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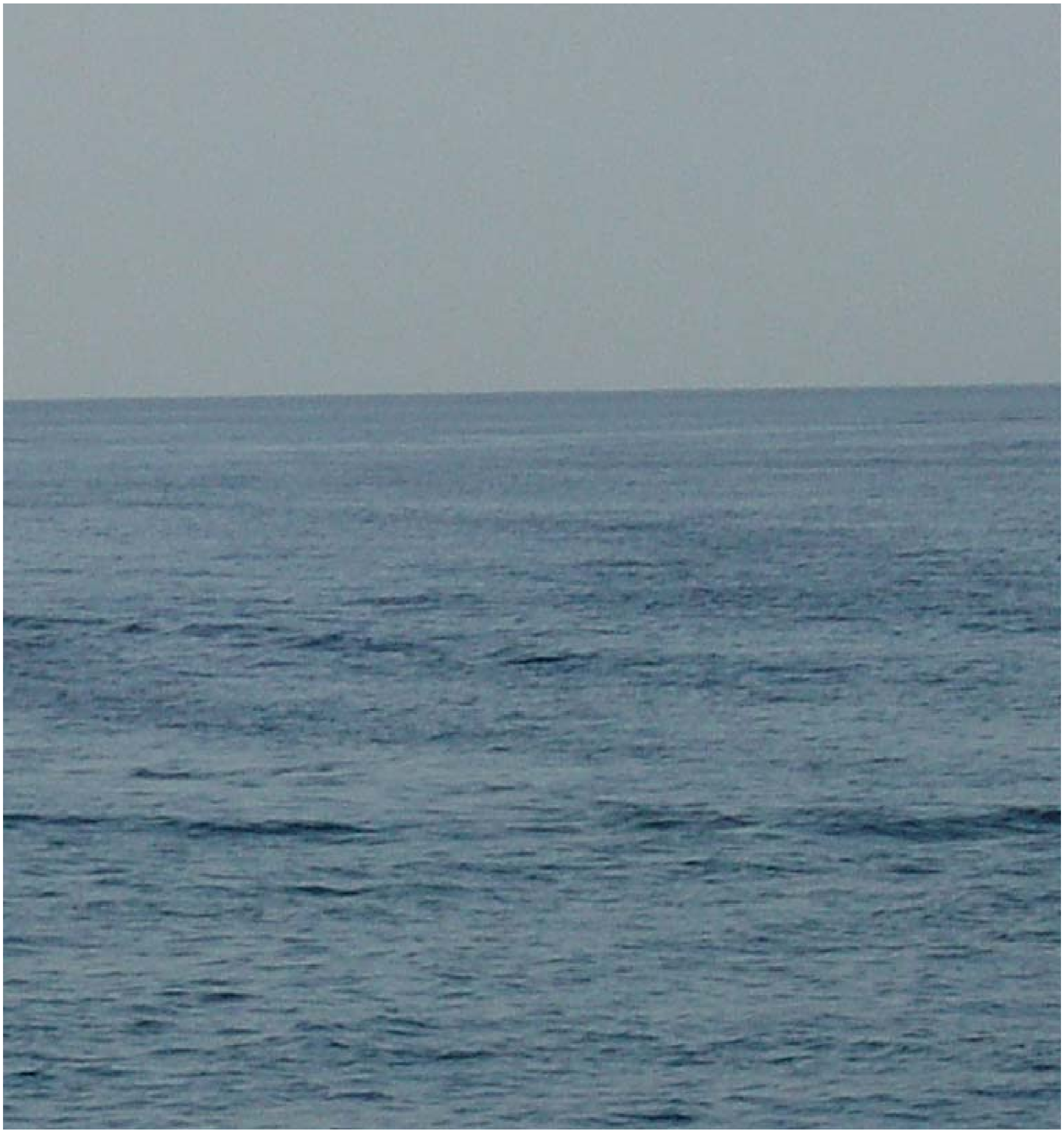
Fishery Ecosystem Plan for Pacific Pelagic Fisheries of the Western Pacific Region



Western Pacific Regional Fishery Management Council
1164 Bishop Street, Suite 1400
Honolulu, Hawaii 96813

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Draft September 30, 2005

EXECUTIVE SUMMARY

The Pacific Pelagic Fishery Ecosystem Plan (FEP) was developed by the Western Pacific Regional Fishery Management Council and represents the first phase in an incremental and collaborative multi-step approach to implement ecosystem approaches management of pelagic fisheries in the Western Pacific Region.

Since the 1980s the Council has managed fisheries throughout the Western Pacific Region through the Pelagic Fishery Management Plan (FMP), consistent with the Magnuson-Stevens Fishery Conservation and Management Act (MSA). 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.

The Pacific Pelagic FEP establishes the framework under which the Council will manage fishery resources, and begins the integration and implementation of ecosystem approaches to management in the Western Pacific Region. It does not, at this time establish any new fishery management regulations but it does explicitly incorporate community input and local knowledge into the management process. This FEP also reviews a range of important 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 advance the implementation of ecosystem science and principles. Such actions will 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.

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ACRONYMS AND DEFINTIONS

APA	Administrative Procedure Act
ASG	American Samoa Government
B:	Stock biomass
B_{FLAG}:	Minimum Biomass Flag
B_{MSY}:	Biomass Maximum Sustainable Yield
B_{OY}:	Biomass Optimum Yield
^{0}C:	Degrees Celsius
BMUS	Bottomfish Management Unit Species
BO	Biological Opinion
CFR	Code of Federal Regulations
CITES:	Council on International Trade and Endangered Species
cm	Centimeters
CNMI	Commonwealth of the Northern Mariana Islands
CPUE	Catch Per Unit Effort
$CPUE_{MSY}$:	Catch per unit effort Maximum Sustainable Yield
$CPUE_{REF}$:	Catch per unit effort
CRAMP:	Coral Reef Assessment and Monitoring Program
CRE:	Coral Reef Ecosystem
CRE-FMP:	Coral Reef Ecosystem Fishery Management Plan
CRTF:	Coral Reef Task Force
CVM	Contingent Valuation Method
CZMA	Coastal Zone Management Act
DAWR	Division of Aquatic and Wildlife Resources, Government of Guam
DBEDT	Department of Business, Economic Development and Tourism, State of Hawaii
DFW	Division of Fish and Wildlife, CNMI
DLNR:	Department of Land and Natural Resources, Hawaii
DMWR	Department of Marine and Wildlife Resources, American Samoa Government
DOC:	Department of Commerce
DOD	United States Department of Defense
DOI:	Department of the Interior
E:	Effort
E_{AVG}:	Effort average
EA	Environmental Assessment
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
FCZ	Fishery Conservation Zone
FDM:	Farallon de Medinilla, CNMI
FFS	French Frigate Shoals
FLPMA	Federal Land Policy and Management Act
fm	Fathoms
FMP	Fishery Management Plan
FOIA	Freedom of Information Act
FR	Federal Register
FRFA	Final Regulatory Flexibility Analysis
ft	Feet
FWCA	Fish and Wildlife Coordination Act
g:	grams
GIS:	Geographic information systems
GATT	General Agreement on Tariffs and Trade
GPS	Global Positioning System
HAPC:	Habitat Areas of Particular Concern
HCRI:	Hawaii Coral Reef Initiative Research Program
HDAR	Division of Aquatic Resources, State of Hawaii
HINWR:	Hawaiian Islands National Wildlife Refuge
HIR:	Hawaiian Islands Reservation
HMSRT	Hawaiian Monk Seal Recovery Team
ICB	Information Collection Budget
ICRI:	International Coral Reef Initiative
IRFA	Initial Regulatory Flexibility Analysis
kg	Kilograms
km	Kilometers
lb	Pounds
LOF	List of Fisheries
LORAN	Long Range Aid to Navigation
m:	meters
mt:	metric ton
maxFMT:	maximum fishing mortality threshold
MBTA	Migratory Bird Treaty Act
MHI:	Main Hawaiian Islands
min SST:	minimum spawning stock threshold
mm:	millimeters
MMPA:	Marine Mammal Protection Act
MPA:	Marine Protected Area
MSFCMA:	Magnuson-Stevens Fisheries Conservation and Management Act
MSST	Minimum Stock Size Threshold
MSY	Maximum Sustainable Yield
MUS:	Management Unit Species

NAFTA	North American Free Trade Agreement
NDSA	Naval Defense Sea Areas
NEPA	National Environmental Policy Act
nm or nmi	Nautical Miles
NMFS	National Marine Fisheries Service
NMFS-PIFSC	NMFS, Pacific Islands Fisheries Science Center
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
OSP	Optimum Sustainable Population
OY:	Optimum Yield
PBR	Potential Biological Removal
PIRO	Pacific Islands Regional Office (NMFS)
PRA	Paperwork Reduction Act
PRIA	Pacific Remote Island Area
PT:	Plan Team (for FMP development)
RA:	Regional Administrator, NMFS PIRO
RFA	Regulatory Flexibility Act
RIN	Regulatory Identifier Number
RIR	Regulatory Impact Review
SBREFA	Small Business Regulatory Enforcement Fairness Act
SEIS	Supplemental Environmental Impact Statement
SFA	Sustainable Fisheries Act
SLA:	Submerged Lands Act
SPR	Spawning Potential Ratio
SWR	State Wildlife Refuge
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
WPRFMC	Western Pacific Regional Fishery Management Council

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Hand Harvest: Harvesting by handline.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

RA: Regional Administrator, NMFS Southwest Region

Recreational Fishing: Fishing primarily for sport or pleasure.

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

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

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

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

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

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

Restoration: The transplanting of live organisms from their natural habitat in one area to another area where losses of, or damage to, those organisms has occurred with the purpose of restoring the damaged or otherwise compromised area to its 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.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

CHAPTER 1: INTRODUCTION

1.1 Introduction

In 1976, the United States Congress passed the Magnuson Fishery Conservation and Management Act which was subsequently 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 (PRIAs) of the Western Pacific Region.[1]

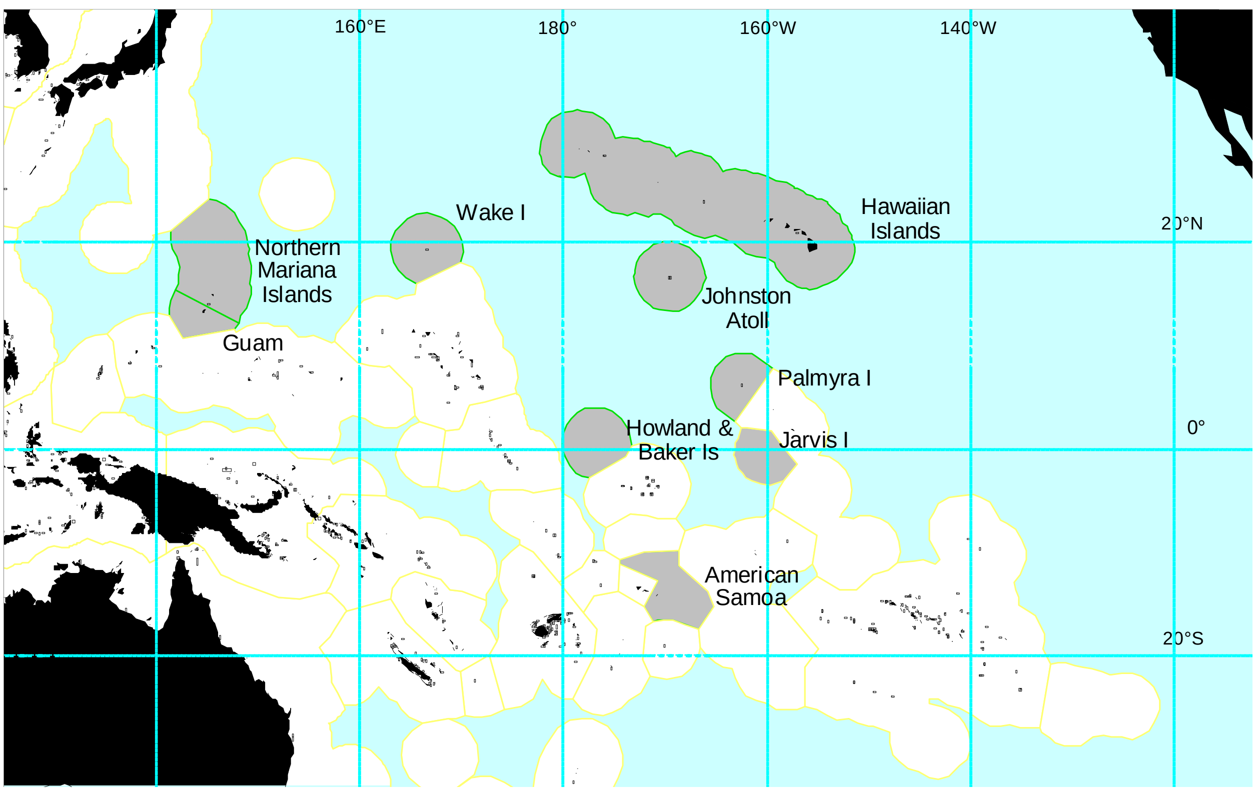

Figure 1: The Western Pacific Region

[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 Hawaii, Midway is considered part of the PRIAs because it is not a part of the State of Hawaii.

