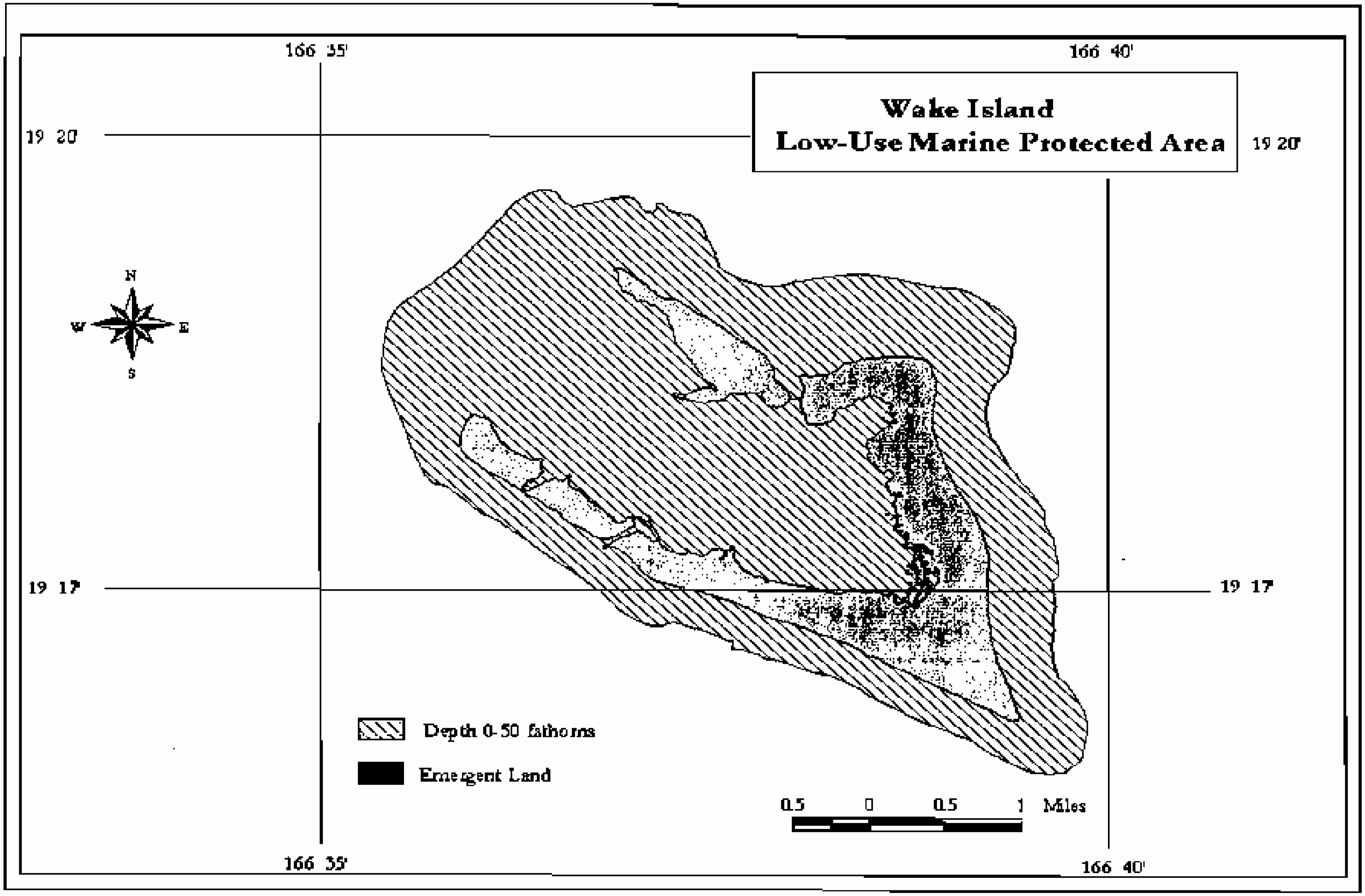
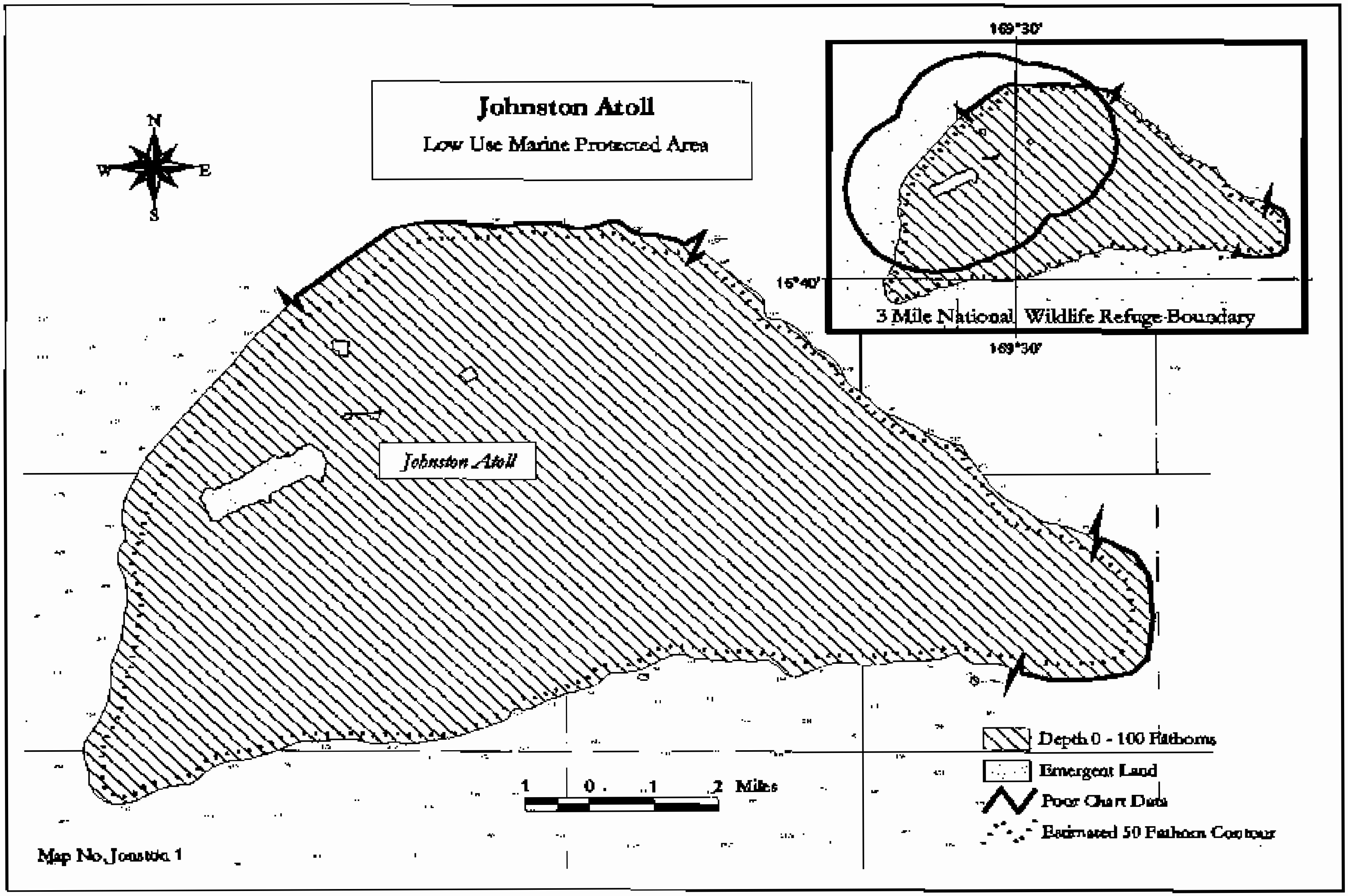


Figure 5.14 : Johnston Atoll Marine Protected Area.



CHAPTER 6

IDENTIFICATION AND DESCRIPTION OF ESSENTIAL FISH HABITAT

6.1 EFH Background

The Sustainable Fisheries Act—which amended the MSFCMA in 1996—requires several new FMP provisions. The identification and description of essential fish habitat (EFH) for all managed species[1] is among the most important of these additions. According to the MSFCMA, EFH is "those waters and substrate necessary to fish for spawning, breeding or growth to maturity." This new mandate represents a significant shift in fishery management policy. Because councils must now consider management unit species' ecological role, they must move beyond traditional single- or multi-species management to a broader ecosystem-based approach. This fits well with the objectives of this fishery ecosystem plan, and more generally, the principals set forth by the Ecosystem Principles Advisory Panel (EPAP 1999), which have guided this plan's development. As their report pointed out, many existing MSFCMA requirements—EFH in particular—contribute to the ecosystem approach, if effectively implemented.

The EFH provisions are especially important because of the procedural requirements they impose on both councils and federal agencies. First, in their FMPs, councils must identify adverse impacts to EFH resulting from both fishing and non-fishing activities, and describe measures to minimize these impacts. Second, councils can provide comments and make recommendations to federal or state agencies that propose actions that may affect the habitat, including EFH, of a managed species. Based on these comments, and comments from other agencies, the Secretary of Commerce makes recommendations to the action agency on how to minimize the adverse impacts of their actions. Within 30 days, the action agency must provide a written response, describing how they intend to minimize or mitigate identified adverse impacts.

EFH designations in this FMP are based on the best available scientific information, including both environmental and fisheries data. This information was obtained through a series of public meetings of the Council, Scientific and Statistical Committee, FMP plan teams, and fishing industry advisory panels. In addition, the Council worked in close cooperation with NMFS scientists.

[1]Subsequent guidance allows either individual species or species assemblages to be described.

6.1.1 Description of EFH

NMFS guidelines for EFH implementation require that in their FMPs councils:

- Identify and describe EFH for all species managed under an FMP;
- Describe adverse impacts to EFH from fishing activities;
- Describe adverse impacts to EFH from non-fishing activities; and,
- Recommend conservation and enhancement measures to minimize and mitigate the adverse impacts to EFH resulting from fishing- and non-fishing-related activities.

The guidelines recommend that each Council prepare a preliminary inventory of available environmental and fisheries information on managed species. Such an inventory is useful in describing and identifying EFH, and helps to identify missing information about the habitat of a particular species. A wide range of basic information is needed to identify EFH, including data on current and historic stock size, the geographic range of the managed species, the habitat requirements by life history stage, and the distribution and characteristics of those habitats. Since EFH has to be identified for each major life history stage, information about a species' distribution, density, growth, mortality, and production within all the habitats it occupies, or formerly occupied, is also necessary. The inventory should classify these data according to their quality, using these four categories:

Level 1: All that is known is where a species occurs based on distribution data for all or part of the geographic range of the species;

Level 2: Data on habitat-related densities or relative abundance of the species are available;

Level 3: Data on growth, reproduction or survival rates within habitats are available; and,

Level 4: Production rates by habitat are available.

With higher quality data, those habitats most highly valued by a species can be identified, allowing a more precise designation of EFH. Habitats of intermediate and low value also may be essential, depending on the health of the fish population and the ecosystem. For example, if a species is overfished, and habitat loss or degradation is thought to contribute to its overfished condition, all habitats currently used by the species may be essential. However, no Level 3 or Level 4 data are yet available for CRE MUS.

Despite these data limitations, this FMP describes EFH in text and tables that provide information on the biological requirements for the egg, larvae, juvenile, and adult life stages of all MUS. Because of these limitations, the Council adopted a precautionary approach to EFH designation. As result, the Council's EFH designation for CRE MUS covers all the waters and habitat at depths from the sea surface to 50 fathoms extending from the shoreline (including state and territorial lands and waters) to the outer boundary of the EEZ. This broad EFH designation will ensure that enough habitat is protected to sustain managed species.

In addition to text and tabular descriptions, the distribution and geographic limits of CRE MUS EFH were mapped, using a computer-based geographic information system. This facilitates analysis and presentation. More detailed and informative maps will be produced as more complete information about population responses (e.g., growth, survival, or reproductive rates) to habitat characteristics becomes available.

The Western Pacific Region comprises a range of marine ecosystems used as habitat by coral reef organisms, and each constituent state differs in the type of reef habitat that they contain (Green 1997). (Table 6.1 summarizes their distribution.) Most of the reefs in the Main Hawaiian Islands are large non-structural or fringing reefs. There are also a few barrier reefs and banks or shoals. In contrast, most of the reefs in the NWHI are banks/shoals, although there are also a few atolls, and non-structured and fringing reefs. Similarly, the reefs in the CNMI tend to be mostly banks/shoals or non-structural reefs, although there are some fringing and barrier/lagoon reefs. American Samoa has mostly fringing reefs, with two remote atolls and two non-structural reefs. Most of the reefs on Guam are a mixture of banks/shoals, barrier/lagoon and fringing or non-structural reefs. Other U.S. Pacific Islands are either atolls or have fringing reefs.

Table 6.1: Occurrence of habitat types in the Western Pacific Region.

	AS	CNMI	Guam	HI	Other
Estuaries	x	x	x	x	
Fringing Reefs	x	x	x	x	x
Atolls	x			x	x
Barrier/Lagoon	x	x	x	x	
Non-structural Reef	x	x	x	x	
Banks and Shoals	x	x	x	x	x
Seagrass Beds		x	x	x	x
Mangroves	x	x	x	x	x
Pelagic/Open Ocean	x	x	x	x	x
Deep Slope Terraces	x	x	x	x	x
Patch Reefs	x	x	x	x	x
Reef Communities/ Apron Reefs	x	x	x	x	x

Habitat protection is an essential component of a coral reef ecosystem management regime. Clearly, healthy and intact habitats are fundamental to the health and survival of coral reef species. At the same time, very little data are available to adequately document the extent of these habitats, to identify those that may be particularly critical to various life phases of significant commercial and recreational species, or to best locate appropriate areas for marine reserves.

6.1.2 EFH Designation for MUS

Ten alternatives for EFH designation were considered: (1) no action/status quo; (2) species-by-species; (3) family-by-family; (4) habitat/behavioral group; (5) reef obligate species/reef-associated species; (6) designate MUS at a higher taxonomic order; (7) representative species; (8) indicator species; (9) habitat composites; and (10) designate the sessile benthos MUS (e.g., reef-building corals) as EFH for those organisms themselves and for associated species.

This FMP uses an approach similar to one used by both the South Atlantic and the Pacific Fishery Management Councils. Using this approach, MUS are linked to specific habitat "composites" (e.g., sand, live coral, seagrass beds, mangrove, open ocean) for each life history stage, consistent with the depth of the ecosystem to 50 fathoms and to the limit of the EEZ. These designations could also protect species managed under other Council FMPs to the degree that they share these habitats.

Except for several of the major coral reef associated species, very little is known abont the life histories, habitat utilization patterns, food habits, or spawning behavior of most coral reef associated species. For this reason, the Council has designated EFH using a two-tiered approach based on the division of MUS into the Currently Harvested Coral Reef Taxa (CHCRT) and Potentially Harvested Coral Reef Taxa (PHCRT) categories (see Section 1.6.2). This is also consistent with the use of habitat composites.

Currently Harvested Coral Reef Taxa MUS

In the first tier, EFH has been identified for species which are: (1) currently being harvested in state and federal waters and for which some fishery information is available, and (2) are likely to be targeted in the near future based on historical catch data. Table 6.2 summarizes the habitat types used by CHCRT species, grouped into higher taxonomic orders. (Tables 6.2-6.6 may be found after Section 6.2.) The designations of EFH for these MUS are summarized in Table 6.3.

To reduce the complexity and the number of EFH identifications required for individual species and life stages, the Council has designated EFH for species assemblages pursuant to 50 CFR 600.815 (a)(2)(ii)(E). The designation of these "complexes" is based on the ecological relationships among species and their preferred habitat. These species complexes are grouped by the known depth distributions of individual MUS. For a broader description of the life history and habitat utilization patterns of CHCRT, see Volume III.

Potentially Harvested MUS

EFH has also been designated for the second tier, Potentially Harvested Coral Reef Taxa. These taxa include literally thousands of species encompassing almost all coral reef fauna and flora. However, there is very little scientific knowledge about the life histories and habitat requirements of the thousands of species of organisms that compose these taxa. In fact, a large percentage of these biota have not been described by science. Therefore, the Council has used the precautionary approach in designating EFH for PHCRT so that enough habitat is protected to sustain managed species. Table 6.4 summarizes the habitat types used by PHCRT species, grouped into higher taxonomic orders. The designation of EFH for these MUS is summarized in Table 6.5. As with CHCRT, the Council has designated EFH for species assemblages pursuant to the federal regulations cited above, and Volume III also contains more detailed descriptions of PHCRT.

6.2 Habitat Areas of Particular Concern

In addition to EFH, the Council also identified habitat areas of particular concern (HPAC) for Coral Reef Ecosystem MUS. HAPCs are specific areas within EFH that are essential to the life cycle of important coral reef species. In determining whether a type or area of EFH should be designated as an HAPC, one or more of the following criteria established by NMFS must be met: (1) the ecological function provided by the habitat is important; (2) the habitat is sensitive to human-induced environmental degradation; (3) development activities are, or will be, stressing the habitat type; or (4) the habitat type is rare. However, it is important to note that if an area meets only one of the HAPC criteria, it will not necessarily be designated an HAPC.

Because of the already-noted lack of sciantific data, the Council considered locations that are known to support populations of Coral Reef Ecosystem MUS and meet NMFS criteria for HAPC. Although not one of the criteria established by NMFS, the Council considered designating areas that are already protected—for example, wildlife refuges—as HAPC. The HAPCs identified in Table 6.6 have met at least one of the four criteria listed above, or the fifth criterion just identified. However, a great deal of life history work needs to be done in order to adequately identify the extent of HAPCs and link them to particular species or life stages.

Table 6.2a: Occurrence of Currently Harvested Management Unit Species.

Habitats: Mangrove (Ma) Lagoon (La) Estuarine (Es) Seagrass Beds (SB) Soft substrate (Ss) Coral Reef/Hard Substrate (Cr/Hr) Patch Reefs (Pr) Surge Zone (Sz) Deep-slope Terraces (DST) Pelagic/Open Ocean (Pe)

Life-history stages: Egg (E) Larvae (L) Juvenile (J) Adult (A) Spawners (S)

	Ma	La	Es	SB	Ss	Cr/Hs	Pr	Sz	DST	Pe
Acanthuridae (surgeonfishes) Subfamily Acanthurinae (surgeonfishes) Orange-spot surgeonfish (*Acanthurus olivaceus*) Yellowfin surgeonfish (*Acanthurus xanthopterus*) Convict tang (*Acanthurus triostegus*) Eye-striped surgeonfish (*Acanthurus dussumieri*) Blue-lined surgeon (*Acanthurus nigroris*) Whitebar surgeonfish (*Acanthurus leucopareius*) Blue-banded surgeonfish (*Acanthurus lineatus*) Blackstreak surgeonfish (*Acanthurus nigricauda*) Whitecheek surgeonfish (*Acanthurus nigricans*) White-spotted surgeonfish (*Acanthurus guttatus*) Ringtail surgeonfish (*Acanthurus blochii*) Brown surgeonfish (*Acanthurus nigrofuscus*) Elongate surgeonfish (*Acanthurus mata*) Mimic surgeonfish (*Acanthurus pyroferus*) Yellow-eyed surgeonfish (*Ctenochaetus strigousus*) Striped bristletooth (*Ctenochaetus striatus*) Twospot bristletooth (*Ctenochaetus binotatus*)	J	A, J, S	A, J, S	J	A, J, S	A, J, S	A, J, S		A, J	E, L
Subfamily Nasianae (Unicornfishes) Bluespine unicornfish (*Naso unicornus*) Orangespine unicornfish (*Naso lituratus*) Humpnose unicornfish (*Naso tuberosus*) Blacktounge unicornfish (*Naso hexacanthus*) Bignose unicornfish (*Naso vlamingii*) Whitemargin unicornfish (*Naso annulatus*) Spotted unicornfish(*Naso brevirostris*) Humpback unicornfish(*Naso brachycentron*) Barred unicornfish (*Naso thynnoides*) Gray unicornfish (*Naso caesius*)	J	A, J, S	J		A, S	A, J, S	A, J, S		A, S	All

	Ma	La	Es	SB	Ss	Cr/Hs	Pr	Sz	DST	Pe
Balistidae (Trigger Fish) Titan triggerfish (*Balistoides viridescens*) Clown triggerfish (*B. conspicillum*) Orangstriped trigger (*Balistapus undulatus*) Pinktail triggerfish (*Melichthys vidua*) Black triggerfish (*M. niger*) Blue Triggerfish (*Pseudobalistesfucus*) Picassofish (*Rhinecanthus aculeatus*) Wedged Picassofish (*B. rectangulus*) Bridled triggerfish (*Sufflamen fraenatus*)	J	A, J, S	J	J		A, J, S	A, J, S	A	A, S	E, L
Carangidae (jacks) Bigeye scad (Selar crumenophthalmus) Mackerel scad (Decapterus macarellus)	A, J, S	A, J, S	A, J, S	J	A, J, S	A, J, S	A, J, S	A, J, S	All	
Carcharhinidae Grey reef shark (*Carcharhinus amblyrhynchos*) Silvertip shark (Carcharhinus albimarginatus) Galapagos shark (*Carcharhinus galapagenis*) Blacktip reef shark (*Carcharhinus melanopterus*) Whitetip reef shark (*Triaenodon obesus*)	A, J	A, J	A, J	J	A, J	A, J	A, J		A, J	A, J

	Ma	La	Es	SB	Ss	Cr/Hs	Pr	Sz	DST	Pe
Holocentridae (soldierfish/squirrelfish) Bigscale soldierfish (*Myripristis berndti*) Bronze soldierfish (*Myripristis adusta*) Blotcheye soldierfish (*Myripristis murdjan*) Bricksoldierfish (*Myripristis amaena*) Scarlet soldierfish (*Myripristis pralinia*) Violet soldierfish (*Myripristis violacea*) Whitetip soldierfish (*Myripristis vittata*) Yellowfin soldierfish (*Myripristis chryseres*) Pearly soldierfish(*Myripristis kuntee*) (*Myripristis hexagona*) Tailspot squirrelfish (*Sargocentron caudimaculatum*) Blackspot squirrelfish (*Sargocentron melanospilos*) File-lined squirrelfish(*Sargocentron microstoma*) Pink squirrelfish(*Sargocentron tieroides*) Crown squirrelfish (*Sargocentron diadema*) Peppered squirrelfish (*Sargocentron punctatissimum*) Blue-lined squirrelfish (*Sargocentron tiere*) Ala'ihi (*Sargocentron xantherythrum*) (*Sargocentron furcatum*) (*Sargocentron spiniferum*) Spotfin squirrelfish(*Neoniphon spp.*)		A, J, S	A, J, S	J		A, J, S	A, J, S		A, S	E, L
Kuhliidae (flagtails) Hawaiian flag-tail (*Kuhlia sandvicensis*) Barred flag-tail (*Kuhlia mugil*)	A, J	A, J	A, J	A, J				A		E, L
Kyphosidae (rudderfishes) Rudderfish (*Kyphosus bigibbus*) (*K. Cinerascens*) (*K. Vaigiensis*)	J	A, J, S	A, J, S		A, J	A, J, S	A, J, S	A, J		All

	Ma	La	Es	SB	Ss	Cr/Hs	Pr	Sz	DST	Pe
Labridae (wrasses) Saddleback hogfish (*Bodianus bilunulatus*) Razor wrasse (Xyrichthys pavo) Whitepatch wrasse (*Xyrichtes aneitensis*)		J	J	J	A, J, S	A, J, S	A, J, S		A, J, S	E, L
Triple-tail wrasse (*Cheilinus trilobatus*) Floral wrasse (*Cheilinus chlorourus*) Harlequin tuskfish (*Cheilinus fasciatus*)		A, J	J		A, J, S	A, J, S	A, J, S		A, J, S	E, L
Ring-tailed wrasse (*Oxycheilinus unifasciatus*) Bandcheek wrasse (*Oxycheilinus diagrammus*) Arenatus wrasse (*Oxycheilinus arenatus*)		A, J			A, J, S	A, J, S	A, J, S		A, J, S	E, L
Blackeye thicklip (*Hemigymnus melapterus*) Barred thicklip (*Hemigymnus fasciatus*)		A, J		J	A, J, S	J	J, S		A, J, S	E, L
Cigar wrass (*Cheilio inermis*)										
Threespot wrasse (*Halichoeres trimaculatus*) Checkerboard wrasse (*Halichoeres hortulanus*) Weedy surge wrasse (*Halichoeres margaritacous*) (*Halichoeres zeylonicus*)		A, J	J		A, J, S	A, J, S		A, J		E, L
Surge wrasse (*Thalassoma purpureum*) Redribbon wrasse (*Thalassoma quinquevittatum*) Sunset wrasse (*Thalassoma lutescens*)		A, J		J	A, J, S	A, J, S	A, J, S			E, L
Longface wrasse (*Hologymnosus doliatus*) Rockmover wrasse (*Novaculichthys taeniourus*)		A, J			A, J, S	A, J, S		A, J		
Napoleon wrasse (*Cheilinus undulatus*)	J	J		J		A, J, S	A, J, S		A, S	E, L

	Ma	La	Es	SB	Ss	Cr/Hs	Pr	Sz	DST	Pe
Mullidae (goatfish) Yellow goatfish (*Mulloidichthys spp.*) (*Mulloidichthys* Pfleugeri) (*Mulloidichthys* vanicolensis) (*Mulloidichthys flaviolineatus*) Banded goatfish (*Parupeneus spp.*) (*Parupeneus barberinus*) (*Parupeneus bifasciatus*) (*Parupeneus heptacanthus*) (*Parupeneus ciliatus*) (*Parupeneus ciliatus*) (*Parupeneus cyclostomes*) (*Parupeneus pleurostigma*) (*Parupeneus indicus*) (*Parupeneus multifaciatus*) Bantail goatfish (*Upeneus arge*)		A, J	A	A, J	A, J	A, J	A, J			E, L
Octopodidae (octopuses) *Octopus cyanea* *O. ornatus*	A, J, S	All	A, J, S	All	All	All	All		All	L
Mugilidae (Mullets) Stripped mullet (*Mulgil cephalus*) Engel's mullet (*Moolgarda engeli*) False mullet (*Neomyxus leuciscus*) Fringelip mullet (*Crenimugil crenilabis*)	J	A,J,S	A,J,S	J		A, J		A		E,L
Muraenidae (moray eels) Yellowmargin moray (*Gymnothorax flavimarginatus*) Giant moray (*Gymnothorax javanicus*) Undulated moray (Gymnothorax undulatus)	A, J, S	A, J, S	A, J, S	A, J	A, J, S	A, J, S	A, J, S	A, J, S	E, L	
Polynemidae (threadfins) Threadfin (*Polydactylus sexfilis*) -Moi	A, J	A, J, S	A, J, S		A, J, S			A, J		E, L

	Ma	La	Es	SB	Ss	Cr/Hs	Pr	Sz	DST	Pe
Priacanthidae (bigeyes) Glasseye (*Heteropriacanthus cruentatus*) Bigeye (*Priacanthus hamrur*)						A, J	A, J		A, J	E, L
Siganidae (rabbitfish) Forktail rabbitfish (*Siganus aregentus*) Golden rabbitfish (*Siganus guttatus*) Gold-spot rabbitfish (*Siganus punctatissimus*) Randall's rabbitfish (*Siganus randalli*) Scribbled rabbitfish (*Siganus spinus*) Vermiculate rabbitfish (*Signeus vermiculatus*)	A, J, S	A, J, S	A, J, S	J		A, J, S	A, J, S		E, L	
Scaridae (parrotfishes) Parrotfishes (*Scarus spp.*) Pacific longnose parrotfish (Hipposcarus longiceps) Stareye parrotfish (Catolomus carolinus)	J	A, J, S		A, J		A, J, S	A, J, S			E, L
Bumphead parrotfish (*Bolbometopon muricatum*)	J	J		J		A, J, S	A, J, S		A, J	E, L
Scombridae (tuna/mackerel) Dogtooth tuna (*Gymnosarda unicolor*)		A, J, S			A, J	A, J, S	A, J,		A, J	E, L
Sphyraenidae (barracudas) Heller's barracuda (*Sphyraena helleri*) Great Barracuda (*Sphyraena barracuda*)	A, J	A, J, S	A, J, S	J		A, J, S	A, J, S		A, S	All
Turbinidae (turban shells) Turbo sp.		A, J, S				A, J, S	A, J, S		A	E, L

Table 6.2b: Occurrence of Currently Harvested Management Unit Species: Aquarium Taxa/Species.

	Ma	La	Es	SB	Ss	Cr/Hs	PR	Sz	DST	Pe
Acanthuridae (surgeonfishes) Yellow tang (*Zebrasoma flavescens*) Yellow-eyed surgeonfish (*Ctenochaetus strigosus*) Achilles tang (*Acanthurus achilles*)	J	A, J, S	A, J, S	J	A, J, S	A, J, S	A, J, S		A, J	E, L
Zanclidae Moorish Idol (*Zanclus cornutus*)	J	A, J, S	J	J		A, J, S	A, J, S			E, L
Pomacanthidae (angelfishes) *Centropyge shepardi* *C. flavissimus*		A, J				A, J	A, J	A	J	E, L
Muraenidae Dragon moray (*Enchelycore pardalis*,)	A, J, S	A, J, S	A, J, S	A, J	A, J, S	A, J, S	A, J, S	A	A, J, S	E, L
Cirrhilidae (hawkfishes) Longnose hawkfish (*Oxycirrhites typus*) Flame hawkfish (*Neocirrhitus armatus*)		A, J, S				A, J, S	A, J, S	A	A, J, S	All
Chaetodontidae (butterflyfishes) Threadfin butterflyfish (*Chaetodon auriga*) Raccoon butterflyfish (*Chaetodon lunula*) Black-backed butterflyfish (*Chaetodon melannotus*) Saddled butterflyfish (*Chaetodon ephippium*)		A, J				A, J	A, J			E, L
Pomacentridae (damselfishes) Blue-green chromis (*Chromis viridis*) Humbug dascyllus (*Dascyllus aruanus*) Threespot dascyllus (*Dascyllus trimaculatus*)		A, J				A, J	A, J	A	A, J	E, L
Sabellidae (feather-duster worms)	A, J, S	A, J, S	A, J, S		A, J, S	A, J, S	A, J, S	A	A, J, S	E, L

Table 6.3: Summary of EFH designations for Currently Harvested Coral Reef Taxa.

Species Assemblage/Complex	EFH (Egg and Larvae)	EFH (Adult and Juvenile)
Acanthuridae	The water column from the shoreline to the outer boundary of the EEZ to a depth of 50 fm.	All bottom habitat and the adjacent water column from 0 to 50 fm.
Balistidae	The water column from the shoreline to the outer boundary of the EEZ to a depth of 50 fm.	All bottom habitat and the adjacent water column from 0 to 50 fm.
Carangidae	The water column from the shoreline to the outer boundary of the EEZ to a depth of 50 fm.	All bottom habitat and the adjacent water column from 0 to 50 fm.
Carcharhinidae	N/A	All bottom habitat and the adjacent water column from 0 to 50 fm to the outer extent of the EEZ.
Holocentridae	The water column from the shoreline to the outer boundary of the EEZ to a depth of 50 fm.	All rocky and coral areas and the adjacent water column from 0 to 50 fm.
Kuhliidae	The water column from the shoreline to the outer limits of the EEZ to a depth of 50 fm.	All bottom habitat and the adjacent water column from 0 to 25 fm.
Kyphosidae	Egg, Larvae and Juvenile: the water column from the shoreline to the outer boundary of the EEZ to a depth of 50 fm.	All rocky and coral bottom habitat and the adjacent water column from 0 to 15 fm.
Labridae	The water column and all bottom habitat extending from the shoreline to the outer boundary of the EEZ to a depth of 50 fm.	
Mullidae	The water column extending from the shoreline to the outer boundary of the EEZ to a depth of 50 fm.	All rocky/coral and sand-bottom habitat and adjacent water column from 0 to 50 fm.
Mugilidae	The water column from the shoreline to the outer limits of the EEZ to a depth of 50 fm.	All sand and mud bottoms and the adjacent water column from 0 to 25 fm.
Muraenidae	The water column from the shoreline to the outer boundary of the EEZ to a depth of 50 fm.	All rocky and coral areas and the adjacent water column from 0 to 50 fm.
Octopodidae	Larvae: The water column from the shoreline to the outer limits of the EEZ to a depth of 50 fm.	EFH for the adult, juvenile phase and demersal eggs is defined as all coral, rocky and sand-bottom areas from 0 to 50 fm.

Species Assemblage/Complex	EFH (Egg and Larvae)	EFH (Adult and Juvenile)
Polynemidae	The water column extending from the shoreline to the outer boundary of the EEZ to a depth of 50 fm.	All rocky/coral and sand-bottom habitat and the adjacent water column from 0 to 50 fm.
Priacanthidae	The water column extending from the shoreline to the outer boundary of the EEZ to a depth of 50 fm.	All rocky/coral and sand-bottom habitat and the adjacent water column from 0 to 50 fm.
Scaridae	The water column from the shoreline to the outer limit of the EEZ to a depth of 50 fm.	All bottom habitat and the adjacent water column from 0 to 50 fm
Siganidae	The water column from the shoreline to the outer boundary of the EEZ to a depth of 50 fm.	All bottom habitat and the adjacent water column from 0 to 50 fm.
Scombridae	EFH for all life stages of dogtooth tuna is designated as the water column from the shoreline to the outer boundary of the EEZ to a depth of 50 fm.	
Sphyraenidae	EFH for all life stages in the family Sphyraenidae is designated as the water column from the shoreline to the outer boundary of the EEZ to a depth of 50 fm.	
Turbinidae	The water column from the shoreline to the outer boundary of the EEZ to a depth of 50 fm.	All bottom habitat and the adjacent water column from 0 to 50 fm.
Aquarium Species/Taxa	All waters from 0-50 fm from the shoreline to the limits of the EEZ.	All coral, rubble, or other hard-bottom features and the adjacent water column from 0-50 fm.

Table 6.4: Occurrence of Potentially Harvested Coral Reef Taxa.

Habitat: Mangrove (Ma) Lagoon (La) Estuarine (Es) Seagrass Beds (SB) Soft substrate (Ss) Coral Reef/Hard Substrate (Cr/Hr) Patch Reefs (Pr) Deep-slope Terraces (DST) Pelagic/Open Ocean (Pe).

Life History Stage: Egg (E) Larvae (L) Juvenile (J) Adult (A) Spawners (S).

