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Fishery Ecosystem Plan for the Pacific Remote Island Areas

Western Pacific Regional Fishery Management Council
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Cover Artwork Courtesy of Kellen Mae Igtanloc, St. Anthony Catholic School, Tamuning, Guam

EXECUTIVE SUMMARY

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) authorizes fishery management councils to create fishery management plans (FMP). The Western Pacific Regional Fishery Management Council developed this Fishery Ecosystem Plan (FEP) as an FMP, consistent with the MSA and the national standards for fishery conservation and management. The FEP represents the first step in an incremental and collaborative approach to implement ecosystem approaches to fishery management in the Pacific Remote Island Areas (PRIA) of Baker, Jarvis, Wake and Howland Islands, Kingman Reef, and Johnston and Palmyra Atolls.

Since the 1980s, the Council has managed fisheries throughout the Western Pacific Region through separate species-based fishery management plans (FMP) – the Bottomfish and Seamount Groundfish FMP (WPRFMC 1986a), the Crustaceans FMP (WPRFMC 1981), the Precious Corals FMP (WPRFMC 1979), the Coral Reef Ecosystems FMP (WPRFMC 2001)and the Pelagic FMP (WPRFMC 1986b). However, the Council is now moving towards an ecosystem-based approach to fisheries management and is restructuring its management framework from species-based FMPs to place-based FEPs. Recognizing that a comprehensive ecosystem approach to fisheries management must be initiated through an incremental, collaborative, and adaptive management process, a multi-step approach is being used to develop and implement the FEPs. To be successful, this will require increased understanding of a range of issues including biological and trophic relationships, ecosystem indicators and models, and the ecological effects of non-fishing activities on the marine environment. This FEP, in conjunction with the Council's American Samoa Archipelago, Hawaii Archipelago, Mariana Archipelago and Pacific Pelagic FEPs, replaces the Council's existing Bottomfish and Seamount Groundfish, Coral Reef Ecosystems, Crustaceans, Precious Corals and Pelagic Fishery Management Plans, and reorganizes their associated regulations into a place-based structure aligned with the FEPs.

The PRIA FEP establishes the framework under which the Council will manage fishery resources, and begin the integration and implementation of ecosystem approaches to management in the PRIA. This FEP does not establish any new fishery management regulations at this time but rather consolidates existing fishery regulations for demersal species. Specifically, this FEP identifies as management unit species those current management unit species known to be present in waters around the PRIA and incorporates all of the management provisions of the Bottomfish and Seamount Groundfish FMP, the Crustaceans FMP, the Precious Corals FMP, and the Coral Reef Ecosystems FMP that are applicable to the area. Although pelagic fishery resources play an important role in the biological as well as socioeconomic environment of these islands, they will be managed separately through the Pacific Pelagic FEP.

In addition, under the PRIA FEP, the organizational structure for developing and implementing Fishery Ecosystem Plans explicitly incorporates community input and local knowledge into the management process. This FEP also identifies topics in ecosystem approaches to management and identifies 10 overarching objectives to guide the Council in further implementing ecosystem approaches to management.

Future fishery management actions are anticipated to incorporate additional information as it becomes available. An adaptive management approach will be used to further advance the implementation of ecosystem science and principles. Such actions would be taken in accordance with the Magnuson-Stevens Fishery Conservation and Management Act, the National Environmental Policy Act, the Endangered Species Act, the Marine Mammal Protection Act, and other applicable laws and statutes.

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ACRONYMS

APA:	Administrative Procedure Act
B:	Stock biomass
B_{FLAG}:	Minimum Biomass Flag
B_{MSY}:	Biomass Maximum Sustainable Yield
B_{OY}:	Biomass Optimum Yield
BMUS:	Bottomfish Management Unit Species
CFR:	Code of Federal Regulations
CITES:	Council on International Trade and Endangered Species
CNMI:	Commonwealth of the Northern Mariana Islands
CPUE:	Catch per unit effort at the reference point
$CPUE_{MSY}$:	Catch per unit effort Maximum Sustainable Yield
$CPUE_{REF}$:	Catch per unit effort at the Reference Point
CRAMP:	Coral Reef Assessment and Monitoring Program
CRE:	Coral Reef Ecosystem
CRE-FMP:	Coral Reef Ecosystem Fishery Management Plan
CRTF:	Coral Reef Task Force
DAR:	Division of Aquatic Resources, State of Hawaii
DOC:	United States Department of Commerce
DOD:	United States Department of Defense
DOI:	United States Department of the Interior
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
FLPMA:	Federal Land Policy and Management Act
fm:	fathoms
FMP:	Fishery Management Plan
FR:	Federal Register
FRFA:	Final Regulatory Flexibility Analysis
ft:	feet
FWCA:	Fish and Wildlife Coordination Act
GIS:	Geographic information systems
GPS:	Global Positioning System
HAPC:	Habitat Areas of Particular Concern

IQA:	Information Quality Act
IRFA	Initial Regulatory Flexibility Analysis
kg:	kilograms
km:	kilometers
lb:	pounds
LOF	List of Fisheries
m:	meters
mt:	metric tons
MFMT:	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
MSA:	Magnuson-Stevens Fishery Conservation and Management Act
MSST:	Minimum Stock Size Threshold
MSY:	Maximum Sustainable Yield
MUS:	Management Unit Species
NDSA:	Naval Defense Sea Areas
NEPA:	National Environmental Policy Act
nm or nmi:	nautical miles
NMFS:	National Marine Fisheries Service (also known as NOAA Fisheries Service)
NOAA:	National Oceanic and Atmospheric Administration
NWHI:	Northwestern Hawaiian Islands
NWR:	National Wildlife Refuge
NWRSAA:	National Wildlife Refuge System Administration Act
OMB:	Office of Management and Budget
OY:	Optimum Yield
PBR:	Potential Biological Removal
PIFSC:	Pacific Islands Fisheries Science Center, NMFS
PIRO:	Pacific Islands Regional Office, NMFS
PRA:	Paperwork Reduction Act
PRIA:	Pacific Remote Island Areas
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
USCG:	United States Coast Guard
USFWS:	United States Fish and Wildlife Service
VMS:	Vessel Monitoring System
WPacFIN:	Western Pacific Fisheries Information Network, NMFS
WPRFMC:	Western Pacific Regional Fishery Management Council

DEFINITIONS

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

Bycatch: Any fish harvested in a fishery 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.

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 Ecosystem Plan, commercial fishing includes the commercial extraction of biocompounds.

Consensual Management: Decision making process where stakeholders meet and reach consensus on management measures and recommendations.

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.

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. These areas are designated pursuant to the ESA as having physical or biological features essential to the conservation of listed species.

Dealer: Any person who (1) Obtains, with the intention to resell management unit species, or portions thereof, that were harvested or received by a vessel that holds a permit or is otherwise regulated under this FEP; or (2) Provides recordkeeping, purchase, or sales assistance in obtaining or selling such management unit species (such as the services provided by a wholesale auction facility).

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 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 ecological changes.

Economic Discards: Fishery 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: A geographically specified system of organisms (including humans), the environment, and the processes that control its dynamics.

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

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) to assess alternatives and analyze the impact on the environment of proposed major Federal actions significantly affecting the human environment.

Essential Fish Habitat (EFH): Those waters and substrate necessary to a species or species group or complex, 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 the Magnuson Act, 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.

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 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 Ecosystem Plan: A fishery ecosystem management plan that contains conservation and management measures necessary and appropriate for fisheries within a given ecosystem to prevent overfishing and rebuild overfished stocks, and to protect, restore, and promote the long-term health and stability of the fishery.

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.

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

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

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

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

Habitat Area of Particular Concern (HAPC): Those areas of EFH identified pursuant to Section 600.815(a)(8). In determining whether a type or area of EFH should be designated as a HAPC, one or more of the following criteria should 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.

Harvest: The catching or taking of a marine organism or fishery MUS by any means.

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

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: A Marine Protected Area zoned to allow limited fishing activities.

Main Hawaiian Islands (MHI): The islands of the Hawaiian Islands archipelago consisting of Niihau, Kauai, Oahu, Molokai, Lanai, Maui, Kahoolawe, Hawaii and all of the smaller associated islets lying east of 161° W longitude.

Marine Protected Area (MPA): An area designated to allow or prohibit certain fishing activities.

Maximum Sustainable Yield (MSY): The largest long-term average catch or yield that can be taken, from a stock or stock complex under prevailing ecological and environmental conditions and fishery technological characteristics (e.g., gear selectivity), and the distribution of catch among fleets.

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

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

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

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.

Overfished: A stock or stock complex is considered “overfished” when its biomass has declined below a level that jeopardizes the capacity of the stock or stock complex to produce maximum sustainable yield on a continuing basis.

Overfishing: (to overfish) occurs whenever a stock or stock complex is subjected to a level of fishing mortality or total annual catch that jeopardizes the capacity of a stock or stock complex to produce maximum sustainable yield on a continuing basis.

Pacific Remote Island Areas (PRIA): Baker Island, Howland Island, Jarvis Island, Johnston Atoll, Kingman Reef, Midway Atoll, Wake Island and Palmyra Atoll.

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

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

Recreational Fishing: Fishing 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 whenever caught, or are required to retain but not sell.

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 original, 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 manually 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.

Social Acceptability: The acceptance of the suitability of management measures 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.

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 to obtain food for personal and/or community use rather than for profit sales or recreation.

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

Trophic Web: A 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.

Western Pacific Regional Fishery Management Council (WPRFMC or Coucil): A Regional Fishery Management Council established under the MSA, consisting of the State of Hawaii, the Territory of American Samoa, the Territory of Guam, and the Commonwealth of the Northern Mariana Islands which has authority over the fisheries in the Pacific Ocean seaward of such States, Territories, Commonwealths, and Possessions of the United States in the Pacific Ocean Area. The Council has 13 voting members including eight appointed by the Secretary of Commerce at least one of whom is appointed from each of the following States: Hawaii, the Territories of American Samoa and Guam, and the Commonwealth of the Northern Mariana Islands.

CHAPTER 1: INTRODUCTION

1.1 Introduction

In 1976, the United States Congress passed the Magnuson Fishery Conservation and Management Act that was subsequently twice reauthorized as the Magnuson–Stevens Fishery Conservation and Management Act (MSA). Under the MSA, the United States (U.S.) has exclusive fishery management authority over all fishery resources found within its Exclusive Economic Zone (EEZ). For purposes of the MSA, the inner boundary of the U.S. EEZ extends from the seaward boundary of each coastal state to a distance of 200 nautical miles from the baseline from which the breadth of the territorial sea is measured. The Western Pacific Regional Fishery Management Council (Council) has authority over the fisheries based in, and surrounding, the State of Hawaii, the Territory of American Samoa, the Territory of Guam, the Commonwealth of the Northern Mariana Islands, and the U.S. Pacific Remote Island Areas (PRIA) of the Western Pacific Region.[1]

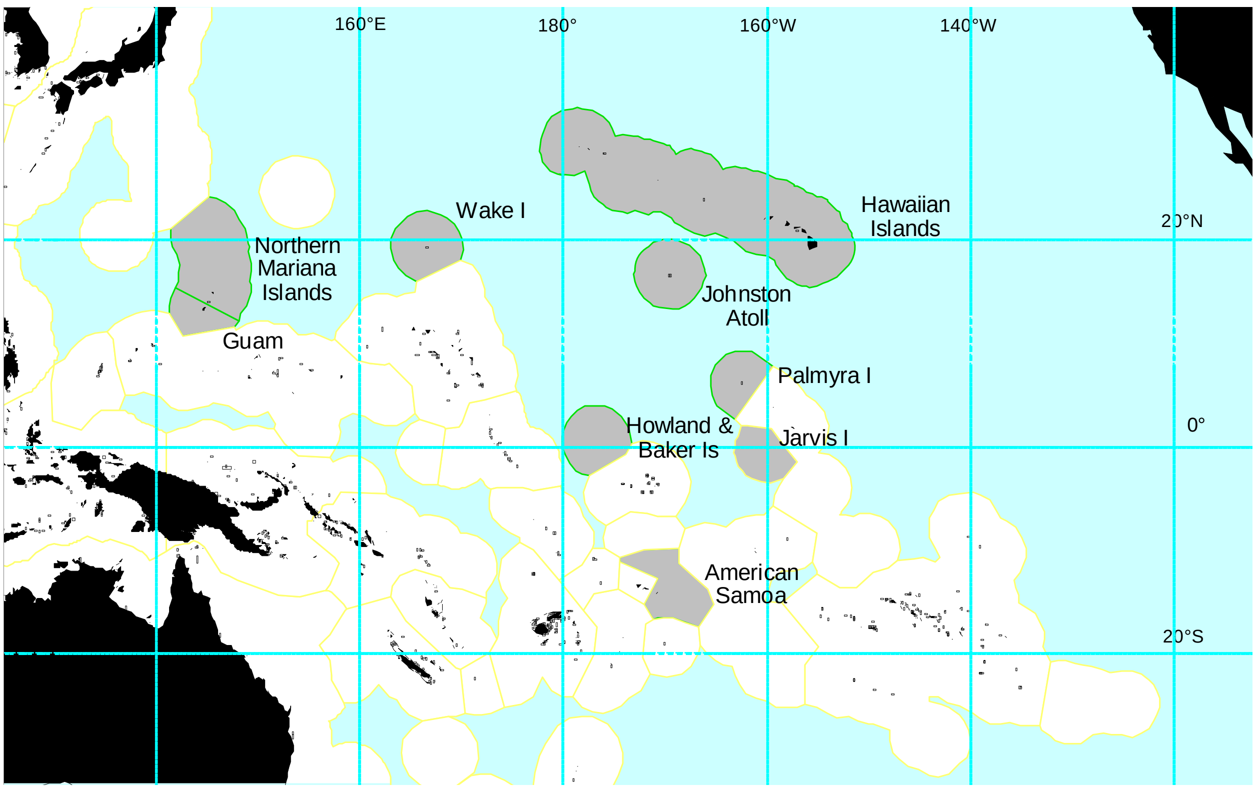

Figure 1: Western Pacific Region

[1] The Pacific Remote Island Areas comprise Baker Island, Howland Island, Jarvis Island, Johnston Atoll, Kingman Reef, Wake Island, Palmyra Atoll, and Midway Atoll. Although physically located in the Hawaiian Archipelago, administratively, Midway is considered part of the PRIA because it is not a part of the State of Hawaii. However, because Midway is located in the Hawaii Archipelago, it is included in the Hawaii Archipelago FEP. As used in this document the terms, “Pacific Remote Island Areas” and “PRIA” do not include Midway Atoll.

In the Western Pacific Region, responsibility for the management of marine resources is shared by a number of federal and local government agencies. At the federal level, the Council, the National Marine Fisheries Service (NMFS, also known as NOAA Fisheries Service), the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Department of Commerce develop and implement fishery management measures. Additionally, NOAA's Ocean Service co-manages (with the State of Hawaii) the Hawaiian Islands Humpback Whale National Marine Sanctuary, manages the Fagatele Bay National Marine Sanctuary in American Samoa, and administers the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve.

The U.S. Department of the Interior, through the U.S. Fish and Wildlife Service, manages ten National Wildlife Refuges throughout the Western Pacific Region. Some refuges are co-managed with other federal and state agencies, while others are not.

The U.S. Department of Defense, through the Air Force, Army, Navy, and Marine Corps, also controls access and use of various marine waters throughout the region.

The Territory of American Samoa, the Territory of Guam, and the State of Hawaii manage all marine resources within waters 0–3 miles from their shorelines. In the Commonwealth of the Northern Mariana Islands (CNMI), the submerged lands and marine resources from the shoreline to 200 miles are owned by the Federal government, although CNMI is currently seeking to acquire jurisdiction of the area from 0 to 3 miles through various legal means.

1.2 Purpose and Need for Action

The Western Pacific Region includes a series of archipelagos with distinct cultures, communities, and marine resources. For thousands of years, the indigenous people of these Pacific islands relied on healthy marine ecosystems to sustain themselves, their families, and their island communities. It remains true today that Pacific Island communities continue to depend on the ecological, economic, and social benefits of healthy marine ecosystems.

On international, national, and local levels, institutions and agencies tasked with managing marine resources are moving toward an ecosystem approach to fisheries management. One reason for this shift is a growing awareness that many of Earth's marine resources are stressed and the ecosystems that support them are degraded. In addition, increased concern regarding the potential impacts of fishing and non-fishing activities on the marine environment, and a greater understanding of the relationships between ecosystem changes and population dynamics, have all fostered support for a holistic approach to fisheries management that is science based and forward thinking (Pikitch et al. 2004).

In 1998, the U.S. Congress charged NMFS with the establishment of an Ecosystem Principles Advisory Panel (EPAP) responsible for assessing the extent that ecosystem principles were being used in fisheries management and research, and recommending how to further their use to improve the status and management of marine resources. The EPAP was composed of members of academia, fishery and conservation organizations, and fishery management agencies.

The EPAP reached consensus that Fishery Ecosystem Plans (FEPs) should be developed and implemented to manage U.S. fisheries and marine resources. According to the EPAP, a FEP should contain and implement a management framework to control harvests of marine resources on the basis of available information regarding the structure and function of the ecosystem in which such harvests occur (EPAP 1999). The EPAP constructed eight ecosystem principles that it believes to be important to the successful management of marine ecosystems which were recognized and used as a guide by the Council in developing this FEP. These principles are as follows:

- The ability to predict ecosystem behavior is limited.
- Ecosystems have real thresholds and limits that, when exceeded, can affect major system restructuring.
- Once thresholds and limits have been exceeded, changes can be irreversible.
- Diversity is important to ecosystem functioning.
- Multiple scales interact within and among ecosystems.
- Components of ecosystems are linked.
- Ecosystem boundaries are open.
- Ecosystems change with time.

The Food and Agriculture Organization of the United Nations provides that the purpose of an ecosystem approach to fisheries "is to plan, develop and manage fisheries in a manner that addresses the multiple needs and desires of societies, without jeopardizing the options for future generations to benefit from a full range of goods and services provided by marine ecosystems" (Garcia et al. 2003).

Similarly, NOAA defines an ecosystem approach as "management that is adaptive, specified geographically, takes account of ecosystem knowledge and uncertainties, considers multiple external influences, and strives to balance diverse social objectives." In addition, because of the wide ranging nature of ecosystems, successful implementation of ecosystem approaches will need to be incremental and collaborative (NOAA 2004).

Given the above, on December 20, 2005 the Council recommended the establishment and implementation of this FEP for the PRIA. In particular, this FEP:

1. Identifies the management objectives of the PRIA FEP;
2. Delineates the boundaries of the PRIA FEP;
3. Designates the management unit species included in the PRIA FEP;
4. Details the federal fishery regulations applicable under the PRIA FEP; and
5. Establishes appropriate Council structures and advisory bodies to provide scientific and management advice to the Council regarding the PRIA FEP.

In addition, this document provides the information and rationale for these measures; discusses the key components of the PRIA ecosystem, including an overview of the region's non-pelagic fisheries, and explains how the measures contained here are consistent with the MSA and other applicable laws. This FEP, in conjunction with the Council's American Samoa Archipelago, Hawaii Archipelago, Mariana Archipelago, and Pacific Pelagic FEPs, incorporates by reference and replaces the Council's existing Fishery Management Plans for Bottomfish and Seamount Groundfish, Coral Reef Ecosystems, Crustaceans, Precious Corals and Pelagics (and their amendments) and reorganizes their associated regulations into a place-based structure aligned with the FEPs.

1.3 Incremental Approach to Ecosystem-based Management

As discussed above, fishery scientists and managers have recognized that a comprehensive ecosystem approach to fisheries management must be implemented through an incremental and collaborative process (Jennings 2004; NOAA 2004; National Oceanic and Atmospheric Administration 2004; Sissenwine and Murawski 2004). The PRIA FEP establishes the framework under which the Council will manage fisheries, and begin the integration and implementation of ecosystem approaches to management. This FEP does not establish any new fishery management regulations at this time but rather consolidates existing fishery regulations for demersal species. Specifically, this FEP identifies as management unit species those current management unit species known to be present in waters in PRIA and incorporates all of the management provisions of the Bottomfish and Seamount Groundfish FMP, the Crustaceans FMP, the Precious Corals FMP, and the Coral Reef Ecosystems FMP that are applicable to the area. Although pelagic fishery resources play an important role in the biological environment of these islands, they will be managed separately through the Pacific Pelagic FEP. The goal of the measures contained in this document is to begin this process by establishing a place-based FEP with appropriate boundaries, management unit species, and advisory structures.

Successful ecosystem-based fisheries management will require an increased understanding of a range of social and scientific issues including appropriate management objectives, biological and trophic relationships, ecosystem indicators and models, and the ecological effects of non-fishing activities on the marine environment. Future fishery management actions are anticipated to utilize this information as it becomes available, and adaptive management will be used to further advance the implementation of ecosystem science and principles.

1.4 Pacific Remote Island Areas FEP Boundaries

NOAA defines an ecosystem as a geographically specified system of organisms (including humans), the environment, and the processes that control its dynamics (NOAA 2004). Ecosystems can be considered at various geographic scales—from a coral reef ecosystem with its diverse species and benthic habitats to a large marine ecosystem such as the Pacific Ocean.

From a marine ecosystem management perspective, the boundary of an ecosystem cannot be readily defined and depends on many factors, including life history characteristics, habitat requirements, and geographic ranges of fish and other marine resources including their interdependence between species and their environment. Additionally, processes that affect and influence abundance and distribution of natural resources; such as environmental cycles, extreme natural events, and acute or chronic anthropogenic impacts, must also be considered. Serious considerations must also be given to social, economic, and/or political constraints. For the purposes of this document, ecosystems are defined as geographically specified system of organisms, the environment, and the processes that control its dynamics. Humans and their society are considered to be an integral part of these ecosystems, and the alternatives considered here are cognizant of the human jurisdictional boundaries and varying management authorities that are present in the Western Pacific Region. This is also consistent with NMFS' EPAP's 1999 report to Congress recommending that Councils should develop FEPs for the ecosystems under their jurisdiction and delineate the extent of those ecosystems.

In the PRIA, jurisdiction over fishery resources and habitat is the responsibility of the U.S. Department of Commerce (DOC). Jurisdictional boundaries in this area are expressed in varying terms ranging from fathoms, miles, the territorial sea, to the EEZ. In addition, seaward boundaries are not clearly defined because some islands in the PRIA do not appear to have a seaward boundary as defined by U.S. law (i.e., MSA) (Beuttler 1995). Furthermore, administrative authority over the PRIA has been conferred by various Executive Orders to either the Department of Defense (DOD) or the DOI. As a result, agencies often assert differing interpretations of regulatory authority. With regard to MSA authority, the NOAA General Counsel has opined that such authority applies to all marine waters around federally owned possessions (i.e., PRIA), including marine resources within bays, inlets, and other marine waters to the shoreline (Beuttler 1995) (See Chapter 9 for a more detailed discussion on jurisdictional issues in the PRIA).

For the purposes of this document, the PRIA FEP boundaries are the Federal waters (0-200 nm) surrounding each PRIA and overlay the National Wildlife Refuge boundaries asserted by the USFWS. This is consistent with the regulations implementing the Coral Reef Ecosystems FMP (Final Rule, 69 FR 8346, February 24, 2004) which defined the Coral Reef Ecosystems FMP regulatory area for the PRIA as the area between the shoreline and the outer boundary of the EEZ (i.e., 0-200 nm). To ensure consistency between the management regimes of different Federal agencies with jurisdiction in the PRIA, the regulations which implemented the Coral Reef Ecosystems FMP stated that fishing for coral reef management unit species is not allowed within the boundary of a National Wildlife Refuge unless specifically authorized by the USFWS (Final Rule, 69 FR 8346, February 24, 2004). Chapter 5 (FEP Management Program) and Chapter 10 (Draft Regulations) of this FEP maintain these provisions. See Chapter 9 (Other Marine Resource Laws) for a more detailed discussion on jurisdictional boundaries in the PRIA. Although the boundary of the PRIA FEP overlaps with the boundaries of the Council's Pacific Pelagic FEP for pelagic fisheries, the PRIA FEP specifically manages those demersal resources and habitats associated with the Federal waters around these island areas.

Under the approach described in this document, continuing adaptive management could include subsequent actions to refine these boundaries if and when supported by scientific data and/or management requirements. Such actions would be taken in accordance with the MSA, the National Environmental Policy Act (NEPA), the Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), and other applicable laws and statutes.

1.5 Pacific Remote Island Areas FEP Management Objectives

The MSA mandates that fishery management measures achieve long-term sustainable yields from domestic fisheries while preventing overfishing. In 1999, the 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 the EPAP, the Council initiated the development of FEPs for each major ecosystem under its jurisdiction beginning with the Coral Reef Ecosystems FMP, which was implemented in March 2004. This PRIA FEP represents—along with the Pacific Pelagic FEP, the American Samoa Archipelago FEP, the Mariana Archipelago FEP, and the Hawaii Archipelago FEP—the next step in the establishment and successful implementation of place-based FEPs for all of the fisheries within the Council's jurisdiction which will manage using an ecosystem approach.

The overall goal of the PRIA FEP is to establish a framework under which the Council will improve its abilities to realize the goals of the MSA through the incorporation of ecosystem science and principles.

To achieve this goal, the Council has adopted the following ten objectives for the PRIA FEP:

Objective 1: To maintain biologically diverse and productive marine ecosystems and foster the long-term sustainable use of marine resources in an ecologically and culturally sensitive manner through the use of a science-based ecosystem approach to resource management.

Objective 2: To provide flexible and adaptive management systems that can rapidly address new scientific information and changes in environmental conditions or human use patterns.

Objective 3: To improve public and government awareness and understanding of the marine environment in order to reduce unsustainable human impacts and foster support for responsible stewardship.

Objective 4: To encourage and provide for the sustained and substantive participation of local communities in the exploration, development, conservation, and management of marine resources.

Objective 5: To minimize fishery bycatch and waste to the extent practicable.

Objective 6: To manage and comanage protected species, protected habitats, and protected areas.

Objective 7: To promote the safety of human life at sea.

Objective 8: To encourage and support appropriate compliance and enforcement with all applicable local and Federal fishery regulations.

Objective 9: To increase collaboration with domestic and foreign regional fishery management and other governmental and non-governmental organizations, communities, and the public at large to successfully manage marine ecosystems.

Objective 10: To improve the quantity and quality of available information to support marine ecosystem management.

1.6 Pacific Remote Island Areas FEP Management Unit Species

Management unit species (MUS) are those species that are managed under each FEP (formerly under the FMPs). In fisheries management, MUS typically include those species that are caught in quantities sufficient to warrant management or specific monitoring by NMFS and the Council. An exception to this general rule is the inclusion of a range of little harvested species (termed Potentially Harvested Coral Reef Taxa) in the Coral Reef Ecosystems FMP. This FMP was the Council's first step towards ecosystem management and inclusion of these species as MUS allowed the Council to require that harvesters obtain federal permits and submit federal logbooks detailing their catch and effort and other fishery information. Although not currently the target of focused harvests, the PHCRT are believed to be vulnerable to potentially rapid localized depletion should they become commercially valuable due to shifting consumer tastes.

The primary impact of inclusion of species in an MUS list is that the species (i.e., the fishery targeting that species) can be directly managed. National Standard 3 of the MSA requires that 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. Under the PRIA FEP, MUS include only those current bottomfish and seamount MUS, crustacean MUS, precious coral MUS, and coral reef ecosystem MUS that are known to be present within EEZ waters around the PRIA. Although, certain pelagic MUS are known to occur within the boundary of the PRIA FEP, they are managed under a separate Pelagic FEP.

Tables 1–5 list those current bottomfish and seamount MUS, crustacean MUS, precious coral MUS, and coral reef ecosystem MUS that are known to be present within the boundary of the PRIA FEP and are thus managed under this plan. Some of the species included as MUS are not subject to significant fishing pressure and there are no estimates of maximum sustainable yield (MSY) or minimum stock size threshold (MSST, the level of biomass beneath which a stock or stock complex is considered overfished) or maximum fishing mortality threshold (MFMT, the level of fishing mortality, on an annual basis, above which overfishing in occurring), available for these species at this time. However, these species are important components of the ecosystem and for that reason are included in this FEP. Permitting and data collection measures established under the existing FMPs will be continued under this FEP. Including these species as MUS in the FEP is consistent with MSA National Standard 3 which states, that "To the extent practicable, an individual stock of fish shall be managed as a stock throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination" (50 CFR 600.320). This section further provides that "A management unit may contain, in addition to regulated species, stocks of fish for which there is not enough information available to specify MSY and optimum yield (OY) or to establish management measures, so that data on these species may be collected under the FMP". Under the adaptive approach that utilizes the best available scientific information, the

Council, in coordination with NMFS, will continue to develop and refine estimates or proxies of MSY for these species when sufficient data are available. The establishment of MSY proxies is consistent with regulations regarding MSA National Standard 1 which states that “When data are insufficient to estimate MSY directly, Councils should adopt other measures of productive capacity that can serve as reasonable proxies of MSY to the extent possible” (50 CFR 600.310). Future management measures that would directly affect the harvest of any MUS contained in this FEP will be subject to the requirements of the MSA and other applicable laws.

Table 1: PRIA Bottomfish Management Unit Species

Scientific Name	English Common Name
Aphareus rutilans	silver jaw jobfish
Caranx ignobilis	giant trevally
C. lugubris	black jack
Epinephelus fasciatus	blacktip grouper
E. quernus	sea bass
Etelis carbunculus	red snapper
E. coruscans	longtail snapper
Lethrinus rubrioperculatus	redgill emperor
Pristipomoides auricilla	yellowtail snapper
P. filamentosus	pink snapper
P. seiboldii	pink snapper
Variola louti	lunartail grouper

Table 2: PRIA Crustacean Management Unit Species

Scientific Name	English Common Name
Panulirus penicillatus	spiny lobster
Family Scyllaridae	slipper lobster
Ranina ranina	Kona crab
Heterocarpus spp.	deepwater shrimp

Table 3: PRIA Precious Corals Management Unit Species

Scientific Name	English Common Name

Corallium secundum	pink coral (also called red coral)
Corallium regale	pink coral (also called red coral)
Corallium laauense	pink coral (also called red coral)
Gerardia spp.	gold coral
Narella spp.	gold coral
Lepidisis olapa	bamboo coral
Antipathes dichotoma	black coral
Antipathes grandis	black coral
Antipathes ulex	black coral

Table 4: PRIA Coral Reef Ecosystem Management Unit Species, Currently Harvested Coral Reef Taxa

Family Name	Scientific Name	English Common Name
Acanthuridae (Surgeonfishes)	*Acanthurus olivaceus*	orange-spot surgeonfish
	Acanthurus xanthopterus	yellowfin surgeonfish
	Acanthurus triostegus	convict tang
	Acanthurus dussumieri	eye-striped surgeonfish
	Acanthurus nigroris	blue-lined surgeon
	Acanthurus leucopareius	whitebar surgeonfish
	Acanthurus lineatus	blue-banded surgeonfish
	Acanthurus nigricauda	blackstreak surgeonfish
	Acanthurus nigricans	whitecheek surgeonfish
	Acanthurus guttatus	white-spotted surgeonfish
	Acanthurus blochii	ringtail surgeonfish
	Acanthurus nigrofuscus	brown surgeonfish
	Ctenochaetus strigosus	yellow-eyed surgeonfish

Family Name	Scientific Name	English Common Name
	Ctenochaetus striatus	striped bristletooth
	Ctenochaetus binotatus	twospot bristletooth
	Zebrasoma flavescens	yellow tang
	Naso unicornus	bluespine unicornfish
	Naso lituratus	orangespine unicornfish
	Naso hexacanthus	black tongue unicornfish
	Naso vlamingii	bignose unicornfish
	Naso annulatus	whitemargin unicornfish
	Naso brevirostris	spotted unicornfish
Labridae (Wrasses)	*Cheilinus undulatus*	Napoleon wrasse
	Cheilinus trilobatus	triple-tail wrasse
	Cheilinus chlorourus	floral wrasse
	Oxycheilinus unifasciatus	ring-tailed wrasse
	Oxycheilinus diagrammus	bandcheek wrasse
	Hemigymnus fasciatus	barred thicklip
	Halichoeres trimaculatus	three-spot wrasse
	Thalassoma quinquevittatum	red ribbon wrasse
	Thalassoma lutescens	sunset wrasse
Mullidae (Goatfishes)	*Mulloidichthys* spp.	yellow goatfish
	Mulloidichthys pfleugeri	orange goatfish
	Mulloidichthys flavolineatus	yellowstripe goatfish
	Parupeneus spp.	banded goatfish
Mullidae (Goatfishes)	*Parupeneus barberinus*	dash-dot goatfish
	Parupeneus cyclostomas	yellowsaddle goatfish
	Parupeneus multifaciatus	multi-barred goatfish
	Upeneus arge	bantail goatfish
Mugilidae (Mullets)	*Crenimugil crenilabis*	fringelip mullet
	Moolgarda engeli	Engel's mullet
	Neomyxus leuciscus	false mullet

Family Name	Scientific Name	English Common Name
Muraenidae (Moray eels)	*Gymnothorax flavimarginatus*	yellowmargin moray eel
	Gymnothorax javanicus	giant moray eel
	Gymnothorax undulatus	undulated moray eel
Octopodidae	*Octopus cyanea*	octopus
	Octopus ornatus	octopus
Pricanthidae (Bigeye)	*Heteropriacanthus cruentatus*	glasseye
Scaridae (Parrotfishes)	*Bolbometopon muricatum*	humphead parrotfish
	Scarus spp.	parrotfish
	Hipposcarus longiceps	pacific longnose parrotfish
	Calotomus carolinus	stareye parrotfish
Scombridae	*Gymnosarda unicolor*	dogtooth tuna
Sphyraenidae (Barracuda)	*Sphyraena barracuda*	great barracuda

Table 5: PRIA Coral Reef Ecosystem Management Unit Species, Potentially Harvested Coral Reef Taxa

Scientific Name	English Common Name
Labridae	wrasses (Those species not listed as CHCRT)
Carcharhinidae Sphyrnidae	sharks (Those species not listed as CHCRT)
Myliobatidae Mobulidae	rays and skates
Serrandiae	groupers (Those species not listed as CHCRT or as BMUS)
Carangidae	jacks and scads (Those species not listed as CHCRT or as BMUS)
Holocentridae	solderfishes and squirrelfishes,(Those species not listed as CHCRT)

Scientific Name	English Common Name
Mullidae	goatfishes,(Those species not listed as CHCRT)
Ephippidae	batfishes
Haemulidae	sweetlips
Echeneidae	remoras
Malacanthidae	tilefishes
Pseudochromidae	dottybacks
Plesiopidae	prettyfins
Acanthuridae	surgeonfishes (Those species not listed as CHCRT)
Lethrinidae	emperors (Those species not listed as CHCRT or as BMUS)
Clupeidae	herrings
Gobiidae	gobies
Lutjanidae	snappers (Those species not listed as CHCRT or as BMUS)
Balistidae	trigger fishes (Those species not listed as CHCRT)
Siganidae	rabbitfishes (Those species not listed as CHCRT)
Muraenidae Chlopsidae Congridae Ophichthidae	eels (Those species not listed as CHCRT)
Apogonidae	cardinalfishes
Zanclidae	moorish idols
Chaetodontidae	butterfly fishes
Pomacanthidae	angelfishes
Pomacentridae	damselfishes
Scorpaenidae	scorpionfishes
Blenniidae	blennies
Sphyraenidae	barracudas (Those species not listed as CHCRT)
Pinguipedidae	sandperches
Kyphosidae	rudderfishes (Those species not listed as CHCRT)
Caesionidae	fusiliers

Scientific Name	**English Common Name**
Cirrhitidae	hawkfishes (Those species not listed as CHCRT)
Antennariidae	frogfishes
Syngnathidae	pipefishes and seahorses
Bothidae	flounders and soles
Ostraciidae	trunkfishes
Tetradontidae	puffer fishes and porcupine fishes
Aulostomus chinensis	trumpetfish
Fistularia commersoni	cornetfish
Heliopora	blue corals
Tubipora	organpipe corals
Azooxanthellates	ahermatypic corals
Fungiidae	mushroom corals
	small and large coral polyps
Millepora	fire corals
	soft corals and gorgonians
Actinaria	anemones
Zoanthinaria	soft zoanthid corals
Hydrozoans and Bryzoans	
Tunicates	sea squirts
Echinoderms	sea cucumbers and sea urchins
Mollusca	Those species not listed as CHCRT
Gastropoda	sea snails
Trochus spp.	
Opistobranchs	sea slugs
Pinctada margaritifera	black lipped pearl oyster

Scientific Name	English Common Name
Tridacnidae	giant clam
Other Bivalves	other clams
Cephalopods	
Crustaceans	lobsters, shrimps/mantis shrimps, true crabs and hermit crabs (Those species not listed as CMUS)
Porifera	sponges
Stylasteridae	lace corals
Solanderidae	hydroid corals
Annelids	segmented worms
Algae	seaweed
Live rock	
All other coral reef ecosystem management unit species that are marine plants, invertebrates, and fishes that are not listed in the preceding tables or are not bottomfish management unit species, crustacean management unit species, Pacific pelagic management unit species, precious coral or seamount groundfish.	

1.7 Regional Coordination

In the Western Pacific Region, the management of ocean and coastal activities is conducted by a number of agencies and organizations at the federal, state, county, and even village levels. These groups administer programs and initiatives that address often overlapping and sometimes conflicting ocean and coastal issues.

To be successful, ecosystem approaches to management must be designed to foster intra- and interagency cooperation and communication (Schrope 2002). Increased coordination with state and local governments and community involvement will be especially important to the improved management of near-shore resources that are heavily used. To increase collaboration with domestic and international management bodies, as well as other governmental and non-governmental organizations, communities, and the public, the Council has adopted the multi-level approach described below.

1.7.1 Council Panels and Committees

FEP Advisory Panel

The FEP Advisory Panel advises the Council on fishery management issues, provides input to the Council regarding fishery management planning efforts, and advises the Council on the content and likely effects of management plans, amendments, and management measures.

The Advisory Panel consists of four sub-panels. In general, each Advisory Sub-panel includes two representatives from the area's commercial, recreational, and subsistence fisheries, as well as two additional members (fishermen or other interested parties) who are knowledgeable about the area's ecosystems and habitat. The exception is the Mariana FEP Sub-panel, which has four representatives from each group to represent the combined areas of Guam and the Northern Mariana Islands (see Table 6). The Hawaii FEP Sub-panel addresses issues pertaining to demersal fishing in the PRIA due to the lack of a permanent population and because such PRIA fishing has primarily originated in Hawaii. The FEP Advisory Panel meets at the direction of the Council to provide continuing and detailed participation by members representing various fishery sectors and the general public. FEP Advisory Panel members are representatives from various fishery sectors that are selected by the Council and serve two-year terms.

Table 6: **FEP Advisory Panel and Sub-panel Structure**

Representative	**American Samoa FEP Sub-panel**	**Hawaii FEP Sub-panel**	**Mariana FEP Sub-panel**	**Pelagic FEP Sub-panel**
Commercial representatives	Two members	Two members	Four members	Two members
Recreational representatives	Two members	Two members	Four members	Two members
Subsistence representatives	Two members	Two members	Four members	Two members
Ecosystems and habitat representatives	Two members	Two members	Four members	Two members

Archipelagic FEP Plan Team

The Archipelagic FEP Plan Team oversees the ongoing development and implementation of the American Samoa, Hawaii, Mariana, and PRIA FEPs and is responsible for reviewing information pertaining to the performance of all the fisheries and the status of all the stocks managed under the four Archipelagic FEPs. Similarly, the Pelagic FEP Plan Team oversees the ongoing development and implementation of the Pacific Pelagic FEP. These teams monitor the performance of the FEP through production of an annual stock assessment and fishery evaluation (SAFE) Report and provide information on the status of the fish stocks and other components of the ecosystem. The FEP Plan Team also makes recommendations for conservation and management adjustments under framework procedures to better achieve management objectives.

The Archipelagic Plan Team meets at least once annually and comprises individuals from local and federal marine resource management agencies and non-governmental organizations. It is led by a Chair who is appointed by the Council Chair after consultation with the Council's Executive Standing Committee. The Archipelagic Plan Team's findings and recommendations are reported to the Council at its regular meetings. Plan teams are a form of advisory panel authorized under Section 302(g) of the MSA. FEP Plan Team members comprise Federal, State and non-government specialists that are appointed by the Council and serve indefinite terms.

Science and Statistical Committee

The Scientific and Statistical Committee (SSC) is composed of scientists from local and federal agencies, academic institutions, and other organizations. These scientists represent a range of disciplines required for the scientific oversight of fishery management in the Western Pacific Region. The role of the SSC is to (a) identify scientific resources required for the development of FEPs and amendments, and recommend resources for Plan Teams; (b) provide multi-disciplinary review of management plans or amendments, and advise the Council on their scientific content; (c) assist the Council in the evaluation of such statistical, biological, economic, social, and other scientific information as is relevant to the Council's activities, and recommend methods and means for the development and collection of such information; and (d) advise the Council on the composition of both the Archipelagic and Pelagic Plan Teams. Members of the SSC are selected by the Council from a pool of applicants with appropriate education and training in physical, natural, and social sciences and serve indefinite terms.

The recently amended MSA may affect the duties of some of the various subgroups identified in this section. For example, the SSC will now have a strong role in specifying total allowable catches for stocks managed under this FEP.

FEP Standing Committees

The Council’s four FEP Standing Committees are composed of Council members who, prior to Council action, review all relevant information and data including the recommendations of the FEP Advisory Panels, the Archipelagic and Pelagic Plan Teams, and the SSC. The Standing Committees are the American Samoa FEP Standing Committee, the Hawaii FEP Standing Committee (as in the Advisory Panels, the Hawaii Standing Committee will also consider demersal issues in the PRIA), the Mariana FEP Standing Committee, and the Pelagic FEP Standing Committee. The recommendations of the FEP Standing Committees, along with the recommendations from all of the other advisory bodies described above, are presented to the full Council for their consideration prior to taking action on specific measures or recommendations.

Regional Ecosystem Advisory Committees

Regional Ecosystem Advisory Committees for each inhabited area (American Samoa, Hawaii, and the Mariana archipelago) comprise Council members and Council selected representatives from federal, state, and local government agencies; businesses; and non-governmental organizations that have responsibility or interest in land-based and non-fishing activities that potentially affect the area’s marine environment. Committee membership is by invitation and provides a mechanism for the Council and member agencies to share information on programs and activities, as well as to coordinate management efforts or resources to address non-fishing related issues that could affect ocean and coastal resources within and beyond the jurisdiction of the Council. Committee meetings coincide with regularly scheduled Council meetings, and recommendations made by the Committees to the Council are advisory as are recommendations made by the Council to member agencies. Regional Ecosystem Advisory Committees are a form of advisory panel authorized under Section 302(g) of the MSA.

1.7.2 Community Groups and Projects

As described above, communities and community members are involved in the Council's management process in explicit advisory roles, as sources of fishery data and as stakeholders invited to participate in public meetings, hearings, and comment periods. In addition, cooperative research initiatives have resulted in joint research projects in which scientists and fishermen work together to increase both groups' understanding of the interplay of humans and the marine environment, and both the Council's Community Development Program and the Community Demonstration Projects Program foster increased fishery participation by indigenous residents of the Western Pacific Region.