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 waters surrounding 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 Corp 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 have been found to be owned by the Federal government, although CNMI is currently seeking to acquire jurisdiction of the area from 0-3 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. This remains true in the today's modern period, in which 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 towards an ecosystem approach to fisheries management. One reason for this shift is a growing awareness that many of the 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, as well as 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 the National Marine Fisheries Service (NMFS, also known as NOAA Fisheries Service) with the establishment of an Ecosystem Principles Advisory Panel (Panel) responsible for assessing the extent which 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 Panel was composed of members of academia, fishery and conservation organizations and fishery management agencies.
The EPAP (1999) reached consensus that Fishery Ecosystem Plans (FEPs) should be developed and implemented to manage U.S. fisheries and marine resources. According to the Panel, an FEP should contain and implement a management framework to control harvests of marine resources based on available information regarding the structure and function of the ecosystem in which such harvests occur. The EPAP also constructed seven ecosystem principles that they believe to be important to the successful management of marine ecosystems which are as follows:

- The ability to predict ecosystem behavior is limited.
- Ecosystems have real thresholds and limits which, when exceeded, can effect 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" (FAO 2003).

Similarly, the National Oceanic and Atmospheric Administration (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, due to their wide ranging nature, successful implementation of ecosystem approaches will need to be incremental and collaborative (NOAA 2004).

Given the above, this document establishes a Fishery Ecosystem Plan for the Pacific Pelagic Fisheries of the Western Pacific Region (Pelagic FEP). In particular it:

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

In addition this document provides the information and rationale for these measures, discusses the key components of the Western Pacific Region's pelagic ecosystem including an overview of the region's pelagic fisheries, and explains how the measures contained here are consistent with the MSA and other applicable laws.

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, Sissenwine and Murawski 2004, NOAA 2004). The goal of the measures contained in this document is to begin this process by establishing a Pelagic FEP with appropriate boundaries, management unit species and advisory structures. Successful ecosystem 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 Pelagic FEP Boundaries

As described in Chapter 2, an ecosystem is generally considered as a system containing complex interactions among species, communities and the non-living environment. 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 which 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 integral part of these ecosystems and the measures 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' Ecosystem Principles Advisory Panel's 1999 report to Congress recommending that Councils should develop FEPs for the ecosystems under their jurisdiction, and delineate the extent of the those ecosystems. Taking these factors into account, the Pelagic FEP encompasses all areas of pelagic fishing operations in the EEZ or on the high seas, for any domestic vessels that:

1. fish for, possess, or transship Pelagic Management Unit Species (see Section 1.6) within the EEZ waters of the Western Pacific Region; or
2. land Pelagic Management Unit Species within the states, territories, commonwealths or unincorporated U.S. island possessions of the Western Pacific Region.

Although this overlaps with the boundaries of the Council's archipelagic FEPs for demersal fisheries, the Pelagic FEP specifically manages those resources and habitats associated with the pelagic ecosystem.

Under the approach described contained in this document, continuing adaptive management could include subsequent actions to refine or expand 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 Pelagic FEP Management Objectives

The Magnuson-Stevens Act 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 EPAP the Council initiated the development of FEPs for each major ecosystem under its jurisdiction beginning with the Coral Reef Ecosystems Fishery Management Plan (FMP), implemented in March 2004. This Pelagic FEP represents the next step in the establishment and successful implementation of FEPs for all of the fisheries within its jurisdiction.

The overall goal of the Pelagic 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 Pelagic FEP:

Objective 1: *To maintain healthy 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 conserve and appropriately manage protected species.*

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

Objective 8: *To encourage and support appropriate enforcement of, and voluntary compliance 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 Pelagic FEP Management Unit Species

Table 1: Pelagic MUS

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

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 inter-agency cooperation and communication (Schrope 2002 in NOAA 2003). 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 Panels

Fishery Ecosystem Plan Advisory Panels advise the Council on fishery management issues, provide input to the Council regarding fishery management planning efforts, and advise the Council on the content and likely effects of management plans, amendments, and management measures.

In general each Advisory 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 which has four representatives from each group to represent the combined areas of Guam and the Northern Mariana Islands (see Table 2). The Hawaii FEP Advisory 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 from Hawaii. The FEP Advisory Panels meet at the direction of the Council to provide continuing and detailed participation by members representing various fishery sectors and the general public.

Table 2: FEP Advisory Panel Structure

	Samoa FEP	**Hawaii FEP**	**Mariana FEP**	**Pelagic FEP**
Commercial Representatives	2 members	2 members	4 members	2 members
Recreational Representatives	2 members	2 members	4 members	2 members
Subsistence Representatives	2 members	2 members	4 members	2 members
Ecosystems & Habitat Representatives	2 members	2 members	4 members	2 members

Pelagic FEP Plan Team

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

The Pelagic Plan Team meets at least once annually and is comprised of 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 Pelagic Plan Team's findings and recommendations are reported to the Council at their regular meetings.

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: (1) identify scientific resources required for the development of FEPs and amendments and recommend resources for Plan Teams; (2) provide multi-disciplinary review of management plans or amendments and advise the Council on their scientific content; (3) 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 (4) advise the Council on the composition of both the Pelagic and Demersal Plan Teams.

FEP Standing Committees

The Councils five 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 Pelagic and Demersal Plan Teams and the SSC. The Standing Committees are the Pelagic FEP Standing Committee, the Samoa FEP Standing Committee, and 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. The recommendations of the Standing Committees, along with the recommendations from all of 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) are comprised of 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 which 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 committee to the Council are advisory, as are recommendations made by the Council to member agencies.

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 where scientists and fishermen work together to increase both groups' understanding of the interplay of humans and the marine environment, and the Council's Community Development Program and Community Demonstration Projects Program both 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. These include agreements made by the Inter-American Tropical Tuna Commission (of which the U.S. is a member) and the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Central and Western Pacific Region (of which the U.S. is a cooperating non-member). 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 they depend (i.e. the Forum Fisheries Agency and the Secretariat of the Pacific Community's Oceanic Fisheries Programme). 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, Pitkitch et al. 2004, Laffoley 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 amongst scientists and policy makers on how to best apply these often theoretical objectives and principles in a real-world regulatory environment (Hilborn 2004, Garcia 2003). In many cases it is a lack of scientific information that hinders their implementation (e.g. ecosystem indicators), in others 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 widely recognized that ecosystems are not static, but that the structure and functions vary over time due various dynamic processes (Kay and Schneider 1994, Christensen et al. 1996, NMFS 1999). The term "ecosystem" was coined in 1935 by A. G. Tansley, who defined ecosystems 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 (although 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, for example, 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 1994). NOAA's Ecosystem 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 which 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 (NMFS 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 measure 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 (Pitkitch 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 to the current situation which in general allows uses unless managers can demonstrate such impacts (Hildreth et al. 2004). 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. 2004). 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. 2004). As increased information and an improved understanding of the managed ecosystem becomes 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, 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 (Dayton et al. 2002; Browman et al. 2004).

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 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 *State of Coral Reefs Ecosystems of the United States and Pacific Freely Associated States: 2005*, anthropogenic stressors that are potentially detrimental to coral reef resources in include:

- 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 are fundamental components 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 handle due to differences in collection methodologies coupled with a lack of meta-data or documentation of how the data was collected and coded. This has resulted in incompatible datasets as well as data that is 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 (MAFAC 2003, EPAP 1999, de Young et al. 2004).

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 what is changing, and to what extent (state variables, e.g. coral reef biomass); why is it changing (pressure variables, e.g. bleaching); why it is important, and what should be done (response variables, e.g. management measures). 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 pers. comm. 2005).

While much has been written on potential marine ecosystem indicators (FAO 1999, ICES 2000, ICES 2005) to date there are 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 and 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) also examined the challenges of ecosystem modeling and presented several approaches to incorporating uncertainty into such models. However, Walters (2005) cautions against becoming overly reliant on models to assess the relative risks of various management alternatives and suggests that modeling exercises should be used as aids in experimental design rather than as precise prescriptive tools.

2.7 Single-species Management vs. Multi-species Management

A major theme in ecosystem approaches to fisheries management is the movement from conventional, single-species management to multi-species management (Sherman 1986, Mace 2004). 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). However Hilborn (2004) noted that some of the species that were historically over exploited (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 process surrounding them (Hilborn, 2004). Thus a distinction must be made between the use of single 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 both single 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 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 (Murawski 2004; ICES 2000; Witherell et al. 2000).

Recognizing the lack of a concise blueprint to implement 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 (Sissenwine and Murawski 2004; Browman and Stergiou 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 EO13158 was issued for the purpose of expanding the Nation's existing system of Marine Protected Areas (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 marine protected areas. 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 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 in NOAA 2003). 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 have 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 decisonmaking 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 which 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.

CHAPTER 3: DESCRIPTION OF THE ENVIRONMENT

3.1 Introduction

Chapter 3 describes the environment and resources included within the Pacific Pelagic FEP. Although this FEP will not manage the Western Pacific Region's demersal resources, successful ecosystem management requires considerations of interactions between the pelagic and demersal environments. For that reason 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 Pacific Ocean's physical environment has 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 over a third of Earth's surface (~ 64 million sq miles). From North to South, its over 9,000 miles long, and 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 such as the South China Sea, Celebes Sea, Coral Sea, and Tasman Sea.

3.2.2 Geology and Topography

The theory of plate tectonics provides that there are several plates above the hot, molten lava core of Earth. Figure 2 is schematic diagram of the Earth's tectonic plates. These plates are made of different kinds of rock with varying densities and can be thought of as pieces of a giant jigsaw puzzle– where the movement of one plate affects the position of another. Tectonic processes and plate movements have defined the contours of the Pacific Ocean. Generally, the floor of the Pacific Ocean basin is relatively uniform, with a mean depth of about 4270 m (14,000 ft) (Tomzack and Godfrey 2003). Dotting the Pacific basin, however, are underwater mountain chains, seamounts, islands, underwater valleys and trenches which affect the movement of water and occurrence and distribution of marine organisms.

Generally, the topography of the Pacific Ocean is the result of boundary movements of the Pacific Plate. Divergent boundaries or "sea floor spreading" occurs as the crust of the Pacific Plate pulls apart and forms a hot spot. The resulting molten lava released in the ocean builds up and spreads outward from the hot spot and long island chains are formed when the plate moves over the hot spot source[1]. A well known example of sea floor spreading is the formation of the Hawaiian Islands and the Emperor Seamounts, which when connected, form a 6,000 mile chain[2].