Management Unit Species/Taxa	Ma	La	Es	SB	Ss	Cr/Hs	Pr	DST	Pe
Labridae spp. (wrasses)	J	A, J, E	J	J	A, J	A, J, S	A, J, S	A, J	E, L
Kuhliidae	A, J	A, J	All	A, J		A, S	A, S		E, L
Carcharhinidae*, Sphymidae, (sharks)	A, J	A, J	A, J		A, J	A, J	A, J	A, J	A, J
Dasyatididae, Myliobatidae, Mobulidae (rays)	A, J	A, J	A, J		A, J	A, J	A, J	A, J	A, J
Serranidae spp.* (groupers)	J	A, J		J	A, J, S	A, J, S	A J, S	A, S	E, L
Carangidae* (jacks/trevallies)	A, J, S	A, J, S	A, J, S	J	A, J, S	A, J, S	A, J, S	A, J, S	All
Holocentridae spp. (soldierfish/squirrelfish)		A, J, S	A, J, S	J		A, J, S	A, J, S	A, S	E, L
Scaridae spp. (parrotfishes)	J	A, J, S		A, J		A, J, S	A, J, S		E, L
Bumphead parrotfish (*Bolbometopon muricatum*)	J	J		J		A, J, S	A, J, S		E, L
Mullidae spp. (goatfish)	A, J, S	A, J, S	A, J, S	A, J	A, J, S	A, J, S	A, J, S	A, J	E, L
Acanthuridae spp. (surgeonfish/unicornfish)	J	A, J, S	A, J, S	J	A, J, S	A, J, S	A, J, S	A, J	E, L
Lethrinidae spp. (emperors), *	J	A, J, S	J	J	A, J, S	A, J, S	A, J, S	A, S	E, L
Chlopsidae, Congridae, Moringuidae, Ophichthidae, Muraenidae (eels)	A, J, S	A, J, S	A, J, S	A, J	A, J, S	A, J, S	A, J, S	A, J, S	E, L
Apogonidae (cardinalfish)	A, J, S	A, J, S	A, J, S	A, J, S		A, J, S	A, J, S	A, J, S	E, L
Zanclidae spp. (moorish idols)		A, J				A, J	A, J		E, L
Chaetodontidae spp. (butterflyfish)	J	A, J, S	J	J		A, J, S	A, J, S	A, S	E, L
Pomacanthidae spp. (angelfish)	J	A, J, S	J	J		A, J, S	A, J, S	A, S	E, L
Pomacentridae spp. (damselfish)	J	A, J, S	J	J		A, J, S	A, J, S	A, S	E, L

Management Unit Species/Taxa	Ma	La	Es	SB	Ss	Cr/Hs	Pr	DST	Pe
Scorpaenidae (scorpionfish)	J	A, J, S	A, J, S	J		A, J, S	A, J, S		E, L
Blenniidae (blennies)		A, J, S	A, J, S		A, J, S	A, J, S	A, J, S	A, J, S	E, L
Ephippidae (batfish)	J	A, J, S	J		A, S	A, J, S	A, J, S	A, S	All
Monodactylidae (mono)	A, J, S	A, J, S	A, J, S			A, J, S	A, J, S		E, L
Haemulidae (sweetlips)	J	A, J, S	A, J, S	J		A, J, S	A, J, S		E, L
Echineididae (remoras)						A, J, S	A, J, S	A, J, S	E, L
Malacanthidae (tilefish)		A, J, S			A, J, S	A, J, S	A, J, S		E, L
Acanthoclinidae (spiny basslets)						A, J		A, J	E, L
Pseudochromidae (dottybacks)	J	J		J		A, J, S	A, J, S		E, L
Plesiopidae (prettyfins)	J	A, J, S				A, J, S	A, J, S		E, L
Tetrarogidae (waspfish)	J	A, J, S				A, J, S	A, J, S		E, L
Caracanthidae (coral crouchers)						A, J, S	A, J, S		E, L
Grammistidae (soapfish)						A, J, S	A, J, S		E, L
Aulostomus chinensis (trumpetfish)	J	A, J, S		A, J	A	A, J, S	A, J, S		E, L
Fistularia commersoni (coronetfish)	J	A, J, S		A, J		A, J, S	A, J, S		E, L
Anomalopidae (flashlightfish)						J	J	A, J, S	E, L
Clupeidae (herrings)	A, J, S	A, J, S	A, J, S			A, J, S	A, J, S	A, S	All
Engraulidae (anchovies)	A, J, S	A, J, S	A, J, S			A, J, S	A, J, S	A, S	All
Gobiidae (gobies)	All	All	All	All	All	All	All	All	All
Lutjanids (snappers)*	A, J, S	A, J, S	A, J, S	J		A, J, S	A, J, S	A, S	E, L
Ballistidae/Monocanthidae spp.	J	A, J, S	J	J		A, J, S	A, J, S	A, S	L
Siganidae spp. (rabbitfishes)	A, J, S	A, J, S	A, J, S	J		A, J, S	A, J, S		E, L

Management Unit Species/Taxa	Ma	La	Es	SB	Ss	Cr/Hs	Pr	DST	Pe
Kyphosidae	J	A, J, S	A, J, S			A, J, S	A, J, S		All
Caesionidae	J	A, J, S			A, S	A, J, S	A, J, S	A, S	All
Cirrhitidae		A, J, S				A, J, S	A, J, S	A, J, S	All
Antennariidae (frogfishes)		All		All		All	All		L
Syngnathidae (pipefishes/seahorses)	All	All		All		All	All		L
Sphyraenidae spp. (barracudas)	A, J	A, J, S	A, J, S	J		A, J, S	A, J, S	A, S	All
Priacanthidae	J	A, J, S	J			A, J, S	A, J, S	A, S	E, L
Stony corals		A, J, S	A, J, S			A, J, S	A, J, S	A, J, S	E, L
Heliopora (blue)		A, J, S	A, J, S			A, J, S	A, J, S	A, J, S	E, L
Tubipora (organpipe)						A J	A, J		
Azooxanthellates (non-reefbuilders)		A, J, S	A, J, S		A, J, S	A, J, S	A, J, S	A, J, S	E, L
Fungiidae (mushroom corals)		A, J, S	A, J, S			A, J, S	A, J, S	A, J, S	E, L
Sm/Lg Polyped Corals (endemic spp.)		A, J				A, J	A, J	A, J	
Millepora (firecorals)		A, J, S				A, J, S	A, J, S	A, J, S	E, L
Soft corals and Gorgonians		A, J, S			A, J, S	A, J, S	A, J, S	A, J, S	E, L
Anemones (non-epifaunal)	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	E, L
Zooanthids	A, J, S	A, J, S	A, J, S		A, J, S	A, J, S	A, J, S	A, J, S	E, L
Sponges	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	E, L
Hydrozoans	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	E, L
Stylasteridae (lace corals)	A, J, S	A, J, S	A, J, S			A, J, S	A, J, S	A, J, S	E, L
Solanderidae (hydroid fans)	A, J, S	A, J, S	A, J, S			A, J, S	A, J, S	A, J, S	E, L
Bryozoans	A, J, S	A, J, S	A, J, S	A, J		A, J, S	A, J, S	A, J, S	E, L

Management Unit Species/Taxa	Ma	La	Es	SB	Ss	Cr/Hs	Pr	DST	Pe
Tunicates (solitary/colonial)	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	E, L
Feather duster worms (Sabellidae)	A, J, S	A, J, S	A, J, S		A, J, S	A, J, S	A, J, S	A, J, S	E, L
Echinoderms (e.g., sea cucumbers, sea urchins)	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	E, L
Mollusca	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	E, L
Sea Snails (gastropods)	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	E, L
Trochus spp.		A, J, S				A, J, S	A, J, S		E, L
Opistobranchs (sea slugs)	A, J	A, J, S		A, J, S	A, J, S	A, J, S	A, J, S	A, J	E, L
Pinctada margaritifera (black lipped pearl oyster)	A, J	A, J, S				A, J, S	A, J, S	A, J, S	E, L
Tridacnidae		A, J, S			A, J, S	A, J, S	A, J, S		E, L
Other Bivalves	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	E, L
Cephalopods		All	A, J, S	All	All	All	All	All	E, L
Octopodidae	A, J, S	All	A, J, S	All	All	All	All	All	L
Crustaceans*	A, J	All	A, J	A, J	A, J	All	All	All	L
Lobsters*		All			A, J	All	All	All	L
Shrimp/Mantis		All	A, J	A, J	A, J	All	All	All	L
Crabs*	A, J	All	A, J	A, J	A, J	All	All	All	L
Annelids	A, J, S	A J, S	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	A, J, S	E, L
Algae	All	All	All	All	All	All	All	All	
Live rock		A, J	A, J			A, J, A	A, J, A	A J, A	E, L

*Some species belonging to this taxa will be managed under other FMPs, but ecosystem effects will be addressed by this FMP.

Table 6.5: Summary of EFH designations for Potentially Harvested Coral Reef Taxa.

Species Assemblage/Complex	EFH (Egg and larvae)	EFH (Adult and Juvenile)
All Potentially Harvested Coral Reef Taxa	EFH for all life stages of Potentially Harvested Coral Reef Taxa is designated as the water column and bottom habitat from the shoreline to the outer boundary of the EEZ to a depth of 50 fm	

Table 6.6: Habitat Areas of Particular Concern for CRE MUS.

	Rarity of Habitat	Ecological function	Susceptibility to Human Impact	Likelihood of Developmental Impacts	Existing Protective Status
NWHI					
All substrate 0-10 fm	x	x	x		x
Laysan: All substrate 0-50 fm	x	x			
Midway: All substrate 0-50 fm	x	x	x		x
FFS: All substrate 0-50 fm	x	x	x	x	
Main Hawaiian Islands					
Kaula Rock (entire bank)		x	x		x
Niihau (Lehua Island)	x	x	x		
Kauai (Kaliu Point)		x	x		
Oahu					
Pupukea (MLCD)		x	x	x	x
Shark's Cove (MLCD)			x	x	x
Waikiki (MLCD)			x	x	x
Makapuu Head/Tide Pool Reef Area		x	x	x	
Kaneohe Bay	x	x	x	x	
Kaena Point		x	x		
Kahe Reef		x	x		
Maui					
Molokini	x	x	x	x	x
Olowalo Reef Area		x	x	x	
Honolua-Mokuleia Bay (MLCD)		x	x		x
Ahihiki Kinau Natural Area Reserve	x	x	x		x
Molokai (south shore reefs)		x	x		

Table 6.6 (cont.).

	Rarity of Habitat	Ecological function	Susceptibility to Human Impact	Likelihood of Developmental Impacts	Existing Protective Status
Main Hawaiian Is. (cont.)					
Lanai					
Halope Bay		x	x		
Manele Bay		x	x	x	
Five Needles		x	x		
Hawaii					
Lapakahi Bay State Park (MLCD)		x	x		x
Pauko Bay and Reef (MLCD)		x	x		x
Kealakekua		x	x		x
Waialea Bay (MLCD)	x	x	x		x
Kawaihae Harbor-Old Kona Airport (MLCD)		x	x		x
Additional Areas					
All long-term research sites		x	x		
All CRAMP sites		x	x		
American Samoa					
Fagatele Bay	x	x			x
Larsen Bay		x	x	x	
Steps Point		x	x		
Pago Pago (North Coast of Tutuila), National Park of American Samoa	x	x	x		x
Aunuu Island	x	x	x	x	
Rose Atoll	x	x			x
South coast Ofu (marine areas)	x	x	x	x	
Aua Transect- Pago Pago harbor, oldest coral reef transect	x	x	x	x	
Tau Island	x	x	x		

Table 6.6 (cont.)

	Rarity of Habitat	Ecological function	Susceptibility to Human Impact	Likelihood of Developmental Impacts	Existing Protective Status
Guam					
Cocos Lagoon	x	x	x		
Orote Point Ecological Reserve Area	x	x	x	x	x
Haputo Point Ecological Reserve Area	x	x			x
Ritidian Point	x	x			x
Jade Shoals	x	x	x		
CMNI					
Saipan (Saipan Lagoon)	x	x	x	x	
US Pacific Remote Islands					
Wake Atoll	x	x			x
Johnston Atoll	x	x		x	x
Palmyra Atoll	x	x	x		x
Kingman Reef	x	x	x		x
Howland Island	x	x			x
Baker Island	x	x			x
Jarvis Island	x	x			x

6.3 Fishing Activities That May Adversely Affect EFH

The Council is required to act to prevent, mitigate, or minimize any adverse effects from fishing if there is evidence that a fishing practice is having an identifiable adverse effect on EFH for any management unit species (MUS) covered by an FMP. Table 6.7 summarizes EFH for species managed by other FMPs. Adverse fishing impacts may include physical, chemical, or biological alterations of the substrate and loss of, or injury to, benthic organisms, prey species, and their habitat or other components of the ecosystem. FMPs must also contain an assessment of the potential adverse effects of all fishing equipment types used in waters described as EFH. This assessment should consider the relative impacts of all fishing eqnipment types used in EFH on different types of habitat found within EFH.

The predominant fishing gear types—hook-and-line, longline, troll, traps—used in the fisheries managed by the Council cause few fishing-related impacts to the benthic habitat utilized by coral reef species, bottomfish, crustaceans, or precious corals. The current management regime prohibits the use of bottom trawls, bottom-set nets, explosives, and poisons. The use of non-selective gear to harvest precious corals in the MHI is prohibited. Under this FMP, only selective and non-destructive gear may be allowed to fish for CRE-MUS. Additionally, any gear type not listed in Section 5.4.2 must first be evaluated by the PIAO Administrator in consultation with the Council and the director of the affected state fishery management agency before any such gear may be used. The Council has determined that current management measures to protect fishery habitat are adequate and no additional measures are necessary at this time. However, the Council has identified the following potential sources of fishery-related impacts to benthic habitat that may occur during normal fishing operations:

- Anchor damage from vessels attempting to maintain position over productive fishing habitat.
- Heavy weights and line entanglement occurring during normal hook-and-line fishing operations.
- Lost gear from lobster fishing operations.
- Remotely operated vehicle (ROV) tether damage to precious coral daring harvesting operations.

Trash is sometimes discarded by fishing vessels operating in the EEZ, and fishing hardware—such as leaders, hooks, and weights—are occasionally lost after becoming snagged on the bottom. The Council determined that the effects of this marine debris on habitat are not adverse. However, the Council is concerned that marine debris originating from fishing operations outside the Western Pacific Region may have impacts on habitat. The source of this debris and its impacts are being investigated by NMFS. International cooperation will be necessary to find solutions to this broader problem.

Because the habitat of pelagic species is the open-ocean water column, and managed fisheries employ varianta of hook-and-line gear, there are no direct impacts to EFH. Lost gear may be a hazard to some species due to entanglement, but it has no direct effect on habitat. A possible impact would be caused by fisheries that target and deplete key prey species, but currently there is no such fishery.

Table 6.7: Essential Fish Habitat for Management Unit Species Managed Under Other Fishery Management Plans.

FMP	Species Complex	EFH	HAPC
Pelagic	**Temperate species** Striped Marlin (*Tetrapurus audax*); Bluefin Tuna (*Thunnus thynnus*); Swordfish (*Xiphias gladius*); Albacore (*Thunnus alalunga*); Mackeral (*Scomber* spp); Bigeye (*Thunnus obesus*); Pomfmt (family Bramidae	**Eggs and larvae:** the (epipelagic zone) water column down to a depth of 200 m (100 fathoms) from the shoreline to the outer limit of the EEZ. **Juvenile/adults:** the water column down to a depth of 1,000 m (500 fathoms) from the shoreline to the outer limit of the EEZ	The water column from the surface down to a depth of 1,000 m (500 fathoms) above all seamounts and banks with summits shallower than 2,000 m (1,000 fathoms) within the EEZ.
Pelagic	**Tropical species** Yellowfin (*Thunnus albacares*); Kawakawa (*Euthynnus affinis*); Skipjack (*Katsuwonus pelamis*); Frigate and bullet tunas (*Auxis thazard, A. rochei*); Blue marlin (*Makaira nigricans*); Slender tunas (*Allothunnus fallai*); Black marlin (*Makaira indica*); Dogtooth tuna (*Gymnosarda unicolor*); Spearfish (*Tetrapturus spp*); Sailfish (*Istiophorus platypterus*); Mahimahi (*Coryphaena hippurus, C. equiselas*); Ono (*Acanthocybium solandri*); Opah (*Lampris* sp)	**Eggs and larvae:** the (epipelagic zone) water column down to a depth of 200 m (100 fathoms) from the shoreline to the outer limit of the EEZ. **Juvenile/adults:** the water column down to a depth of 1,000 m (500 fathoms) from the shoreline to the outer limit of the EEZ	The water column from the surface down to a depth of 1,000 m (500 fathoms) above all seamounts and banks with summits shallower than 2,000 m (1,000 fathoms) within the EEZ.
Pelagic	**Sharks** Requiem sharks (family Carcharinidae); Thresher sharks (family Alopiidae); Mackeral sharks (family Lamnidae); Hammerheads sharks (family Sphymidae)	**Eggs and larvae:** the (epipelagic zone) water column down to a depth of 200 m (100 fathoms) from the shoreline to the outer limit of the EEZ. **Juvenile/adults:** the water column down to a depth of 1,000 m (500 fathoms) from the shoreline to the outer limit of the EEZ	The water column from the surface down to a depth of 1,000 m (500 fathoms) above all seamounts and banks with summits shallower than 2,000 m (1,000 fathoms) within the EEZ.
Bottomfish and Seamount Groundfish	**Shallow water species (0-50 fm):** Uku (*Aprion virescens*), Thicklip trevally (*Pseudocaranx dentex*), Lunartail grouper (*Variola louti*), Blacktip grouper (*Epinephelus fasciatus*), Ambon emperor (*Lethrinus amboinensis*), Redgill emperor (*Lethrinus rubrioperculatus*), Giant trevally (*Caranx ignoblis*), Black trevally (*Caranx lugubris*), Amberjack (*Seriola dumerili*), Taape (*Lutjanus kasmira*)	**Eggs and larvae:** the water column extending from the shoreline to the outer limit of the EEZ down to a depth of 400 m (200 fathoms). **Juvenile/adults:** the water column and all bottom habitat extending from the shoreline to a depth of 400 m (200 fathoms)	All slopes and escarpments between 40-280 m (20 and 140 fathoms). Three known areas of juvenile opakapaka habitat: Two off Oahu and one off Molokai

FMP	Species Complex	EFH	HAPC
Bottomfish and Seamount Groundfish	**Deep water species 50-200 fm):** Ehu (*Etelis carbunculus*), Onaga (*Etelis coruscans*), Opakapaka (*Pristipomoides filamentosus*), Yellowtail Kalekale (*P. auricilla*), Yelloweye opakapaka (*P. flavipinnis*), Kalekale (*P. sieboldii*), Gindai (*P. zonatus*), Hapupuu (*Epinephelus quernus*), Lehi (*Aphareus rutilans*)	**Eggs and larvae:** the water column extending from the shoreline to the outer limit of the EEZ down to a depth of 400 m (200 fathoms). **Juvenile/adults:** the water column and all bottom habitat extending from the shoreline to a depth of 400 m (200 fathoms)	All slopes and escarpments between 40-280 m (20 and 140 fathoms). Three known areas of juvenile opakapaka habitat: Two off Oahu and one off Molokai
Bottomfish and Seamount Groundfish	**Seamount Groundfish species (50-200 fm):** Armorhead (*Pseudopentaceros richardsoni*), Ratfish/butterfish (*Hyperoglyphe japonica*), Alfonsin (*Beryx splendens*)	**Eggs and larvae:** the (epipelagic zone) water column down to a depth of 200 m (100 fathoms) of all EEZ waters bounded by latitude 29°-35° **Juvenile/adults:** all EEZ waters and bottom habitat bounded by latitude 29°-35° N and longitude 171° E-179° W between 200 and 600 m (100 and 300 fathoms	No HAPC designated for Seamount Groundfish
Crustaceans	**Spiny and Slipper Lobster Complex** Hawaiian spiny lobster (*Panulirus marginatus*), Spiny lobster (*P. penicillatus*, *P.* sp.), Ridgeback slipper lobster (*Scyllarides haanii*). Chinese slipper lobster (*Parribacus antarticus*) **Kona Crab** Kona crab (*Ranina ranina*)	**Eggs and larvae:** the water column from the shoreline to the outer limit of the EEZ down to a depth of 150 m (75 fathoms) **Juvenile/adults:** the all bottom habitat from the shoreline to a depth of 100 m (50 fathoms)	All banks in the NWHI with summits less than or equal to 30 m (15 fathoms) from the surface.
Precious Corals	**Deep-water Precious Corals (150-750 fm)** Pink coral (*Corallium secundum*), Red coral (*C. regale*), Pink coral (*C. laauense*), Midway deepsea coral (*C.* sp nov.), Gold coral (*Gerardia* sp), Gold coral (*Callogorgia gilberti*), Gold coral (*Narella* spp.), Gold coral (*Calyptrophora* spp.), Bamboo coral (*Lepidisis olapa*), Bamboo coral (*Acanella* spp.) **Shallow-water Precious Corals (10-50 fm)** Black coral (*Antipathes dichotoma*), Black coral (*Antipathis grandis*), Black coral (*Antipathes ulex*)	EFH for Precious Corals is confined to six known precious coral beds located off Keahole Point, Makapuu, Kaena Point, Wespac bed, Brooks Bank and 180 Fathom Bank. EFH has also been designated for three beds known for black corals in the Main Hawaiian Islands between Milolii and South Point on the Big Island, the Auau Channel and the southern border of Kauai	Includes the Makapuu bed, Wespac bed, Brooks Banks bed. For Black Corals, the Auau Channel has been identified as a HAPC.

There is also a concern that invasive marine and terrestrial species may be introduced into sensitive environments by fishing vessels transiting from populated islands and grounding on shallow reef areas. Of most concern is the potential for unintentional introduction of rats (*Ratus spp.)* to the remote islands in the NWHI and PRIA that harbor endemic landbirds. Although there are no restrictions that prohibit fishing vessels from transiting near these remote islands areas, no invasive species introductions due to this activity have been documented. However, the Council is concerned that this could occur as fisheries expand and emerging fisheries develop in the future. Establishing no-take MPAs—which are mostly contiguous around these remote islands—will deter fishing vessels from transiting near the islands, thus reducing the potential for unintentional groundings and introductions of invasive species.

While the Council has determined that current management measares to protect fishery habitat are adequate, should future research demonstrate a need, the Council will act accordingly to protect habitat necessary to maintain a sustainable and productive fishery in the Western Pacific Region. For a full assessment of potential adverse impacts to EFH from fishing gear currently used in areas designated as EFH see Appendix A- Catalogue of Fishing Gear.

In modern times, some reefs have been degraded by a range of human activities. Comprehensive lists of human threats to coral reefs in the U.S. Pacific Islands are provided by Maragos *et al.* (1996), Birkeland (1997b), Grigg 1997, and Clark and Gulko (1999). (These findings are summarized in Table 6.8.) In general, reefs closest to human population centers are more heavily used and are in worse condition than those in remote locations (Green 1997). Nonetheless, it is difficult to generalize about the present condition of coral reefs in the U.S. Pacific Islands because of their broad geographic distribution and the lack of long-term monitoring to document environmental and biological baselines. Coral reef conditions and use patterns vary throughout the U.S. Pacific Islands.

A useful distinction is between coral reefs near inhabited islands of American Samoa, CNMI, Guam, and the main Hawaiian islands and coral reefs in the remote NWHI, PRIAs, and northern islands of the CNMI. Reefs near the inhabited islands are heavily used for small-scale artisanal, recreational, and subsistence fisheries, and those in Hawaii, Saipan (CNMI), and Guam are also the focus for extensive non-consumptive marine recreation. Rather than a relatively few large-scale mechanized operations, many fishermen each deploy more limited gear. The more accessible banks in the main Hawaiian Islands (Penguin Bank, Kaula Rock), Guam (southern banks), and the CNMI (Esmeralda Bank, Farallon de Medinilla) are the most heavily fished offshore reefs in the FMP management area.

The vast majority of the reefs in the CRE-FMP management area are remote and, in some areas, they have protected status. Most of these are believed to be in good condition. (Table 6.9 summarizes coral reef conditions in the region.) Existing fisheries are limited. The major exception is in the NWHI, where there are commercial fisheries for spiny lobster and deep-slope bottomfish (Green 1997). Poaching by foreign fishing fleets is suspected at Guam's southern banks, in the PRIA, and possibly in other areas. Poachers usually target high-value, and often rare or overfished, coral reef resources. These activities are already illegal but difficult to detect.

Table 6.8: Threats to Coral Reef in the U.S. Pacific Islands (after Maragos *et al.* 1996; Grigg 1997; Birkeland 1997; Jokiel 1999; Clark and Gulko 1999).

Activity	American Samoa	Guam	Hawaii		CNMI	Remote U.S. island possessions
			MHI	NWHI		
Coastal construction	X	X	X		X	X
Destructive fishing	X		X		X	
Flooding	X	X	X			
Industrial pollution	X				X	
Overuse/over harvesting	X	X	X		X	
Nutrient loading (sewage/eutrophication)	X	X	X		X	
Poaching/depletion of rare species	X				X	X
Soil erosion/sedimentation	X	X			X	
Vessel groundings/oil spills	X	X		X	X	
Military activity		X	X	X	X	X
Hazardous waste		X		X		X
Tourist impacts		X	X		X	
Urbanization		X	X			
Thermal pollution			X			
Marine debris			X	X		
Introduced species			X			

Table 6.9: Summary of coral reef condition in nearshore areas (0-3 nmi from shore) and offshore areas (3-200 nm from shore) in sub-areas of the U.S. Pacific Islands (after Green, 1997).

Location	**0-3 nmi**	**3-200 nmi**
American Samoa	Poor-Excellent	Good-Excellent
CNMI	Poor-Excellent	Good-Excellent
Guam	Poor-Good	Good-Excellent
Hawaii		
Main Hawaiian Islands	Poor-Good	Good-Excellent
Northwestern Hawaiian Islands	Excellent	Excellent
Remote Islands	Poor-Excellent	Excellent
Overall	**Poor-Excellent**	**Good-Excellent**

6.4 Non-fishing Related Activities That May Adversely Affect EFH

Based on the guidelines established by the Secretary under Section 305 (b)(1)(A) of the MSFCMA, NMFS has developed a set of guidelines to assist councils meet the requirement to describe adverse impacts to EFH from non-fishing activities in their FMPs. A wide range of non-fishing activities throughout the U.S. Pacific Islands contribute to EFH degradation. FMP implementation will not directly mitigate these activities. However, as already noted, it will allow NMFS and the Council to make recommendations to any federal or state agency about actions that may impact EFH. Not only could this be a mechanism to minimize the environmental impacts of agency action, it will help them focus their conservation and management efforts.

The Council is required to identify non-fishing activities that have the potential to adversely affect EFH quality and, for each activity, describe its known potential adverse impacts and the EFH most likely to be adversely affected. The descriptions should explain the mechanisms or processes that may cause the adverse effects and how these may affect habitat function. The Council considered a wide range of non-fishing activities that may threaten important properties of the habitat used by managed species and their prey, including dredging, dredge material disposal, mineral exploration, water diversion, aquaculture, wastewater discharge, oil and hazardous substance discharge, construction of fish enhancement structures, coastal development, introduction of exotic species, and agricultural practices. These activities and impacts, along with mitigation measures are detailed in the next section.

6.4.1 Habitat Conservation and Enhancement Recommendations

Background

According to NMFS guidelines, this FMP must describe ways to avoid, minimize, or compensate for the adverse effects to EFH. It must also promote the conservation and enhancement of EFH. Generally, non-water dependent actions that may have adverse impacts should not be located in EFH. Activities that may result in significant adverse effects on EFH should be avoided where less environmentally harmful alternatives are available. If there are no alternatives, the impacts of these actions should be minimized. Environmentally sound engineering and management practices should be employed for all actions that may adversely affect EFH. Disposal or spillage of any material (dredge material, sludge, industrial waste, or other potentially harmful materials) that would destroy or degrade EFH should be avoided. If avoidance or minimization is not possible, or will not adequately protect EFH, compensatory mitigation to conserve and enhance EFH should be recommended. FMPs may recommend proactive measures to conserve or enhance EFH. When developing proactive measures, councils may develop a priority ranking of the recommendations to assist federal and state agencies undertaking such measures. FMPs should describe a variety of options to conserve or enhance EFH, which may include, but are not limited to:

Enhancing of rivers, streams, and coastal areas through new federal, state, or local government planning efforts to restore river, stream, or coastal area watersheds.

Improve water quality and quantity through the use of best land management practices to ensure that water quality standards at state and federal levels are met. The practices include improved sewage treatment, disposing of waste materials properly, and maintaining sufficient in-stream flow to prevent adverse effects to estuarine areas.

Restore or create habitat, or convert non-EFH to EFH, to replace lost or degraded EFH, if conditions merit. However, habitat conversion at the expense of other naturally functioning systems must be justified within an ecosystem context.

6.4.2 Description of Mitigation Measures for Identified Activities and Impacts

Established policies and procedures of the Council and NMFS provide the framework for conserving and enhancing EFH. Components of this framework include adverse impact avoidance and minimization, provision of compensatory mitigation whenever the impact is significant and unavoidable, and incorporation of enhancement. New and expanded responsibilities contained in the MSFCMA will be met through appropriate application of these policies and principles. In assessing the potential impacts of proposed projects, the Council and the NMFS are guided by the following general considerations:

- The extent to which the activity would directly and indirectly affect the occurrence, abundance, health and continued existence of fishery resources.
- The extent to which the potential for cumulative impacts exists.
- The extent to which adverse impacts can be avoided through project modification, alternative site selection or other safeguards.
- The extent to which the activity is water dependent if loss or degradation of EFH is involved.
- The extent to which mitigation may be used to offset unavoidable loss of habitat functions and values.

Seven non-fishing activities have been identified that directly or indirectly affect habitat used by management unit species. Impacts and conservation measares are summarized below for each of these activities. Although not all-inclusive, what follows is a good example of the kinds of measures that can help to minimize or avoid the adverse effects of identified non-fishing activities on EFH.

Habitat Loss and Degradation

<u>Impacts</u>

- Infaunal and bottom-dwelling organisms.
- Turbidity plumes.
- Biological availability of toxic substances.
- Damage to sensitive habitats.
- Current patterns/ water circulation modification.
- Loss of habitat function.
- Contaminant runoff.
- Sediment runoff.
- Shoreline stabilization projects.

<u>Conservation Measures</u>

1. To the extent possible, fill materials resulting from dredging operations should be placed on an upland site. Fills should not be allowed in areas with subaquatic vegetation, coral reefs or other areas of high productivity.

2. The cumulative impacts of past and current fill operations on EFH should be addressed by federal, state and local resource management and permitting agencies and considered in the permitting process.

3. The disposal of contaminated dredge material should not be allowed in EFH.

4. When reviewing open-water disposal permits for dredged material, state and federal agencies should identify the direct and indirect impacts such projects may have on EFH. When practicable, benthic productivity should be determined by sampling prior to any discharge of fill material. Sampling design should be developed with input from state and federal resource agencies.

5. The areal extent of the disposal site should be minimized. However, in some cases, thin layer disposal may be less deleterious. All non-avoidable impacts should be mitigated.

6. All spoil disposal permits shonld reference latitude-longitude coordinates of the site so information can be incorporated into GIS systems. Inclusion of aerial photos may also be required to help geo-reference the site and evaluate impacts over time.

7. Further fills in estuaries and bays for development of commercial enterprises should be curtailed.

8. Prior to installation of any piers or docks, the presence or absence of coral reefs and submerged aquatic vegetation should be determined. These areas should be avoided. Benthic productivity should also be determined, and areas with high productivity avoided. Sampling design should be developed with input from state and federal resource agencies.

9. The use of dry stack storage is preferable to wet mooring of boats. If that method is not feasible, construction of piers, docks and marinas should be designed to minimize impacts to the coral reef substrate and subaquatic vegetation.

10. Bioengineering should be used to protect altered shorelines. The alteration of natural, stable shorelines should be avoided.

Pollution and Contamination

Impacts

- Introduction of chemicals.
- Introduction of animal wastes.
- Increased sedimentation.
- Wastewater effluent with high contaminant levels.
- High nutrient levels down-current of outfalls.
- Biocides to prevent biofouling.
- Thermal effects.
- Turbidity plumes.
- Affected submerged aquatic vegetation sites.
- Stormwater runoff.
- Direct physical contact.
- Indirect exposure
- Cleanup.

Conservation Measures

1. Outfall structures should be placed sufficiently far offshore to prevent discharge water from affecting areas designated as EFH. Discharges should be treated using the best available technology, including implementation of up-to-date methodologies for reducing discharges of biocides (*e.g.*, chlorine) and other toxic substances.

2. Benthic productivity should be determined by sampling prior to any construction activity. Areas of high productivity should be avoided to the maximum extent possible. Sampling design should be developed with input from state and federal resource agencies.

3. Mitigation should be provided for the degradation or loss of habitat from placement of the outfall structure and pipeline as well as the treated water plume.

4. Containment equipment and sufficient supplies to combat spills should be on-site at all facilities that handle oil or hazardous substances.

5. Each facility should have a "Spill Contingency Plan," and all employees should be trained in how to respond to a spill.

6. To the maximum extent practicable, storage of oil and hazardous substances should be located in an area that would prevent spills from reaching the aquatic environment.

7. Construction of roads and facilities adjacent to aquatic environments should include a storm-water treatment component that would filter out oils and other petroleum products.

8. The use of pesticides, herbicides and fertilizers in areas that would allow for their entry into the aquatic environment should be avoided.

9. The best land management practices should be used to control topsoil erosion and sedimentation.

Dredging

Impacts

- Infaunal and bottom-dwelling organisms.
- Turbidity plumes.
- Bioavailability of toxic substances.
- Damage to sensitive habitats.
- Water circulation modification.

Conservation Measures

1. To the maximum extent practicable, dredging should be avoided. Activities that require dredging (such as placement of piers, docks, marinas, etc.) should be sited in deepwater areas or designed in such a way as to alleviate the need for maintenance dredging.

Projects should be permitted only for water-dependent purposes, when no feasible alternatives are available.

2. Dredging in coastal and estuarine waters should be performed during the time frame when MUS and prey species are least likely to be entrained. Dredging should be avoided in areas with submerged aquatic vegetation and coral reefs.

3. All dredging permits should reference latitude-longitude coordinates of the site so information can be incorporated into Geographic Information Systems (GIS). Inclusion of aerial photos may also be required to help geo-reference the site and evaluate impacts over time.

4. Sediments should be tested for contaminants as per Environmental Protection Agency and U.S. Army Corps of Engineers requirements.