1.7.3 International Management and Research

The Council is an active participant in the development and implementation of international agreements regarding marine resources. The majority deal with management of the highly migratory pelagic species and include decisions made by the Inter-American Tropical Tuna Commission (IATTC), of which the U.S. is a member, and under the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Central and Western Pacific Region (Convention). On September 4, 2000, the United States voted for the adoption of and signed the Convention along with 19 other participants in the Conference on the Conservation and Management of Highly Migratory Fish Stocks of the Central and Western Pacific (or MHLC, for Multilateral High-Level Conference). The Convention established the Commission (WCPFC) to conserve and manage highly migratory species in the vast area of the western and central Pacific west of 150° meridian of west longitude. As of December 8, 2006, with passage of the amended MSA, the WCPFC was ratified and the U.S. will be a member of the Convention upon depositing the articles of association with the repository nation (New Zealand).

The Council is serving as a role model to other member nations with regards to ecosystem based-management through its participation in these and other international organizations. For example, the Council's comprehensive and interdisciplinary approach to pelagics fisheries management is an example of advances in conservation through improved gear technology; community participation through the public meeting process; sustainable fishing through limited entry programs and adherence to quota management; and using the best available science through cooperative research, improved stock assessments, and sharing knowledge within the regional fishery management organization (RFMO) process.

The Council also participates in and promotes the formation of regional and international arrangements through other RFMOs (e.g., the Forum Fisheries Agency, the Secretariat of the Pacific Community's Oceanic Fisheries Programme, the Food and Agriculture Organization of the U.N., the Intergovernmental Oceanographic Commission of UNESCO, the Inter-American Convention for the Protection and Conservation of Sea Turtles, the International Scientific Council, and the North Pacific Marine Science Organization) for assessing and conserving all marine resources throughout their range, including the ecosystems and habitats that they depend on. The Council is also developing similar linkages with the Southeast Asian Fisheries

Development Center and its turtle conservation program. Of increasing importance are bilateral agreements regarding demersal resources that are shared with adjacent countries (e.g., Samoa).

CHAPTER 2: TOPICS IN ECOSYSTEM APPROACHES TO MANAGEMENT

2.1 Introduction

An overarching goal of an ecosystem approach to fisheries management is to maintain and conserve the structure and function of marine ecosystems by managing fisheries in a holistic manner that considers the ecological linkages and relationships between a species and its environment, including its human uses and societal values (Garcia et al. 2003; Laffoley et al. 2004; Pikitch et al. 2004). Although the literature on the objectives and principles of ecosystem approaches to management is extensive, there remains a lack of consensus and much uncertainty among scientists and policy makers on how to best apply these often theoretical objectives and principles in a real-world regulatory environment (Garcia et al. 2003; Hilborn 2004). In many cases, it is a lack of scientific information that hinders their implementation (e.g., ecosystem indicators); in other cases, there are jurisdictional and institutional barriers that need to be overcome before the necessary changes can be accomplished to ensure healthy marine fisheries and ecosystems (e.g., ocean zoning). These and other topics are briefly discussed below to provide a context for the Council’s increasing focus on ecosystem approaches to management.

2.2 Ecosystem Boundaries

It is widely recognized that ecosystems are not static, but that their structure and functions vary over time due to various dynamic processes (Christensen et al. 1996; Kay and Schneider 1994; EPAP 1999). The term *ecosystem* was coined in 1935 by A. G. Tansley, who defined it as “an ecological community together with its environment, considered as a unit” (Tansley 1935). The U.S. Fish and Wildlife Service has defined an ecosystem as “a system containing complex interactions among organisms and their non-living, physical environment” (USFWS 1994), while NOAA defines an ecosystem as “a geographically specified system of organisms (including humans), the environment, and the processes that control its dynamics” (NOAA 2004).

Although these definitions are more or less consistent (only NOAA explicitly includes humans as part of ecosystems), the identification of ecosystems is often difficult and dependent on the scale of observation or application. Ecosystems can be reasonably identified (e.g., for an intertidal zone on Maui, Hawaii, as well as the entire North Pacific Ocean). For this reason, hierarchical classification systems are often used in mapping ecosystem linkages between habitat types (Allen and Hoekstra 1992; Holthus and Maragos 1995). NOAA’s Ecosystem Principles Advisory Panel found that although marine ecosystems are generally open systems, bathymetric and oceanographic features allow their identification on a variety of bases. In order to be used as functional management units, however, ecosystem boundaries need to be geographically based and aligned with ecologically meaningful boundaries (FAO 2002). Furthermore, if used as a basis for management measures, an ecosystem must be defined in a manner that is both scientifically and administratively defensible (Gonsalez 1996). Similarly, Sissenwine and Murawski (2004) found that delineating ecosystem boundaries is necessary to an ecosystem approach, but that the scale of delineation must be based on the spatial extent of the system that is to be studied or influenced by management. Thus, the identification of ecosystem boundaries for management purposes may differ from those resulting from purely scientific assessments, but in all cases ecosystems are geographically defined, or in other words, place- based.

2.3 Precautionary Approach, Burden of Proof, and Adaptive Management

There is general consensus that a key component of ecosystem approaches to resource management is the use of precautionary approaches and adaptive management (EPAP 1999). The FAO Code of Conduct for Responsible Fisheries states that under a precautionary approach:

> …in the absence of adequate scientific information, cautious conservation management measures such as catch limits and effort limits should be implemented and remain in force until there is sufficient data to allow assessment of the impacts of an activity on the long-term sustainability of the stocks, whereupon conservation and management measures based on that assessment should be implemented. (FAO 1995)

This approach allows appropriate levels of resource utilization through increased buffers and other precautions where necessary to account for environmental fluctuations and uncertain impacts of fishing and other activities on the ecology of the marine environment (Pikitch et al. 2004).

A notion often linked with the precautionary approach is shifting the "burden of proof" from resource scientists and managers to those who are proposing to utilize those resources. Under this approach, individuals would be required to prove that their proposed activity would not adversely affect the marine environment, as compared with the current situation that, in general, allows uses unless managers can demonstrate such impacts (Hildreth et al. 2005). Proponents of this approach believe it would appropriately shift the responsibility for the projection and analysis of environmental impacts to potential resource users and fill information gaps, thus shortening the time period between management decisions (Hildreth et al. 2005). Others believe that it is unrealistic to expect fishery participants and other resource users to have access to the necessary information and analytical skills to make such assessments.

The precautionary approach is linked to adaptive management through continued research and monitoring of approved activities (Hildreth et al. 2005). As increased information and an improved understanding of the managed ecosystem become available, adaptive management requires resource managers to operate within a flexible and timely decision structure that allows for quick management responses to new information or to changes in ecosystem conditions, fishing operations, or community structures.

2.4 Ecological Effects of Fishing and Non-fishing Activities

Fisheries may affect marine ecosystems in numerous ways, and vice versa. Populations of fish and other ecosystem components can be affected by the selectivity, magnitude, timing, location, and methods of fish removals. Fisheries can also affect marine ecosystems through vessel disturbance, bycatch or discards, impacts on nutrient cycling, or introduction of exotic species, pollution, and habitat disturbance. Historically, federal fishery management focused primarily on ensuring long-term sustainability by preventing overfishing and by rebuilding overfished stocks. However, the reauthorization of the MSA in 1996 placed additional priority on reducing non-target or incidental catches, minimizing fishing impacts to habitat, and eliminating interactions with protected species. While fisheries management has significantly improved in these areas in recent years, there is now an increasing emphasis on the need to account for and minimize the unintended and indirect consequences of fishing activities on other components of the marine environment such as predator–prey relationships, trophic guilds, and biodiversity (Browman and Stergiou 2004; Dayton et al. 2002).

For example, fishing for a particular species at a level below its maximum sustainable yield can nevertheless limit its availability to predators, which, in turn, may impact the abundance of the predator species. Similarly, removal of top-level predators can potentially increase populations of lower level trophic species, thus causing an imbalance or change in the community structure of an ecosystem (Pauly et al. 1998). Successful ecosystem management will require significant increases in our understanding of the impacts of these changes and the formulation of appropriate responses to adverse changes.

Marine resources are also affected by non-fishing aquatic and land-based activities. For example, according to NOAA's (2005b) *State of Coral Reefs Ecosystems of the United States and Pacific Freely Associated States*, anthropogenic stressors that are potentially detrimental to coral reef resources include the following:

- Coastal development and runoff
- Coastal pollution
- Tourism and recreation
- Ships, boats, and groundings
- Anchoring
- Marine debris
- Aquatic invasive species
- Security training activities

Non-anthropogenic impacts arise from events such as weather cycles, hurricanes, and environmental regime changes. While managers cannot regulate or otherwise control such events, their occurrence can often be predicted and appropriate management responses can lessen their adverse impacts.

Understanding the complex inter-relationships between marine organisms and their physical environment is a fundamental component of successful ecosystem approaches to management. Obtaining the necessary information to comprehensively assess, interpret, and manage these inter-relationships will require in-depth and long-term research on specific ecosystems.

2.5 Data and Information Needs

Numerous research and data collection projects and programs have been undertaken in the Western Pacific Region and have resulted in the collection of huge volumes of potentially valuable detailed bathymetric, biological, and other data. Some of this information has been processed and analyzed by fishery scientists and managers; however, much has proven difficult to utilize and integrate due to differences in collection methodologies coupled with a lack of meta-data or documentation of how the data were collected and coded. This has resulted in incompatible datasets as well as data that are virtually inaccessible to anyone except the primary researchers. The rehabilitation and integration of existing datasets, as well as the establishment of shared standards for the collection and documentation of new data, will be an essential part of successful and efficient ecosystem management in the Western Pacific Region.

2.6 Use of Indicators and Models

Clearly, ecosystem-based management is enhanced by the ability to understand and predict environmental changes, as well as the development of measurable characteristics (e.g., indices) related to the structure, composition, or function of an ecological system (de Young et al. 2004; EPAP 1999; MAFAC 2003).

Indicators

The development and use of indicators are an integral part of an ecosystem approach to management as they provide a relatively simple mechanism to track complex trends in ecosystems or ecosystem components. Indicators can be used to help answer questions about whether ecosystem changes are occurring, and the extent (state variables; e.g., coral reef biomass) to which causes of changes (pressure variables; e.g., bleaching) and the impacts of changes influence ecosystem patterns and processes. This information may be used to develop appropriate response measures in terms of management action. This pressure–state–response framework provides an intuitive mechanism for causal change analyses of complex phenomena in the marine environment and can clarify the presentation and communication of such analyses to a wide variety of stakeholders (Wakeford 2005).

Monitoring and the use of indicator species as a means to track changes in ecological health (i.e., as an identifier of stresses) have been studied in various marine ecosystems including Indo-Pacific coral reefs using butterflyfishes (Crosby and Reese 1996) and boreal marine ecosystems in the Gulf of Alaska using pandalid shrimp, a major prey of many fish species (Anderson 2000). Others have examined the use of spatial patterns and processes as indicators of management performance (Babcock et al. 2005), and others have used population structure parameters, such as mean length of target species, as an indicator of biomass depletion (Francis and Smith 1995). Much has been written on marine ecosystem indicators (FAO 1999; ICES 2000, 2005). There are, however, no established reference points for optimal ecosystem structures, composition, or functions. Due to the subjective nature of describing or defining the desirable ecosystems that would be associated with such reference points (e.g., a return to some set of prehistoric conditions vs. an ecosystem capable of sustainable harvests), this remains a topic of much discussion.

Models

The ecosystem approach is regarded by some as endlessly complicated as it is assumed that managers need to completely understand the detailed structure and function of an entire ecosystem in order to implement effective ecosystem-based management measures (Browman and Stergiou 2004). Although true in the ideal, interim approaches to ecosystem management need not be overly complex to achieve meaningful improvements.

Increasing interest in ecosystem approaches to management has led to significant increases in the modeling of marine ecosystems using various degrees of parameter and spatial resolution. Ecosystem modeling of the Western Pacific Region has progressed from simple mathematical models to dynamically parameterized simulation models (Polovina 1984; Polovina et al. 1994; Polovina et al. 2004).

While physical oceanographic models are well developed, modeling of trophic ecosystem components has lagged primarily because of the lack of reliable, detailed long-term data. Consequently, there is no single, fully integrated model that can simulate all of the ecological linkages between species and the environment (de Young et al. 2004).

De Young et al. (2004) examined the challenges of ecosystem modeling and presented several approaches to incorporating uncertainty into such models. However, Walters (2005) cautioned against becoming overly reliant on models to assess the relative risks of various management alternatives and suggested that modeling exercises should be used as aids in experimental design rather than as precise prescriptive tools.

2.7 Single-species Management versus Multi-species Management

A major theme in ecosystem-based approaches to fisheries management is the movement from conventional single-species management to multi-species management (Mace 2004; Sherman 1986). Multi-species management is generally defined as management based on the consideration of all fishery impacts on all marine species rather than focusing on the maximum sustainable yield for any one species. The fact that many of the ocean's fish stocks are believed to be overexploited (FAO 2002) has been used by some as evidence that single-species models and single-species management have failed (Hilborn 2004; Mace 2004). Hilborn (2004) noted that some of the species that were historically overexploited (e.g., whales, bluefin tuna) were not subject to any management measures, single- species or otherwise. In other cases (e.g., northern cod), it was not the models that failed but the political processes surrounding them (Hilborn 2004). Thus, a distinction must be made between the use of single-species or multi-species models and the application of their resultant management recommendations. Clearly, ecosystem management requires that all fishery impacts be considered when formulating management measures, and that both single-species and multi-species models are valuable tools in this analysis. In addition, fishery science and management must remain open and transparent, and must not be subjected to distorting political perspectives, whether public or private. However, it also appears clear that fishery regulations must continue to be written on a species-specific basis (e.g., allowing participants to land no more than two bigeye tuna and two fish of any other species per day), as to do otherwise would lead to species highgrading (e.g., allowing participants to land no more than four fish [all species combined] per day could result in each participant landing four bigeye tuna per day) and likely lead to overexploitation of the most desirable species.

Although successful ecosystem management will require the holistic analysis and consideration of marine organisms and their environment, the use of single-species models and management measures will remain an important part of fishery management (Mace 2004). If applied to all significant fisheries within an ecosystem, conservative single-species management has the potential to address many ecosystem management issues (ICES 2000; Murawski 2005; Witherell et al. 2000).

Recognizing the lack of a concise blueprint to implement the use of ecosystem indicators and models, there is growing support for building upon traditional single-species management to incrementally integrate and operationalize ecosystem principles through the use of geographically parameterized indicators and models (Browman and Stergiou 2004; Sissenwine and Murawski 2004).

2.8 Ocean Zoning

The use of ocean zoning to regulate fishing and non-fishing activities has been a second major theme in the development of marine ecosystem management theory (Browman and Stergiou 2004). In general, these zones are termed *Marine Protected Areas* (MPAs) and are implemented for a wide variety of objectives ranging from establishing wilderness areas to protecting economically important spawning stocks (Lubchenco et al. 2003). In 2000, Executive Order 13158 was issued for the purpose of expanding the Nation's existing system of MPAs to "enhance the conservation of our Nation's natural and cultural marine heritage and the ecologically and economically sustainable use of the marine environment for future generations." The Executive Order also established an MPA Federal Advisory Committee charged with providing expert advice and recommendations on the development of a national system of MPAs. In June 2005, this Committee released its first report, which includes a range of objectives and findings including the need for measurable goals, objectives, and assessments for all MPAs (NOAA 2005). Today, MPAs can be found throughout the Western Pacific Region and are considered to be an essential part of marine management. Ongoing research and outreach is anticipated to result in the implementation of additional MPAs as ecosystem research provides additional insights regarding appropriate MPA locations and structures to achieve specific objectives.

2.9 Intra-agency and Inter-agency Cooperation

To be successful, ecosystem approaches to management must be designed to foster intra- and inter-agency cooperation and communication (Schrope 2002). As discussed in Chapter 1, the Western Pacific Region includes an array of federal, state, commonwealth, territory, and local government agencies with marine management authority. Given that these many agencies either share or each has jurisdiction over certain areas or activities, reaching consensus on how best to balance resource use with resource protection is essential to resolving currently fragmented policies and conflicting objectives. Coordination with state and local governments will be especially important to the improved management of near-shore resources as these are not under Federal authority. The recently released U.S. Ocean Action Plan (issued in response to the report of the U.S. Ocean Commission on Policy) recognized this need and established a new cabinet level Committee on Ocean Policy (U.S. Ocean Action Plan 2004) to examine and resolve these issues. One alternative would be to centralize virtually all domestic marine management authority within one agency; however, this would fail to utilize the local expertise and experience contained in existing agencies and offices, and would likely lead to poor decision making and increased social and political conflict.

2.10 Community-based Management

Communities are created when people live or work together long enough to generate local societies. Community members associate to meet common needs and express common interests, and relationships built over many generations lead to common cultural values and understandings through which people relate to each other and to their environment. At this point, collective action may be taken to protect local resources if they appear threatened, scarce, or subject to overexploitation. This is one example of community-based resource management.

As ecosystem principles shift the focus of fishery management from species to places, increased participation from the primary stakeholders (i.e., community members) can enhance marine management by (a) incorporating local knowledge regarding specific locations and ecosystem conditions; (b) encouraging the participation of stakeholders in the management process, which has been shown to lead to improved data collection and compliance; and (c) improving relationships between communities and often centralized government agencies (Dyer and McGoodwin 1994).

Top-down management tends to center on policy positions that polarize different interest groups and prevent consensus (Yaffee 1999). In contrast, "place"—a distinct locality imbued with meaning—has value and identity for all partners and can serve to organize collaborative partnerships. Despite often diverse backgrounds and frequently opposing perspectives, partners are inspired to take collective on-the-ground actions organized around their connections and affiliations with a particular place (Cheng et al. 2003).

In August 2004, President Bush issued Executive Order 13352 to promote partnerships between federal agencies and states, local governments, tribes, and individuals that will facilitate cooperative conservation and appropriate inclusion of local participation in federal decision making regarding the Nation's natural resources. Similarly, the U.S. Ocean Action Plan (2004) found that "local involvement by those closest to the resource and their communities is critical to ensuring successful, effective, and long-lasting conservation results."

Successful resource management will need to incorporate the perspectives of both local and national stakeholder groups in a transparent process that explicitly addresses issues of values, fairness, and identity (Hampshire et al. 2004). Given their long histories of sustainable use of marine resources, indigenous residents of the Western Pacific Region have not universally embraced increasingly prohibitive management necessitated by the modern influx of foreign colonizers and immigrants. In addition, some recent campaigns by non-governmental organizations representing often far-off groups vigorously opposed to virtually all use of marine resources have increased what many see as the separation of local residents from the natural environment that surrounds them. As humans are increasingly removed and alienated from the natural environment, feelings of local ownership and stewardship are likely to decline, and subsequent management and enforcement actions will become increasingly difficult (Hampshire et al. 2004). This is especially relevant in the Western Pacific Region, which comprises a collection of remote and far-flung island areas, most of which have poorly funded monitoring and enforcement capabilities.

2.10.1 Community Participation

The Council's community program developed out of the need for an indigenous program to address barriers to the participation of indigenous communities in fisheries managed by the Council. An objective of the indigenous program is to arrive at a point of collaboration, reconciliation and consensus between the native indigenous community and the larger immigrant communities in CNMI, Guam and Hawaii. The community in American Samoa is 80 – 90 percent native but the objective is the same—to arrive at a point of collaboration, reconciliation and consensus with the larger U.S..

The Council's community program is consistent with the need for the development of Fishery Ecosystem Plans. Fishery Ecosystem Plans are place-based fishery management plans that allow the Council to incorporate ecosystem principles into fishery management. Human communities are important elements for consideration in ecosystem-based resource management plans. Resources are managed for people, communities. NOAA has recognized that communities are part of the ecosystem.

Any community-based initiative is about empowering the community. The Council's efforts to develop fishery ecosystem plans (FEP) are focused on community collaboration, participation and partnership. The efforts result in the development of strong community projects such as community-led data collection and monitoring programs and revitalization of traditional and cultural fishing practices. Finding and partnering with communities and organizations is time-consuming and resource depleting. Outreach to communities in the form of presentations and participation in school and community activities and other fora is ongoing to find projects that the Council can support.

Community-Based Resource Management (CBRM) is a way for communities to gain control of and manage their resources in ways that allow them to harvest and cultivate products in a sustainable manner. CBRM is based on the principle of empowering people to manage the natural and material resources that are critical to their community and regional success. This FEP increases the community's capacity and expertise in natural resource management, and provides viable alternatives to uncontrolled resource depletion.

Because of the Council's role in fishery conservation and management, many resources and skills are available within the Council. These assets form the base for the application of Asset Based Community Development (ABCD) – Community assets connected to organization assets produce strong community-based projects.

Community assets include, but are not limited to, cultural knowledge, resource areas, habitats, sites, organizations, schools, individuals, families, community diversity and all of the attributes that bring value to and define a community.

The community program of the Council is the application of Council assets to community assets to produce community-based projects that strengthen the community's ability to conserve and manage their marine resources.

2.10.2 Community Development

In recent years, attention has been given to the potential impact of growth and development on communities. In general, growth has been viewed as healthy and desirable for communities because it leads to additional jobs; increased economic opportunities; a broader tax base; increased access to public services and the enhancement of cultural amenities. Growth is also accompanied by changes in social structure, increased fiscal expenditures for necessary public services and infrastructure, increased traffic, increased and changed utilization and consumption of local natural resources and loss of open space and unique cultural attributes. Development decisions are often made without a sufficient understanding of the consequences of those decisions on overall community well-being. Changes induced by growth in a community are not always positive. Fishery ecosystem planning requires the participation of communities. Careful, planned decision-making is necessary for ensuring that growth and development is consistent with the long-range goals of the community.

CHAPTER 3: DESCRIPTION OF THE ENVIRONMENT

3.1 Introduction

Chapter 3 describes the environment and resources included within the PRIA FEP. For more information, please see the Council's FMPs, FMP amendments and associated annual reports. Additional information is also available[2] in a 2008 environmental assessment for the Crustaceans FMP (WPRFMC 2008a), a 2001 Final EIS for the Coral Reef Ecosystems FMP (WPRFMC 2001), 2007 and 2008 environmental assessments for the Precious Corals FMP (WPRFMC 2007b, WPRFMC 2008b), a 2005 Final EIS to the Bottomfish FMP (WPRFMC 2005a), a 2007 Final Supplemental EIS to the Bottomfish FMP (WPRFMC 2007a) and a 2006 environmental assessment under the Crustaceans and Bottomfish FMPs prepared in association with the inclusion of the PRIA into the management area of those FMPs (WPRFMC 2006), which are incorporated here by reference. Although this FEP will not manage the Western Pacific Region's pelagic fisheries, successful management requires consideration of interactions between pelagic and demersal environments at an ecosystem level, thus both are discussed here.

3.2 Physical Environment

The following discussion presents a broad summary of the physical environment of the Pacific Ocean. The dynamics of the Pacific Ocean's physical environment have direct and indirect effects on the occurrence and distribution of life in marine ecosystems.

3.2.1 The Pacific Ocean

The Pacific Ocean is world's largest body of water. Named by Ferdinand Magellan as *Mare Pacificum* (Latin for "peaceful sea"), the Pacific Ocean covers more than one third of Earth's surface (~64 million square miles). From north to south, it's more than 9,000 miles long; from east to west, the Pacific Ocean is nearly 12,000 miles wide (on the Equator). The Pacific Ocean contains several large seas along its western margin including the South China Sea, Celebes Sea, Coral Sea, and Tasman Sea.

3.2.2 Geology and Topography

Pacific islands have been formed by geologic processes associated with plate tectonics, volcanism, and reef accretion. The theory of plate tectonics provides that Earth's outer shell, the "lithosphere", is constructed of more than a dozen large solid "plates" that migrate across the planet surface over time and interact at their edges. The plates sit above a solid rocky mantle that is hot, and capable of flow. Figure 2 is a schematic diagram of Earth's lithospheric plates. These are made of various kinds of rock with different densities and can be thought of as pieces of a giant jigsaw puzzle–where the movement of one plate affects the position of others. Generally, the oceanic portion of plates is composed of basalt enriched with iron and magnesium which is

[2] Available from the Council at www.wpcouncil.org or at 1164 Bishop St. Ste 1400, Honolulu, HI 96813.

denser than the continental portion composed of granite which is enriched with silica.[3] Tectonic processes and plate movements define the contours of the Pacific Ocean. Generally, the abyssal plain or seafloor of the central Pacific basin is relatively uniform, with a mean depth of about 4270 m (14,000 ft).[4] Within the Pacific basin, however, are underwater plate boundaries that define long mountainous chains, submerged volcanoes, islands and archipelagos, and various other bathymetric features that influence the movement of water and the occurrence and distribution of marine organisms.

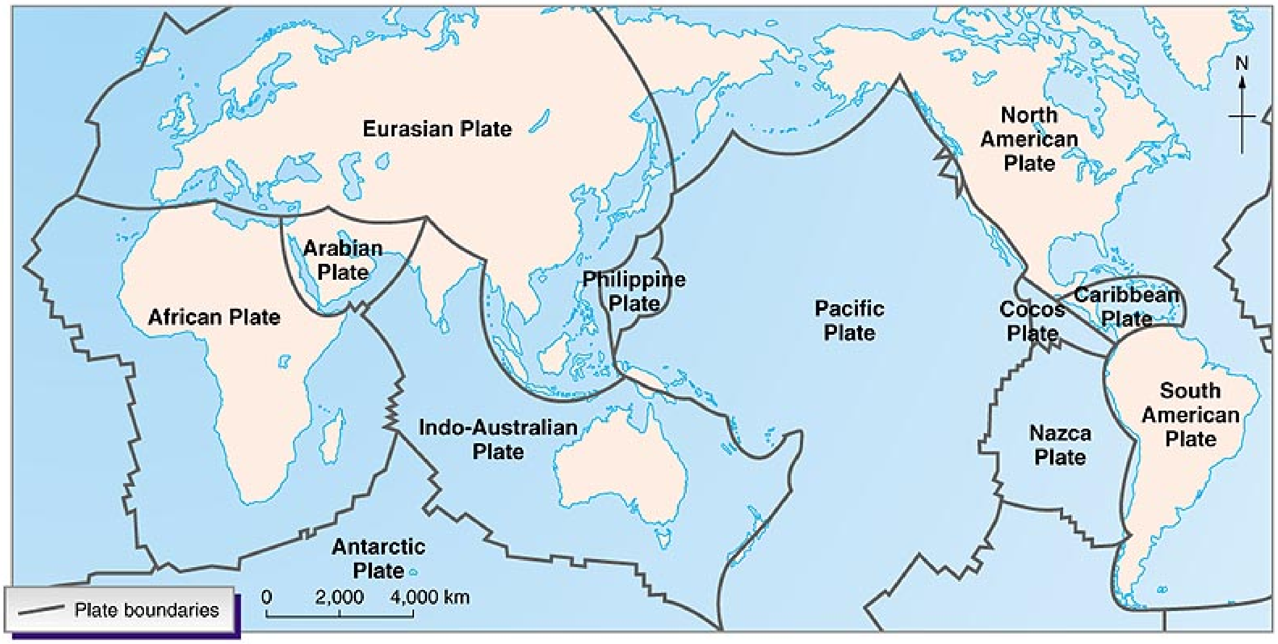

Figure 2: Schematic Diagram of the Earth's Lithospheric Plates
Source: Dr. C.H. Fletcher III, UH Dept. of Geology and Geophysics, personal communication

Divergent plate boundaries —locations where lithospheric plates separate from each other—form "spreading centers" where new seafloor is constructed atop high mid-ocean ridges. These ridges stretch for thousands of kilometers[5] and are characterized by active submarine volcanism and earthquakes. At these ridges, magma is generated at the top of the mantle immediately underlying an opening, or rift, in the lithosphere. As magma pushes up under the spreading lithosphere it inflates the ridges until a fissure is created and lava erupts onto the sea floor (Fryer and Fryer 1999). The erupted lava, and its subsequent cooling, forms new seafloor on the edges of the separating plates. This process is responsible for the phenomenon known as "seafloor spreading", where new ocean floor is constantly forming and sliding away from either side of the ridge.[6]

Convergent plate boundaries are locations where two plates move together and one plate, usually composed of denser basalt, subducts or slides beneath the other which is composed of less dense

[3] http://www.soest.hawaii.edu/coasts/chip/ch02/ch_2_7.asp
[4] http://www.physicalgeography.net/fundamentals/8o.html (accessed January 2007)
[5] http://www.washington.edu/burkemuseum/geo_history_wa/The Restless Earth v.2.0.htm (accessed July 2006)
[6] http://www.washington.edu/burkemuseum/geo_history_wa/The Restless Earth v.2.0.htm (accessed July 2006)

rock, and is recycled into the mantle. When two plates of equivalent density converge, the rock at the boundary fractures and shears like the front ends of two colliding cars, and forms a large mountain range. The Himalayan Range has this origin. There are three different types of plate convergence: 1) ocean-continent convergence, 2) ocean-ocean convergence, and 3) continent-continent convergence (Fryer and Fryer 1999). A well known example of ocean-ocean convergence is observed in the western Pacific, where the older and denser Pacific Plate subducts under the younger and less dense Philippine Plate at a very steep angle. This results in the formation of the Marianas Trench which at nearly 11 km (~36,000 ft) is the deepest point of the seafloor.[7] Ocean-ocean convergent boundary movements may result in the formation of island arcs, where the denser (generally older) plate subducts under the less dense plate. Melting in the upper mantle above the subducting plate generates magma that rises into the overlying lithosphere and may lead to the formation of a chain of volcanoes known as an island arc.[8] The Indonesian Archipelago has this geologic origin, as does the Aleutian Island chain.

Transform boundaries, a third type of plate boundary, occur when lithospheric plates neither converge nor diverge, but shear past one another horizontally, like two ships at sea that rub sides. The result is the formation of very hazardous seismic zones of faulted rock, of which California's San Andreas Fault is an example (Fryer and Fryer 1999).

In addition to the formation of island arcs from ocean-ocean convergence, dozens of linear island chains across the Pacific Ocean are formed from the movement of the Pacific Plate over stationary sources of molten rock known as hot spots (Fryer and Fryer 1999). A well known example of hot spot island formation is the Hawaiian Ridge-Emperor Seamounts chain that extends some 6,000 km from the "Big Island" of Hawaii (located astride the hotspot) to the Aleutian Trench off Alaska where ancient islands are recycled into the mantle.[9] Although less common, hot spots can also be found at mid-ocean ridges, exemplified by the Galapagos Islands in the Pacific Ocean.[10]

The Pacific Ocean contains nearly 25,000 islands which can be simply classified as high islands or low islands. High islands, like their name suggests, extend higher above sea level, and often support a larger number of flora and fauna and generally have fertile soil. Low islands are generally atolls built by layers of calcium carbonate secreted by reef building corals and calcareous algae on a volcanic core of a former high island that has submerged below sea level. Over geologic time, the rock of these low islands has eroded or subsided to where all that is remaining near the ocean surface is a broad reef platform surrounding a usually deep central lagoon (Nunn 2003).

3.2.3 Ocean Water Characteristics

Over geologic time, the Pacific Ocean basin has been filled in by water produced by physical and biological processes. A water molecule is the combination of two hydrogen atoms bonded with one oxygen atom. Water molecules have asymmetric charges, exhibiting a positive charge on the

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[7] http://www.soest.hawaii.edu/coasts/chip/ch02/ch_2_7.asp
[8] http://www.soest.hawaii.edu/coasts/chip/ch02/ch_2_7.asp
[9] http://pubs.usgs.gov/publications/text/Hawaiian.html
[10] http://pubs.usgs.gov/publications/text/hotspots.html#anchor19620979

hydrogen sides and a negative charge on the oxygen side of the molecule. This charge asymmetry allows water to be an effective solvent, thus the ocean contains a diverse array of dissolved substances. Relative to other molecules, water takes a great deal of heat to change temperature, and thus the oceans have the ability to store large amounts of heat. When water evaporation occurs, large amounts of heat are absorbed by the ocean (Tomzack and Godfrey 2003). The overall heat flux observed in the ocean is related to the dynamics of four processes: (a) incoming solar radiation, (b) outgoing back radiation,(c) evaporation, and (d) mechanical heat transfer between ocean and atmosphere (Bigg 2003).

The major elements (> 100 ppm) present in ocean water include chlorine, sodium, magnesium, calcium, and potassium, with chlorine and sodium being the most prominent, and their residue (sea salt–NaCL) is left behind when seawater evaporates. Minor elements (1–100 ppm) include bromine, carbon, strontium, boron, silicon, and fluorine. Trace elements (< 1 ppm) include nitrogen, phosphorus, and iron (Levington 1995).

Oxygen is added to seawater by two processes: (a) atmospheric mixing with surface water, and (b) photosynthesis. Oxygen is subtracted from water through respiration of all organisms including bacterial decomposition of organic matter (Tomzack and Godfrey 2003).

3.2.4 Ocean Layers

On the basis of the effects of temperature and salinity on the density of water (as well as other factors such as wind stress on water), the ocean can be separated into three layers: the surface layer or mixed layer, the thermocline or middle layer, and the deep layer. The surface layer generally occurs from the surface of the ocean to a depth of around 400 meters (or less depending on location) and is the area where the water is mixed by currents, waves, and weather. The thermocline is generally from 400 meters –to 800 meters and where water temperatures significantly differ from the surface layer, forming a temperature gradient that inhibits mixing with the surface layer. More than 90 percent of the ocean by volume occurs in the deep layer, which is generally below 800 meters and consists of water temperatures around 0–4° C. The deep zone is void of sunlight and experiences high water pressure (Levington 1995).

The temperature of ocean water is important to oceanographic systems. For example, the temperature of the mixed layer has an affect on the evaporation rate of water into the atmosphere, which in turn is linked to the formation of weather. The temperature of water also produces density gradients within the ocean, which prevents mixing of the ocean layers (Bigg 2003). See Figure 3 for a generalized representation of water temperatures and depth profiles

The amount of dissolved salt or salinity varies between ocean zones, as well as across oceans. The average salinity of the oceans is 35 parts-per-thousand (ppt), but it can vary at different latitudes depending on evaporation and precipitation rates. At the Equator, where salinity is 35 ppt, the dilution of sea water by rain is offset by the loss of water by evaporation. But in the latitudes bordering the Equator the opposite condition prevails -- evaporation exceeds rainfall because high temperatures plus increased winds accelerate evaporation losses. Salinity also varies with depth causing vertical salinity gradients (Bigg 2003). See Figure 3 for a generalized representation of a salinity cline at various ocean depths.

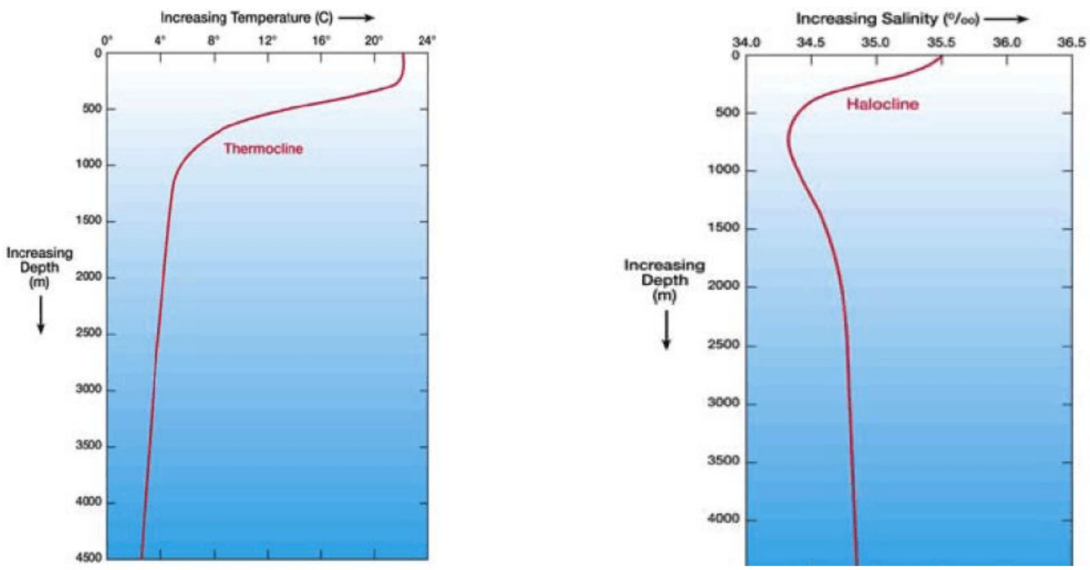

Figure 3: Temperature and Salinity Profile of the Ocean

Sources: http://www.windows.ucar.edu/tour/link=/earth/Water/temp.html&edu=high (accessed July 2005 http://www.windows.ucar.edu/tour/link=/earth/Water/salinity_depth.html&edu=high (accessed July 2005).

3.2.5 Ocean Zones

The ocean can be separated into the following five zones (see Figure 4) relative to the amount of sunlight that penetrates through seawater: (a) epipelagic, (b) mesopelagic, (c) bathypelagic, (d) abyssalpelagic, and (e) hadalpelagic. Sunlight is the principle factor of primary production (phytoplankton) in marine ecosystems, and because sunlight diminishes with ocean depth, the amount of sunlight penetrating seawater and its affect on the occurrence and distribution of marine organisms are important. The epipelagic zone extends to nearly 200 meters and is the near extent of visible light in the ocean. The mesopelagic zone occurs between 200 meters and 1,000 meters and is sometimes referred to as the "twilight zone." Although the light that penetrates to the mesopelagic zone is extremely faint, this zone is home to wide variety of marine species. The bathypelagic zone occurs from 1,000 feet to 4,000 meters, and the only visible light seen is the product of marine organisms producing their own light, which is called "bioluminescence." The next zone is the abyssalpelagic zone (4,000 m–6,000 m), where there is extreme pressure and the water temperature is near freezing. This zone does not provide habitat for very many creatures except small invertebrates such as squid and basket stars. The last zone is the hadalpelagic (6,000 m and below) and occurs in trenches and canyons. Surprisingly, marine life such as tubeworms and starfish are found is this zone, often near hydrothermal vents.

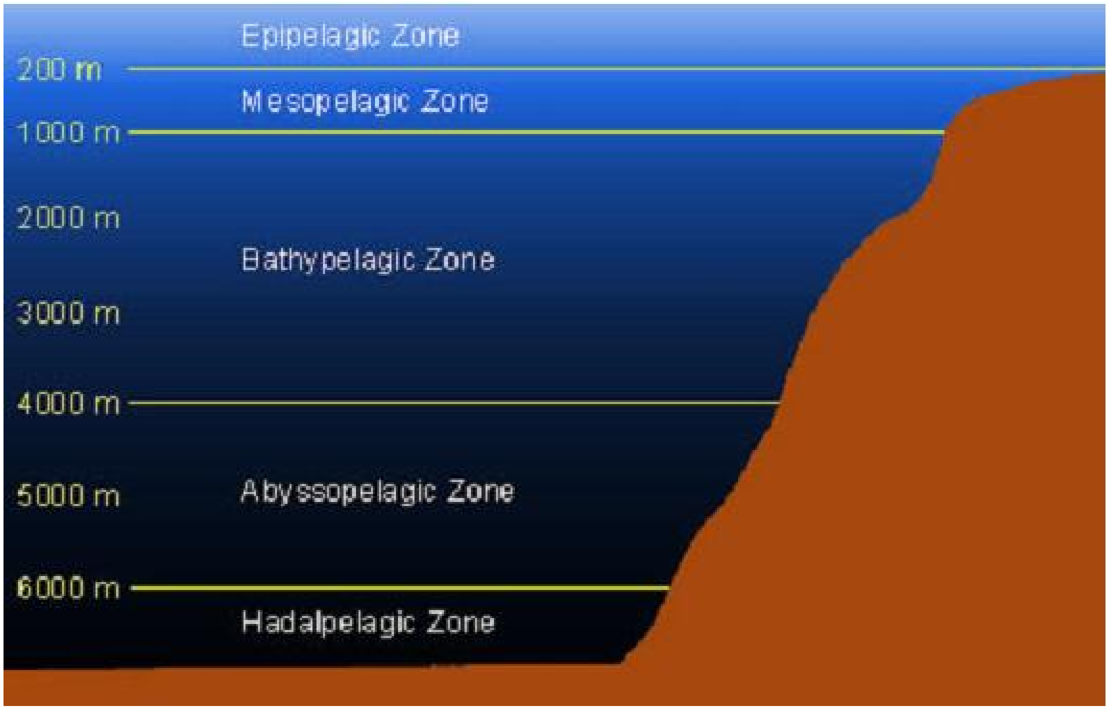

Figure 4: Depth Profile of Ocean Zones
Source: WPRFMC 2005b.

3.2.6 Ocean Water Circulation

The circulation of ocean water is a complex system involving the interaction between the oceans and atmosphere. The system is primarily driven by solar radiation that results in wind being produced from the heating and cooling of ocean water, and the evaporation and precipitation of atmospheric water. Except for the equatorial region, which receives a nearly constant amount of solar radiation, the latitude and seasons affect how much solar radiation is received in a particular region of the ocean. This, in turn, has an affect on sea–surface temperatures and the production of wind through the heating and cooling of the system (Tomzack and Godfrey 2003).

3.2.7 Surface Currents

Ocean currents can be thought of as organized flows of water that exist over a geographic scale and time period in which water is transported from one part of the ocean to another part of the ocean (Levington 1995). In addition to water, ocean currents also transport plankton, fish, heat, momentum, salts, oxygen, and carbon dioxide. Wind is the primary force that drives ocean surface currents; however, Earth’s rotation and wind determine the direction of current flow. The sun and moon also influence ocean water movements by creating tidal flow, which is more readily observed in coastal areas rather than in open-ocean environments (Tomzack and Godfrey 2003). Figure 5 shows the major surface currents of the Pacific Ocean.