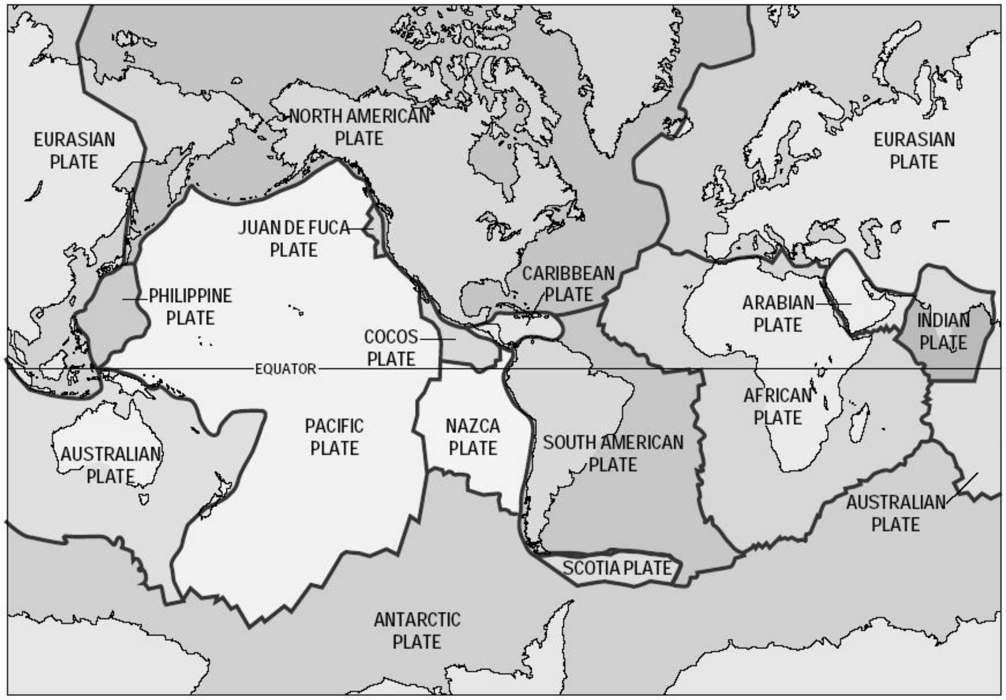

Figure 2: Earth's Tectonic Plates
(Source: U.S.Geological Survey)

Convergent boundary movements—the subduction of the Pacific Plate under less dense plates—can produce island arcs as well as deep trenches such as the Mariana Trench, which at nearly 36,000 ft, is the deepest point on Earth. Convergent boundary movements also result in the formation of island arcs, where the denser plate subducts under a less dense plate and begins to melt under the pressure. The formed lava is then released by convection and the result is the formation of island archipelagos[3].

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 upon layers of calcium carbonate which was secreted from reef building corals. Over geologic time, the rock of these low islands have eroded or subsided to where all that is remaining near the ocean surface is the secreted calcium carbonated produced by reef building corals (Nunn 2003).

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[1]http://www.washington.edu/burkemuseum/geo_history_wa/The Restless Earth v.2.0.htm
[2] http://pubs.usgs.gov/publications/text/Hawaiian.html
[3] http://www.washington.edu/burkemuseum/geo_history_wa/The Restless Earth v.2.0.htm

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 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 to 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 sea water 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 sea water by two processes: 1) atmospheric mixing with surface water, and 2) photosynthesis. Oxygen is subtracted from water through respiration of bacterial decomposition of organic matter (Tomzack and Godfrey 2003).

3.2.3 Ocean Layers

Based on 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 depth of around 400 m (or less depending on location) and is area where the water is mixed by currents, waves, and weather. The thermocline is generally from 400 m - 800 m and where water temperatures significantly differ from the surface layer; forming a temperature gradient which inhibits mixing with the surface layer. Over 90 percent of the ocean by volume occurs in the deep layer, which is generally below 800 m and consists of water temperatures around 0-4 degrees Celsius. 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. For example, the Atlantic Ocean has higher salinity levels than the Pacific Ocean due to input from the Mediterranean Sea (several large rivers flow in the Mediterranean). The average salt content of the ocean 35 ppt, but can vary at different latitudes depending on evaporation and precipitation rates. Salinity is lower near the equator than at middle latitudes due to a higher rainfall amounts. Salinity also varies at depth because and horizontal salinity gradients are often observed in the oceans (Bigg 2003). See Figure 4 for a generalized representation of salinity at various ocean depths.

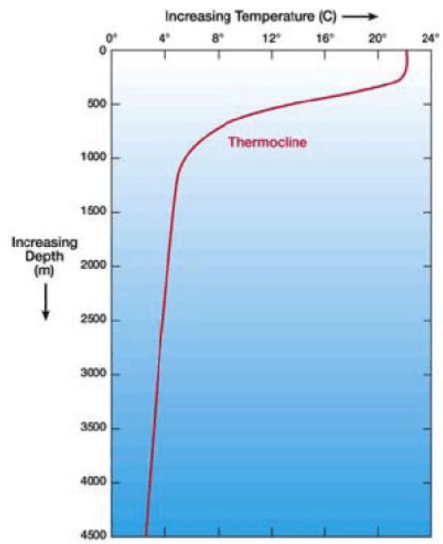

Figure 3: Temperature Profile of the Ocean

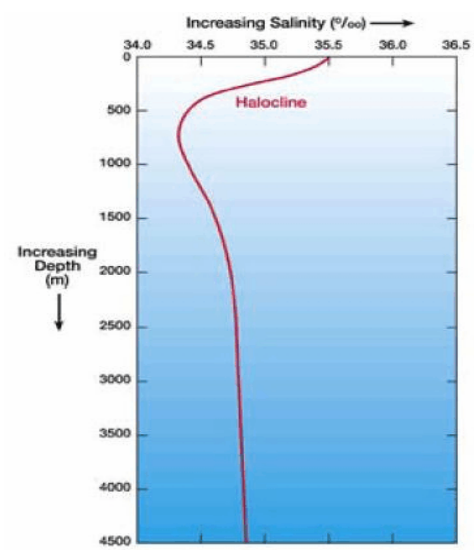

Figure 4: Salinity Profile of the Ocean

Source: http://www.windows.ucar.edu/tour/link=/earth/Water/temp.html&edu=high

3.2.5 Ocean Zones

The ocean can separated into the following five zones (see Figure 5) relative to the amount of sun light that penetrates through sea water: a) epipelagic, b) mesopelagic, c) bathypelagic, d) abyssalpelagic, e) hadalpelagic. Sunlight is the principle factor of primary production (phytoplankton) in marine ecosystems, and since sun light diminishes with ocean depth, the amount of sun light penetrating sea water and its affect on the occurrence and distribution of marine organisms is important. The epipelagic zone extends to nearly 200 m and is the near extent of visible light in the ocean. The mesopelagic zone occurs between 200 m and 1,000 m 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 ft to 4,000 m and the only visible light seen is the product of marine organism producing their own light call 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 expect small invertebrates such as squid and basket stars. The last zone is called the hadalpelagic (6,000 m and below) and occurs in trenches and canyons. Surprisingly, marine life such as tube worms and starfish are found is this zone, often near hydrothermal vents.

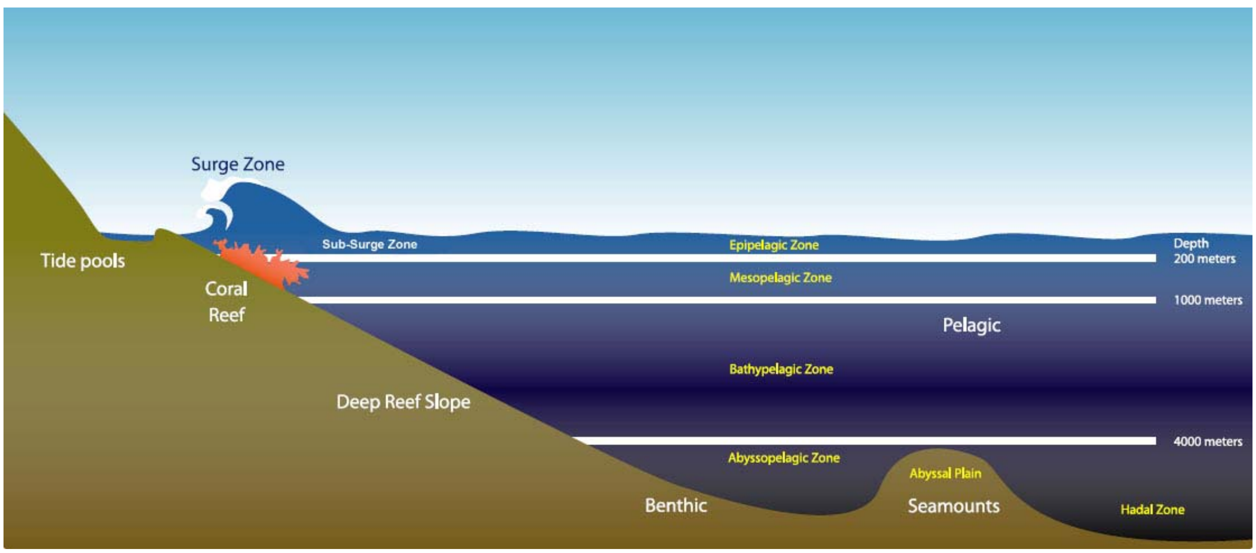

Figure 5: Depth Profile of Ocean Zones

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 which results in wind being produced from the heating and cooling of ocean water and the evaporation and precipitation of atmospheric water. Except for 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 which exist over a geographic scale and time period in which is water 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 which drives ocean surface currents, however the Earth's rotation and wind determines 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 open ocean environments (Tomzack and Godfrey 2003). Figure 6 shows the major surface currents of the Pacific Ocean.

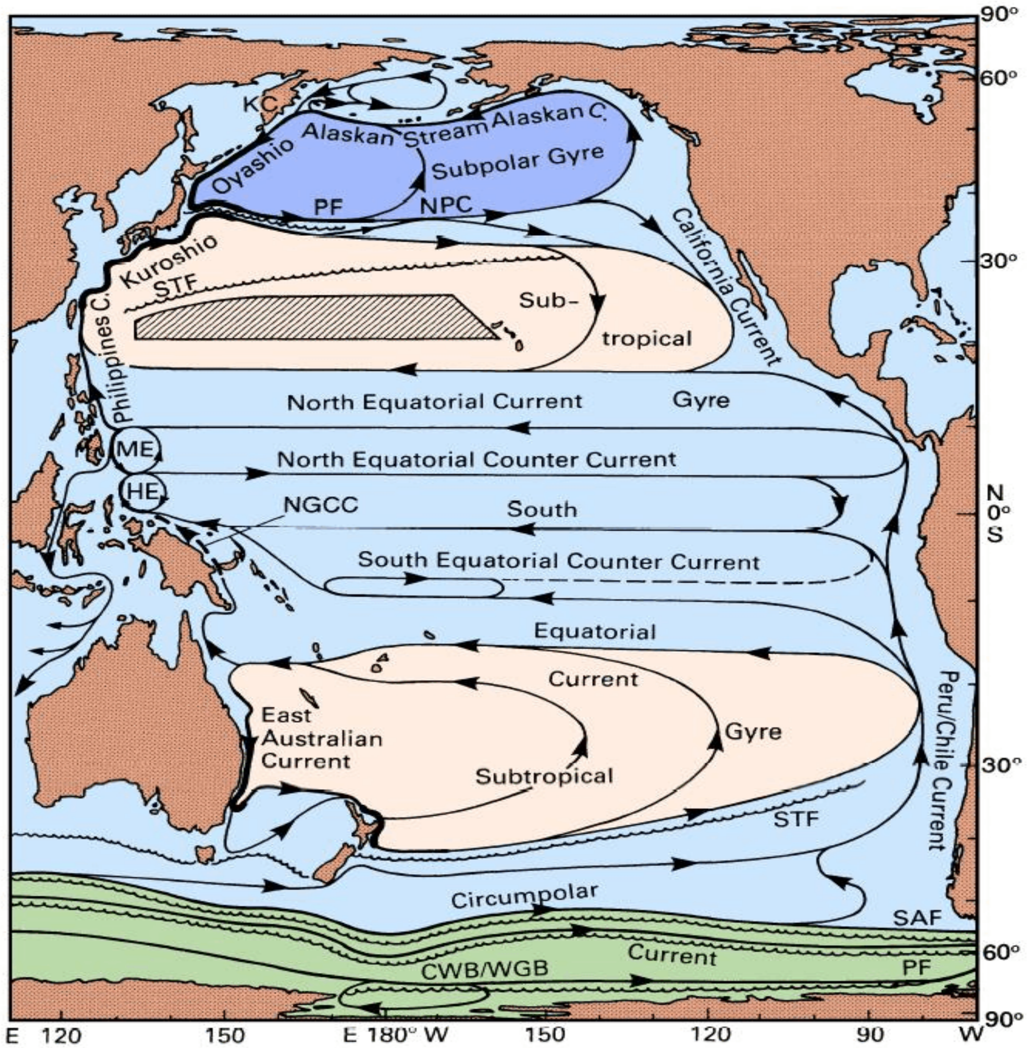

Figure 6: Major Surface Currents of the Pacific Ocean
(Source: Tomzack & Godfrey 2003)

Surface currents of the Pacific Ocean. Abbreviations are used for 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, CWB/WGB: Continental Water Boundary / Weddell Gyre Boundary. The shaded region indicates banded structure (Subtropical Countercurrents). In the western South Pacific Ocean the currents are shown for April - November when the dominant winds are the Trades. During December - March the region is under the influence of the northwest monsoon, flow along the Australian coast north of 18°S and along New Guinea reverses, the Halmahera Eddy changes its sense of rotation and the South Equatorial Current joins the North Equatorial Countercurrent east of the eddy (Tomzack & Godfrey 2003).