5. The cumulative impacts of past and current dredging operations on EFH should be addressed by federal, state and local resource management and permitting agencies and considered in the permitting process.

6. If dredging needs are caused by excessive sedimentation in the watershed, those causes should be identified and appropriate management agencies contacted to assure action is done to curtail those causes.

7. Pipelines and accessory equipment used in conjunction with dredging operations should, to the maximum extent possible, avoid coral reefs, seagrass beds, estuarine habitats and areas of subaquatic vegetation.

Marine Mining

Impacts

- Loss of habitat function.
- Turbidity plumes.
- Resuspension of fine-grained mineral particles
- Composition of the substrate altered.

Conservation Measures

1. Mining in areas identified as coral reef ecosystem should be avoided.

2. Mining in areas of high biological productivity should be avoided.

3. Mitigation should be provided for loss of habitat due to mining.

Water Intake Structures

Impacts

- Entrapment, impingement, and entrainment.
- Loss of prey species.

Conservation Measures

1. New facilities that rely on surface waters for cooling should not be located in areas where coral reef organisms are concentrated. Discharge points should be located in areas that have low concentrations of living marine resources, or they should incorporate cooling towers that employ sufficient safeguards to ensure against release of blow-down pollutants into the aquatic environment.

2. Intake structures should be designed to prevent entrainment or impingement of MUS larvae and eggs.

3. Discharge temperatures (both heated and cooled effluent) should not exceed the thermal tolerance of the plant and animal species in the receiving body of water.

4. Mitigation should be provided for the loss of EFH from placement of the intake structure and delivery pipeline.

Aquaculture Facilities

Impacts

- Discharge of organic waste from the farms.
- Impacts to the seafloor below the cages or pens.

Conservation Measures

1. Facilities should be located in upland areas as often as possible. Tidally influenced wetlands should not be enclosed or impounded for mariculture purposes. This includes hatchery and grow-out operations. Siting of facilities should also take into account the size of the facility, the presence or absence of submerged aquatic vegetation and coral reef ecosystems, proximity of wild fish stocks, migratory patterns, competing uses, hydrographic conditions and upstream uses. Benthic productivity should be determined by sampling prior to any operations. Areas of high productivity should be avoided to the maximum extent possible. Sampling design should be developed with input from state and federal resource agencies.

2. To the extent practicable, water intakes should be designed to avoid entrainment and impingement of native fauna.

3. Water discharge should be treated to avoid contamination of the receiving water and should be located only in areas having good mixing characteristics.

4. Where cage mariculture operations are undertaken, water depths and circulation patterns should be investigated and should be adequate to preclude the buildup of waste products, excess feed and chemical agents.

5. Non-native, ecologically undesirable species that are reared may pose a risk of escape or accidental release, which could adversely affect the ecological balance of an area. A thorough scientific review and risk assessment should be undertaken before any non-native species are allowed to be introduced.

6. Any net pen structure should have small enough webbing to prevent entanglement by prey species.

7. Mitigation should be provided for the EFH areas impacted by the facility.

Introduction of Exotic Species

Impacts

- Habitat alteration.
- Trophic alteration.
- Gene pool alteration.
- Spatial alteration.
- Introduction of disease.

Conservation Measures

1. Vessels should discharge ballast water far enough out to sea to prevent introduction of non-native species to bays and estuaries.

2. Vessels should conduct routine inspections for presence of exotic species in crew quarters and hull of the vessel prior to embarking to remote islands (PRIAs, NWHI and northern islands of the CNMI).

3. Exotic species should not be introduced for aquaculture purposes unless a thorough scientific evaluation and risk assessment are performed (see section on aquaculture).

4. Effluent from public aquaria display laboratories and educational institutes using exotic species should be treated prior to discharge.

6.5 EFH Research Needs

Additional research is needed to make available sufficient information to support a higher level of description and identification of EFH and HAPC. Additional research may also be necessary to identify and evaluate actual and potential adverse effects on EFH, including, but not limited to, direct physical alteration; impaired habitat quality/functions; cumulative impacts from fishing; or indirect adverse effects, such as sea level rise, global warming, and climate shifts.

The following scientific data are needed to more effectively address EFH provisions:

- The distribution of early life history stages (eggs and larvae) of MUS by habitat.
- Description of juvenile habitat (including physical, chemical, and biological features that determine suitable juvenile habitat).
- Food habits (feeding depth, major prey species, etc.).
- Habitat-related densities for all management unit species life history stages.
- Habitat utilization patterns for different life history stages and species.
- Growth, reproduction, and survival rates for management unit species within habitats.
- Inventory of coral reef ecosystem habitats in the EEZ of the Western Pacific Region.
- Location of important spawning sites.
- Identification of post-larval settlement habitat.
- Establishment of baseline parameters (CPUE) for coral reef ecosystem resources.
- High resolution mapping of bottom topography, bathymetry, currents, substrate types, algal beds, and habitat relief.

NMFS guidelines suggest that the Council and NMFS periodically review and update the EFH components of FMPs as new data become available. The Council recommends that new information be reviewed, as necessary, during preparation of the annual reports by the CRE Plan Team. EFH designations may be changed under the FMP framework processes if information presented in an annual review indicates that modifications are justified

CHAPTER 7

SCIENTIFIC DATA AND RESEARCH NEEDS

7.1 Ongoing and Proposed Coral Reef-related Research

In response to threats to coral reef ecosystems, President Clinton issued Executive Order 13089 - Coral Reef Protection in June 1998 to direct state and federal agencies to identify actions that may affect U.S. coral reef ecosystems and to use programs and authorities to protect and enhance the condition of these ecosystems.

Before the executive order was signed, state and federal government authorities, in collaboration with NGOs and international government authorities, recognized the necessity of preserving coral reef resources. Each region began formulating a plan of action to strengthen coral reef resource management in response to and with support from the U.S. Coral Reef Initiative. These plans focus on the collection of baseline assessments and identifying problems and areas of concern.

Table 7.1 summarizes the variety of coral reef projects ongoing or proposed around the Pacific Region. (Table 7.1 may be found at the end of this chapter.) The Council supports these research initiatives, because much of the information gained from these projects will complement the Council's research initiatives proposed in this chapter. While the extent of possible research on coral reef ecosystems is tremendous, the Council and its advisory bodies focused on research questions directly related to ecosystem management needs and issues that cut across the various FMPs.

7.2 Council Recommendations

The coral reef ecosystems covered under this FMP are geographically distinct, with management areas separated by 5,000 miles of Pacific Ocean. Species composition and richness vary widely between regions, as do fishing and non-fishing threats to the coral reefs.

An adaptive management strategy underlies this FMP because it is based on ecosystem principles. The research outlined in Table 7.1 addresses traditional species-specific management questions. While these projects can help to answer ecosystem-related questions, the Council's research recommendations more specifically support ecosystem-based adaptive management.

Specific questions focus on the multi-use nature of coral reefs, the role of the various coral reef habitats, trophic interactions and the effect of fishing, the value and function of MPAs, and the individual and synergistic effects that anthropogenic and natural disturbances have on the ecosystem. Particularly important research would address the interactions between fisheries, because the established crustacean, bottomfish, and precious coral fisheries all occur to some extent in the coral reef ecosystem. The following recommendations are derived from needs outlined by the Plan Teams for each of the FMPs, the Ecosystem and Habitat and Indigenous Rights Advisory Panels, and the Scientific and Statistical Committee.

7.2.1 Summary of Council-proposed Research

American Samoa

1. Examine recovery rates and yields of coral reefs that have been severely damaged by sustained high fishing pressures (Tutuila), with those where fishing pressure is much lower (Manu'a) or entirely absent (Rose Atoll MPA).

CNMI/ Guam

2. Socio-economic and cultural study of the fishing communities with respect to potential resource allocation.
3. Various projects addressing the multiple land-based threats to the near-shore coral reef ecosystem.

Main Hawaiian Islands

4. Effect of alien species on coral raef ecosystems, speed of dispersion.
5. Improve Fishery Statistical Surveys to complement commercial fisheries monitoring programs and to facilitate capturing landing and effort data from recreational fishing sectors.
6. Study of historic fisheries data.

Northwestern Hawaiian Islands

7. Protected species.
8. Effects of ecotourism.
9. Study of deep benthic habitat in relation to ecosystem.
10. Interactions between fisheries operating within the coral reef ecosystem.

PRIAs

11. Assessments and monitoring as benchmarks for total and species specific biomass, species composition and how habitat structure relates to species density.

12. Mapping.
13. Rapid ecological assessments, biomass surveys, long-term remote and direct monitoring.
14. Education.
15. Marine debris.
16. Effectiveness of MPAs as management tools.
17. Archaeo-ichthyological studies.
18. Relationship between habitat and stock abundance.
19. Determination of indicator species for rapid assessment of reef's health.
20. Relation of natural and anthropogenic stressors.
21. Trophic interactions for ecosystem modeling.
22. Standardization of data collection systems to facilitate use in management.

7.2.2 Region-specific Research Needs

The islands of the Western Pacific Region extend in a great arc over the Central and Western Pacific and include parts of Micronesia and Polynesia. The four inhabited archipelagos—Hawaii, Northern Mariana Islands, Guam and American Samoa—all have different geographic, social, and economic characteristics, which influence the types of coral reef fisheries research required in each location. Furthermore, large areas of the Western Pacific Region are uninhabited or under military control and therefore off-limits to commercial fishing. Research in these areas may not be driven primarily by fishery-related issues but by other concerns, such as protected species interactions in the case of the Northwestern Hawaiian Islands, or as benchmarks for comparison between fished and unfished sites.

American Samoa

American Samoa has a rapidly increasing population, most of which is found on the main large island of Tutuila. The island's population is mainly Polynesian and they are strongly linked through ancestral ties with the people of neighboring (Western) Samoa.[1] Population growth is driven by both new births and the migration of Western Samoans, who can get work permits for American Samoa. Very high harvests of reef fish and invertebrates from American Samoan reefs were documented in the late 1970s.

However, a combination of natural and anthropogenic effects has had a serious impact on American Samoan reefs, particularly on Tutuila, with the effect of depressing catch rates and the volume of fish produced through reef fishing. These include a crown-of-thorns outbreak in the 1970s, which ultimately destroyed 95% of live coral cover in some locations, followed by two severe hurricanes in 1990 and 1991. The hurricanes destroyed most of the coral growth to a depth of 10-15 m, particularly on the north side of the island. This was followed by a mass coral

[1] Western Samoa renamed itself Samoa in 1998, despite protest from American Samoa.

bleaching event in 1994, probably connected with El Niño. These disturbances, coupled with increasing human impacts such as sedimentation on the reefs, eutrophication of nearshore waters, coastal construction, and solid and chemical waste discharges have resulted in major changes to coral reef habitats and associated reef fish assemblages.
Successive damage to the Tutuila reefs means that American Samoa may be a natural laboratory to look at the behavior and recovery of fish populations in conditions where production has declined through a mix of habitat destruction and high fishing pressure. In response, the commercial fishery has changed its focus over the years from reef fishing to bottomfishing, and currently to longline fishing for albacore and other pelagic fish. Consumer demand for reef fish is now being met in large part by imports from Samoa (formerly Western Samoa). Fishing pressures on reef fish stocks in the less populated Manu'a Islands, to the east of Tutuila, have not changed in the same manner. Fish stocks are not considered over-exploited, and traditional coral reef fishing is currently practiced. Because one of the MPAs slated for implementation through this FMP is at Rose Atoll, American Samoa offers the potential to examine the recovery rates and yields of coral reefs that have been severely damaged by sustained high fishing pressures with those where fishing pressure is much lower or entirely absent.

Commonwealth of the Northern Mariana Islands and Guam

High population growth due to migrants is a feature of both Guam and the Northern Mariana Islands. Most of the immigrants come from East and Southeast Asia to work in the garment industry. Because of their cultural preferences they eat a lot of fish and other seafood. Therefore, they add to the demand for fishery production from coral reef areas. Small-boat fishermen dominate fishing in nearshore areas, catching deep- and shallow-water reef fish and bottomfish species. Due to their proximity to Asia, the potential for a live reef fish fishery exporting to Asia is greatest in these islands. The aforementioned Southeast Asian population—because of its high per capita rate of seafood consumption—will put additional pressure on coral reef resources. Because of this potential increase in fishing pressure, a socio-economic and cultural study of potential resource allocation in their fishing communities has been suggested.

The other major influence on the reefs of the Mariana Islands stems from the growth of the tourist industry in both Guam and CNMI. This has led to the landscaping of large areas of the coast for hotels, golf courses, shops, and other leisure activities. Construction brings with it the threat of sedimentation that smothers live corals, while the development of extensive golf courses may have an effect on near-shore lagoon waters through eutrophication from fertilizer-enriched runoff. Finally, the activities of the tourists themselves can harm reefs. Through spearfishing and charter fishing they add to local fishing pressure. Important habitat-related benthos is lost when they take shells and corals for souvenirs. They can also destroy habitat by walking on reefs in boots and diving fins; using jet-skis in shallow water has a similar, but potentially more widespread, effect. The latter activity has been blamed for diminishing habitat for rabbitfish, which are a popular target species on Guam.

CNMI is also subject to military activity on the island of Farallon de Medinilla (FDM), which is the only northern island in the Mariana chain with substantial coral reefs. FDM is also one of the few potential locations where fisheries can expand in the future. It has been used as a target in U.S. military activities for many years, with subsequent disturbance to the reef from direct bombing and accelerated erosion of the island as well.

Coral reef fisheries research in Guam and the CNMI should focus on how to achieve the best balance between tourism and fishing, given that the leisure industry is the single largest industry in both places. Bombing of FDM has been reported to have only a limited direct effect on the coral reef, but it removes a large area of coral reef from use by fishermen, who must fish more intensively on the remaining reef areas. This may have the undesired effect of placing stresses to stocks occupying those locations.

Main Hawaiian Islands

Like the Mariana Islands, the Main Hawaiian Islands' reefs are affected by the growing tourist industry in Hawaii, where large parts of the coastline have been landscaped for hotels, golf courses, and other leisure activities. Over six million people visit Hawaii each year, while the state has a resident population of about one million people. However, the Hawaiian Islands are much larger than their Micronesian counterparts, and larger areas of the coast are also untouched.

Of all areas within the Western Pacific Region, fishermen in the MHI have the most diverse array of fishing gears and fisheries. These include specialist targeting of small reef fish for the aquarium industry; fish trapping; a variety of crustacean trapping methods; directed fisheries for nearshore small pelagic fishes; and more typical methods like hook-and-line, gill net, seine net, cast net, and spear fishing. Alien species have been introduced into Hawaii through bilge and ballast water, by well-intentioned projects, and through federally supported aquaculture programs. The bluelined snapper (*Lutjanus kasmira*) was one of most contentions introductions; this species has spread throughout the state's coastal waters since its original introduction from French Polynesia. It has been blamed for the subsequent decline of bottomfish species even though there is no evidence for this. Although popular elsewhere in the Pacific, people in Hawaii are unfamiliar with it, and—although common—they do not like to eat it.

Extensive research has been conducted on Hawaii's reefs, but comparatively little is known about reef fisheries in Hawaii. Ironically, large volumes of data are compiled by the State of Hawaii Division of Aquatic Resources on commercial landings and nominal effort of coral reef fisheries by various gear types, with some data extending back to the late 1940s. Furthermore, a detailed survey of fishing in the Hawaiian Islands in the early 1900s provides an important benchmark. Besides landings and nominal effort, there are also indices of fishing effort contained in other databases, such as the Department of Boating and Ocean Recreations (DBOR) small vessel registration records. These data include registration of vessels for commercial fishing and for pleasure, with breakdown by size class and propulsion type. Much of these data remain unanalyzed and their management value unrealized. For example, this type of data was used to generate production models and MSY for bottomfish fisheries in the MHI (Ralston and Polovina 1982).

In February 2001, the Division of Aquatic Resources, in partnership with NMFS, re-initiated fishery statistical surveys for the MHI. These surveys are designed to collect data on participation, effort, and catch composition, primarily from the vessel-based recreational fishing sector. The Hawaii Marine Recreational Fisheries Surveys (HMRFS) consist of three components: (1) random digit surveys of Hawaii residents to estimate participation and effort for private boats and shore fishing, (2) weekly telephone surveys of 10% of Hawaii charter boat operators, and (3) an intercept snrvey of private and charter boat fishermen to collect catch data. This component of HMRFS is similar to the creel surveys conducted in other island areas. Re-establishing a detailed survey of fishing in the MHI is essential to increasing managers' knowledge of landings and nominal effort for coral reef fisheries. Not only will it help them to better understand coral reef fisheries in the commercial sector, but in other sectors—including recreational fishing—as well.

In summary, coral reef ecosystem problems in the MHI are similar to those in the Mariana Islands: the MHI also suffer from the impacts of urbanization and the effects of coastal landscaping driven by tourism and population expansion. But because the MHI are relatively large with some inaccessible coasts, there are extensive coastal areas free from these anthropogenic influences. This allows areas with different land nses and population densities to be compared in order to see the impacts on coral reef fisheries. In addition, there are unresolved questions about the impacts of exotic species on indigenous fauna, particularly the successful proliferation of the bluelined snapper. Lastly, unlike other areas of the Western Pacific Region, large volumes of data extending over several decades are available on commercial reef fisheries in Hawaii. It should also be noted that there are many different surveys and sampling programs in Hawaii for both commercial and recreational fisheries. All these data sources should be assessed in order to see what information can be gleaned to better manage Hawaii's coral reef fisheries.

Low-use Marine Protected Areas

The NWHI are a special concern, both regionally and nationally. Native people and foreign fishermen have fished in this area for hundreds of years. However, very little is known about the level of fishing pressure before Council-implemented management. The low-use MPAs that this FMP implements for the NWHI will begin seaward of what is currently a *de facto* no-take MPA (out to 10 fathoms), based on current regulations and fishing practices, and will generally extend from 10-50 fathoms.[1] It has been hypothesized that MPAs are havens where large, fecund species can repopulate the surrounding reef. However, this hypothesis needs to be studied in the presence of regulated fishing pressure. The low-use MPAs of the NWHI will be an ideal location for this research.

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[1]As described in Section 5.2, the CRE-FMP designates as no-take MPAs EEZ waters 0-10 fm as well as 0-50 fm around three other atolls, French Frigate Shoals, Laysan and the northern half of Midway.

No-take Marine Protected Areas

This FMP will also implement no-take MPAs in remote Howland, Baker, and Jarvis Islands, and Kingman Reef. These islands have experienced the least fishing pressure of any location under Council jurisdiction. They are also far removed from non-fishing impacts. Therefore, they are the best sites to determine a benchmark for total and species-specific biomass, species composition, and how habitat structure relates to species density. Assessments are currently underway at many of these locations, and many coral reef scientists want to conduct projects in these near-pristine environments. In order to use the research in these areas for fisheries management, the Council recommends that the scientists coordinate their work. This will allow independent data sets to be coordinated with management-related research elsewhere.

7.2.3 Council Recommendations for Ecosystem-based Research

Each of the topics below has been suggested by one or more of the plan teams and advisory panels involved in the drafting of the Coral Reef Ecosystem FMP. They are the Coral Reef Ecosystem, Bottomfish, Crustacean, Ecosystem and Habitat, and Precious Corals Plan Teams and Advisory Panels, the Indigenous People Advisory Panel, and the Scientific and Statistical Committee.

Interactions of Other FMP's MUS in the Coral Reef Ecosystem

This FMP proposes close coordination between the plan teams of the Bottomfish, Crustacean and Precious Coral FMPs and the Coral Reef Ecosystem Plan Team. Each of the plan teams recommended research on various associations and interdependencies, thus giving a more integrated picture of the coral reef ecosystem. A greater understanding of these interactions will aid in identifying and addressing issues for resolution among the various FMPs.

Effects of Gear and Marine Debris on Coral Reef Habitat

Marine debris is an important concern, especially in the NWHI. But this debris generally comes from North Pacific fisheries not under Council jurisdiction. A multi-agency effort has been active in removing and cataloguing tons of this debris. The Council supports this effort but believes issues regarding gear and debris originating from Western Pacific fisheries is also of concern. The Council has recommended research on gear and debris effects on the deeper benthic environment. On several occasions concern has been raised about the impact lobster traps have on the coral reef habitat, but almost no research has been conducted to date. Tangle nets were used in the late 1980s to harvest precious coral from the NWHI. The effects from this fishing have also never been analyzed. The NWHI omnibus proposal will have a far greater impact on management issues within the Council's jurisdiction, and has been recommended by the Crustacean and Precious Corals Plan Teams and advisory panels.

Trophic Interactions

Simulation models for coral reef ecosystems (ECOPATH and ECOSIM, see Section 2.4) have become sophisticated tools, which can aid resource managers in predicting cascading effects from changes in the system. While these models can provide valuable insight, they require some basic data on trophic interactions. These models will never be able to simultaneously include the thousands of species found in the ecosystem. Research must first determine appropriate model species to use in a given coral reef ecosystem. This will require an understanding of the trophic interactions between habitat, primary production, and representative species of herbivores, omnivores, and top predators.

Role of Habitat in Stock Abundance

Researchers have observed correlations between habitat and stock abundance in several environments. Each of the implemented FMPs' plan teams were interested in designing projects that would address specific questions under this heading.

The Bottomfish Plan Team proposed a project on the importance of precious coral habitat and coral reef habitat on the survivability of juvenile bottomfish MUS. The Crustacean Plan Team proposed a project to differentiate the habitat qualities of the known lobster banks and how these differences contribute to successful recruitment and survival of lobster. The Precious Coral Plan Team is interested in how recruitment of gold coral is affected by bottom habitat. This question is also directly related to possible research on the way in which precious coral habitat affects the abundance of bottomfish, eels, octopus, and other species that use it as refuge.

The teams have also suggested more general research on how the percent cover of live coral affects overall species abundance. Live coral coverage varies widely, due mainly to land-based activities in populated areas and how well it is sheltered from storm events in remote areas. At depths shallower than 10 m coral cover can be determined through satellite imagery, which has become very accessible to scientists in recent years. Combining this information with stock assessments could be very useful in determining productivity and sustainable yields.

Effect of MPAs in the Ecosystem and Their Role as Management Tools

Marine protected areas have become a high profile conservation tool over the past decade. The President's initiative to designate 20% of all U.S. coral reefs as MPAs by 2010 underscores a national commitment to their designation. However, for all of their acceptance as valuable conservation and fishery management tools, very little definitive evidence is available on the effect of MPAs beyond their immediate boundaries. Thus, additional research is needed to best determine their most effective size and locations so that in the future they can be truly effective management tools.

This FMP implements MPAs in the NWHI and PRIAs. The PRIAs have never had much fishing pressure and relatively little anthropogenic disturbance in the past. Designating the entire coral reef habitat as "no-take" for most of these islands ensures that these sites are preserves and not tools for management. The NWHI, in contrast, has experienced fishing pressure in the past and will continue to experience it in the low-use MPAs. Interactions between the low-use and no-take MPAs under varying oceanographic conditions and fishing pressure along the NWHI archipelago should be examined to better understand what makes MPAs more or less successful in terms of fisheries management and sustainable yield.

Interactions and Individual Effects of Anthropogenic and Natural Stressors

Coral reefs throughout the Pacific are subject to high surf and surge associated with strong seasonal storms. Reefs found near populated areas are subject to land-based stressors and various other human activities. In areas with less shelter from storms, natural events determine the state of the reef. In sheltered areas, which are often near population centers, anthropogenic activities have a greater effect on the reef. Much research has assessed the causes and effects of, and mitigation options for, coral reef threats. In contrast, little research has been conducted to determine the synergistic effects of natural and anthropogenic stresses or combined anthropogenic stresses. In order to focus on the most serious threats to the ecosystem, and to foster interagency cooperation to address these threats, more research of this type is needed.

Additionally, climate and ecosystem shifts may occur over decadal scale cycles or longer which in turn, result in changes in recruitment and productivity of coral reef ecosystem resources. In the past, a climactic shift is believed to have occurred in the central North Pacific in the late 1980s. This produced an ecosystem shift in the NWHI that resulted in a lowering of carrying capacity and declined productivity. Additional research on both short-term and long-term ecosystem variability is needed in order to understand its effects on resources.

Determining Indicator Species or Using the Most Commonly Landed Species to Assess Ecosystem Health

Coral reef monitoring is an expensive and time-consuming process. The value of intensive monitoring has been questioned by some scientists, but deemed vital by others. It is impossible to study every organism in the coral reef ecosystem to determine the state of their health. Thus, as is done in terrestrial and freshwater environments, appropriate indicator species must be identified from which overall ecosystem health can be extrapolated. Baseline studies on their population densities, age structure and seasonal variation could then be completed. If indicator species can be identified, intensive monitoring can be reduced and research money will be available to address emerging issues and specific management needs.

Protected Species

Many protected and endangered species rely on the coral reef environment, especially in the NWHI. Specific research programs are in place to study monk seals, sea turtles, and seabirds. These are very important programs for this FMP because protected species are a major factor in fisheries regulations. The Council continues to use data derived from these programs and continually puts forth new questions to help address issues in fisheries management.

7.3 Other Research Addressing Ecosystem Management

A great deal of research effort has been expended studying the coral reefs of the Hawaiian Islands over the past 100 years. This includes gathering fishery data, reef surveys and monitoring, trophic studies, and a host of other efforts. NMFS, the U.S. Fish and Wildlife Service and the Hawaii Department of Land and Natural Resources undertook a tripartite study of the NWHI in the late 1970s and early 1980s, culminating in two symposia in 1980 and 1983. The wide scope of this research is a benchmark for future research in the NWHI.

Anthropogenic threats are limited in the NWHI. Land-based activities, which cause the greatest damage to reefs in populated areas, are virtually absent. Threats from fishing activities are also limited, due to a limited entry program and other regulatory controls for the two established NWHI fisheries. Limited entry permits for the NWHI fisheries are limited to seventeen permits for the bottomfish fishery and 15 permits for the crustacean fishery. Generally between five and seven lobster vessels actively fish one or two months a year. They are able to fish over a distance of 1,100 miles covering 11,554 km^2 of coral reef habitat. The renewed precious coral fishery has yet to venture to the NWHI, but substantial potential for harvest has been identified.

Potential threats from emerging fisheries, marine debris accumulating on NWHI reefs from north Pacific fisheries, and the health of the resident endangered species region-wide are the major concerns of the Council. In addition, this FMP is a demonstration plan for the ecosystem approach to fisheries management. The following project proposals were developed, keeping in mind the abundance of accumulated knowledge, the true threats to the various reefs under the Council's authority, and the emerging importance of the ecosystem approach to fisheries management. These efforts are principally guided by specific management questions derived from all of the Council's FMPs.

7.3.1 NWHI Omnibus Research Proposal

Project Deep Reef is a two-year study of the deep reef benthic fishery in the NWHI, using Deepworker 2000 submersibles. The project's goal is to obtain information about deepwater habitats by conducting habitat and stock assessments for lobsters, bottomfish, precious corals, and coral reef ecosystems in order to include all of the NWHI deep reef habitat resources in the Council's FMPs.

For lobsters, specific projects may deal with:

- Monk seal prey dependency.
- Habitat specifics for productive vs. unproductive area comparisons.
- Impact of ghost fishing on lobsters.
- Impact of lobster traps on coral reef habitats.
- Night versus day behavior and stock density differences.
- Characterization of steep-wall habitats for lobsters.

For bottomfish, specific projects may deal with:

- Characterization of juvenile and adult bottomfish habitats.
- Placement of potential reserves.

For precious corals, specific projects may deal with:

- Stock assessments for deep banks and pinnacles particularly around Midway.
- Impact of past dredging by foreign fleets at 180 Fathom Bank (north of Midway).
- Definition of habitat requirement of monk seals for gold coral and arrowtooth eels.

For coral reef ecosystems, specific projects may deal with:

- Depth and range extensions for deep coral reef ecosystems.
- Impacts of the other benthic fisheries in the NWHI on coral reef ecosystems.
- Designation of "protected areas" to establish marine preserves.

7.3.2 Archaeo-Ichthyological Research

The archaeological, historical and socio-cultural records from Pacific Islands are increasingly recognized as important data sources for fishery management. Since most fishery biology studies are short-term efforts conducted over a few years at best, and rarely over several decades, they represent only snapshots of a fishery in time. The study period may include years during which conditions in the fishery are extremely favorable, or years when the fishery is in a production trough. The NWHI lobster fishery is a good example of this; it expanded during a favorable oceanic inter-decadal cycle, which produced over-optimistic estimates of fishery production. Landings then fell by an order of magnitude during a subsequent regime shift to a less productive oceanic cycle.

Data from archaeological investigations may cover many centuries rather than a few years and give a much more balanced perspective on resource use and sustainability. Dalzell (1998) has reviewed a number of different archaeological studies that contain insights into coral reef resources use in the Pacific Islands. Excavated mollusc shells and fish bones allow researchers to reconstruct the species composition of pre-historic fishing. In some instances it is possible to reconstruct size frequencies from the data, and in turn generate life history parameters of exploited fish stocks over many centuries.

The archaeological and historical record can also clarify the social and cultural importance of fisheries, and traditional property rights. This is especially important when urbanization and European colonization has caused these practices to decline. This has been amply demonstrated in New Zealand (Aotearoa), where the original Polynesian Maori population was economically and socially marginalized following European settlement in the nineteenth century. Europeans generally ignored Maori concepts of marine tenure and fishery access rights.

However, archaeological studies have produced evidence of a diverse range of Maori fishing activities: they exploited a wide range of fishes and marine mammals—such as seals—and also preserved large amounts of fish. Indeed, in some areas, such as the Muriwhenua region of New Zealand's North Island, fishing became a principal source of nutrition as human populations increased and food from hunting and agriculture became increasingly limited. The Maori have used such evidence to successfully gain recognition of traditional fisheries property rights, which were guaranteed under the 1840 Treaty of Waitangi (Dalzell 1998).

Johannes (1998) has argued that traditional fishery knowledge and folklore of Pacific Islanders is an invaluable assemblage of observations on the biology and ecology of reef and lagoon fishes. He also published a landmark paper in which he used traditional knowledge of fishermen to illustrate the spawning strategies of reef and lagoon fish in the Pacific Islands (Johannes 1978). He has discussed at length the value of traditional knowledge and traditional tenure systems and other customs for the management of Pacific reef and lagoon fisheries (Johannes 1998). Much of Hawaii's cultural fishing heritage has been lost following contact and colonization, however, Carlos Andrade (pers. comm. to Paul Bartram) has suggested that the songs and chants of the people of Ni'ihau Island may be an important source of traditional knowledge on resource use and abundance in the pre-historic NWHI. In Northern Europe a similar oral knowledge source, the Icelandic Sagas, have been used to establish the long term history of herring and cod fisheries (Beverton 1962).

In summary, conventional scientific studies on reef fisheries are needed to manage the resources. There is also information from archaeological, historical, and socio-cultural sources that can provide information for fishery management. Fishery managers in the Western Pacific need to acquaint themselves with these sources and evaluate them for their utility.

7.3.3 Hawaii Coral Reef Initiative

The University of Hawaii, in collaboration with the State DLNR Division of Aquatic Resources, has established the Hawaii Coral Reef Initiative (HCRI) Research Program. The primary purpose of the program is to support monitoring and research activities aimed at building capacity to manage Hawaii's coral reef ecosystems. To fulfill its mission, the program works with local, state and federal agencies, as well as private organizations, in order to achieve the following goals:

- Assess major threats to coral reef ecosystems and provide information for more effective management.
- Advance understanding of biological and physical processes that affect the health of coral reefs.
- Develop a database and information system to store and access data and results.
- Conduct public awareness programs on threats to coral reef ecosystems.
- Implement education and training for coral reef scientists and managers.

Specific objectives of the program are to:

- Monitor coral reef health at sites around the main Hawaiian Islands.
- Monitor impacts of aquarium fish harvesting to West Hawaii coral reefs.
- Identify algae and develop a quantitative sampling method that supports coral reef monitoring.
- Develop real-time water quality monitoring of some coral reefs and the impact of runoff, using macroalgae as an indicator of pollution.
- Develop a rapid assessment method for describing coral reef resources of the NWHI.
- Assess the effectiveness of MPAs to conserve fishery resources and the impact of fishing in a management area.

For 1999-2000, the HCRI Research Program has sponsored four projects, including the statewide Coral Reef Assessment and Monitoring Program (CRAMP), which is designed to identify the controlling factors, both natural and anthropogenic, contributing to the overall health and condition of Hawaii's coral reefs. In addition, the HCRI Research Program will provide professional training for Department of Aquatic Resources staff, broaden public outreach and education efforts, and develop a website to profile management initiatives, research, and the ecosystem.

Table 7.1: Coral reef related research, monitoring, and management activities in the region.

Ongoing Coral Reef Initiatives
National Marine Fisheries Service **Monitoring:** rapid and long term assessments, with ships, satellites, buoys in NWHI, PRIAs. **Fishing impacts:** habitat and trophic linkages. **Management:** work with Council and Coral Reef Ecosystem Fishery Management Plan. **MPAs:** effectiveness and EFH. **Protected species:** seal and turtle studies. **Education:** marine debris. **Mapping:** reef habitat and oceanographic properties. **Debris:** remove, assess, identify source and impacts. **Fisheries research:** biology and ecology of coral reef fish. **Socio-economic:** small boat survey. **Other:** determine indicator taxa for quick assessment
US Fish & Wildlife Service **Monitoring:** reef fish stock assessmants, seabirds in NWHI, monitoring of all NWRs in region, except Guam. **Management:** review refuge and ecological services programs. **Protected species:** seal trophic study, green turtle, dolphin. **Mapping:** reef habitat mapping of NWHI, Guam, PRIAs in progress. **Debris:** monitor and removal at Tern Island, French Frigate Shoals. **Fisheries research:** *ulua* tagging. **Socio- economic:** PCBs and asbestos on Tern Island and PRIAs. **Other:** alien species control and eradication.
International Coral Reef Initiative Seeks to develop, coordinate and implement policy, coastal and marine management, law enforcement and education programs in collaboration with governments and other organizations for the protection of coral reefs. The International Coral Reef Initiative will also produce an annual report evaluating the health, status and success of implemented programs.

Ongoing Coral Reef Initiatives
Global Coral Reef Monitoring Network **Monitoring:** tourist monitoring program, rapid assessments. **Management:** strengthen institutional linkages. **Education:** produce annual reports. **Socio- economic:** link regional socio-economic and cultural organizations.
Great Barrier Reef Marine Park Authority **Monitoring:** assess natural variability. **Management:** advise marine park managers. **Education:** increase information dissemination.
James Cook University **Monitoring:** resource assessment. **MPAs:** response to fishing pressures. **Fisheries research:** life history, age demographics. **Socio- economic:** tourism impacts. **Other:** coral recruitment.
South Pacific Commission **Fishing impacts:** analyze fisheries data. **Management:** advise countries; management of live reef fisheries. **Education:** training and gear development. **Fisheries research:** sustainability of live reef fish fisheries.