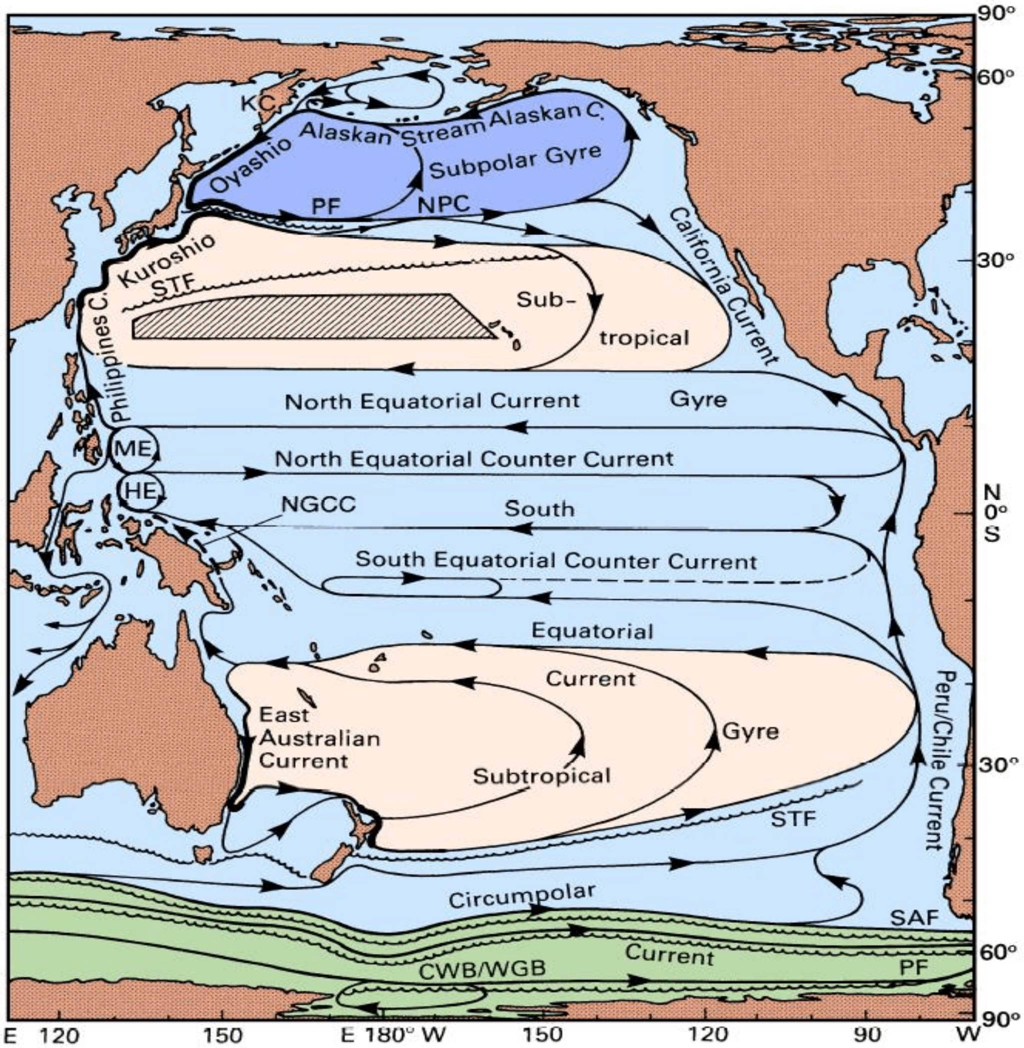

Figure 5: Major Surface Currents of the Pacific Ocean

Source: Tomczack and Godfrey (2003).Note: Abbreviations include: the Mindanao Eddy (ME), the Halmahera Eddy (HE), the New Guinea Coastal (NGCC), the North Pacific (NPC), and the Kamchatka Current (KC). Other abbreviations refer to fronts: NPC (North Pacific Current), STF (Subtropical Front), SAF (Subantarctic Front), PF (Polar Front), and CWB/WGB (Continental Water Boundary/Weddell Gyre Boundary).

3.2.8 Transition Zones

Transition zones are areas of ocean water bounded to the north and south by large-scale surface currents originating from subartic and subtropical locations (Polovina et al. 2001). Located generally between 32° N and 42° N, the North Pacific Transition Zone is an area between the southern boundary of the Subartic Frontal Zone (SAFZ) and the northern boundary of the Subtropical Frontal Zone (STFZ; see Figure 6). Individual temperature and salinity gradients are observed within each front, but generally the SAFZ is colder (~8° C) and less salty (~33.0 ppm) than the STFZ (18° C, ~35.0 ppm, respectively). The North Pacific Transition Zone (NPTZ) supports a marine food chain that experiences variation in productivity in localized areas due to changes in nutrient levels brought on, for example, by storms or eddies. A common characteristic among some of the most abundant animals found in the Transition Zone such as flying squid, blue sharks, Pacific pomfret, and Pacific saury is that they undergo seasonal migrations from summer feeding grounds in subartic waters to winter spawning grounds in the subtropical waters. Other animals found in the NPTZ include swordfish, tuna, albatross, whales, and sea turtles (Polovina et al. 2001).

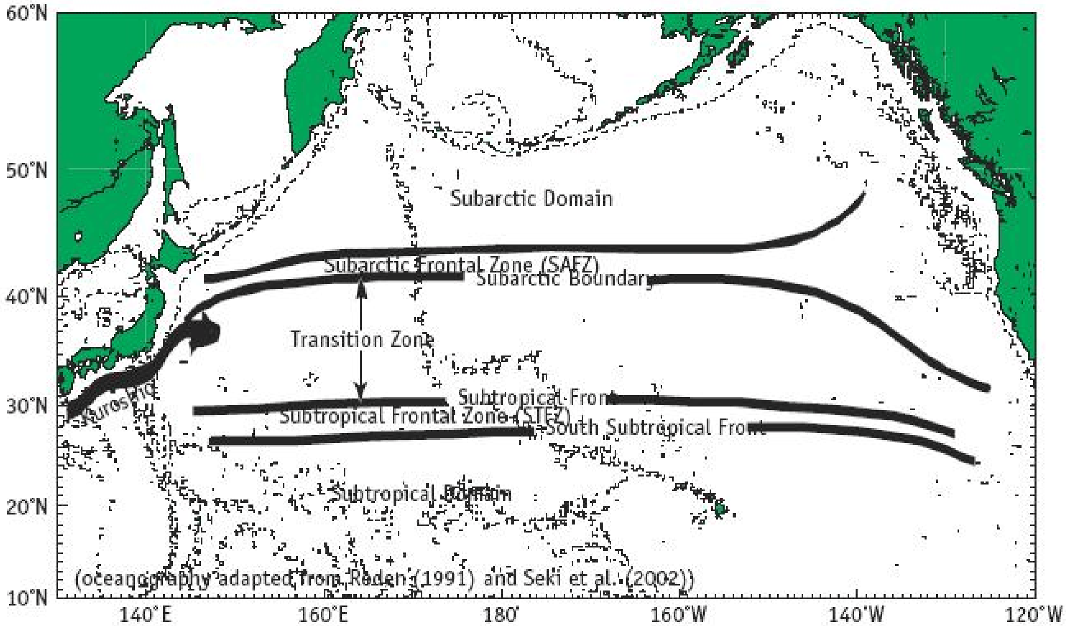

Figure 6: North Pacific Transition Zone
Source: : http://www.pices.int/publications/special_publications/NPESR/2005/File_12_pp_201_210.pdf (accessed July 2005)

3.2.9 Eddies

Eddies are generally short to medium term water movements that spin off of surface currents and can play important roles in regional climate (e.g., heat exchange) as well as the distribution of marine organisms. Large-scale eddies spun off of the major surface currents often blend cold water with warm water, the nutrient rich with the nutrient poor, and the salt laden with fresher waters (Bigg 2003). The edges of eddies, where the mixing is greatest, are often targeted by fishermen as these are areas of high biological productivity.

3.2.10 Deep-Ocean Currents

Deep-ocean currents, or thermohaline movements, are a result of density differences in the ocean from the effects of salinity and temperature on seawater (Tomzack and Godfrey 2003). In the Southern Ocean, for example, water exuded from sea ice is extremely dense due to its high salt content and, therefore, sinks to the bottom and flows down filling up the deep polar ocean basins. The system delivers water to deep portions of the polar basins as the dense water spills out into oceanic abyssal plains. The movement of the dense water is influenced by bathymetry. For example, the Arctic Ocean does not contribute much of its dense water to the Pacific Ocean due to the narrow shallows of the Bering Strait. Generally, the deep-water currents flow through the Atlantic Basin, around South Africa, into the Indian Ocean, past Australia, and into the Pacific Ocean. This process has been labeled the "ocean conveyor belt"—taking nearly 1,200 years to complete one cycle. The movement of the thermohaline conveyor can affect global weather patterns, and has been the subject of much research as it relates to global climate variability. See Figure 7 for a simplified schematic diagram of the deep-ocean conveyor belt system.

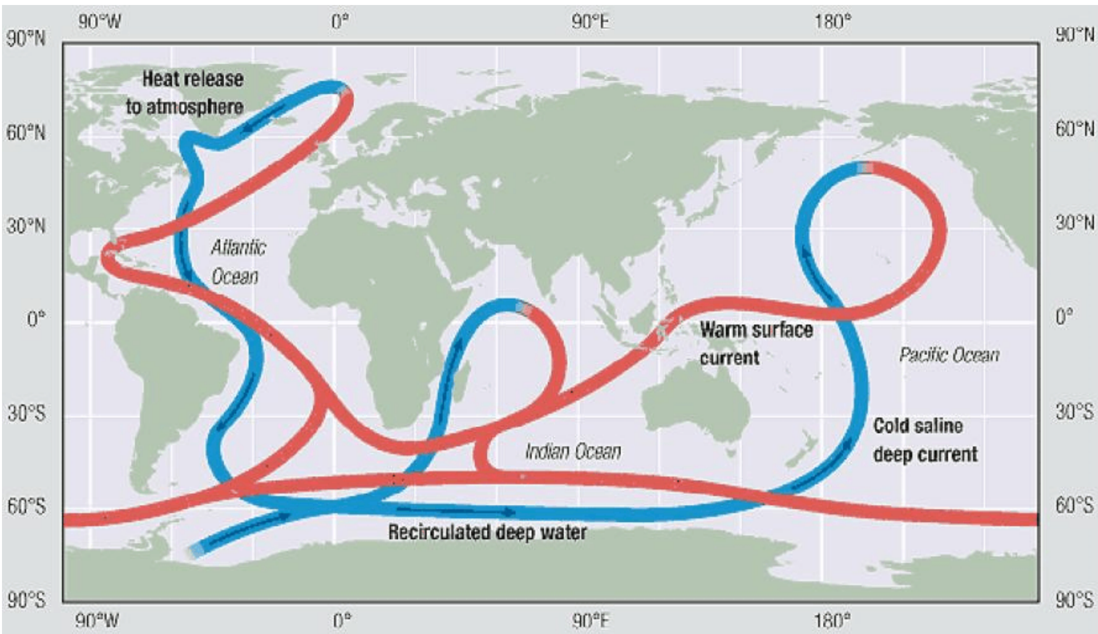

Figure 7: Deep-Ocean Water Movement
Source: U.N. GEO Yearbook 2004

3.2.11 Prominent Pacific Ocean Meteorological Features

The air–sea interface is a dynamic relationship in which the ocean and atmosphere exchange energy and matter. This relationship is the basic driver for the circulation of surface water (through wind stress) as well as for atmospheric circulation (through evaporation). The formation of weather systems and atmospheric pressure gradients are linked to exchange of energy (e.g., heat) and water between air and sea (Bigg 2003).

Near the equator, intense solar heating causes air to rise and water to evaporate, thus resulting in areas of low pressure. Air flowing from higher trade wind pressure areas move to the low pressure areas such as the Intertropical Convergence Zone (ITCZ) and the South Pacific Convergence Zone (SPCZ), which are located around 5° N and 30° S, respectively. Converging trade winds in these areas do not produce high winds, but instead often form areas that lack significant wind speeds. These areas of low winds are known as the "doldrums." The convergence zones are associated near ridges of high sea–surface temperatures, with temperatures of 28° C and above, and are areas of cloud accumulation and high rainfall amounts. The high rainfall amounts reduce ocean water salinity levels in these areas (Sturman and McGowan 2003).

The air that has risen in equatorial region fans out into the higher troposphere layer of the atmosphere and settles back toward Earth at middle latitudes. As air settles toward Earth, it creates areas of high pressure known as subtropical high-pressure belts. One of these high-pressure areas in the Pacific is called the “Hawaiian High Pressure Belt,” which is responsible for the prevailing trade wind pattern observed in the Hawaiian Islands (Sturman and McGowan 2003).

The Aleutian Low Pressure System is another prominent weather feature in the Pacific Ocean and is caused by dense polar air converging with air from the subtropical high-pressure belt. As these air masses converge around 60° N, air is uplifted, creating an area of low pressure. When the relatively warm surface currents (Figure 5) meet the colder air temperatures of subpolar regions, latent heat is released, which causes precipitation. The Aleutian Low is an area where large storms with high winds are produced. Such large storms and wind speeds have the ability to affect the amount of mixing and upwelling between ocean layers, such as the mixed layer and thermocline (Polovina et al. 1994).

The dynamics of the air–sea interface do not produce steady states of atmospheric pressure gradients and ocean circulation. As discussed in the previous sections, there are consistent weather patterns (e.g., ITCZ) and surface currents (e.g., north equatorial current); however, variability within the ocean–atmosphere system results in changes in winds, rainfall, currents, water column mixing, and sea-level heights, which can have profound effects on regional climates as well as on the abundance and distribution of marine organisms.

One example of a shift in ocean–atmospheric conditions in the Pacific Ocean is El Niño–Southern Oscillation (ENSO). ENSO is linked to climatic changes in normal prominent weather features of the Pacific and Indian Oceans, such as the location of the ITCZ. ENSO, which can occur every 2–10 years, results in the reduction of normal trade winds, which reduces the intensity of the westward flowing equatorial surface current (Sturman and McGowan 2003). In turn, the eastward flowing countercurrent tends to dominate circulation, bringing warm, low-salinity low-nutrient water to the eastern margins of the Pacific Ocean. As the easterly trade winds are reduced, the normal nutrient-rich upwelling system does not occur, leaving warm surface water pooled in the eastern Pacific Ocean.

The impacts of ENSO events are strongest in the Pacific through disruption of the atmospheric circulation, generalized weather patterns, and fisheries. ENSO affects the ecosystem dynamics in the equatorial and subtropical Pacific by considerable warming of the upper ocean layer, rising of the thermocline in the western Pacific and lowering in the east, strong variations in the intensity of ocean currents, low trade winds with frequent westerlies, high precipitation at the dateline, and drought in the western Pacific (Sturman and McGowan 2003). ENSO events have the ability to significantly influence the abundance and distribution of organisms within marine ecosystems. Human communities also experience a wide range of socioeconomic impacts from ENSO such as changes in weather patterns resulting in catastrophic events (e.g., mudslides in California due to high rainfall amounts) as well as reductions in fisheries harvests (e.g., collapse of anchovy fishery off Peru and Chile; Levington 1995; Polovina 2005).

Changes in the Aleutian Low Pressure System are another example of interannual variation in a prominent Pacific Ocean weather feature profoundly affecting the abundance and distribution of marine organisms. Polovina et al. (1994) found that between 1977 and 1988 the intensification of the Aleutian Low Pressure System in the North Pacific resulted in a deeper mixed-layer depth, which led to higher nutrients levels in the top layer of the euphotic zone. This, in turn, led to an increase in phytoplankton production, which resulted in higher productivity levels (higher abundance levels for some organisms) in the Northwestern Hawaiian Islands. Changes in the Aleutian Low Pressure System and its resulting effects on phytoplankton productivity are thought to occur generally every ten years. The phenomenon is often referred to as the "Pacific Decadal Oscillation" (Polovina 2005; Polovina et al. 1994).

3.2.12 Pacific Island Geography

The following sections briefly describe the island areas of the Western Pacific Region to provide background on the diversity of island nations and the corresponding physical and political geography surrounding the PRIA. These Pacific islands areas are generally grouped into three major areas: (a) Micronesia, (b) Melanesia, and (c) Polynesia. However, the islands of Japan and the Aleutian Islands in the North Pacific are generally not included in these three areas, and they are not discussed here as this analysis focuses on the Western Pacific Region and its ecosystems. Information used in this section was obtained from the online version of the U.S.Central Intelligence Agency's World Fact Book. [11]

3.2.12.1 Micronesia

Micronesia, which is primarily located in the western Pacific Ocean, is made up of hundreds of high and low islands within six archipelagos including the: (a) Caroline Islands, (b) Marshall Islands, (c) Mariana Islands, (d) Gilbert Islands, (e) Line Islands, and (f) Phoenix Islands.

The Caroline Islands (~850 square miles) are composed of many low coral atolls, with a few high islands. Politically, the Caroline Islands are separated into two countries: Palau and the Federated States of Micronesia.

The Marshall Islands (~180 square miles) are made up of 34 low-lying atolls separated into two chains: the southeastern Ratak Chain and the northwestern Ralik Chain. Wake Island is geologically a part of the Marshall Islands archipelago.

The Mariana Islands (~396 square miles) are composed of 15 volcanic islands that are part of a submerged mountain chain that stretches nearly 1,500 miles from Guam to Japan. Politically, the Mariana Islands are split into the Territory of Guam and the Commonwealth of Northern Mariana Islands, both of which are U.S. possessions.

[11] http://www.cia.gov/cia/publications/factbook/index.html

Nauru (~8 square miles), located southeast of the Marshall Islands, is a raised coral reef atoll rich in phosphate. The island is governed by the Republic of Nauru, which is the smallest independent nation in the world.

The Gilbert Islands are located south of the Marshall Islands and are made up of 16 low-lying atolls.

The Line Islands, located in the central South Pacific, are made up of ten coral atolls, of which Kirimati is the largest in the world (~609 square miles). The U.S. possessions of Kingman Reef, Palmyra Atoll, and Jarvis Island (a part of the PRIA) are located within the Line Islands. Most of the islands and atolls in these three chains, however, are part of the Republic of Kiribati (~ 811 square miles), which has an EEZ of nearly one million square miles.

The Phoenix Islands, located to the southwest of the Gilbert Islands, are composed of eight coral atolls. Howland and Baker Islands (U.S. possessions) are located within the Phoenix archipelago.

3.2.12.2 Melanesia

Melanesia is composed of several archipelagos that include: (a) Fiji Islands, (b) New Caledonia, (c) Solomon Islands, (d) New Guinea, (e), Vanuatu Islands, and (f), Maluku Islands.

Located approximately 3,500 miles northeast of Sydney, Australia, the Fiji archipelago (~18,700 square miles) is composed of nearly 800 islands: the largest islands are volcanic in origin and the smallest islands are coral atolls. The two largest islands, Viti Levu and Vanua Levu, make up nearly 85 percent of the total land area of the Republic of Fiji Islands.

Located nearly 750 miles east–northeast of Australia, is the volcanic island of Grande Terre or New Caledonia (~6,300 square miles). New Caledonia is French Territory and includes the nearby Loyalty Islands and the Chesterfield Islands, which are groups of small coral atolls.

The Solomon Islands (~27,500 square miles) are located northwest of New Caledonia and east of Papua New Guinea. Thirty volcanic islands and several small coral atolls make up this former British colony, which is now a member of the Commonwealth of Nations. The Solomon Islands are made up of smaller groups of islands such as the New Georgia Islands, the Florida Islands, the Russell Islands, and the Santa Cruz Islands. Approximately 1,500 miles separate the western and eastern island groups of the Solomon Islands.

New Guinea is the world's second largest island and is thought to have separated from Australia around 5000 BC. New Guinea is split between two nations: Indonesia (west) and Papua New Guinea (east). Papua New Guinea (~178,700 square miles) is an independent nation that also governs several hundred small islands within several groups. These groups include the Bismarck Archipelago and the Louisiade Islands, which are located north of New Guinea, and Tobriand Islands, which are southeast of New Guinea. Most of the islands within the Bismark and Lousiade groups are volcanic in origin, whereas the Tobriand Islands are primarily coral atolls.

The Vanuatu Islands (~4,700 square miles) make up an archipelago that is located to the southeast of the Solomon Islands. There are 83 islands in the approximately 500-mile long Vanuatu chain, most of which are volcanic in origin. Before becoming an independent nation in 1980 (Republic of Vanuatu), the Vanuatu Islands were colonies of both France and Great Britain, and known as New Hebrides.

The Maluku Islands (east of New Guinea) and the Torres Strait Islands (between Australia and New Guinea) are also classified as part of Melanesia. Both of these island groups are volcanic in origin. The Maluku Islands are under Indonesia's governance, while the Torres Strait Islands are governed by Australia.

3.2.12.3 Polynesia

Polynesia is composed of several archipelagos and island groups including: (a) New Zealand and associated islands, (b) Tonga, (c) Samoa Islands, (d) Cook Islands, (e) Tuvalu, (f) Tokelau , (g) the Territory of French Polynesia, (h) Pitcairn Islands, (i) Easter Island (Rapa Nui), and (j) Hawaii.

New Zealand (~103,470 square miles) is composed of two large islands, North Island and South Island, and several small island groups and islands. North Island (~44,035 square miles) and South Island (~58,200 square miles) extend for nearly 1,000 miles on a northeast–southwest axis and have a maximum width of 450 miles. The other small island groups within the former British colony include the Chatham Islands and the Kermadec Islands. The Chatham Islands are a group of ten volcanic islands located 800 kilometers east of South Island. The four emergent islands of the Kermadec Islands are located 1,000 kilometers northeast of North Island and are part of a larger island arc with numerous subsurface volcanoes. The Kermadec Islands are known to be an active volcanic area where the Pacific Plate subducts under the Indo-Australian Plate.

The islands of Tonga (~290 square miles) are located 450 miles east of Fiji and consist of 169 islands of volcanic and raised limestone origin. The largest island, Tongatapu (~260 square miles), is home to two thirds of Tonga's population (~106,000). The people of Tonga are governed under a hereditary constitutional monarchy.

The Samoa archipelago is located northeast of Tonga and consists of seven major volcanic islands, several small islets, and two coral atolls. The largest islands in this chain are Upolu (~436 square miles) and Savai`i (~660 square miles). Upolu and Savai`i and its surrounding islets and small islands are governed by the Independent State of Samoa with a population of approximately 178,000 people. Tutuila (~55 square miles), the Manua Islands (a group of three volcanic islands with a total land area of less than 20 square miles), and two coral atolls (Rose Atoll and Swains Island) are governed by the U.S. Territory of American Samoa. More than 90 percent of American Samoa's population (~68,000 people) live on Tutuila. The total land mass of American Samoa is about 200 square kilometers, surrounded by an EEZ of approximately 390,000 square kilometers.

To the east of the Samoa archipelago are the Cook Islands (~90 square miles), which are separated into the Northern Group and Southern Group. The Northern Group consists of six sparsely populated coral atolls, and the Southern Group consists of seven volcanic islands and two coral atolls. Rorotonga (~26 square miles), located in the Southern Group, is the largest island in the Cook Islands and also serves as the capitol of this independent island nation. From north to south, the Cook Islands spread nearly 900 miles, and the width between the most distant islands is nearly 450 miles. The Cook Islands EEZ is approximately 850,000 square miles.

Approximately 600 miles northwest of the Samoa Islands is Tuvalu (~10 square miles), an independent nation made up of nine low-lying coral atolls. None of the islands have elevation higher than 14 feet, and the total population of the country is around 11,000 people. Tuvalu’s coral island chain extends for nearly 360 miles, and the country has an EEZ of 350,000 square miles.

East of Tuvalu and north of Samoa are the Tokelau Islands (~4 square miles). Three coral atolls make up this territory of New Zealand, and a fourth atoll (Swains Island) is of the same group, but is controlled by the U.S Territory of American Samoa.

The 32 volcanic islands and 180 coral atolls of the Territory of French Polynesia (~ 1,622 square miles) are made up of the following six groups: the Austral Islands, Bass Islands, Gambier Islands, Marquesas Islands, Society Islands, and the Tuamotu Islands. The Austral Islands are a group of six volcanic islands in the southern portion of the territory. The Bass Islands are a group of two islands in the southern-most part of the territory, with their vulcanism appearing to be much more recent than that of the Austral Islands. The Gambier Islands are a small group of volcanic islands in a southeastern portion of the Territory and are often associated with the Tuamotu Islands because of their relative proximity; however, they are a distinct group because they are of volcanic origin rather than being coral atolls. The Tuamotu Islands, of which there are 78, are located in the central portion of the Territory and are the world’s largest chain of coral atolls. The Society Islands are group of several volcanic islands that include the island of Tahiti. The island of Tahiti is home to nearly 70 percent of French Polynesia’s population of approximately 170,000 people. The Marquesa Islands are an isolated group of islands located in the northeast portion of the territory, and are approximately 1,000 miles northeast of Tahiti. All but one of the 17 Marquesas Islands are volcanic in origin. French Polynesia has one of the largest EEZs in the Pacific Ocean at nearly two million square miles.

The Pitcairn Islands are a group of five islands thought to be an extension of the Tuamotu Archipelago. Pitcairn Island is the only volcanic island, with the others being coral atolls or uplifted limestone. Henderson Island is the largest in the group; however, Pitcairn Island is the only one that is inhabited.

Easter Island, a volcanic high island located approximately 2,185 miles west of Chile, is thought to be the eastern extent of the Polynesian expansion. Easter Island, which is governed by Chile, has a total land area of 63 square miles and a population of approximately 3,790 people.

The northern extent of the Polynesian expansion is the Hawaiian Islands, which are made up of 137 islands, islets, and coral atolls. The exposed islands are part of a great undersea mountain range known as the Hawaiian-Emperor Seamount Chain, which was formed by a hot spot within the Pacific Plate. The Hawaiian Islands extend for nearly 1,500 miles from Kure Atoll in the northwest to the Island of Hawaii in the southeast. The Hawaiian Islands are often grouped into the Northwestern Hawaiian Islands (Nihoa to Kure) and the Main Hawaiian Islands (Hawaii to Niihau). The total land area of the 19 primary islands and atolls is approximately 6,423 square miles, and the over 75 percent of the 1.2 million population lives on the island of Oahu.

3.3 Biological Environment

This section contains general descriptions of marine trophic levels, food chains, and food webs, as well as a description of two general marine environments: benthic or demersal (associated with the seafloor) and pelagic (the water column and open ocean). A broad description of the types of marine organisms found within these environments is provided, as well as a description of organisms important to fisheries. Protected species are also described in this section. . This section is intended to provide background information on the ecosystems which will be given consideration in managing the fisheries of the PRIA.

3.3.1 Marine Food Chains, Trophic Levels, and Food Webs

Food chains are often thought of as a linear representation of the basic flow of organic matter and energy through a series of organisms. Food chains in marine environments are normally segmented into six trophic levels: primary producers, primary consumers, secondary consumers, tertiary consumers, quaternary consumers, and decomposers.

Generally, primary producers in the marine ecosystems are organisms that fix inorganic carbon into organic carbon compounds using external sources of energy (i.e., sunlight). Such organisms include single-celled phytoplankton, bottom-dwelling algae, macroalgae (e.g., sea weeds), and vascular plants (e.g., kelp). All of these organisms share common cellular structures called “chloroplasts,” which contain chlorophyll. Chlorophyll is a pigment that absorbs the energy of light to drive the biochemical process of photosynthesis. Photosynthesis results in the transformation of inorganic carbon into organic carbon such as carbohydrates, which are used for cellular growth.

Primary consumers in the marine environment are organisms that feed on primary producers, and depending on the environment (i.e., pelagic vs. benthic) include zooplankton, corals, sponges, many fish, sea turtles, and other herbivorous organisms. Secondary, tertiary, and quaternary consumers in the marine environment are organisms that feed on primary or higher level consumers and include fish, mollusks, crustaceans, mammals, and other carnivorous and omnivorous organisms. Decomposers live off dead plants and animals, and are essential in food chains as they break down organic matter and make it available for primary producers (Valiela 2003).

Marine food webs are complex representations of overall patterns of feeding among organisms, but generally they are unable to reflect the true complexity of the relationships between organisms, so they must be thought of as simplified representations. An example of a marine food web applicable to the Western Pacific is presented in Figure 8. The openness of marine ecosystems, lack of specialists, long life spans, and large size changes and food preferences across the life histories of many marine species make marine food webs more complex than their terrestrial and freshwater counterparts (Link 2002). Nevertheless, food webs are an important tool in understanding ecological relationships among organisms.

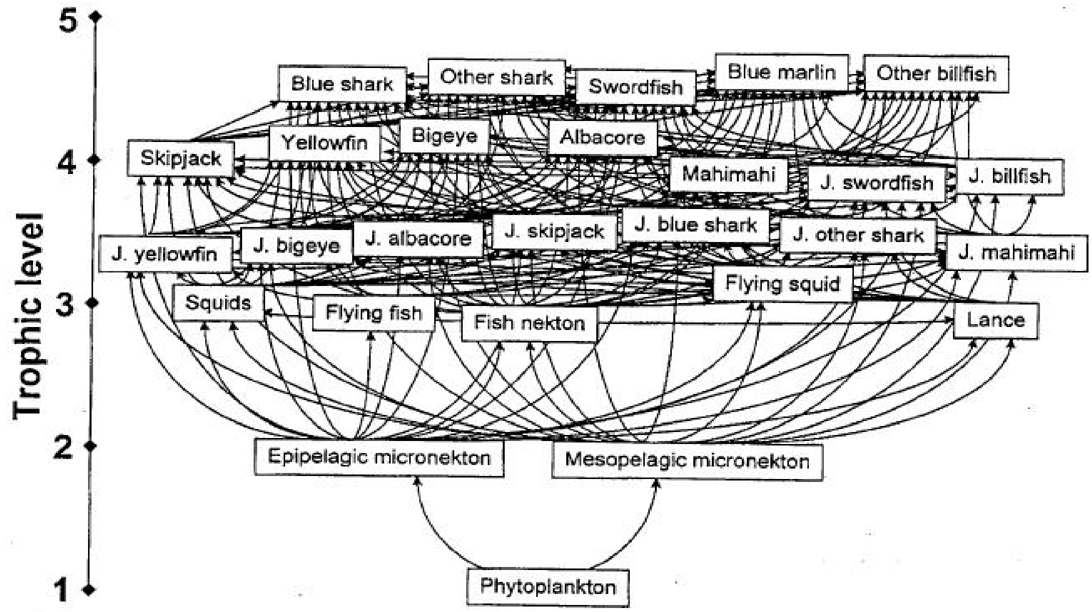

Figure 8: Central Pacific Pelagic Food Web
Source: Kitchell et al. 1999

This tangled "bird's nest" represents interactions at the approximate trophic level of each pelagic species, with increasing trophic level toward the top of the web (Kitchell et al. 1999).

3.3.2 Benthic Environment

The word *benthic* comes from the Greek work *benthos* or "depths of the sea." The definition of the benthic (or demersal) environment is quite general in that it is regarded as extending from the high-tide mark to the deepest depths of the ocean floor. Benthic habitats are home to a wide range of marine organisms forming complex community structures. This section presents a simple description of the following benthic zones: (a) intertidal tide pools, (b) subtidal (e.g., coral reefs), (c) deep-reef slope, (d) banks and seamounts and (e) deep-ocean bottom (see Figure 9).

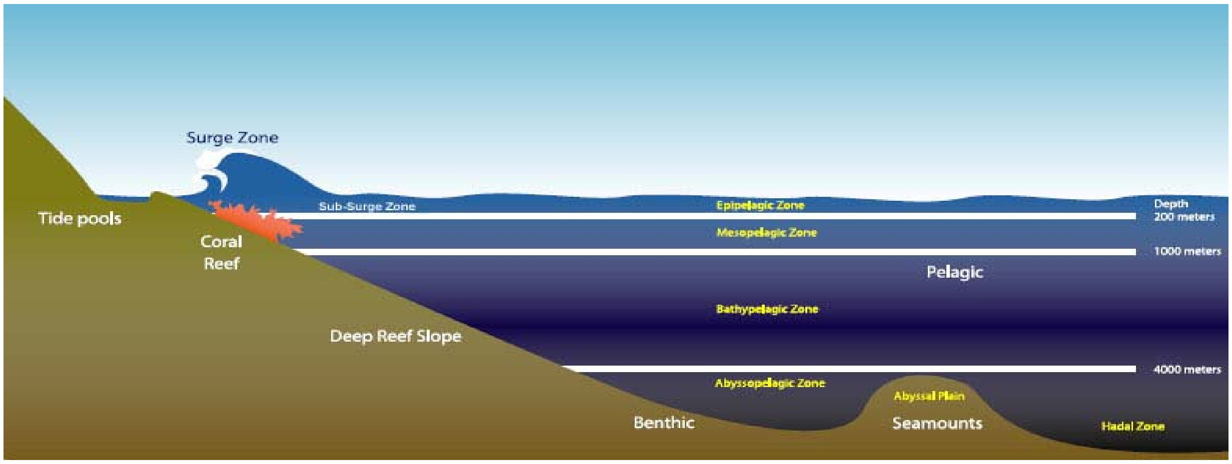

Figure 9: Benthic Environment Source: WPRFMC 2005b

3.3.2.1 Intertidal Zone

The intertidal zone is a relatively small margin of seabed that exists between the highest and lowest extent of the tides. Because of wave action on unprotected coastlines, the intertidal zone can sometimes extend beyond tidal limits due to the splashing effect of waves. Vertical zonation among organisms is often observed in intertidal zones, where the lower limits of some organisms are determined by the presence of predators or competing species, whereas the upper limit is often controlled by physiological limits and species' tolerance to temperature and drying (Levington 1995). Organisms that inhabit the intertidal zone include algae, seaweeds, mollusks, crustaceans, worms, echinoderms (starfish), and cnidarians (e.g., anemones).

Many organisms in the intertidal zone have adapted strategies to combat the effects of temperature, salinity, and desiccation due to the wide-ranging tides of various locations. Secondary and tertiary consumers in intertidal zones include starfish, anemones, and seabirds. Marine algae are the primary produces in most intertidal areas. Many species' primary consumers such as snails graze on algae growing on rocky substrates in the intertidal zone. Due to the proximity of the intertidal zone to the shoreline, intertidal organisms are important food items to many human communities. In Hawaii, for example, intertidal limpet species (snails) such as `opihi (*Cellana exarata*) were eaten by early Hawaiian communities and are still a popular food item in Hawaii today. In addition to mollusks, intertidal seaweeds are also important food items for Pacific islanders.

3.3.2.2 Seagrass Beds

Seagrasses 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), seagrasses 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. Seagrass beds are the habitat of certain commercially valuable shrimps, and provide food for reef-associated species such as surgeonfishes (Acanthuridae) and rabbitfishes (Siganidae). Seagrasses 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 coral reef 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.

3.3.2.3 Mangrove Forests

Mangroves are terrestrial shrubs and trees that are able to live in the salty environment of the intertidal zone. Their prop roots form important substrate on which sessile organisms can grow, and they provide shelter for fishes. Mangroves are believed to also provide important nursery habitat for many juvenile reef fishes. 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 are important as nursery grounds for peneaeid shrimps and some inshore fish species. They also provide a habitat for some commercially valuable crustaceans. There are no native mangroves in the PRIA.

3.3.2.4 Coral Reefs

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 in the Pacific Ocean, coral reefs are confined to the warm tropical and subtropical waters lying between 30° N and 30° S. Coral reef ecosystems are some of 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 (Hatcher et al. 1989).

Coral reefs and reef-building organisms are confined to the shallow upper euphotic zone. Maximum reef growth and productivity occur between 5 and 15 meters (Hopley and Kinsey 1988), and maximum diversity of reef species occurs at 10–30 meters (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 past 10,000 years, and many reefs below this depth drowned during this period. Coral reef habitat does extend deeper than 30 meters, but few well-developed reefs are found below 50 meters. Many coral reefs are bordered by broad areas of shelf habitat (reef slope) between 50 and 100 meters that were formed by wave erosion during periods of lower sea levels. These reef slope habitats consist primarily of carbonate rubble, algae, and microinvertebrate communities, some of which may be important nursery grounds for some coral reef fish, as well as a habitat for several species of lobster. However, the ecology of this habitat is poorly known, and much more research is needed to define the lower depth limits of coral reefs, which by inclusion of shelf habitat could be viewed as extending to 100 meters.

The symbiotic relationship between the animal coral polyps and algal cells (dinoflagellates, 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, because of the low nitrogen content of the carbohydrates derived from photosynthesis. Due to reef-building coral's symbiotic relationship with photosynthetic zooxanthellae, reef-building corals do not generally occur at depths greater than 100 meters (~300 ft)(Hunter 1995).

Primary production on coral reefs is associated with phytoplankton, algae, seagrasses, and zooxanthellae. Primary consumers include many different species of corals, mollusks, crustaceans, echinoderms, gastropods, sea turtles, and fish (e.g., parrot fish). Secondary consumers include anemones, urchins, crustaceans, and fish. Tertiary consumers include eels, octopus, barracudas, and sharks.

The corals and coral reefs of the Pacific are described in Wells and Jenkins (1988) and Veron (1995). The number of coral species declines in an easterly direction across the western and central Pacific, which is in common with the distribution of fish and invertebrate species. More than 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 Marquesas 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 important, 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. As a consequence, Hawaiian coral reefs provide limited "protecting" three-dimensional space. This is thought to account for the exceptionally high rate of endemism among Hawaiian marine species. Furthermore, many believe that this is the reason certain fish and invertebrate species look and act very differently from similar members of the same species found in other parts of the South Pacific (Gulko 1998).

Coral Reefs of the PRIA

NOAA's *The State of Coral Reef Ecosystems of the United States and Pacific Freely Associated States: 2005* (NOAA 2005) concluded that coral reef ecosystems around the PRIA are generally healthy and quite productive. Assessments conducted by the Coral Reef Ecosystem Division (CRED) of NMFS' Pacific Islands Fisheries Science Center and the USFWS between 2000 and 2004 found that corals at Baker, Howland, Jarvis, Kingman and Palmyra remained in a recovery phase following an apparent mass bleaching event within the few years before 2004 (NOAA 2005). In 2004, these surveys found corals at Howland and Baker to have little signs of disease, however corals inside the Johnston Atoll lagoon had a 3.1 percent disease rate. Surface runoff is nearly non-existent in the PRIA as there has not been any coastal development since the World War II era. Surface run-off is similarly low as they have porous carbonate soils that readily absorb rainfall. The airplane runways at Wake and Johnston are designed as rainfall catchment systems, while those at Palmyra, Jarvis, Howland and Baker have either deteriorated or lie within an arid zone, and all are incapable of collecting rainfall and generating surface runoff (NOAA 2005). Surveys for crown of thorns starfish were also conducted with aggregations sighted around Palmyra in 2001 and 2002. By 2004 these aggregations had disappeared. Aggregations were also seen in 2004 at Johnston (2.9 starfish/km). Crown of thorns starfish were most abundant at Kingman Reef with recorded sighting increasing by 44 percent between 2002 and 2004 (from 13.8 to19.9 starfish/km). No aggregations have been observed in other parts of the PRIA. The health, functioning, and biogeography of the coral reef ecosystems of the PRIA are primarily controlled by the oceanographic conditions to which fish, coral, algae, and other invertebrates are exposed. Due to its higher latitude, Johnston is periodically exposed to hurricanes and significant wave events that play a fundamental role in forming and maintaining the biogeographic distribution of corals, algae, fishes and invertebrates within its coral reef ecosystem (NOAA 2005). Based on a review of literature as well as the surveys conducted by CRED and the USFWS, NOAA's report concludes that based on inventories, assessments, and monitoring thus far, several summary statements can be made:

- Based on the fish assemblage composition surveyed from 2000-2004, coral reef ecosystems of the PRIA appear to remain quite healthy and productive.
- Levels of unauthorized fishing around the U.S. Line and Phoenix Islands are unknown but believed to be negligible to light. Overall, reef fish assemblages at these islands appear to be basically healthy, with large apex predators common.
- There is presently no known harvesting for the coral and live reef fish/species trades in these islands.
- Substantial crown-of-thorns starfish predation on corals has been observed at Kingman and Palmyra but appears low elsewhere in the PRIA.
- High densities of small planktivorous fishes found along the west side of the equatorial islands (Jarvis, Baker, Howland) were associated with upwelling caused by impingement of the Equatorial Undercurrent.
- Coral larvae transported in the Equatorial Counter Current from the western Pacific may be responsible for the substantially higher levels of coral species diversity at Palmyra and Kingman.
- Surveys conducted at Kingman in 2004 suggest an apparent decline in large fish densities (e.g., gray reef sharks, jacks, groupers) from earlier years.
- Abandoned WWII material, military construction, occupation, and ship groundings continue to be sources of stress, alien species, and perhaps coral disease to resident reef ecosystems.
- Although uninhabited atolls and islands serve as important minimally disturbed refuges, they are also vulnerable to unauthorized fishing and collecting due to the lack of on-site surveillance and enforcement.

Coral Reef Productivity

Coral reefs are among the most biologically productive environments in the world. The global potential for coral reef fisheries has been estimated at nine million metric tons per year, which is impressive given the small area of reefs compared with the extent of other marine ecosystems, which collectively produce between 70 and 100 million metric tons per year (Munro 1984; Smith 1978). An apparent paradox of coral reefs, however, is their location in the low-nutrient areas of the tropical oceans. Coral reefs themselves are characterized by the highest gross primary production in the sea, with sand, rubble fields, reef flats, and margins adding to primary production rates. The main primary producers on coral reefs are the benthic microalgae, macroalgae, symbiotic microalgae of corals, and other symbiont-bearing invertebrates (Levington 1995). 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, so their contribution to total coral reef primary productivity is small (WPRFMC 2001).

Although the ocean's surface waters in the tropics generally have low productivity, these waters are continually moving. Coral reefs, therefore, have access to open-water productivity and thus, particularly in inshore continental waters, shallow benthic habitats such as reefs are not always the dominant sources of nutrients for fisheries. 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, as well as active transport onto reefs via fishes that shelter on reefs but that feed in adjacent habitats. There is, therefore, greater potential for nourishment of inshore reefs than offshore reefs by external sources, and this inshore nourishment is enhanced by large land masses (Birkeland 1997a).

For most of the Pacific Islands, rainfall typically ranges from 2 to 3.5 meters per year. Low islands, such as atolls, tend to have less rainfall and may suffer prolonged droughts. Furthermore, when rain does fall on coral islands that have no major catchment area, there is little nutrient input into surrounding coastal waters and lagoons. Lagoons and embayments around high islands in the South Pacific are therefore likely to be more productive than atoll lagoons. There are, however, some exceptions such as Palmyra Atoll and Rose Atoll which receive up to 4.3 meters of rain per year. 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. In addition, 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 biodiversity found in such locations.

Coral Reef Communities

A major portion of the primary production of the coral reef ecosystem comes from complex interkingdom relationships of animal/plant photosymbioses hosted by animals of many taxa, most notably stony corals. Most of the geological structure of reefs and habitat are 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 1997a).

In areas with high gross primary production—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 1997a).

Typically, spawning of coral reef fish 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 an extremely high fecundity. Coral reef species exhibit a wide range of strategies related to larval dispersal and ultimately recruitment into the same or new areas. Some larvae are dispersed as short-lived, yolk-dependent (lecithotrophic) organisms, but the majority of coral reef invertebrate species disperse their larvae into the pelagic environment to feed on various types of plankton (planktotrophic) (Levington 1995). For example, larvae of the coral *Pocillopora damicornis*, which is widespread throughout the Pacific, has been found in the plankton of the open ocean exhibiting a larval life span of more than 100 days (Levington 1995). Because many coral reefs are space limited for settlement, therefore, planktotrophic larvae are a likely strategy to increase survival in other areas (Levington 1995). Coral reef fish experience their highest predation mortality in their first few days or weeks, thus rapid growth out of the juvenile stage is a common strategy.

The condition of the overall populations of particular species is linked to the variability among subpopulations: the ratio of sources and sinks, their degrees of recruitment connection, and the proportion of the subpopulations with high variability in reproductive capacity. Recruitment to populations of coral reef organisms depends largely on the pathways of larval dispersal and “downstream” links.

Reproduction and Recruitment

The majority of coral reef associated species 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 species 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, multispecies mass spawnings, and spawning aggregations in predictable locations (Birkeland 1997a).

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 juvenile survival (Birkeland 1997a). In response, some fishes—such as scarids (parrotfish) and labrids (wrasses)—grow rapidly compared with other coral reef fishes. But they still grow relatively slowly compared with pelagic species. In addition, scarids and labrids, parrotfishes and wrasses, respectively, may have complex haremic (i.e., harem forming reproductive strategy) 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 management more difficult (Birkeland 1997a).