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 7). 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).

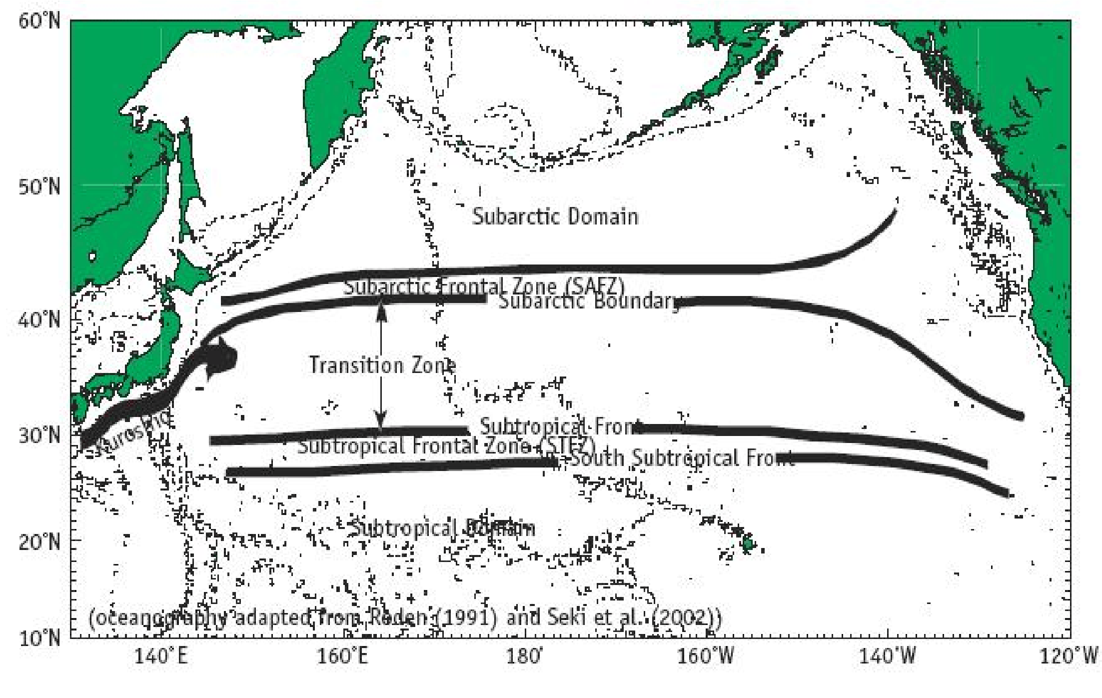

Figure 7: North Pacific Transition Zone
(source: http://www.pices.int/publications/special_publications/NPESR/2005/File_12_pp_201_210.pdf)

3.2.9 Eddies

Eddies are generally short to medium term water movement which 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 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

As described in Tomzack and Godfrey (2003), deep ocean currents or thermohaline movements, result from effect of salinity and temperature on the density of sea water. In the Southern Ocean, for example, water exuded from sea ice is extremely dense due to its high salt content. The dense sea water then sinks to the bottom and flows downhill 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 influence 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 Straight. 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 1200 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 8 for a simplified schematic diagram of the deep ocean conveyor belt system.

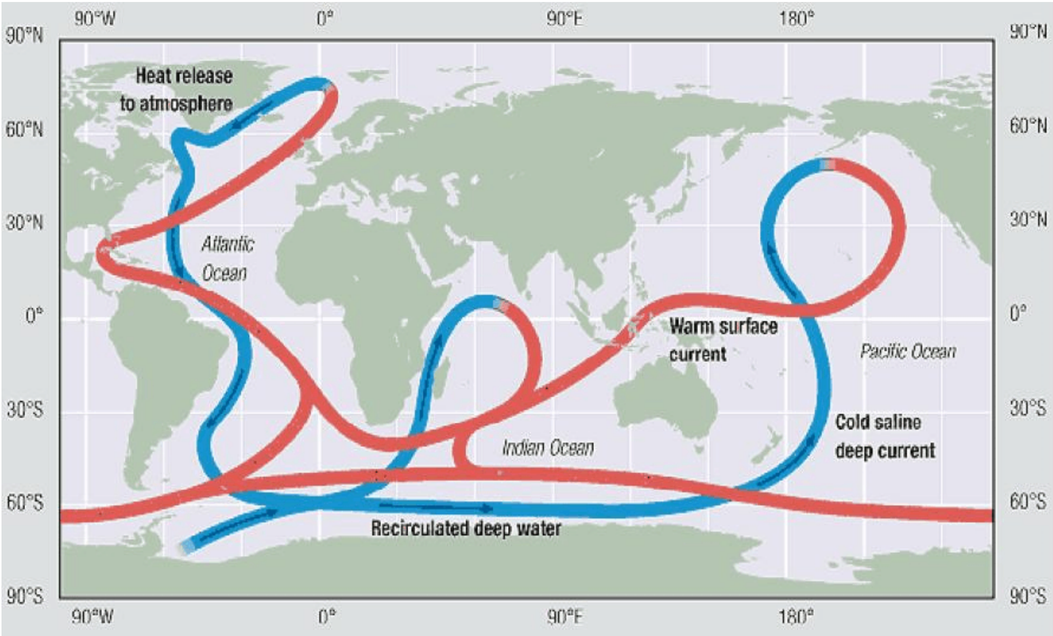

Figure 8: Deep Ocean Water Movement
(Source: UN GEO Yearbook 2004)

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 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 which 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 in to the higher troposphere layer of the atmosphere and settles back towards Earth at middle latitudes. As the air settles towards 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 in an area of low pressure. When the relatively warm surface currents (Figure 6) meet the colder air temperatures of sub-polar regions, latent heat is released causing 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 (e.g. 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 the previous sections, there are consistent weather patterns (e.g. ITCZ) and surface currents (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 Nino 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 socio-economic impacts from ENSO such changes in weather patterns resulting in catastrophic events (e.g. mud-slides in California due to high rainfall amounts) as well as linked to 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 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 et al.1994, Polovina 2005).

3.2.12 Pacific Island Geography

The Pacific islands can be generally grouped into three major areas: 1) Micronesia, 2) Melanesia, and 3) 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.[4]

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: a) Caroline Islands, b) Marshall Islands, c) Mariana Islands, d) Gilbert Islands, e) Line Islands, and f) Phoenix Islands.

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

The Caroline Islands (~ 850 sq 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 sq miles) are made up of 34 low lying atolls separate between two chains; the southeastern Ratak Chain and the northwestern Ralik Chain.

The Mariana Islands (~ 396 sq miles) are composed of 15 volcanic islands which are part of a submerged mountain chain that stretch 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, of which both are U.S. possessions. Size of EEZ?

Nauru (~ 21 sq 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 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. 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 sq miles). The U.S. possessions of Kingman Reef, Palmyra Atoll, and Jarvis Island 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 sq miles), which has an EEZ of nearly 1 million sq miles.

3.2.12.2 Melanesia

Melanesia is composed of several archipelagos which include: a) Fiji Islands, b) New Caledonia, c) Solomon Islands, d) New Guinea, e) Bismark Archipelago, f) Louisiade Islands, g) Tobriand Islands, h) Vanuatu Islands, i) Maluku Islands, and j) Torres Strait Islands.

Located approximately 3,500 miles northeast of Sydney, Australia, the Fiji Archipelago (~ 18,700 sq miles) is composed of nearly 800 islands, of which the largest are volcanic in origin and the smaller islands are coral atolls. The two largest islands, Viti Levu and Vanua Levu, comprise nearly 85 % of the Republic of Fiji Islands' total land area.

Located nearly 750 miles east-northeast of Australia, is the volcanic island of Grande Terre or New Caledonia (~ 6,300 sq 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 sq 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 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 separates 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 sq miles) is an independent nation that also governs several hundred small islands within several groups. These groups include the Bismark 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 Muluku Islands (east of New Guinea) and the Torres Strait Islands (between Australia and New Guniea) are also classified as part of Melanesia. Both of these island groups are volcanic in origin. The Muluku Islands are under by Indonesia's governance, while the Torres Strait Islands are governed by Australia.

The Vanuatu Islands (4,700 sq miles) comprise an archipelago that is located to the southeast of the Solomon Islands. There are 83 islands in the approximately 500 mile long Vanuatu chain, of which mostly all 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.

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) Tuvalu d) Tokelau,
e) Cook Islands, f) Easter Island (Rapa Nui) and g) Hawaii.

New Zealand (~ 103,470 sq miles) is composed of two large islands, North Island and South Island and several small island groups and islands. North Island (~ 44, 035 sq miles) and South Island (~ 58, 200 sq miles) extend for nearly 1000 miles on 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 km east of South Island. The four emergent islands of the Kermadec Islands are located 1,000 km northeast North Island 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 sq miles) are located 450 miles east of Fiji and consist of 169 islands of volcanic and raised limestone origin. The largest island, Tongatapu (~ 260 sq 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 sq miles) and Savai`i (~ 660 sq 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 sq miles), the Manua Islands (a group of four volcanic islands with a total land area of less than 20 sq miles), and two coral atolls, Rose Atoll and Swains Island, are governed by the U.S. Territory of American Samoa. Over 90 percent of American Samoa's population (~ 68,000) live on Tutuila.

To the east of the Samoa Archipelago are the Cook Islands (~ 90 sq miles), which are separated into the Northern Group and Southern Group. The Northern Group consist of six sparsely populated coral atolls and the Southern Group consists of seven volcanic islands and two coral atolls. Rorotonga (~ 26 sq 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 sq miles.

Approximately 600 miles northwest of the Samoa Islands is Tuvalu (~ 10 sq 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 in around 11,000 people. Tuvalu's coral island chain extends for nearly 360 miles and the country has an EEZ of 350,000 sq miles.

East of Tuvalu and north of Samoa are the Tokelau Islands (~ 4 sq miles). Three coral atolls comprise 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 Territory of French Polynesia (~ 1,622 sq 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 southeastern portion of the Territory and 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 central portion of the Territory and are the world's largest chain of coral atolls. The Society Islands are group of several volcanic islands which 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; 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 2 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 Islands 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 sq miles and population of approximately 3,790 people.

The northern extent of the Polynesian expansion is the Hawaiian Islands, which is 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 hotspot 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 from (Hawaii to Niihau). The total land area of the 19 primary islands and atolls is approximately 6,423 sq miles and the over 75 percent of the 1.2 million population lives in 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 sea floor) 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.

3.3.1 Marine Food Chains,Trophic Levels and Food Webs

Food chains are often thought of as of 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 such: primary producers, primary consumers, secondary consumers, tertiary consumers, quaternary consumers, and decomposers.

Generally, primary producers in the marine ecosystems are organisms which 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 which 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 which feed upon primary 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 to break down organic matter and make it available for primary producers (Valeila 2003).