Proposed Coral Reef Initiatives
Coral Reef Task Force Monitoring: national coordination, web-based data system. Fishing impacts: stop destructivs practices. Management: link marine and land practices, foster ecosystsm approach to fisheries management. MPAs: strengthen protection, goal of 20% coverage by 2010. Education: education coordinator, user groups, decision makers. Mapping: high and low resolution; emphasizes MPAs, change. Alien Species: work with coral reef aquaculture. Socio- economic: user conflict, community- based management. Land pollution: water quality, create partnerships, control discharge. Other: Create coral resf disease consortium, foster international cooperation.
Management needs and strategies from the U.S. Pacific Island Coral Reef Initiative Funded by NOAA and DOI, Office of Insular Affairs
American Samoa Monitoring: reef fish and invertebrate surveys. Management: revise laws, enhance enforcement. MPAs: educate public on importance. Education: marine resource education center. Land pollution: water quality assessment. Other: laws and enforcement.
CNMI Monitoring: bottomfish surveys, standardize protocol. MPAs: identify areas and collect baseline information. Education: State of the Reef Report. Other: deploy eight FADs

Management needs and strategies from the U.S. Pacific Island Coral Reef Initiative Funded by NOAA and DOI, Office of Insular Affairs
Guam
Monitoring: Territorial Seashore Reserve Plan, restore Tumon Bay.
Fishing Impacts: gillnet impact on resource.
Education: Project Reef Check, Tumon Bay outreach.
Debris: remove gillnets.
Other: coral cultivation, recruitment, reseeding & settlement.
Land pollution: runoff in Tumon Bay reef.
Hawaii
Monitoring: CRAMP- monitor 30 sites; Rapid Ecological Assessment in the NWHI.
Education: community-based education and monitoring.
Mapping: purchase satellite images.

CHAPTER 8

REGULATIONS, PERMIT APPLICATIONS AND DATA FORMS

8.1 Draft Regulations for other western Pacific fisheries Fishery Management Plans

The Coral Reef Ecosystem Fishery Management Plan amends the Bottomfish and Seamount Groundfish, Crustaceans, Pacific Pelagics and the Precious Corals Fishery Management Plans under 660.18, by prohibiting the harvest of all management unit species in no-take areas defined in the Coral Reef Ecosystem FMP and in the CFR §660.12 for western Pacific fisheries. The CRE FMP also amends these existing FMPs under 660.13 to require vessel insurance for operating or transiting in MPAs. These new regulations are included in subpart B - Western Pacific Fisheries - General.

In addition, the CFR §660 Subpart B, Western Pacific Fisheries- General will be amended with the addition of the following line in 660.12 (Definitions):

§660.12 Pacific pelagic management unit species, will be amended by striking the following: Dogtooth tuna *(Gymnosarda unicolor)*, Family *Alopiidae*, Family *Carcharhinidae*, Family *Lamnidae*, Family *Sphyrnidae* and ;

Adding the following: (1) Pelagic thresher shark (*Alapias pelagious*), (2) Bigeye thresher shark (*Alopias superciliousus*), (3) Common thresher shark (*Alopias vulpinus*), (4) Silky shark (*Carcharhinus falciformis*), (5) Oceanic whitetip shark (*Carcharhinus longimanus*), (6) Blue shark (*Prianace glauca*), (7) Shortfin mako shark (*Isurus axyrinchus*), (8) Longfin mako shark (*Isurus paucus*), and (9) salmon shark (*Lamna ditrapis*).

8.1.1 Regulations

§ 660.11 Purpose and scope.

(b) Regulations specific to individual fisheries are included in subparts C, D, E, F, and J of this part.

§ 660.12 Definitions

In addition to the definitions in the Magnuson-Stevens Fishery Conservation and Management Act, and in §600.10, the terms used in subpart B through F and subpart J have the following meanings:

Coral reef ecosystem management unit species means all of the taxa listed in Table 3, Currently Harvested Coral Reef Ecosystem Management Unit Species, and Table 4, Potentially Harvested Coral Reef Ecosystem Management Unit Species, of this part and do not include the species defined as "bottomfish management unit species," "crustaceans management unit species," "Pacific pelagic management unit species" and "precious corals management species:"

Low use marine protected area means an area of the EEZ where fishing for or harvesting of coral reef resources is allowed only under a special permit, as specified. Low-use areas are defined as the EEZ around the Northwestern Hawaiian Islands shallower than 50 fathoms which have not been designated no-take, waters shallower than 50 fathoms around Johnston Atoll (16°45' N lat., 169°31' W long.), Wake Island (19° 18' N lat., 166° 35' E long.), Palmyra Atoll (5°53' N lat., 162°05' W long.), and the southern half of the Midway Atoll NWR bisected by the 28° 14' N parallel.

No-take marine protected area means an area of the EEZ that is closed to fishing for or harvesting of all defined management unit species. The no-take areas designated in the Coral Reef FMP apply to harvesting of MUS from every Western Pacific Council Fishery Management Plan. These areas are defined as follows: Federal waters shallower than 10 fathoms in the Northwestern Hawaiian Islands and federal waters shallower than 50 fathoms around Jarvis Island (0°23' S, 160°01' W), Howland Island (0°48' N lat., 176° 38' W long.), Baker Island (0° 13' N lat., 176°38' W long.), Kingman Reef (6°23' N lat., 162°24' W long.), Laysan Island (25° 45' N lat., 171°45' W long.), French Frigate Shoals (23° 45' N lat., 166°15' W long.), the northern half of the Midway Atoll NWR bisected by the 28° 14' N parallel, and Rose Atoll (14° 33' S lat., 168°09' W long.).

Pacific pelagic management unit species means the following fish:

Pacific Pelagic Management Unit Species List

Scientific Name	English Common Name
Coryphaena spp.	Mahimahi (dolphinfishes)
Acanthocybium solandri	Wahoo
Makaira mazara: *M. indica*	Indo-Pacific blue marlin Black marlin
Tetrapturus audax	Striped marlin
T. angustirostris	Shortbill spearfish

Xiphias gladius	Swordfish
Istiophorus platypterus	Sailfish
Alapias pelagicus	Pelagic thresher shark
Alopias superciliousus	Bigeye thresher shark
Alopias vulpinus	Common thresher shark
Carcharhinus falciformis	Silky shark
Carcharhinus longimanus	Oceanic whitetip shark
Prionace glauca	Blue shark
Isurus oxyrinchus	Shortfin mako shark
Isurus paucus	Longfin mako shark
Lamna ditropis	salmon shark
Thunnus alalunga	Albacore
T. obesus	Bigeye tuna
T. albacares	Yellowfin tuna
T. thynnus	Northern bluefin tuna
Katsuwonus pelamis	Skipjack tuna
Euthynnus affinis	Kawakawa
Lampris spp.	Moonfish
Gempylidae	Oilfish family
family Bramidae	Pomfret
Auxis spp., *Scomber* spp.; *Allothunus* spp.	Other tuna relatives

Remote U.S. Pacific island possessions means the islands of Wake, Howland, Baker, Jarvis, Johnston atoll, Palmyra atoll and Kingman Reef.

Special permit means a permit issued to allow fishing of coral reef ecosystem resources in restricted marine protected areas and to fish for any potentially-harvested coral reef taxa.

<u>§ 660.13 Permits and fees.</u>

(c) Application.

(3) Insurance: All fishing vessels (including those permitted under existing FMPs) operating or transiting in areas designated as marine protected areas shall be required to have insurance to cover vessel removal and pollution liability in the event of a grounding, depending on category of vessel, type of permit, and fishing area.

§ 660.14 Reporting and recordkeeping

(b) *Transshipment logbooks.* Any person subject to the requirements of 660.21(c) or holds a special permit under 660.101(a.1.iii) must maintain on board the vessel an accurate and complete NMFS transshipment logbook containing report forms provided by the Regional Administrator. All information specified on the forms must be recorded on the forms within 24 hours after the day of transshipment. Each form must be signed and dated by the receiving vessel operator. The original logbook for each day of transshipment activity must be submitted to the PIAO Administrator within 72 hours of each landing of Pacific pelagic management unit species. The original logbook for each day of transshipment activity must be submitted to the PIAO Administrator within seven days of each landing of coral reef ecosystem management unit species.

(f) *Availability of records for inspection.*

(4) *Coral reef ecosystem management unit species.* Any person who has a Coral Reef Ecosystem permit and who is required by state laws and regulations to maintain and submit records of catch and effort, landings and sales for coral reef ecosystem management unit species by this subpart and subpart J of this part must make those records immediately available for federal inspection and copying upon request by an authorized officer.

(g) *State reporting.* Any person who has a permit under §660.21, 660.61, or 660.101 and who is regulated by state laws and regulations to maintain and submit records of catch and effort, landings and sales for vessels regulated by subparts C, E and J of this part must maintain and submit those records in the exact manner required by state laws and regulations.

§ 660.18 Area restrictions.

Fishing, harvesting or taking of management unit species under all FMPs described in subparts C, D, E, F, and J is prohibited in no-take MPAs as defined in §660.12 and;

(1) within the EEZ landward of the 10-fathom curve, as depicted on National Ocean Survey Charts, Numbers 19016, 19019 and 19022, around the Northwestern Hawaiian Islands.

(2) within the EEZ landward of the 50-fathom curve, as depicted on National Ocean Survey Charts, Numbers 19019, 19401 and 19481, around the Northwestern Hawaiian Islands of Laysan, French Frigate Shoals, and the north half of Midway, as defined in the no-take Marine Protected Area definition.

(3) within the EEZ landward of the 50-fathom curve, as depicted on National Ocean Survey Charts, Numbers 83116, 83153 and 83157, around the Pacific Remote Island Areas of Jarvis, Howland and Baker Islands, and Kingman Reef as defined in the no-take Marine Protected Area definition.

(4) within the EEZ landward of the 50-fathom curve, as depicted on National Ocean Survey Charts, Number 83484, around Rose Atoll, as defined in the no-take Marine Protected Area definition.

Subpart J – Western Pacific Coral Reef Ecosystem Fisheries

__§ 660.101 Permits and fees.__

(a) Applicability.

(1) Special Permit: Any person or vessel of the United States fishing for, taking or retaining coral reef ecosystem management unit species/taxa must have a special permit if that vessel is used:

(i) To fish for any coral reef ecosystem management unit species/taxa in low-use marine protected areas around the Northwestern Hawaiian Islands or remote U.S. Pacific island possessions, as defined in § 660.12.

(ii) To fish for any potentially-harvested coral reef ecosystem management unit species/taxa in the EEZ around American Samoa, Guam, the main Hawaiian Islands, or the portion of the EEZ measured from a baseline drawn in such a manner that each point on it is 3 nautical miles from the Northern Mariana Islands.

(iii) To transship coral reef ecosystem management unit species shoreward of the outer boundary of the EEZ.

(iv) To fish for any coral reef ecosystem management unit species/taxa for which it has been specifically required to obtain a special permit through framework action.

(v) To fish for any coral reef ecosystem management unit species/taxa with any gear not specifically allowed in this subpart.

(2) Exceptions:

(i) Any vessel fishing for MUS covered under a separate FMP does not need an additional permit to fish as outlined by this FMP.

(ii) Any vessel fishing for currently harvested coral reef ecosystem species/taxa outside of a marine protected area, unless specifically enacted via a framework measure.

(iii) Collecting of marine organisms for scientific research or assessment purposes (permit issued directly by NMFS).

(b) *Validity*. Each permit will be valid for fishing only in the fishery management subarea specified on the permit.

(c) *General requirements*. General requirements governing application information, issuance, fees, expiration, replacement, transfer, alteration, display, sanctions and appeals for permits are contained in 660.13.

(d) *Low use marine protected area special permit.* No direct or incidental harvest of coral reef ecosystem management unit species may be conducted in low-use marine protected areas unless authorized by a special permit issued by the PIAO Administrator in accordance with the criteria and procedures specified in this section (other than identified in exceptions).

(1) *Application.* An applicant for a special permit must snbmit to the PIAO Administrator, at least 60 days before the desired date of permit action, a written application including, but not limited to, the following information:

(i) The date of the application.

(ii) The applicant's name, mailing address, and telephone number.

(iii) A statement describing the objectives of the fishing activity for which a special permit is needed, inclnding a general description of the expected disposition of the resources harvested under the permit (i.e., stored live, fresh, frozen, preserved; sold for food, ornamental, research, or other use).

(iv) For each vessel to be covered by a special permit:

(A) Vessel name (if applicable)

(B) Name, address, and telephone number of owner and operator

(C) USCG documentation, state license, or registration number

(D) Home port

(E) Length of vessel

(F) Net tonnage

(G) Gross tonnage

(H) Documentation of vessel insurance to cover cost of vessel removal and pollution liability (name of insurer and amount of insurance coverage against accidental grounding and oil spill).

(vi) A description of the planned fishing operation, including general timing, duration and location of fishing and gear operation, resources (directed and incidental) expected to be harvested under the special permit, expected catch, and estimated ecosystem-level, habitat, and protected species impacts of the proposed harvest.

(viii) The signature of the applicant

(2) *Incomplete applications.* The PIAO Administrator may request from an applicant additional information necessary to make the determinations required under this section. An applicant will be notified of an incomplete application within 10 working days of receipt of the application. An incomplete application will not be considered nntil corrected in writing.

(3) *Issuance.*

(i) If an application contains all of the required information, the PIAO Administrator will forward copies of the application to the Council, the USCG, the fishery management agency of the affected state, and other interested parties, accompanied by the following information:

(A) The current utilization of domestic annual harvesting and processing capacity of the directed and incidental species for which a special permit is being requested.

(B) The current status of resources to be harvested (direct and incidental) in relation to the overfishing definition in the FMP.

(C) Estimated ecosystem, habitat, and protected species impacts of the proposed activity.

(D) Other biological and ecological information relevant to the proposal.

(ii) Following receipt of a complete application, the PIAO Administrator will consult with the Council and the Director of the affected state fishery management agency concerning the permit application and will receive their recommendations for approval or disapproval of the application. The applicant will be notified in advance of a meeting (if needed) at which the application will be considered, and invited to appear in support of the application, if the applicant desires.

(iii) Following a review of the Council's recommendation and supporting rationale, the Regional Administrator may:

(A) Concur with the Council's recommendation and, after finding that it is consistent with the goals and objectives of the FMP, the national standards, and other applicable laws, approve a special permit; or

(B) Reject the Council's recommendation, in which case, written reasons will be provided by the Regional Administrator to the Council for the rejection.

(iv) Within 30 working days after the consultation in paragraph (ii) of this section, or as soon as practicable thereafter, NMFS will notify the applicant in writing if the decision to grant or deny the special permit and, if denied, the reasons for the denial. Grounds for denial of a special permit include the following:

(A) The applicant has failed to disclose material information required, or has made false statements as to any material fact, in connection with his or her application.

(B) According to the best scientific information available, the harvest to be conducted under the permit would detrimentally affect any coral reef resource or coral reef ecosystem in a significant way.

(C) Issuance of the special permit would inequitably allocate fishing privileges among domestic fishermen or would have economic allocation as its sole purpose.

(D) Activities to be conducted under the special permit would be inconsistent with the intent of this section or the management objectives of the FMP.

(E) The applicant has failed to demonstrate a valid justification for the permit.

(F) The activity proposed under the special permit would create a significant enforcement problem.

(G) The applicant has failed to provide documentation of vessel insurance which provides for the cost of vessel removal and pollution liability.

(v) The Regional Administrator may attach terms and conditions to the special permit, if it is granted, consistent with the management objectives of the FMP, including but not limited to:

(A) The maximum amount of each resource that can be harvested and landed during the term of the special permit, including trip limits, where appropriate.

(B) The number, sizes, names and identification numbers of the vessels authorized to conduct fishing activities under the special permit.

(C) The times and places where fishing may be conducted.

(D) The type, size, and amount of gear which may be used by each vessel operated under the special permit.

(E) Data reporting requirements.

(F) Such other conditions as may be necessary to ensure compliance with the purposes of the special permit consistent with the objectives of the FMP.

(4) *Duration*. Unless otherwise specified in the special permit or a superceding notice or regulation, a special permit is effective for no longer than one year, unless revoked, suspended, or modified. Special permits may be renewed following the general procedures in § 660.13.

(5) *Alteration*. Any special permit that has been altered, erased, or mutilated is invalid.

(6) *Validity*. A permit is valid only for the particular vessel(s) named in the application.

(7) *Inspection*. Any special permit must be carried aboard the vessel(s) for which it was issued. The special permit must be presented for inspection upon request of any authorized officer.

(8) *Sanctions*. Failure of the holder of a special permit to comply with the terms and conditions of a special permit, the provisions of § 660.13, any other applicable provisions of this part, the Magnuson Act, or any other regulation promulgated thereunder, is grounds for revocation, suspension, or modification of the special permit with respect to all persons and vessels conducting activities under the special permit. Any action taken to revoke, suspend, or modify a special permit will be governed by 15 CFR part 904 subpart D. Other sanctions available under the statute will be applicable.

(9) *Protected species.* Persons fishing under a special permit must report any incidental take or fisheries interaction with protected species (i.e., all species of sea turtles, seabirds and marine mammals) on a form provided for that purpose. Reports must be submitted to the Regional Administrator within three days of arriving in port.

(10) *Appeals of permit actions.*

(i) Except as provided in subpart D of 15 CFR part 904, any applicant for a permit or a permit holder may appeal the granting, denial, conditioning, or suspension of their permit or a permit affecting their interests to the Regional Administrator. In order to be considered by the Regional Administrator, such appeal must be in writing, must state the action(s) appealed, and the reasons therefore, and must be submitted within 30 days of the original action(s) by the Regional Administrator. The appellant may request an informal hearing on the appeal.

(ii) Upon receipt of an appeal authorized by this section, the Regional Administrator will notify the permit applicant, or permit holder as appropriate, and will request such additional information and in such form as will allow action upon the appeal. Upon receipt of sufficient information, the Regional Administrator will rule on the appeal in accordance with the permit eligibility criteria set forth in this section and the FMP, as appropriate, based upon information relative to the application on file at NMFS and the Council and any additional information, the summary record kept of any hearing and the hearing officer's recommended decision, if any, and such other considerations as deemed appropriate. The Regional Administrator will notify all interested persons of the decision, and the reasons therefor, in writing, normally within 30 days of the receipt of sufficient information, unless additional time is needed for a hearing.

(iii) If a hearing is requested, or if the Regional Administrator determines that one is appropriate, the Regional Administrator may grant an informal hearing before a hearing officer designated for that purpose after first giving notice of the time, place, and subject matter of the hearing in the Federal Register. Such a hearing shall normally be held no later than 30 days following publication of the notice in the Federal Register, unless the hearing officer extends the time for reasons deemed equitable. The appellant, the applicant (if different), and, at the discretion of the hearing officer, other interested persons, may appear personally or be represented by counsel at the hearing and submit information and present arguments as determined appropriate by the hearing officer. Within 30 days of the last day of the hearing, the hearing officer shall recommend in writing a decision to the Regional Administrator.

(iv) The Regional Administrator may adopt the hearing officer's recommended decision, in whole or in part, or may reject or modify it. In any event, the Regional Administrator will notify interested persons of the decision, and the reason(s) therefore, in writing, within 30 days of receipt of the hearing officer's recommended decision. The Regional Administrator's action constitutes final action for the agency for the purposes of the Administrative Procedures Act.

(v) Any time limit prescribed in this section may be extended for good cause, for a period not to exceed 30 days by the Regional Administrator, either upon his or her own motion or upon written reqnest from the appellant or applicant stating the reason(s) therefore.

(11) *Fees*. A fee is charged for each application for a restricted marine protected area special permit, including permit transfers and permit renewals. The amount of the fee is calculated in accordance with the procedures of the NOAA Finance Handbook, available from the Regional Administrator, for determining the administrative costs of each special product or service. The fee may not exceed such costs and is specified with each application fonn. The appropriate fee must accompany each application. Failure to pay the fee will preclude issnance of a special permit.

§ 660.102 Prohibitions.

In addition to the prohibitions in § 600.725 of this chapter, it is unlawful for any person to:

(a) Fish for, take, retain, possess or land any coral reef resource in any portion of the management area as defined in § 660.12 unless:

(1) A valid permit has been issued for the fishing vessel and area, as specified;
(2) A permit is not required, as outlined in the permit section of these regulations or;
(3) The coral reef resources possessed on board the vessel originated outside the management area and this can be demonstrated through receipts of purchase, invoices, fishing logbooks or other documentation.

(b) Fish for, take, or retain any coral reef ecosystem resource:

(1) That is determined overfished and announced by the Regional Administrator.
(2) By means of gear or methods prohibited nnder allowable and restricted gear in this subpart.
(3) In no-take marine protected areas (except for scientific research).
(4) In low-use marine protected areas unless a valid special permit has been issued.
(5) In violation of any permit issued under § 660.13 or in the permit section of this subpart.

(c) Fish for, take, or retain any wild live rock or live hard coral for commercial purposes except under a valid special permit for scientific research (issued by NMFS), aquaculture seed stock collection or traditional and ceremonial purposes by indigenous people.

(d) Engage in fishing without a valid permit or facsimile of a valid permit on board the vessel and available for inspection by an authorized officer, when a permit is required under § 660.13 or in the permit section of this subpart, unless the vessel was at sea when the permit was issued, in which case the permit must be on board the vessel before its next trip.

(e) File false information on any application for a general permit under § 660.13 or a special permit.

(f) Fail to file reports in the exact manner required by a state law or regulation, as required, provided that the person is required to do so by applicable state law or regulation.

(g) Falsify or fail to make, keep, maintain, or submit any logbook or logbook form or other record or report required.

(h) Refuse to make available to an authorized officer or designee of the Regional Administrator for inspection or copying, any records that must be made available.

(i) Fail to affix or maintain vessel or gear markings, as required.

(j) Violate a term or condition of a special permit.

(k) Fail to report any take or interaction with protected species as required.

(l) Fail to notify officials as required.

<u>§ 660.103 Notification.</u>

(a) *Before fishing in low-use marine protected area.* The permit holder for a fishing vessel subject to the requirements of the special permit, or agent designated by the permit holder, shall provide a notice to the Regional Administrator at least 72 hours (not including weekends and federal holidays) before the vessel leaves port on any fishing trip, any part of which occurs in any portion of the EEZ designated as a low-use marine protected area. The vessel operator will be presumed to be an agent designated by the permit holder unless the PIAO Administrator is otherwise notified by the permit holder. The notice must be provided to the office or telephone number designated by the PIAO Administrator. The notice must provide the official number of the vessel, the name of the vessel, the intended departure date, time, and location, the name of the operator of the vessel, and the name and telephone number of the agent designated by the permit holder to be available between 8:00 a.m. to 5:00 p.m. (Hawaii time) on weekdays for NMFS to contact.

(b) *Before landing after fishing in low-use marine protected area.* The operator of a fishing vessel that has been granted a special permit under §660.101 and that has made a trip that harvested coral reef resources in a low-use marine protected area must contact NMFS Enforcement at least 24 hours before landing, and report the port and the approximate date and time at which the coral reef resources harvested on the trip will be landed.

§ 660.104 Allowable gear and gear restrictions.

(a) *Allowable gear and methods.* Coral reef ecosystem resources may be taken only with allowable gear and methods, as follows:

(1) hand harvest;
(2) spear;
(3) slurp gun;
(4) hand net/dip net, hoop net (for Kona crab);
(5) throw net;
(6) barrier net (for aquarium fish);
(7) surround/purse nets for targeted schools (e.g., baitfish, big-eyed scad, goatfish) with a minimum of bycatch, and must be attended by swimmers or divers at all times;
(8) hook-and-line (includes handline [powered or not], rod-and-reel, and trolling);
(9) traps (with conditions); and,
(10) remote-operating vehicles/submersibles.

(b) *Poisons, explosives, intoxicating substances.* Coral reef resources may not be taken by means of poisons, explosives, or intoxicating substances. Possession of these materials by any vessel having a coral reef ecosystem permit or that is otherwise established to be fishing for coral reef ecosystem resources in the EEZ is prohibited.

(c) *Spearfishing with scuba.* Coral reef resources may not be taken by means of spearfishing with scuba at night (from 6 pm to 6 am) in the Northwestern Hawaiian Islands or the Pacific Remote Island Areas.

(d) *Possession of gear.* Possession or use of trawl nets, gill nets, hookah breathers, or any other gear that is not expressly allowed under these regulations by any vessel holding a permit or that is otherwise established to be fishing for coral reef ecosystem resonrces in the EEZ is prohibited. Possession of any gear not approved under §660.104 or approved by the PIAO Administrator in the permit process while established to be fishing for coral reef resources in the EEZ is prohibited.

(e) *Existing FMP fisheries.* Existing FMP fisheries shall follow the allowable gear and methods outlined in their respective plans.

(f) *Non-listed gear.* Anyone wishing to fish with gear not included in this list must describe the gear and its method of deployment in the special permit applination. A ruling on the allowability of this gear type will be determined by the PIAO Administrator after consultation with the Council and the director of the affected state fishery management agency.

§ 660.105 Unattended Gear and Gear Identification.

(a) *Identification*. The owner's identification must be marked legibly on all fish and crab traps on board the vessel or deployed in the water by any vessel holding a permit under §660.13 or in this subpart or that is otherwise established to be fishing for coral reef ecosystem resources in the EEZ.

(b) *Enforcement action*.

(1) Unattended traps not marked in compliance with these regulations and found deployed in the EEZ will be considered unclaimed or abandoned property, and may be disposed of in any manner considered appropriate by NMFS or an authorized officer.

(2) Unattended surround nets or bait seine nets found deployed in the EEZ will be considered unclaimed or abandoned property, and may be disposed of in any manner considered appropriate by NMFS or an authorized officer.

§ 660.106 Area Restrictions

(a) *Low-use MPAs*: Fishing for coral reef ecosystem resources in low-use marine protected areas is allowed only by persons or by vessels for which a special permit has been issued:

(1) Within the EEZ to an inner boundary coterminous with the 10-fathom curve, as depicted on National Ocean Survey Charts, Numbers 19016, 19019 and 19022, around the Northwestern Hawaiian Islands, except for the EEZ landward of the 50-fathom curve around Laysan, French Frigate Shoals, and the southern half of Midway, as defined in 660.12.

(2) Within the EEZ, as depicted on National Ocean Survey Charts, Numbers 83637 and 81664, around the Pacific Remote Island Areas of Palmyra, Johnston Atoll and Wake Island.

(3) Permitted vessels fishing under other FMPs follow regulations in their respective FMP.

(b) Anchoring by fishing vessels over 50 feet in overall length is prohibited in the EEZ seaward of the Territory of Guam west of 144.5 E longitude except in the event of an emergency caused by ocean conditions or by a vessel malfunction that can be documented.

§ 660.107 Framework for Regulatory Adjustments.

(a) *Procedure for established measures.*

(1) Established measures are management measures that, at some time, have been included in regulations implementing the FMP, or for which the impacts have been evaluated in Council/NMFS documents in the context of current conditions.

(2) Following framework procedures of the CRE-FMP, the Council may recommend to the Regional Administrator that established measures be modified, removed, or re-instituted. Such recommendation shall include supporting rationale and analysis, and shall be made after advance public notice, public discussion and consideration of public comment. NMFS may implement the Council's recommendation by rulemaking if approved by the Regional Administrator.

(b) *Procedure for new measures.*

(1) New measures are management measures that have not been included in regulations implementing the FMP, or for which the impacts have not been evaluated in Council/NMFS documents in the context of current conditions. New measures include but are not limited to: catch limits; resource size limits; closures; effort limitations; permit requirements; reporting and recordkeeping requirements.

(2) Following the framework procedures of the FMP, the Council will publicize, including by Federal Register notice, and solicit public comment on, any proposed new management measure. After a Council meeting at which the measure is discussed, the Council will consider recommendations and prepare a Federal Register notice summarizing the Council's deliberations, rationale, and analysis for the preferred action, and the time and place for any subsequent Council meeting(s) to consider the new measure. At subsequent public meeting(s), the Council will consider public comments and other information received to make a recommendation to the Regional Administrator about any new measure. NMFS may implement the Council's recommendation by rule making if approved by the Regional Administrator.

(i) The Regional Administrator will consider the Council's recommendation and supporting rationale and analysis, and, if he or she concurs with the Council's recommendation, will propose regulations to carry out the action. If the Regional Administrator rejects the Council's proposed action, a written explanation for the denial will be provided to the Council within two weeks of the decision.

(ii) The Council may appeal denial by writing to the Assistant Administrator, who must respond in writing within 30 days.

(iii) The Regional Administrator and the Assistant Administrator will make their decisions in accord with the MSFCMA, other applicable laws, and the Coral Reef Ecosystem FMP.

(iv) To minimize conflicts between the federal and state/territorial/ commonwealth management systems, the Council will use the procedures in paragraph (a)(2) in this section to respond to state/territorial/commonwealth management actions. Council consideration of action would normally begin with a representative of the state, territorial or commonwealth government bringing a potential or actual management conflict or need to the Council's attention.

§ 660.108 Management subareas.

(a) The fishery management area is divided into six subareas for the regulation of fishing for coral reef ecosystem management unit species:

(1) Main Hawaiian Islands means the EEZ of the Hawaiian Islands Archipelago lying to the east of 161°20' long.

(2) Northwestern Hawaiian Islands means the EEZ of the Hawaiian Islands Archipelago lying to the west of 161°20'. For purposes of the regulations issued under this subpart, Midway Island is treated as part of the Northwestern Hawaiian Islands.

(3) Guam means the EEZ seaward of the Territory of Guam waters.

(4) American Samoa means the EEZ seaward of the Territory of American Samoa waters.

(5) Commonwealth of the Northern Mariana Islands (CNMI) means that portion of the EEZ seaward from a baseline line drawn 3 nautical miles offshore of the Northern Mariana Islands.

(6) Remote U.S. Pacific island possessions means the EEZ seaward of the islands of Johnston, Wake, Palmyra, Kingman Reef, Howland, Jarvis and Baker.

(b) The inner boundary of the fishery management area is a line coterminous with the shoreline of the Midway Islands, and the Remote U.S. Pacific Island Possessions, with the seaward boundaries of the State of Hawaii, the Territory of Guam, the Territory of American Samoa, and with a baseline drawn three nautical miles offshore of the Commonwealth of the Northern Mariana Islands.

(c) The outer boundary of the fishery management area is a line drawn in such a manner that each point is 200 nautical miles from the baseline from which the territorial sea is measured, or is coterminous with adjacent international maritime boundaries. The outer boundery of the fishery management area north of Guam will extend to those points which are equidistant between Guam and the island of Rota in CNMI.

§ 660.109 Annual Reports.

(a) *Annual reports*. By July 31 of each year, a Council-appointed coral reef ecosystem plan team will prepare an annual report covering the following topics:

(1) Fishery performance data, with detailed catch-effort information for target, non-target (incidental) resources and bycatch.

(2) Summary of new coral reef resource information obtained from fishery-dependent and non-fishery dependent sources.

(3) Essential fish habitat conditions and sources of degradation including fishing and non-fishing impact to EFH and HAPC in all areas.

(4) Coral reef ecosystem-level impacts associated with fishing activities regulated under this and other fishery management plans.

(5) Enforcement activities and problems.

(6) Administrative actions (e.g., data collection and reporting, permits).

(7) State and territorial management actions.

(8) Assessment of need for Council action (including biological, economic, social, enforcement, administrative, and state/territorial/commonwealth/ federal needs, problems, and trends). Indication of potential problems warranting further investigation may be signaled by the following indicator criteria:

(i) Significant change in habitat structure or stability.

(ii) Significant change in trophic structure or biodiversity.

(iii) Significant change in interactions among different fisheries.

(iv) Significant change in mean size of the catch of any species or species group.

(v) Significant change in catch-per-unit-effort for any species or species group.

(vi) Significant change in gear types or methods of fishing.

(vii) Interactions with protected species.

(viii) Significant coral reef ecosystem cumulative effects.

(9) Recommendation for Council action.

(10) Estimated impacts of recommended action.

The FMP establishes a non-regulatory formal process for coordination of the Coral Reef Ecosystem FMP with the existing Bottomfish, Crustaceans, Pelagics and Precious Corals FMPs. Ecosystem issues will be identified and mitigation options identified through interaction among the plan teams.

(b) *Recommendation of management action.*

(1) The Council will evaluate the annual report and advisory body recommendations and may recommend management action by either the state/territorial/commonwealth governments or by federal regulation.

(2) If the Council believes that management action should be considered, it will make specific recommendations to the Regional Administrator after considering the views of its advisory bodies. The Council will assess the need for federal management action.

Table 3 to Part §660. - Currently Harvested Coral Reef Ecosystem Management Unit Species.