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, but represent notably different habitats. For example, 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 Northwestern Hawaiian Islands (NWHI) are further characterized by (a) high-latitude coral atolls; (b) a mild temperate to subtropical climate, where inshore water temperatures can drop below 18° C in late winter; (c) species that are common on shallow reefs and attain large sizes, which to the southeast occur only rarely or in deep water; and (d) inshore shallow reefs that are largely free of fishing pressure (Maragos and Gulko 2002).

3.3.2.5 Deep Reef Slopes

As most Pacific islands are oceanic islands versus continental islands, they generally lack an extensive shelf area of relatively shallow water extending beyond the shoreline. For example, the average global continental shelf extends 40 miles, with a depth of around 200 feet (Postma and Zijlstra 1988). While lacking a shelf, many oceanic islands have a deep reef slope, which is often angled between 45° and 90° toward the ocean floor. The deep reef slope is home to a wide variety of marine of organisms that are important fisheries target species such as snappers and groupers. Biological zonation does occur on the reef slope, and is related to the limit of light penetration beyond 100 meters. For example, reef-building corals can be observed at depths less than 100 meters, but at greater depths gorgonian and black corals (referred to as precious corals) are more readily observed (Colin et al. 1986).

3.3.2.6 Banks and Seamounts

Banks are generally volcanic structures of various sizes and occur both on the continental shelf and in oceanic waters. Coralline structures tend to be associated with shallower parts of the banks as reef-building corals are generally restricted to a maximum depth of 30 meters. Deeper parts of banks may be composed of rock, coral rubble, sand, or shell deposits. Banks thus support a variety of habitats that in turn support a variety of fish species (Levington 1995).

Fish distribution on banks is affected by substrate types and composition. Those suitable for lutjanids, serranids, and lethrinids tend to be patchy, leading to isolated groups of fish with little lateral exchange or adult migration except when patches are close together. These types of assemblages may be regarded as consisting of metapopulations that are associated with specific features or habitats and are interconnected through larval dispersal. From a genetic perspective, individual patch assemblages may be considered as the same population; however, not enough is known about exchange rates to distinguish discrete populations.

Seamounts are undersea mountains, mostly of volcanic origin, which rise steeply from the sea bottom to below sea level (Rogers 1994). On seamounts and surrounding banks, species composition is closely related to depth. Deep-slope fisheries typically occur in the 100–500 meter depth range. A rapid decrease in species richness typically occurs between 200 and 400 meters deep, and most fishes observed there are associated with hard substrates, holes, ledges, or caves (Chave and Mundy 1994). Territoriality is considered to be less important for deep-water species of serranids, and lutjanids tend to form loose aggregations. Adult deep-water species are believed to not normally migrate between isolated seamounts.

Seamounts have complex effects on ocean circulation. One effect, known as the Taylor column, relates to eddies trapped over seamounts to form quasi-closed circulations. It is hypothesized that this helps retain pelagic larvae around seamounts and maintain the local fish population. Although evidence for retention of larvae over seamounts is sparse (Boehlert and Mundy 1993), endemism has been reported for a number of fish and invertebrate species at seamounts (Rogers 1994). Wilson and Kaufman (1987) concluded that seamount species are dominated by those on nearby shelf areas, and that seamounts act as stepping stones for transoceanic dispersal. Snappers and groupers both produce pelagic eggs and larvae, which tend to be most abundant over deep reef slope waters, while larvae of Etelis snappers are generally found in oceanic waters. It appears that populations of snappers and groupers on seamounts rely on inputs of larvae from external sources.

3.3.2.7 Deep Ocean Floor

At the end of reef slopes lies the dark and cold world of the deep ocean floor. Composed of mostly mud and sand, the deep ocean floor is home to deposit feeders and suspension feeders, as well as fish and marine mammals. Compared with shallower benthic areas (e.g., coral reefs), benthic deep-slope areas are lower in productivity and biomass. Due to the lack of sunlight, primary productivity is low, and many organisms rely on deposition of organic matter that sinks to the bottom. The occurrence of secondary and tertiary consumers decreases the deeper one goes due to the lack of available prey. With increasing depth, suspension feeders become less abundant and deposit feeders become the dominant feeding type (Levington 1995).

Although most of the deep seabed is homogenous and low in productivity, there are hot spots teeming with life. In areas of volcanic activity such as the mid-oceanic ridge, thermal vents exist that spew hot water loaded with various metals and dissolved sulfide. Chemotrophs, mainly bacteria found in these areas are able to make energy from the sulfide (thus considered primary producers). A variety of organisms either feed on, or contain these bacteria in their bodies within special organs called “trophosomes.” Types of organisms found near these thermal vents include crabs, limpets, tubeworms, and bivalves (Levington 1995).

3.3.2.7.1 Benthic Species of Economic Importance

Coral Reef Associated Species

The most commonly harvested species of coral reef associated organisms include the following: surgeonfishes (Acanthuridae), triggerfishes (Balistidae), jacks (Carangidae), parrotfishes

(Scaridae), soldierfishes/squirrelfishes (Holocentridae), wrasses (Labridae), octopus (*Octopus cyanea, O. ornatus*), goatfishes (Mullidae), and giant clams (Tridacnidae). Studies on coral reef fishes and ecology are relatively recent, with the earliest papers dating from the mid and late-1950's.

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 and Adams (1997) estimated that the average maximum sustainable yield for Pacific reefs in general may be able to approach 16 t km^{-2} yr^{-1} based on 43 yield estimates where the proxy for fishing effort was population density.

However, Birkeland (1997b) expressed skepticism about the sustainability of the high yields reported for Pacific and Southeast Asian reefs. Among other examples, he noted that the high values for American Samoa reported by Wass (1982) during the early 1970s were followed by a 70 percent drop in coral reef fishery catch rates between 1979 and 1994. Saucerman (1995), however, 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 percent in 1979 to between 3 and 13 percent in 1993.

Furthermore, problems still remain in rigorously quantifying the effects of factors on yield estimates 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 yield 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, indicates that depleted biomass levels may recover to preexploitation 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 Southeast 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 (1997b) cited the example of a pinnacle reef off Guam fished down over a period of six months in 1967 that has still not recovered 30 years later.

Estimating the recovery from, and reversibility of, fishing effects over large reef areas appears more difficult to determine. 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 is due to recruitment overfishing because it takes time to rebuild adult spawning biomasses and high fecundities (Polunin and Morton 1992). Furthermore, 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 global extinctions of some such species, particularly if there is also associated habitat damage.

Crustaceans

Crustaceans are harvested on small scales throughout the inhabited islands of the Western Pacific Region. The most common harvests include lobster species of the taxonomic groups Palinuridae (spiny lobsters) and Scyllaridae (slipper lobsters). Adult spiny lobsters are typically found on rocky substrate in well-protected areas, in crevices, and under rocks. Unlike many other species of *Panulirus*, the juveniles and adults of *P. marginatus* are not found in separate habitats apart from one another (MacDonald and Stimson 1980; Parrish and Polovina 1994). Juvenile *P. marginatus* recruit directly to adult habitat; they do not utilize separate shallow-water nursery habitats apart from the adults as do many Palinurid lobsters (MacDonald and Stimson 1980; Parrish and Polovina 1994). Juvenile and adult *P. penicillatus* also share the same habitat (Pitcher 1993).

In the southwestern Pacific, spiny lobsters are typically found in association with coral reefs which provide shelter as well as a diverse and abundant supply of food items. Kanciruk (1980) and Pitcher (1993) found that *P. penicillatus* inhabits the rocky shelters in the windward surf zones of oceanic reefs while other species of *Panulirus* show more general patterns of habitat utilization. As nocturnal predators, *P. penicillatus* moves onto reef flat at night to forage.

Spiny lobsters are non-clawed decapod crustaceans with slender walking legs of roughly equal size. Spiny lobster have a large spiny carapace with two horns and antennae projecting forward of their eyes and a large abdomen terminating in a flexible tail fan (Uchida et al.1980). Uchida and Uchiyama (1986) provided a detailed description of the morphology of slipper lobsters (*S. squammosus* and *S. haanii)* and noted that the two species are very similar in appearance and are easily confused (Uchida and Uchiyama 1986). The appearance of the slipper lobster is notably different than that of the spiny lobster.

Spiny lobsters (*Panulirus* spp.) are dioecious, i.e., have separate male and female individuals (Uchida and Uchiyama 1986). The male spiny lobster deposits a spermatophore or sperm packet on the female's abdomen and fertilization of the eggs occurs externally (Uchida et al. 1980). The female lobster scratches and breaks the mass, releasing the spermatozoa while simultaneously ova are released from the female's oviduct, are fertilized and attach to the setae of the female's pleopods. At this point, the female lobster is ovigerous, or "berried" (WPRFMC 1981). The fertilized eggs hatch into phyllosoma larvae after 30–40 days (MacDonald 1986; Uchida and Uchiyama 1986). Spiny lobsters have very high fecundity (WPRFMC 1981). The release of the phyllosoma larvae appears to be timed to coincide with the full moon and in some species at dawn (Pitcher 1993). In *Scyllarides* spp. fertilization is internal (Uchida and Uchiyama 1986).

Very little is known about the planktonic phase of the phyllosoma larvae of *Panulirus marginatus* (Uchida et al. 1980). After hatching, the "leaf-like" larvae (or phyllosoma) enter a planktonic phase, the duration of which varies depending on the species and geographic region. The planktonic larval stage may last from 6 months to 1 year from the time of the hatching of the eggs (WPRFMC 1983, MacDonald 1986).

Johnson (1968) suggested that fine-scale oceanographic features, such as eddies and currents, serve to retain lobster larvae within island areas. In the NWHI, for example, lobster's larvae settlement appears to be linked to the north and southward shifts of the North Pacific Central Water type (MacDonald 1986). The relatively long pelagic larval phase for palinurids results in very wide dispersal of spiny lobster larvae; palinurid larvae are transported up to 2,000 miles by prevailing ocean currents (MacDonald 1986).

Reef Slope, Bank, and Seamount Associated Species

Bottomfish

The families of bottomfish and seamount fish that are often targeted by fishermen include snappers (Lutjanidae), groupers (Serranidae), jacks (Carangidae), and emperors (Lethrinidae). Distinct depth associations are reported for certain species of emperors, snappers, and groupers. Many snappers and some groupers are restricted to feeding in deep water (Parrish 1987). The emperor family (Lethrinidae) are bottom-feeding carnivorous fish found usually in shallow coastal waters on or near reefs, with some species observed at greater depths (e.g., *L. rubrioperculatus*). Lethrinids are not reported to be territorial, but may be solitary or form schools. Snappers are largely confined to continental shelves and slopes, as well as corresponding depths around islands. Adults are usually associated with the bottom. The genus *Lutjanus* is the largest of this family, consisting primarily of inhabitants of shallow reefs. Species of the genus *Pristipomoides* occur at intermediate depths, often schooling around rocky outcrops and promontories (Ralston et al. 1986), while Eteline snappers are deep-water species. Groupers are relatively larger and mostly occur in shallow areas, although some occupy deep-slope habitats. Groupers in general are more sedentary and territorial than snappers or emperors, and are more dependent on hard substrata. In general, groupers may be less dependent on hard-bottom substrates at depth (Parrish 1987). For each family, schooling behavior is reported more frequently for juveniles than for adults. Spawning aggregations may, however, occur even for the solitary species at certain times of the year, especially among groupers.

A commonly reported trend is that juveniles occur in shallow water and adults are found in deeper water (Parrish 1989). Juveniles also tend to feed in different habitats than adults, possibly reflecting a way to reduce predation pressures. Not much is known about the location and characteristics of nursery grounds for juvenile deep-slope snappers and groupers. In Hawaii, juvenile snappers (*P. filamentosus)* have been found on flat, featureless shallow banks, as opposed to high-relief areas where the adults occur. Juveniles of the deep-slope grouper, (*Epinephelus quernus*), are found in shallow water (Moffitt 1993). Ralston and Williams (1988), however, found that for deep-slope species, size is poorly correlated with depth.

The distribution of adult bottomfish is correlated with suitable physical habitat. Because of the volcanic nature of the islands within the region, most bottomfish habitat consists of steep-slope areas on the margins of the islands and banks. The habitat of the major bottomfish species tend to overlap to some degree, as indicated by the depth range where they are caught. Within the overall depth range, however, individual species are more common at specific depth intervals.

Depth alone does not assure satisfactory habitat. Both the quantity and quality of habitat at depth are important. Bottomfish are typically distributed in a non-random patchy pattern, reflecting bottom habitat and oceanographic conditions. Much of the habitat within the depths of occurrence of bottomfish is a mosaic of sandy low-relief areas and rocky high-relief areas. An important component of the habitat for many bottomfish species appears to be the association of high-relief areas with water movement. In the Hawaiian Islands and at Johnston Atoll, bottomfish density is correlated with areas of high relief and current flow (Haight 1989; Haight et al. 1993a; Ralston et al. 1986).

Although the water depths utilized by bottomfish may overlap somewhat, the available resources may be partitioned by species-specific behavioral differences. In a study of the feeding habitats of the commercial bottomfish in the Hawaii archipelago, Haight et al. (1993b) found that ecological competition between bottomfish species appears to be minimized through species-specific habitat utilization. Species may partition the resource through both the depth and time of feeding activity, as well as through different prey preferences.

Precious Corals

Currently, there are minimal harvests of precious corals in the Western Pacific Region. However, in the 1970s to early 1990s both deep- and shallow-water precious corals were targeted in EEZ waters around Hawaii. The commonly harvested precious corals include pink coral (*Corallium secundum, Corallium regale, Corallium laauense*), gold coral (*Narella* spp., *Gerardia* spp., *Calyptrophora* spp.), bamboo coral (*Lepidisis olapa, Acanella* spp.), and black coral (*Antipathes dichotoma*, *Antipathes grandis*, *Antipathes ulex*).

In general, western Pacific precious corals share several ecological characteristics: they lack symbiotic algae in tissues (they are ahermatypic), and most are found in deep water below the euphotic zone; they are filter feeders; and many are fan shaped to maximize contact surfaces with particles or microplankton in the water column. Because precious corals are filter feeders, most species thrive in areas swept by strong-to-moderate currents (Grigg 1993). Although precious corals are known to grow on a variety of hard substrate, they are most abundant on substrates of shell sandstone, limestone, or basaltic rock with a limestone veneer.

All precious corals are slow growing and are characterized by low rates of mortality and recruitment. Natural populations are relatively stable, and a wide range of age classes is generally present. This life history pattern (longevity and many year classes) has two important consequences with respect to exploitation. First, the response of the population to exploitation is drawn out over many years. Second, because of the great longevity of individuals and the associated slow rates of turnover in the populations, a long period of reduced fishing effort is required to restore the ability of the stock to produce at the MSY if a stock has been over exploited for several years.

Because of the great depths at which they live, precious corals may be insulated from some short-term changes in the physical environment; however, not much is known regarding the long-term effects of changes in environmental conditions, such as water temperature or current velocity, on the reproduction, growth, or other life history characteristics of the precious corals (Grigg 1993).

3.3.3 Pelagic Environment

Connectivity of the different marine environments mandates the importance each has on the others with regards to species diversity and abundance, reproduction, sustainable harvest, habitat needs, and trophic connections. The pelagic or open ocean ecosystem is very large compared with any other marine ecosystem; however, other oceanic communities are vitally important to pelagic species in part because of the food-poor nature of much of the pelagic environment. For example, the mesopelagic boundary area described as being between 200 and 1,000 m depth and bordered by the photic zone above, and the aphotic zone below, provides habitat for a unique community of fishes, crustaceans, mollusks and other invertebrates which become prey for tunas and other pelagic species. Acoustic sampling studies off the coasts of Oahu and Kona were implemented by Benoit-Bird et al. (2001) to assess the spatial heterogeneity, horizontal and vertical migration patterns, relative abundances, and temporal patterns of the mesopelagic community as well as the linkages among this community, the influence of the coastlines, and oceanographic parameters. The Benoit-Bird et al. study showed that the horizontal component of the mesopelagic community migration indicates a clear link between the nearshore and oceanic ecosystems in the Hawaiian Islands, which in turn affects the presence and abundance of the pelagic predator species.

Additional studies near the Hawaiian Islands indicate that concentrations of spawning tuna near the islands may be due to increased forage species in these areas associated with elevated primary productivity (Itano 2001). Spawning in yellowfin tuna has been correlated to sea surface temperatures (SSTs), mainly above 24 - 26°C and may also be correlated with frontal areas such as the edge of Western Pacific Warm Pool (WPWP). The WPWP is the largest oceanic body of warm water with surface temperatures consistently above 28°C (Yan et al. 1992 *in* Itano 2001). The edge zones of this warm area are convergence zones which bring up nutrient rich waters and create high productivity areas resulting in high densities of tuna forage (i.e., baitfish such as anchovy) and thus large numbers of tuna. Offshore areas of high pelagic catch rates and spawning frequencies were found around several productive seamounts which also exhibit high productivity due to interactions of submarine topography, current gyres and being located in the lee of the main Hawaiian Islands (Itano 2001). Trophic linkages such as those evident in tunas whereby ocean anchovy are a primary forage species [of tuna] which themselves feed primarily on copepods provide a critical link between zooplankton and larger pelagic fishes (Ozawa and

Tsukahara 1973 *in* Itano 2001). Understanding these linkages is an essential component of successful ecosystem based fishery management.

Phytoplankton contribute to more than 95 percent of primary production in the marine environment (Valiela 1995) and represent several different types of microscopic organisms that require sunlight for photosynthesis. Phytoplankton primarily live in the upper 100 meters of the euphotic zone of the water column and provide primary production in the marine ecosystem as food for zooplankton, which in turn, feeds small organisms such as crustaceans and so forth on up the food chain. For example, large pelagic species are commonly most concentrated near islands and seamounts that create divergences and convergences, which concentrate forage species, and also near upwelling zones along ocean current boundaries and along gradients in temperature, oxygen, and salinity. Swordfish and numerous other pelagic species tend to concentrate along food-rich temperature fronts between cold upwelled planton-rich water and warmer oceanic water masses (NMFS 2001).

These frontal zones have been identified as likely migratory pathways across the Pacific for loggerhead turtles (Polovina et al. 2000) and other pelagic species. Loggerhead turtles are opportunistic omnivores that feed on floating prey such as the pelagic cnidarian *Vellela vellela* ("by the wind sailor") and the pelagic gastropod *Janthia sp*., both of which are likely to be concentrated by the weak downwelling associated with frontal zones (Polovina et al. 2000).

Migration patterns of pelagic fish stocks in the Pacific Ocean are not easily understood or categorized, despite extensive tag-and-release projects for many of the species. This is particularly evident for the more tropical tuna species (e.g., yellowfin, skipjack, bigeye) that appear to roam extensively within a broad expanse of the Pacific centered on the equator. Although tagging and genetic studies have shown that some interchange does occur, it appears that short life spans and rapid growth rates restrict large-scale interchange and genetic mixing of eastern, central, and far-western Pacific stocks of yellowfin and skipjack tuna. The movement of the cooler water tuna (e.g., bluefin, albacore) is more predictable and defined, with tagging studies documenting regular, well-defined seasonal movement patterns relating to specific feeding and spawning grounds. The oceanic migrations of billfish are poorly understood, but the results of limited tagging work conclude that most billfish species are capable of transoceanic movement, and some seasonal regularity has been noted (NMFS 2001).

In the ocean, light and temperature diminish rapidly with increasing depth, especially in the region of the thermocline. Many pelagic fish make vertical migrations through the water column following other smaller prey species such as small fishes, crustaceans and zooplankton. They tend to inhabit surface waters at night and deeper waters during the day, but several species make extensive vertical migrations between surface and deeper waters throughout the day. Certain species, such as swordfish and bigeye tuna, are more vulnerable to fishing when they are concentrated near the surface at night. Bigeye tuna may visit the surface during the night, but generally, longline catches of this fish are highest when hooks are set in deeper, cooler waters just above the thermocline (275–550 m or 150-300 fm). Surface concentrations of juvenile albacore are largely concentrated where the warm mixed layer of the ocean is shallow (above 90 m or 50 fm), but adults are caught mostly in deeper water (90–275 m or 50–150 fm). Swordfish are usually caught near the ocean surface but are known to venture into deeper waters. Swordfish demonstrate an affinity for thermal oceanic frontal systems that may act to aggregate their prey and enhance migration by providing an energetic gain through moving the fish along with favorable currents (Olsen et al. 1994).

3.3.4 Protected Species

To varying degrees, protected species in the Western Pacific Region face various natural and anthropogenic threats to their continued existence. These threats include regime shifts, habitat degradation, poaching, fisheries interactions, vessel strikes, disease, and behavioral alterations from various disturbances associated with human activities. This section presents available information on the current status of protected species (generally identified as sea turtles, marine mammals, and seabirds) known to occur (perhaps only occasionally) in waters of the Western Pacific Region. Information on Endangered Species Act consultations and findings for the fisheries covered in this FEP is presented in Chapter 8 of this document.

3.3.4.1 Sea Turtles

All Pacific sea turtles are designated under the Endangered Species Act as either threatened or endangered. The breeding populations of Mexico's olive ridley sea turtles (*Lepidochelys olivacea*) are currently listed as endangered, while all other ridley populations are listed as threatened. Leatherback sea turtles (*Dermochelys coriacea*) and hawksbill turtles (*Eretmochelys imbricata*) are also classified as endangered. Loggerhead (*Caretta caretta*) and green sea turtles (*Chelonia mydas*) are listed as threatened (the green sea turtle is listed as threatened throughout its Pacific range, except for the endangered population nesting on the Pacific coast of Mexico). These five species of sea turtles are highly migratory, or have a highly migratory phase in their life history (NMFS 2001).

Leatherback Sea Turtles

Leatherback turtles (*Dermochelys coriacea*) are widely distributed throughout the oceans of the world, and are found in waters of the Atlantic, Pacific, and Indian Oceans; the Caribbean Sea; and the Gulf of Mexico (Dutton et al. 1999). Increases in the number of nesting females have been noted at some sites in the Atlantic (Dutton et al. 1999), but these are far outweighed by local extinctions, especially of island populations, and the demise of once-large populations throughout the Pacific, such as in Malaysia (Chan and Liew 1996) and Mexico (Sarti et al. 1996; Spotila et al. 1996). In other leatherback nesting areas, such as Papua New Guinea, Indonesia, and the Solomon Islands, there have been no systematic, consistent nesting surveys, so it is difficult to assess the status and trends of leatherback turtles at these beaches. In all areas where leatherback nesting has been documented, current nesting populations are reported by scientists, government officials, and local observers to be well below abundance levels of several decades ago. The collapse of these nesting populations was most likely precipitated by a tremendous overharvest of eggs coupled with incidental mortality from fishing (Sarti et al. 1996).

Leatherback turtles are the largest of the marine turtles, with a shell length often exceeding 150 centimeters (cm) and front flippers that are proportionately larger than in other sea turtles and that may span 270 cm in an adult (NMFS 1998). The leatherback is morphologically and physiologically distinct from other sea turtles, and it is thought that its streamlined body, with a smooth dermis-sheathed carapace and dorso-longitudinal ridges may improve laminar flow.

Leatherback turtles lead a completely pelagic existence, foraging widely in temperate waters, except during the nesting season when gravid females return to tropical beaches to lay eggs. Males are rarely observed near nesting areas, and it has been proposed that mating most likely takes place outside of tropical waters, before females move to their nesting beaches (Eckert and Eckert 1988). Leatherbacks are highly migratory, exploiting convergence zones and upwelling areas in the open ocean, along continental margins, and in archipelagic waters (Eckert 1998). In a single year, a leatherback may swim more than 10,000 kilometers (Eckert 1998).

Satellite telemetry studies indicate that adult leatherback turtles follow bathymetric contours over their long pelagic migrations and typically feed on cnidarians (jellyfish and siphonophores) and tunicates (pyrosomas and salps), and their commensals, parasites, and prey (NMFS 1998). Because of the low nutrient value of jellyfish and tunicates, it has been estimated that an adult leatherback would need to eat about 50 large jellyfish (equivalent to approximately 200 liters) per day to maintain its nutritional needs (Duron 1978). Compared with greens and loggerheads, which consume approximately 3–5 percent of their body weight per day, leatherback turtles may consume 20–30 percent of their body weight per day (Davenport and Balazs 1991).

Females are believed to migrate long distances between foraging and breeding grounds, at intervals of typically two or four years (Spotila et al. 2000). The mean renesting interval of females on Playa Grande, Costa Rica to be 3.7 years, while in Mexico, 3 years was the typical reported interval (L. Sarti, Universidad Naçional Autonoma de Mexico [UNAM], personal communication, 2000 in NMFS 2004). In Mexico, the nesting season generally extends from November to February, although some females arrive as early as August (Sarti et al. 1989). Most of the nesting on Las Baulas takes place from the beginning of October to the end of February (Reina et al. 2002). In the western Pacific, nesting peaks on Jamursba-Medi Beach (Papua, Indonesia) from May to August, on War-Mon Beach (Papua) from November to January (Starbird and Suarez 1994), in peninsular Malaysia during June and July (Chan and Liew 1989), and in Queensland, Australia in December and January (Limpus and Reimer1994).

Migratory routes of leatherback turtles originating from eastern and western Pacific nesting beaches are not entirely known. However, satellite tracking of postnesting females and genetic analyses of leatherback turtles caught in U.S. Pacific fisheries or stranded on the west coast of the U.S. presents some strong insights into at least a portion of their routes and the importance of particular foraging areas. Current data from genetic research suggest that Pacific leatherback stock structure (natal origins) may vary by region. Due to the fact that leatherback turtles are highly migratory and that stocks mix in high-seas foraging areas, and based on genetic analyses of samples collected by both Hawaii-based and west-coast-based longline observers, leatherback turtles inhabiting the northern and central Pacific Ocean comprise individuals originating from nesting assemblages located south of the equator in the western Pacific (e.g., Indonesia, Solomon Islands) and in the eastern Pacific along the Americas (e.g., Mexico, Costa Rica; Dutton et al. 2000).

Recent information on leatherbacks tagged off the west coast of the United States has also revealed an important migratory corridor from central California to south of the Hawaiian Islands, leading to western Pacific nesting beaches. Leatherback turtles originating from western Pacific beaches have also been found along the U.S. mainland. There, leatherback turtles have been sighted and reported stranded as far north as Alaska (60° N) and as far south as San Diego, California (NMFS 1998). Of the stranded leatherback turtles that have been sampled to date from the U.S. mainland, all have been of western Pacific nesting stock origin (P. Dutton NMFS, personal communication 2000 in NMFS 2004).

Leatherback Sea Turtles in the PRIA
There are no known reports of leatherback sea turtles in waters around the PRIA, however, these waters are within the habitat of leatherback turtles and therefore they may be present but unobserved due to the largely uninhabited nature of the PRIA.

Loggerhead Sea Turtles

The loggerhead sea turtle (*Caretta caretta*) is characterized by a reddish brown, bony carapace, with a comparatively large head, up to 25 cm wide in some adults. Adults typically weigh between 80 and 150 kilograms (kg), with average curved carapace length (CCL) measurements for adult females worldwide between 95-–100 cm CCL (Dodd 1988) and adult males in Australia averaging around 97 cm CCL (Limpus 1985, in Eckert 1993). Juveniles found off California and Mexico measured between 20 and 80 cm (average 60 cm) in length (Bartlett 1989, in Eckert 1993). Skeletochronological age estimates and growth rates were derived from small loggerheads caught in the Pacific high-seas driftnet fishery. Loggerheads less than 20 cm were estimated to be 3 years old or less, while those greater than 36 cm were estimated to be 6 years old or more. Age-specific growth rates for the first 10 years were estimated to be 4.2 cm/year (Zug et al. 1995).

For their first years of life, loggerheads forage in open-ocean pelagic habitats. Both juvenile and subadult loggerheads feed on pelagic crustaceans, mollusks, fish, and algae. The large aggregations of juveniles off Baja California have been observed foraging on dense concentrations of the pelagic red crab *Pleuronocodes planipes* (Nichols et al. 2000). Data collected from stomach samples of turtles captured in North Pacific driftnets indicate a diet of gastropods (*Janthina* spp.), heteropods (*Carinaria* spp.), gooseneck barnacles (*Lepas* spp.), pelagic purple snails (*Janthina* spp.), medusae (*Vellela* spp.), and pyrosomas (tunicate zooids). Other common components include fish eggs, amphipods, and plastics (Parker et al. 2002).

Loggerheads in the North Pacific are opportunistic feeders that target items floating at or near the surface, and if high densities of prey are present, they will actively forage at depth (Parker et al. 2002). As they age, loggerheads begin to move into shallower waters, where, as adults, they forage over a variety of benthic hard- and soft-bottom habitats (reviewed in Dodd, 1988). Subadults and adults are found in nearshore benthic habitats around southern Japan, as well as in the East China Sea and the South China Sea (e.g., Philippines, Taiwan,Vietnam).

The loggerhead sea turtle is listed as threatened under the ESA throughout its range, primarily due to direct take, incidental capture in various fisheries, and the alteration and destruction of its habitat. In general, during the last 50 years, North Pacific loggerhead nesting populations have declined 50–90 percent (Kamezaki et al. 2003). From nesting data collected by the Sea Turtle Association of Japan since 1990, the latest estimates of the number of nesting females in almost all of the rookeries are as follows: 1998 −2,479 nests, 1999 −2,255 nests, and 2000 −2,589 nests.[12]

In the South Pacific, Limpus (1982) reported an estimated 3,000 loggerheads nesting annually in Queensland, Australia during the late 1970s. However, long-term trend data from Queensland indicate a 50 percent decline in nesting by 1988–89 due to incidental mortality of turtles in the coastal trawl fishery. This decline is corroborated by studies of breeding females at adjacent feeding grounds (Limpus and Reimer 1994). Currently, approximately 300 females nest annually in Queensland, mainly on offshore islands (Capricorn-Bunker Islands, Sandy Cape, Swains Head; Dobbs 2001). In southern Great Barrier Reef waters, nesting loggerheads have declined approximately 8 percent per year since the mid-1980s (Heron Island), while the foraging ground population has declined 3 percent and comprised less than 40 adults by 1992. Researchers attribute the declines to recruitment failure due to fox predation of eggs in the 1960s and mortality of pelagic juveniles from incidental capture in longline fisheries since the 1970s (Chaloupka and Limpus 2001).

Loggerhead Sea Turtles in the PRIA

There are no known reports of loggerhead turtles in waters around the PRIA, however, these waters are within the habitat of loggerhead turtles and therefore they may be present but unobserved due to the largely uninhabited nature of the PRIA.

Green Sea Turtles

Green turtles (*Chelonia mydas*) are distinguished from other sea turtles by their smooth carapace with four pairs of lateral “scutes,” a single pair of prefrontal scutes, and a lower jaw edge that is coarsely serrated. Adult green turtles have a light to dark brown carapace, sometimes shaded with olive, and can exceed 1 meter in carapace length and 100 kg in body mass. Females nesting in Hawaii averaged 92 cm in straight carapace length (SCL), while at Olimarao Atoll in Yap, females averaged 104 cm in curved carapace length and approximately 140 kg in body mass. In the rookeries of Michoacán, Mexico, females averaged 82 cm in CCL, while males averaged 77 cm in CCL (NMFS1998). Based on growth rates observed in wild green turtles, skeletochronological studies, and capture–recapture studies, all in Hawaii, it is estimated that an average of at least 25 years would be needed to achieve sexual maturity (Eckert 1993).

Although most adult green turtles appear to have a nearly exclusively herbivorous diet, consisting primarily of seagrass and algae (Wetherall 1993), those along the east Pacific coast seem to have a more carnivorous diet. Analysis of stomach contents of green turtles found off Peru revealed a large percentage of mollusks and polychaetes, while fish and fish eggs, jellyfish, and commensal amphipods made up a lesser percentage (Bjorndal 1997). Seminoff et al. (2000) found that 5.8 percent of gastric samples and 29.3 percent of the fecal samples of east Pacific

[12] In the 2001, 2002, and 2003 nesting seasons, a total of 3,122, 4,035 and 4,519 loggerhead nests, respectively, were recorded on Japanese beaches (Matsuzawa, March 2005, final report to the WPRFMC).

green turtles foraging in the northern Sea of Cortéz, Mexico, contained the remains of the fleshy sea pen (*Ptilosarcus undulatus*).

Green sea turtles are a circumglobal and highly migratory species, nesting and feeding in tropical/subtropical regions. Their range can be defined by a general preference for water temperature above 20° C. Green sea turtles are known to live in pelagic habitats as posthatchlings/juveniles, feeding at or near the ocean surface. The non-breeding range of this species can lead a pelagic existence many miles from shore while the breeding population lives primarily in bays and estuaries, and are rarely found in the open ocean. Most migration from rookeries to feeding grounds is via coastal waters, with females migrating to breed only once every two years or more (Bjorndal 1997).

Tag returns of eastern Pacific green turtles (often reported as black turtles) establish that these turtles travel long distances between foraging and nesting grounds. In fact, 75 percent of tag recoveries from 1982–1990 were from turtles that had traveled more than 1,000 kilometers from Michoacán, Mexico. Even though these turtles were found in coastal waters, the species is not confined to these areas, as indicated by sightings recorded in 1990 from a NOAA research ship. Observers documented green turtles 1,000–2,000 statute miles from shore (Eckert 1993). The east Pacific green is also the second-most sighted turtle in the east Pacific during tuna cruises; they frequent a north–south band from 15° N to 5° S along 90° W and an area between the Galapagos Islands and the Central American Coast (NMFS 1998).

In a review of sea turtle sighting records from northern Baja California to Alaska, Stinson (1984, in NMFS 1998) determined that the green turtle was the most commonly observed sea turtle on the U.S. Pacific coast, with 62 percent reported in a band from southern California and southward. The northernmost (reported) year-round resident population of green turtles occurs in San Diego Bay, where about 30–60 mature and immature turtles concentrate in the warm water effluent discharged by a power plant. These turtles appear to have originated from east Pacific nesting beaches, on the basis of morphology and preliminary genetic analysis (NMFS and USFWS 1998). California stranding reports from 1990–1999 indicate that the green turtle is the second most commonly found stranded sea turtle (48 total, averaging 4.8 annually; J. Cordaro, NMFS, personal communication, April 2000, NMFS 2004).

Stinson (1984) found that green turtles will appear most frequently in U.S. coastal waters when temperatures exceed 18° C. An east Pacific green turtle was tracked along the California coast by a satellite transmitter that was equipped to report thermal preferences of the turtle. This turtle showed a distinct preference for waters that were above 20° (S. Eckert, unpublished data). Subadult green turtles routinely dive to 20 meters for 9–23 minutes, with a maximum recorded dive of 66 minutes (Lutcavage et al. 1997).

The non-breeding range of green turtles is generally tropical, and can extend approximately 500–800 miles from shore in certain regions (Eckert 1993). The underwater resting sites include coral recesses, undersides of ledges, and sand bottom areas that are relatively free of strong currents and disturbance from natural predators and humans. In the Pacific, the only major (> 2,000 nesting females) populations of green turtles occur in Australia and Malaysia. Smaller colonies occur in the insular Pacific islands of Polynesia, Micronesia, and Melanesia (Wetherall 1993) and on six small sand islands at French Frigate Shoals, a long atoll situated in the middle of the Hawaii archipelago (Balazs et al. 1995).

Green turtles were listed as threatened under the ESA on July 28, 1978, except for breeding populations found in Florida and the Pacific coast of Mexico, which were listed as endangered. Using a precautionary estimate, the number of nesting female green turtles has declined by 48 percent to 67 percent over the last three generations (~150 years; Troeng and Rankin 2005). Causes for this decline include harvest of eggs, subadults, and adults; incidental capture by fisheries; loss of habitat; and disease. The degree of population change is not consistent among all index nesting beaches or among all regions. Some nesting populations are stable or increasing (Balazs and Chaloupka 2004; Chaloupka and Limpus 2001; Troeng and Rankin 2005). However, other populations or nesting stocks have markedly declined. Because many of the threats that have led to these declines have not yet ceased, it is evident that green turtles face a measurable risk of extinction (Troeng and Rankin 2005).

Green turtles in Hawaii are considered genetically distinct and geographically isolated, although a nesting population at Islas Revillagigedos in Mexico appears to share the mtDNA haplotype that commonly occurs in Hawaii. In Hawaii, green turtles nest on six small sand islands at French Frigate Shoals, a crescent-shaped atoll situated in the middle of the Hawaii archipelago (Northwestern Hawaiian Islands; Balazs et al. 1995). Ninety to 95 percent of the nesting and breeding activity occurs at the French Frigate Shoals, and at least 50 percent of that nesting takes place on East Island, a 12-acre island. Long-term monitoring of the population shows that there is strong island fidelity within the regional rookery. Low-level nesting also occurs at Laysan Island, Lisianski Island, and on Pearl and Hermes Reef (NMFS 1998).

Since the establishment of the ESA in 1973, and following years of exploitation, the nesting population of Hawaiian green turtles has shown a gradual but definite increase (Balazs 1996; Balazs and Chaloupka 2004). In three decades, the number of nesting females at East Island increased from 67 nesting females in 1973 to 467 nesting females in 2002. Nester abundance increased rapidly at this rookery during the early 1980s, leveled off during the early 1990s, and again increased rapidly during the late 1990s to the present. This trend is very similar to the underlying trend in the recovery of the much larger green turtle population that nests at Tortuguero Costa Rica (Bjorndal et al. 1999). The stepwise increase of the long-term nester trend since the mid-1980s is suggestive, but not conclusive, of a density-dependent adjustment process affecting sea turtle abundance at the foraging grounds (Balazs and Chaloupka 2004; Bjorndal et al. 2000;). Balazs and Chaloupka (2004) concluded that the Hawaiian green sea turtle stock is well on the way to recovery following 25 years of protection. This increase is attributed to increased female survivorship since the harvesting of turtles was prohibited in addition to the cessation of habitat damage at the nesting beaches since the early 1950s (Balazs and Chaloupka 2004).

Green Sea Turtles in the PRIA

Green sea turtles are reported to nest at Palmyra and Jarvis Islands, and resident turtles inhabit the lagoon waters at Wake and Palmyra. Green turtles have also been seen in the marine environment around Howland, Baker, Kingman and Johnston but nesting at these areas is unknown. According to the 1998 Recovery Plan for the green sea turtle, seawall construction at

Johnston Atoll negates the potential for nesting while military hazardous and toxic wastes have contaminated the coastal waters. Beach erosion has been targeted as a problem at Palmyra Atoll, causing barriers to adult and hatchling turtle movements, and degrading nesting habitat. When the U.S. military occupied Palmyra during World War II, their base was along the coast of a northern island about 5 kilometers from known turtle nesting and feeding areas.

Hawksbill Sea Turtles

Hawksbill sea turtles (*Eretmochelys imbriacata*) are circumtropical in distribution, generally occurring from latitudes 30° N to 30° S within the Atlantic, Pacific, and Indian Oceans and associated bodies of water (NMFS 1998). While data are somewhat limited on their diet in the Pacific, it is well documented that in the Caribbean hawksbill turtles are selective spongivores, preferring particular sponge species over others (Dam and Diez 1997b). Foraging dive durations are often a function of turtle size, with larger turtles diving deeper and longer. At a study site also in the northern Caribbean, foraging dives were made only during the day and dive durations ranged from 19 to 26 minutes at depths of 8–10 meters. At night, resting dives ranged from 35 to 47 minutes in duration (Dam and Diez 1997a).

As a hawksbill turtle grows from a juvenile to an adult, data suggest that the turtle switches foraging behaviors from pelagic surface feeding to benthic reef feeding (Limpus 1992). Within the Great Barrier Reef of Australia, hawksbills move from a pelagic existence to a “neritic” life on the reef at a minimum CCL of 35 cm. The maturing turtle establishes foraging territory and will remain in this territory until it is displaced (Limpus 1992). As with other sea turtles, hawksbills will make long reproductive migrations between foraging and nesting areas (Meylan 1999), but otherwise they remain within coastal reef habitats. In Australia, juvenile turtles outnumber adults 100:1. These populations are also sex biased, with females outnumbering males 2.57:1 (Limpus 1992).

Along the far western and southeastern Pacific, hawksbill turtles nest on the islands and mainland of southeast Asia, from China to Japan, and throughout the Philippines, Malaysia, Indonesia, Papua New Guinea, the Solomon Islands (McKeown 1977), and Australia (Limpus 1982).

The hawksbill turtle is listed as endangered throughout its range. In the Pacific, this species is threatened by the harvesting of the species for its meat, eggs, and shell, as well as impacted by coastal development and the destruction of nesting habitat. The historic take of hawksbill turtles for their shell to supply the bekko trade was, and perhaps continues to be, a significant impact to Pacific populations. Along the eastern Pacific Rim, hawksbill turtles were common to abundant in the 1930s (Cliffton et al. 1982). By the 1990s, the hawksbill turtle was rare to absent in most localities where it was once abundant (Cliffton et al. 1982).

Hawksbill Sea Turtles in the PRIA

There are no records of nesting hawksbill turtles in the PRIA. The hawksbill sea turtle is regularly sighted in the waters of Palmyra Atoll and has been reported from Baker, Howland and Jarvis Islands. The Recovery Plan indicates that waters around the PRIA may provide marine feeding grounds for this species.

Olive Ridley Sea Turtles

Olive ridley turtles (*Lepidochelys olivacea*) are olive or grayish green above, with a greenish white underpart, and adults are moderately sexually dimorphic (NMFS and USFWS1998d). Olive ridleys lead a highly pelagic existence (Plotkin 1994). These sea turtles appear to forage throughout the eastern tropical Pacific Ocean, often in large groups, or flotillas. In a 3-year study of communities associated with floating objects in the eastern tropical Pacific, Arenas et al. (1992) found that 75 percent of sea turtles encountered were olive ridleys and were present in 15 percent of the observations, thus implying that flotsam may provide the turtles with food, shelter, and/or orientation cues in an otherwise featureless landscape. It is possible that young turtles move offshore and occupy areas of surface-current convergences to find food and shelter among aggregated floating objects until they are large enough to recruit to the nearshore benthic feeding grounds of the adults, similar to the juvenile loggerheads mentioned previously.

While it is true that olive ridleys generally have a tropical range, individuals do occasionally venture north, some as far as the Gulf of Alaska (Hodge and Wing 2000). The postnesting migration routes of olive ridleys, tracked via satellite from Costa Rica, traversed thousands of kilometers of deep oceanic waters ranging from Mexico to Peru and more than 3,000 kilometers out into the central Pacific (Plotkin 1994). Stranding records from 1990–1999 indicate that olive ridleys are rarely found off the coast of California, averaging 1.3 strandings annually (J. Cordaro, NMFS, personal communication, NMFS 2004).

The olive ridley turtle is omnivorous, and identified prey include a variety of benthic and pelagic prey items such as shrimp, jellyfish, crabs, snails, and fish, as well as algae and seagrass (Marquez 1990). It is also not unusual for olive ridley turtles in reasonably good health to be found entangled in scraps of net or other floating synthetic debris. Small crabs, barnacles, and other marine life often reside on debris and are likely to attract the turtles. Olive ridley turtles also forage at great depths, as a turtle was sighted foraging for crabs at a depth of 300 meters (Landis 1965, in Eckert et al. 1986). The average dive lengths for adult females and males are reported to be 54.3 and 28.5 minutes, respectively (Plotkin 1994, in Lutcavage and Lutz 1997).