Marine food webs are complex representations of overall patterns of feeding among organisms, but generally they are unable to the true complexity of the relationships between organisms and so they must be thought of simplified representations. An example of a marine food web is presented in Figure 9. The openness of marine ecosystems, lack of specialists, long lifespans, 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 important tool in understanding ecological relationships amongst organisms.

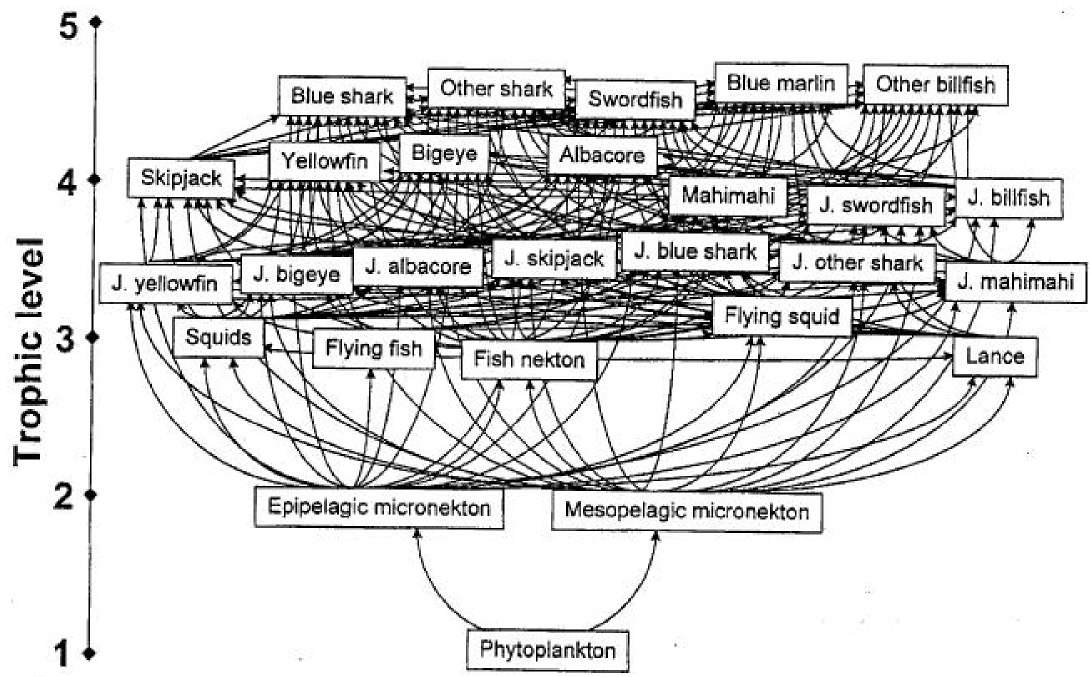

Figure 9: Central Pacific Pelagic Food Web
(Source: Kitchell et al. 1999)

3.3.2 Pelagic Environment

Pelagic species are closely associated with their physical and chemical environment. Suitable physical environment for these species depends on gradients in temperature, oxygen or salinity, all of which are influenced by oceanic conditions on various scales. In the pelagic environment, physical conditions such as isotherm and isohaline boundaries often determine whether or not the surrounding water mass is suitable for pelagic fish, and many of the species are associated with specific isothermic regions. Additionally, areas of high trophic transfer as found in fronts and eddies are important habitat for foraging, migration, and reproduction for many species (Bakun 1996).

The pelagic ecosystem is very large compared to any other marine ecosystems. Biological productivity in the pelagic zone is highly dynamic, characterized by advection of organisms at lower trophic levels and by extensive movements of animals at higher trophic levels, both of which are strongly influenced by ocean climate variability and meso-scale hydrographic features.

Phytoplankton, which contributes to over 95 percent of primary production in the marine environment (Valiela 1995), represents several different types of microscopic organisms which require sunlight for photosynthesis. Phytoplankton, which primarily live in the upper 100 m of the euphotic zone of the water column, include organisms such as diatoms, dinoflagellates, coccolithophores, silicoflagellates, and cyanobacteria. Although some phytoplankton have structures (e.g. flagella) which allow them some movement, generally phytoplankton distribution is controlled by current movements and water turbulence.

Diatoms can either be single celled or form chains with other diatoms and mostly found in areas with high nutrient levels such as coastal temperate and polar regions. Diatoms are the largest contributor to primary production in the ocean (Valiela 1995). Dinoflagellates are unicellular (one celled) organisms which are often observed in high abundance in subtropical and tropical regions. Coccolithophores, which also unicellular, are mostly observed in tropical pelagic regions (Levington 1995). Cyanobacteria, or blue-green algae, are often found in warm, nutrient-poor waters of tropical ocean regions.

Oceanic pelagic fish such as skipjack and yellowfin tuna, and blue marlin prefer warm surface layers, where the water is well mixed by surface winds and is relatively uniform in temperature and salinity. Other fish such as albacore, bigeye tuna, striped marlin and swordfish, prefer cooler, more temperate waters, often meaning higher latitudes or greater depths. Preferred water temperature often varies with the size and maturity of pelagic fish, and adults usually have a wider temperature tolerance than sub-adults. Thus, during spawning, adults of many pelagic species usually move to warmer waters, the preferred habitat of their larval and juvenile stages. Large-scale oceanographic events (such as El Niño) change the characteristics of water temperature and productivity across the Pacific, and these events have a significant effect on the habitat range and movements of pelagic species. Tuna are commonly most concentrated near islands and seamounts that create divergences and convergences which concentrate forage species, 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 water and warmer oceanic water masses (NMFS 2001).

These frontal zones have also been found to be likely migratory pathways across the Pacific for loggerhead turtles (Polovina et al. 2000). 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). Data from on-board observers in the Hawaii-based longline fishery indicate that incidental catch of loggerheads occurs along the 17° C front (STF) during the first quarter of the year and along the 20° C front (SSTF) in the second quarter of the year. The interaction rate, however is substantially greater along the 17° C front (Polovina et al. 2000).

3.3.2.1 Pelagic Species of Economic Importance

The most commonly harvested pelagic species in the Western Pacific Region are: tunas (*Thunnus obesus, Thunnus albacares, Thunnus alalunga, Katsuwonus pelamis*), billfish (*Tetrapturus auda, Makaira mazara, Xiphias gladius),* dolphinfish (*Coryphaena hippurus, C. equiselas)* and wahoo (*Acanthocybium solandri).* Species of oceanic pelagic fish live in tropical and temperate waters throughout the world's oceans. They are capable of long migrations that reflect complex relationships to oceanic environmental conditions. These relationships are different for larval, juvenile and adult stages of life. The larvae and juveniles of most species are more abundant in tropical waters, whereas the adults are more widely distributed. Geographic distribution varies with seasonal changes in ocean temperature. In both the Northern and Southern Hemispheres, there is seasonal movement of tunas and related species toward the pole in the warmer seasons and a return toward the equator in the colder seasons. In the western Pacific, pelagic adult fish range from as far north as Japan to as far south as New Zealand. Albacore, striped marlin and swordfish can be found in even cooler waters at latitudes as far north as latitude 50° N. and as far south as latitude 50° S. As a result, fishing for these species is conducted year-round in tropical waters and seasonally in temperate waters (NMFS 2001).

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) which 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. Morphometric studies of yellowfin tuna also support the hypothesis that populations from the eastern and western Pacific derive from relatively distinct sub-stocks in the Pacific. The stock structure of bigeye in the Pacific is poorly understood, but a single, Pacific-wide population is assumed. The movement of the cooler-water tuna (e.g., bluefin, albacore) is more predictable and defined, with tagging studies documenting regular and 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. 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 meters or 150-300 fathoms). 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 which may act to aggregate their prey and enhance migration by providing an energetic gain by moving the fish along with favorable currents (Olsen et al. 1994).

3.3.3 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 hide 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, b) subtidal (e.g. coral reefs), c) banks and seamounts, d) deep-reef slope, e) deep ocean bottom (see figure___).

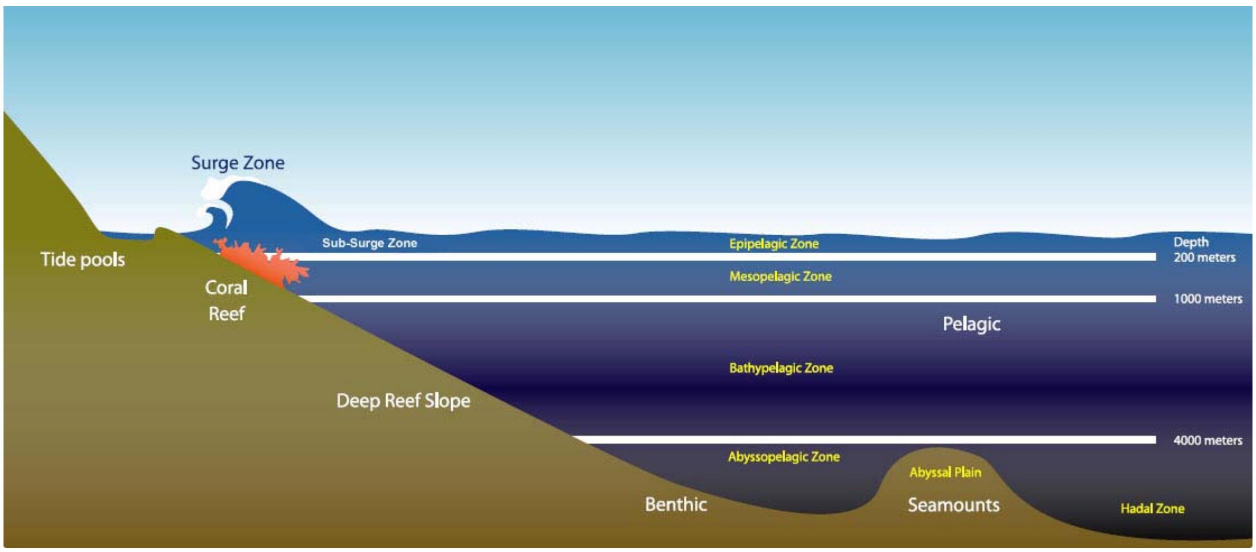

Figure 10: Ocean Zones From Shore

3.3.3.1 Intertidal Zone

The intertidal zone is relatively small margin of seabed that exists between the highest and lowest extent of the tides. Due to wave action on unprotected coastlines, the intertidal zone can sometimes extend beyond tidal limits due the splashing effect of waves. Vertical zonation amongst organisms are 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 which 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 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.

3.3.3.2 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), sea grasses stabilize sediments because leaves slow current flow, thus increasing sedimentation of particles. The roots and rhizomes form a complex matrix that binds sediments and stops erosion. 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 reef coral and associated habitats such as mangroves, seagrass beds, shallow lagoons, bays, inlets and harbors, and the reef slope beyond the limit of coral reef growth, contribute to the total yield from coral reef-associated fisheries.

3.3.3.3 Mangrove Forests

Mangroves are terrestrial shrubs and trees which are able to live the salty environment of the intertidal zone. Their prop roots form important substrate on which sessile organisms can grow as well as provided shelter for fishes. Mangroves are believed to 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, and form the habitat for some commercially valuable crustaceans.

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

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 m (300 ft) (Hunter 1995).

Primary production on coral reefs is associated phytoplankton, algae, sea grasses, and zooxanthellae. Primary consumers included 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 in common with the distribution of fish and invertebrate species. Over 330 species are contained in 70 genera on the Australian Barrier Reef, compared with only 30 coral genera present in the Society Islands of French Polynesia, and 10 genera in the 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 importantly, lacks most of the branching or "tabletop" Acropora species that form the majority of reefs elsewhere in the Pacific. The Acropora species provide a large amount of complex three-dimensional structure and protected habitat for a wide variety of fishes and invertebrates. 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. Further, 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 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 to the extent of other marine ecosystems, which collectively produce between 70 - 100 million metric tons per year (Munro 1984; Smith 1978). An apparent paradox of coral reefs, however, are 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 106 cells cm-2 of live coral surface—and the high rugosity of the surfaces on which they live, as well as their own photosynthetic potential. However, zones of high coral cover make up only a small part of entire coral reef ecosystems, and so their contribution to total coral reef primary productivity is small (WPFMC 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, and active transport onto reefs via fishes that shelter on reefs but feed in adjacent habitats. There is, therefore, greater potential for nourishment of inshore reefs than offshore reefs by external sources, and this inshore nourishment is enhanced by large land masses (Birkland 1997).