Acanthuridae (Surgeonfishes)	Orange-spot surgeonfish (*Acanthurus olivaceus*) Yellowfin surgeonfish (*Acanthurus xanthopterus*) Convict tang (*Acanthurus triostegus*) Eye-striped surgeonfish (*Acanthurus dussumieri*) Blue-lined surgeon (*Acanthurus nigroris*) Whitebar surgeonfish (*Acanthurus leucopareius*) Blue-banded surgeonfish (*Acanthurus lineatus*) Blackstreak surgeonfish (*Acanthurus nigricauda*) Whitecheek surgeonfish (*Acanthurus nigricans*) White-spotted surgeonfish (*Acanthurus guttatus*) Ringtail surgeonfish (*Acanthurus blochii*) Brown surgeonfish (*Acanthurus nigrofuscus*) Elongate surgeonfish (*Acanthurus mata*) Mimic surgeonfish (*Acanthurus pyroferus*) Yellow-eyed surgeonfish (*Ctenochaetus strigousus*) Striped bristletooth (*Ctenochaetus striatus*) Twospot bristletooth (*Ctenochaetus binotatus*)
	Bluespine unicornfish (*Naso unicornus*) Orangespine unicornfish (*Naso lituratus*) Humpnose unicornfish (*Naso tuberosus*) Blacktounge unicornfish (*Naso hexacanthus*) Bignose unicornfish (*Naso vlamingii*) Whitemargin unicornfish (*Naso annulatus*) Spotted unicornfish(*Naso brevirostris*) Humpback unicornfish(*Naso brachycentron*) Barred unincornfish (*Naso thynnoides*) Gray unicornfish (*Naso caesius*)
Balistidae (Triggerfishes)	Titan triggerfish (*Balistoides viridescens*) Clown triggerfish (*B. conspicillum*) Orangstriped trigger (*Balistapus undulatus*) Pinktail triggerfish (*Melichthys vidua*) Black triggerfish (*M. niger*) Blue triggerfish (*Pseudobalistes fucus*) Picassofish (*Rhinecanthus aculeatus*) Wedged Picassofish (*B. rectangulus*) Bridled triggerfish (*Sufflamen fraenatus*)
Carangidae (Jacks)	Bigeye scad (*Selar crumenophthalmus*) Mackerel scad (*Decapterus macarellus*)
Carcharhinidae (Sharks)	Grey reef shark (*Carcharhinus amblyrhynchos*) Silvertip shark (Carcharhinus albimarginatus) Galapagos shark (*Carcharhinus galapagenis*) Blacktip reef shark (*Carcharhinus melanopterus*) Whitetip reef shark (*Triaenodon obesus*)

Holocentridae (Soldierfish/Squirrelfish)	Bigscale soldierfish (*Myripristis berndri*) Bronze soldierfish (*Myripristis adusta*) Blotcheye soldierfish (*Myripristis murdjan*) Brick soldierfish (*Myripristis amaena*) Scarlet soldierfish (*Myripristis pralinia*) Violet soldierfish (*Myripristis violacea*) Whitetip soldierfish (*Myripristis vittata*) Yellowfin soldierfish (*Myripristis chryseres*) Pearly soldierfish(*Myripristis kuntee*) (*Myripristis hexagona*) Tailspot squirrelfish (*Sargocentron caudimaculatum*) Blackspot squirrelfish (*Sargocentron melanospilos*) File-lined squirrelfish(*Sargocentron microstoma*) Pink squirrelfish(*Sargocentron tieroides*) Crown squirrelfish (*Sargocentron diadema*) Peppered squirrelfish (*Sargocentron punctatissimum*) Blue-lined squirrelfish (*Sargocentron tiere*) Ala'ihi (*Sargocentron xantherythrum*) (*Sargocentron furcatum*) (*Sargocentron spiniferum*) Spotfin squirrelfish (*Neoniphon spp.*)
Kuhliidae (Flag-tails)	Hawaiian flag-tail (*Kuhlia sandvicensis*) Barred flag-tail (*Kuhlia mugil*)
Kyphosidae (Rudderfish)	Rudderfish (*Kyphosus biggibus*) (*Kyphosus cinerascens*) (*Kyphosus vaigienses*)
Labridae (Wrasses)	Saddleback hogfish (*Bodianus bilunulatus*) Napoleon wrasse (*Cheilinus undulatus*) Triple-tail wrasse (*Cheilinus trilobatus*) Floral wrasse (*Cheilinus chlorourus*) Harlequin tuskfish (*Cheilinus fasciatus*) Ring-tailed wrasse (*Oxycheilinus unifasciatus*) Bandcheek wrasse (*Oxycheilinus diagrammus*) Arenatus wrasse (*Oxycheilinus arenatus*) Razor wrasse (Xyricthys pavo) Whitepatch wrasse (*Xyrichtes aneitensis*) Cigar wrass (*Cheilio inermis*) Blackeye thicklip (*Hemigymnus melapterus*) Barred thicklip (*Hemigymnus fasciatus*) Threespot wrasse (*Halichoeres trimaculatus*) Checkerboard wrasse (*Halichoeres hortulanus*) Weedy surge wrasse (*Halichoeres margaritacous*) (*Halichoeres zeylonicus*) Surge wrasse (Thalassoma purpureum) Redribbon wrasse (Thalassoma quinquevittatum) Sunset wrasse (Thalassoma lutescens) Longface wrasse (Hologymnosus doliatus) Rockmover wrasse (Novaculichthys taeniourus)

Mullidae (Goatfishes)	Yellow goatfish (*Mulloidichthys spp.*) (*Mulloidichthys* Pfleugeri) (*Mulloidichthys* vanicolensis) (*Mulloidichthys flaviolineanus*) Banded goatfish (*Parupeneus spp.*) (*Parupeneus barberinus*) (*Parupeneus bifasciatus*) (*Parupeneus heptacanthus*) (*Parupeneus cilianus*) (*Parupeneus cilianus*) (*Parupeneus cyclostomas*) (*Parupeneus pleurostigma*) (*Parupeneus indicus*) (*Parupeneus multifacianus*) Bantail goatfish (*Upeneus arge*)
Muglildae (Mullets)	Stripped mullet (*Mulgil cephalus*) Engel's mullet (*Moolgarda engeli*) False mullet (*Neomyxus leuciscus*) Fringelip mullet (*Crenimugil crenilabis*)
Muraenidae (Moray eels)	Yellowmargin moray (*Gymnothorax flavimarginatus*) Giant moray (*Gymnothorax javanicus*) Undulated moray (*Gymnothorax undulatus*)
Ocotpodidae	Octopus (*Octupus cyanea; O. ornatus*)
Polynemidae	Threadfin (*Polydactylus sexfilis*) -Moi
Prlcanthidae (Bigeye)	Glasseye (*Heteropriacanthus cruentatus*) Bigeye (*Priacanthus hamrur*)
Scaridae (Parrotfishes)	Humphead parrotfish (Bulbometapon muracatum) Parrotfishes (*Scarus spp.*) Pacific longnose parrotfish (Hipposcarus longiceps) Stareye parrotfish (Catolomus carolinus)
Scombridae (Dogtooth tuna)	Dogtooth tuna (*Gymnosarda unicolor*)
Slganldae (Rabbitfish)	Forktail rabbitfish (*Siganus aregentus*) Golden rabbitfish (*Siganus guttanus*) Gold-spot rabbitfish (*Siganus punctatissimus*) Randall's rabbitfish (*Siganus randalli*) Scribbled rabbitfish (*Siganus spinus*) Vermiculate rabbitfish (*Signaus vermiculatus*)
Sphyraenidae (Barracuda)	Heller's barracuda (*Sphyraena helleri*) Great Barracuda (*Sphyraena barracuda*)
Turbinidae (turban shells/green snails)	Green snails (*Turbo spp.*)

Aquarium Taxa/Species	**Acanthuridae** Yellow tang (*Zebrasoma flavescens*) Yellow-eyed surgeon fish (*Ctenochaenus strigosus*) Achilles tang (*Acanthurus achilles*) **Muraenidae** Dragon eel (*Enchelycore pardalis*) **Zanclidae** Morrish idol (*Zanclus cornutus*) **Pomacanthidae** Angelfish (*Centropyge shepardi* and *C. flavissimus*) **Cirrhitidae** Flame hawkfish (*Neocirrhitus armatus*) **Chatetodontidae** Butterflyfish (*Chaetodon auriga, C. lunula, C. melannotus* and *C. ephippium*) **Pomacentridae** Damselfish (*Chromis viridis, Dascyllus aruanus* and *D. trimaculatus*) **Sabellidae** Featherduster worm (*Sabellidae*)

Table 4 to Part §660. – Potentially Harvested Coral Reef Ecosystem Management Unit Species.

Other Labridae spp. (wrasses) *(Those species not listed on CHCRT list)*	Ephippidae (batfish)
Other Carcharhinidae, Sphyrnidae *(Those species not listed on CHCRT list)*	Monodactylidae (mono)
Dasyatididae, Myliobatidae, Mobulidae (rays)	Haemulidae (sweetlips)
Other Serranidae spp. (groupers) *(Those species not managed under the Bottomfish FMP)*	Echineididae (remoras)
Carangidae (jacks/trevallies) *(Those species not listed on CHCRT list or managed under Bottomfish FMP)*	Malacanthidae (tilefish)
	Acanthoclinidae (spiny basslets)
Other Holocentridae spp. (soldierfish/squirrelfish) *(Those species not listed on CHCRT list)*	Pseudochromidae (dottybacks)
Other Mullidae spp. (goatfish) *(Those species not listed on CHCRT list)*	Plesiopidae (prettyfins)
Other Acanthuridae spp. (surgeonfish/unicornfish) *(Those species not listed on CHCRT list)*	Tetrarogidae (waspfish)
Other Lethrinidae spp. (emperors) *(Those species not managed under the Bottomfish FMP)*	Caracanthidae (coral crouchers)

Chlopsidae, Congridae, Moringuidae, Ophichthidae (eels) Other Muraenidae (morays eels) (*Those species not listed on CHCRT list*)	Grammistidae (soapfish)
Apogonidae (cardinalfish)	*Aulostomus chinensis* (trumpetfish)
Other Zanclidae spp. (moorish idols)	*Fistularia commersoni* (coronetfish)
Other Chaetodontidae spp. (butterflyfish)	Anomalopidae (flashlightfish)
Other Pomacanthidae spp. (angelfish)	Clupeidae (herrings)
Other Pomacentridae spp. (damselfish)	Engraulidae (anchovies)
Scorpaenidae (scorpionfish)	Gobiidae (gobies)
Blenniidae (blennies)	Lutjanidae *(Those species not managed under Bottomfish FMP)*
Other Sphyraenidae spp. (barracudas)	Other Bailistidae/Monocanthidae spp. (*Those species not listed on CHCRT list*)
Pinguipedidae (sandperches)	Other Siganidae spp. (*Those species not listed on CHCRT list*)
	Other Kyphosidae spp.
Bothidae/Soleidae/Pleurnectidae (flounder/sole)	Caesionidae
Ostraciidae (trunkfish)	Cirrhitidae
Tetradontidae/Diodontidae (puffer/porcupinefish)	Antennariidae (frogfishes)
	Syngnathidae (pipefishes/seahorses)
Stony corals	Echinoderms (e.g., sea cucumbers, sea urchins)
Heliopora (blue)	Mollusca
Tubipora (organpipe)	Sea snails (gastropods)
Azooxanthellates (non-reefbuilders)	Trochus spp.
Fungiidae (mushroom corals)	Opistobranchs (sea slugs)
Sm/Lg Polyped Corals (endemic spp.)	*Pinctada margaritifera* (black lipped pearl oyster)
Millepora (firecorals)	Tridacnidae
Soft corals and gorgonians	Other bivalves
Anemones (non-epifaunal)	Cephalopods
Zooanthids	Crustaceans (lobsters, shrimps/mantis, true crabs and hermit crabs) (*Those species not managed under the Crustacean FMP*)

Sponges (non-epifaunal)	Stylasteridae (lace corals)
Hydrozoans	Solanderidae (hydroid fans)
Bryozoans	Annelids
	Algae
Tunicates (solitary/colonial)	Live rock
All other coral reef ecosystem marine plants, invertebrates and fishes not listed under existing FMPs.	

6.2 Draft Permit Applications and Data Entry Forms

The following five forms and their associated directions are examples of the forms that will be required as specified earlier (see section 5.3). These forms have been generated by combining the suggestions from each advisory body. As the general permit and data entry forms may be implemented through a framework process at the recommendation of the Council, and the requirements of the special permit and data entry forms are determined on a case by case basis, these forms should only be viewed as examples of what likely will be required.

General Coral Reef Ecosystem Fishing Permit Application Form

Applicant Information: Date:____/____/____

Name:______________________ Phone:______________ Fax:____________

Address: Street ________ Apt # ________ City ________ State ________ Zip Code ________

Vessel Name: ______________ Home Port: ______________

Length:__________ Net Tonnage:__________ Gross Tonnage:__________

Vessel USCG Documentation / State License / Vessel Registration (circle one)
Number:__________

Vessel operator:

Name:______________________ Phone:______________ Fax:____________

Address: Street ________ Apt # ________ City ________ State ________ Zip Code ________

Is this permit solely to transship coral reef ecosystem taxa received from another vessel around the EEZ of American Samoa, Guam, the main Hawaiian Islands or CNMI?______________________

In which EEZ Management Subarea will fishing be conducted ? (circle only one)

Main Hawaiian Islands Guam American Samoa CNMI

(Optional) Provide general description of planned fishing operation (e.g., type and amount of gear, intended usage, target and expected catch of incidental species, expected volume of catch, intended disposition of catch, or any additional information). Use back of this sheet, if necessary.

Target Species			Expected Incidental Species		
Species Name	Expected Catch (#, wt.)	Why harvested? [1]	Species Name	Expected Catch (#, wt.)	keep?

[1] Food, ornamental, research, other

This information is true to the best of my knowledge.

Signature:______________________________

Return to: Pacific Islands Area Office, Southwest Region, NMFS;
Tel: (808) 973-2937; Fax: (808) 973-2941

Instructions for General Coral Reef Ecosystem Fishing Permit Application Form

1. Date the application. A response will be sent to the applicant within 15 days after the receipt of a completed application.

2. Write the name of the vessel for which this permit will be affixed per CFR §660.13 (k). Circle the type of registration the vessel is under and give the appropriate number.

3. Specify whether this permit is for transshipment. If so, describe where and when transshipment will occur as well as which species are likely to be transhipped and for what purpose. This can be done as an attachment. No other information will be needed. Only sign the document. Vessels wishing to transship coral reef ecosystem management unit species shoreward of the outer boundary of the EEZ around the Northwestern Hawaiian Islands and remote U.S. Pacific island possessions must fill out a special permit application.

4. Specify the subarea in which fishing will take place. Each permit will be valid for fishing only in the fishery management subarea specified on the permit.

5. (Optional) Provide general description of planned fishing operation with information regarding gear, target species and related information.

6. Sign.

If an incomplete or improperly completed application is filed, the applicant will be sent a notice of deficiency. If the applicant fails to correct the deficiency within 30 days following the date of notification, the application will be considered abandoned.

Special Coral Reef Ecosystem Fishing Permit Application Form

Applicant Information Date: ___/___/___

Name:______________________ Phone:______________ Fax: ______________

Address: Street ______ Apt # ______ City ______ State ______ Zip Code ______

Vessel Name: __________________ Home Port: ______________________

Length:___________ Net Tonnage:___________ Gross Tonnage:____________

Vessel USCG Documentation / State License / Vessel Registration (circle one)

Number:____________

Vessel operator:

Name:______________________ Phone:______________ Fax: ______________

Address: Street ______ Apt # ______ City ______ State ______ Zip Code ______

Is this permit solely to transship coral reef ecosystem taxa received from another vessel around the EEZ of the Northwest Hawaiian Islands, the Pacific Remote Island Areas, or any other MPA?______

Do you agree to accommodate an observer on board while fishing, if required?______

Does vessel have an individual Vessel Monitoring System?______

Does vessel have insurance covering removal/clean-up in event of a grounding?_____Name of Insurer:__________

Do you agree to submit data within 30 days of returning to port?______

Circle any special exemption for which you qualify and would like to be eligible for under this permit application (attach description of conditions under which you apply):

Other FMP

Scientific Bioprospecting General Indigenous Indigenous use of live rock/coral Aquaculture seed stock of coral

In which EEZ Management Subarea will fishing be conducted ? (circle only one)

Main Hawaiian Islands Northwest Hawaiian Islands Guam Guam's Southern Banks

American Samoa CNMI PRIA (specify all) ______________________

Describe your intended fishing effort, general fishing grounds, gear to be used and methods of collection

Target Species or Taxa				Expected Incidental Species or Taxa		
Species Name	Expected Catch (lb)	How will it be processed?[1]	Why harvested? [2]	Species Name	Expected Catch (lb)	keep?

Use back, if necessary; total expected catch during permit period for target species required for permit approval

[1]Live, fresh, frozen, preserved, other

[2] Food, ornamental, research, other

Attach statement regarding objectives of fishing operation, estimated ecosystem, habitat and protected species impacts, and any additional information to help support approval of this application

This information is true to the best of my knowledge.

Signature:____________________________________

Return to: Pacific Islands Area Office, Southwest Region, NMFS
Tel: (808) 973-2935; Fax: (808) 973-2941

Instructions for Special Coral Reef Ecosystem Fishing Permit Application Form

1. Date the application. A response will be sent to the applicant within 15 days after the receipt of a completed application.

2. Write the name of the vessel for which this permit will be affixed per CFR 660.13 (k). Circle the type of registration the vessel is under and give the appropriate number.

3. Answer the five questions after the information for the vessel operator yes or no. Give the name of the insurer of the vessel for which this permit is being applied. All fishing vessels (including existing FMP fisheries) operating in or transiting a marine protected area must have insurance to cover removal and clean-up.

4. If you intend to harvest live rock or coral, additional information must be attached to show why you are eligible for this exemption. If you intend to harvest in an MPA designated for indigenous use, attach relevant information as well. Scientific and bioprospecting permits may require additional information. Those applying under these circumstances should contact the PIAO before submitting an application.

5. Describe intended fishing effort as best possible (e.g., seasons, duration, etc.).

6. In describing the fishing gear, traps must have permanent legible identification. Describe what the identification is, if applicable. Describe how the gear is intended to be deployed and retrieved.

7. List all expected target and incidental species or taxa in the table and other information as best possible. Provide both numbers and weight for the catch, if appropriate.

8. Sign.

If an incomplete or improperly completed application is filed, the applicant will be sent a notice of deficiency. If the applicant fails to correct the deficiency within 30 days following the date of notification, the application will be considered abandoned.

General Coral Reef Taxa Daily Catch Report

Name of Licensee:____________________ Coral Reef Ecosystem Permit No.____________________

Vessel Name:__________________ Radio Call Sign:________Vessel Number:____________________

Area Fished:________________________ (follow regional fishing area designations, where applicable)

Type of Gear Used (one report form for each haul with each gear type per day):________________

Date Gear Set: ____/____/____ Time at Start:_______ Units of Gear Set: ______

Date Gear Hauled: ____/____/____ Time at End: _______ Units of Gear Lost:______

Wind Speed:______ Wind Direction:______ Sea Surface Temperature:______ Average Depth:_____

Target Species (list all):____

If gear was lost, give explanation as to reason why (no penalty for lost gear).________________

____

Describe any observed damage to the coral reef and how it occurred.____________________

____

____

____

Species	No. Caught	Lbs. Caught	No. Kept	Lbs. Kept	If discarded, why ?	How processed?

Protected Species Observation			
Enter Seal & Turtle numbers;	Monk Seal	Turtle	Other
Observed in area			
Observed in vicinity of gear			
Interfering with fishing operations			
Preying on catch			
Entangled, released alive			
Entangled, released dead			

Print Name:____________________ Signature:______________________ Date:____/____/____

All information must be logged within 24 hours after the completion of the fishing day.
Submit this form to NMFS within 30 days of each landing of coral reef harvest.

NMFS Honolulu Laboratory, 2570 Dole St., Honolulu, HI 96822; fax: (808) 983-2902

Instructions for General Coral Reef Taxa Daily Catch Report

1. From the coral reef ecosystem permit, record the permitee and permit number.

2. If the area fished has a specific regional designation, use it. Otherwise use an understandable description or latitudinal and longitudinal coordinates.

3. List units of gear lost and provide an explanation as to why (strong current, storm, bottom topography, etc). There is no penalty for lost gear. This information is solely used for management purposes.

4. Describe damage to the reef. Again, as long as operating within the regulations, there is no penalty for this. This information is solely used for management purposes.

5. Fill in the table as specifically as practical. If a percentage of number or pounds kept is more appropriate, be as accurate in your estimate as possible. Give reasons for any discarded catch. Describe how processed (e.g., live, fresh, frozen, preserved, etc.).

6. Give numbers for all protected species observed in most appropriate box. Do not list same animal in two separate boxes for the same day. List it in the most specific category (generally more specific down the list).

7. All information must be logged, signed and dated within 24 hours after completion of the fishing day.

8. All daily catch reports must be submitted to NMFS within 30 days of landing catch.

Special Permit/low-use Marine Protected Areas Coral Reef Taxa Daily Catch Report

Name of Licensee:________________________Coral Reef Ecosystem Permit No.________________
Vessel Name:__________________ Radio Call Sign:________Vessel Number:__________________
Area Fished:______________________________ (follow regional fishing area designations)
Type of Gear Used (one report form for each haul with each gear type per day):____________
Date Gear Set: ___/___/___ Time at Start:_______ Units of Gear Set: ______
Date Gear Hauled: ___/___/___ Time at End: _______ Units of Gear Lost:_____
Wind Speed:______ Wind Direction:______ Sea Surface Temperature:______ Average Depth:_____
Target Species (list all):____
Observer on board?_______
If gear was lost, give explanation as to reason why (no penalty for lost gear).____________________
____
Describe any observed damage to the coral reef and how it occurred.________________________
____

Species	No. Caught	Lbs. Caught	No. Kept	Lbs. Kept	If discarded, why ?	How processed?

Protected Species Observation			
Enter Seal & Turtle numbers; identify other in appropriate box	Monk Seal	Turtle	Other
Observed in area			
Observed in vicinity of gear			
Interfering with fishing operations			
Preying on catch			
Entangled, released alive			
Entangled, released dead			

Print Name:________________________Signature:________________________Date:____/____/____

All information must be logged within 24 hours after the completion of the fishing day.
Submit this form to NMFS within 30 days of each landing of coral reef harvest.

NMFS Honolulu Laboratory, 2570 Dole St., Honolulu, HI 96822; fax: (808) 983-2902

Instructions for Special Permit Coral Reef Taxa Daily Catch Report

1. From the coral reef ecosystem permit, record the permittee and permit number.

2. If the area fished has a specific regional designation, use it. Otherwise use an understandable description or latitudinal and longitudinal coordinates.

3. List units of gear lost and provide an explanation as to why (strong current, storm, bottom topography, etc). There is no penalty for lost gear. This information is solely used for management purposes.

4. Describe damage to the reef. Again, as long as operating within the regulations, there is no penalty for this. This information is solely used for management purposes.

5. Fill in the table as specifically as practical. If a percentage of number or pounds kept is more appropriate, be as accurate in your estimate as possible. Give reasons for any discarded catch. Describe how processed (e.g., live, fresh, frozen, preserved, etc.).

6. Give numbers for all protected species observed in most appropriate box. Do not list same animal in two separate boxes for the same day. List it in the most specific category (generally more specific down the list).

7. All information must be logged, signed and dated within 24 hours after completion of the fishing day.

8. All daily catch reports must be submitted to NMFS within 30 days of landing catch.

NMFS Transshipment Log for Coral Reef Ecosystem Management Unit Species

Vessel:________________ Permit No.:________________ Date:___/___/___
(Vessel receiving fish)
Broker or Shipping Agent:

Vessel:______________________________ Radio Call Sign:______________
(Vessel offloading fish) Permit Number:______________
Total number of days fished:________ Type of Gear Used: ______________
Average units of gear set per day:__________ Area of Catch:______________

Species	Number Received	Total Weight Received (Lbs.)

Print Name:__________________ Signature:________________ Date:___/___/___
(Vessel captain / operator)
All required information must be recorded on the form within 24 hours after the day of transshipment.
Submit report to National Marine Fisheries Service within 7 days following the date the vessel arrived in port to land transshipped fish.

NMFS Honolulu Laboratory, 2570 Dole St., Honolulu, HI 96822; fax: (808) 983-2902

Instructions for Transshipment Log Report

1. Vessel receiving ship is the vessel registered to land or transship, shoreward of the outer boundary of the fishery management area, coral reef ecosystem management unit species that were harvested by a vessel in accordance with the CRE FMP.

2. Permit number is the number of the CRE fishing permit issued to the vessel owner by NMFS.

3. Date is the month/day/year that the fish were offloaded to (received by) the vessel.

4. The broker/agent, if any, is the shipping agent handling the transshipment operations for the vessel.

5. Name the vessel offloading the fish (the vessel transferring fish to the receiving vessel).

6. If the vessel offloading fish is a fishing vessel, list type of gear used for fishing and average units of gear set per day. Also list the area (lat/long or sector) that was fished.

7. For each management unit species transferred, enter the number and total weight received.

8. Print the name of the vessel captain/owner submitting the report.

9. Sign and date upon completion of the form.

CHAPTER 9

CONSISTENCY WITH NATIONAL STANDARDS AND OTHER LAWS AND POLICIES

9.1. National Standards for Fishery Conservation and Management

National Standard 1 – *Prevent Overfishing. Achieve Optimum Yield – Conservation and Management Measures Shall Prevent Overfishing While Achieving, on a Continuing Basis, the Optimum Yield from Each Fishery for the United States Fishing Industry.*

The CRE-FMP would, through permit and reporting requirements, monitor and control fishing effort in the EEZ to prevent overfishing of coral reef resources. A special permit and reporting system would be established for new fisheries in the EEZ targeting previously unharvested coral reef resources for which there is insufficient information to define overfishing or optimum yield. A special permit would also be required for any CRE fishing in low-use MPAs. In addition, large tracts of coral reef in the EEZ would be designated as no-take MPAs. These would conserve a large reservoir of spawning biomass and provide "insurance" against periods of poor recruitment or overexploitation of down-current sub-populations. Furthermore, deep-water spawning stocks of fish species that have already been heavily exploited at shallow depths would be protected from intensive harvest using scuba-assisted spearfishing.

National Standard 2 – *Best Scientific Information – Conservation and Management Measures Shall Be Based upon the Best Scientific Information Available.*

For coral reef resources already targeted by existing fisheries and for which there is sufficient information to define sustainable yield, the CRE-FMP would prevent overfishing according to the protocol described in the FMP. For previously unharvested MUS, the FMP would collect detailed fishery-dependent information through a special permit and reporting system. This would be supplemented by fishery-independent data collected through research. Through a framework procedure, the FMP could adapt to new information and unforeseen impacts. An evaluation of new data and the biological, economic, and social impacts of the management system would be made each year as part of the annual status report prepared by the Council for the coral reef fisheries managed in the Western Pacific.

National Standard 3 – *Manage Stocks as a Unit – To the Extent Practicable, an Individual Stock of Fish Shall Be Managed as a Unit Throughout its Range, and Interrelated Stocks of Fish Shall Be Managed as a Unit or in Close Coordination.*

Individual sub-populations of larger stocks of reef species may increase, decrease, or cease to exist locally without adversely affecting the overall population. The condition of the overall populations of particular species is linked to the variability among sub-populations: the ratio of sources and sinks, their degrees of recruitment connection, and the proportion of the sub-populations with high variability in reproductive capacity. Recruitment to populations of coral reef organisms depends largely on the pathways of larval dispersal and "downstream" links. One needs to ask, Are the connections sufficient to actually enhance distant sub-populations or only enough to maintain a homogenous genetic stock? There is poor understanding of the basics, much less the intricacies, of individual stocks and of their interrelationships in the coral reef ecosystem. To compensate, the CRE-FMP proposes extensive no-take MPAs. They do not require detailed knowledge of species while holistically conserving multi-species resources and the functional attributes of coral reef ecosystems.

National Standard 4 – *Do Not Discriminate Between States – Conservation and Management Measures Shall Not Discriminate Between Residents of Different States. If it Becomes Necessary to Allocate or Assign Fishing Privileges among Various United States Fishermen, Such Allocation Shall Be (A) Fair and Equitable to All Such Fishermen; (B) Reasonably Calculated to Promote Conservation; and (C) Carried out in Such Manner That No Particular Individual, Corporation, or Other Entity Acquires an Excessive Share of Such Privileges.*

The allocation of fishing privileges to indigenous participants in coral reef fisheries resulting from the proposed management measures is rationally connected to the furtherance of CRE-FMP objectives. Furthermore, the total potential benefits that indigenous participants may receive from the preferred alternatives outweigh the potential hardship that may be imposed on non-indigenous participants, when the centuries-old dependence of native people on coral reefs and the social importance of indigenous cultural continuity are considered. The measure is reasonably calculated to promote conservation, and no particular individual, corporation, or other entity is expected to acquire an excessive share of the fishing privileges allocated to indigenous participants. Participation in coral reef fisheries will not be limited to residents of the U.S. Pacific Islands.

National Standard 5 – *Efficiency in Utilization – Conservation and Management Measures Shall, Where Practicable, Consider Efficiency in the Utilization of Fishery Resources; Except That No Such Measure Shall Have Economic Allocation as its Sole Purpose.*

Coral reefs harbor a great diversity of marine organisms, but the relative productivity and potential harvest of any single species is limited. Existing methods of harvesting coral reef resources in the U.S. Pacific are highly inefficient, and the CRE-FMP purposely does not promote greater efficiency in these fisheries. In fact, the proposed conservation and management measures would create additional inefficiencies in the form of area closures (i.e., no-take MPAs), special permit and reporting requirements, and fishing gear restrictions.

The preferred alternatives emphasize the need to sustain existing small-scale fisheries for coral reef resources, while limiting the harvest of new resources targeted by new fisheries until sustainable use can be demonstrated. Particular support is given to fishing communities and indigenous participants because of the importance of coral reef resources as a source of food for local consumption and as a means of preserving and perpetuating indigenous cultural values. The many economic and social benefits of coral reefs to island societies would be maintained by the proposed conservation measures in the plan.

It is impossible to provide a quantitative estimate of how many more coral reef resources would be available if the CRE-FMP is approved and implemented, or how much additional benefit would accrue to the Nation by this increase. It is clear, however, that the value of the potential economic and social benefits derived from the proposed conservation and management measures outweigh the costs that may be imposed on fishing activities affected by the closure of MPAs, special permit and reporting requirements, and gear limitations.

National Standard 6 – *Allow for Variations – Conservation and Management Measures Shall Take into Account and Allow for Variations Among, and Contingencies In, Fisheries, Fishery Resources and Catches.*

The special permit and reporting requirements for low-use MPAs and for new coral reef resources targeted by new fisheries are expected to produce new information, especially for poorly understood coral reef taxa for which there are few data to define sustainable yield. An evaluation of new data and unforeseen biological, economic, and social impacts resulting from the FMP management system will be made each year as part of the annual status report prepared by the Council for the coral reef fisheries managed in the Western Pacific region. During the evaluation, the views and opinions of the full range of stakeholders, including consumptive and non-consumptive users of coral reefs, will be solicited. The conservation and management measures may be adjusted as new information becomes available.

National Standard 7 – *Management Measures Shall Minimize Costs – Conservation and Management Measures Shall, Where Practicable, Minimize Costs and Avoid Duplication.*

Several of the proposed conservation and management measures would add substantially to the responsibilities and costs of fishery administration and enforcement. Specific elements likely to increase the difficulty and cost of fishery management are (1) the designation of seaward boundaries for no-take MPAs, (2) zoning of low-use MPAs, (3) the requirement for wreck removal and pollution liability insurance for all fishing vessels passing through MPAs, and (4) the highly discretionary special permit application and reporting process. The preferred alternative, however, avoids duplication with existing local permits issued by island governments and with federal permits for fishing activities conducted in the EEZ under existing FMPs for lobster, bottomfish, and precious corals.

National Standard 8 – *Importance to Fishing Communities – Conservation and Management Measures Shall, Consistent with Conservation Requirements of this Act (Including the Prevention of Overfishing and Rebuilding of Overfished Stocks), Take into Account the Importance of Fishery Resources to Fishing Communities in Order to (A) Provide for the*

Sustained Participation of Such Communities; and (B) to the Extent Practicable, Minimize Adverse Economic Impacts on Such Communities.

The social and economic history of the populated U.S. Pacific Islands differs considerably from that of the continental U.S. Samoa, Hawaii, and the Mariana Islands were originally settled in ancient times by seafaring peoples. The lack of terrestrial resources in most areas led to great dependence on fishing for food security. This dependence shaped the social organization, cultural values, and spiritual beliefs of the indigenous populations.

The era of European discovery brought the island cultures into direct conflict with western traditions of proprietorship. Repeated contacts with western culture eroded the stability of the social structures and subsistence economies created by indigenous people.

With the exception of American Samoa and small enclaves in Guam, Hawaii, and the Northern Mariana Islands, the modern-day indigenous descendants are dispersed as part of cosmopolitan populations. Island societies have become pluralistic, and many aspects of their economies and cultures have evolved in modern times. Yet, the vast majority of contemporary island residents continue to depend on coral reef resources for consumptive and non-consumptive uses. Most residents consume seafood, and many are at least part-time fishermen. The harvest of coral reef resources is important to U.S. Pacific Island inhabitants as a source of food for local consumption, for local income and employment, and as a means of preserving and perpetuating indigenous cultural values.

The MSFCMA has recognized that Pacific insular areas "contain unique historical, cultural, legal, political and geographic circumstances which make fisheries resources important in sustaining their growth." The proposed conservation and management measures take into account the centuries-old relationships of indigenous people with coral reef resources, and the continuing dependence of modern-day, pluralistic island communities on these resources. The siting of no-take MPAs in remote areas of the EEZ, the proposed allocation of a portion of low-use MPAs for indigenous fishing activities, and the reliance on proposed local reporting requirements in parts of the EEZ adjacent to existing fishing communities and indigenous activities are expected to minimize adverse economic impacts.

National Standard 9 – *Minimize Bycatch – Conservation and Management Measures Shall, to the Extent Practicable, (A) Minimize Bycatch and (B) to the Extent Bycatch Cannot Be Avoided, Minimize the Mortality of Such Bycatch.*

Existing coral reef fisheries in the U.S. Pacific Islands produce little bycatch because of relatively selective gears and diverse food preferences of island seafood consumers. The restrictions on gear and fishing methods are intended to minimize bycatch. A condition of the permit system will require that all bycatch be reported. If a particular fishery, gear, or method is shown to produce excessive bycatch, regulatory or administrative action can be taken.

National Standard 10 – *Promote Safety – Conservation and Management Measures Shall, to the Extent Practicable, Promote the Safety of Human Life at Sea.*

The FMP proposes to designate MPAs where vessel anchorage and passage would be restricted. These measures would not promote vessel safety, but neither are they expected to put vessels at risk because anchoring and passage would not be restricted in emergency situations. The latter are recognized under maritime law (*force majeure*) regardless of any regulations implemented through the FMP.

9.2 Other Applicable Laws and Policies

9.2.1 Federal Laws and Policies

Coastal Zone Management Act (CZMA)

Section 307 (C) of the CZMA requires that any Federal activity affecting the land or water uses or natural resources of a state's coastal zone be consistent with that state's approved coastal management program, to the maximum extent practicable. In this instance, Hawaii, Guam, American Samoa, and the CNMI all have approved coastal zone management programs. This Fishery Management Plan, therefore, must be reviewed to determine if the measures will or are likely to affect the coastal zone. The management measures in this CRE-FMP will be implemented in a manner that is consistent to the maximum extent practicable with the approved coastal zone management programs of American Samoa, CNMI, Guam, and Hawaii. The Council will send a copy of the draft FMP to the state coastal agencies for concurrence.