Declines in olive ridley populations have been documented in Playa Nancite, Costa Rica; however, other nesting populations along the Pacific coast of Mexico and Costa Rica appear to be stable or increasing, after an initial large decline due to harvesting of adults. Historically, an estimated 10-million olive ridleys inhabited the waters in the eastern Pacific off Mexico (Cliffton et al. 1982, in NMFS and USFWS 1998e). However, human-induced mortality led to declines in this population. Beginning in the 1960s, and lasting over the next 15 years, several million adult olive ridleys were harvested by Mexico for commercial trade with Europe and Japan (NMFS and USFWS 1998e). Although olive ridley meat is palatable, it is not widely sought; eggs, however, are considered a delicacy, and egg harvest is considered one of the major causes for its decline. Fisheries for olive ridley turtles were also established in Ecuador during the 1960s and 1970s to supply Europe with leather (Green and Ortiz-Crespo 1982). In the Indian Ocean, Gahirmatha supports perhaps the largest nesting population; however, this population continues to be threatened by nearshore trawl fisheries. Direct harvest of adults and eggs, incidental capture in commercial fisheries, and loss of nesting habits are the main threats to the olive ridley's recovery.

Olive Ridley Sea Turtles in the PRIA
There are no known reports of olive ridley turtles in waters around the PRIA however, these waters are within the habitat of olive ridley turtles and therefore they may be present but unobserved due to the largely uninhabited nature of the PRIA.

3.3.4.2 Marine Mammals

Cetaceans listed as endangered under the ESA and that have been observed in the Western Pacific Region include the humpback whale (*Megaptera novaeangliae*), sperm whale (*Physeter macrocephalus*), blue whale (*Balaenoptera musculus*), fin whale (*B. physalus*), and sei whale (*B. borealis*). In addition, one endangered pinniped, the Hawaiian monk seal (*Monachus schauinslandi*), occurs in the region.

Humpback Whales

Humpback whales (*Megaptera novaeangliae*) can attain lengths of 16 meters. Humpback whales winter in shallow nearshore waters of usually 100 fathoms or less. Mature females are believed to conceive on the breeding grounds one winter and give birth the following winter. Genetic and photo identification studies indicate that within the U.S. EEZ in the North Pacific, there are at least three relatively separate populations of humpback whales that migrate between their respective summer/fall feeding areas to winter/spring calving and mating areas (Hill and DeMaster 1999). The Central North Pacific stock of humpback whales winters in the waters of the Main Hawaiian Islands (Hill et al. 1997). At least six well-defined breeding stocks of humpback whales occur in the Southern Hemisphere. In Fagatele Bay National Marine Sanctuary, southern humpback whales mate and calve from June through September. Humpbacks arrive in American Samoa from the south between June and December (Reeves et al. 1999). This area is probably a calving area and mating ground for the New Zealand group of Antarctic humpbacks. Humpback whales were observed by NMFS and USFWS scientists at Johnston Atoll during their 2000-2004 surveys (NOAA 2005). This finding is important as there are no other modern records of this species there and Johnston may represent a newly established or re-established mating ground for the north Pacific population.

There is no precise estimate of the worldwide humpback whale population. The humpback whale population in the North Pacific Ocean basin wa estimated to contain 6,000–8,000 individuals (Calambokidis et al. 1997). The Central North Pacific stock appears to have increased in abundance between the early 1980s and early 1990s; however, the status of this stock relative to its optimum sustainable population size is unknown (Hill and DeMaster 1999).

Sperm Whales

The sperm whale (*Physeter macrocephalus*) is the most easily recognizable whale with a darkish gray-brown body and a wrinkled appearance. The head of the sperm whale is very large, making up to 40 percent of its total body length. The current average size for male sperm whales is about 15 meters, with females reaching up to 12 meters.

Sperm whales are found in tropical to polar waters throughout the world (Rice 1989). They are among the most abundant large cetaceans in the region. Sperm whales have been sighted around several of the Northwestern Hawaiian Islands (Rice 1960) and off the main islands of Hawaii (Lee 1993). The sounds of sperm whales have been recorded throughout the year off Oahu (Thompson and Friedl 1982). Sightings of sperm whales were made during May–July in the 1980s around Guam, and in recent years strandings have been reported on Guam (Reeves et al. 1999). Historical observations of sperm whales around Samoa occurred in all months except February and March (Reeves et al. 1999). Sperm whales are occasionally seen in the Fagatele Bay Sanctuary as well.

According to NOAA (www.nmfs.noaa.gov/pr/species/mammals/cetaceans/spermwhale.htm, accessed April 17, 2009) the world's population of sperm whales is estimated to be between 200,000 and 1,500,000 individuals. However, the methods used to make this estimate are in dispute, and there is considerable uncertainty over the remaining number of sperm whales. The world population is at least in the hundreds of thousands, if not millions. The status of sperm whales in Hawaii waters relative to the optimum sustainable population is unknown, and there are insufficient data to evaluate trends in abundance (Forney et al. 2000).

Blue Whales

The blue whale (*Balaenoptera musculus*) is the largest living animal. Blue whales can reach lengths of 30 meters and weights of 160 tons (320,000 lbs), with females usually being larger than males of the same age. They occur in all oceans, usually along continental shelves, but can also be found in the shallow inshore waters and on the high seas. No sightings or strandings of blue whales have been reported in the PRIA, but acoustic recordings made off Oahu and Midway Islands have reported blue whales somewhere within the EEZ around Hawaii (Thompson and Friedl 1982). The stock structure of blue whales in the North Pacific is uncertain (Forney et al. 2000). Prior to whaling, the worldwide population of blue whales is believed to have been about 200,000 animals. Only 8,000-12,000 are estimated to be alive today. Blue whales have always been more abundant in the Antarctic than in the northern hemisphere. An estimated 4,900 to 6,000 blue whales are believed to have inhabited the north Pacific prior to whaling. The north Pacific population is now estimated at 1,200 to 1,700 animals.

Fin Whales

Fin whales (*Balaenoptera physalus*) are found throughout all oceans and seas of the world from tropical to polar latitudes (Forney et al. 2000). Although it is generally believed that fin whales make poleward feeding migrations in summer and move toward the equator in winter, few actual observations of fin whales in tropical and subtropical waters have been documented, particularly in the Pacific Ocean away from continental coasts (Reeves et al. 1999). There is insufficient information to accurately determine the population structure of fin whales in the North Pacific, but there is evidence of multiple stocks (Forney et al. 2000).

Sei Whales

Sei whales (*Balaenoptera borealis*) have a worldwide distribution but are found mainly in cold temperate to subpolar latitudes rather than in the tropics or near the poles (Horwood 1987). They are distributed far out to sea and do not appear to be associated with coastal features. Two sei whales were tagged in the vicinity of the Northern Mariana Islands (Reeves et al. 1999). Sei whales are rare in Hawaii waters. The International Whaling Commission only considers one stock of sei whales in the North Pacific, but some evidence exists for multiple populations (Forney et al. 2000). In the southern Pacific most observations have been south of 30°(Reeves et al. 1999).

There are no data on trends in sei whale abundance in the North Pacific (Forney et al. 2000). It is especially difficult to estimate their numbers because they are easily confused with Bryde's whales, which have an overlapping, but more subtropical, distribution (Reeves et al. 1999).

Hawaiian Monk Seals

The Hawaiian monk seal (*Monachus schauinslandi*) is a tropical seal endemic to the Hawaiian Islands. Today, the entire population of Hawaiian monk seals is about 1,300 to 1,400 and occurs mainly in the NWHI. The six major reproductive sites are French Frigate Shoals, Laysan Island, Lisianski Island, Pearl Reef, Hermes Reef, Midway Atoll, and Kure Atoll. Small populations at Necker Island and Nihoa Island are maintained by immigration, and an increasing number of seals are distributed throughout the Main Hawaiian Islands.

The subpopulation of monk seals on French Frigate Shoals has shown the most change in population size, increasing dramatically in the 1960s–1970s and declining in the late 1980s–1990s. In the 1960s–1970s, the other five subpopulations experienced declines. However, during the last decade the number of monk seals increased at Kure Atoll, Midway Atoll, Pearl Reef, and Hermes Reef while the subpopulations at Laysan Island and Lisianski Island remained relatively stable. The recent subpopulation decline at French Frigate Shoals is thought to be caused by male aggression, shark attack, entanglement in marine debris, loss of habitat, and decreased prey availability. The Hawaiian monk seal is assumed to be well below its optimum sustainable population, and, since 1985 the overall population has declined approximately 3 percent per year (Forney et al. 2000).

A female monk seal appeared at Johnston Atoll in 1968. The first was tagged as a pup on Laysan and was the first to be recorded outside the Hawaiian archipelago. It stayed until at least mid-August 1972, and in 1969 an untagged female hauled out and pupped. After the female left a month or so later, the pup remained until it died in 1971. Marks indicated that the cause of death was probably a shark attack (Amerson and Shelton 1976). More recently another female has been seen at Johnston Atoll from July to September 1999. Nine Hawaiian monk seals were translocated to Johnston Atoll from Laysan Island in 1984, and one or two of these tagged seals have repeatedly been observed at Johnston Atoll (O'Daniel, USFWS, Johnston Atoll National

Wildlife Refuge, personal communication). A report of a monk seal at Palmyra Atoll was made in 1990 (Redmond 1990).

Other Marine Mammals

Table 7 lists known non-ESA listed marine mammals that occur in the Western Pacific Region.

Table 7: Non-ESA Listed Marine Mammals of the Western Pacific

Common Name	Scientific Name	Common Name	Scientific Name
Blainsville beaked whale	*Mesoplodon densirostris*	Pygmy sperm whale	*Kogia breviceps*
Bottlenose dolphin	*Tursiops truncatus*	Risso's dolphin	*Grampus griseus*
Bryde's whale	*Balaenoptera edeni*	Rough-toothed dolphin	*Steno bredanensis*
Cuvier's beaked whale	*Ziphius cavirostris*	Short-finned pilot whale	*Globicephala macrorhynchus*
Dwarf sperm whale	*Kogia simus*	Spinner dolphin	*Stenella longirostris*
False killer whale	*Pseudorca crassidens*	Spotted dolphin	*Stenella attenuata*
Killer whale	*Orcinus orca*	Striped dolphin	*Stenella coeruleoalba*
Melon-headed whale	*Peponocephala electra*	Pacific white-sided dolphin	*Lagenorhynchus obliquidens*
Pygmy killer whale	*Feresa attenuata*	Minke whale	*Balaenoptera acutorostrata*
Fraser's dolphin	*Lagenodelphis hosei*	Dall's porpoise	*Phocoenoides dalli*
Longman's beaked whale	*Indopacetus pacificus*	Common Dolphin	*Delphinus delphis*
Minke Whale	*Balaenoptera acutorostrata*	Fraser's Dolphin	*Lagenodelphis hosei*

3.3.4.3 Seabirds

Seabirds listed as threatened or endangered under the ESA are managed by the USFWS. The bristle-thighed curlew, which is listed as "vulnerable" under the ESA, is a migratory seabird that has been reported at Palmyra Atoll.

Short-Tailed Albatross

The short-tailed albatross (*Phoebastria immutabilis*) is the largest seabird in the North Pacific, with a wingspan of more than 3 meters (9 ft) in length. It is characterized by a bright-pink bill with a light-blue tip and defining black line extending around the base. The plumage of a young fledgling (i.e., a chick that has successfully flown from the colony for the first time) is brown, and at this stage, except for the bird's pink bill and feet, the seabird can easily be mistaken for a black-footed albatross. As the juvenile short-tailed albatross matures, the face and underbody become white and the seabird begins to resemble a Laysan albatross. In flight, however, the short-tailed albatross is distinguished from the Laysan albatross by a white back and by white patches on the wings. As the short-tailed albatross continues to mature, the white plumage on the crown and nape changes to a golden yellow.

Before the 1880s, the short-tailed albatross population was estimated to be in the millions, and it was considered the most common albatross species ranging over the continental shelf of the U.S. (DeGange 1981). Between 1885 and 1903, an estimated five million short-tailed albatrosses were harvested from the Japanese breeding colonies for the feather, fertilizer, and egg trade, and by 1949 the species was thought to be extinct (Austin 1949). In 1950, ten short-tailed albatrosses were observed nesting on Torishima (Tickell 1973).

The short-tailed albatross is known to breed only in the western North Pacific Ocean, south of the main islands of Japan. Although at one time there may have been more than ten breeding locations (Hasegawa 1979), today there are only two known active breeding colonies: Minami Tori Shima Island and Minami-Kojima Island. On December 14, 2000, one short-tailed albatross was discovered incubating an egg on Yomejima Island of the Ogasawara Islands (southernmost island among the Mukojima Islands). A few short-tailed albatrosses have also been observed attempting to breed, although unsuccessful, at Midway Atoll in the NWHI.

Historically, the short-tailed albatross ranged along the coasts of the entire North Pacific Ocean from China, including the Japan Sea and the Okhotsk Sea (Sherburne 1993) to the west coast of North America. Prior to the harvesting of the short-tailed albatross at their breeding colonies by Japanese feather hunters, this albatross was considered common year-round off the western coast of North America (Robertson 1980). In 2000, the breeding population of the short-tailed albatross was estimated at approximately 600 breeding age birds, with an additional 600 immature birds, yielding a total population estimate of 1,200 individuals (65 FR 46643, July 31, 2000). At that time, short-tailed albatrosses were estimated to have an overall annual survival rate of 96 percent and a population growth rate of 7.8 percent (65 FR 46643, July 31, 2000). More recently, NMFS estimated the global population to consist of approximately 1,900 individuals (P. Sievert, personal communication; in NMFS 2005), and the Torishima population was estimated to have increased by 9 percent between the 2003–04 and 2004–05 seasons (Harrison 2005).

The short-tailed albatross was first listed under the Endangered Foreign Wildlife Act in June 1970. On July 31, 2000, the United States Fish and Wildlife Service extended the endangered status of the short-tailed albatross to include the species' range in the United States. The primary threats to the species are destruction of breeding habitat by volcanic eruption or mud- and landslides, reduced genetic variability, limited breeding distribution, plastics ingestion, contaminants, airplane strikes, and incidental capture in longline fisheries. There have been no reports of short-tailed albatrosses in the PRIA. No critical habitat has been established for the short-tailed albatross and none of the fisheries described in this FEP are likely to interact with this species.

Newell's Shearwater

The Newell's shearwater (*Puffinus auricularis newelli*) is listed as threatened under the ESA. Generally, the at-sea distribution of the Newell's shearwater is restricted to the waters surrounding the Hawaii archipelago, with preference given to the area east and south of the main Hawaiian Islands. The Newell's shearwater has been listed as threatened because of its small population, approximately 14,600 breeding pairs, its isolated breeding colonies, and the numerous hazards affecting them at their breeding colonies (Ainley et al. 1997). The Newell's shearwater breeds only in colonies on the main Hawaiian Islands (Ainley et al. 1997), where it is threatened by urban development and introduced predators like rats, cats, dogs, and mongooses (Ainley et al. 1997).

Shearwaters are most active in the day and skim the ocean surface while foraging. During the breeding season, shearwaters tend to forage within 50–62 miles (80–100 km) of their nesting burrows (Harrison 1990). Shearwaters also tend to be gregarious at sea, and the Newell's shearwater is known to occasionally follow ships (Harrison 1990. Shearwaters feed by surface seizing and pursuit plunging (Warham 1990). Often shearwaters will dip their heads under the water to sight their prey before submerging (Warham 1990).

Shearwaters are extremely difficult to identify at sea, as the species is characterized by mostly dark plumage, long and thin wings, a slender bill with a pair of flat and wide nasal tubes at the base, and dark legs and feet. Like the albatross, the nasal tubes at the base of the bill enhance the bird's sense of smell, assisting them to locate food while foraging (Ainley et al. 1997).

Other Seabirds

Other seabirds found in the region include the black-footed albatross (*Phoebastria nigripes*), Laysan albatross (*Phoebastria immutabilis*), masked booby (*Sula dactylatra*), brown booby (*Sula leucogaster*), red-footed booby (*Sula sula*), wedge-tailed shearwater (*Puffinus pacificus*), Christmas shearwater (*Puffinus nativitatis*), petrels (*Pseudobulweria* spp., *Pterodroma* spp.), tropicbirds (*Phaethon* spp.), frigatebirds (*Fregata* spp.), and noddies (*Anous* spp.)

3.3.5 Description of the PRIA

The following sections provide detailed information on the physical, biological, and social environments of the PRIA managed under this FEP.

3.3.5.1 Baker Island

Baker Island, which is part of the Phoenix Islands archipelago, is located 13 miles north of the equator at 0° 13' N and 176° 38' W and approximately 1,600 nautical miles to the southwest of Honolulu. It is a coral-topped seamount surrounded by a narrow-fringing reef that drops steeply very close to the shore. The total amount of emergent land area of Baker Island is 1.4 square kilometers (CIA World Fact Book 2005).

Coral Reefs

Within the 10-fathom curve, the potential coral reef area of Baker Island is estimated at 5.2 km^2 (Rohman et al. 2005). At Baker Island, the following number of coral reef associated organisms are reported to occur: 80 species of corals, 13 genera of algae, and 241 species coral reef fishes (Brainard et. al 2005).Although environmental and anthropogenic stressors such as climate change and coral bleaching, diseases, tropical storms, and marine debris remain, the coral reef ecosystem around Baker Island appears to be healthy and productive (Brainard et al. 2005).

Deep Reef Slope

To date, data on the habitat of Baker Island's deep-reef slope and the marine life it supports are unavailable.

Pelagic Habitat

Because of its position near the equator, Baker Island lies within the westward flowing South Equatorial Current. Baker Island also experiences an eastward flowing Equatorial Undercurrent that causes upwelling of nutrient and plankton rich waters on the west side of the island (Brainard et. al 2005). Sea surface temperatures of pelagic EEZ waters around Baker Island are often near 30° C.[13] Although the depth of the mixed layer in the pelagic waters around Baker Island is seasonally variable, average mixed layer depth is around 100 meters (R. Moffitt, PIFSC, personal communication).

Sea Turtles

Green and hawksbill sea turtles have been observed foraging in the nearshore areas around Baker Island (USFWS 2007a). However, they have not been observed nesting on the island (Beth Flint, USFWS personal communication). Other species of sea turtles may occur in the EEZ waters around Baker Island, but to date, data on species type and abundance are not available.

Marine Mammals

A resident population of bottlenose dolphins is reported to occur near Howland and Baker Islands (Brainard et al. 2005). Although other cetaceans such as sperm whales are believed to occur around Baker Island, information on the types of species and their abundance is currently unknown. In the summer of 2005, researchers from the NMFS's Southwest Science Center conducted a cruise to record the occurrence of marine mammals around the PRIA. The data from that research cruise are presently being analyzed.

Seabirds

Baker Island provides habitat for a wide variety of resident and migratory seabirds. The USFWS is currently compiling information on the number species of seabirds that utilize the island.

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[13] http://oceanwatch.pifsc.noaa.gov/

Social Environment
In 1924, Bishop Museum archaeologist Kenneth Emory discovered several Polynesian structures as well as stone paths and pits, and concluded that Baker Island was known to early Polynesians.[14] In the early nineteenth century, several whaling ships landed on the island, including the *Gideon Howard* for whose captain, Michael Baker, the island is named. Captain Baker later sold his rights to the island to the American Guano Company, which extensively mined the island's phosphate deposits from 1859 to 1878. In 1935, American colonists attempted to settle the island and built dwellings, a lighthouse, and planted trees and shrubs.[15] The settlement was abandoned due to World War II. Baker Island was designated a National Wildlife Refuge in 1974 and is administered by the USFWS. Currently, Baker Island is uninhabited. The Coral Reef Ecosystems FMP (69 FR 8336) established a no-take MPA from 0 to 50 fathoms around Baker Island and this FEP maintains that regulation.

3.3.5.2 Howland Island

Howland Island, which is also part of Phoenix Islands archipelago, is located 48 miles north of the equator at 0° 48' N and 176° 38' W, and 36 nautical miles north of Baker Island. The island, which is the emergent top of a seamount, is fringed by a relatively flat coral reef that drops off sharply. Howland Island is approximately 1.5 miles long and 0.5 miles wide. The island is flat and supports some grasses and small shrubs. The total land area is 1.6 square kilometers (CIA World Fact Book).

Coral Reefs
The potential coral reef area with the 10-fathom curve of Howland is estimated 3.0 square kilometers (Rohman et al. 2005). At Howland Island, the following numbers of coral reef associated organisms are reported to occur: 91 species of corals, nine genera of algae, and 302 species coral reef fishes (Brainard et. al 2005). Although environmental and anthropogenic stressors such as climate change, coral bleaching, diseases, tropical storms, and marine debris remain, the coral reef ecosystem around Howland Island appears healthy and productive (Brainard et al. 2005).

Deep Reef Slope
Howland Island is a seamount surrounded by a narrow-fringing reef that drops steeply very close to the shore. To date, data on the habitat of Howland Island's deep reef slope and the marine life it supports are unavailable.

Pelagic Habitat
Because of its position slightly north of the equator, Howland Island lies within the margins of the eastward flowing North Equatorial Counter Current and the margins of the westward flowing South Equatorial Current. Sea–surface temperatures of pelagic EEZ waters around Baker Island are often near 30° C.[16] Although the depth of the mixed layer in the pelagic waters

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[14] Source: Bishop Museum, Honolulu, Hawaii, past exhibits (1995) and at ; http://www.bishopmuseum.org/exhibits/pastExhibits/1995/hawaiilo/hawbaker.html
[15] http://www.janeresture.com/baker/
[16] http://oceanwatch.pifsc.noaa.gov/

around Howland Island is seasonally variable, average mixed layer depth is around 70 meters to 90 meters (R. Moffitt, PIFSC, personal communication).

Sea Turtles
Green and hawksbill sea turtles are reported to occur in the nearshore reef areas of Howland Island (USFWS 2007b). However, the abundance and occurrence of other sea turtles around Howland Island are currently unknown.

Marine Mammals
A resident population of bottlenose dolphins is reported to occur near Howland and Baker Islands (Brainard et al. 2005). Although other cetaceans such as sperm whales are believed to occur in the EEZ around Howland Island, information on the types of species and their abundance is currently unknown. In the summer of 2005, researchers from NMFS' Southwest Science Center conducted a cruise to record the occurrence of marine mammals around the PRIA. The data from that research cruise are presently being analyzed.

Seabirds
Howland Island provides habitat for a wide variety of resident and migratory seabirds. The USFWS is currently compiling information on the number of species of seabirds that utilize the island.

Social Environment
Throughout the whaling era of the early nineteenth century, several ships are believed to have landed at Howland Island. In 1857, Howland Island was claimed by the American Guano Company, which mined several hundred thousand tons of guano between 1857 and 1878. American colonists landed on the island in 1935 and later built a runway that was planned to be used by Ameila Earhart on her circumnavigation flight in 1937. Earhart was supposed to land on Howland on July 2, 1937, as a stopover during her flight from Lau, New Guinea, to Oahu, Hawaii. However, Earhart never arrived nor was she heard from again. The lighthouse at Howland Island is called Amelia Earhart light.[17] In 1942, following attacks on the island by Japanese forces, the American colonists were removed. Since that time, the island has remained uninhabited. In 1974, management authority of the refuge was transferred to the USFWS. The Coral Reef Ecosystems FMP (69 FR 8336) established a no-take MPA from 0 to 50 fm around Howland Island and this FEP maintains that provision.

3.3.5.3 Jarvis Island

Jarvis Island, which is part of the Line Island archipelago, is located at 0° 23' S, 160° 01' W and approximatley 1,300 miles south of Honolulu and 1,000 miles east of Baker Island. Jarvis Island is a relatively flat (15–20-ft beach rise), sandy coral island with a total land area of 4.5 square kilometers. It experiences a very dry climate with limited rainfall (CIA World Fact Book).

Coral Reefs

[17] http://www.janeresture.com/howland/

Jarvis Island is surrounded by a narrow-fringing reef. The potential coral reef area with the 10-fathom curve is estimated at 3.0 square kilometers (Rohman et al. 2005). At Jarvis Island, the following numbers of coral reef associated organisms are reported to occur: 49 species of corals, 10 genera of algae, and 252 species of coral reef fishes (Brainard et al. 2005). Despite environmental and anthropogenic stressors such as climate change, coral bleaching, diseases, tropical storms, and marine debris remain, the coral reef ecosystem around Jarvis Island appears healthy and productive (Brainard et al. 2005).

Deep Reef Slope
Jarvis Island is surrounded by a narrow-fringing reef that drops steeply very close to the shore. To date, data on the habitat of Jarvis Island's deep reef slope and the marine life it supports are unavailable.

Pelagic Habitat
Due to its position below the equator, Jarvis Island lies within the South Equatorial Current, which runs in a westerly direction. Sea surface temperatures of pelagic EEZ waters around Jarvis Island are often 28°– 30° C.[18] Although depth of the mixed layer in the pelagic waters around Jarvis Island is seasonally variable, average mixed layer depth is around 80 meters (R. Moffitt, PIFSC, personal communication).

Sea Turtles
Green and hawksbill sea turtles are reported to occur in the nearshore reef areas of Jarvis Island (USFWS 2007c). Their abundance as well as the occurrence of other sea turtles around Jarvis Island is currently unknown.

Marine Mammals
A resident population of bottlenose dolphins is reported to occur near Jarvis Island (Brainard et al. 2005). Although other cetaceans such as sperm whales are believed to occur in the EEZ around Jarvis Island, information on the types of species and their abundance is currently unknown. In the summer of 2005, researchers from the NMFS' Southwest Science Center conducted a cruise to record the occurrence of marine mammals around the PRIA. The data from that research cruise are currently being analyzed.

Seabirds
Jarvis Island provides habitat for a wide variety of resident and migratory seabirds, including nearly three million pairs of sooty terns (USFWS 2007c). The USFWS is currently compiling information on the number species of seabirds that utilize the island. The anticipated completion date for this study is unknown.

Social Environment
Between 1859 and 1878, Jarvis Island was extensively mined for its rich guano deposits by the American Guano Company. In 1889, Great Britain annexed the island and leased it to a British mining company, which did not extract large amounts of guano. In 1935, American colonists reclaimed Jarvis as an American possession and built a group of buildings that they named Millerstown. Jarvis was abandoned by the colonists due to attacks from Japanese forces during

[18] http://oceanwatch.pifsc.noaa.gov/

World War II, and since 1974 it has been a National Wildlife Refuge administered by the USFWS. The Coral Reef Ecosystems FMP (69 FR 8336) established a no-take MPA from 0 to 50 fathoms around Jarvis Island, and this FEP maintains that provision.

3.3.5.4 Palmyra Atoll

Palmyra Atoll comprises approximately 52 islets surrounding three central lagoons. This low-lying coral atoll system is approximately 1,056 nm south of Honolulu and is located at 5° 53' N latitude and 162° 05' W longitude. Palmyra Atoll and Kingman Reef occur at the northern end of the Line Island archipelago, situated halfway between Hawaii and American Samoa. Palmyra Atoll is located in the ITCZ, an area of high rainfall (see Chapter 3)

Coral Reefs
Palmyra Atoll is surrounded by extensive reef flats on all sides. The potential coral reef area within the 10-fathom curve around Palmyra Atoll is estimated at 47.2 square kilometers (Rohman et al. 2005). At Palmyra Atoll, the following numbers of coral reef associated organisms are reported to occur: 170 species of corals, 13 genera of algae, and 343 species of coral reef fishes (Brainard et al. 2005). Palmyra Atoll is observed to have a higher diversity of corals, anemones, and fishes than other Pacific Remote Islands because it is located within the eastward flowing Equatorial Counter Current which flows from areas in the western Pacific with high levels of biodiversity (Brainard et al. 2005).

Deep Reef Slope
Data on the deep reef slope around Palmyra Atoll and the marine life it supports are unavailable. However, the area of deep reef slope is not believed to be extensive.

Pelagic Habitat
Because of its relative proximity to the equator, Palmyra Atoll lies in the North Equatorial Counter Current, which flows in eastward direction. Sea–surface temperatures of pelagic EEZ waters around Palmyra Atoll are often 27°–30° C.[19] Although the depth of the mixed layer in the pelagic waters around Palmyra Atoll is seasonally variable, the average mixed layer depth is around 90 meters (R. Moffitt, PIFSC, personal communication).

Sea Turtles
Both green sea turtles and hawksbill sea turtles have been observed at Palmyra Atoll, with the green sea turtle observed to nest on Cooper’s Island, which is the largest island within the Palmyra Atoll system (USFWS 1998).

Marine Mammals
Pilot whales and bottlenose dolphins have been observed in the lagoon of Palmyra Atoll (Fefer 1987), and a Hawaiian monk seal was sighted in 1990 (Redmond 1990). Melon headed whales, which primarily feed on squid, have been observed on the southwestern side of Palmyra Atoll. Palmyra’s southwestern side is likely an area of higher productivity than areas because the main

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[19] http://oceanwatch.pifsc.noaa.gov/

channel into the lagoon is located there and is believed to be the major output source of nutrient-rich lagoon waters (Brainard et al. 2005).

Seabirds
Palmyra Atoll supports 29 species migratory seabirds and shorebirds and has the largest nesting colonies of red-footed boobies and black noddies in the central Pacific (USFWS 1998). The islets of the atoll are important habitat for the bristle-thighed curlew (*Numenius tahitiensis*), a shorebird that is considered vulnerable due to declining numbers.

Social Environment
Palmyra has had an interesting history involving shipwrecks, pirates, and buried treasure, and a double murder in the mid-1970s. Palmyra first became an American possession when it was claimed by the American Guano Company in 1859. In 1862, King Kamehameha IV claimed Palmyra for the kingdom of Hawaii. In 1898, when the U.S. annexed the Territory of Hawaii, President McKinley also included Palmyra Atoll. In 1912, a judge from Honolulu bought all of Palmyra Atoll, which he later sold to the Fullard-Leo family. From 1940–1946, the U.S. Navy took control of Palmyra and used it as a naval aviation facility. In 1947, the U.S. Supreme Court returned ownership of Palmyra to the Fullard-Leo family from the U.S. Navy. In 1961, President Kennedy assigned the U.S. Department of Interior to have civil administration over Palmyra. In 2000, the Nature Conservancy bought Palmyra Atoll from the Fullard-Leo family and in July 2004 established the Palmyra Atoll Research Consortium (PARC). Palmyra Atoll is managed cooperatively by the USFWS and the Nature Conservancy, which owns Cooper Island which it manages as a nature preserve with limited recreational fishing (e.g., flyfishing for bonefish). The USFWS administers the atoll as a National Wildlife Refuge. The Coral Reef Ecosystems FMP (69 FR 8336) established a low-use MPA from 0 to 50 fathoms around Palmyra Atoll and this FEP maintains that provision.

3.3.5.5 Kingman Reef

Kingman Reef, which is located 33 nautical miles northwest of Palmyra Atoll at 6° 23' N and 162° 24' W, is a series of fringing reefs around a central lagoon. Kingman Reef does not have any emergent islets that support vegetation. The USFWS administers the reef area as a National Wildlife Refuge. The Coral Reef Ecosystems FMP (69 FR 8336) established a no-take MPA from 0 to 50 fathoms around Kingman Reef and this FEP maintains that provision.

Coral Reefs
The potential coral reef area within the 10 fm curve Kingman Reef is estimated at 20.9 km^2 (Rohman et al. 2005). At Kingman Reef, 155 species of corals, 15 genera of algae, and 225 species of reef fishes are reported to occur (Brainard et al. 2005).

Deep Reef Slope
Data on the deep reef slope around Kingman Reef and the marine life it supports are unavailable. However, the area of deep reef slope is not believed to be extensive.

Pelagic Habitat

Because of its relative proximity to the equator, Kingman Reef lies in the North Equatorial Countercurrent, which flows in a west to east direction. Sea–surface temperatures of pelagic EEZ waters around Palmyra Atoll are often 27°–30° C.[20] Although the depth of the mixed layer in the pelagic waters around Kingman Reef is seasonally variable, average mixed layer depth is around 80 meters (R. Moffitt, PIFSC, personal communication).

Sea Turtles
Green sea turtles and hawksbill sea turtles are likely found at Kingman Reef, as both species are found at nearby Palmyra Atoll.

Marine Mammals
Because of its close proximity to Palmyra Atoll, bottlenose dolphins, pilot whales, and melon headed whales are likely to occur around Kingman Reef.

Seabirds
Seabirds which nest at Palmyra are likely to visit areas near Kingman Reef. However, because there are no emergent islands at Kingman Reef, it is believed that no seabirds nest there.

Social Environment
In 2001, management authority of Kingman Reef was transferred to the U.S. Fish and Wildlife Service. The USFWS administers the island as a National Wildlife Refuge and asserts a 12-nautical mile boundary around the atoll. The Coral Reef Ecosystem FMP (69 FR 8336) established a no-take MPA from 0-50 fathoms around Kingman Reef.

3.3.5.6 Wake Island

Wake Island is located at 19° 18' N latitude and 166° 35' E longitude, and is the northernmost atoll of the Marshall Islands archipelago, located approximately 2,100 miles west of Hawaii. Wake Island has a total land area of 6.5 square kilometers and comprises three islets: Wake, Peale, and Wilkes.

Coral Reefs
The potential coral reef area within the 10-fathom curve around Wake is estimated at 22.9 square kilometers (Rohman et al. 2005). One hundred and twenty-four species of reef fish have been recorded at Wake. Sharks, particularly the gray reef, are reportedly abundant. The giant clam (*T. maxima*) is reported to be abundant in the lagoon.

Deep Reef Slope
Data on the deep reef slope around Wake Island and the marine life it supports are unavailable. However, the area of deep reef slope is not believed to be extensive because the outer reef slope descends sharply to great depth.

Pelagic Habitat

[20] http://oceanwatch.pifsc.noaa.gov/

Sea–surface temperatures of pelagic EEZ waters around Wake Island are often 27°–30° C.[21] The depth of the mixed layer in the pelagic waters around Wake Atoll is seasonally variable, with the average mixed layer depth at around 80 meters (R. Moffitt, PIFSC, personal communication).

Sea Turtles
Green sea turtles are believed to be present in the nearshore areas around Wake Island. However, their abundance is unknown.

Marine Mammals
Spinner dolphins, Pacific bottlenose dolphins (*Tursiops truncatus*), and Cuvier's beaked whales are thought to occur at Wake Island.

Seabirds
Wake Island supports a wide variety of both resident and migratory seabirds (Beth Flint, U.S. USFWS, pers. comm.).

Social Environment
The written historical record provides no evidence of permanent prehistoric populations on Wake Island. However, for 2,000 years Marshall Islanders occasionally visited Wake, giving it the name *Eneen-kio*.[22] The island was annexed by the U.S. in 1899. Before the 1930s, the only visitors were scientists and survivors of shipwrecks. The U.S. 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, and the Japanese overtook U.S. forces on Wake in 1941. The U.S. reoccupied 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. This area is closed to the public and permission is needed to enter the area. The USFWS is currently considering incorporating Wake Island as part of the National Wildlife Refuge system. The Coral Reef Ecosystems FMP (69 FR 8336) established a low-use MPA from 0 to 50 fathoms around Wake Island, and this FEP maintains that provision.

3.3.5.7 Johnston Atoll

Johnston Atoll is located at 16° 44' N latitude and 169° 31' W longitude and is approximately 720 nautical miles southwest of Honolulu. French Frigate Shoals in the NWHI is the nearest land mass (~ 450 nm to the northwest), and due to its proximity to the Hawaiian Islands there is believed to be genetic and larval connectivity between Johnston Atoll and the Hawaiian Islands. Johnston Atoll is an egg-shaped coral reef and lagoon complex residing on a relatively flat, shallow platform approximately 21 miles in circumference (205 square kilometers). Johnston Atoll comprises four small islands totaling 2.8 square kilometers. Johnston Island, the largest and main island, is natural in origin, but has been enlarged by dredge and fill operations. Sand Island is composed of a naturally formed island (eastern portion) connected by a narrow, man-made

[21] http://oceanwatch.pifsc.noaa.gov/
[22] http://www.enenkio.org/history_main.htm

causeway to a dredged coral island (western portion). The remaining two islands, North Island and East Island, are completely man-made from dredged coral (USAF 2004).

Coral Reefs
The potential coral reef area within the 10-fathom curve of Johnston Atoll is estimated at 150 square kilometers (Rohman et al. 2005). Johnston Atoll, which has 45 Scleractinian and Hydrozoan corals present, has fewer coral species than are found in the Hawaiian Islands. The reef is composed of alternating sand/loose coral and live coral, with the most dominant coral species present being *Acropora*. The coral *Montipora* is also widely found. Approximately 300 species of fish have been recorded in the nearshore waters and reefs of Johnston Atoll. This number is smaller than that of other islands in the Central Pacific, and is likely due to Johnston Atoll's small size and remote location. One species of angelfish, *Centropyge nahackyi*, is endemic (USAF 2004).

Deep Reef Slope
Data on the deep reef slope around Johnston Atoll and the marine life it supports limited. However, the area of deep reef slope is not believed to be extensive.

Pelagic Habitat
Sea surface temperatures of pelagic EEZ waters around Johnston Atoll are often 27°–30° C.[23] Although the depth of the mixed layer in the pelagic waters around Johnston Atoll is seasonally variable, average mixed layer depth is around 80 meters (R. Moffitt, PIFSC, personal communication).

Sea Turtles
Green and hawksbill sea turtles have been observed at Johnston Atoll. It is estimated that nearly 200 green sea turtles forage near its southern shore. However, it is thought that green sea turtles do not nest on Johnston Atoll (USAF 2004).

Marine Mammals
The following marine mammals have been observed at Johnston Atoll: Hawaiian monk seals, humpback whales, Cuvier's beaked whales, spinner dolphins, and bottlenose dolphins (USAF 2004). Most marine mammals observed near Johnston Atoll occur outside the lagoon. However, a Cuvier's beaked whale has been seen inside the lagoon.

A female Hawaiian monk seal appeared at Johnston Atoll in 1968. It was tagged as a pup on Laysan and was the first to be recorded outside the Hawaiian archipelago. It stayed in the area until at least mid-August 1972. Also, in 1969 an untagged female hauled out and pupped; the female left a month or so later and the pup remained until it died in 1971. Marks indicated that the cause of death was probably a shark attack (Amerson and Shelton 1976). Nine Hawaiian monk seals were translocated to Johnston Atoll from Laysan Island in 1984, and one or two of these tagged seals have repeatedly been observed at Johnston Atoll (O'Daniel, USFWS, Johnston Atoll National Wildlife Refuge, personal communication). More recently another female was observed at Johnston Atoll from July to September 1999.

[23] http://oceanwatch.pifsc.noaa.gov/

Seabirds
The following table provides a list of seabirds observed at Johnston Atoll.

Table 8: Seabirds of Johnston Atoll
Source: USAF 2004

Common name	**Scientific name**
Great frigatebird	*Fregata minor*
Brown booby	*Sula leucogaster*
Masked booby	*Sula dactylatra*
Red-footed booby	*Sula sula*
Red-tailed tropicbird	*Phaethon rubricauda*
White-tailed tropicbird	*Phaethon lepturus*
Christmas shearwater	*Puffinus nativitatis*
Wedge-tailed shearwater	*Puffinus pacificus*
Bulwer's petrel	*Bulweria bulwerii*
Sooty tern	*Sterna fuscata*
Gray-backed tern	*Sterna lunata*
White tern	*Gygis alba*
Black noddy	*Anous minutus*
Brown noddy	*Anous stolidus*
Winter Residents	
Bristle-thighed curlew	*Numenius tahitiensis*
Pacific golden-plover	*Pluvialis fulva*
Ruddy turnstone	*Arenaria interpres*
Sanderling	*Calidris alba*
Wandering tattler	*Heteroscelus incanus*
Blue-gray noddy	*Procelsterna cerulea*

Social Environment
Although both the U.S. and Great Britain annexed Johnston Atoll in the mid-1850s, only the U.S. (American Guano Company) mined phosphates from the island (CIA World Fact Book). President Theodore Roosevelt designated Johnston Atoll as a wildlife refuge in 1926, and in 1934, the U.S. Navy administered the area. In 1948, Johnston Atoll was managed by the U.S. Air Force, which in the 1950s - 1960s used the area for high-altitude nuclear tests. Until 2000, Johnston Atoll was managed by the U.S. Department of Defense as a storage and disposal site for chemical weapons. In 2004, cleanup and closure of the storage and disposal facilities was completed. Currently, the USFWS manages Johnston Atoll as a National Wildlife Refuge. Recreational fishing occurs within the refuge. The Coral Reef Ecosystems FMP (69 FR 8336) established a low-use MPA from 0 to 50 fathoms around Johnston Atoll, and this FEP maintains that provision.

CHAPTER 4: DESCRIPTION OF PRIA FISHERIES

4.1 Introduction

Chapter 4 describes the non-pelagic fisheries of the PRIA and provides information on the history of fishing in the area, including information on catches, landings, participation and bycatch for each fishery managed under this FEP. For more information, please see the Council's FMPs, FMP amendments and associated annual reports. Additional information is also available[24] in a 2008 environmental assessment for the Crustaceans FMP (WPRFMC 2008a), a 2001 Final EIS for the Coral Reef Ecosystems FMP (WPRFMC 2001), 2007 and 2008 environmental assessments for the Precious Corals FMP (WPRFMC 2007b, WPRFMC 2008b), a 2005 Final EIS to the Bottomfish FMP (WPRFMC 2005a), a 2007 Final Supplemental EIS to the Bottomfish FMP (WPRFMC 2007a) and a 2006 environmental assessment under the Crustaceans and Bottomfish FMPs prepared in association with the inclusion of the PRIA into the management area of those FMPs (WPRFMC 2006), which are incorporated here by reference.

4.2 PRIA Bottomfish Fisheries

The PRIA were added to the Bottomfish and Seamount Groundfish Fishery Management Plan through publication of a final rule on September 12, 2006 (71 FR 53605) which became effective on October 12, 2006. While there are currently no known bottomfish fisheries operating in the PRIA, several vessels have been known to occasionally fish for bottomfish in Federal waters around the PRIA.

Low levels of commercial fishing have occurred at Palmyra Atoll and Kingman Reef, and recreational fishing, through the Nature Conservancy, is offered at Palmyra. The recent renovation of the airstrip and construction of vessel reprovisioning facilities by a fishing venture promoted increased fishing activity in and around Palmyra and Kingman waters. Recent restrictions on pelagic and other fishing activity (NMFS 2004 Biological Opinion for the Pelagic Fishery and Department of Interior Secretarial Orders) could likely limit or prohibit this venture. In 1998, two Hawaii-based troll and handline vessels, and one demersal longline vessel targeting sharks fished in EEZ waters around Palmyra and Kingman Reef. These vessels targeted both pelagic and bottomfish species, including deep slope snappers, yellowfin and bigeye tuna, wahoo, mahimahi, and sharks (WPRFMC 2000b). One vessel made seven trips to these areas in 1999, targeting the two-spot snapper, *Lutjanus bohar*, at Kingman Reef, of which they caught 40,000 pounds. The fishermen tested much of the catch for ciguatera without a single positive and shipped the catch to New York and Florida. They stopped fishing after results of a single specimen submitted for testing to the University of Hawaii's School of Medicine showed slight traces of ciguatera.

[24] Available from the Council at www.wpcouncil.org or at 1164 Bishop St. Ste 1400, Honolulu, HI 96813.

In 2006 and 2007, several PRIA troll/handline/bottomfish fishing permits were issued by NMFS, however, to date only one has been used. The catch and operations of this vessel cannot be revealed due to confidentiality requirements.