For most of the Pacific Islands, rainfall typically ranges from 2,000 to 3,500 mm per year. Low islands, such as atolls, tend to have less rainfall and may suffer prolonged droughts. Further, 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 4,300 mm 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 contribute 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 inter-kingdom relationships of animal/plant photo-symbioses hosted by animals of many taxa, most notably stony corals. Most of the geological structure of reefs and habitat is produced by these complex symbiotic relationships. Complex symbiotic relationships for defense from predation, removal of parasites, building of domiciles, and other functions are also prevalent. About 32 of the 33 animal phyla are represented on coral reefs (only 17 are represented in terrestrial environments) and this diversity produces complex patterns of competition. The diversity also produces a disproportionate representation of predators, which have strong influences on lower levels of the food web in the coral reef ecosystem (Birkeland 1997).

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 1997).

Typically, spawning of coral reef fish occur in the vicinity of the reef and is characterized by frequent repetition throughout a protracted time of the year, a diverse array of behavioral patterns, and extremely high fecundity. Coral reef species exhibit a wide range of strategies related 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 (planktotrophic) into the pelagic environment to feed on various types of plankton (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 over 100 days (Levington 1995). Because many coral reefs being space limited for settlement, planktotrophic larvae is a likely a 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 sub-populations: the ratio of sources and sinks, their degrees of recruitment connection, and the proportion of the sub-populations with high variability in reproductive capacity. Recruitment to populations of coral reef organisms depends largely on the pathways of larval dispersal and "downstream" links.

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, multi-species mass spawnings, and spawning aggregations in predictable locations (Birkeland 1997).

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 1997). 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 to pelagic species. In addition, scarids and labrids may have complex haremic territorial social structures that contribute to the overall effect of harvesting these resources. It appears that many tropical reef fishes grow rapidly to near-adult size, and then often grow relatively little over a protracted adult life span; they are thus relatively long-lived. In some groups of fishes, such as damselfish, individuals of the species are capable of rapid growth to adult size, but sexual maturity is still delayed by social pressure. This complex relationship between size and maturity makes resource management more difficult (Birkeland 1997).

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 NWHI is further characterized by: (1) high latitude coral atolls; (2) a mild temperate to subtropical climate, where inshore water temperatures can drop below 18° C in late winter; (3) species that are common on shallow reefs and attain large sizes, which to the southeast occur only rarely or in deep water; and 4) inshore shallow reefs that are largely free of fishing pressure (Maragos and Gulko 2002).

3.3.3.5 Deep Reef Slopes

As most Pacific islands are oceanic islands vs. 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 ft (Postma and Zijlstra 1988). While lacking a shelf, many oceanic islands have a deep reef slope which is often angled between 45 and 90 degrees towards the ocean floor. The deep reef slope is home to a wide variety marine of organisms which 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 m. For example, reef-building corals can be observed at depths less than 100 m, but at greater depths gorgonian and anthozoan corals are more readily observed (Colin 1986).

3.3.3.6 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 m. Deeper parts of banks may be composed of rock or 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 meta-populations that are associated with specific features or habitats, 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 m depth range. A rapid decrease in species richness typically occurs between 200-400 m depth, and most fish observed 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 were dominated by those on nearby shelf areas, and that seamounts act as stepping stones for trans-oceanic 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.

3.3.3.7 Deep Ocean Floor

At the end of reef slope 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, suspension feeders, as well as fish and marine mammals. Compared to 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 which sinks to the bottom. The occurrence of secondary and tertiary consumers decrease the deeper one goes due to the lack of available prey. Also with increasing depth, suspension feeders become less abundant and deposit feeders become the dominant feeding type (Levington 1995).

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

3.3.3.7.1 Benthic Species of Economic Importance

Coral Reef Associated Species

The most commonly harvested species of coral reef associated organisms include: surgeonfishes (Acanthuridae), triggerfishes (Balistidae), jacks (Carangidae), soldierfish/squirrelfish (Holocentridae), wrasses (Labridae), parrotfishes (Scaridae), octopus (Octupus cyanea, O. ornatus) and goatfishes (Mullidae). Studies on coral reef fisheries are relatively recent, commencing with the major study by Munro and his co-workers during the late 1960s in the Caribbean (Munro 1983). Even today, only a relatively few examples are available of in-depth studies on reef fisheries.

It was initially thought that the maximum sustainable yields for coral reef fisheries were in the range of 0.5-5 t/km-2yr-1, based on limited data (Marten and Polovina 1982; Stevenson and Marshall 1974). Much higher yields of around 20 t/km-2yr-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) suggest that the average MSY for Pacific reefs is in the region of 16 t/km-2yr-1 based on 43 yield estimates where the proxy for fishing effort was population density.

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

Further, 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, indicated that depleted biomass levels may recover to pre-exploitation levels within one to two years. In the Philippines, abundances of several reef fishes have increased in small reserves within a few years of their establishment (Russ and Alcala 1994; White 1988), although recovery in numbers of fish is much faster than recovery of biomass, especially in larger species such as groupers. Other studies in the Caribbean and 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 (1997) cites the example of a pinnacle reef off Guam fished down over a period of six months in 1967, that has still not recovered thirty years later.

Estimating the recovery from, and reversibility of, fishing effects over large reef areas appears more difficult 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 was due to recruitment overfishing because it takes time to rebuild adult spawning biomasses and high fecundities (Polunin and Morton 1992). Further, many coral reef species have limited distributions; they may be confined to a single island or a cluster of proximate islands. Widespread heavy fishing could cause 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 habitat 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 habitat apart from the adults as do many Palinurid lobsters (MacDonald and Stimson 1980; Parrish and Polovina 1994). Juvenile and adult P. marginatus do utilize shelter differently from one another (MacDonald and Stimson 1980). Similarly, juvenile and adult P. pencillatus also share the same habitat (Pitcher 1993).

Pitcher (1993) observes that, 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, he notes. Pitcher also states that in this region, P. pencillatus inhabits the rocky shelters in the windward surf zones of oceanic reefs, an observation also noted by Kanciruk (1980). Other species of Panulirus show more general patterns of habitat utilization, Pitcher continues. At night, P. penicillatus moves on to reef flat to forage, Pitcher continues. Spiny lobsters are nocturnal predators

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 tailfan (Uchida et al.1980). Uchida and Uchiyama (1986) provide a detailed description of the morphology of slipper lobsters (S. squammosus and S. haanii) and note 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 sp.) are dioecious (Uchida and Uchida 1986). Generally, the different species of the genus Panulirus have the same reproductive behavior and life cycle (Pitcher 1993). The male spiny lobster deposits a spermatophore or sperm packet on the female's abdomen (WPRFMC 1983). In Panulirus sp., the fertilization of the eggs occurs externally (Uchida et al. 1980). The female lobster scratches and breaks the mass, releasing the spermatozoa (WPRFMC 1983). Simultaneously, ova are released for the female's oviduct and are then fertilized and attach to the setae of the female's pleopod (WPRFMC 1983, Pitcher 1993). At this point the female lobster is ovigerous, or "berried" (WPRFMC 1983). The fertilized eggs hatch into phyllosoma larvae after 30–40 days (MacDonald 1986, Uchida 1986). Spiny lobsters are very fecund (WPRFMC 1983). The release of the phyllosoma larvae appears to be timed to coincide with the full moon and dawn in some species (Pitcher 1993). In Scyllarides sp. 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 (WPRFMC 1983). The duration of this planktonic phase varies depending on the species and geographic region (WPRFMC 1983). 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).

Johnston (1968) suggests that fine-scale oceanographic features, such as eddies and currents, serve to retain lobster larvae within island areas. In the NWHI, for example, lobsters 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 which are often targeted include snappers (Lutjanidae), groupers (Serranidae), jacks (Carangidae), and emperors (Lethrinidae). See Section 1.6 for a complete list of Western Pacific Management Unit Species. Distinct depth associations are reported for certain species of emperors, snappers and groupers and 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. The snapper family (Lutjanidae) is 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 (Serranidae) 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 upon hard bottom substrates at depth (Parrish 1987). For each family, schooling behavior is reported more frequently for juveniles than 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 on the location and characteristics of nursery grounds for juvenile deep slope snappers and groupers. In Hawaii, juvenile opakapaka (P. filamentosus) have been found on flat, featureless shallow banks, as opposed to high relief areas where the adults occur. Similarly, juveniles of the deep slope grouper, Hāpu`upu`u (Epinephelus quernus) are found in shallow water (Moffitt 1993). Ralston and Williams (1988), however, found that for deep slope species, size was 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. 1993b; 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 Hawaiian Archipelago, Haight et al. (1993a) 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, and through different prey preferences.

<u>Precious Corals</u>

Currently, there are minimal harvests of precious corals in the Western Pacific Region. However in the 1970's to early 1990's 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 maximum sustainable yield (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).

3.3.4 Protected Species

To varying degrees, protected species in the Western Pacific Region face various natural and anthropogenic threats to their continued existence such as 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) believed to be present in the Western Pacific Region.

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 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 (Spotila et al. 1996; Sarti 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, however, 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 cm and front flippers that are proportionately larger than in other sea turtles and 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 the 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 nutritive 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 to 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 re-nesting 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 Suarez1994), in peninsular Malaysia in 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 post-nesting females and genetic analyses of leatherback turtles caught in U.S. Pacific fisheries or stranded on the west coast of the U.S. present 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 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 are comprised of 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).

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 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).

These 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, in the East China Sea and the South China Sea (e.g., Philippines, Taiwan, and 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 numbers of nesting females in almost all of the rookeries are as follows: 1998 - 2,479 nests; 1999 - 2,255 nests; 2000 - 2,589 nests5.

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% per year since the mid-1980s (Heron Island), while the foraging ground population has declined 3% and comprised less than 40 adults by 1992. Researchers attribute the declines to perhaps 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).

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

[5] 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).

coarsely serrated. Adult green turtles have a light to dark brown carapace, sometimes shaded with olive, and can exceed one 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 the rookeries of Michoacán, Mexico females averaged 82 cm in CCL, while males averaged 77 cm 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 green turtles appear to have a nearly exclusively herbivorous diet, consisting primarily of sea grass and algae (Wetherall et al.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, and jellyfish and commensal amphipods comprised 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 green turtles foraging in the northern Sea of Cortez, 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 post hatchlings/juveniles, feeding at or near the ocean surface. The non-breeding range of this species can lead a pelagic existence many miles from shore. The breeding range primarily live 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 km from Michoacán, Mexico. Even though these turtles were found in coastal waters, the species is not confined to these areas, as indicated by 1990 sightings records 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 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, based on morphology and preliminary genetic analysis (NMFS and FWS 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, pers. comm., April 2000).

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 satellite transmitter which was equipped to report thermal preferences of the turtle. This turtle showed a distinct preference for waters that were above 20° (S. Eckert, unpub. 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, the undersides of ledges, and sand bottom areas that are relatively free of strong currents and disturbance from natural predators and humans. In the MHI, these foraging and resting areas for adults usually occur at depths greater than ten meters, but probably not normally exceeding 40 m. Available information indicates that the resting areas are in proximity to the feeding pastures. 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 et al. 1993) and on six small sand islands at French Frigate Shoals, a long atoll situated in the middle of the Hawaiian 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 to 67 percent over the last three generations (~ 150 yrs) (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 Chalolupka 2004; Troeng and Rankin 2005; Chaloupka and Limpus 2001). 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 Hawaiian Archipelago (Northwestern Hawaiian Islands) (Balazs 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 before again increasing rapidly during the late 1990s and up 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 (Bjorndal et al. 2000; Balazs and Chaloupka 2004). Balazs and Chaloupka (2004) conclude 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 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).