Endangered Species Act (ESA)

The Endangered Species Act provides for the protection and conservation of endangered and threatened species. Once a species is listed as endangered or threatened, it is afforded protection under the ESA and takings are prohibited. This process ensures that projects authorized, funded, or carried out by federal agencies do not jeopardize the species' existence or result in the destruction or modification of habitat critical to the species existence. Consultation takes place by NMFS, and USFWS as appropriate, and is required if the fishery affects, directly or indirectly, endangered or threatened species or any designated critical habitat. While developing the CRE-FMP, the Council included measures to minimize any adverse impacts. Therefore, the Council has determined that this FMP is not likely to have any significant adverse effects to listed species or their critical habitats.

Under the ESA, NMFS is required to prepare an impact assessment, which may serve as a biological assessment for consultation under Section 7 of the ESA. This document (including Volume II, the EIS) assesses the impacts to endangered and threatened species and their habitats from the management measures in the CRE-FMP.

The species that have been listed as endangered or threatened under the Endangered Species Act and have been observed in the region where reef-related fisheries operate are as follows:

Hawaiian monk seal (*Monachus schauinslandi*)

Olive ridley turtle (*Lepidochelys olivacea*)

Leatherback turtle (*Dermochelys coriacea*)

Loggerhead turtle (*Caretta caretta*)

Hawksbill turtle (*Eretmochelys imbricata*)

Green turtle (*Chelonia mydas*)

Humpback whale (*Megaptera novaeangliae*)

Sperm whale (*Physeter macrocephalus*)

Blue whale (*Balaenoptera musculus*)

Fin whale (*B. Physalus*)

Sei whale (*B.Borealis*)

North Pacific Right whale (*Eubalaena japonica*)

Other listed species that potentially could be affected by the actions proposed under the preferred alternative of the plan are land based. These species could be impacted by potential invasive species accidentally introduced by fishing vessel grounding or discharge of floating debris.

Laysan duck (*Anas platyrhynchos laysanensis*)

Laysan finch (*Telespyza cantans*)

Nihoa millerbird (*Acrocephalus familiaris kingi*)

Nihoa finch (*Telespyza ultima*)

Micronesian megapode (*Megapodius laperouse laperouse*)

Sesbania tomentosa (legume)

Schiedea verticillata (fleshy root herb)

Pritchardia remota (palm)

Amaranthus brownii (weedy herb)

Mariscus pennatiformes (sedge)

Cenchrus agriminioides (*kamanomano*)

Marine Memmel Protection Act (MMPA)

The Marine Mammal Protection Act of 1972, as amended, allows for the incidental take of marine mammals during commercial operations under certain limited circumstances, including incidental takings during commercial fishing. However, all fisheries in the Western Pacific Region are classified as Category III, which designates the fishery as having a remote likelihood or no known incidental taking of marine mammals. If any interactions do occur, the fishermen are required to report them. In developing the CRE-FMP, the Council considered actions which would minimize adverse impacts from the fishery, and developed mitigation measures.

The following marine mammal species (cetaceans) that are protected under the MMPA, but not listed as endangered or threatened, occur in the areas where reef-related fisheries operate:

Pacific white sided dolphin (*Lagenorhynchus obliquidens*)

Rough-toothed dolphin (*Steno bredanensis*)

Risso's dolphin (*Grampus griseus*)

Bottlenose dolphin (*Tursitops truncatus*)

Spotted dolphin (*Stenella attenuata*)

Spinner dolphin (*Stenella longirastris*)

Striped dolphin (*Stenella coeruleoalba*)

Melon-headed whale (*Peponocephala electra*)

Pygmy killer whale (*Feresa attenuata*)

False killer whale (*Pseudorca crassidens*)

Killer whale (*Orcinus orca*)

Pilot whale (*Globicephala melas*)

Blainsville's beaked whale (*Mesoplodon densirostris*)

Cuvier's beaked whale (*Ziphius cavirostris*)

Pygmy sperm whale (*Kogia breviceps*)

Dwarf sperm whale (*Kogia simus*)

Bryde's whale (*Balaenoptera edeni*)

National Environmental Policy Act (NEPA)

The National Environmental Policy Act requires that any major federal action significantly affecting the human environment must disclose the environmental consequences of the proposed action through an Environmental Impact Statement (EIS). An EIS was prepared for this FMP, and all required components of the EIS are contained in Volume II, including issues relating to public scoping periods, consulted agencies, impacts, and alternatives.

Paperwork Reduction Act (PRA)

The purpose of the PRA is to control the burden on the public (i.e., fishermen), businesses, county, state, and territorial governments, and other entities of providing information to the federal government. The Act is intended to ensure that the information collected under the proposed action is needed and collected in an efficient manner (44 U.S.C. 3501(1)).

Proposed Data Collection Program:

This FMP will not initially require additional reporting in the populated areas of American Samoa, Guam, CNMI, and the main Hawaiian Islands for Currently Harvested Coral Reef Taxa (CHCRT). In these areas, where local data collection and fishery monitoring already occurs, the Council will work through these existing reporting programs to obtain data. For other Council FMPs, coordinated data processing has been established for Hawaii, Guam, the CNMI, and American Samoa. The CRE-FMP will follow these established procedures. Creel survey, logbook, and/or commercial buyer's data will be collected and processed by the appropriate local agencies. In areas where no reporting systems exist, the Council will develop mechanisms for monitoring and reporting specifically for that locality. Reporting requirements for these areas could include reporting types and quantity of gear used, units of gear set, time at start and end of set, units of gear lost, numbers and weights of species kept, numbers released, reason for discards, how the catch is processed, area(s) fished, length of the trip, average weather conditions, depth of area fished, observed damage to the coral reef, and all protected species interactions. For all fishing in the NWHI and the PRIAs (where allowed), and for emerging fisheries harvesting previously unharvested taxa in the CNMI and MHI, reporting requirements will be established via special permits. The annual report required under the FMP will summarize and analyze the information collected. Island-specific annual report modules will be produced by island agency Plan Team members and provided to the Council where they will be combined with other required materials to produce the CRE-FMP Annual Report. Federal logbooks are submitted directly to the NMFS-HL. Annual reports are due by July 31 of each year.

Although this FMP will not require additional permits to harvest CHCRT in populated areas, in the low-use MPAs in the NWHI and at Palmyra, Johnston, and Wake, a special permit will be required for CHCRT. Also, for emerging fisheries in the CNMI and MHI, a special permit will be required for targeting Potentially Harvested Coral Reef Taxa. For all areas, incidental catch of coral reef taxa taken under other FMP-managed fisheries will require no additional permit or reporting other than existing systems.

Estimate of Permit Application and Reporting Burden and Cost:

The permit application and reporting requirements would require a certain level of scientific expertise, which would bring a certain level of costs. Under the special permit application, the applicant is required to provide a description of the planned fishing operation, including general timing, duration and location of fishing and gear operation, resources (directed and incidental) expected to be harvested under the special permit, expected catch, and estimated ecosystem-level, habitat, and protected species impacts of the proposed harvest. A typical fisherman's knowledge and expertise is sufficient to meet the special permit reporting requirements. Because reporting costs are variable, the differential effects among entities would be small. Relatively few of the region's coral reef fishery participants would be affected by the measures outlined in the CRE-FMP, and of these participants only a few would be significantly affected.

It is estimated that between 10-20 permits will be issued annually to coral reef-related fisheries in the EEZ of the Western Pacific Region. The general permit application, although not immediately implemented under the preferred alternative, is estimated to require one hour to complete. Therefore, the permitting burden for general permits would be 10-20 hours annually. The special permit is estimated to require two hours to complete, totaling 20-40 hours for the special permit annual burden.

The total reporting burden hours are estimated to be 1,125 hours per year, assuming 15 vessels in the fleet make an average of 10 trips per year, averaging 15 days per trip, and the additional daily burden is 30 minutes. The total burden hours for the special permit are estimated to be 750 hours per year, assuming five vessels in the fleet make an average of 10 trips per year averaging 15 days per trip and the additional daily burden is one hour per fishing day.

See the Regulatory Impact Review (Appendix B) for additional information on estimated reporting burden and cost.

Regulatory Flexibility Act (RFA)

The Regulatory Flexibility Act requires that agencies assess and present the impacts of their proposed actions on small business entities. It has been determined that an initial RFA (IRFA) is required. After public review, a final RFA may be required. The IRFA may be found in Appendix B.

National Wildlife Refuge Administration Act of 1966 (NWRAA)

The NWRAA establishes guidelines, policies, and directives for the administration and management of areas within the National Wildlife Refuge System (NWRS). The NWRAA authorizes the Secretary of the Interior to administer the NWRS for the conservation and management of wildlife and plant resources, while providing for compatible wildlife-dependant recreational activities within the NWRS boundaries. The Act requires congressional action for the divestiture of lands and waters within the NWRS, with few exceptions.

Under the CRE-FMP, no USFWS-managed resources are expected to be negatively affected because the FMP has designated all coral reef habitat found within and around refuges as no-take or low-use MPAs. In no-take MPAs, the harvest of all marine resources is prohibited, including those resources managed under other FMPs. Areas designated as low-use MPAs allows for the continuation of recreational fishing and on-island consumption under the special permit regime.

Any proposed fishing activity within the NWR boundary would require a compatibility determination by the USFWS and thorough evaluation through the special permit system proposed under this FMP.

Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act, as amended, created a coordination process between the USFWS and other federal and state agencies whose actions may modify, impound, divert, or otherwise control waters or other bodies of water. Agencies must consult for the purpose of "preventing loss of and damage to wildlife resources." Added provisions require equal consideration and coordination of wildlife conservation with other water resource development programs and authorizes the Secretary of the Interior to provide public fishing areas and accept donations of lands and funds. Under the CRE-FMP, waters under the joint jurisdiction of the Department of Commerce and the Department of Interior will not be modified, impounded, diverted or controlled by the proposed action. Areas containing coral reef habitat within refuge boundaries, where the USFWS prohibits all extractive uses, are designated no-take MPAs under this FMP. In areas where the USFWS allows recreational fishing and on-island consumption, the CRE-FMP has accommodated this by designating these areas as low-use MPA requiring special permits. Details of MPAs are discussed in Section 5.2- Marine Protected Areas.

Executive Order 8682

Executive Order 8682 established Naval Defensive Sea Areas and Naval Airspace Reservations around the territorial waters of several islands and reefs in the PRIAs. The Order authorizes the Secretary of the Navy to control entry into areas designated as naval defensive seas areas. The CRE-FMP recognizes the authority of the Department of Defense to control entry into naval defensive sea areas around those territories at any time to facilitate military preparedness. Thus, it will in no way affect the authority of the Department of Defense to conduct activities in any area it administers.

Executive Order No. 12866-Regulatory Impact Review

Executive Order 12866 requires that a Regulatory Impact Review (RIR) be prepared for all regulatory actions that are of public interest. This review provides an overview of the problem, policy objectives, and anticipated impacts of the action, and ensures that management alternatives are systematically and comprehensively evaluated so that the public welfare can be enhanced in the most efficient and cost-effective way. Also, the RIR requires analysis of distributive impacts and costs of government administration and private compliance with the proposed measures.

The general purpose of the RIR, as well as the RFA described above, is to make the regulatory process open and transparent so that the steps in the regulatory decision-making process are easily followed. The economic analysis provides decision-makers and the public with the agency's best estimate of the impacts of proposed actions and their alternatives.

In compliance with this EO, an analysis of impacts of regulatory actions is provided in the draft Regulatory Impact Review found in Appendix B.

Executive Order No. 13112- Invasive Species

Executive Order 13112 establishes guidelines to ensure that actions proposed by federal agencies, to the extent practicable by law, take into account and mitigate the introduction of invasive species. The EO also establishes an Invasive Species Council to provide national leadership regarding invasive species and to ensure that federal agency activities concerning invasive species are coordinated, cost-efficient, and effective. The management measures proposed in the CRE-FMP likely will not cause or promote the introduction of invasive species, rather they will minimize the risk of introduction of alien species by restricting access in the no-take and low-use MPA proposed for sensitive coral reef ecosystems. Additionally, special permits, which are issued on a case-by-case basis, will be required for fishing in low-use MPAs in the NWHI, Wake, Palmyra, and Johnston Atoll.

Executive Order No. 13089-Coral Reef Protection

In June 1998 the President signed an Executive Order for Coral Reef Protection, which established the Coral Reef Task Force (CRTF) and directed all federal agencies with coral reef-related responsibilities to develop a strategy for coral reef protection. Federal agencies were directed to work cooperatively with state, territorial, commonwealth, and local agencies; non-governmental organizations; the scientific community; and commercial interests to develop the plan. The Task Force was directed to develop and implement a comprehensive program of research and mapping to inventory, monitor, and address the major causes and consequences of degradation of coral reef ecosystems. The Order directs federal agencies to use their authorities to protect coral reef ecosystems and, to the extent permitted by law, prohibits them from authorizing, funding, or carrying out any actions that will degrade these ecosystems.

Of particular interest to the Council is the implementation of measures to address: (1) fishing activities that may degrade coral reef ecosystems, such as overfishing, which could affect ecosystem processes (e.g., the removal of herbivorous fishes leading to the overgrowth of corals by algae) and destroy the availability of coral reef resources (e.g., extraction of spawning aggregations of groupers); (2) destructive fishing techniques, which can degrade essential fish habitat (EFH) and are thereby counter to the Magnuson-Stevens Act; (3) removal of reef substrata; and (4) discarded and/or derelict fishing gear, which can degrade EFH and cause "ghost fishing."

To meet the requirements of Executive Order 13089, the Coral Reef Task Force issued the *National Action Plan to Conserve Coral Reefs* in March 2000. In response to the recommendations outlined in the *Action Plan*, the President announced Executive Order 13158, which is designed to strengthen and expand Marine Protected Areas.

Executive Order No. 13158–Marine Protected Areas Memorandum of Understanding on Protection of U.S. Coral Reefs in the Northwest Hawaiian Islands

On May 26, 2000, the President announced his commitment to protect the natural and cultural resources found within the marine environment by strengthening and expanding the Nation's system of marine protected areas (MPAs) to protect the natural and cultural marine heritage for future generations. This is to be accomplished by all pertinent federal agencies sharing information, tools, and strategies to develop a national system of MPAs. The Department of Commerce and the Department of the Interior are required to consult with those states that contain parts of the marine environment, and Regional Fishery Management Councils, among others, to promote coordination when establishing and managing MPAs.

Under Executive Order 13158, each federal agency whose authorities provide for the establishment or management of MPAs shall take appropriate autions to enhance or expand protection of existing MPAs and establish or recommend, as appropriate, new MPAs. Throughout the development of the CRE-FMP, the Council, along with the advisory bodies and plan teams, have analyzed existing MPAs and developed recommendations to establish new ones in all areas under Council jurisdiction. This FMP includes those recommendations.

Concurrent with the announcement of the President's Executive Order 13158, a Memorandum of Understanding was delivered by the President. In this memorandum, the President determined that the coral reef ecosystem in the Northwestern Hawaiian Islands deserved strong and lasting protection. To this end, he directed the Secretary of the Interior and the Secretary of Commerce, working cooperatively with the State of Hawaii and consulting with the Western Pacific Regional Fishery Management Council, to develop recommendations within 90 days for a new, coordinated management regime to increase protection of the ecosystem and provide for sustainable use.

In the process of developing the CRE-FMP, the Council has consistently worked cooperatively with the Department of the Interior, the Department of Commerce, and the State of Hawaii, as well as numerons other agencies. Currently, the Chairman of the State of Hawaii Department of Land and Natural Resources is a designated voting member of the Council, and the Pacific Islands Manager of the U.S. Fish and Wildlife Service serves as a non-voting member. In addition, in developing the CRE-FMP the Council relied on members of the various plan teams to develop recommendations based on their combined expertise. Staff members from the U.S. Fish and Wildlife Service and the State of Hawaii Department of Aquatic Resources are represented on the coral reef ecosystem plan team.

The main issues to be addressed by the EO and recommendations from the memorandum of understanding figure prominently in the CRE-FMP. For example, after much discussion, the advisory panels developed an MPA network that will protect coral reef areas of special value in the NWHI and PRIA. The Council advocates that 24% of NWHI coral reefs be classified no-take MPAs. In the areas where human activities are allowed, the FMP establishes measures to ensure that their actions will not degrade the coral reef ecosystem. In addition, throughout the FMP the

Council has considered the potential for human impacts on threatened and endangered species, and developed measures designed to afford the greatest protection.

In addition to the fishery-related cooperative recommendations, the cooperative recommendations should identify any further measures necessary to protect cultural and historic resources and artifacts, and also allow culturally significant uses of the NWHI marine resources by Native Hawaiians. History clearly demonstrates how coral reef ecosystems have been vital to Native Hawaiians, and throughout the CRE-FMP this relationship is documented. The Council developed a Fishery Rights of Indigenous Peoples Advisory Panel to work closely with other advisory bodies, ensuring that the rights of the indigenous peoples are not overlooked.

In addition, the cooperative recommendations should also establish a framework for scientific research and exploration, and establish a framework for facilitating recreation and tourism in the NWHI as well. An important theme in the CRE-FMP is balancing coral reef ecosystem conservation with sustainable human use. The scientific data obtained in the NWHI are critical to an understanding of coral reef ecosystems, which will ensure comprehensive management.

The Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve (Executive Orders 13178 and 13196)

On December 4, 2000, President Clinton announced Executive Order 13178, which established the Northwestern Hawaiian Islands Coral Reef Ecosystem (NWHI-CRE) Reserve. It established conservation measures that restrict activities throughout the Reserve, and Reserve Preservation Areas around certain islands, atolls, and banks, where almost all consumptive or extractive uses are prohibited. Executive Order 13196, issued January 18, 2001, modified the earlier Executive Order by revising some of the conservation measures and making the Reserve Preservation Areas permanent. The reserve is approximately 1,200 nm long and 100 nm wide, and includes all submerged lands and waters seaward of the seaward boundaries of the State of Hawaii and the Midway Atoll National Wildlife Refuge in the NWHI.

The Reserve is intended to be a temporary management regime until completion of the process to designate the NWHI as a National Marine Sanctuary. On January 19, 2001, the NOAA/NOS Office of National Marine Sanctuaries announced its intent to initiate the Sanctuary designation process for the Reserve pursuant to sections 303 and 304 of the National Marine Sanctuaries Act (16 USC 1433, 1434). During this process, NOAA will prepare an environmental impact statement and management plan, which will examine the management, boundary, and regulatory alternatives associated with sanctuary designation. As required, NOAA must also initiate public scoping meetings to solicit information and comments on the range and significance of issues related to sanctuary designation and management. The Executive order states that "the Secretary of Commerce shall supplement or complement the existing Reserve, and ... in consultation with the Governor of the State of Hawaii, determine whether State submerged lands and waters should be included as part of the Sanctuary."

As summarized here, a range of conservation measures are established by the EO. All current commercial federal fishing permits and effort and take are capped at the previous year's level (from December 4, 2000) except for bottomfish fishing, which is capped to the individual permittee's average annual take over the previous five years. Only vessels with permits valid in the year preceding December 4, 2000, are allowed to operate in the Reserve. An individual harvest quota will be established for each permit holder, but permits are non-transferable (they expire with the individual permit holder). Recreational fishing and pelagic trolling are capped at levels reported taken preceding the order. Additionally, no permits will be issued for any fishing activity that did not have a permit in the year preceding December 4 2000." The Executive orders further states that "the Secretary, following consideration of any advice or recommendations of the Western Pacific Fishery Management Council, may further restrict fishing activities." Other prohibited activities (unless noted otherwise) inclnde no offshore oil or mineral development, no anchoring on live or dead coral where the bottom can be seen, no drilling or dredging, no discharging material, and no removal of living/non-living resources.

In Reserve Preservation Areas, executive orders measures prohibit almost all activities to 100 fm around most islands. These include anchoring where buoys are available or outside a designated area, taking or touching living or dead coral, and discharging or depositing any material except cooling water or engine exhaust. Straight-line latitude /longitude boundaries are to be developed for each Reserve Preservation Area. Bottomfishing and recreational trolling are still allowed to 25 fm around some islands (Nihoa, Necker, Gardner, Maro, Lisianski) and to 50 fm around Laysan. Some banks are closed out to 12 nm from their approximate center; these are the bank east of French Frigate Shoals, SE Brooks Bank, St. Rogatien, the bank west of St. Rogatien and the bank east of Gardner, Raita Bank and Pioneer Bank. However, except for the bank east of French Frigate Shoals and SE Brooks Bank, bottomfishing and recreational trolling are allowed. For Raita Bank and the bank west of St. Rogatien, bottomfishing and recreational trolling will be allowed for five more years. Native Hawaiian uses specified by the Executive order allow subsistence, and cultural and religious uses in the Reserve and Preservation Areas (in yet-to-be-identified sub-areas), provided that these uses do not injure the coral reef ecosystem and related marine resources. The Midway Atoll National Wildlife Refuge (NWR; 22 x 22 nm) is not included in the Reserve. Complementary management with the Hawaiian Islands NWR is proposed, but nothing in the Executive order shall enlarge or diminish the jurisdiction or authority of DOI in managing its Refuge. The Department of Defense and USCG are exempt from the Executive order.

The Secretary of Commerce has not established final departmental policy for several important stipulations in the EO that are unclear. Enforcement agencies are unable to develop a complete enforcement plan and there are no published regulations. It is also unclear how restrictions will be enforced since boundaries defined by bottom contours must be converted to straight-lines defined by latitude-longitude coordinates. How individual fishing caps will be determined based on the "year preceding the December 4 2000 EO" is still being discussed. (According to the Code of Federal Register §660.12, the fishing year begins on January 1 and ends on December 31. How fishing caps will be determined for recreational fishing is also problematic because there is no permit or reporting requirement for recreational fishing in Hawaii.

Ecosystem-Based Fishery Management

Recognizing the potential of an ecosystem-based management approach to improve fisheries management, Congress requested that NMFS convene a panel of experts to assess the extent to which ecosystem principles are currently applied in fisheries research and management and recommend how best to integrate ecosystem principles into future fisheries management and research. In April 1999, this Ecosystems Principles Advisory Panel (EPAP) submitted a report to Congress entitled *Ecosystem-Based Fishery Management*. It concludes that the U.S. must develop governance systems that have as their primary goals ecosystem health and sustainability, rather than short-term economic gain. In addition, the report states that adopting ecosystem-based fishery management and research will result in more sustainable fisheries and healthier marine ecosystems, and also more economically sound coastal communities. The panel provides fisheries management and policy recommendations for implementation by NMFS and the Councils.

As discussed in this FMP, the Council developed the CRE-FMP to incorporate ecosystem approaches into the present regulatory structure. In its *Ecosystem-Based Fishery Management Report*, the EPAP stressed that "FMPs for single species or species complexes should be the basic tool of fisheries management for the foreseeable future. However, management actions alone are not sufficient to implement an ecosystem approach." The mechanism to integrate FMPs with ecosystem principles, goals, and policies recommended by the EPAP is a demonstration Fisheries Ecosystem Plans. This CRE-FMP is intended to serve as the demonstration plan.

9.2.2 Coral Reef Legislation

Several bills have been initiated in response to Executive Order 13089 addressing coral reef conservation, restoration, and preservation. These bills, introduced by both the House and the Senate, would provide grants to state, federal, territorial, and commonwealth natural resource management authorities, or any educational institution or other non-government organization with coral reef conservation expertise. A brief description of the language of the bills as they exist in their current form are outlined below.

Coral Reef Conservation Act of 1999, S.725

This bill was introduced by Senator Snowe to preserve, protect, and restore the health of coral reefs and coral reef ecosystems, to assist in the conservation and protection of coral reefs by supporting conservation programs and providing financial resources for such programs, and to establish a formal mechanism for collecting and allocating monetary donations from the private sector to be used for coral reef conservation projects. Any U.S. state or territory natural resource management authority, other government agency with jurisdiction over coral reefs, or any educational institution or non-government organization with demonstrated expertise in conservation of coral reefs is eligible to apply for the grant. If passed, appropriations of $15 million would be available for each fiscal year 2001-2004.

Coral Reef Protection Act of 1999, S.1253

This Bill was introduced by Senator Inouye to preserve and restore the health of coral reef ecosystems, support coordinated conservation programs, provide financial assistance, and establish a funding allocation mechanism. This grant would be open to any state, federal, or territorial agency with coral reef jurisdiction, or any organization with coral reef expertise. If passed, appropriations of $20 million for each fiscal year 2000-2004 would be available.

Coral Reef Conservation Act of 2000, H.R. 1653

The Coral Reef Conservation Act of 2000, passed into law in 2001, authorizes $16 million annually from 2000-2004 to the Secretary of Commerce for two coral reef programs. The National Program allows the Secretary to conduct coral reef related activities such as mapping, research assessments, monitoring, restoration, marine debris removal and public outreach. This program will also allow the Secretary to conduct activities to enhance compliance with laws that regulate the taking of coral reef resources, develop scientific information on the conditions of coral reefs, and coordinate activities and programs related to coral reefs conducted by federal agencies. The Coral Reef Conservation Program allows the Secretary to fund grant projects that conserve coral reefs and involve affected local communities. Projects funded by this program require a 50% matching fund or in-kind contributions unless waived by the Secretary.

9.2.3 State, Local, and Other Applicable Laws and Policies

Green (1997) summarizes existing state laws and policies that relate to the management of coral reef ecosystems. Every effort has been made to ensure that the management measures in this FMP are compatible with state laws and policies in order to simplify implementation and assist enforcement efforts. Table 9.1 summarizes existing state regulations and resource management activities pertaining to coral reefs.

9.2.4 Safety Considerations: fishery access and weather-related vessel safety

The management measures contained within this FMP will not negatively impact the safety of vessels participating in the coral reef fisheries of the Western Pacific Region. New permit requirements will enhance safety by allowing monitoring of the number and type of vessels participating in coral reef resource harvesting. The proposed framework action to require satellite-based vessel monitoring systems (VMS) to track vessels participating in coral reef fisheries would greatly increase vessel safety by allowing government enforcement agencies to continuously monitor vessel positions. In addition, VMS units provide vessel operators the ability to send emergency signals to the USCG if needed. The framework action to create "no anchor zones" would limit the number of vessels on the banks at one time therefore reducing the likelihood of vessel collisions and groundings. However, more vessels in close proximity to one another increase the response and assistance time if an emergency were to occur enhancing safety at sea.

Table 9.1: Summary of existing state resource management activities in American Samoa, CNMI, Guam, and Hawaii that contribute to the protection of coral reef ecosystems (modified from PBDC 1995).

Activity	American Samoa	CNMI	Guam	Hawaii
1. General Laws and Regulations	DMWR: Manage, protect and preserve marine resources, including coral reef ecosystems; ban spearfishing with scuba (2001). ASEPA: Water quality regulation of activities in the water. FBNMS: Prohibits gathering, taking, breaking, cutting, destroying or possessing corals and other invertebrates. Fishing restrictions also apply. ASCMP: Protect unique areas and resources; develop strategies for coastal hazards; conservation of marine resources; coordination of planning, monitoring, and enforcement by government agencies.	CRM: Coastal use permitting, enforcement and education. DEQ: Environmental quality, earthmoving, stormwater control permitting, pesticide application certification, wastewater disposal system permitting; water quality standards and permitting; recreation water quality monitoring. DLNRM: Submerged lands leasing. (Transferred to Dept. of Public Lands). DFW: Fishing regulations, marine sanctuary regulations, management and enforcement; aquarium fish permitting and enforcement; Public Law 10-year moratorium on the harvest of sea cucumbers and seaweeds. Historic Preservation Office: Submerged historic property protection.	DOA/DAWR: Preservation and protection of fish and wildlife; protection of endangered species and habitats; regulates destructive fishing and sizes of lobster (no spearing), trochus and giant clam; 3 no-take and 2 limited-take MPAs (enforced since Jan 00). DLM: Seashore protection act review for development on shoreline to 10 fm. Territorial Seashore Protection Commission reviews and approves or disapproves development in Seashore Reserves. Parks & Recreation: Recreation water use management plan implementation. GCMP: Reviews, approves or disapproves activities requiring Federal Action in coral reef areas through Federal consistency. GEPA: Water Pollution Control Act, Water Quality Standards, and Soil Control & sedimentation regs, protect water quality and aquatic resources. Clearing and Grading permits designed to protect coral reefs and habitats.	CZM: Preservation of valuable coral reef resources; Federal consistency review. DLNR: Establish and Manage Marine Life Conservation Districts in which taking of coral or altering substrate normally prohibited. DOH: Rules prohibit discharge of pollutants into state waters. NPDES permit required. Admin. Rules 11-54 requires conservation of coral reefs and wilderness areas in AA waters.

Table 9.1 (cont.)

Activity	American Samoa	CNMI	Guam	Hawai
2. Prohibiting or Restricting Taking of Corals	DMWR: Regulations prohibit collecting of coral in less than 60 feet of water; commercial harvest below 60 ft requires permit; dynamite fishing illegal; willful destruction of coral while fishing is illegal; destruction of fish habitat illegal. FBNMS: Regulations state that no corals can be taken; damage prohibited; NMFS enforces—agreement with DMWR for enforcement pending. ASCMP: Rules prohibit dredging or filling of coral reefs and other submerged lands unless public need demonstrated, no environ. preferable alternatives available, and adverse impacts minimized; protect marine resources and unique areas including reefs; only dependent uses permitted.	DFW: Fishing regulations prohibit taking of live or dead coral except for betel lime—all types of coral covered.	DOA: Specific statutes prohibit taking of coral without permit—"need for revision." Seashore Protection Act: Permit required for removal. Only removal for scientific purposes permitted. GEPA: Water Pollution Control Act and Water Quality Standards provide general protection of coral reefs and marine resources (successful out-of-court settlement in coral damage from ship grounding).	DLNR: HRS 188-68 prohibits the intentional taking of, breaking or damaging any live stony coral including any live reef or mushroom coral. Eight species are identified in the statute. Exceptions may be granted for certain scientific, education or other public purpose if adverse impacts are minimized.

Table 9.1 (cont.)

Activity	American Samoa	CNMI	Guam	Hawaii
3. Prohibiting Drilling, Blasting and/or Dredging	ASCMP: Project Notification and Review System reviews all projects in AS. Board's concern in avoiding or mitigating damage to environ., including coral reefs. Enforcement provided by ASCMP (2 wetland conservation officers and 2 compliance officers). Violations result in stop work orders; continued violations referred to AG. DMWR: Prohibit use of explosives on reefs and destruction of fish habitat. Regs enforced by DMWR enforcement officers. EPA: Water Quality Standards required Certificate for any of these activities. FBNMS: Drilling, dredging, blasting and any other alteration of the seabed prohibited.	CRNL Actions affecting reefs subject to CRM permitting. Enforcement via permitting programs by CRM staff. DFW: Regulations prohibit taking of live or dead coral except for betel lime—all types of coral covered.	DLM: Territorial Seashore Protection Commission: Permits required for all such activities within Seashore Reserve (to 10 fathoms). Requirement for EA or EIS which must be approved by Guam EPA. Environmental Protection Plan required and must be approved by GEPA before DPW permit can be issued. GEPA: Section 401 certification required: All operations would require an approved Environmental Protection Plan. Blasting would require approved blasting plan to limit fish kill radius to 100' max. Enforcement done by inspectors from DPW, GEPA, and DLM.	DLNR: HRS 188-23 prohibits possession of explosive for taking of aquatic life. Drilling, dredging and blasting in nearshore waters require Conservation District Use Permit. Because ACOE permit also required, CZM would conduct Federal consistency review. If permit based on CWA 404 permit, Water Quality Certification from DOH also mandatory.

Table 9.1 (cont.)

Activity	American Samoa	CNMI	Guam	Hawaii
4. Prohibiting or Restricting Anchoring	FBNMS: Anchoring must be done so that there is no damage to bottom formations. Mooring buoys have been installed in the past, but currently none. No restrictions exist in other parts of the Territory.	No restrictions. DLNRM has placed mooring buoys in 17 locations. A DFW grant enabled the now extant Marine Technology program at Northern Marianas Community College to install 10 mooring buoys at popular dive sites on Saipan-Tinian in 1995-96.	No law addresses anchor damage to coral reefs. DAWR installed 30 shallow-water moorings around Guam to address anchor damage.	DLNR: HRS 190 authorizes regulation of anchoring and mooring in Marine Life Conservation Districts; HRS 200 restricts boats in certain reef areas; Day moorings exist in some areas and rules to curb anchoring in coral rich areas have been proposed. CZM: HRS 205A restricts anchoring on coral reefs because of likely adverse environmental and ecological impacts.
5. Prohibiting or Restricting Vessel Discharge	ASEPA: AS law prohibits discharge of oil or hazardous substances from boats. Fines $100-$1,000. USCG also enforces discharge regs (OPA 90) and levies fines for oil and sewage spills. FBNMS: Discharge prohibited.	No local regulations. USCG has regulations under OPA 90 and DEO is a first responder to a spill.	GEPA: Local water quality standards regulations restrict vessel discharges in local waters; Police Department, GEPA, and DAWR have enforcement authority under Guam Safe Boating Act, Rec. Water Use Mgt. Rules and Regs., Endangered Species Act, Guam Clean Water Act, and Guam Litter Control Act.	DOH: All vessel discharges are prohibited in State waters. USCG: Has OPA 90 rules in effect. DPS Marine Patrol and USCG enforce discharge regulations cooperatively.
6. Control of Other Point Source Pollution	ASCMP: PNRS provides for review of all projects and compliance with Federal and Territorial laws and regs. ASEPA: NPDES permits required for all discharges. AS Environmental Quality Act provides for standards at and distances from discharges. FBNMS: Discharges prohibited.	CRM: Permitting program; enforcement via field monitoring and enforcement program.	USCG: Has OPA 90 rules and enforcement authority. GEPA: NPDES permit required for point source discharges; Section 401 certification required for discharges; water quality monitoring for discharges.	DOH: NPDES permit is primary regulation and control of discharges in coral reef areas. Applications are reviewed for their impact of aquatic ecosystems by DLNR and for consistency with CZM objectives and policies by CZM program. USFWS and NMRS have programmatic monitoring and enforcement responsibilities.

Table 9.1 (cont.)

Activity	American Samoa	CNMI	Guam	Hawaii
7. Control of Non-Point Source Pollution	ASEPA: AS Water Quality Act covers regulations for use of septic tanks, pesticides, activities resulting in soil erosions, littler and solid waste disposal. ASCMP + other agencies: PNRS requires permits for new projects. Admin. rules prohibit discharge of untreated sewage, petroleum products and other pollutants or hazardous material; taking of sand and aggregate material outside designated sites; destruction of reef matter not assoc. w/permitting; disposal of trash; un-permitted dredge and fill activities. Non-regulatory measures include public education aimed at reducing erosion and impact of piggeries; TA provided when required; solid waste and oil collection facilities provided.	CRM: Project permitting, plan apprevals; new best management practices evaluation sterting. DEQ: Water quality monitoring.	GEPA: Construction Site Erosion and Sediment Controls required. New rules in formative stage including vegetative control and landscaping standards.	DOH: Limited control over non-point source pollution. Storm water runoff from county and industrial sources requires NPDES permit. Have programs that promote methods for controlling non-point source pollution. Counties have promulgaled requirements for construction sites. County and other State agencies within the CZM network of agencies have other regulatory and non-regulatory measures that contribute to control of non-point source pollution. Non-regulatory measures include use of siltation basins, grassing, and prohibition of motorized traffic.