Very little bottomfish research has been conducted in the PRIA to date. Research cruises to Howland, Baker, and Jarvis Islands and to Palmyra Atoll and Kingman Reef were conducted in 2000 - 2004. These continuing investigations are focusing on the status of the shallow-water habitat including percentage of live reef coverage, biodiversity, and reef species stock assessments. As the assessments are being conducted with towed-sled scuba techniques, the deep-water habitat, including many of the commercially valuable snappers, is still unknown.

4.2.1 Bottomfish Fishery Management Actions to Date

The Fishery Management Plan (FMP) for Bottomfish and Seamount Groundfish Fisheries in the Western Pacific Region became effective on August 27, 1986 (51 FR 27413). Initial bottomfish fishery management measures prohibited certain destructive fishing techniques, including explosives, poisons, trawl nets, and bottom-set gillnets; established a moratorium on the commercial harvest of seamount groundfish stocks at the Hancock Seamounts, and implemented a permit system for fishing for bottomfish in EEZ waters around the Northwestern Hawaiian Islands (NWHI). The plan also established a management framework that provided for regulatory adjustments to be made, such as catch limits, size limits, area or seasonal closures, fishing effort limitations, fishing gear restrictions, access limitations, permit and/or catch reporting requirements, as well as a rules-related notice system.

Amendments 7 and 8 to the FMP specifically affect any potential PRIA bottomfish fishery.

Amendment 7 was prepared and transmitted to NMFS in conjunction with the Coral Reef Ecosystem FMP (CREFMP). It prohibits harvests of BMUS in the no-take marine protected areas (MPAs) established under the CREFMP including areas around Kingman Reef, Jarvis Island, Howland Island, and Baker Island. A final rule implementing this approval was published on February 24, 2004 (69 FR 8336).

Amendment 8 (71 FR 53605a) brought the Federal waters around the PRIA into the FMP and in doing so subjected them to the FMP’s prohibitions on the use of destructive gear types or poisons. It also implemented requirements for fishery participants to obtain Federal permits and submit Federal catch reports of their bottomfishing catch and effort around the PRIA.

Please see Chapter 5 for details on the current regulations for this fishery.

4.2.2 Status of PRIA Bottomfish Fishery

Overfished and Overfishing Determinations
To date, the PRIA’s bottomfish fisheries have not been determined to be overfished or subject to overfishing.

MSY
No estimates of MSY are currently available for bottomfish management unit species in the PRIA.

OY
OY is the amount of bottomfish that will be caught by fishermen fishing in accordance with applicable fishery regulations in this FEP in the EEZ and adjacent waters of the Western Pacific Region.

Domestic processing capacity
Bottomfish harvested in the Western Pacific Region are marketed as fresh product with each vessel processing its catch at sea. Therefore the domestic processing capacity and levels will equal or exceed the harvest for the foreseeable future.

Total Allowable Level of Foreign Fishing
The domestic fleets in the Western Pacific Region have sufficient harvesting capacity to take the entire Optimum Yield, therefore, the Total Allowable Fishing Effort (TALFF) appears to be zero.

4.2.3 Review of PRIA Bottomfish Bycatch

There is currently very little bottomfish fishing activity in the PRIA. There are no finfish or invertebrate species captured in the bottomfish fisheries whose capture or retention is prohibited by law. No observer data are available in the bottomfish fisheries of the PRIA.

However bycatch rates are relatively low in the bottomfish fisheries in other island areas. Only hook-and-line gears are used in the bottomfish fisheries, and these gears strongly select for carnivores, particularly aggressive predators. These types of species, with the exception of sharks, tend to be favored in markets, thus they tend to be retained as target species. The flesh of many shark species is difficult to market, and shark fins have recently become much more difficult to market because of the prohibition on finning.

4.2.4 Potential for Protected Species Interactions

From October 2003 – June 2005, the Hawaii-based bottomfish NWHI fishery was monitored under a mandatory NMFS observer program. Data for seven calendar quarters are available on the PIRO website. From the fourth quarter of 2003 through the second quarter of 2005, observer coverage in the bottomfish fleet averaged 21.4 percent, and there were no observed interactions with sea turtles or marine mammals. There were a total of six observed seabird interactions, including two unidentified boobies, one brown booby, one black-footed albatross and two Laysan albatrosses. Only the black-footed albatross interaction occurred during bottomfish fishing operations. All of the other interactions were observed in transit during trolling operations. Due to the type of fishing gears and methods used (hook-and-line fishing from largely stationary vessels), interactions between seabirds and bottomfishing operations around the PRIA are believed to occur rarely if at all. There have been no reported or observed physical interactions with any species of sea turtle and whales in any of the bottomfish fisheries based out of Hawaii, including during the NMFS 1990–1993 NWHI bottomfish vessel observer program[25] (Nitta 1999) and the more recent 2003-2005 observer program. An average of 2.67 dolphin-damaged fish per 1,000 fish caught was also observed (Kobayashi and Kawamoto 1995). The impact of the bottomfish fishery on the behavior or foraging success of bottlenose dolphins is unknown, but is not believed to be adverse.

Following consultations under section 7 of the ESA, NMFS has determined that bottomfish fisheries are not likely to adversely affect any ESA-listed species or critical habitat in the PRIA.

NMFS has also concluded that the PRIA commercial bottomfish fisheries will not affect marine mammals in any manner not considered or authorized under the Marine Mammal Protection Act.

There are no specific regulations currently in place which are aimed at protected species interaction mitigation, however, prohibitions on certain destructive gear types are in place as described above and in Section 5.3.3.

4.3 PRIA Precious Coral Fisheries

No precious corals harvester has received a Federal permit to harvest corals from the EEZ surrounding the PRIA since the implementation of the Precious Corals FMP in 1980; however, this does not preclude any future permit issuance. The U.S. EEZ surrounding the PRIA has been defined, for the purposes of precious coral fisheries management, as an Exploratory Precious Coral Permit Area.

There are no known extensive precious coral beds in the PRIA nor are there known harvests of precious corals in the PRIA at this time, however, it is possible a future fishery may develop.

4.3.1 Precious Corals Fishery Management Actions to Date

The quota limiting the amount of precious corals that may be taken in any precious corals permit area in EEZ waters around the PRIA during a fishing year is 1,000 kg, all species combined (except black corals). Only selective gear may be used to harvest precious corals and minimum sizes apply. Please see Chapter 5 for details on the current regulations for this fishery.

4.3.2 Status of PRIA Precious Corals Fishery

Overfished and Overfishing Determinations
To date, the PRIA's precious corals have not been harvested, therefore, there are no determinations of the fishery being overfished or subject to overfishing.

MSY and OY
There are no estimates available of MSY or OY values for precious corals around the PRIA.

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[25] Nitta (1999) defined "interaction" to mean "instances in which fish caught during bottomfishing operations were stolen or damaged by marine mammals or marine mammals [sic] and/or other protected species were caught or entangled in bottomfishing gear".

TALFF
The TALFF for each Exploratory Area shall be its quota minus two times of the amount harvested by domestic vessels between July 1 and December 31 of the proceeding year. The TALFF will be available for foreign fishing under a scientific research plan approved by NMFS in consultation with the Council and State agencies.

4.3.3 Review of Bycatch

Precious corals resources are not currently harvested in PRIA waters. Therefore, at this time, there is no reported bycatch associated with this fishery. Should a fishery develop only selective gear would be permitted (i.e with submersibles or by hand). Precious coral fisheries in Hawaii have no bycatch and none would be expected in the PRIA.

4.3.4 Potential for Protected Species Interactions

There have been no reported or observed interactions between marine mammals, sea turtles or seabirds and the active precious corals fishery in the Hawaiian Archipelago. There could be some impact on marine mammals or sea turtles from routine fishing vessel operations (e.g., behavioral or physiological reactions to noise, collisions, or releases of pollutants), however such impacts would be extremely rare and would be expected to constitute a low-level risk to these species marine mammals if a PRIA precious corals fishery were to develop. Following consultations under section 7 of the ESA, NMFS has determined that precious corals fisheries will not adversely affect any ESA-listed species or critical habitat in the PRIA.

NMFS has also concluded that the PRIA commercial precious corals fisheries will not affect marine mammals in any manner not considered or authorized under the Marine Mammal Protection Act.

4.4 PRIA Crustacean Fisheries

A few fishermen have expressed interest in fishing for lobsters in the PRIA, and at least two have attempted it. In 1999, one vessel left Hawaii to explore the lobster fishery in Palmyra/Kingman waters. However, tropical lobsters (green spiny, *P. penicillatus*) do not go into traps readily, and the lobster harvest was unsuccessful as 800 traps were deployed and no lobsters were caught. They also dove on the reef to try to catch lobsters by hand, but were not much more successful and returned with about 20 tails. In addition, this vessel deployed traps at 300–800 meters to target deep-water shrimp and red crab around Palmyra and Kingman. Although there is a danger of losing gear when setting this deep, the operation did not lose many traps, and the catch-per-unit effort (CPUE) was very high, at approximately 30 kg/trap.

Over the past few years, other fishermen have expressed interest in exploring a live lobster fishery in EEZ waters around some of the PRIA (i.e., Palmyra and Johnston Atolls). The possibility of using the airstrips of either island to airfreight live lobsters to Hawaii or elsewhere creates a possible gap in catch reporting. If the catch is air freighted to Honolulu, the catch would most likely be recorded by customs, but the information is not required to be passed to NMFS or the Hawaii Department of Aquatic Resources (HDAR).

There is virtually no research data regarding crustaceans in the PRIA. Detailed fishery data have been collected by the vessel mentioned above, which fished for deep-water shrimp around Palmyra in 1999.

4.4.1 Crustaceans Fishery Management Actions to Date

The PRIA were added to the Crustaceans Fishery Management Plan through publication of a final rule on September 12, 2006 (71 FR 53605) which became effective on October 12, 2006. While there are currently no known crustacean fisheries operating in the PRIA several vessels have been known to fish for crustaceans in Federal waters, although on a small scale.

In order to identify participants and to collect adequate harvest and effort data, Federal permits and logbook reporting are required for all vessels used to fish for crustaceans in EEZ waters around the PRIA. Please see Chapter 5 for details on the current regulations for this fishery.

4.4.2 Status of PRIA Crustacean Fisheries

Overfished and Overfishing Determinations
To date, the PRIA's crustacean fisheries have not been determined to be overfished or subject to overfishing.

MSY and OY
No estimates of MSY or OY currently exist for crustaceans in PRIA.

Domestic processing capacity
Crustaceans harvested in the Western Pacific Region are marketed as fresh product or as frozen lobster tails, with each vessel processing its catch at sea. Therefore the domestic processing capacity and domestic processing levels will equal or exceed the harvest for the foreseeable future.

TALFF
The domestic fishery has the capability and desire to harvest the entire optimum yield from the fishery, therefore the TALFF appears to be zero.

4.4.3 Review of PRIA Crustacean Bycatch

Crustacean harvest is not ongoing and has occurred very sporadically. There is no bycatch associated with this fishery at this time. It is anticipated that emergent lobster fisheries will utilize hand harvesting techniques as lobsters in this area do not readily enter traps and, therefore this fishery would be expected to have very low levels of bycatch.

4.4.4 Potential for Protected Species Interactions

Lobsters around many Western Pacific island areas do not appear to enter traps and thus are hand harvested. There have been no observed or reported interactions with protected species in

Hawaii's precious coral fisheries and the potential for interactions in Federal waters around PRIA is believed to be very low due to the hand harvest methods which would be used if an active fishery were to become established. Following consultations under section 7 of the ESA, NMFS has determined that crustacean fisheries are not likely to adversely affect any ESA-listed species or critical habitat in the PRIA.

NMFS has also concluded that the PRIA commercial crustacean fisheries will not affect marine mammals in any manner not considered or authorized under the Marine Mammal Protection Act.

4.5 PRIA Coral Reef Fisheries

No domestic coral reef fishery has ever occurred at Howland, Baker, Jarvis, or Kingman Reefs. Recreational fishing for bonefish has occurred at Palmyra, through the Nature Conservancy and the USFWS, however, information on the catch statistics is unavailable. No information is available on coral reef catches at Wake Island or Johnston Atoll.

4.5.1 Coral Reef Fisheries Management Actions to Date

Under this FEP there are two categories of MPAs, low-use and no-take. From 0-50 fm the following are no-take MPAs: Baker Island, Howland Island, Jarvis Island, and Kingman Reef. From 0-50 fm the following are low-use MPAs: Johnston Atoll, Palmyra Atoll, and Wake Island. Any person who harvests coral reef ecosystem MUS in low-use MPAs is required to have a Federal special permit issued by NMFS. Issuance of special permits is on a case-by-case basis and based upon several factors including the potential for bycatch, the sensitivity of the area to the type of fishing proposed, and the level of fishing occurring in relation to the level considered sustainable in a low-use MPA. A person permitted and targeting non-CRE MUS under other fishery management plans is not required to obtain a special permit to fish in low-use MPAs.

In addition to the permit requirement for low-use MPAs, in order to identify participants, collect harvest and effort data, and control harvests, special permits are required for any directed fisheries on potentially harvested coral reef taxa (PHCRT) within the regulatory area, or to fish for any CRE MUS in the coral reef regulatory area with any gear not normally permitted.

Please see Chapter 5 for details on the current regulations for this fishery.

4.5.2 Status of PRIA Coral Reef Fisheries

Overfished and Overfishing Determinations
To date no PRIA coral reef fisheries have been determined to be overfished or subject to overfishing.

MSY
No MSY estimates are available for PRIA coral reef ecosystem management unit species.

OY
OY for coral reef ecosystem associated species is defined as 75 percent of their MSY.

Domestic processing capacity
Available information indicates that U.S. processors have sufficient capacity to process the entire OY.

TALFF
Available information indicates that U.S. vessels currently have the capacity to harvest the OY on an annual basis and therefore the TALFF appears to be zero.

4.5.3 Review of PRIA Coral Reef Bycatch

No information is currently available on bycatch in the PRIA's coral reef fisheries however given the extremely limited activity and the common gear types in this fishery it is unlikely that there is any associated bycatch. If a future fishery is established bycatch reporting would be required and future bycatch reduction methodology may be established if deemed necessary. In addition, most coral reef fisheries produce very little bycatch because all species are utilized with very few exceptions and because the gear is selective towards target species.

4.5.4 Potential for Protected Species Interactions

There have been no reported or observed interactions between protected species and coral reef fisheries in Federal waters around PRIA and the potential for interactions is believed to be low due to the gear types and fishing methods used. Following consultations under section 7 of the ESA, NMFS has determined that coral reef fisheries are not likely to adversely affect any ESA-listed species or critical habitat in the PRIA.

NMFS has also concluded that the PRIA commercial coral reef fisheries will not affect marine mammals in any manner not considered or authorized under the Marine Mammal Protection Act.

CHAPTER 5: PRIA FEP MANAGEMENT PROGRAM

5.1 Introduction

This chapter describes the Council's management program for bottomfish, crustaceans, precious corals, and coral reef ecosystem fisheries of the Pacific Remote Island Areas as well as the criteria used to assess the status of managed stocks. The 2003 administrative and enforcement costs of conserving and managing the domestic fisheries of the Western Pacific Region were estimated by NMFS and the Council to total $37 million, with future annual costs predicted to be $74 million (NOAA and WPRFMC 2004).

5.2 Description of National Standard 1 Guidelines on Overfishing

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 produce 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 guidelines for National Standard 1 call for the identifying "good" versus "bad" fishing conditions in the fishery and the stock and describing how a variable such as F will be controlled as a function of some stock size variable such as B in order to achieve good fishing conditions. Restrepo et al. 1998 provides a number of recommended default control rules that may be appropriate, depending on such things as the richness of data available. For the purpose of illustrating the following discussion of approaches for fulfilling the overfishing-related requirements of the MSA, a generic model that includes example MSY, target, and rebuilding control rules is shown in Figure 10. The y-axis, F/F_{MSY}, indicates the variable which managers must control as a function of B/B_{MSY} on the x-axis. The specific application of National Standard 1 to each fishery is described in the following sections. This FEP carries forward the provisions pertaining to compliance with the Sustainable Fisheries Act which were recommended by the Council and subsequently approved by NMFS (68 FR 16754, April 7, 2003). Because biological and fishery data are limited for all species managed by this FEP, MSY-based control rules and overfishing thresholds are specified for multi-species stock complexes.

The Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006 (MSRA) amended the MSA to include new requirements for annual catch limits (ACLs) and accountability measures (AMs) and other provisions regarding preventing and ending overfishing and rebuilding fisheries as follows:

SEC. 302. *REGIONAL FISHERY MANAGEMENT COUNCILS*
(h) FUNCTIONS.--Each Council shall, in accordance with the provisions of this Act--
(6) develop annual catch limits for each of its managed fisheries that may not exceed the fishing level recommendations of its scientific and statistical committee or the peer review process established under subsection g;

SEC. 303. *CONTENTS OF FISHERY MANAGEMENT PLANS*
(a) REQUIRED PROVISIONS – Any fishery management plan which is prepared by any Council, or by the Secretary, with respect to any fishery, shall -
(10) specify objective and measurable criteria for identifying when the fishery to which the plan applies is overfished (with an analysis of how the criteria were determined and the relationship of the criteria to the reproductive potential of stocks of fish in that fishery) and, in the case of a fishery which the Council or the Secretary has determined is approaching an overfished condition or is overfished, contain conservation and management measures to prevent overfishing or end overfishing and rebuild the fishery;
(15) establish a mechanism for specifying annual catch limits in the plan (including a multiyear plan), implementing regulations, or annual specifications, at a level such that overfishing does not occur in the fishery, including measures to ensure accountability.

EFFECTIVE DATES; APPLICATION TO CERTAIN SPECIES.—The amendment made by subsection (a)(10) [and 303 (a)(15) above]—
(1) shall, unless otherwise provided for under an international agreement in which the United States participates, take effect—
(A) in fishing year 2010 for fisheries determined by the Secretary to be subject to overfishing; and
(B) in fishing year 2011 for all other fisheries; and
(2) shall not apply to a fishery for species that have a life cycle of approximately 1 year unless the Secretary has determined the fishery is subject to overfishing of that species; and
(3) shall not limit or otherwise affect the requirements of section 301(a)(1) or 304(e) of the Magnuson-Stevens Fishery Conservation and Management Act.

The Council will continue the development of a mechanism(s) to meet the new requirements for specifying ACLs including measures to ensure accountability and this FEP will undergo future amendments to meet the new MSRA requirements. For additional information on NMFS' guidance regarding National Standard 1 please see 74 FR 3178.

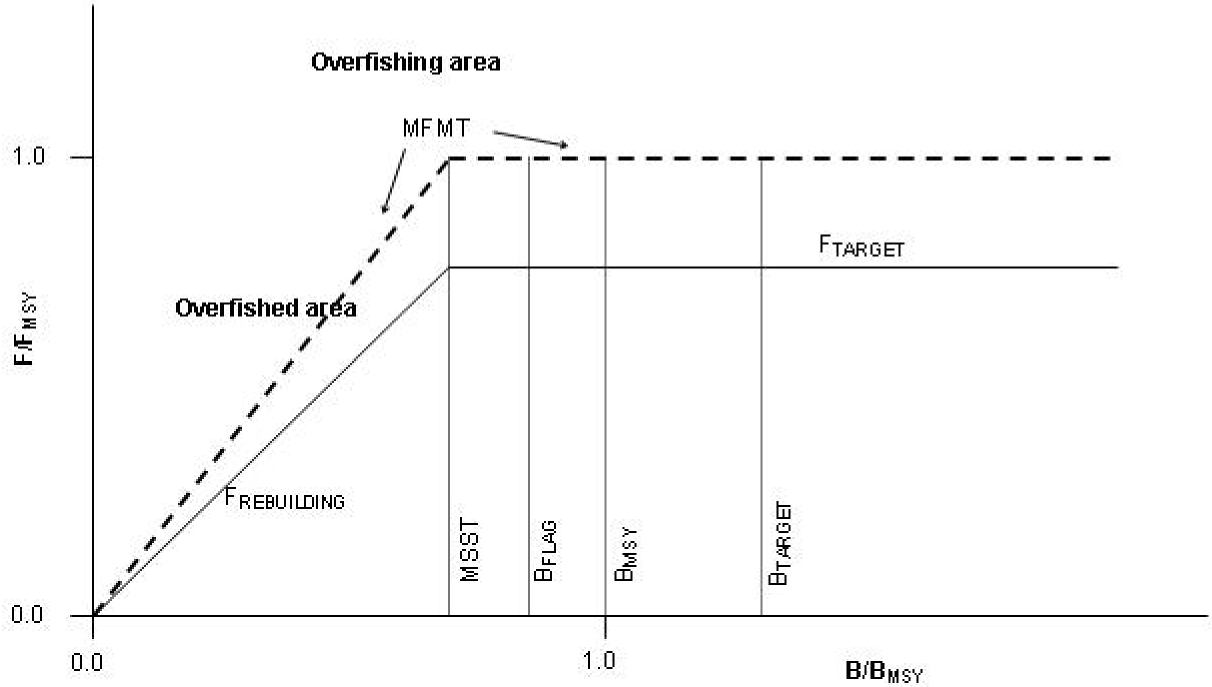

Figure 10: Example MSY, Target, and Rebuilding Control Rules
The dashed horizontal and diagonal line represents a model MSY control rule that is used as the MFMT; the solid horizontal and diagonal line represents a model integrated target (F_{TARGET}) and rebuilding ($F_{REBUILDING}$) control rule.
Source: Restrepo et al. 1998

5.2.1 MSY Control Rule and Stock Status Determination Criteria

An MSY control rule is a control rule that specifies the relationship of F to B or other indicator of productive capacity under an MSY harvest policy. Because fisheries must be managed to achieve optimum yield, not MSY, the MSY control rule is a benchmark control rule rather than an operational one. However, the MSY control rule is useful for specifying the "objective and measurable criteria for identifying when the fishery to which the plan applies is overfished" that are required under the MSA. The National Standard Guidelines (74 FR 3178) refer to these criteria as "status determination criteria" and state that they must include two limit reference points, or thresholds: one for F that identifies when overfishing is occurring and a second for B or its proxy that indicates when the stock is overfished.

The status determination criterion for F is the maximum fishing mortality threshold (MFMT). Minimum stock size threshold (MSST) is the criterion for B. If fishing mortality exceeds the MFMT for a period of one year or more, overfishing is occurring. A stock or stock complex is considered overfished if its stock biomass has declined below a level that jeopardizes the capacity of the stock to produce MSY on a continuing basis (i.e., the biomass falls below MSST). A Council must take remedial action in the form of a new FMP, an FMP amendment, or proposed regulations within two years following notification when it has been determined by the Secretary of Commerce that overfishing is occurring, a stock or stock complex is overfished or, either of the two thresholds is being approacheding an overfished condition,[26] or existing remedial action to end previously identified overfishing or to rebuild an overfished stock has not resulted in adequate progress. The Secretary reports annually to the Congress and the Councils on the status of fisheries according to the above overfishing criteria.

The National Standard Guidelines state that the MFMT may be expressed as a single number or as a function of some measure of the stock's productive capacity. Guidance in Restrepo et al. (1998:17) regarding specification of the MFMT is based on the premise that the MSY control rule constitutes the MFMT. In the example in Figure 10 the MSY control rule sets the MFMT constant at F_{MSY} for values of B greater than the MSST and decreases the MFMT linearly with biomass for values of B less than the MSST. This is the default MSY control rule recommended in Restrepo et al. (1998). Again, if F is greater than the MFMT for a period of one year or more, overfishing is occurring.

The National Standard Guidelines state that to the extent possible MSST should equal whichever of the following is greater: One-half the MSY stock size, or the minimum stock size at which rebuilding to the MSY level would be expected to occur within 10 years if the stock or stock complex were exploited at the MFMT. The MSST is indicated in Figure 10 by a vertical line at a biomass level somewhat less than B_{MSY}. A specification of MSST below B_{MSY} would allow for some natural fluctuation of biomass above and below B_{MSY}, which would be expected under, for example, an MSY harvest policy. Again, if B falls below MSST the stock is overfished.

Warning reference points comprise a category of reference points that will be considered in this FEP together with the required thresholds. Although not required under the MSA, warning reference points could be specified in order to provide warning in advance of B or F approaching or reaching their respective thresholds. Considered in this FEP is a stock biomass flag (B_{FLAG}) that would be specified at some point above MSST, as indicated in Figure 10. The control rule would not call for any change in F as a result of breaching B_{FLAG} – it would merely serve as a trigger for consideration of action or perhaps preparatory steps towards such action. Intermediate reference points set above the thresholds could also be specified in order to trigger changes in F – in other words, the MFMT could have additional inflection points.

5.2.2 Target Control Rule and Reference Points

A target control rule specifies the relationship of F to B for a harvest policy aimed at achieving a given target. Optimum yield (OY) is one such target, and National Standard 1 requires that conservation and management measures both prevent overfishing and achieve OY on a continuing basis. Optimum yield is the yield that will provide the greatest overall benefits to the nation, and is prescribed on the basis of MSY, as reduced by any relevant economic, social, or ecological factor. MSY is therefore an upper limit for OY.

A target control rule can be specified using reference points similar to those used in the MSY control rule, such as F_{TARGET} and B_{TARGET}. For example, the recommended default in Restrepo et al.

[26] A stock or stock complex is approaching an overfished condition when it is projected that there is more than a 50 percent chance that the biomass of the stock or stock complex will decline below MSST within two years (74 FR 3178).

(1998) for the target fishing mortality rate for certain situations (ignoring all economic, social, and ecological factors except the need to be cautious with respect to the thresholds) is 75 percent of the MFMT, as indicated in Figure 14. Simulation results using a deterministic model have shown that fishing at 0.75 F_{MSY} would tend to result in equilibrium biomass levels between 1.25 and 1.31 B_{MSY} and equilibrium yields of 0.94 MSY or higher (Mace 1994).

It is emphasized that while MSST and MFMT are limits, the target reference points are merely targets. They are guidelines for management action, not constraints. For example, Restrepo et al. state that "Target reference points should not be exceeded more than 50% of the time, nor on average."

5.2.3 Rebuilding Control Rule and Reference Points

If it has been determined that overfishing is occurring, a stock or stock complex is overfished, or approaching an overfished condition, or existing remedial action to end previously identified overfishing or to rebuild an overfished stock has not resulted in adequate progress, the Council must take remedial action within two years. In the case that a stock or stock complex is overfished (i.e., biomass falls below MSST in a given year), the action must be taken through a stock rebuilding plan (which is essentially a rebuilding control rule as supported by various analyses) with the purpose of rebuilding the stock or stock complex to the MSY level (B_{MSY}) within an appropriate time frame, as required by MSA §304(e)(4). The details of such a plan, including specification of the time period for rebuilding, would take into account the best available information regarding a number of biological, social, and economic factors, as required by the MSA and National Standard Guidelines.

If B falls below MSST, management of the fishery would shift from using the target control rule to the rebuilding control rule. Under the rebuilding control rule in the example in Figure 10, F would be controlled as a linear function of B until B recovers to MSST (see $F_{REBUILDING}$), then held constant at F_{TARGET} until B recovers to B_{MSY}. At that point, rebuilding would have been achieved and management would shift back to using the target control rule (F set at F_{TARGET}). The target and rebuilding control rules "overlap" for values of B between MSST and the rebuilding target (B_{MSY}). In that range of B, the rebuilding control rule is used only in the case that B is recovering from having fallen below MSST. In the example in Figure 10 the two rules are identical in that range of B (but they do not need to be), so the two rules can be considered a single, integrated, target control rule for all values of B.

5.2.4 Measures to Prevent Overfishing and Overfished Stocks

The control rules specify how fishing mortality will be controlled in response to observed changes in stock biomass or its proxies. Implicitly associated with those control rules are management actions that would be taken in order to manipulate fishing mortality according to the rules. In the case of a fishery which has been determined to be "approaching an overfished condition or is overfished," MSA §303(a)(10) requires that the FMP "contain conservation and management measures to prevent overfishing or end overfishing and rebuild the fishery."

5.3 Management Program for Bottomfish and Seamount Groundfish Fisheries

The PRIA were added to the Bottomfish and Seamount Groundfish Fishery Management Plan through publication of a final rule on September 12, 2006 (71 FR 53605) which became effective on October 12, 2006. While there are currently no known bottomfish fisheries operating in the PRIA, several vessels have been known to occasionally fish for bottomfish in Federal waters around the PRIA.

5.3.1 Management Areas and Subareas

Pacific Remote Island Areas means that portion of the EEZ seaward of the Pacific Remote Island Areas, with the exception of Midway Atoll.

5.3.2 Permit and Reporting Requirements

In order to identify participants and to collect adequate harvest and effort data, Federal permits and logbook reporting are required for all vessels used to fish for bottomfish management unit species in the Pacific Remote Island Areas Subarea. Fishery participants have the option of using NMFS approved electronic logbooks in lieu of paper logbooks.

5.3.3 Gear Restrictions

To protect habitat and reduce bycatch, fishing for bottomfish and seamount groundfish with bottom trawls and bottom set gillnets is prohibited. Possession of a bottom trawl and bottom set gillnet by any vessel having a bottomfish permit or otherwise established to be fishing for bottomfish or seamount groundfish is prohibited. The possession or use of any poisons, explosives, or intoxicating substances for the purpose of harvesting bottomfish and seamount groundfish is prohibited. .

5.3.4 At-sea Observer Coverage

To gather additional information, all fishing vessels with a bottomfish permit fishing in the PRIA must carry an observer when directed to do so by the Regional Administrator. In addition, any fishing vessel (commercial or non-commercial) operating in the territorial seas or EEZ of the U.S. in a fishery identified through NMFS' annual determination process must carry an observer when directed to do so.

5.3.5 Framework for Regulatory Adjustments

By June 30 of each year, a Council-appointed bottomfish monitoring team will prepare an annual report on the fishery by area covering the following topics: fishery performance data; summary of recent research and survey results; habitat conditions and recent alterations; enforcement activities and problems; administrative actions (e.g., data collection and reporting, permits); and state and territorial management actions. Indications of potential problems warranting further investigation may be signaled by the following indicator criteria: mean size of the catch of any species in any area is a pre-reproductive size; ratio of fishing mortality to natural mortality for any species; harvest capacity of the existing fleet and/or annual landings exceed best estimate of MSY in any area; significant decline (50 percent or more) in bottomfish catch per unit of effort from baseline levels; substantial decline in ex-vessel revenue relative to baseline levels; significant shift in the relative proportions of gear in any one area; significant change in the frozen/fresh components of the bottomfish catch; entry/exit of fishermen in any area; per-trip costs for bottomfishing exceed per-trip revenues for a significant percentage of trips; significant decline or increase in total bottomfish landings in any area; change in species composition of the bottomfish catch in any area; research results; habitat degradation or environmental problems; and reported interactions between bottomfish fishing operations and protected species.

The team may present management recommendations to the Council at any time. Recommendations may cover actions suggested for Federal regulations, state/territorial action, enforcement or administrative elements, and research and data collection. Recommendations will include an assessment of urgency and the effects of not taking action. The Council will evaluate the team's reports and recommendations, and the indicators of concern. The Council will assess the need for one or more of the following types of management action: catch limits, size limits, closures, effort limitations, access limitations, or other measures. The Council may recommend management action by either the state/territorial governments or by Federal regulation.

If the Council believes that management action should be considered, it will make specific recommendations to the NMFS Regional Administrator after requesting and considering the views of its Scientific and Statistical Committee and Bottomfish Advisory Panel and obtaining public comments at a public hearing. The Regional Administrator will consider the Council's recommendation and accompanying data, 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 2 weeks of the decision. The Council may appeal denial by writing to the Assistant Administrator, who must respond in writing within 30 days.

5.3.6 Bycatch Measures

As described above, to protect habitat and reduce bycatch, fishing for bottomfish and seamount groundfish with bottom trawls and bottom set gillnets is prohibited and the possession or use of any poisons, explosives, or intoxicating substances for the purpose of harvesting bottomfish and seamount groundfish is prohibited. In addition five types of non-regulatory measures aimed at reducing bycatch and bycatch mortality, and improving bycatch reporting are being implemented. They include: 1) outreach to fishermen and engagement of fishermen in management, including research and monitoring activities, to increase awareness of bycatch issues and to aid in development of bycatch reduction methods; 2) research into fishing gear and method modifications to reduce bycatch quantity and mortality; 3) research into the development of markets for discard species; and 4) improvement of data collection and analysis systems to better quantify bycatch; and 5) outreach and training of fishermen in methods to reduce baraotrauma in fish that are to be released.

5.3.7 Application of National Standard 1

MSY Control Rule

Biological and fishery data are poor for all bottomfish species in the PRIA. Generally, data are only available on commercial landings by species and catch-per-unit-effort (CPUE) for the multi-species complexes as a whole. At this time, it is not possible to partition these effort measures among the various Bottomfish Management Unit Species (BMUS).

The overfishing criteria and control rules specified are applied to individual species within the multi-species stock whenever possible. Where this is not possible, they will be based on an indicator species for the multi-species stock. It is important to recognize that individual species will be affected differently based on this type of control rule, and it is important that for any given species fishing mortality does not exceed a level that would lead to its becoming depleted or to causing impacts to the ecosystem. For the seamount groundfish stocks, armorhead serves as the indicator species. No indicator species will be used for the five managed bottomfish multi-species stock complexes (American Samoa, CNMI, Guam, Hawaii and the PRIA). Instead, the control rules are applied to each of the five stock complexes as a whole.[27]

The MSY control rule is used as the MFMT. The MFMT and MSST are specified based on the recommendations of Restrepo et al. (1998) and both are dependent on the natural mortality rate (M). The value of M used to determine the reference point values are not specified in this document. The latest estimate, published periodically in the SAFE report, is used and the value is occasionally re-estimated using the best available information. The range of M among species within a stock complex is taken into consideration when estimating and choosing the M to be used for the purpose of computing the reference point values.

In addition to the thresholds MFMT and the MSST, a warning reference point, B_{FLAG}, is also specified at some point above the MSST to provide a trigger for consideration of management action prior to B reaching the threshold. MFMT, MSST, and B_{FLAG} are specified as indicated in Table 9.

Table 9: Overfishing Threshold Specifications for Bottomfish and Seamount Groundfish stocks

MFMT	MSST	B_{FLAG}
$F(B) = \frac{F_{MSY} B}{c\, B_{MSY}}$ for $B \le c\, B_{MSY}$ $F(B) = F_{MSY}$ for $B > c\, B_{MSY}$	$c\, B_{MSY}$	B_{MSY}
Where $c = \max(1\text{-}M, 0.5)$		

[27] The National Standards Guidelines allow overfishing of "other" components in a mixed stock complex if (1) long-term benefits to the nation are obtained, (2) similar benefits cannot be obtained by modification of the fishery to prevent the overfishing, and (3) the results will not necessitate ESA protection of any stock component or ecologically significant unit.

Standardized values of fishing effort (E) and catch-per-unit-effort (CPUE) are used as proxies for F and B, respectively, so E_{MSY}, $CPUE_{MSY}$, and $CPUE_{FLAG}$ are used as proxies for F_{MSY}, B_{MSY}, and B_{FLAG}, respectively.

In cases where reliable estimates of $CPUE_{MSY}$ and E_{MSY} are not available, they will be estimated from catch and effort times series, standardized for all identifiable biases. $CPUE_{MSY}$ will be calculated as half of a multi-year average reference CPUE, called $CPUE_{REF}$. The multi-year reference window will be objectively positioned in time to maximize the value of $CPUE_{REF}$. E_{MSY} will be calculated using the same approach or, following Restrepo et al. (1998), by setting E_{MSY} equal to E_{AVE}, where E_{AVE} represents the long-term average effort prior to declines in CPUE. When multiple estimates are available, the more precautionary will be used.

Since the MSY control rule specified here applies to multi-species stock complexes, it is important to ensure that no particular species within the complex has a mortality rate that leads to required protection. In order to accomplish this, a secondary set of reference points is specified to evaluate stock status with respect to recruitment overfishing. A secondary "recruitment overfishing" control rule is specified to control fishing mortality with respect to that status. The rule applies only to those component stocks (species) for which adequate data are available. The ratio of a current spawning stock biomass proxy ($SSBP_t$) to a given reference level ($SSBP_{REF}$) is used to determine if individual stocks are experiencing recruitment overfishing. SSBP is CPUE scaled by percent mature fish in the catch. When the ratio $SSBP_t/SSBP_{REF}$, or the "SSBP ratio" (SSBPR) for any species drops below a certain limit ($SSBPR_{MIN}$), that species is considered to be recruitment overfished and management measures will be implemented to reduce fishing mortality on that species. The rule will apply only when the SSBP ratio drops below the $SSBPR_{MIN}$, but it will continue to apply until the ratio achieves the "SSBP ratio recovery target" ($SSBPR_{TARGET}$), which will be set at a level no less than $SSBPR_{MIN}$. These two reference points and their associated recruitment overfishing control rule, which prescribes a target fishing mortality rate ($F_{RO-REBUILD}$) as a function of the SSBP ratio, are specified as indicated in Table 10. Again, E_{MSY} would be used as a proxy for F_{MSY}.

Table 10: Recruitment Overfishing Control Rule Specifications for Bottomfish and Seamount Groundfish Stocks

$F_{RO-REBUILD}$	$SSBPR_{MIN}$	$SSBPR_{TARGET}$
$F(SSBPR) = 0$ for $SSBPR \leq 0.10$ $F(SSBPR) = 0.2\ F_{MSY}$ for $0.10 < SSBPR \leq SSBPR_{MIN}$ $F(SSBPR) = 0.4\ F_{MSY}$ for $SSBPR_{MIN} < SSBPR \leq SSBPR_{TARGET}$	0.20	0.30

Target Control Rules and Reference Points

No target control rules or reference points are currently specified for bottomfish stocks of the PRIA, i.e., while there is an established OY, it is not quantified or in the form of a control rule.

Rebuilding Control Rule and Reference Points

No rebuilding control rule or reference points are currently specified for the bottomfish stocks of the PRIA.

Stock Status Determination Process

Stock status determinations involve three procedural steps. First, the appropriate MSY, target or rebuilding reference points are specified. However, because environmental changes may affect the productive capacity of the stocks, it may be necessary to occasionally modify the specifications of some of the reference points or control rules. Modifications may also be desirable when better assessment methods become available, when fishery objectives are modified (e.g., OY), or better biological, socio-economic, or ecological data become available.

Second, the values of the reference points are estimated and third, the status of the stock is determined by estimating the current or recent values of fishing mortality and stock biomass or their proxies and comparing them with their respective reference points.

The second step (including estimation of M, on which the values of the overfishing thresholds will be dependent) and third step will be undertaken by NMFS and the latest results published annually in the Stock Assessment and Fishery Evaluation (SAFE) report. In practice, the second and third steps may be done simultaneously—in other words, the reference point values could be re-estimated as often as the stocks' status. No particular stock assessment period or schedule is specified, but in practice the assessments are likely to be conducted periodically in coordination with the preparation of the annual SAFE report.

The best information available is used to estimate the values of the reference points and to determine the status of stocks in relation to the status determination criteria. The determinations are based on the latest available stock and fishery assessments. Information used in the assessments includes logbook data, creel survey data, vessel observer data, and the findings of fishery-independent surveys when they are conducted.

Measures to Address Overfishing and Overfished Stocks

To date no bottomfish stocks in the PRIA have been determined to be overfished or that overfishing is occurring. If in the future it is determined that overfishing is occurring, a stock is, or either of those two conditions is being approached, the Council will establish additional management measures. Measures that may be considered include additional area closures, seasonal closures, establishment of limited access systems, limits on catch per trip, limits on effort per trip, and fleet-wide limits on catch or effort.

The combination of control rules and reference points is illustrated in Figure 11. The primary control rules that will be applied to the stock complexes are shown in part (a). Note that the position of the MSST is illustrative only; its value would depend on the best estimate of M at any given time. The secondary control rule that will be applied to particular species to provide for recovery from recruitment overfishing is shown in part (b).

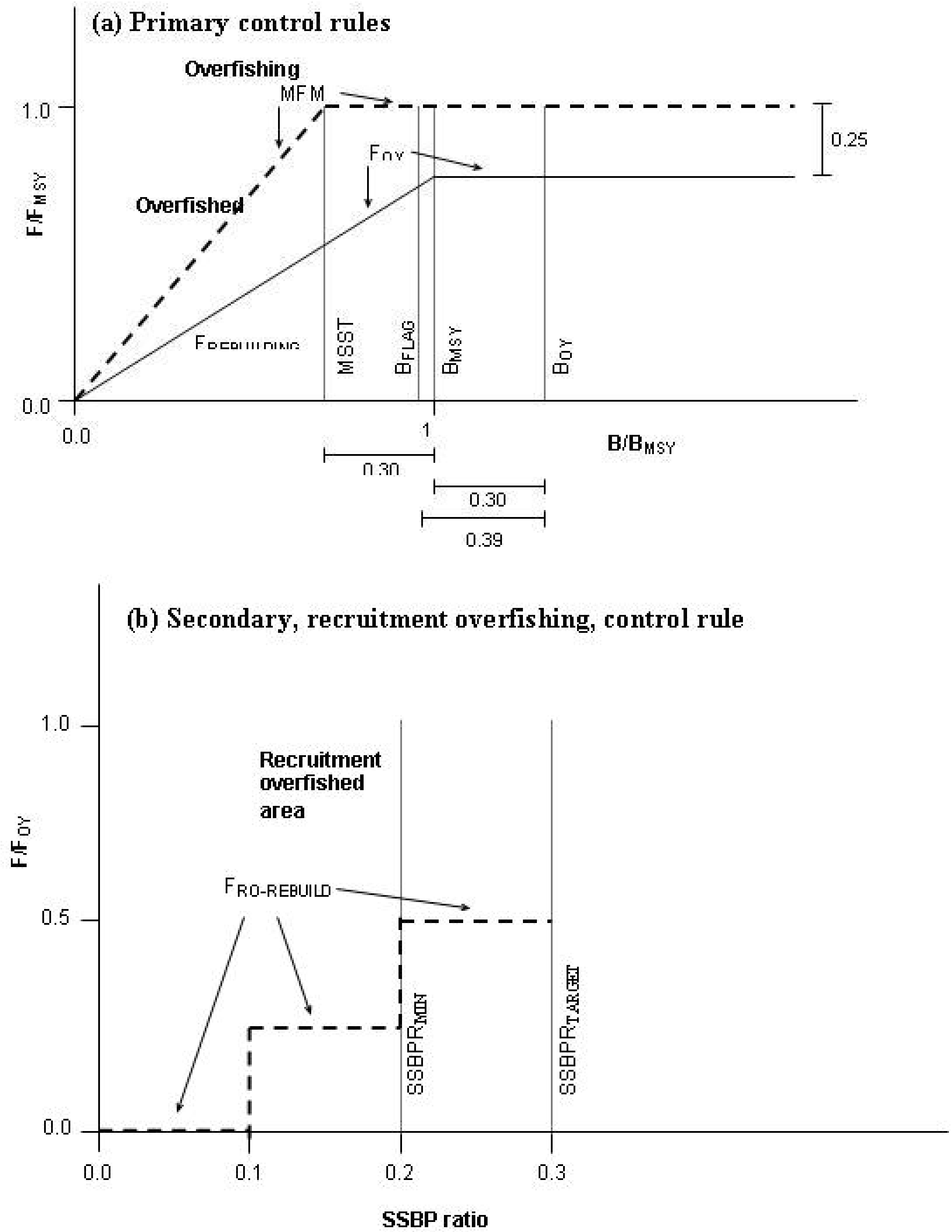

Figure 11: Combination of Control Rules and Reference Points for Bottomfish and Seamount Groundfish Stocks

5.4 Management Program for Precious Corals Fisheries

No precious corals harvester has received a Federal permit to harvest corals from the EEZ surrounding the PRIA since the implementation of the Precious Corals FMP in 1980; however, this does not preclude any future permit issuance. The U.S. EEZ surrounding the PRIA has been defined, for the purposes of precious coral fisheries management, as an Exploratory Precious Coral Permit Area.