Hawksbill Sea Turtles

Hawksbill sea turtles (Eretmochelys imbricate) 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 (NMFS1998). Hawksbills have a relatively unique diet of sponges (Meylan 1985; 1988). While data are somewhat limited on diet in the Pacific, it is well documented in the Caribbean where 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 19-26 minutes at depths of 8-10 m. At night, resting dives ranged from 35-47 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 rapidly approaching extinction primarily due to the harvesting of the species for its meat, eggs and shell, as well as the destruction of nesting habitat by human occupation and disruption. 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). In the Pacific, this species is rapidly approaching extinction primarily due to the harvesting of the species for its meat, eggs, and shell, as well as the destruction of nesting habitat by human occupation and disruption (NMFS 1998).

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 FWS1998d). 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 three 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 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 post-nesting 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, pers. comm., April 2000).

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 sea grass (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 m (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 was not widely sought; its 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.

3.3.4.2 Marine Mammals

Cetaceans listed as endangered under the ESA 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 m. 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). It is not unusual to observe humpback whales during the months of October to May in the nearshore waters off of the island of Oahu. Another northern hemisphere stock of humpbacks uses the northwestern part of the Philippine Sea in winter. Some animals of this stock move south to the Northern Mariana Islands, including Saipan and Guam. Sightings have been reported in Guam in January and February (Reeves et al. 1999). At least six well-defined breeding stocks of humpback whales occur in the southern hemisphere. Humpbacks arrive in American Samoa from the south between June and December (Reeves et al. 1999). This area is probably another calving area and mating ground for the New Zealand group of Antarctic humpbacks.

There is no precise estimate of the worldwide humpback whale population. The humpback whale population in the North Pacific ocean basin is estimated to contain 6,000 to 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, comprising up to 40 percent of its total body length. The current average size for male sperm whales is about 15 m, with females reaching up to 12 m.

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 Hawai'i (Lee 1993). The sounds of sperm whales have been recorded throughout the year off Oahu (Thompson and Freidl 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).

The world population size of sperm whales had been estimated to be approximately two million. 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 size is at least in the hundreds of thousands, if not millions. The status of sperm whales in Hawai'i 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 m, and weights of 160 tons (360,000 lbs) with females usually 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 the high seas. No sightings or strandings of blue whales have been reported in Hawaii, 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). The status of this species 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).

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 towards 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 have only been a few sightings of fin whales in Hawaii waters.

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). The status of fin 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).

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 degrees (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 to1,400 and occurs mainly in the NWHI. The six major reproductive sites are French Frigate Shoals, Laysan Island, Lisianski Island, Pearl and 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 sub-population 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 sub-populations experienced declines. However, during the last decade the number of monk seals increased at Kure Atoll, Midway Atoll and Pearl and Hermes Reef while the sub-populations at Laysan Island and Lisianski Island remained relatively stable. The recent sub-population decline at French Frigate Shoals is thought to have been 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 three percent per year (Forney et al. 2000).

Other Marine Mammals

The following table lists known non-ESA listed marine mammals which occur in the Western Pacific Region.

Table 3: Non-ESA Listed Marine Mammals of the Hawaii Archipelago

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*		

3.3.4.3 Seabirds

Short-tailed Albatross

The short-tailed albatross (*Phoebastria immutabilis*) is the largest seabird in the North Pacific with a wingspan of more than 3 m (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 United States (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, pers. comm. in NMFS 2005), and the Torishima population was estimated to have increased by 9 percent between the 2003-2004 and 2004-2005 seasons (Harrison 2005).

The short-tailed albatross was first listed under the Endangered Foreign Wildlife Act in June 1970. On July 31, 2000, the USFWS 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 land slides, reduced genetic variability, limited breeding distribution, plastics ingestion, contaminants, airplane strikes, and incidental capture in longline fisheries.

<u>Newell's Shearwater</u>

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 Hawaiian 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 size, 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) from 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 enhances 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*.)

3.4 Social Environment

3.4.1 American Samoa

Under the MSA, the islands of American Samoa are recognized as a fishing community. However, American Samoa's history, culture, geography and relationship with the U.S. are vastly different from those of the typical community in the continental U.S. and are closely related to the heritage, traditions and culture of neighboring independent Samoa. The seven islands that comprise American Samoa were ceded in 1900 and 1904 to the United States and governed by the U.S. Navy until 1951, when administration was passed to the U.S.Department of the Interior, which continues to provide technical assistance, represent territorial views to the Federal government and oversee Federal expenditures and operations. American Samoa elected its first governor in 1978 and is represented by a non-voting member of Congress.

Tutuila, American Samoa's largest island, is the center of government and business and is home to 90 percent of the estimated 63,000 total population of the territory. American Samoan natives born in the Territory are classified as U.S. nationals and categorized as native Americans by the U.S. government (TPC/Dept. of Commerce 2000). Population density is about 320 people/km^2 and the annual population growth rate is nearly three percent, with projected population doubling time only 24 years (SPC 2000). The net migration rate from American Samoa was estimated as 3.75 migrants/1,000 population in the year 2000 (CIA World Factbook).

The only U.S. territory south of the equator, American Samoa is considered "unincorporated" because the U.S. Constitution does not apply in full even though it is under U.S. sovereignty (TPC/Dept. of Commerce 2000). American Samoa's vision for the future is not fundamentally different from that of any other people in the U.S. but American Samoa has additional objectives that are related to its covenant with the U.S., its own constitution and its distinctive culture (Territorial Planning Commission/Dept.of Commerce 2000). A central premise of ceding eastern Samoa to the U.S. was to preserve the rights and property of the islands' inhabitants. American Samoa's constitution makes it government policy to protect persons of American Samoan ancestry from the alienation of their lands and the destruction of the Samoan way of life and language. It provides for such protective legislation and encourages business enterprise among persons of American Samoan ancestry (Territorial Planning Commission//Dept. of Commerce 2000).

American Samoa has a small developing economy, dependent mainly on two primary income sources: the American Samoa Government (ASG), which receives income and capital subsidies from the Federal government, and the two fish canneries on Tutuila (BOH 1997). These two primary income sources have given rise to a third: a services sector that derives from and complements the first two. In 1993, the latest year for which the ASG has compiled detailed labor force and employment data, the ASG employed 4,355 persons (32.2 percent of total employment), followed by the two canneries with 3,977 persons (29.4 percent) and the rest of the services economy with 5,211 persons (38.4 percent). As of 2000, there were 17,644 people 16 years and older in the labor force, of whom 16,718, or 95 percent, were employed (American Samoa Census 2000).

A large proportion of the territory's work force is from Western Samoa (now officially called Samoa) (BOH 1997). While it would be true to say that Western Samoans working in the territory are legally alien workers, in fact they are the same people, by culture, history, and family ties.

Statistics on household income indicate that the majority of American Samoans live in poverty according to U.S. income standards. American Samoa has the lowest gross domestic product and highest donor aid per capita among the U.S.-flag Pacific islands (Adams et al. 1999). However, by some regional measures American Samoa is not a poor economy. It's estimated per capita income of $4,357 (Census 2000) is almost twice the average for all Pacific island economies, although it is less than half of the per capita income in Guam, where proximity to Asia has led to development of a large tourism sector. Sixty-one percent of the population in 1999 was at or below poverty level (Census 2000).

From the time of the Deeds of Cession to the present, despite increasing western influences on American Samoa, American Samoans native have expressed a very strong preference for and commitment to the preservation of their traditional matai (chief), aiga (extended family) and communal land system, which provides for social continuity, structure and order. The traditional system is ancient and complex, containing nuances that are not well understood by outsiders (TPC/Dept. of Commerce 2000).

American Samoan dependence on fishing undoubtedly goes back as far as the peopled history of the islands of the Samoan archipelago, about 3,500 years ago (Severance and Franco 1989). Many aspects of the culture have changed in contemporary times but American Samoans have retained a traditional social system that continues to strongly influence and depend upon the culture of fishing. Centered around an extended family (`aiga) and allegiance to a hierarchy of chiefs (matai), this system is rooted in the economics and politics of communally-held village land. It has effectively resisted Euro-American colonial influence and has contributed to a contemporary cultural resiliency unique in the Pacific islands region (Severance et al. 1999).

Traditional American Samoan values still exert a strong influence on when and why people fish, how they distribute their catch and the meaning of fish within the society. When distributed, fish and other resources move through a complex and culturally embedded exchange system that supports the food needs of `aiga, as well as the status of both matai and village ministers (Severance et al. 1999).

The excellent harbor at Pago Pago and certain special provisions of U.S. law form the basis of American Samoa's largest private industry, fish processing, which is now more than forty years old (BOH 1997). The territory is exempt from the Nicholson Act, which prohibits foreign ships from landing their catches in U.S. ports. American Samoan products with less than 50 percent market value from foreign sources enter the United States duty free (Headnote 3(a) of the U.S. Tariff Schedule). The parent companies of American Samoa's fish processing plants enjoy special tax benefits, and wages in the territory are set not by Federal law but by recommendation of a special U.S. Department of Labor committee that reviews economic conditions every two years and establishes minimum wages by industry.

The ASG has estimated that the tuna processing industry directly and indirectly generates about 15 percent of current money wages, 10 to 12 percent of aggregate household income and 7 percent of government receipts in the territory (BOH 1997). On the other hand, both tuna canneries in American Samoa are tied to multinational corporations that supply virtually everything but unskilled labor, shipping services and infrastructure facilities (Schug and Galeai 1987). Even a substantial portion of the raw tuna processed by Star-Kist Samoa is landed by vessels owned by the parent company. The result is that few backward linkages have developed, and the fish-processing facilities exist essentially as industrial enclaves. Furthermore, most of the unskilled labor of the canneries is imported. Up to 90 percent of cannery jobs are filled by foreign nationals from Western Samoa and Tonga. The result is that much of the payroll of the canneries "leaks" out of the territory in the form of overseas remittances.

Harsh working conditions, low wages and long fishing trips have discouraged American Samoans from working on foreign longline vessels delivering tuna to the canneries. American Samoans prefer employment on the U.S. purse seine vessels, but the capital-intensive nature of purse seine operations limits the number of job opportunities for locals in that sector as well. However, the presence of the industrial tuna fishing fleet has had a positive economic effect on the local economy as a whole. Ancillary businesses involved in reprovisioning the fishing fleet generate a significant number of jobs and amount of income for local residents. Fleet expenditures for fuel, provisions and repairs in 1994 were estimated to be between $45 million and $92 million (Hamnett and Pintz 1996).

The tuna processing industry has had a mixed effect on the commercial fishing activities undertaken by American Samoans. The canneries often buy fish from the small-scale domestic longline fleet based in American Samoa, although the quantity of this fish is insignificant compared to cannery deliveries by the U.S. purse seine, U.S. albacore and foreign longline fleets. The ready market provided by the canneries is attractive to the small boat fleet, and virtually all of the albacore caught by the domestic longline fishery is sold to the canneries. Nevertheless, local fishermen have long complained that a portion of the frozen fish landed by foreign longline vessels enters the American Samoa restaurant and home-consumption market, creating an oversupply and depressing the prices for fresh fish sold by local fishermen.

Local fishermen have indicated an interest in participating in the far more lucrative overseas market for fresh fish. To date, however, inadequate shore-side ice and cold storage facilities in

American Samoa and infrequent and expensive air transportation links have been restrictive factors.

Using information obtained from industry sources for a presentation to the American Samoa Legislature (E. Faleomavaega 2002), canning the 3,100 mt of albacore landed in American Samoa by the domestic longline fishery in 2001 is estimated to have generated 75 jobs, $420,000 in wages, $5 million in processing revenue and $1.4 million in direct cannery spending in the local economy. Ancillary businesses associated with the tuna canning industry also contribute significantly to American Samoa's economy. The American Samoa government calculates that the canneries represent, directly and indirectly, from 10 – 12 percent of aggregate household income, 7 percent of government receipts and 20 percent of power sales (Bank of Hawaii Economic Research Dept. 2002).