Table 9.1 (cont.)

	Activity	American Samoa	CNMI	Guam	Hawaii
8.	Proposed Non-Point Source Pollution Measures	ASCMP: Current policy of stream bank buffer of 25 ft for private and 50 ft. for commercial project now used in environmental review will be made part of ASCMP Admin. rules. Non-regulalery measures include demo project voluntary compliance on proposals, public education, tax incentives and subsidies for those using BMPs.	CRM and DEQ now developing coastal non-point source pollution plan. 6217 marina measures expected to be incorporated. Additional mgt. measures to be developed for golf course development and wildfires. DEQ existing requirements cover storm waters. Marine water quality monitoring expected to be upgraded.	Land-Use Master Plan for Guam contains performance standards designed to reduce non-point source pollution.	Numerous non-regulatory provisions are being considered for marina, agricultural forestry, urban and other activities. State dedicated to developing a workable non-point source pollution plan in the Hawaiian context. Conflicting perspectives and values of feds and state may make it difficult to complete program. Legislative action will drive schedule.
9.	CZMA 6217 Plan Completed	Final approved expected in October 2002.	Final approval expected in 2003.	Final approval expected in June 2003.	Implemented July 2000.

Acronyms:

ASCMP: American Samoa Coastal Management Program
ASEPA: American Samoa Environmental Protection Agency
CRM: Coastal Resources Management, CNMI
CZM: Coastal Zone Management Program, HI
DAWR: Division of Aquatic and Wildlife Resources, DOA, Guam
DEO: Division of Environmental Quality, CNMI
DFW: Division of Fish and Wildlife, CNMI
DLM: Department of Land Management, Guam
DLNR: Department of Land and Natural Resources, HI
DMWR: Department of Marine and Wildlife Resources, AS
DOA: Department of Agriculture, Guam

DOH: Department of Health
DPS:Department of Public Safety
EPA: Environmental Protection Agency
GCMP: Guam Coastal Management Program
GEPA: Guam Environmental Protection Agency
NPDES: National Pollution Discharge Elimination System
PNRS: Project Review and Notification System, AS
USCG: United States Coast Guard

9.3 Jurisdictional Issues

9.3.1 Introduction

This section reviews the complex issues surrounding marine boundaries in the Western Pacific Region. Delineation of current marine boundaries is discussed and specific areas of contention between various federal and state authorities are summarized.

9.3.2 Exclusive Economic Zone

The 1976 Fishery Conservation and Management Act (the Magnuson Act, and later, after amendments, the MSFCMA)[1] established U.S. jurisdiction from the seaward boundary of the territorial sea out to 200 miles for the purpose of managing fishery resources. Passage of the Magnuson Act was the first unilateral declaration of jurisdiction over a 200-mile zone by a major power. Presidential Proclamation 5030 of March 10, 1983, expanded Magnuson Act jurisdiction by establishing the U.S. exclusive economic zone; it declared, "to the extent permitted by international law ... sovereign rights for the purpose of exploring, exploiting, conserving and managing natural resources, both living and non-living, of the seabed and subsoil and the superjacent waters" in the 200-mile zone. The assertion of jurisdiction over the EEZ of the United States provided a basis for economic explomtion and exploitation, scientific research, and protection of the environment under the exclusive control of the U.S. government. Congress confirmed presidential designation of the EEZ in1986 amendments to the Magnuson Act. Under the Magnuson Act, fishery management authority in the EEZ off American Samoa, Guam, Hawaii, the Northern Mariana Islands, and other U.S. islands in the central and western Pacific is the responsibility of the Western Pacific Regional Fishery Management Council.

The EEZ is measured from the "baseline" of U.S. states and overseas territories and possessions out to 200 nautical miles. Under the Magnuson Act , the shoreward boundary of the EEZ is a line coterminous with the seaward boundary, baseline, of each "state." (As nsed elsewhere in this document, U.S. territories and possessions in the Western Pacific fall within the definition of state under the Magnuson Act (16 U.S.C. 1802, MSFCMA § 3 104-297)). In the case of the CNMI and the PRIAs, the EEZ extends to the shoreline (Beuttler 1995).

Seaward boundaries (territorial seas) for states are recognized as extending out to a distance of three miles from the ordinary low-water mark, as established by the Submerged Lands Act (SLA) of 1953.[2] The Territorial Submerged Lands Act (TSLA) of 1960 was enacted to convey to the

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[1]The MSFCMA was initially referred to as the Magnuson Fishery Conservation and Management Act, which was changed to the Magnuson-Stevens Fishery Conservation and Management Act by the 1996 amendment to the Act.

[2]Under the SLA, the term "boundaries" or the term "lands beneath navigable waters" is interpreted as extending from the coastline to three geographical miles into the Atlantic Ocean or the Pacific Ocean, or three marine leagues (9 miles) into the Gulf of Mexico.

governments of American Samoa, Guam and Virgin Islands the submerged lands from the mean high-tide line out to three geographic miles from their coast lines (Beuttler 1995).

The CNMI was part of the United Nations Trust Territory of the Pacific Islands (administered by the U.S.) until 1978 when its citizens chose to be become a U.S. commonwealth by plebiscite and it was agreed to by Congress. Although title of the emergent land was conveyed to the Commonwealth, the U.S. government withheld title to the submerged lands of the archipelago.[3] Submerged lands and underlying resources adjacent to CNMI remain owned by the federal government and subject to its management authority (Beuttler 1995).

In the PRIAs, for which there are no sovereign entities similar to states or territories, various federal agencies have jurisdictional authority. Authority is often established through statutes, Executive orders, and Presidential Proclamations, and marine boundaries are often unclear. For this reason, the extent to which an agency exercises its jurisdictional authority is subject to legal interpretation.

9.3.3 Territorial Seas

State of Hawaii

The State of Hawaii consists of all islands, together with their appurtenant reefs and territorial waters, which were included in the Territory of Hawaii under the Organic Act of 1900. Under the Admissions Act of 1959, Congress granted to Hawaii the status of statehood and all amenities of a state, which included the reversion of title and ownership of the lands beneath the navigable waters from the mean high-tide line seaward, out to a distance of three miles, as stated by the SLA of 1953. Congress excluded Palmyra Atoll Kingman Reef, and Johnston Atoll, including Sand Island, from the definition of the State of Hawaii in 1959. The federal government also retained 1,765 acres of emergent land in the NWHI, which had been set aside by Executive Order 1019 in 1909, establishing the Hawaiian Islands Reservation (HIR). The HIR was later renamed the Hawaiian Islands National Wildlife Refuge (HINWR) after it was transferred from the Department of Agriculture to the Department of Interior in 1939 (Yamase 1982).

Territories of Guam and American Samoa

Pursuant to the TSLA of 1960, the Territories of Guam and American Samoa own and have management responsibilities over the marine resources out to three "geographic" miles. In general, the authority of the MSFCMA begins at three nautical miles from the shoreline at Guam and American Samoa. There are, however, exceptions to the management authority in the Territories. For example, the federal government administers waters in National Wildlife Refuges and naval defense sea areas (NDSA)(see below).

[3] The Territorial Submerged Lands Act was enacted for CNMI on October 5, 1974 (Beuttler 1995). Congress approved the mutually negotiated "Covenant to Establish a Commonwealth of the Northern Marianas (CNMI in political union with the U.S.)". However, the Covenant was not fully implemented until 1986, pursuant to Presidential Proclamation number 5564, which terminated the trusteeship agreement (Beuttler 1995).

9.3.4 US Fish and Wildlife Refuges and Units

The USFWS has been given authority to manage a number of NWRs in the Western Pacific Region. The USFWS asserts the authority to manage marine resources and activities, including fishing activities within Refuge boundaries pursuant to the National Wildlife Refuge System Administration Act (NWRSAA) of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997, and other authorities (Gillman 2000). The USFWS asserts that NWRs are closed to all uses until they are specifically opened for such uses. They also claim that the USFWS is "solely" charged with making decisions whether to open NWRs for specific purposes that are compatible with the refuge's primary purposes and mission (Smith 2000a).

Executive Order 1019 reserved and set apart Laysan and Lisanski Islands, and Maro and Pearl and Hermes Reefs, excluding Midway, "as a preserve and breeding ground for native birds" to be administered by the Department of Agriculture. The HIR was transferred to the DOI in 1939 and in 1940 renamed the HINWR through Presidential Proclamation 2466, with control transferred to the USFWS. Within the HINWR, the USFWS asserts management authority over coral reef resources to a depth of 10 fm around all islands with the exception of Necker Island, where it asserts a 20 fm boundary. The USFWS acknowledges that all HINWR islands are part of the State of Hawaii, but asserts that the islands are federally owned and administered as a NWR by the USFWS (Smith 2000b; USFWS 1999b).

Kure Atoll was initially included in Executive Order 1019 in 1909, which establish the HIR. However, Kure Atoll was returned to the Territory of Hawaii in 1952 by Executive Order 10413 (Yamase 1982). Kure Atoll is the only State Wildlife Refuge in the NWHI and extends out three miles, to the State's seaward boundary (J. Feder pers. com.).

In the PRIAs, the USFWS—based on interpretation of Executive Order 7358—asserts that its refuge boundaries extend to the extent of the NDSA, which was administered by the Department of Defense before the transfer of surplus land to the USFWS. The USFWS currently manages seven wildlife refuges in the PRIAs: Palmyra Atoll, Kingman Reef, Jarvis, Baker, and Howland Islands, and Johnston and Midway Atolls (Smith 2000b).

On January 18, 2001, the USFWS, through Secretarial Order 3223, declared Kingman Reef and the surrounding submerged lands and waters as a National Wildlife Refuge out to a distance of 12 nautical miles. Additionally, Secretarial Order 3224 declared the waters of Palmyra Atoll as a National Wildlife Refuge out to a distance of 12 nautical miles. Tidal waters, submerged lands, and emergent lands were excluded from this order.[4]

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[4]A September 15 2000, legal opinion by Randolph Moss, Assistant Attorney General, U.S. Department of Justice, states that they are "unconvinced that the President has the authority to establish or expand a wildlife refuge within the U.S. territorial sea (12 miles) or the EEZ using presidential authority recognized in *Midwest Oil*." Because the National Wildlife Refuge System Administration Act does not itself contain a provision authorizing the President to withdraw land for a wildlife refuge, the DOI argues that the President could rely on the implied authority to reserve public lands recognized in *United States v. Midwest Oil Co.* 236, U.S. 459 (1915). The Federal Land Policy and

Midway Atoll NWR, established under Executive Order 13022 in 1996, is located in the NWHI and has a refuge boundary that is within a 22 by 22 mile quadrant surrounding the atoll (the exact boundary is disputed). The Navy established a Naval Air Facility at Midway in 1941. The USFWS established an overlay refuge in 1988 to manage the fish and wildlife on the Atoll. Through the Base Alignment Closure Act of 1990, as amended, the Naval Air Facility closed in 1993 and the property was transferred to the USFWS in 1996 (USFWS 1999a). The mission of the refuge is to protect and restore biological diversity and historic resources of Midway Atoll, while providing opportunities for compatible recreational activities, education and scientific research (Shallenberger 2000). Through a long-term cooperative agreement with a private company (Midway Phoenix Corp.), the refuge has been open to the public for marine recreation and education (Shallenberger 2000).

Johnston Atoll NWR is managed cooperatively with the Navy. The atoll was first established as a federal bird refuge on June 29, 1926, through Presidential Executive Order 4467 to be administered by the Department of Agriculture. In 1934, through Executive Order 6935, the atoll was placed under the jurisdiction of the Navy for administrative purposes and has been used as a military installation since 1939. In 1941 Executive Order 8682 designated Johnston and other Pacific atolls NDSAs. Since 1976, the USFWS, under agreement with the military, assists in management of fish and wildlife resources on the atoll. The USFWS manages a recreational fishing program in the NWR (Smith 2000b).

Administration of Jarvis, Howland, and Baker Islands were transferred from the Office of Territorial Affairs to the USFWS in 1936 to be run as NWRs. The USFWS asserts refuge boundaries out to three nautical miles, and it prohibits fishing and any type of unauthorized entry (Smith 2000b). The USFWS acknowledges the Council's fishery management authority, in coordination with the NMFS, within the "200-nautical mile EEZ" (Smith 2000b).

Rose Atoll NWR, located in American Samoa, was established through a cooperative agreement between the Territory of American Samoa and the USFWS in 1973. Presidential Proclamation 4347 exempted Rose Atoll from a general conveyance of submerged lands around American Samoa to the Territorial Government. The boundary of the refuge extends out to three miles around the atoll and is under the joint jurisdiction of the Departments of Commerce and Interior, in cooperation of the Territory of American Samoa. Here too, the USFWS acknowledges fishery management authority of the Council, in coordination with the NMFS, within the "200-nautical mile EEZ" (Smith 2000b).

Management Act (FLPMA) of 1976 repealed the Presidents authority, effective on and after approval of the Act, to make withdrawals and reservations resulting from acquiescence of Congress (*U.S. v. Midwest Oil Co.*). Moss continued by stating that they find "it likely that a court would find that §704(a) of the FLPMA prohibits the President from relying on the implied *Midwest Oil* authority to withdraw lands, regardless of where those lands are located." Also, he notes that "they do not think history makes it clear that the President may continue make *Midwest Oil* withdrawals in the territorial sea or EEZ following the enactment of the FLPMA."

In the Ritidian Unit of the Guam National Wildlife Refuge, USFWS has fee title, which includes 371 acres of emergent land and 401 acres of submerged lands down to the 100-foot bathymetric contour. The submerged lands adjacent to Ritidian were never transferred to the Territory of Guam pursuant to the TSLA by the Federal government. In 1993, the USFWS acquired the emergent land of the Ritidian Unit and the surrounding submerged lands from the Navy at no cost (Smith 2000b).

9.3.5 Department of Defense Naval Defensive Sea Areas

A number of Executive Orders have given administrative authority over territories and possessions to the Army, Navy, or the Air Force for use as military airfields and for weapons testing. In particular, Executive Order 8682 of 1941 authorizes the Secretary of the Navy to control entry into NDSAs around Palmyra, Johnston, and Midway Atolls, Wake Island, and Kingman Reef. The NDSA includes "territorial waters between the extreme high-water marks and the three-mile marine boundaries surrounding" the areas noted above. The objectives of the NDSA are to control entry into naval defensive sea areas; to provide for the protection of military installations; and to protect the physical security of, and ensure the full effectiveness of, bases, stations, facilities, and other installations (32 CFR Part 761). In addition, the Navy has joint administrative authority with the USFWS of Johnston Atoll and sole administrative authority over Kingman Reef. In 1996 Executive Order 13022 rescinded the Midway Atoll NDSA, and the Wake Island NDSA has also been suspended until further notice.

The Navy exerts jurisdiction over Farallon de Mendinilla in the CNMI and Ka'ula Rock in the main Hawaiian Islands, which are used as military bombing ranges. The Navy also exerts jurisdiction over a variety of waters offshore from military ports and air bases in Hawaii, PRIAs, Guam, and the CNMI.

9.3.6 Issues

Claims between "state" and federal resource management agencies involving marine boundaries over individual islands, reefs and atolls, continue to be unresolved in the Western Pacific Region. Tables 9.2 through 9.4 summarizes these various claims.

Northwestern Hawaiian Islands

The NWHI are primarily uninhabited atolls, islands, banks and shoals and are currently under multi-agency jurisdiction including the State of Hawaii, the U.S. Fish and Wildlife Service, the National Marine Fisheries Service and the Western Pacific Regional Fishery Management Council. Overlaps in jurisdiction and the varying regulatory authorities embodied in the management of this area can create numerous challenges and has led to contention regarding access and use for the region.

The State of Hawaii claims jurisdiction of all submerged lands from the shoreline to the extent of the State's jurisdiction in the NWHI. In accordance with the Hawaii Organic Act of April 30, 1900, c 339, 31 Stat 141 Section 2, and the Hawaii Admissions Act of March 18, 1959, Pub L 86-3, 73 Stat 4 Section 2, the Islands of the Hawaiian Archipelago, together with their appurtenant reefs and territorial waters, with the exception of Midway Atoll, are part of the territory of Hawaii and are managed by the State of Hawaii including all submerged lands and marine resources. The State of Hawaii, Department of Land and Natural Resources has stewardship responsibility for managing, administering and exercising control over the coastal and submerged lands, ocean waters and marine resources under State jurisdiction around each of the Northwestern Hawaiian Islands under Title 12, Chapter 171.3 Hawaii Revised Statutes. Under an Executive Order issued by President Truman, the emergent lands at Kure Atoll are also managed as a State Wildlife Refuge.

In addition to the State of Hawaii, the USFWS also claims jurisdiction over atolls, islands, banks and shoals in the NWHI. Following the Hawaii Admissions Act of March 18,1959, federal agencies were directed to inventory all lands for which there was a continuing need. The USFWS in 1963, reported a continuing need of 1,765 acres of land in the NWHI. This area consisted of only the emergent land in the NWHI as was claimed by the Department of Agriculture as the original boundary of the Hawaiian Island Refuge (Yamase 1982). More recently however, the USFWS claims that the HINWR includes 252,000 acres of submerged lands based on their interpretation of the terms "reef and inlets" contained in Executive Order 1019 (U.S. Fish and Wildlife Service 1986). Within the HINWR, the USFWS asserts management authority over coral reef resources to a depth of 10 fathoms around all islands with the exception of Necker Island where it asserts a 20 fathom boundary. The USFWS acknowledges that all HINWR islands are part of the State of Hawaii, but asserts that the islands are federally owned and administered as a NWR by the USFWS (U.S. Fish and Wildlife Service 1999, Smith 2000). Other jurisdictional disputes also involve East and Tern Islands in French Frigate Shoals. [5] [6]

Issues have developed from a series of directives from President Clinton that focused public attention on protection of U.S. coral reef ecosystems. Executive Order 13089, Coral Reef Protection, issued in June 1998, requires agencies to (1) identify actions that may affect U.S.

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[5] In 1940, Territorial Governor Poindexter, issued an Executive Order in concurrence with the President of the U.S. to set aside East Island, for the use and purpose of the United States as a radar station communication base under the DOC (Yamase 1982). Prior to statehood, the DOC returned East Island to the Territory of Hawaii (Yamase 1982). However, the DOI contends that East Island was part of the HIR as established by Executive Order 1019 in 1909 and later transferred to the DOI in 1939. Therefore, East Island remains included in the HINWR and under authority of DOI.

[6] Tern Island was expanded from 11 to 37 acres in 1942 by military dredging (Yamase 1982). In 1948, the Navy conveyed Tern Island to the Territory of Hawaii which then permitted the U.S. Coast Guard in 1952 to establish a navigational Loran station (Yamase 1982). In 1979, USCG operations were terminated and the Hawaii State Legislature adopted resolutions requesting the Governor to take immediate action to acquire and return Tern Island for use as a fishing base to support commercial activities (Yamase 1982). The Federal government asserts that it retains jurisdiction over Tern Island based on Executive Order 1019 and that the Navy did not have the authority to legally convey title to the Territory of Hawaii, therefore, the conveyance is void (Yamase 1982).

coral reef ecosystems; (2) use their programs and authorities to protect and enhance the condition of such ecosystems; and (3) ensure that any actions they authorize, fund, or carry out will not degrade the conditions of coral reef ecosystems. Agencies whose actions affect U.S. coral reef ecosystems must provide for implementation of measures needed to research, monitor, manage and restore affected ecosystems, including, but not limited to, measures reducing impacts from pollution, sedimentation, and fishing. The E.O. also established the U.S. Coral Reef Task Force composed of the heads of 11 federal agencies and the Governors of the seven states, territories, or commonwealths with responsibilities for coral reefs. In March 2000, the Task Force issued the National Action Plan to Conserve Coral Reefs, which presents a cohesive national strategy to implement EO 13089.

In May 2000, the President issued a Memorandum stating that it is time to implement the Coral Reef Task Force's recommendations in order to comprehensively protect the coral reef ecosystem of the NWHI.[7] The Memorandum directed the Secretaries of Interior and Commerce, in cooperation with the State of Hawaii, and in consultation with the WPRFMC, to develop recommendations for a new, coordinated management regime to increase protection for the NWHI coral reef ecosystem and provide for sustainable use. After considering their recommendations and comments received during the public visioning process on this initiative, President Clinton issued Executive Order 13178 on December 4, 2000, establishing the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve, pursuant to the National Marine Sanctuaries Amendments Act of 2000 (NMSA). The EO was revised and finalized by Executive Order 13196, issued January 18, 2001. Pursuant to Executive Order 13178 and the NMSA, NOAA is initiating the process to designate the Reserve as a national marine sanctuary (66 FR 5509, January 19, 2001). These actions to protect the coral reef ecosystem of the NWHI and provide for sustainable use of the area underscore the immediate need for a comprehensive assessment of the impacts of fishing activity on this ecosystem.

Because the final rules for the Reserve have not yet been published, and an EIS will be prepared for the marine sanctuary, a comprehensive analysis of the impact of the Reserve can not be completely assessed at this time. Preliminary potential impacts to the human environment are addressed in the environmental consequences section of the EIS. However, two alternatives considered by the EIS (3 and 4, described in Chapter 2) are consistent with the concept of establishing marine reserves in the NWHI, as described in the CRE-FMP.

The USFWS and the Council have different opinions about primary fishery management responsibilities in EEZ waters within NWR boundaries. Since the late 1960s, citing USFWS interim administrative policy and interpretation of Executive Order 1019, the USFWS ha

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[7] The President's directive coincided with Executive Order 13158, which requires federal agencies to establish a comprehensive national network of marine protected areas throughout U.S. marine waters. The Executive Order calls for expansion of the nation's MPA system to include examples of all types of marine ecosystems. According to the executive order, a MPA means any area of the marine environment that has been reserved by federal, state, territorial, tribal, or local laws or has regulations to provide lasting protection for part or all of the natural and cultural resources therein.

asserted that they would enforce refuge regulations within the "de facto" boundaries of the HINWR, which include all emergent land and their surrounding waters out to a depth of 10 fm for all islands and later 20 fm around Necker Island (Smith 2000b). Under the authority of the MSFCMA, the Council promulgated fishery regulations within federal waters that correspond with USFWS refuge boundaries of 0-10 fathoms within NWHI federal waters, except at Necker where it is 20 fm (WPRFMC 1986). The Council recognizes state waters in the NWHI from 0-3 miles and asserts management authority over fishery resources in all federal waters (3-200 miles), except at Midway where it asserts authority from 0-200 miles (Gillman 2000).

Main Hawaiian Islands

The State of Hawaii claims jurisdiction beyond its territorial seas of 0-3 nautical miles by claiming archipelagic status over channel waters between the main Hawaiian islands (MacDonald and Mitsuyasu, 2000). The Federal Government does not recognize the State's claim of archipelagic jurisdiction, but interprets the State's seaward authority to stop at three nautical miles from the baseline (Feder 1997; MacDonald and Mitsuyasu 2000). The authority of the Magnuson Act therefore, begins at 3 miles from the shoreline around all main Hawaiian islands in the State of Hawaii. However the State of Hawaii does not agree with this interpretation.

American Samoa

The legal relationship between the Territory of American and the U.S. with regard to fisheries management is unresolved due to a discrepancy in the wording of the deeds of cession signed by the chiefs of what is now American Samoa and the law enacted by Congress which extended U.S. sovereignty over the eastern Samoa islands in 1900. Language contained in the deeds of cession signed by the chiefs of Tutuila district state that they ceded, transferred and yielded up "all these islands of Tutuila and Aunu'u and all other islands, rocks, reefs, foreshores and waters lying between the 13th degree and the 15th degree of south latitude and between the 171st degree and 167th degree of west longitude...." Likewise, the chiefs of the Manu'a Islands also ceded to the U.S. "the whole of eastern portion of the Samoan Islands lying east of 171 degrees west of Greenwich and known as Tau, Olosega, Ofu and Rose Islands, and all other , the waters and property adjacent thereto...."

In contrast, Title 48 United States Code, Section 661, by which Congress accepted, confirmed and ratified these cessions by the chiefs, refer only to the islands, and not to the reefs, foreshores and waters or property adjacent lying between the referenced coordinates. Whether Congress deliberately or unintentionally failed to extend sovereignty over reef and ocean waters transferred by the chiefs of Tutuila and Manu'a is uncertain.

A central premise for ceding eastern Samoa to the U.S. was to preserve the rights and property of the islands' inhabitants. Additionally, American Samoa's constitution makes it government policy to protect persons of Samoan ancestry from the alienation of their lands and the destruction of the Samoan way of life and language and to encourage business enterprise among persons of Samoan ancestry. Therefore, any federal actions within the EEZ waters of American Samoa that would stymie these rights, including restriction on fishing, may be perceived to be contrary to American Samoa's constitution.

CNMI

Currently, the EEZ includes all waters surrounding CNMI from shore out to 200 miles. However, through the legal system CNMI is pursuing a claim that the Commonwealth is vested authority out to 12 miles from the archipelagic baseline. The Council, for the purposes of fisheries management, defers management in waters 0-3 nm to the CNMI while managing fishery resources 3-200 nm.

Guam

The Territory of Guam questions the legality of the transference of the Ritidian Unit from the Navy to the USFWS. In its property inventory to the General Services Administration the Navy listed the Ritidian Unit as excess lands, not of continual need and available for reversion to the Territory. The area represents ancestral lands of Chamorro families. Therefore, the Territory asserts that the fee title should not have been transferred to the USFWS (J. Guthertz pers. comm.).

In 1976, the Federal Fishery Conservation Zone (later known as the EEZ) was extended to 200 nmi around Guam which gave the federal government authority to manage marine resources within the EEZ. In 1980, the Guam Legislature passed and the Governor signed legislation providing for a 200 mile territorial limit for Guam (DOI 1993). The purpose of this legislation, was to allow the government of Guam to sell foreign fishing rights within Guam's EEZ. In 1996, the Magnuson-Stevens Act authorized the Secretary of State to negotiate foreign fishing agreements for fishing within the EEZ at the request of the Governor of Guam. However, in addition to the "state" waters around Guam, the government has also expressed a continuing interest in obtaining greater authority in managing the EEZ surrounding Guam.

PRIAs

In the PRIAs, primary jurisdiction over nearshore fisheries is an ongoing issue between the Department of the Interior and the Department of Commerce. Management authority is currently unresolved because no clear baseline boundary has been designated from which the seaward boundary of the PRIAs are measured. Seaward boundaries are not clearly defined because some islands in the PRIAs do not appear to have a seaward boundary as defined by U.S. law (i.e., MSFCMA) (Beuttler 1995). For this reason, jurisdictional boundaries have been claimed by federal agencies in terms of fathoms, miles, or the territorial sea. Furthermore, it is recognized that various Executive orders have given administrative authority of the PRIAs to either the DOD or DOI. However, Executive orders themselves do not convey title of submerged lands, unless specifically stated. In any case, based on tentative interpretation by the NOAA legal counsel, MSFCMA authority applies to all marine waters around federally owned possessions (i.e., PRIAs), including marine resources within bays, inlets, and other marine waters to the shoreline (Beuttler 1995).

Additionally, because the NWRSAA does not explicitly authorize the President to withdraw land for a wildlife refuge, the DOI argues that the President could rely on the implied authority to reserve public lands recognized in _United States v. Midwest Oil Co._ 236, U.S. 459 (1915). However, since the Federal Land and Policy Act of 1976 repealed the President's authority, effective on and after approval of the Act, to make withdrawals and reservations resulting from the acquiescence of Congress (_U.S. v. Midwest Oil Co_.), it appears that since 1976 the President has not had the authority to establish or expand a wildlife refuge within the U.S. territorial sea (12 miles) or the EEZ using presidential authority recognized in _Midwest Oil_ (Moss 2000). This could call into question asserted marine boundaries of any NWRs established after enactment of the FLPMA.

Table 9.2: Marine boundary claims by various jurisdictions in the Western Pacific Region. Note: a dashed line (-) indicates no jurisdiction.

Island or Area	State/Commonwealth/ Territory	Department of Commerce	Department of the Interior and Department of Defense (as noted)
PRIAs			
Howland I.	-	WPRFMC/NMFS 0-200 nm	USFWS: 0-3 nm
Baker I.	-	WPRFMC/NMFS 0-200 nm	USFWS: 0-3 nm
Jarvis I.	-	WPRFMC/NMFS 0-200 nm	USFWS: 0-3 nm
Johnston I.*	-	WPRFMC/NMFS 0-200 nm	USFWS/US Navy: 0-3 nm
Kingman R.	-	WPRFMC/NMFS 0-200 nm	USFWS: 0-12 nm[1]
Palmyra A.*	-	WPRFMC/NMFS 0-200 nm	USFWS: 0-12 nm[2]
Wake I.***	-	WPRFMC/NMFS 0-200 nm	DOI/USArmy: 0-3 nm
Midway A.*	-	WPRFMC/NMFS 0-200 nm	USFWS: 22x22 nm quad
Hawaii			
MHI	Hawaii: 0-3 nm	WPRFMC/NMFS 3-200 nm	
Nihoa I.	Hawaii: 0-3 nm	WPRFMC/NMFS 3-200 nm	USFWS: 0-10 fm**
Necker I.	Hawaii: 0-3 nm	WPRFMC/NMFS 3-200 nm	USFWS: 0-20 fm**

[1] Boundary formerly 0-3 miles under the jurisdiction of the U.S. Navy. Secretarial Order 3223 extended Department of the Interior's jurisdiction to 12 nm.
[2] Secretarial Order 3224 (Palmyra Atoll) extended USFWS administrative authority from 3 to 12 nm.
*At Palymyra, Johnston, and Midway special permit fishing is only for recreational and on-island consumption: at Midway, the northern half of the atoll would be a no-take MPA and the southern half a low-use MPA.
**USFWS boundary begins at the shoreline; legally defined outer boundary of the Hawaiian Islands NWR is unresolved.
*** As of 1962, the jurisdiction over Wake Island has been vested with the Department of the Interior. Since 1994, the Department of the Army has maintained administrative use of Wake Island.

Table 9.2 (cont.)

Island or Area	State/Territory/Commonwealth	Department of Commerce	Department of the Interior and Department of Defense (as noted)
FFS	Hawaii: 0-3 nm	WPRFMC/NMFS 3-200 nm	USFWS: 0-10 fm**
Gardner Pinnacles	Hawaii: 0-3 nm	WPRFMC/NMFS 3-200 nm	USFWS: 0-10 fm**
Maro R.	Hawaii: 0-3 nm	WPRFMC/NMFS 3-200 nm	USFWS: 0-10 fm**
Laysan I.	Hawaii: 0-3 nm	WPRFMC/NMFS 3-200 nm	USFWS: 0-10 fm**
Lisanski I.	Hawaii: 0-3 nm	WPRFMC/NMFS 3-200 nm	USFWS: 0-10 fm**
Pearl and Hermes R.	Hawaii: 0-3 nm	WPRFMC/NMFS 3-200 nm	USFWS: 0-10 fm**
Kure A.	Hawaii: 0-3 nm	WPRFMC/NMFS 3-200 nm	-
Guam	Guam: 0-3 nm	WPRFMC/NMFS 3-200 nm	
Ritedan Unit			USFWS: 100 ft. isobath
CNMI	CNMI: 0-3 nm***	WPRFMC/NMFS 3-200 nm	
American Samoa	American Samoa: 0-3 nm	WPRFMC/NMFS 3-200 nm	
Rose Atoll		WPRFMC/NMFS 0-200 nm	USFWS: 0-3 nm[3]

[3]At Rose Atoll, the Department of the Interior/U.S. Fish and Wildlife Service has a cooperative agreement with the Territory of American Samoa to manage the atoll as a national wildlife refuge, and shares jurisdiction with the Department of Commerce.
**USFWS boundary begins at the shoreline; legally defined outer boundary of the Hawaiian Islands NWR is unresolved.
***The CRE-FMP proposes to defer management in 0-3 nm to the CNMI while managing fisheries 3-200 nm.

Table 9.3 : Comparison of No-take and Low-use Marine Protected Areas of the Coral Reef Ecosystem FMP with the NWHI Reserve Preservation Areas (RPAs), U.S. Fish and Wildlife Service and State/Commonwealth/Territory (a dash indicates no jurisdiction).