5.4.1 Permits and Reporting

In order to identify participants and to collect harvest and effort data, Federal permits and reporting are required for any vessel of the United States fishing for, taking or retaining precious corals in EEZ waters around the PRIA. Each permit will be valid for fishing only in the permit area. No more than one permit will be valid for any one person at any one time. The holder of a valid permit to fish one permit area may obtain a permit to fish another permit area only upon surrendering to the NMFS Regional Administrator any current permit for the precious corals fishery. Fishery participants have the option of using NMFS approved electronic logbooks in lieu of paper logbooks.

5.4.2 Seasons and Quotas

The fishing year for precious corals begins on July 1 and ends on June 30 the following year.

The quota limiting the amount of precious corals that may be taken in any precious corals permit area in EEZ waters around the PRIA during a fishing year is 1,000 kg, all species combined (except black corals).

Quotas are determined limiting the amount of precious corals that may be taken in any precious corals permit area during the fishing year. Only live coral is counted toward the quota. Live coral means any precious coral that has live coral polyps or tissue.

The quotas for exploratory areas will be held in reserve for harvest by vessels of the U.S. by determining at the beginning of each fishing year that the reserve for each of the three exploratory areas will equal the quota minus the estimated domestic annual harvest for that year. And, as soon as practicable after December 31, each year, the Regional Administrator will determine the amount harvested by vessels of the U.S. between July 1 and December 31 of that year. NMFS will release to TALFF an amount of precious coral for each exploratory area equal to the quota minus the two times amount harvested by vessels of the U.S. in that July 1 to December 31 period. Finally, NMFS will publish in the Federal Register a notification of the Regional Administrator’s determination and a summary of the information of which it is based a soon as practicable after the determination is made.

5.4.3 Closures

If the NMFS Regional Administrator determines that the harvest quota for any exploratory area will be reached prior to the end of the fishing year NMFS will issue a Federal Register notice closing the bed and the public will be informed through appropriate news media. Any such field order must indicate the reason for the closure, delineate the bed being closed, and identify the effective date of the closure. A closure is also effective for a permit holder upon the permit holder's actual harvest of the applicable quota.

5.4.4 Restrictions

Size Restrictions--The height of a live coral specimen shall be determined by a straight line measurement taken from its base to its most distal extremity. The stem diameter of a living coral specimen shall be determined by measuring the greatest diameter of the stem at a point no less than one inch (2.54 cm) from the top surface of the living holdfast. Live pink coral harvested from any precious corals permit area must have attained a minimum height of 10 inches (25.4 cm). Live black coral harvested from any precious corals permit area must have attained either a minimum stem diameter of 1 inch (2.54 cm), or a minimum height of 48 inches (122 cm). An exemption permitting a person to hand-harvest from any precious corals permit area black coral which has attained a minimum base diameter of 3/4 inches (1.91 cm), measured on the widest portion of the skeleton at a location 1 inch above the holdfast, will be issued to a person who reported a landing of black coral to the State of Hawaii within 5 years before the effective date of the final rule. A person seeking an exemption under this section must submit a letter requesting an exemption to the NMFS Pacific Islands Area Office.

Gear Restrictions-- To protect habitat and reduce bycatch, only selective gear may be used to harvest coral from any precious corals permit area. Selective gear means any gear used for harvesting corals that can discriminate or differentiate between type, size, quality, or characteristics of living or dead corals.

Gold Coral Harvest Moratorium-- To prevent overfishing and stimulate research on gold corals, fishing for, taking, or retaining any gold coral (live and dead) in any precious coral permit area is prohibited through June 30, 2013. This includes all EEZ waters of the Western Pacific Region. Additional research results on gold coral age structures, growth rates, and correlations between length and age will be considered by the Council and NMFS prior to the expiration of the 5-year moratorium.

5.4.5 Framework Procedures

Established management measures may be revised and new management measures may be established and/or revised through rulemaking if new information demonstrates that there are biological, social, or economic concerns in a precious corals permit area. By June 30 of each year, the Council-appointed Precious Corals Plan Team will prepare an annual report on the fishery in the management area. The report will contain, among other things, recommendations for Council action and an assessment of the urgency and effects of such action(s).

Established measures are management measures that, at some time, have been included in regulations implementing the FEP, and for which the impacts have been evaluated in Council/NMFS documents in the context of current conditions. According to the framework procedures of Amendment 3 to the former Precious Corals FMP, the Council may recommend to the Regional Administrator that established measures be modified, removed, or re-instituted. Such recommendation will include supporting rationale and analysis and will 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.

New measures are management measures that have not been included in regulations implementing the FEP, or for which the impacts have not been evaluated in Council/NMFS documents in the context of current conditions. Following the framework procedures of Amendment 3 to the Precious Corals FMP, the Council will publicize, including by a Federal Register document, 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 document 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 a subsequent public meeting, the Council will consider public comments and other information received before making a recommendation to the Regional Administrator about any new measure. If approved by the Regional Administrator, NMFS may implement the Council's recommendation by rulemaking.

5.4.6 Bycatch Measures

To reduce the potential for bycatch, only selective gear can be used to harvest precious corals in the Western Pacific Region. In addition, four types of non-regulatory measures aimed at reducing bycatch and bycatch mortality, and improving bycatch reporting are being implemented. They include: 1) outreach to fishermen and engagement of fishermen in management, including research and monitoring activities, to increase awareness of bycatch issues and to aid in development of bycatch reduction methods; 2) research into fishing gear and method modifications to reduce bycatch quantity and mortality; 3) research into the development of markets for discard species; and 4) improvement of data collection and analysis systems to better quantify bycatch. Because any future harvesting would only be allowed by selective gear (i.e with submersibles or by hand) no bycatch would be expected in the PRIA. In addition, any fishing vessel (commercial or non-commercial) operating in the territorial seas or EEZ of the U.S. in a fishery identified through NMFS' annual determination process must carry an observer when directed to do so.

5.4.7 Application of National Standard 1

Due to the paucity of information on the existence and distribution of precious corals, and the absence of a precious coral fishery in the PRIA, specification of MSY, OY and overfishing have not been specifically determined for precious coral management unit species in the PRIA. However, as a precautionary approach, a quota for precious corals in the Exploratory Precious Coral Permit Area (which includes the PRIA) has been set at 1,000 kg/year. Should a precious coral fishery develop in the PRIA, the Council may develop specifications for specific coral beds depending on the information and stock assessment tools available.

Measures to address overfishing

To date no stocks of precious corals have been determined to be overfished or that overfishing is occurring. Provisions of the Precious Corals FMP, as amended, are sufficient to prevent overfishing and these measures will be carried over into the FEP. Precious coral beds are classified as Established (with fairly accurate estimated harvest levels), Conditional (with extrapolated MSY estimates) or Refugia (reproductive reserves or baseline areas). Exploratory Areas are grounds available for exploratory harvesting with an Exploratory Permit.

5.5 Management Program for Crustacean Fisheries

The PRIA were added to the Crustaceans Fishery Management Plan through publication of a final rule on September 12, 2006 (71 FR 53605) which became effective on October 12, 2006. While there are currently no known crustacean fisheries operating in the PRIA several vessels have been known to fish for crustaceans in Federal waters, although on a small scale.

5.5.1 Management Areas and Subareas

Crustaceans Permit Area 4 means the EEZ around the PRIA, with the exception of EEZ waters around Midway Atoll.

5.5.2 Permit and Reporting Requirements

In order to identify participants and to collect adequate harvest and effort data, Federal permits and logbook reporting are required for all vessels used to fish for lobsters or deepwater shrimp in Permit Area 4. Fishery participants have the option of using NMFS approved electronic logbooks in lieu of paper logbooks.

5.5.3 Gear Restrictions

At present there are no gear restrictions for crustacean fisheries occurring in the PRIA.

5.5.4 At-sea Observer Coverage

To support fishery monitoring, all fishing vessels with a Crustaceans Permit for Permit Area 4 must carry an observer when requested to do so by the Regional Administrator. In addition, any fishing vessel (commercial or non-commercial) operating in the territorial seas or EEZ of the U.S. in a fishery identified through NMFS' annual determination process must carry an observer when directed to do so.

5.5.5 Framework Procedures

New management measures may be added through rulemaking if new information demonstrates that there are biological, social, or economic concerns. By June 30 of each year, the Council-appointed Crustaceans Plan Team will prepare an annual report on the fisheries in the management area. The report shall contain, among other things, recommendations for Council action and an assessment of the urgency and effects of such action(s).

Established measures are management measures that, at some time, have been included in regulations implementing the FEP, and for which the impacts have been evaluated in Council/NMFS documents in the context of current conditions. Following the framework procedures of Amendment 9 to the FMP, the Council may recommend to the NMFS 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.

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. Following the framework procedures of Amendment 9 to the FMP, the Council will publicize, including by a Federal Register document, 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 document 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 rulemaking if approved by the Regional Administrator.

5.5.6 Bycatch Measures

At present there are no regulatory measures to reduce bycatch in crustacean fisheries occurring in the PRIA because there is no known bycatch occurring. Four types of non-regulatory measures aimed at reducing bycatch and bycatch mortality, and improving bycatch reporting are being implemented. They include: 1) outreach to fishermen and engagement of fishermen in management, including research and monitoring activities, to increase awareness of bycatch issues and to aid in development of bycatch reduction methods; 2) research into fishing gear and method modifications to reduce bycatch quantity and mortality; 3) research into the development of markets for discard species; and 4) improvement of data collection and analysis systems to better quantify bycatch.

5.5.7 Application of National Standard 1

Specifications of OY and overfishing have not been determined for crustacean management unit species in the PRIA. However, should the Council determine that a stock status determination is needed, the Council will rely on the specification target and rebuilding control rules and reference points established for the NWHI lobster fishery until appropriate specifications are developed for crustacean fishery resources of the PRIA. The specifications would be applied to multi-species stock complexes or to individual species, depending on the information and stock assessment tools available.

5.6 Management Program for Coral Reef Ecosystem Fisheries

5.6.1 Marine Protected Areas

Under this FEP there are two categories of MPAs, low-use and no-take. From 0-50 fm the following are no-take MPAs: Baker Island, Howland Island, Jarvis Island, and Kingman Reef. From 0-50 fm the following are low-use MPAs: Johnston Atoll, Palmyra Atoll, and Wake Island.

5.6.2 Permit and Reporting Requirements

Any person who harvests coral reef ecosystem MUS in low-use MPAs is required to have a Federal special permit issued by NMFS. Issuance of special permits is on a case-by-case basis and based upon several factors including the potential for bycatch, the sensitivity of the area to the type of fishing proposed, and the level of fishing occurring in relation to the level considered sustainable in a low-use MPA. A person permitted and targeting non-CRE MUS under other fishery management plans is not required to obtain a special permit to fish in low-use MPAs.

In addition to the permit requirement for low-use MPAs, in order to identify participants, collect harvest and effort data, and control harvests, special permits are required for any directed fisheries on potentially harvested coral reef taxa (PHCRT) within the regulatory area, or to fish for any CRE MUS in the coral reef regulatory area with any gear not normally permitted. Those issued a Federal permit to fish for non-CRE MUS, but who incidentally catch CRE MUS are exempt from the CRE permit requirement. Those fishing for currently harvested coral reef taxa (CHCRT) outside of a MPA and do not retain any incidentally-caught PHCRT, or any person collecting marine organisms for scientific research are also exempt from the CRE permit requirement. Permits are only valid for fishing in the fishery management subarea specified on the permit. See tables in chapter 1 for complete list of PCHRT and CHCRT species.

The harvest of live rock and living corals is prohibited throughout the federally managed U.S. EEZ waters of the region; however, under special permits with conditions specified by NMFS following consultation with the Council, indigenous people could be allowed to harvest live rock or coral for traditional uses, and aquaculture operations could be permitted to harvest seed stock. A Federal reporting system for all fishing under special permits is in place and fishery participants have the option of using NMFS approved electronic logbooks in lieu of paper logbooks. Resource monitoring systems administered by state, territorial, and commonwealth agencies continue to collect fishery data on the existing coral reef fisheries that do not require special permits.

5.6.3 Notification

To support fishery monitoring, any special permit holder must contact the appropriate NMFS enforcement agent in Hawaii at least 24 hours before landing any CRE MUS harvested under a special permit, and report the port and the approximate date and time at which the catch will be landed.

5.6.4 Gear Restrictions

To protect habitat and reduce bycatch, allowable gear types comprise: (1) Hand harvest; (2) spear; (3) slurp gun; (4) hand/dip net; (5) hoop net for Kona crab; (6) throw net; (7) barrier net; (8) surround/purse net that is attended at all times; (9) hook-and-line (powered and unpowered handlines, rod and reel, and trolling); (10) crab and fish traps with vessel ID number affixed; and (11) remote operating vehicles/submersibles. New fishing gears that are not included in the allowable gear list may be allowed under the special permit provision.

CRE MUS may not be taken by means of poisons, explosives, or intoxicating substances. Possession and use of these materials is prohibited. In addition, CRE MUS may not be taken by means of spearfishing with SCUBA at night (from 1800 – 0600 hrs.) in the U.S. EEZ around Howland Island, Baker Island, Jarvis Island, Johnston Atoll, Kingman Reef and Palmyra Atoll.

All fish and crab trap gear used by permit holders must be identified with the vessel number. Unmarked traps and unattended surround nets or bait seine nets found deployed in the CRE regulatory area will be considered unclaimed property and may be disposed of by NMFS or other authorized officers.

5.6.5 Framework Procedures

A framework process, providing for an administratively simplified procedure to facilitate adjustments to management measures previously analyzed in the CRE FMP, is an important component of the FEP. These framework measures include designating ``no-anchoring'' zones and establishing mooring buoys, requiring vessel monitoring systems on board fishing vessels, designating areas for the sole use of indigenous peoples, and including species not specifically listed as PHCRT under the “special permit” regime as warranted. A general fishing permit program could also be established for all U.S. EEZ coral reef ecosystem fisheries under the framework process. Framework measures are implemented via preparation of a draft document that outlines the need for action, 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.

5.6.6 Bycatch Measures

Almost all fishes caught in the PRIA are considered food fishes and are kept, regardless or size or species. There is no available information on bycatch in PRIA coral reef fisheries currently however it is expected that bycatch is not occurring. However four types of non-regulatory measures aimed at reducing bycatch and bycatch mortality, and improving bycatch reporting are being implemented. They include: 1) outreach to fishermen and engagement of fishermen in management, including research and monitoring activities, to increase awareness of bycatch issues and to aid in development of bycatch reduction methods; 2) research into fishing gear and method modifications to reduce bycatch quantity and mortality; 3) research into the development of markets for discard species; and 4) improvement of data collection and analysis systems to better quantify bycatch. In addition, any fishing vessel (commercial or non-commercial) operating in the territorial seas or EEZ of the U.S. in a fishery identified through NMFS' annual determination process must carry an observer when directed to do so.

5.6.7 Application of National Standard 1

MSY Control Rule and Stock Status Determination

Available biological and fishery data are poor for all coral reef ecosystem management unit species in the PRIA. 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. Additionally, total fishing effort cannot be adequately partitioned between the various MUS for any fishery or area. Biomass, maximum sustainable yield, and fishing mortality estimates are not available for any single MUS. 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.

When 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 their becoming depleted.

For the coral reef fisheries, the multi-species complex as a whole is used to establish limits and reference points for each area.

When 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.

Establishing Reference Point Values

Standardized values of catch per unit effort (CPUE) and effort (E) are used to establish limit and reference point values, which act as proxies for relative biomass and fishing mortality, respectively. Limits and reference points are calculated in terms of $CPUE_{MSY}$ and E_{MSY} included in Table 11.

Table 11: 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*

When reliable estimates of E_{MSY} and $CPUE_{MSY}$ are not available, they are estimated from the available time series of catch and effort values, standardized for all identifiable biases using the best available analytical tools. $CPUE_{MSY}$ is calculated as one-half a multi-year moving average reference CPUE ($CPUE_{REF}$).

Measures to Address Overfishing and Overfished Stocks

At present, no CRE stocks in the PRIA have been determined to be overfished or subject to overfishing. If in the future it is determined that overfishing is occurring, a stock is overfished, or either of those two conditions is being approached, the Council will establish additional management measures. Measures that may be considered include additional area closures, seasonal closures, establishment of limited access systems, limits on catch per trip, limits on effort per trip, and fleet-wide limits on catch or effort.

While managing the multi-species stocks 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 that would lead to its becoming depleted. Preventing recruitment overfishing on any component stock will satisfy this need in a precautionary manner. Best available data are 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, are the best candidates for determining these values.

Using the best available data, managers will monitor changes in species abundance 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.

CHAPTER 6: IDENTIFICATION AND DESCRIPTION OF ESSENTIAL FISH HABITAT

6.1 Introduction

In 1996, Congress passed the Sustainable Fisheries Act, which amended the MSA and added several new FMP provisions. From an ecosystem management perspective, the identification and description of EFH for all federally managed species were among the most important of these additions.

According to the MSA, EFH is defined as "those waters and substrate necessary to fish for spawning, breeding or growth to maturity." This new mandate represented a significant shift in fishery management. Because the provision required councils to consider a MUS's ecological role and habitat requirements in managing fisheries, it allowed Councils to move beyond the traditional single-species or multispecies management to a broader ecosystem-based approach. In 1999, NMFS issued guidelines intended to assist Councils in implementing the EFH provision of the MSA, and set forth the following four broad tasks:

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

The guidelines recommended that each Council prepare a preliminary inventory of available environmental and fisheries information on each managed species. Such an inventory is useful in describing and identifying EFH, as it also helps to identify missing information about the habitat utilization patterns of particular species. The guidelines note that a wide range of basic information is needed to identify EFH. This includes 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. Because EFH has to be identified for each major life history stage, information about a species' distribution, density, growth, mortality, and production within all of the habitats it occupies, or formerly occupied, is also necessary.

The guidelines also state that the quality of available data used to identify EFH should be rated using the following four-level system:

- 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.
- 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 may also 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.

The EFH provisions are especially important because of the procedural requirements they impose on both Councils and federal agencies. First, for each FMP, Councils must identify adverse impacts to EFH resulting from both fishing and non-fishing activities, and describe measures to minimize these impacts. Second, the provisions allowed Councils to provide comments and make recommendations to federal or state agencies that propose actions that may affect the habitat, including EFH, of a managed species. In 2002, NMFS revised the guidelines by providing additional clarifications and guidance to ease implementation of the EFH provision by Councils.

None of the fisheries operating under the PRIA FEP are expected to have adverse impacts on EFH or HAPC for species managed under the different fisheries. Continued and future operations of fisheries under the PRIA FEP are not likely to lead to substantial physical, chemical, or biological alterations to the habitat, or result in loss of, or injury to, these species or their prey.

6.2 EFH Designations

The following EFH designations were developed by the Council and approved by the Secretary of Commerce. EFH designations for Bottomfish and Seamount Groundfish, Crustaceans, Precious Corals and Pelagic MUS were approved by the Secretary on February 3, 1999 (64 FR 19068). EFH designations for Coral Reef Ecosystem MUS were approved by the Secretary on June 14, 2002 (69 FR 8336). For the purpose of this plan, Pelagics MUS are not part of the PRIA MUS.

In describing and identifying EFH for Bottomfish and Seamount Groundfish, Crustacean, Precious Coral, Coral Reef Ecosystem, and Pelagic MUS, four alternatives were considered: (1) designate EFH based on the best available scientific information (preferred alternative), (2) designate all waters EFH, (3) designate a minimal area as EFH, and (4) no action. Ultimately, the Council selected Alternative 1 designate EFH based on observed habitat utilization patterns in localized areas as the preferred alternative.

This alternative was preferred by the Council for three reasons. First, it adhered to the intent of the MSA provisions and to the guidelines that have been set out through regulations and expanded on by NMFS because the best available scientific data were used to make carefully considered designations. Second, it resulted in more precise designations of EFH at the species complex level than would be the case if Alternative 2 were chosen. At the same time, it did not run the risk of being arbitrary and capricious as would be the case if Alternative 3 were chosen. Finally, it recognized that EFH designation is an ongoing process and set out a procedure for reviewing and refining EFH designations as more information on species' habitat requirements becomes available.

The Council has used the best available scientific information to describe EFH in text and tables that provide information on the biological requirements for each life stage (egg, larvae, juvenile, adult) of all MUS. Careful judgment was used in determining the extent of the essential fish habitat that should be designated to ensure that sufficient habitat in good condition is available to maintain a sustainable fishery and the managed species' contribution to a healthy ecosystem. Because there are large gaps in scientific knowledge about the life histories and habitat requirements of many MUS in the Western Pacific Region, the Council adopted a precautionary approach in designating EFH to ensure that enough habitats are protected to sustain managed species.

The preferred depth ranges of specific life stages were used to designate EFH for bottomfish and crustaceans. In the case of crustaceans, the designation was further refined based on productivity data. The precious corals designation combines depth and bottom type as indicators, but it is further refined based on the known distribution of the most productive areas for these organisms. Species were grouped into complexes because available information suggests that many of them occur together and share similar habitat.

In addition to the narratives, the general distribution and geographic limits of EFH for each life history stage are presented in the forms of maps. The Council incorporated these data into a geographic information system to facilitate analysis and presentation. More detailed and informative maps will be produced as more complete information about population responses to habitat characteristics (e.g., growth, survival or reproductive rates) becomes available.

At the time the Council's EFH designations were approved by the Secretary, there was not enough data on the relative productivity of different habitats to develop EFH designations based on Level 3 or Level 4 data for any of the Western Pacific Regional Fishery Management Council's MUS. Council adopted a fifth level, denoted Level 0, for situations in which there is no information available about the geographic extent of a particular managed species' life stage. Subsequently, very limited habitat information has been made available for MUS for the Council to review and use to revise the initial EFH designations previously approved by the Secretary. Fish and benthic surveys conducted during the NMFS Coral Reef Ecosystem Division's Pacific-Wide Rapid Assessment and Monitoring Program, along with other near-shore coral reef habitat health assessments undertaken by other agencies, may provide additional information to refine EFH designations for Coral Reef Ecosystem MUS in all island areas, including the PRIA.

For additional details on the life history and habitat utilization patterns of individual PRIA MUS, please see the EFH descriptions and maps contained in Supplements to Amendment 4, 6 and 10 respectively to the Precious Corals, Bottomfish and Seamount Groundfish, and Crusteaceans FMPs respectively (WPRFMC 2002), and the Coral Reef Ecosystems FMP (WPRFMC 2001).

6.2.1 Bottomfish

Except for several of the major commercial species, very little is known about the life histories, habitat utilization patterns, food habits, or spawning behavior of most adult bottomfish and seamount groundfish species. Furthermore, very little is known about the distribution and habitat requirements of juvenile bottomfish.

Generally, the distribution of adult bottomfish in the Western Pacific Region is closely linked to suitable physical habitat. Unlike the U.S. mainland with its continental shelf ecosystems, Pacific islands are primarily volcanic peaks with steep drop-offs and limited shelf ecosystems. The BMUS under the Council's jurisdiction are found concentrated on the steep slopes of deepwater banks. The 100-fathom isobath is commonly used as an index of bottomfish habitat. Adult bottomfish are usually found in habitats characterized by a hard substrate of high structural complexity. The total extent and geographic distribution of the preferred habitat of bottomfish is not well known. Bottomfish populations are not evenly distributed within their natural habitat; instead, they are found dispersed in a non-random, patchy fashion. Deepwater snappers tend to aggregate in association with prominent underwater features, such as headlands and promontories.

There is regional variation in species composition, as well as a relative abundance of the MUS of the deepwater bottomfish complex in the Western Pacific Region. At this time, very little information is available on the BMUS EFH found in the PRIA, however, it is expected that BMUS would be found in similar habitats at similar depths as they are in other Council-managed island areas.

To reduce the complexity and the number of EFH identifications required for individual species and life stages, the Council has designated EFH for bottomfish assemblages pursuant to Section 600.805(b) of 62 FR 66551. The species complex designations include deep-slope bottomfish (shallow water and deep water) and seamount groundfish complexes. 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 BMUS throughout the Western Pacific Region. These are summarized in Table 16.

At present, there is not enough data on the relative productivity of different habitats to develop EFH designations based on Level 3 or Level 4 data. Given the uncertainty concerning the life histories and habitat requirements of many BMUS, the Council designated EFH for adult and juvenile bottomfish as the water column and all bottom habitat extending from the shoreline to a depth of 400 meters (200 fathoms) encompassing the steep drop-offs and high-relief habitats that are important for bottomfish throughout the Western Pacific Region.

The eggs and larvae of all BMUS are pelagic, floating at the surface until hatching and subject thereafter to advection by the prevailing ocean currents. There have been few taxonomic studies of these life stages of snappers (lutjanids) and groupers (epinepheline serranids). Presently, few larvae can be identified to species. As snapper and grouper larvae are rarely collected in plankton surveys, it is extremely difficult to study their distribution. Because of the existing scientific uncertainty about the distribution of the eggs and larvae of bottomfish, the Council designated the water column extending from the shoreline to the outer boundary of the EEZ to a depth of 400 meters as EFH for bottomfish eggs and larvae throughout the Western Pacific Region.
In the past, a large-scale foreign seamount groundfish fishery extended throughout the southeastern reaches of the northern Hawaiian Ridge. The seamount groundfish complex consists

of three species (pelagic armorheads, alfonsins, and ratfish). These species dwell at 200–600 meters on the submarine slopes and summits of seamounts. A collapse of the seamount groundfish stocks has resulted in a greatly reduced yield in recent years. Although a moratorium on the harvest of the seamount groundfish within the EEZ has been in place since 1986, no substantial recovery of the stocks has been observed. Historically, there has been no domestic seamount groundfish fishery.

The life histories and distributional patterns of seamount groundfish are also poorly understood. Data are lacking on the effects of oceanographic variability on migration and recruitment of individual management unit species. On the basis of the best available data, the Council designated the EFH for the adult life stage of the seamount groundfish complex as all waters and bottom habitat bounded by latitude 29°–35° N and longitude 171° E–179° W between 80–600 meters. EFH for eggs, larvae, and juveniles is the epipelagic zone (~200 m) of all waters bounded by latitude 29°–35° N and longitude 171° E–179° W.

6.2.2 Crustaceans

Spiny lobsters are found throughout the Indo-Pacific region. All spiny lobsters in the Western Pacific Region belong to the family Palinuridae. The slipper lobsters belong to the closely related family, Scyllaridae. There are 13 species of the genus *Panulirus* distributed in the tropical and subtropical Pacific between 35° N and 35° S. *P. penicillatus* is the most widely distributed, the other three species are absent from the waters of many island nations of the region. The Hawaiian spiny lobster (*P. marginatus*) is endemic to Hawaii and Johnston Atoll.

In the MHI, most of the commercial, recreational, and subsistence catches of spiny lobster are taken from waters under Statejurisdiction. Between 1984 and 2004, total reported commercial catch landings of lobsters around the MHI were 185,263 pounds with annual landings ranging between 7,000 and 12,000 pounds (Kelly and Messer 2005. However, the magnitude of the subsistence and recreational catch remains known. In America Samoa, the Northern Mariana Islands, and Guam, the species composition or the magnitude of the subsistence, recreational, and commercial catch is also unknown.

In the southwestern Pacific, spiny lobsters are typically found in association with coral reefs. Coral reefs provide shelter as well as a diverse and abundant supply of food items. *Panulirus penicillatus* inhabits the rocky shelters in the windward surf zones of oceanic reefs and moves on to the reef flat at night to forage.

To reduce the complexity and the number of EFH identifications required for individual species and life stages, the Council has designated EFH for crustacean species assemblages. The species complex designations are spiny and slipper lobsters and Kona crab. The designation of these complexes is based on the ecological relationships among species and their preferred habitat.

At present, there is not enough data on the relative productivity of different habitats of CMUS to develop EFH designations based on Level 3 or Level 4 data. There are little data concerning growth rates, reproductive potentials, and natural mortality rates at the various life history stages. The relationship between egg production, larval settlement, and stock recruitment is also poorly understood. The depth distribution of phyllosoma larvae of other species of *Panulirus* common in the Indo-Pacific region has been documented. Later stages of panulirid phyllosoma larvae have been found at depths between 80 and 120 meters. For these reasons, the Council designated EFH for spiny lobster larvae as the water column from the shoreline to the outer limit of the EEZ down to a depth of 150 meters throughout the Western Pacific Region. The EFH for juvenile and adult spiny lobster is designated as the bottom habitat from the shoreline to a depth of 100 meters throughout the Western Pacific Region. The EFH for deepwater shrimp eggs and larvae is designated as the water column and associated outer reef slopes between 550 m and 700m, and the EFH for juveniles and adults is designated as the outer reef slopes at depths between 300-700 m (see Table 16).

6.2.3 Precious Corals

In the Hawaiian Islands, precious coral beds have been found only in the deep interisland channels and off promontories at depths between 300 and 1,500 meters and 30 and 100 meters. The six known beds of pink, gold, and bamboo corals in the Western Pacific Region are Keahole Point, Makapuu, Kaena Point, Wespac, Brooks Bank, and 180 Fathom Bank. Makapuu is the only bed that has been surveyed accurately enough to estimate MSY. The Wespac bed, located between Necker and Nihoa Islands in the NWHI, has been set aside for use in baseline studies and as a possible reproductive reserve. The harvesting of precious corals is prohibited in this area. Within the Western Pacific Region, the only directed fishery for precious corals has occurred in the Hawaiian Islands. At present, there is no commercial harvesting of precious corals in the EEZ, but several firms have expressed interest.

Precious corals may be divided into deep- and shallow-water species. Deep-water precious corals are generally found between 350 and 1,500 meters and include pink coral (*Corallium secundum*), gold coral (*Gerardia* sp. and *Parazoanthus* sp.), and bamboo coral (*Lepidistis olapa*). Shallow-water species occur between 30 and 100 meters and consist primarily of three species of black coral: *Antipathes dichotoma*, *Antipathes grandis,* and *Antipathes ulex*. In Hawaii, *Antipathes dichotoma* accounts for around 90 percent of the commercial harvest of black coral, and virtually all of it is harvested in Statewaters.

Precious corals are non–reef building and inhabit depth zones below the euphotic zone. They are found on solid substrate in areas that are swept relatively clean by moderate-to-strong (> 25 cm/sec) bottom currents. Strong currents help prevent the accumulation of sediments, which would smother young coral colonies and prevent settlement of new larvae. Precious coral yields tend to be higher in areas of shell sandstone, limestone, and basaltic or metamorphic rock with a limestone veneer.

Pink, bamboo, and gold corals all have planktonic larval stages and sessile adult stages. Larvae settle on solid substrate where they form colonial branching colonies. The length of the larval stage of all species of precious corals is unknown.

The habitat sustaining precious corals is generally in pristine condition. There are no known areas that have sustained damage due to resource exploitation, notwithstanding the alleged illegal heavy foreign fishing for corals in the Hancock Seamounts area.

To reduce the complexity and the number of EFH identifications required for individual species and life stages, the Council designated EFH for precious coral assemblages. The species complex designations are deep- and shallow-water complexes (see Table 16). The designation of these complexes is based on the ecological relationships among the individual species and their preferred habitat.

The Council considered using the known depth range of individual PCMUS to designate EFH, but rejected this alternative because of the rarity of the occurrence of suitable habitat conditions. Instead, the Council designated the six known beds of precious corals as EFH. The Council believes that the narrow EFH designation will facilitate the consultation process.

6.2.4 Coral Reef Ecosystems

In designating EFH for Coral Reef Ecosystem MUS, the Council used 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 FEPs to the degree that they share these habitats.

Except for several of the major coral reef associated species, very little is known about the life histories, habitat utilization patterns, food habits, or spawning behavior of most coral reef associated species. For this reason, the Council, through the CRE FMP, 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. 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 that (a) are currently being harvested in State and Federal waters and for which some fishery information is available and (b) are likely to be targeted in the near future based on historical catch data. Table13 summarizes the habitat types used by CHCRT species.

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. The EFH designations for CHCRT throughout the Western Pacific Region are summarized in Table 12.

Potentially Harvested Coral Reef Taxa MUS

EFH has also been designated for the second tier, PHCRT. 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 14 summarizes the habitat types used by PHCRT species. The designation of EFH for PHCRT throughout the Western Pacific Region is summarized in Table 15. As with CHCRT, the Council has designated EFH for species assemblages pursuant to the Federal regulations cited above.

Table 12: 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)

Species	**Ma**	**La**	**Es**	**SB**	**Ss**	**Cr/Hs**	**Pr**	**Sz**	**DST**	**Pe**
Acanthuridae (surgeonfishes)	J	A, J, S	A, J, S	J	A, J, S	A, J, S	A, J, S		A, J	E, L
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*)										

Species	**Ma**	**La**	**Es**	**SB**	**Ss**	**Cr/Hs**	**Pr**	**Sz**	**DST**	**Pe**
Subfamily Nasianae (unicornfishes) Bluespine unicornfish (*Naso unicornus*) Orangespine unicornfish (*Naso lituratus*) Humpnose unicornfish (*Naso tuberosus*) Blacktongue 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*)	J	A, J, S	J		A, S	A, J, S	A, J, S		A, S	All
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	

Species	**Ma**	**La**	**Es**	**SB**	**Ss**	**Cr/Hs**	**Pr**	**Sz**	**DST**	**Pe**
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

Species	**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

Species	**Ma**	**La**	**Es**	**SB**	**Ss**	**Cr/Hs**	**Pr**	**Sz**	**DST**	**Pe**
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
Labridae (wrasses) Saddleback hogfish (*Bodianus bilunulatus*) Razor wrasse (*Xyricthys 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 wrasse (*Cheilio inermis*)										

Species	**Ma**	**La**	**Es**	**SB**	**Ss**	**Cr/Hs**	**Pr**	**Sz**	**DST**	**Pe**
Threespot wrasse (*Halichoeres trimaculatus*)										
Checkerboard wrasse (*Halichoeres hortulanus*)		A, J	J		A, J, S	A, J, S		A, J		E, L
Weedy surge wrasse (*Halichoeres margaritacous*)										
(*Halichoeres zeylonicus*)		A, J		J	A, J, S	A, J, S	A, J, S			E, L
Surge wrasse (*Thalassoma purpureum*)										
Redribbon wrasse (*Thalassoma quinquevittatum*)										
Sunset wrasse (*Thalassoma lutescens*)		A, J			A, J, S	A, J, S		A, J		
Longface wrasse (*Hologynmosus doliatus*)										
Rockmover wrasse (*Novaculichthys taeniourus*)										
Napoleon wrasse (*Cheilinus undulatus*)	J	J		J		A, J, S	A, J, S		A, S	E, L

Species	**Ma**	**La**	**Es**	**SB**	**Ss**	**Cr/Hs**	**Pr**	**Sz**	**DST**	**Pe**
Mullidae (goatfish) Yellow goatfish (*Mulloidichthys* spp.) (*Mulloidichthys Pfleugeri*) (*Mulloidichthys* vanicolensis) (*Mulloidichthys flavolineatus*) Banded goatfish (*Parupeneus spp*.) (*Parupeneus barberinus*) (*Parupeneus bifasciatus*) (*Parupeneus heptacanthus*) (*Parupeneus ciliatus*) (*Parupeneus ciliatus*) (*Parupeneus cyclostomas*) (*Parupeneus pleurostigma*) (*Parupeneus indicus*) (*Parupeneus multifaciatus*) Band-tailed goatfish (*Upeneus arge*)		A, J	A	A, J	A, J	A, J	A, J			E, L
Octopodidae (octopuses) *Octopus cyanea* *Octupus 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

Species	**Ma**	**La**	**Es**	**SB**	**Ss**	**Cr/Hs**	**Pr**	**Sz**	**DST**	**Pe**
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
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 (*Signaus 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

Species	**Ma**	**La**	**Es**	**SB**	**Ss**	**Cr/Hs**	**Pr**	**Sz**	**DST**	**Pe**
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 spp.		A, J, S				A, J, S	A, J, S		A	E, L

Table 13: 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.	

Species Assemblage/Complex	**EFH (Egg and Larvae)**	**EFH (Adult and Juvenile)**
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.
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.

Species Assemblage/Complex	EFH (Egg and Larvae)	EFH (Adult and Juvenile)
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 14: 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)

MUS/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, Sphyrnidae (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

MUS/Taxa	Ma	La	Es	SB	Ss	Cr/Hs	Pr	DST	Pe
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
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

MUS/Taxa	Ma	La	Es	SB	Ss	Cr/Hs	Pr	DST	Pe
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
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

MUS/Taxa	Ma	La	Es	SB	Ss	Cr/Hs	Pr	DST	Pe
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–reef builders)		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
Small/Large 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
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

MUS/Taxa	Ma	La	Es	SB	Ss	Cr/Hs	Pr	DST	Pe
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

Table 15: 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.	

6.3 HAPC Designations

In addition to EFH, the Council identified habitat areas of particular concern (HAPCs) within EFH for all FMPs. 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 should be met: (a) the ecological function provided by the habitat is important; (b) the habitat is sensitive to human-induced environmental degradation; (c) development activities are, or will be, stressing the habitat type; or (c) 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. Table 16 summarizes the EFH and HAPC designations for all Western Pacific Archipelagic MUS, including Pacific Remote Island Areas MUS.

6.3.1 Bottomfish

On the basis of the known distribution and habitat requirements of adult bottomfish, the Council designated all escarpments/slopes between 40–280 meters throughout the Western Pacific Region, including the Pacific Remote Island Areas, as bottomfish HAPC. In addition, the Council designated the three known areas of juvenile opakapaka habitat (two off Oahu and one off Molokai) as HAPC. The basis for this designation is the ecological function that these areas provide, the rarity of the habitat, and the susceptibility of these areas to human-induced environmental degradation. The recent discovery of concentrations of juvenile snappers in relatively shallow water and featureless bottom habitat indicates the need for more research to help identify, map, and study nursery habitat for juvenile snapper in the PRIA.

6.3.2 Crustaceans

Currently, no crustacean HAPC has been designated in the PRIA. Research indicates that banks with summits less than 30 meters support successful recruitment of juvenile spiny lobster while those with summit deeper than 30 meters do not. For this reason, the Council has designated all banks in the NWHI with summits less than 30 meters as HAPC. The basis for designating these areas as HAPC is the ecological function they provide, the rarity of the habitat type, and the susceptibility of these areas to human-induced environmental degradation. The complex relationship between recruitment sources and sinks of spiny lobsters is poorly understood. The Council feels that in the absence of a better understanding of these relationships, the adoption of a precautionary approach to protect and conserve habitat is warranted.

The relatively long pelagic larval phase for palinurids results in very wide dispersal of spiny lobster larvae. Palinurid larvae are transported up to 2,000 nautical miles by prevailing ocean currents. Because phyllosoma larvae are transported by the prevailing ocean currents outside of EEZ waters, the Council has identified habitat in these areas as “important habitat.” To date HAPC has not been identified or designated for deepwater shrimp.

6.3.3 Precious Corals

Currently, no precious coral HAPC has been designated in the PRIA.

6.3.4 Coral Reef Ecosystems

Because of the already-noted lack of scientific 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 because such areas have been singled out for their ecological values during their designation as a protected area, and therefore would likely meet the HAPC criteria as well. The Coral Reef Ecosystem MUS HAPCs for Pacific Remote Island Areas identified in Table 16 have met at least one of the four criteria listed above, or the fifth criterion just identified (i.e., protected areas). 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 16: EFH and HAPC Designations for All Western Pacific Archipelagic MUS (Including the PRIA)

	Species Complex	EFH	HAPC
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 fm). **Juvenile/adults:** the water column and all bottom habitat extending from the shoreline to a depth of 400 m (200 fm)	All slopes and escarpments between 40–280 m (20 and 140 fm) Three known areas of juvenile opakapaka habitat: two off Oahu and one off Molokai
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*), hapuupuu (*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 meters (200 fm)	All slopes and escarpments between 40–280 m (20 and 140 fm) Three known areas of juvenile opakapaka habitat: two off Oahu and one off Molokai

	Species Complex	EFH	HAPC
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 fm) of all EEZ waters bounded by lattitude 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 fm)	No HAPC designated for seamount groundfish
Crustaceans	**Spiny and slipper lobster complex:** Hawaiian spiny lobster (*Panulirus marginatus*), spiny lobster (*P. penicillatus, P.* spp.), 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 fm) **Juvenile/adults:** all of the bottom habitat from the shoreline to a depth of 100 m (50 fm)	All banks with summits less than or equal to 30 m (15 fathoms) from the surface
Crustaceans	**Deepwater shrimp (*Heterocarpus* spp.)**	**Eggs and larvae:** the water column and associated outer reef slopes between 550 and 700 m **Juvenile/adults:** the outer reef slopes at depths between 300-700 m	No HAPC designated for deepwater shrimp.

	Species Complex	EFH	HAPC
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.* spp. 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
Coral Reef Ecosystems	**All Currently Harvested Coral Reef Taxa** **All Potentially Harvested Coral Reef Taxa**	EFH for the Coral Reef Ecosystem MUS includes the water column and all benthic substrate to a depth of 50 fm from the shoreline to the outer limit of the EEZ	Includes all no-take MPAs identified in the CRE-FMP, all Pacific remote islands, as well as numerous existing MPAs, research sites, and coral reef habitats throughout the western Pacific

Table 17: Coral Reef Ecosystem HAPC Designations in the Pacific Remote Island Areas

US Pacific Remote Island	Rarity of Habitat	Ecological Function	Susceptibility to Human Impacts	Likelyhood of Development Impacts	Existing Protective Status
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

6.4 Fishing Related Impacts That May Adversely Affect EFH

The Council is required to act to prevent, mitigate, or minimize adverse effects from fishing on evidence that a fishing practice has identifiable adverse effects on EFH for any MUS covered by an FMP. 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.

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 is prohibited and only selective and non-destructive gear may be allowed to fish for Coral Reef Ecosystem MUS. Although lobster traps have a potential impact on the benthic habitat, the tropical lobster *Panulirus penicillatus* does not enter lobster traps and any emergent PRIA lobster fishery is likely to utilize hand harvests. This technique causes limited damage or no fishing-related impacts to the benthic habitat.

The Council has determined that current management measures to protect fishery habitat are adequate and that 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 during harvesting operations.

Trash and discarded and lost gear (leaders, hooks, weights) by fishing vessels operating in the EEZ, are a Council concern. A report on the first phase of a submersible-supported research project conducted in Hawaii in 2001 preliminarily determined that bottomfish gear exhibited minimal to no impact on the coral reef habitat (C. Kelley, personal communication). A November 2001 cruise in the MHI determined that precious corals harvesting has “negligible” impact on the habitat (R. Grigg, personal communication). The Council is concerned with habitat impacts of marine debris originating from fishing operations outside the Western Pacific Region. NMFS is currently investigating the source and impacts of this debris. International cooperation will be necessary to find solutions to this broader problem.