Island or Area	CRE-FMP	NWHI Reserve	USFWS	State/Commonwealth/Territory
PRIAs				
Howland I.	No-take zone 0-50 fathoms.	–	Howland Island NWR 0 to 3 nm; No fishing allowed.	–
Baker I.	No-take zone 0-50 fathoms.	–	Baker Island NWR 0 to 3 nm; No fishing allowed.	–
Jarvis I.	No-take zone 0-50 fathoms.	–	Jarvis Island NWR 0 to 3 nm; No fishing allowed.	–
Johnston I.	Low-use special permit zone 0-50 fathoms.	–	Johnston Atoll NWR/Navy (Overlay Refuge) 0 to 3 nm; Recreational fishing program.	–
Kingman R.	No-take zone 0-50 fathoms.	–	Kingman Reef NWR 0 to 12 nm; No fishing allowed.	–
Palmyra A.	Low-use special permit zone 0-50 fathoms.	–	Palmyra Atoll NWR 0 to 12 nm; Recreational fishing allowed.	–
Wake I.	Low-use special permit zone 0-50 fathoms.	–	DOI/US Army to 3 nm; Fishing allowed.	–
Midway A.	No-take zone 0-50 fathoms around northern half of Midway. Low-use special permit zone around southern half of Midway.	–	Midway Atoll NWR between 28°5' and 28°25'; 177°10' and 177°30'; following fishing allowed within Refuge boundaries: 1 lobster/person/day; pelagic rec and charter fishing allowed; no bottomfishing; catch and release ulua fishing.	–

Table 9.3 (cont)

Island or Area	CRE-FMP	NWHI Reserve	USFWS	State/Commonwealth/Territory
Hawaii				
MHI	Special permits for "potentially harvested" species.	–	10 wildlife refuges (none with marine boundaries)	State of Hawaii bottomfish area closures (20 closures across MHI): 10 Marine Life Conservation Districts and 14 Marine Fishery Management Areas in MHI (rules and regulations vary with location)
Nihoa I.	No-take MPA in federal waters shallower than 10 fathoms. Low-use special permit zone 10-50 fathoms around Nihoa and nearby banks.	RPA extends from the seaward boundary of Hawaii State waters (3nm) out to a mean depth of 100 fathoms. Bottomfish and recreational trolling for pelagics permitted seaward of 25 fathoms.	Hawaiian Islands NWR (HINWR) 0 to 10 fathoms. No fishing allowed.	State of Hawaii proposed NWHI Marine Fisheries Management Area (NWHI FMA) 0-3 miles.
Misc. banks around Nihoa and Necker (8)	No-take MPA in federal waters shallower than 10 fathoms. Low-use special permit zone 10-50 fathoms.	no current restrictions	HINWR 0 to 10 fathoms. No fishing allowed.	–
Necker	No-take MPA in federal waters shallower than 10 fathoms. Low-use special permit zone 10-50 fathoms.	RPA extends from the seaward boundary of Hawaii State waters (3nm) out to a mean depth of 100 fathoms. Bottomfish and recreational trolling for pelagics permitted seaward of 25 fathoms.	HINWR 0 to 20 fathoms. No fishing allowed.	State of Hawaii proposed NWHI Marine Fisheries Management Area (NWHI FMA) 0-3 miles.
Unnamed bank east of French Frigate Shoal	No-take MPA in federal waters shallower than 10 fathoms. Low-use special permit zone 10-50 fathoms.	RPA to 12 nm from geographic center. No fishing allowed.	HINWR 0 to 10 fathoms. No fishing allowed.	–

Table 9.3 (cont)

Island or Area	CRE-FMP	NWHI Reserve	USFWS	State/Commonwealth/Territory
FFS	No-take zone 0-50 fathoms.	RPA extends from the seaward boundary of Hawaii State waters (3nm) out to a mean depth of 100 fathoms. No fishing allowed.	HINWR 0 to 10 fathoms. No fishing allowed.	State of Hawaii proposed NWHI Marine Fisheries Management Area (NWHI FMA) 0-3 miles.
Brooks Banks (2)	No-take MPA in federal waters shallower than 10 fathoms. Low-use special permit zone 10-50 fathoms around three banks southeast of St. Rogatien including two Brooks Banks and one bank NW of St. Rogatien.	RPA to 12 nm from geographic center of southeast Brooks Bank, but not closer than 3 nm to the next bank west (northwest Brooks Bank). No fishing allowed.	HINWR 0 to 10 fathoms. No fishing allowed.	–
St. Rogatien Bank	No-take MPA in federal waters shallower than 10 fathoms. Low-use special permit zone 10-50 fathoms.	RPA to 12 nm from geographic center, but not closer than 3 nm to the next bank east. Bottomfish and recreational trolling for pelagics permitted.	HINWR 0 to 10 fathoms. No fishing allowed.	–
Unnamed bank between Gardner Pinnacles and St. Rogatien Bank	No-take MPA in federal waters shallower than 10 fathoms. Low-use special permit zone 10-50 fathoms.	RPA to 12 nm from geographic center. Bottomfish and recreational trolling for pelagics allowed for 5 years from order.	HINWR 0 to 10 fathoms. No fishing allowed.	–
Gardner Pinnacles	No-take MPA in federal waters shallower than 10 fathoms. Low-use special permit zone 10-50 fathoms.	RPA extends from the seaward boundary of Hawaii State waters (3nm) out to a mean depth of 100 fathoms. Bottomfish and recreational trolling for pelagics permitted seaward of 25 fathoms.	HINWR 0 to 10 fathoms. No fishing allowed.	State of Hawaii proposed NWHI Marine Fisheries Management Area (NWHI FMA) 0-3 miles.

Table 9.3 (cont)

Island or Area	CRE-FMP	NWHI Reserve	USFWS	State/Commonwealth/Territory
Raita Bank	No-take MPA in federal waters shallower than 10 fathoms. Low-use special permit zone 10-50 fathoms.	RPA to 12 nm from geographic center. Bottomfish and recreational trolling for pelagics allowed for 5 years from order.	HINWR 0 to 10 fathoms. No fishing allowed.	–
Maro R.	No-take MPA in federal waters shallower than 10 fathoms. Low-use special permit zone 10-50 fathoms.	RPA extends from the seaward boundary of Hawaii State waters (3nm) out to a mean depth of 100 fathoms. Bottomfish and recreational trolling for pelagics permitted seaward of 25 fathoms.	HINWR 0 to 10 fathoms. No fishing allowed.	State of Hawaii proposed NWHI Marine Fisheries Management Area (NWHI FMA) 0-3 miles.
Laysan I.	No-take zone 0-50 fathoms. (Crustaceans FMP: Lobster fishing prohibited to 20 nm from geographic center)	RPA extends from the seaward boundary of Hawaii State waters (3nm) out to a mean depth of 100 fathoms. Bottomfish and recreational trolling for pelagics permitted seaward of 50 fathoms.	HINWR 0 to 10 fathoms. No fishing allowed.	State of Hawaii proposed NWHI Marine Fisheries Management Area (NWHI FMA) 0-3 miles.
Misc banks near (SW of) Laysan (4)	No-take MPA in federal waters shallower than 10 fathoms. Low-use special permit zone 10-50 fathoms.	No current restrictions.	HINWR 0 to 10 fathoms. No fishing allowed.	–
Pioneer Bank	No-take MPA in federal waters shallower than 10 fathoms. Low-use special permit zone 10-50 fathoms.	Preservation Area to 12 nm from geographic center. Bottomfish and recreational trolling for pelagics permitted.	HINWR 0 to 10 fathoms. No fishing allowed.	–

Table 9.3 (cont)

Island or Area	CRE-FMP	NWHI Reserve	USFWS	State/Commonwealth/Territory
Lisanski I.	No-fake MPA in federal waters shallower than 10 fathoms. Low-use special permit zone 10-50 fathoms.	RPA extends from the seaward boundary of Hawaii State waters (3nm) out to a mean depth of 100 fathoms. Bottomfish and recreational trolling for pelagics permitted seaward of 25 fathoms.	HINWR 0 to 10 fathoms. No fishing allowed.	State of Hawaii proposed NWHI Marine Fisheries Management Area (NWHI FMA) 0-3 miles.
Misc banks near (W of) Lisianski (2)	No-take MPA in federal waters shallower than 10 fathoms. Low-use special permit zone 10-50 fathoms.	No current restrictions.	HINWR 0 to 10 fathoms. No fishing allowed.	–
Pearl and Hermes R.	No-take MPA in federal waters shallower than 10 fathoms. Low-use special permit zone 10-50 fathoms.	RPA extends from the seaward boundary of Hawaii State waters (3nm) out to a mean depth of 100 fathoms. No fishing allowed.	HINWR 0 to 10 fathoms. No fishing allowed.	State of Hawaii proposed NWHI Marine Fisheries Management Area (NWHI FMA) 0-3 miles.
Misc. banks in the vicinity of Kure, Midway and Pearl and Hermes (4)	No-take MPA in federal waters shallower than 10 fathoms. Low-use special permit zone 10-50 fathoms.	No current restrictions.	HINWR 0 to 10 fathoms. No fishing allowed.	–
Kure A.	No-take MPA in federal waters shallower than 10 fathoms. Low-use special permit zone 10-50 fathoms.	RPA extends from the seaward boundary of Hawaii State waters (3nm) out to a mean depth of 100 fathoms. No fishing allowed.	–	State of Hawaii Wildlife Refuge shoreline to 3 nm. Fishing not prohibited.

Table 9.3 (cont)

Island or Area	CRE-FMP	NWHI Reserve	USFWS	State/Commonwealth/Territory
American Samoa				
Rose Atoll	No-take zone 0-50 fathoms.	–	Rose Atoll NWR 0 to 3 nm; no fishing allowed.	DOI has a cooperative agreement with the Territory of American Samoa to manage Rose Atoll as a national wildlife refuge and shares jurisdiction with DOC
Guam				
Riladan Unit	–	–	Rifidian Unit0 to 100 foot contour. Recreational fishing allowed	–
CNMI	–	–	–	–

Table 9.4: Comparison of Resource Management Authorities and Fishery Management Measures for Coral Reef Ecosystems in Federal Waters of the Western Pacific Region.

NIHOA, NECKER, GARDNER, MARO, LISIANSKI (summary)			
Authority Jurisdiction	**Subareas**	**Permitted activities**	**Special restrictions**
NWHI Coral Reef Ecosystem Reserve (Reserve) (Federal waters to 50 miles around all islands)	No fishing portion of RPA: Federal waters 0-25 fm.	No fishing.	None.
	Bottomfishing/trolling portion of RPA: Federal waters 25-100 fm.	Limited commercial bottomfishing by permit holders and limited commercial and recreational pelagic trolling (all subject to fishing caps based on catch history).	No anchoring in areas where mooring is available; no discharging of any material except cooling water or engine exhaust.
	Other Reserve waters: Federal waters 100 fm-50 miles.	Limited commercial and recreational fishing (all subject to fishing caps based on catch history).	No increase in level of effort or take; no change in gear type or species targeted.
CRE FMP Federal waters to 200 miles	No-take MPA: Federal waters 0-10 fm.	No fishing.	Insurance requirement.
	Low-use MPA: Federal waters 10-50 fm.	Lobster, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders.	CRE special permit needed to target <u>any</u> coral reef ecosystem resources, insurance requirement.
	Non-MPA: Federal waters 50 fm-200 miles.	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders.	CRE special permit needed to target potentially harvested coral reef taxa.
USFWS Federal waters to 10 fathoms [0-20 at Necker]	Refuge: Federal waters 0-10 fathoms [0-20 at Necker].	Activities consistent with Refuge mission- no commercial fishing.	USFWS special use permit required to enter.

Distinguishing Characteristics (this is the most common scenario):

<u>NWHI Reserve</u>

Reserve Preservation Area (RPA)
No fishing RPA 0-25 fm
Fishing RPA 25-100 fm
Recreational fishing 100 fm - 50 miles

<u>CRE FMP</u>

Marine Protected Area (MPA)
No-take MPA 0-10 fm
Low-take MPA 10-50 fm
Non-MPA 50 fm-200 miles

<u>USFWS</u>

Refuge 0-10 fm, 0-20 fm at Necker (no fishing)

NIHOA, NECKER, GARDNER, MARO, LISIANSKI (details)			
Federal waters	**NWHI Reserve**	**CRE FMP**	**USFWS**
0-10 fathoms	No fishing (RPA).	No fishing, insurance requirement (No-take MPA).	No fishing (Refuge). Beyond 10 fathoms, no current restrictions.
10-25 fathoms	No fishing (RPA).	Lobster, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders, CRE special permit needed to target <u>any</u> coral reef ecosystem resources, insurance requirement (Low-use MPA).	No fishing 0-20 fm at Necker (Refuge). Beyond 20 fm no current restrictions.
25-50 fathoms	Limited bottomfish and pelagic trolling by current permit holders; limited recreational trolling for pelagic (RPA).	Lobster, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders, CRE special permit needed to target <u>any</u> coral reef ecosystem resources, insurance requirement (Low-use MPA).	No current restrictions.
50-100 fathoms	Limited bottomfish and pelagic trolling by current permit holders; limited recreational trolling for pelagic (RPA).	Lobster, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa (Non-MPA).	No current restrictions.
100 fm-50 miles	Recreational fishing commercial fishing by bottomfish permit holders; all pelagic trollers (Reserve).	Lobster, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa (Non-MPA).	No current restrictions.
50 - 200 miles	Outside of Reserve.	Lobster, bottomfish, precious corals, troll/handline and longline pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa (Non-MPA).	No current restrictions.

S.E. BROOKS BANK, 1ST BANK EAST OF FFS, ST. ROGATIEN, 1ST BANK WEST OF ST. ROGATIEN*, RAITA*, PIONEER (summary)			
Authority Jurisdiction	**Subareas**	**Permitted activities**	**Special restrictions**
NWHI Coral Reef Ecosystem Reserve (Federal waters to 50 miles around all islands)	Bottomfishing/trolling RPA: Federal waters 0 - 12 miles. (All fishing is prohibited within 12 miles around S.E. Brooks Banks, and the 1st bank west of FFS).	Limited commercial bottomfishing by permit holders and limited commercial and recreational pelagic trolling (all subject to fishing caps based on catch history).	No anchoring in areas where mooring is available; no discharging of any material except cooling water or engine exhaust.
	Other Reserve waters: Federal waters 12-50 miles.	Limited commercial and recreational fishing (all subject to fishing caps based on catch history).	No increase in level of effort or take; no change in gear type or species targeted.
CRE FMP Federal waters to 200 miles	No-take MPA: Federal waters 0-10 fm.	No fishing.	Insurance requirement.
	Low-use MPA: Federal waters 10-50 fm.	Lobster, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders.	CRE special permit needed to target <u>any</u> coral reef ecosystem resources, insurance requirement.
	Non-MPA: Federal waters 50 fm-200 miles.	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders.	CRE special permit needed to target potentially harvested coral reef taxa.
USFWS Federal waters to 10 fathoms	Refuge: Federal waters 0-10 fm.	Activities consistent with Refuge mission-no commercial fishing.	USFWS special use permit required to enter.

Distinguishing characteristics:

NWHI Reserve

(1) The NWHI EO fishing RPA extends from 0-12 miles;
(2) All fishing is prohibited within 12 miles around S.E. Brooks Banks, and the 1st bank east of FFS.

* Under the NWHI EO, the fishing RPAs at these banks will be reviewed after five years.

S.E. BROOKS BANK, 1ST BANK EAST OF FFS, ST. ROGATIEN, 1ST BANK WEST OF ST. ROGATIEN, RAITA, PIONEER (details)			
Federal waters	**NWHI Reserve**	**CRE FMP**	**USFWS**
0-10 fathoms	Limited bottomfish and pelagic trolling by current permit holders; limited recreational trolling for pelagic (RPA).	No fishing, insurance requirement (No-take MPA).	No fishing (Refuge).
10 - 50 fathoms	Limited bottomfish and pelagic trolling by current permit holders; limited recreational trolling for pelagic (RPA).	Lobster, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders, CRE special permit needed to target <u>any</u> coral reef ecosystem resources, insurance requirement (Low-use MPA).	No current restrictions beyond 10 fm.
50 fm-12 miles	Limited bottomfish and pelagic trolling by current permit holders; limited recreational trolling for pelagic (RPA).	Lobster, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa (Non-MPA).	No current restrictions.
12 - 50 miles	Recreational fishing, commercial fishing by bottomfish permit holders, and all pelagic trollers (Reserve).	Lobster, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa (Non-MPA).	No current restrictions.
50 - 200 miles	Outside of Reserve.	Lobster, bottomfish, precious corals, troll/handline and longline pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa (Non-MPA).	No current restrictions.

Note: All fishing is prohibited within 12 miles around S.E. Brooks Banks. and the 1st bank east of FFS.

LAYSAN (summary)			
Authority Jurisdiction	**Subareas**	**Permitted activities**	**Special restrictions**
NWHI Coral Reef Ecosystem Reserve (Federal waters to 50 miles around all islands)	No fishing portion of RPA: Federal waters 0-50 fm.	No fishing.	None.
	Bottomfishing/trolling portion of RPA: Federal waters 50-100 fm.	Limited commercial bottomfishing by permit holders and limited commercial and recreational pelagic trolling (all subject to fishing caps based on catch history).	No anchoring in areas where mooring is available; no discharging of any material except cooling water or engine exhaust.
	Other Reserve waters: Federal waters 100 fm-50 miles.	Limited commercial and recreational fishing (all subject to fishing caps based on catch history).	No increase in level of effort or take; no change in gear type or species targeted.
CRE FMP Federal waters to 200 miles	No-take MPA: Federal waters 0-50 fm.	No fishing.	Insurance requirement.
	Non-MPA Federal waters 50 fm-20 miles.	Bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders (no lobster fishing).	CRE special permit needed to target potentially harvested coral reef taxa.
	Non-MPA: Federal waters 50 fm-50 miles.	Lobster*, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders.	CRE special permit needed to target potentially harvested coral reef taxa.
	Non-MPA: Federal waters 50-200 miles.	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders.	CRE special permit needed to target potentially harvested coral reef taxa.
USFWS Federal waters to10 fathoms	Refuge: Federal waters 0-10 fm.	Activities consistent with Refuge mission- no commercial fishing.	USFWS special use permit required to enter.

Distinguishing characteristics:

CRE FMP

(1) no-take MPA from 0-50 fathoms.

(2) *Crustacean FMP prohibits lobster fishing from 0- 20 miles.

USFWS

(1) assert HINWR also includes State waters 0-10 fm.

LAYSAN (details)			
Federal waters	NWHI Reserve	CRE FMP	USFWS
0-10 fathoms	No fishing (RPA).	No fishing, insurance requirement (No-take MPA).	No fishing (Refuge).
10-50 fathoms	No fishing (RPA).	No fishing, insurance requirement (No-take MPA).	No current restrictions beyond 10 fm.
50-100 fathoms	Limited bottomfish and pelagic trolling by current permit holders; limited recreational trolling for pelagic (RPA).	Bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa (Non-MPA).	No current restrictions.
100 fm-50 miles	Recreational fishing, commercial fishing by bottomfish permit holders, and all pelagic trollers (Reserve).	Lobster*, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa (Non-MPA).	No current restrictions.
50 - 200 miles	Outside of Reserve.	Lobster, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa (Non-MPA).	No current restrictions.

*Crustacean FMP prohibits lobster fishing from 0- 20 miles at Laysan.

FRENCH FRIGATE SHOALS (summary)			
Authority Jurisdiction	**Subareas**	**Permitted activities**	**Special restrictions**
NWHI Coral Reef Ecosystem Reserve (Federal waters to 50 miles)	Entire no fishing RPAs: Federal waters 0-100 fm.	No fishing.	None.
	Other Reserve Areas: Federal waters 100 fm to 50 miles.	Limited commercial bottomfishing by permit holders and limited commercial and recreational pelagic trolling (all subject to fishing caps based on catch history).	No anchoring in areas where mooring is available; no discharging of any material except cooling water or engine exhaust.
CRE FMP Federal waters to 200 miles	No-take MPA: Federal waters 0-50 fm.	Limited commercial and recreational fishing (all subject to fishing caps based on catch history).	No increase in level of effort or take; no change in gear type or species targeted.
	Non-MPA: Federal waters 50 fm-50 miles.	Lobster, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders.	CRE special permit needed to target potantially harvested coral reef taxa.
	Non-MPA: Federal waters 50-200 miles.	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders.	CRE special permit needed to target potentially harvested coral reef taxa.
USFWS Federal waters to 10 fathoms	Refuge: Federal waters 0-10 fm.	Activities consistent with Refuge mission-no commercial fishing.	USFWS special use permit required to enter.

Distinguishing characteristics:

CRE FMP **NWHI Reserve**

(1) No-take MPA from 0-50 fathoms. (2) No fishing RPAs extend from 0-100 fathoms.

FRENCH FRIGATE SHOALS (details)			
Federal waters	**NWHI Reserve**	**CRE FMP**	**USFWS**
0-10 fathoms	No fishing (RPA).	No fishing, insurance requirement (No-take MPA).	No fishing (Refuge).
10-50 fathoms	No fishing (RPA).	No fishing, insurance requirement (No-take MPA).	No current restrictions beyond 10 fm.
50-100 fathoms	No fishing (RPA).	Lobster, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa (Non-MPA).	No current restrictions.
100 fm-50 miles	Recreational fishing, commercial fishing by bottomfish permit holders, and all pelagic trollers (Reserve).	Lobster, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa (Non-MPA).	No current restrictions.
50 - 200 miles	Outside of Reserve.	Lobster, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa (Non-MPA).	No current restrictions.

PEARL & HERMES REEF (summary)			
Authority Jurisdiction	**Subareas**	**Permitted activities**	**Special restrictions**
NWHI Coral Reef Ecosystem Reserve (Federal waters to 50 miles)	Entire no fishing RPA: Federal waters 0-100 fm.	No fishing.	None.
	Other Reserve waters: Federal waters 100 fm-50 miles.	Limited commercial and recreational fishing (all subject to fishing caps based on catch history).	No increase in level of effort or take; no change in gear type or species targeted.
CRE FMP Federal waters to 200 miles	No-take MPA: Federal waters 0-10 fm.	No fishing.	Insurance requirement.
	Low-use MPA: Federal waters 10-50 fm.	Lobster, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders.	CRE special permit needed to target <u>any</u> coral reef ecosystem resources, insurance requirement.
	Non-MPA: Federal waters 50 fm-50 miles.	Lobster, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders.	CRE special permit needed to target potentially harvested coral reef taxa.
	Non-MPA: Federal waters 50-200 miles.	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders.	CRE special permit needed to target potentially harvested coral reef taxa.
USFWS Federal waters to 10 fathoms	Refuge: Federal waters 0-10 fm.	Activities consistent with Refuge mission-no commercial fishing.	USFWS special use permit required to enter.

Distinguishing characteristics:

<u>NWHI Reserve</u>

(1) No fishing RPAs extend from 0-100 fathoms.

PEARL & HERMES REEF (details)			
Federal waters	**NWHI Reserve**	**CRE FMP**	**USFWS**
0-10 fathoms	No fishing (RPA).	No fishing, insurance requirement (No-take MPA).	No fishing (Refuge).
10-50 fathoms	No fishing (RPA).	Lobster, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders, CRE special permit needed to target any coral reef ecosystem resources, insurance requirement (Low-use MPA).	No current restrictions beyond 10 fathoms.
50-100 fathoms	No fishing (RPA).	Lobster, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa , insurance requirement (Non-MPA).	No current restrictions.
100 fm-50 miles	Recreational fishing, commercial fishing by bottomfish permit holders, and all pelagic trollers (Reserve).	Lobster, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa (Non-MPA).	No current restrictions.
50 - 200 miles	Outside of Reserve.	Lobster, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa (Non-MPA).	No current restrictions.

MIDWAY (summary)			
Authority Jurisdiction	**Subareas**	**Permitted activities**	**Special restrictions**
NWHI Coral Reef Ecosystem Reserve (0-50 miles around all islands)	Midway Atoll NWR: approximately 22 x 22 miles around islands (not part of Reserve).	No restrictions.	None.
	Other Reserve waters: Federal waters approximately 22-50 miles.	Limited commercial and recreational fishing (all subject to fishing caps based on catch history).	No increase in level of effort or take; no change in gear type or species targeted.
CRE FMP 0 - 200 miles	No-take MPA: 0-50 fm in northern half of Refuge waters.	No fishing.	Insurance requirement.
	Low-use MPA: 0-50 fm in southern half of Refuge waters.	Lobster, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders.	CRE special permit needed to target any coral reef ecosystem resources - will be issued for recreational fishing for on-island consumption only, insurance requirement.
	Non-MPA: 50 fm-200 miles.	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permits.	CRE special permit needed to target potentially harvested coral reef taxa, insurance requirement.
USFWS approximately 22 x 22 mile square around islands	Refuge: approximately 22 x 22 miles around Midway.	Pelagic and lobster recreational and charter fishing permitted within refuge boundaries.	One lobster per person/day, all other catch and release unless record setting, USFWS special use permit required to enter.

Distinguishing characteristics:

USFWS

(1) Refuge waters extend to 22 miles x 22 miles delineated by specific latitude/longitude coordinates;
(2) Midway Atoll NWR not included as part of the NWHI CRE Reserve;
(3) No State claims to territorial waters.

MIDWAY (details)			
Waters	NWHI Reserve	CRE FMP	USFWS
0-50 fathoms in northern half of Refuge waters	No restrictions.	No fishing, insurance requirement (No-take MPA).	Pelagic and lobster recreational and charter fishing (Refuge).
0-50 fathoms in southern half of Refuge waters	No restrictions.	Lobster, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders, CRE special permit needed to target any coral reef ecosystem resources - will be issued for recreational fishing for on-island consumption only, insurance requirement (Low-use MPA).	Pelagic and lobster recreational and charter fishing (Refuge).
50 fm - 22 miles	No restrictions.	Lobster, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa (Non-MPA).	Pelagic and lobster recreational and charter fishing (Refuge).
22-50 miles	Recreational fishing, commercial fishing by bottomfish permit holders, and all pelagic trollers (Reserve).	Lobster, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa (Non-MPA).	Outside of Refuge.
22 - 200 miles	No restrictions.	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa (Non-MPA).	Outside of Refuge.

KURE (summary)			
Authority Jurisdiction	**Subareas**	**Permitted activities**	**Special restrictions**
NWHI Coral Reef Ecosystem Reserve (Federal waters to 50 miles around all islands)	Entire no fishing RPA: Federal waters 0 - 100 fm.	No fishing.	None.
	Other Reserve waters: Federal waters 100 fm-50 miles.	Limited commercial and recreational fishing (all subject to fishing caps based on catch history).	No increase in level of effort or take; no change in gear type or species targeted.
CRE FMP Federal waters to 200 miles	No-take MPA: Federal waters 0-10 fm.	No fishing.	Insurance requirement.
	Low-use MPA: Federal waters 10-50 fm.	Lobster, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders.	CRE special permit needed to target any coral reef ecosystem resources, insurance requirement.
	Non-MPA: Federal waters 50 fm-50 miles.	Lobster, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders.	CRE special permit needed to target potentially harvested coral reef taxa.
	Non-MPA: Federal waters 50-200 miles.	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders.	CRE special permit needed to target potentially harvested coral reef taxa.
USFWS None	None.	No restrictions.	No restrictions.
State of Hawaii 0-3 miles	State Wildlife refuge: 0-3 miles from shore.	Fishing with a NWHI Taking Permit.	Hand harvest of lobsters permitted.

Distinguishing characteristics:

<u>State of Hawaii</u>

(1) Kure Atoll State Wildlife refuge, 0-3 miles.

KURE (details)			
Waters	**NWHI Reserve**	**CRE FMP**	**State of HI**
0-3 miles	Not part of Reserve.	No restrictions.	NWHI Taking Permit requirement.
0-10 fathoms (outside of state waters)	No fishing (RPA).	No fishing, insurance requirement (No-take MPA).	No current restrictions.
10-50 fathoms (outside of state waters)	No fishing (RPA).	Lobster, bottomfish, precious corals, troll/handline pelagic fishing by other FMP permit holders, CRE special permit needed to target <u>any</u> coral reef ecosystem resources, insurance requirement (Low-use MPA).	No current restrictions.
50 - 100 fm (outside of state waters)	No fishing (RPA).	Lobster, bottomfish, precious corals, troll/handline and longline pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa (Non-MPA).	No current restrictions.
100 fm-50 miles (outside of state waters)	Recreational fishing, commercial fishing by bottomfish permit holders, and all pelagic trollers (Reserve).	Lobster, bottomfish, precious corals, troll/handline and longline pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa (Non-MPA).	No current restrictions.
50 - 200 miles	Outside of Reserve.	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders, CRE special permit needed to target <u>potentially harvested coral reef taxa</u> (Non-MPA).	No current restrictions.

Howland, Baker, Jarvis and Kingman Reef (summary)			
Authority Jurisdiction	**Subareas**	**Permitted activities**	**Special restrictions**
CRE FMP 0 - 200 miles	No-take MPA: 0-50 fm.	No fishing.	Insurance requirement.
	Non-MPA: 50 fm-200 miles.	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders.	CRE special permit needed to target potentially harvested coral reef taxa.
USFWS 0 - 3 miles (0-12 miles at Kingman Reef)	Refuge: 0-3 miles 0-12 miles (Kingman).	Activities consistent with Refuge mission - no commercial fishing.	USFWS special use permit required to enter.

Howland, Baker, Jarvis and Kingman Reef (details)		
Waters	**CRE FMP**	**FWS**
0-50 fathoms	Lobstar, bottomfish, precious corals, pelagic fishing by other FMP permit holders, CRE special permit needed to target <u>any</u> coral reef ecosystem resources will be issued for recreational fishing for on-island consumption only, insurance requirement (Low-use MPA).	No fishing (Refuge).
50 fm - 3 miles	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders, CRE special permit needed to target <u>potentially harvested coral reef taxa</u> (Non-MPA).	No fishing (Refuge).
3-12 miles	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders, CRE special permit needed to target <u>potentially harvested coral reef taxa</u> (Non-MPA).	No fishing (Kingman Reef NWR only).
12 - 200 miles	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders, CRE special permit needed to target <u>potentially harvested coral reef taxa</u> (Non-MPA).	Outside of Refuge.

PALMYRA (summary)			
Authority Jurisdiction	**Subareas**	**Permitted activities**	**Special restrictions**
CRE FMP 0 - 200 miles	Low-use MPA: 0-50 fm.	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders.	CRE special permit needed to target <u>any</u> coral reef ecosystem resources - will be issued for recreational fishing for on-island consumption only, insurance requirement.
	Non-MPA: 50 fm-200 miles.	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders.	CRE special permit needed to target potentially harvested coral reef taxa.
USFWS 0 - 12 miles	Refuge: 0-12 miles.	Activities consistent with Refuge mission- no commercial fishing.	USFWS special use permit required to enter.

Distinguishing characteristics:

CRE FMP Low-use MPA 0-50 fathoms, harvest of CRE species w/special permit for recreational fishing for on island consumption only.

PALMYRA (details)		
Waters	**CRE FMP**	**FWS**
0-50 fathoms	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders, CRE special permit needed to target <u>any</u> coral reef ecosystem resources will be issued for recreational fishing for on-island consumption only, insurance requirement (Low-use MPA).	No commercial fishing (Refuge).
50 fm - 12 miles	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa (Non-MPA).	No commercial fishing (Refuge).
12 - 200 miles	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa (Non-MPA).	Outside of Refuge.

Johnston and Wake Atoll (summary)			
Authority Jurisdiction	**Subareas**	**Permitted activities**	**Special restrictions**
CRE FMP 0 - 200 miles	Low-use MPA: 0-50 fm.	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders.	CRE special permit needed to target any coral reef ecosystem resources - will be issued for recreational fishing for on-island consumption only, insurance requirement.
	Non-MPA: 50 fm-200 miles.	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders.	CRE special permit needed to target potentially harvested coral reef taxa.
USFWS 0 - 3 miles	Refuge: 0-3 miles.	Recreational fishing, activities consistent with Refuge mission- no commercial fishing.	USFWS special use permit required to enter.

Distinguishing characteristics:

CRE FMP Low-use MPA 0-50 fathoms, harvest of CRE species w/special permit for recreational fishing for on island consumption only

Johnston and Wake Atoll (details)		
Waters	**CRE FMP**	**FWS**
0-50 fathoms	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders, CRE special permit needed to target any coral reef ecosystem resources will be issued for recreational fishing for on-island consumption only, insurance requirement (Low-use MPA).	No commercial fishing at Johnston Atoll (Refuge).
50 fm - 3 miles	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa (Non-MPA).	No commercial fishing at Johnston Atoll (Refuge).
3 - 200 miles	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa (Non-MPA).	Outside of Refuge.

AMERICAN SAMOA (summary)			
Authority Jurisdiction	**Subareas**	**Permitted activities**	**Special restrictions**
Government of American Samoa (Territorial waters 0-3 miles)	None.	Local regulations.	None.
CRE FMP Federal waters to 200 miles	No-take MPA: Federal waters 0-50 fathoms around Rose Atoll.	No fishing.	Insurance requirement.
	Non-MPA: Federal waters 3-200 miles.	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders.	CRE special permit needed to target potentially harvested coral reef taxa.
USFWS Cooperative Agreement with American Samoa (0-3 miles at Rose Atoll NWR)	Refuge: (1) The area inside of the extreme low-water line around the seaward side of the atoll reef; (2) The lands and waters from the Refuge boundary out to 3 miles.	No fishing.	USFWS special use permit required to enter.

Distinguishing characteristics:

The USFWS has a cooperative agreement with the Territory of American Samoa to manage Rose Atoll as a National Wildlife Refuge, and the submerged lands and waters out to 3 miles around the refuge. Magnuson-Stevenson Act jurisdiction begins at the shoreline at Rose Atoll. Under the CRE-FMP Rose Atoll is designated as a no-take MPA from 0-50 fathoms.

AMERICAN SAMOA (details)			
Waters	**GOV'T OF A. SAMOA**	**CRE FMP**	**USFWS**
0-3 miles (except at Rose Atoll)	Local regulations.	No restrictions.	-
3-200 miles	No restrictions.	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa (Non-MPA).	-
0-50 fathoms around Rose Atoll	No fishing.	No fishing, insurance requirement (no-take MPA).	No fishing (Refuge).
50 fm-3 miles around Rose Atoll	No fishing.	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa (Non-MPA).	No fishing (Refuge).

COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS (summary)			
Authority Jurisdiction	**Subareas**	**Permitted activities**	**Special restrictions**
CRE FMP 0-200 miles	Non-MPA: 0-3 miles.	No restrictions.	None.
	Non-MPA: 3-200 miles.	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders.	CRE special permit needed to target potentially harvested coral reef taxa.

Distinguishing characteristics:

There are no "state" (territorial) waters around CNMI. However, the CRE FMP will not impose any management measures within 0-3 miles from shore.

COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS (details)	
Federal waters	**CRE FMP**
0-3 miles	No restrictions (Non-MPA).
3-200 miles	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa (Non-MPA).

GUAM (summary)			
Authority Jurisdiction	**Subareas**	**Permitted activities**	**Special restrictions**
Government of Guam 0-3 miles	None.	Local regulations.	None.
CRE FMP Federal waters to 200 miles	Non-MPA: Federal waters 3-200 miles.	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders.	CRE special permit needed to target potentially harvested coral reef taxa.
	Non-MPA: Guam's Southern Banks.	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders.	CRE special permit needed to target potentially harvested coral reef taxa , no anchoring by vessels greater than 50' in length.
USFWS Federal waters to 100 ft at Ritidian	Refuge: Federal waters 0-100 foot isobath.	Recreational fishing.	USFWS special permit required to enter.

Distinguishing characteristics:

There are no CRE MPAs around Guam, but there is an anchoring restriction for the Southern Banks for vessels larger than 50 ft in length.

GUAM (details)			
Federal Waters	**GOV'T OF GUAM**	**CRE FMP**	**USFWS**
0-3 miles	Local regulations.	No restrictions.	None.
0-10 fathoms (at Ritidian, outside of Guam waters)	No restrictions.	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa (Non-MPA).	No commercial fishing (Refuge).
10 fathoms-200 miles (outside of Guam waters)	No restrictions.	Lobster, bottomfish, precious corals, pelagic fishing by other FMP permit holders, CRE special permit needed to target potentially harvested coral reef taxa (Non-MPA).	-

CHAPTER 10

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