Because the habitat of pelagic species is the open ocean, and managed fisheries employ variants 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.

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 (*Rattus* spp.) to the remote islands in the PRIA that harbor endemic land birds or provide roosting areas for seabirds. Although there are no restrictions that prohibit fishing vessels from transiting near these remote island 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.

While the Council has determined that current management measures 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.

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 2002, and Clark and Gulko (1999). In the Pacific Remote Island areas, potential threats include coastal construction, poaching and depletion of rare species, military activities and hazardous wastes. More recently, the U.S. Coral Reef Task Force identified six key threats to coral reefs: (1) landbased sources of pollutions, (2) overfishing, (3) recreational overuse, (4) lack of awareness, (5) climate change, and (6) coral bleaching and disease. However, these threats are of most concern for reef areas near populated island areas.

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, PRIA, 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, 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 FEP management area.

The vast majority of the reefs in the Western Pacific Region are remote and, in some areas, they have protected status. Most of these are believed to be in good condition. Existing fisheries are limited. 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 are difficult to detect.

6.5 Non-Fishing Related Impacts That May Adversely Affect EFH

On the basis of the guidelines established by the Secretary under Section 305 (b)(1)(A) of the MSA, 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. FEP implementation will not directly mitigate these activities. However, as already noted, it will allow NMFS and the Council to make recommendations to any federal, state or territorial 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.

6.5.1 Habitat Conservation and Enhancement Recommendations

According to NMFS guidelines, Councils must describe ways to avoid, minimize, or compensate for the adverse effects to EFH and 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. FEPs 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 and should describe a variety of options to conserve or enhance EFH, which may include, but are not limited to the following:

Enhancement 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 the 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 such activities. However, habitat conversion at the expense of other naturally functioning systems must be justified within an ecosystem context.

6.5.2 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 MSA 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 nonfishing activities have been identified that directly or indirectly affect habitat used by MUS. Impacts and conservation measures 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 nonfishing activities on EFH.

Habitat Loss and Degradation

Impacts

- 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

Conservation Measures

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 should 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 should reference latitude–longitude coordinates of the site so that 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 downcurrent 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 deep-water 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 that 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 the EPA 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 should be 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 a 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 (including moorings or anchors)

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 nonnative 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 (PRIA, 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.

6.6 EFH Research Needs

The Council conducted an initial inventory of available environmental and fisheries data sources relevant to the EFH of each managed fishery. Based on this inventory, a series of tables were created that indicated the existing level of data for individual MUS in each fishery. These tables are available in Supplements to Amendment 4, 6 and 10 respectively to the Precious Corals, Bottomfish and Seamount Groundfish, and Crusteaceans FMPs respectively (WPRFMC 2002), and the Coral Reef Ecosystems FMP (WPRFMC 2001), and are summarized below.

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:

All Species

- Distribution of early life history stages (eggs and larvae) of MUS by habitat
- 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 MUS life history stages
- Habitat utilization patterns for different life history stages and species for BMUS
- Growth, reproduction, and survival rates for MUS within habitats

Bottomfish Species

- Inventory of marine habitats in the EEZ of the Western Pacific Region
- Data to obtain a better SPR estimate for American Samoa’s bottomfish complex
- Baseline (virgin stock) parameters (CPUE, percent immature) for the Guam/NMI deep- and shallow-water bottomfish complexes
- High-resolution maps of bottom topography/currents/water masses/primary productivity

Crustaceans Species

- Identification of postlarval settlement habitat of all CMUS
- Identification of source–sink relationships in the NWHI and other regions (i.e., relationships between spawning sites settlement using circulation models, and genetic techniques)
- Establish baseline parameters (CPUE) for the Guam/Northern Marinas crustacean populations
- Research to determine habitat related densities for all CMUS life history stages in American Samoa, Guam, Hawaii, and NMI
- High-resolution mapping of bottom topography, bathymetry, currents, substrate types, algal beds, and habitat relief

Precious Corals Species

- Distribution, abundance, and status of precious corals in the Western Pacific Region

Coral Reef Ecosystem Species

- 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 MUS life history stages
- Habitat utilization patterns for different life history stages and species
- Growth, reproduction, and survival rates for MUS within habitats.
- Inventory of coral reef ecosystem habitats in the EEZ of the Western Pacific Region
- Location of important spawning sites
- Identification of postlarval settlement habitat
- Establishment of baseline parameters 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 Plan Teams. EFH designations may be changed under the FEP framework processes if information presented in an annual review indicates that modifications are justified.

CHAPTER 7: COORDINATION OF ECOSYSTEM APPROACHES TO FISHERIES MANAGEMENT IN THE PACIFIC REMOTE ISLAND AREAS FEP

7.1 Introduction

In the Western Pacific Region, the management of ocean and coastal activities is conducted by a number of agencies and organizations at the federal, state, county, and even village levels. These groups administer programs and initiatives that address often overlapping and sometimes conflicting ocean and coastal issues.

To be successful, ecosystem approaches to management must be designed to foster intra and inter-agency cooperation and communication (Schrope 2002). Increased coordination with state and local governments and community involvement will be especially important to the improved management of near-shore resources that are heavily used. To increase collaboration with domestic and international management bodies, as well as other governmental and nongovernmental organizations, communities, and the public, the Council has adopted the multilevel approach described below. This process is depicted in Figure 12.

7.2 Council Panels and Committees

FEP Advisory Panel

The FEP Advisory Panel advises the Council on fishery management issues, provides input to the Council regarding fishery management planning efforts, and advises the Council on the content and likely effects of management plans, amendments, and management measures.

The Advisory Panel consists of four sub-panels. In general, each Advisory Sub-panel includes two representatives from the area's commercial, recreational, and subsistence fisheries, as well as two additional members (fishermen or other interested parties) who are knowledgeable about the area's ecosystems and habitat. The exception is the Mariana FEP Sub-panel, which has four representatives from each group to represent the combined areas of Guam and the Northern Mariana Islands (see Table 18). The Hawaii FEP Sub-panel addresses issues pertaining to demersal fishing in the PRIA due to the lack of a permanent population and because such PRIA fishing has primarily originated in Hawaii. The FEP Advisory Panel meets at the direction of the Council to provide continuing and detailed participation by members representing various fishery sectors and the general public.

Table 18: FEP Advisory Panel and Sub-panel Structure

Representative	**American Samoa FEP Sub-panel**	**Hawaii FEP Sub-panel**	**Mariana FEP Sub-panel**	**Pelagic FEP Sub-panel**
Commercial representatives	Two members	Two members	Four members	Two members
Recreational representatives	Two members	Two members	Four members	Two members
Subsistence representatives	Two members	Two members	Four members	Two members
Ecosystems and habitat representatives	Two members	Two members	Four members	Two members

Archipelagic FEP Plan Team

The Archipelagic FEP Plan Team oversees the ongoing development and implementation of the American Samoa, Hawaii, Mariana, and PRIA FEPs and is responsible for reviewing information pertaining to the performance of all the fisheries and the status of all the stocks managed under the four Archipelagic FEPs. Similarly, the Pelagic FEP Plan Team oversees the ongoing development and implementation of the Pacific Pelagic Fishery Ecosystem Plan.

The Archipelagic Plan Team meets at least once annually and comprises individuals from local and federal marine resource management agencies and non-governmental organizations. It is led by a Chair who is appointed by the Council Chair after consultation with the Council's Executive Standing Committee. The Archipelagic Plan Team's findings and recommendations are reported to the Council at its regular meetings. Plan teams are a form of advisory panel authorized under Section 302(g) of the MSA.

Science and Statistical Committee

The Scientific and Statistical Committee (SSC) is composed of scientists from local and federal agencies, academic institutions, and other organizations. These scientists represent a range of disciplines required for the scientific oversight of fishery management in the Western Pacific Region. The role of the SSC is to (a) identify scientific resources required for the development of FEPs and amendments, and recommend resources for Plan Teams; (b) provide multi-disciplinary review of management plans or amendments, and advise the Council on their scientific content; (c) assist the Council in the evaluation of such statistical, biological, economic, social, and other scientific information as is relevant to the Council's activities, and recommend methods and means for the development and collection of such information; and (d) advise the Council on the composition of both the Archipelagic and Pelagic Plan Teams.

FEP Standing Committees

The Council's four FEP Standing Committees are composed of Council members who, prior to Council action, review all relevant information and data including the recommendations of the

FEP Advisory Panels, the Archipelagic and Pelagic Plan Teams, and the SSC. The Standing Committees are the American Samoa FEP Standing Committee, the Hawaii FEP Standing Committee (as in the Advisory Panels, the Hawaii Standing Committee will also consider demersal issues in the PRIA), the Mariana FEP Standing Committee, and the Pelagic FEP Standing Committee. The recommendations of the FEP Standing Committees, along with the recommendations from all of the other advisory bodies described above, are presented to the full Council for their consideration prior to taking action on specific measures or recommendations.

Regional Ecosystem Advisory Committees

Regional Ecosystem Advisory Committees (REACs) for each inhabited area (American Samoa, Hawaii, and the Mariana archipelago) comprise Council members and representatives from federal, state, and local government agencies; businesses; and non-governmental organizations that have responsibility or interest in land-based and non-fishing activities that potentially affect the area's marine environment. Committee membership is by invitation and provides a mechanism for the Council and member agencies to share information on programs and activities, as well as to coordinate management efforts or resources to address non-fishing related issues that could affect ocean and coastal resources within and beyond the jurisdiction of the Council. Committee meetings coincide with regularly scheduled Council meetings, and recommendations made by the Committees to the Council are advisory as are recommendations made by the Council to member agencies. REACs are a form of advisory panel authorized under Section 302(g) of the MSA.

Advisory Body Coordination and Recommendations to Council

Recommendations from each Council advisory body are reviewed separately by the Council, although there may be comments from one advisory body on the recommendations arising in another team or panel. This is partially dependant on timing and typically, the SSC reviews those recommendations arising from the Plan Teams, Advisory Panels and other bodies that have met prior to a Council meeting, and either concurring with these recommendations or suggesting an alternative. The same is true of any recommendations arising from the REACs; the Council would look to the SSC for any comments on recommendations arising from the REACs. Finally, the Pelagics Plan Team coordinates with the Archipelagic Plan Team on small boat issues, since the same fishing platform used for pelagic trolling and handlining, can be used for a variety of other fishing methods, e.g., bottomfish and coral reef fishes, and may involve cross cutting issues that have arisen in the past, such as shark depredation of fish catches.

Community Groups and Projects

As described above, communities and community members are involved in the Council's management process in explicit advisory roles, as sources of fishery data and as stakeholders invited to participate in public meetings, hearings, and comment periods. In addition, cooperative research initiatives have resulted in joint research projects in which scientists and fishermen work together to increase both groups' understanding of the interplay of humans and the marine environment, and both the Council's Community Development Program and the Community

Demonstration Projects Program, described below, foster increased fishery participation by indigenous residents of the Western Pacific Region.

7.3. Indigenous Program

The Council's indigenous program addresses the economic and social consequences of militarization, colonization and immigration on the aboriginal people in the Council's area of responsibility and authority. The resultant cultural hegemony is manifested in the poverty, unemployment, social disruption, poor education, poor housing, loss of traditional, cultural practices and health problems for indigenous communities. These social disorders affect island society. Rapid changes in the patterns of environmental utilization are disruptive to ecological systems that developed over millennia into a state of equilibrium with traditional native cultural practices. The environmental degradation and social disorder impacts the larger community by reducing the quality of life for all island residents. The result is stratification along social and economic lines and conflict within the greater community. Generally, it is believed that there were no permanent indigenous settlements on the PRIA, however there is evidence of human use (e.g., Wake Island, known to Marshall Islanders as *Eneen-kio,* and visited by them for 2,000 years before "western" contact*).*[28]

The primary process for the indigenous community to participate in the Council process is through their participation in the Subsistence and Indigenous Advisory Panel discussions. Grant workshops and other Council public fora provide additional opportunity for the indigenous community to participate in the Council process

There are two programs mandated by the MSA for these communities to participate in the Council process. The Western Pacific Community Development Program (CDP) and the Western Pacific Community Demonstration Project Program (CDPP) were established to provide broad latitude in program development and implementation. The two programs are linked by eligibility criteria published in the Federal Register on April 16, 2002.

7.3.1 Western Pacific Community Development Program (CDP)

The CDP establishes a process to increase participation of the indigenous community in fisheries managed by the Council through FEP amendments, program development or other administrative procedures to manage fisheries. The CDP provides an opportunity for programmatic changes to fisheries managed by the Council; no money is appropriated for this program. Under this program the Council has recommended that two Hawaii Mau Zone bottomfishing permits be reserved for use by indigenous communities and established the Guam Volunteer Fishery Data Collection Project. New projects are being developed for inclusion under this program that will help advance the Council's effort for ecosystem-based management.

[28] http://www.enenkio.org/history_main.htm

The Council will put into service a Community Development Program Advisory Panel (CDP AP). The advisory panel will review recommendations made by a community and report to the Council. The AP will be one of the vehicles for communities to bring their concerns to the Council for consideration in the development and implementation of fishery management plans.

7.3.2 Western Pacific Community Demonstration Project Program (CDPP)

The CDPP is a grant program for which the Council develops funding priorities. The Council has an advisory panel which reviews and ranks proposals and forwards them to the Council for approval and transmittal to the Secretary of Commerce. Congress has appropriated $500K per year for three to five demonstration projects in the region. The CDPP provides grants for projects that demonstrate customary, traditional and cultural practices as well as to provide for the acquisition of equipment and materials for participation in fisheries managed by the Council. The breadth of the proposals and the depth of the need in some of the territories have been astonishing and reinforce the Council's belief that a "one size fits all" approach cannot apply in the Western Pacific. After analyzing the results of three solicitations for CDPP, the Council found that both the CDP and CDPP need expansion and support to address the variety of needs and initiatives in the Western Pacific Region.

The purpose of the Western Pacific Community Demonstration Project Program is to promote the involvement of western Pacific communities in fisheries by demonstrating the application and/or adaptation of methods and concepts derived from traditional indigenous practices. Projects may demonstrate the applicability and feasibility of traditional indigenous marine conservation and fishing practices; develop or enhance community-based opportunities to participate in fisheries; involve research, community education, or the acquisition of materials and equipment necessary to carry out a demonstration project.

To support this program, region wide grant application trainings and workshops are conducted by the Council. These workshops also provide a forum for the community to make recommendations and participate in the Council process.

7.4 International Management and Research and Education

The Council participates in the development and implementation of international agreements regarding marine resources. These include the Western and Central Pacific Fisheries Commission (of which one Council member is a U.S. commissioner) as well as the Inter-American Tropical Tuna Commission (of which the U.S. is a member). Although the focus of these commissions is the management of pelagic fisheries, the Council also participates in workshops regarding demersal fisheries (e.g., the Tonga Bottomfish Workshop held in January of 2007). The Council also participates in and promotes the formation of regional and international arrangements for assessing and conserving all marine resources throughout their range, including the ecosystems and habitats that they depend on (e.g., the Forum Fisheries Agency, the Secretariat of the Pacific Community's Oceanic Fisheries Programme, the Food and Agriculture Organization of the U.N., the Intergovernmental Oceanographic Commission of UNESCO, the Inter-American Convention for the Protection and Conservation of Sea Turtles, the International Scientific Council, and the North Pacific Marine Science Organization). The

Council is also developing similar linkages with the Southeast Asian Fisheries Development Center and its turtle conservation program. Of increasing importance are bilateral agreements regarding demersal resources that are shared with adjacent countries. The Council also participates in broad international education initiatives such as the International Pacific Marine Educators Conference (held January 5-17, 2007 in Honolulu) as well as international marine debris conferences and fisheries forums. The Council will work with the U.S. Department of State and in coordination with NOAA International Affairs to appropriately broach issues of an international nature especially if they involve matters of policy, or law.

Figure 12: Illustration of Institutional Linkages in the Council Process

CHAPTER 8: CONSISTENCY WITH APPLICABLE LAWS

8.1 Introduction

This chapter provides the basis for the Council's belief that the measures contained in this document are consistent with MSA's National Standards and other applicable laws.

8.2 Magnuson-Stevens Fisheries Conservation and Management Act

8.2.1 Required Provisions

8.2.1.1 Fishery Description

For complete descriptions of the fisheries see Chapter 4 and for descriptions of the fisheries management measures, see Chapter 5 of this document. For additional information, see the Council's annual reports which are available at www.wpcouncil.org or by mail.[29]

8.2.1.2 MSY and OY

Available estimates of MSY and definitions of OY for each fishery managed under this FEP are provided in Chapter 4.

8.2.1.3 Domestic Capacity to Harvest and Process OY

Chapter 4 describes the domestic capacity to harvest and process OY for each fishery managed under this FEP.

8.2.1.4 Fishery Data Requirements

Chapter 4 describes pertinent data with respect commercial, recreational, and charter sectors of fisheries operating within Federal waters of the PRIA. For information on the current reporting requirements for PRIA fisheries, please see Chapter 5.

8.2.1.5 Description of EFH

For a description of EFH for fisheries managed under this FEP, please see Chapter 6.

8.2.1.6 Fishery Impact Statement

The institutional structure for ecosystem approaches to management under this FEP does not introduce any new regulatory changes to fishery operations, thereby no short-term impacts are anticipated for fishery participants in the PRIA and no impacts to communities would occur due to the lack of a permanent population and because such PRIA fishing has primarily originated in

[29] Western Pacific Fishery Management Council. 1164 Bishop St. Ste. 1400, Honolulu, HI. 96813

Hawaii. For detailed information on the economic and social impacts of the PRIA FEP see the Council's Programmatic EIS on the Fishery Ecosystem Plans.

8.2.1.7 Overfishing Criteria

Please see Chapter 5 for information on overfishing criteria utilized for the PRIA fisheries.

8.2.1.8 Bycatch Reporting

For general information on bycatch issues in PRIA fisheries refer to Sections 5.3.6, 5.4.6, 5.5.6, and 5.6.6. Bycatch reporting is accomplished via the Federal logbook requirements described in Chapter 5. Bycatch data sources for the region's bottomfish fisheries are listed in Table 19 below.

Table 19: Bycatch Reporting Methodology for PRIA Demersal Fisheries

	Observer programs[30]	NMFS Federal Logbook Programs (EEZ waters)	Creel Surveys (all waters)
Bottomfish	None	Federal logbook required for all catch and effort	None
Coral Reef Ecosystem species	None	Federal logbook required for all PHCRT catch and effort Federal logbook required for all CHCRT catch and effort in low-use MPAs (Johnston, Wake, Palmyra)	None
Precious Corals	None	Federal logbook required for all catch and effort	None
Crustaceans	None	Federal logbook required for all catch and effort	None

8.2.1.9 Recreational Catch and Release

Section 4.4 of this document describes the minimal recreational fisheries in the PRIA. Additional information may be found in the descriptions of the island areas in Chapter 3. There are no MSA recognized catch and release fishery management programs in the PRIA.

8.2.1.10 Description of Fishery Sectors

[30] Pursuant to the Endangered Species Act NMFS may require fishing vessels in fisheries identified through an annual determination process to carry Federal observers (72 FR 43176, August 3, 2007).

Chapter 4 of this document describes the different fishery sectors in the PRIA, however, fishing activity remains low in the PRIA, and some of the catch information from the few active operations is not available to the public due to confidentiality requirements.

8.2.2 National Standards for Fishery Conservation and Management

National Standard 1 states that 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 management measures in the fisheries managed through this FEP are consistent with National Standard 1 because they emphasize managing the fisheries in a sustainable manner using an ecosystem-based approach to best obtain optimum yield. The measures in this FEP are a result of the consolidation of the Council's previous four species-based demersal FMPs (Bottomfish and Seamount Groundfish, Coral Reef Ecosystems, Crustaceans, and Precious Corals) into one place-based Pacific Remote Island Areas Fishery Ecosystem Plan. The reference points and control rules (where designated) for species or species assemblages within those four FMPs are maintained in this FEP without change. There are currently no overfished stocks and no overfishing is occurring in any Council-managed PRIA fishery.

National Standard 2 states that conservation and management measures shall be based upon the best scientific information available.

The management measures in the fisheries managed through this FEP are consistent with National Standard 2 because they use the best scientific information available. Available stock assessments and data on catches, catch rates, and fishing effort are compiled by the NMFS' Pacific Islands Fisheries Science Center and have gone through rigorous review processes. In addition, management decisions have complied with environmental laws including NEPA, which ensures that the public is part of the data review process.

National Standard 3 states that, 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.

The management measures in the fisheries managed through this FEP are consistent with National Standard 3 because they promote the coordinated management of the full range of demersal species known to be present within EEZ waters around the Pacific Remote Island Areas.

National Standard 4 states that 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 management measures in the fisheries managed through this FEP are consistent with National Standard 4 because they do not discriminate between residents of different States or allocate fishing privileges among fishery participants.

National Standard 5 states that 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.

The management measures in the fisheries managed through this FEP are consistent with National Standard 5 because they do not require or promote inefficient fishing practices nor do they allocate fishing privileges among fishery participants.

National Standard 6 states that conservation and management action shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches.

The management measures in the fisheries managed through this FEP are consistent with National Standard 6 because they establish a management structure that is explicitly place based to promote consideration of the local factors affecting fisheries, fishery resources, and catches.

National Standard 7 states that conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.

The management measures in the fisheries managed through this FEP are consistent with National Standard 7 because they encourage the development of management measures that are tailored for the specific circumstances existing in the Pacific Remote Island Areas.

National Standard 8 states that conservation and management measures shall, consistent with the 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 management measures in the fisheries managed through this FEP are consistent with National Standard 8 because they include explicit mechanisms to promote the participation of fishing communities in the development and implementation of further management measures in the Pacific Remote Island Areas.

National Standard 9 states that 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.

The management measures in the fisheries managed through this FEP are consistent with National Standard 9 because the bycatch provisions contained within the Council’s previous FMPs, which were previously determined to be consistent with National Standard 9, are maintained in this FEP without change, and no new measures have been added that would increase bycatch or bycatch mortality.

National Standard 10 states that conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.

The management measures in the fisheries managed through this FEP are consistent with National Standard 10 because the measures contained within the Council's previous FMPs which were previously determined to be consistent with National Standard 9, are maintained in this FEP without change. This FEP does not require or promote any changes to current fishing practices or increase risks to fishery participants.

8.3 Essential Fish Habitat

None of the measures in this FEP are expected to cause adverse impacts to EFH or HAPC for species managed under the Fishery Ecosystem Plans for Pacific Pelagics, the American Samoa Archipelago, the Hawaii Archipelago, the Mariana Archipelago, or the Pacific Remote Island Areas (Table 20). Implementation of the FEPs is not expected to significantly affect the fishing operations or catches of any fisheries, rather it would simply replace and reorganize the FMPs into several geographically defined ecosystem plans. Furthermore, the FEPs are not likely to lead to substantial physical, chemical, or biological alterations to the oceanic and coastal habitat, or result in any alteration to waters and substrate necessary for spawning, breeding, feeding, and growth of harvested species or their prey.

The predominant fishing gear types (hook-and-line, troll, traps) used in the western Pacific fisheries included in this FEP cause few fishing-related impacts to the benthic habitat of bottomfish, crustaceans, coral reefs, and precious corals. The current management regime protects habitat through prohibitions on the use of bottom-set nets, bottom trawls, explosives, and poisons. None of the measures in the FEP will result in a change in fishing gear or strategy, therefore, EFH and HAPC maintain the same level of protection.

Table 20: EFH and HAPC for Management Unit Species of the Western Pacific Region
All areas are bounded by the shoreline, and the seaward boundary of the EEZ, unless otherwise indicated.

MUS	EFH (Juveniles and Adults)	EFH (Eggs and Larvae)	HAPC
Pelagic	Water column down to 1,000 m	Water column down to 200 m	Water column down to 1,000 m that lies above seamounts and banks
Bottomfish	Water column and bottom habitat down to 400 m	Water column down to 400 m	All escarpments and slopes between 40–280 m and three known areas of juvenile opakapaka habitat

MUS	EFH (Juveniles and Adults)	EFH (Eggs and Larvae)	HAPC
Seamount Groundfish	Water column and bottom from 80 to 600 m, bounded by 29° °–35° ° N and 171 ° E –179° ° W (adults only)	Epipelagic zone (0–200 nm) bounded by 29° °–35° ° N and 171° ° E -179° ° W (includes juveniles)	Not identified
Precious Corals	Keahole, Makapuu, Kaena, Wespac, Brooks, and 180 Fathom gold/red coral beds, and Milolii, S. Kauai, and Auau Channel black coral beds	Not applicable	Makapuu, Wespac, and Brooks Bank beds, and the Auau Channel
Crustaceans	**Lobsters** Bottom habitat from shoreline to a depth of 100 m	Water column down to 150 m	All banks with summits less than 30 m
	Deepwater shrimp The outer reef slopes at depths between 300-700 m	Water column and associated outer reef slopes between 550 and 700 m	No HAPC designated for deepwater shrimp.
Coral reef ecosystem	Water column and benthic substrate to a depth of 100 m	Water column and benthic substrate to a depth of 100 m	All MPAs identified in the FEP, all PRIA, many specific areas of coral reef habitat (see Chapter 6)

8.4 Coastal Zone Management Act

The Coastal Zone Management Act requires a determination that a recommended management measure has no effect on the land or water uses or natural resources of the coastal zone or is consistent to the maximum extent practicable with the enforceable policies of an affected state's approved coastal zone management program.

8.5 Endangered Species Act (ESA)

The ESA requires that any action authorized, funded, or carried out by a Federal agency ensure its implementation would not jeopardize the continued existence of listed species or adversely modify their critical habitat. Species listed as endangered or threatened under the ESA that have been observed, or may occur, in the Western Pacific Region are listed below (and are described in more detail in Chapter 3):

- All Pacific sea turtles including the following: olive ridley sea turtles (*Lepidochelys olivacea*), leatherback sea turtles (*Dermochelys coriacea*), hawksbill turtles (*Eretmochelys imbricata*), loggerhead (*Caretta caretta*), and green sea turtles (*Chelonia mydas*).

- The humpback whale (*Megaptera novaeangliae*), sperm whale (*Physeter macrocephalus*), blue whale (*Balaenoptera musculus*), fin whale (*B. physalus*), and sei whale (*B. borealis*). In addition, one endangered pinniped, the Hawaiian monk seal (*Monachus schauinslandi*).

ESA consultations were conducted by NMFS and the U.S. Fish and Wildlife Service (for species under their jurisdiction) to ensure ongoing fisheries operations—including the bottomfish and seamount groundfish fishery, the crustacean fishery, and the harvest of precious corals and coral reef species—are not jeopardizing the continued existence of any listed species or adversely modifying critical habitat. The results of these consultations, conducted under section 7 of the ESA, are briefly described below. Implementation of this FEP would not result in any additional measures not previously analyzed. Therefore, the Council believes that there would be no additional impacts to any listed species or habitat.

Section 7 Consultations

In a biological opinion issued in March 2002 (NMFS 2002), NMFS concluded that the ongoing operation of the Western Pacific Region's botttomfish and seamount fisheries, as managed under the Bottomfish and Seamount Groundfish FMP, was not likely to jeopardize the continued existence of any threatened or endangered species under NMFS's jurisdiction or destroy or adversely modify any critical habitat. The management and conservation measures contained in this FEP for targeting botttomfish or seamount groundfish species are being carried forth from the Bottomfish and Seamount Groundfish FMP and no additional measures are proposed at this time. Therefore, the Council believes that bottomfish and seamount groundfish fishing activities under this FEP are not likely to jeopardize the continued existence of any threatened or endangered species under NMFS's jurisdiction or destroy or adversely modify critical habitat.

A biological opinion issued by NMFS in May 1996 (NMFS 1996), concluded that the ongoing operation of the Western Pacific Region's crustacean fisheries were not likely to jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify critical habitat. The management and conservation measures contained in this FEP for targeting crustacean species are being carried forth from the Crustaceans FMP and no additional measures are proposed at this time. Therefore, the Council believes that crustacean fishing activities under this FEP not likely to jeopardize the continued existence of any threatened or endangered species under NMFS's jurisdiction or destroy or adversely modify critical habitat.

In a biological opinion issued in October 1978 NMFS (NMFS 1978), concluded that the ongoing operation of the Western Pacific Region's precious coral fisheries was not likely to jeopardize the continued existence of any threatened or endangered species under NMFS's jurisdiction or destroy or adversely modify critical habitat.

An informal consultation completed by NMFS in December 2000 concluded that PRIA precious coral fisheries are not likely to adversely affect any ESA-listed species or critical habitat. The management and conservation measures contained in this FEP for targeting precious corals are being carried forth from the Precious Corals FMP and no additional measures are proposed at this time. Therefore, the Council believes that precious coral fishing activities under this FEP not likely to jeopardize the continued existence of any threatened or endangered species under NMFS' jurisdiction or destroy or adversely modify critical habitat.

An informal consultation completed by NMFS in March 2002 concluded that fishing activities conducted under the Coral Reef Ecosystems FMP are not likely to adversely affect endangered or threatened species or critical habitat under NMFS's jurisdiction. On May 22, 2002, the USFWS concurred with the determination of NMFS that the activities conducted under the Coral Reef Ecosystems FMP are not likely to adversely affect listed species under USFWS's exclusive jurisdiction (i.e., seabirds and terrestrial plants) and listed species shared with NMFS (i.e., sea turtles). The management and conservation measures contained in this FEP for targeting coral reef species are being carried forth from the Coral Reef Ecosystems FMP and no additional measures are proposed at this time. Therefore, the Council believes that coral reef fishing activities under this FEP not likely to jeopardize the continued existence of any threatened or endangered species under NMFS's jurisdiction or destroy or adversely modify critical habitat.

8.6 Marine Mammal Protection Act (MMPA)

Under section 118 of the Marine Mammal Protection Act (MMPA), NMFS must publish, at least annually, a List of Fisheries (LOF) that classifies U.S. commercial fisheries into one of three categories. These categories are based on the level of serious injury and mortality of marine mammals that occurs incidental to each fishery. Specifically, the MMPA mandates that each fishery be classified according to whether it has frequent, occasional, or remote likelihood of or no-known incidental mortality or serious injury of marine mammals.

NMFS uses fishery classification criteria, which consist of a two-tiered, stock-specific approach. This two-tiered approach first addresses the total impact of all fisheries on each marine mammal stock and then addresses the impact of individual fisheries on each stock. This approach is based on the rate, in numbers of animals per year, of incidental mortalities and serious injuries of marine mammals due to commercial fishing operations relative to a stock's Potential Biological Removal (PBR) level. The PBR level is defined in 50 CFR 229.2 as the maximum number of animals, not including natural mortalities, which may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population.

Tier 1:
If the total annual mortality and serious injury across all fisheries that interact with a stock is less than or equal to 10 percent of the PBR level of this stock, all fisheries interacting with this stock would be placed in Category III. Otherwise, these fisheries are subject to the next tier of analysis to determine their classification.

Tier 2:
Category I: Annual mortality and serious injury of a stock in a given fishery is greater than or equal to 50 percent of the PBR level.
Category II: Annual mortality and serious injury of a stock in a given fishery is greater than 1 percent and less than 50 percent of the PBR level.
Category III: Annual mortality and serious injury of a stock in a given fishery is less than or equal to 1 percent of the PBR level.

All of the demersal fisheries conducted in waters around the PRIA are listed as Category III (73 FR 73032, December 1, 2008). Fisheries managed under this FEP are not expected to change their historical fishing operations or patterns as a result of implementation of the FEP. Therefore, no increased impacts on marine mammals that occur in the waters around the PRIA are expected. The regulations governing Category III fisheries (found at 50 CFR 229.5) are listed below:

§ 229.5 Requirements for Category III fisheries.

- (a) *General.* Vessel owners and crew members of such vessels engaged only in Category III fisheries may incidentally take marine mammals without registering for or receiving an Authorization Certificate.
- (b) *Reporting.* Vessel owners engaged in a Category III fishery must comply with the reporting requirements specified in §229.6.
- (c) *Disposition of marine mammals.* Any marine mammal incidentally taken must be immediately returned to the sea with a minimum of further injury unless directed otherwise by NMFS personnel, a designated contractor, or an official observer, or authorized otherwise by a scientific research permit in the possession of the operator.
- (d) *Monitoring.* Vessel owners engaged in a Category III fishery must comply with the observer requirements specified under §229.7(d).
- (e) *Deterrence.* When necessary to deter a marine mammal from damaging fishing gear, catch, or other private property, or from endangering personal safety, vessel owners and crew members engaged in commercial fishing operations must comply with all deterrence provisions set forth in the MMPA and any other applicable guidelines and prohibitions.
- (f) *Self-defense.* When imminently necessary in self-defense or to save the life of a person in immediate danger, a marine mammal may be lethally taken if such taking is reported to NMFS in accordance with the requirements of §229.6.
- (g) *Emergency regulations.* Vessel owners engaged in a Category III fishery must comply with any applicable emergency regulations.

Marine mammals are known to occur in waters around the PRIA. Hawaiian monk seals, sperm whales, pilot whales, melon headed whales, Cuvier's beaked whales, and bottle nose and spinner dolphins have been sighted.

NMFS has concluded that PRIA commercial bottomfish, crustacean, precious corals, and coral reef fisheries will not affect marine mammals in any manner not considered or authorized under the Marine Mammal Protection Act.

8.7 National Environmental Policy Act (NEPA)

To comply with the National Environmental Policy Act, a Programmatic Environmental Impact Statement (PEIS) has been prepared to analyze the proposed action to implement this FEP. A Draft PEIS (dated October 27, 2005) was circulated for public review from November 10, 2005 to December 26, 2005 (70 FR 68443).

Subsequent to the circulation of the 2005 Draft PEIS for public review, it was decided to expand the document to contain analyses of impacts related specifically to the approval and implementation of fishery ecosystems plans in the Western Pacific Region. As a result, NMFS' Pacific Islands Regional Office and Council staff revised the Draft PEIS that was released in October 2005 and published a notice of availability of a new Draft PEIS in the Federal Register on April 13, 2007 (72 FR 18644). The public comment period for the revised Draft PEIS ended on May 29, 2007, and responses to the comments received have been incorporated into a Final PEIS and this document where applicable.

8.8 Paperwork Reduction Act (PRA)

The purpose of the Paperwork Reduction Act (PRA) is to minimize the burden on the public by ensuring that any information requirements are needed and are carried out in an efficient manner (44 U.S.C. 350191(1)). This FEP contains no new reporting or compliance requirements and all existing requirements were lawfully approved and have been issued the appropriate OMB control numbers.

8.9 Regulatory Flexibility Act (RFA)

In order to meet the requirements of the Regulatory Flexibility Act (RFA), 5 U.S.C. 601 et seq. requires government agencies to assess the impact of their regulatory actions on small businesses and other small entities via the preparation of regulatory flexibility analyses. The RFA requires government agencies to assess the impact of significant regulatory actions on small businesses and other small organizations. The basis and purpose of the measures contained in this FEP are described in Chapter 1, and the alternatives considered are discussed in the EIS prepared for this action. Because none of the alternatives contain any regulatory compliance or paperwork requirements, the Council believes that this action is not significant (i.e., it will not have a significant impact on a substantial number of small entities) for the purposes of the RFA, and no Regulatory Flexibility Analysis has been prepared.

8.10 Executive Order 12866

In order to meet the requirements of Executive Order 12866 (E.O. 12866), NMFS requires that a Regulatory Impact Review 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 proposed action, and ensures that management alternatives are systematically and comprehensively evaluated such that the public welfare can be enhanced in the most efficient and cost effective way. In accordance with E.O. 12866, the following is set forth by the Council: (1) This rule is not likely to have an annual effect on the economy of more than $100 million or to adversely affect in a material way the economy, a sector of the economy, productivity, jobs, the environment, public health or safety, or state, local, or tribal governments or communities; (2) This rule is not likely to create any serious inconsistencies or otherwise interfere with any action taken or planned by another agency; (3) This rule is not likely to materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights or obligations of recipients thereof; (4) This rule is not likely to raise novel or policy issues arising out of legal mandates, or the principles set forth in the Executive Order; (5) This rule is not controversial. The measures contained in this FEP are anticipated to yield net economic benefits to the nation by improving our ability to maintain healthy and productive marine ecosystems, and foster the long-term sustainable use of marine resources in an ecologically and culturally sensitive manner that relies on the use of a science-based ecosystem approach to resource conservation and management.

8.11 Information Quality Act

The information contained in this document complies with the Information Quality Act and NOAA standards (NOAA Information Quality Guidelines, September 30, 2002) that recognize information quality is composed of three elements: utility, integrity, and objectivity. Central to the preparation of this fishery ecosystem plan is objectivity that consists of two distinct elements: presentation and substance. The presentation element includes whether disseminated information is presented in an accurate, clear, complete, and unbiased manner and in a proper context. The substance element involves a focus on ensuring accurate, reliable, and unbiased information. In a scientific, financial, or statistical context, the original and supporting data shall be generated, and the analytic results shall be developed, using sound statistical and research methods.

At the same time, however, the Federal government has recognized that “information quality comes at a cost.” In this context, agencies are required to weigh the costs and the benefits of higher information quality in the development of information, and the level of quality to which the information disseminated will be held” (OMB Guidelines, pp. 8452–8453).

One of the important potential costs in acquiring "perfect" information (which is never available), is the cost of delay in decision- making. While the precautionary principle suggests that decisions should be made in favor of the environmental amenity at risk (in this case, marine ecosystems), this does not suggest that perfect information is required for management and conservation measures to proceed. In brief, it does suggest that caution be taken but that it not lead to paralysis until perfect information is available. This document has used the best available information and made a broad presentation of it. The process of public review of this document provides an opportunity for comment and challenge to this information, as well as for the provision of additional information.

8.12 Executive Order 13112

Executive Order 13112 requires agencies to use their respective authorities to prevent introduction of invasive species, respond to, and control invasions in a cost effective and environmentally sound manner, and to provide for restoration of native species and habitat conditions in ecosystems that have been invaded. Executive Order 13112 also provides that agencies shall not authorize, fund, or carry out actions that are likely to cause or promote the introduction or spread of invasive species in the U.S. or elsewhere unless a determination is made that the benefits of such actions clearly outweigh the potential harm, and that all feasible and prudent measures to minimize the risk of harm will be taken in conjunction with the actions. The Council has adopted several recommendations to increase the knowledge base of issues surrounding potential introductions of invasive species into waters included in this FEP. The first recommendation is to conduct invasive species risk assessments by characterizing the shipping industry, including fishing, cargo, military, and cruise ships for each FEP's geographic area. This assessment will include a comparative analysis of the risk posed by U.S. fishing vessels in the western Pacific with other vectors of marine invasive species.

The second recommendation is to develop a component in the Council's existing education program to educate fishermen on invasive species issues and inform the fishing industry of methods to minimize and mitigate the potential for inadvertent introduction of alien species to island ecosystems.

Fishing operations are not expected to change under this FEP and therefore are not expected to have increased risks of introducing alien species to the Hawaii archipelago or elsewhere.

8.13 Executive Order 13089

In June 1998 then President Clinton 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 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, in May 2002, which is designed to strengthen and expand Marine Protected Areas.

CHAPTER 9: OTHER RESOURCE MANAGEMENT LAWS OF THE PRIA

9.1 Introduction

Jurisdiction over nearshore fishery resources and habitat around the PRIA is the responsibility of the U.S. Department of the Interior (DOI) and U.S. Department of Commerce (DOC). Jurisdictional boundaries in this area are expressed in varying terms ranging from fathoms, miles, the territorial sea, to the EEZ. In addition, seaward boundaries are not clearly defined because some islands do not appear to have a seaward boundary as defined by U.S. law (i.e., the MSA; Beuttler 1995). Furthermore, administrative authority over the PRIA has been conferred by various Executive Orders to either the Department of Defense (DOD) or the DOI. As a result, agencies often assert differing interpretations of regulatory authority. With regard to MSA authority, NOAA General Counsel has opined that such authority applies to all marine waters around federally owned possessions (i.e., the PRIA), including marine resources within bays, inlets, and other marine waters to the shoreline (Beuttler 1995). The DOI, however, has interpreted its regulatory authority in some refuge areas as excluding uses allowed by MSA authority. The DOI and the DOC continue to confer on these issues. See Table 20 for a comparison of jurisdictional boundaries found within the PRIA.

9.2 U.S. Fish and Wildlife Refuges and Units

The USFWS has been given authority to manage each PRIA (except for Wake Island) as a National Wildlife Refuge (NWR). 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 2000).

The USFWS currently manages six wildlife refuges in the PRIA: Palmyra Atoll; Kingman Reef; Jarvis Island; Baker Island; Howland Island; and Johnston Atoll (Smith 2000b).

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 the management of fish and wildlife resources on the atoll.

Administration of Jarvis, Howland, and Baker Islands was transferred from the Office of Territorial Affairs to the USFWS in 1974. The USFWS acknowledges the Council's fishery management authority, in coordination with the NMFS, within the "200-nautical mile EEZ" (Smith 2000b).

9.3 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 Johnston Atoll, 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 has recently transferred administrative authority over Kingman Reef to the USFWS. The Wake Island NDSA has been suspended until further notice.

Lastly, as described in Chapter 1, to ensure consistency between the management regimes of different Federal agencies with jurisdiction in the PRIA, the regulations implementing the Coral Reef Ecosystems FMP stated that fishing for coral reef management unit species is not allowed within the boundary of a National Wildlife Refuge unless specifically authorized by the USFWS (69 FR 8346, February 24, 2004). The regulations (Chapter 10) for this FEP maintain that provision.

Table 21: Marine Resource Management Boundaries Within the PRIA

Island or Area	State/ Territory	Dept. of Commerce	Dept. of the Interior and Dept. of Defense (as noted)
Howland I.	-	WPRFMC/NMFS 0-200 nm	FWS: 0-3 nm
Baker I.	-	WPRFMC/NMFS 0-200 nm	FWS: 0-3 nm
Jarvis I.	-	WPRFMC/NMFS 0-200 nm	FWS: 0-3 nm
Johnston A.	-	WPRFMC/NMFS 0-200 nm	FWS/US Navy: 0-3 nm
Kingman R.	-	WPRFMC/NMFS 0-200 nm	FWS: 0-12 nm[1]
Palmyra A.	-	WPRFMC/NMFS 0-200 nm	FWS: 0-12 nm[2]
Wake I.*	-	WPRFMC/NMFS 0-200 nm	DOI/US Army: 0-3 nm

[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.
* 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.

9.4 Pacific Remote Islands Marine National Monument

On January 6, 2009, then President George W. Bush established the Pacific Remote Islands Marine National Monument through Presidential Proclamation 8336. The Secretaries of Commerce and Interior must consult with each other for the management of the monument. The Secretary of Defense shall continue to manage Wake Island. Proclamation 8336 states that the Secretary of Commerce may permit noncommercial fishing at specific (unspecified) locations upon request and that noncommercial fishing currently allowed by the U.S.FWS at Palmyra Atoll may continue unless the Secretary of Interior determines that this would be incompatible with the purposes of the the Palymra Atoll National Wildlife Refuge. It goes on to state that the Secretary shall provide a process to ensure that recreational fishing is managed as a sustainable activity in certain (unspecified) areas of the monument. It also directs the Secretaries to prepare management plans within their respective authorites for the proper care and management of monument objects.

CHAPTER 10: PROPOSED REGULATIONS

In preparation.

CHAPTER 11: REFERENCES

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