American Samoa's position in the industry is being eroded by forces at work in the world economy and in the tuna canning industry itself. Whereas wage levels in American Samoa are well below those of the US, they are considerably higher than in other canned tuna production centers around the world. To remain competitive, U.S. tuna producers are purchasing more raw materials, especially pre-cooked loins, from foreign manufacturers. Tax benefits to U.S. canneries operating in American Samoa have also been tempered in recent years by the removal of a provision in the U.S. tax code that previously permitted the tax-free repatriation of corporate income in U.S. territories. Trends in world trade, specifically reductions in tariffs, are reducing the competitive advantage of American Samoa's duty-free access to the U.S. canned tuna market (Territorial Planning Commission/Dept. of Commerce 2000).

Despite the long history of the tuna canning industry in American Samoa, processing and marketing of pelagic fish by local enterprises has not yet developed beyond a few, short-term pilot projects. However, the government's comprehensive economic development strategy (Territorial Planning Commission/Dept. of Commerce 2000) places a high priority on establishing a private sector fish processing and export operation proposed to be located at the Tafuna Industrial Park.

3.4.2 CNMI

The CNMI consists of 14 islands, five of which are inhabited, with a total land area of 176.5 square miles spread over about 264,000 square miles of ocean. The Northern Mariana Islands became part of the Pacific Trust Territory administered by the United States under a mandate granted in 1947. The Covenant that created the Commonwealth and attached it to the United States was fully implemented in 1986, pursuant to a Presidential Proclamation that terminated the Trust Territory of the Pacific Islands as it applied to the Northern Mariana Islands.

Fishery resources have played a central role in shaping the social, cultural and economic fabric of the CNMI. The aboriginal peoples indigenous to these islands relied on seafood as their principal source of protein and developed exceptional fishing skills. Later immigrants to the islands from East and Southeast Asia also possessed a strong fishing tradition. Under the MSA, the CNMI is defined as a fishing community.

Per capita income in the CNMI in 1999 was $9,151. The median household income for the CNMI as whole was $22,898. For Saipan, the median household income was $19,698 in the first quarter of 1999, as compared to $21,457 in 1990. The Commonwealth had an unemployment rate in 1999 of 5.5 percent. Forty-six percent of the CNMI population was at or below poverty in 1999 (Census 2000).

In 2000, CNMI had 20,378 men ages 16 and over in the labor force, of whom 96 percent or 19,458 were employed. There were 24,093 women ages 16 and over in the labor force, of whom 97 percent were employed (CNMI 2000 Census). The economy of the CNMI has historically benefited substantially from financial assistance from the United States, but in recent years this assistance has declined as locally generated government revenues have grown. Between 1988 and 1996, tourism was the commonwealth's largest income source. During that period tourist traffic to the CNMI tripled from 245,505 to 736,117 (BOH 1999c). Total tourist expenditures in the CNMI were estimated to be a record $587 million in 1996. In 1997 and 1998, however, the loss of air service between the CNMI and Korea, together with the impact of the Asian financial crisis on both Korean and Japanese travelers, caused tourist arrivals in the CNMI to drop by one-third (BOH 1999c).

More recently garment production has been an important industry, with shipments of $1 billion to the United States under duty and quota exemptions during 1999 (BOH 1999c). The garment industry is credited with preventing an economic depression in the Commonwealth following the decline of its tourist industry, but the future of the CNMI's garment manufacturers is uncertain. When the Commonwealth was created it was granted an exemption from certain U.S. immigration, naturalization and labor laws. These economic advantages are now a matter of national political debate centered on what some regard as unfair labor practices in the CNMI's garment industry. The two main advantages for manufacturing garments in the CNMI are low-cost foreign labor and duty-free sale in the United States. The controversy over labor practices in the CNMI may cause the Commonwealth to lose these unique advantages, forcing garment-makers to seek alternative low-cost production sites. The end of the quota on foreign textiles in 2005 may cause garment manufacturers to move to China, which has some competitive advantages (Bank of Hawaii 2004).

In the early 1980s, U.S. purse seine vessels established a transshipment operation at Tinian Harbor. The CNMI is exempt from the Jones Act, which requires the use of U.S.-flag and U.S built vessels to carry cargo between U.S. ports. The U.S. purse seiners took advantage of this exemption by offloading their catch at Tinian onto foreign vessels for shipment to tuna canneries in American Samoa. In 1991, a second type of tuna transshipment operation was established on Saipan (Hamnett and Pintz 1996). This operation transships fresh tuna caught in the Federated States of Micronesia from air freighters to wide-body jets bound for Japan. The volume of fish flown into and out of Saipan is substantial, but the contribution of this operation to the local economy is minimal (Hamnett and Pintz 1996).

With the exception of the purse seine support base on Tinian (now defunct), the CNMI has never had a large infrastructure dedicated to commercial fishing. The majority of boats in the local fishing fleet are small, outboard engine-powered vessels. Between 1994-1998, the annual ex-vessel value of commercial landings of bottomfish and pelagic species has averaged about

$473,900, which bottomfish accounts for about 28 percent of the total revenues (WPFMC 1999). Existing planning data for the CNMI are not suited to examining the direct and indirect contributions attributed to various inter-industry linkages in the economy. It is apparent, however, that fishing by the local small-boat fleet represents only a small fraction of the economic activity in the commonwealth.

3.4.3 Guam

Under the MSA, Guam is designated as fishing community. However, Guam's history, culture, geography and relationship with the U.S. are also vastly different from those of the typical fishing community in the continental U.S.

The island of Guam was ceded to the United States following the Spanish American War of 1898 and has been an unincorporated territory since 1949. The main income sources on Guam include tourism, national defense, and trade and services. Per capita income in Guam was $12,722 in 1999, up from $10,152 in 1991. Median household income was $39,317 in 1999, up from $31,118 in 1991. Twenty-three percent of the population in 1999 was at or below poverty level (Guam Census 2000).

The Guam Department of Labor estimated the number of employees on payroll to be 64,230 in 1998, a decrease of 3.8 percent from the 1997 figure. Of the 64,230 employees, 44,780 were in the private sector and 19,450 were in the public sector. The Federal government employs 7.6 percent of the total work force, while the Government of Guam employs 22.7 percent. Guam had an unemployment rate of 15.2 percent in 1999. As of 2000, Guam had 39,143 men age 16 and over in the labor force, of whom 81 percent were employed. There were 29,751 women age 16 and over in the labor force, of which 86 percent were employed (Guam Census 2000).

The major economic factor in Guam for most of the latter part of the twentieth century was the large-scale presence of the U.S. military (BOH 1999b). In the 1990s, however, the military's contribution to Guam's economy has waned and been largely replaced by Asian tourism. Guam's macro-economic situation exhibited considerable growth between 1988 and 1993 as a result of rapid expansion of the tourist industry. In fact, Guam's economy has become so dependent on tourists from Asia, particularly Japan, that any significant economic, financial and foreign exchange development in the region has had an immediate impact on the territory (BOH 1999b). During the mid- to late-1990s, as Japan experienced a period of economic stagnation and cautious consumer spending, the impact was felt just as much in Guam as in Japan. Visitor arrivals in Guam dropped 17.7 percent in 1998. Despite recent efforts to expand the tourist market, Guam's economy remains dependent on Japanese tourists.

The Government of Guam has been a major employer on Guam for many years. However, recent deficits have resulted from a steady rise in government spending at the same time that tax bases have not kept up with spending demands. Many senior government workers have been offered and have accepted early retirement to reduce the payroll burden.

In the 1990s, after three decades of troop reductions, the military presence on the island diminished to the lowest level in decades, but with the post-9/11 emphasis on homeland security, the war in Iraq, and repositioning of military assets from Asia and the mainland U.S., military spending on Guam has rebounded significantly, and the effects have been felt throughout the economy including in employment and housing prices (Los Angeles Times, July 25, 2004).

Over the centuries of acculturation beginning with the Spanish conquest in the late 17^{th} century, many elements of traditional Chamorro culture in Guam were lost. But certain traditional values, attitudes and customs were retained to become a part of contemporary life. Amesbury and Hunter-Anderson et al. (1989:48) note that the practice of sharing one's fish catch with relatives and friends during Christian holidays is rooted in traditional Chamorro culture:

> *A strongly enduring cultural dimension related to offshore fishing is the high value placed on sharing of the catch, and the importance of gifts of fish to relatives and friends.*

Based on creel surveys of fishermen, only about one-quarter to one-third of the inshore catch is sold. The remainder enters non-commercial channels (Knudson 1987). Reef and bottomfish continue to be important for social obligations, such as fiestas and food exchange with friends and families. One study found a preference for inshore fish species in non-commercial exchanges of food (Amesbury and Hunter-Anderson 1989).

The social obligation to share one's fish catch extends to part-time and full-time commercial fishermen. Such gifts are often reef fish or shallow-water bottomfish (Amesbury and Hunter-Anderson 1989). Even when fish are purchased informally by friends, neighbors or relatives of the fisherman, the very personal marketing tends to restrain the price asked (WPRFMC 2003a).

Domestic fishing on Guam supplements family subsistence, which is gained by a combination of small scale gardening, ranching and wage work (Amesbury and Hunter-Anderson 1989). The availability of economic activities such as part-time fishing is among the major reasons that Guam has not experienced more social problems during times of economic hardship and increasing unemployment. The subsistence component of the local economy has gained significance in recent years with the downturn in Guam's major industries and increasing unemployment.

Fishing in Guam continues to be important not only in terms of contributing to the subsistence needs of the Chamorro people but also in terms of preserving their history and identity. Fishing assists in perpetuating traditional knowledge of marine resources and maritime heritage of the Chamorro culture.

The importance of commercial fishing in Guam lies mainly in the territory's status as a major regional fish transshipment center and re-supply base for domestic and foreign tuna fishing fleets. Among Guam's advantages as a home port are well-developed and highly efficient port facilities in Apra Harbor; an availability of relatively low-cost vessel fuel; a well-established marine supply/repair industry; and recreational amenities for crew shore leave (Hamnett and Pintz 1996). In addition, the territory is exempt from the Nicholson Act, which prohibits foreign ships from landing their catches in U.S. ports. Initially, the majority of vessels calling in Apra

Harbor to discharge frozen tuna for transshipment were Japanese purse seine boats and carrier vessels. Later, a fleet of U.S. purse seine vessels relocated to Guam, and since the late 1980s, Guam has become an important port for Japanese and Taiwanese longline fleets. The presence of the longline and purse seine vessels has created a demand for a range of provisioning, vessel maintenance and gear repair services.

By the early 1990s, an air transshipment operation was also established on Guam. Fresh tuna is flown into Guam from the Federated States of Micronesia and elsewhere on air cargo planes and out of Guam to the Japanese market on wide-body passenger planes (Hamnett and Pintz 1996). A second air transshipment operation that began in the mid-1990s is transporting to Europe fish that do not meet Japanese sashimi market standards.

Guam is an important re-supply and transshipment center for the international tuna longline fleet in the Pacific. However, the future of home port and transshipment operations in Guam depends on the island's ability to compete with neighboring countries that are seeking to attract the highly mobile longline fleet to their own ports. Trends in the number of port calls made in Guam by various fishing fleets reflect the volatility of the industry. The number of vessels operating out of Guam decreased by almost half from 1996 to 1997, and further declined in 1998 (Hamnett and Anderson 2000).

The Guam Department of Commerce reported that fleet expenditures in Guam in1998 were about $68 million, and a 1994 study estimated that the home port and transshipment industry employed about 130 people (Hamnett and Pintz 1996). This industry constitutes an insignificant percentage of the gross island product, which was about $2.99 billion in 1996, and is of minor economic importance in comparison to the tourist or defense industries (Hamnett and Anderson 2000). Nevertheless, home port and transshipment operations make an important contribution to the diversification of Guam's economy (Hamnett and Pintz 1996). As a result of fluctuations in the tourism industry and cuts in military expenditures in Guam, the importance of economic diversification has increased.

3.4.4 Hawaii

Income generation in Hawaii is characterized by tourism, Federal defense spending and, to a lesser extent, agriculture. Tourism is by far the leading industry in Hawaii in terms of generating jobs and contributing to gross state product. The World Travel and Tourism Council (1999) estimates that tourism in Hawaii directly generated 134,300 jobs in 1999. This figure represents 22.6 percent of the total workforce.

For 2002, DBEDT estimates that direct and indirect visitor contribution to the state economy was 22.3 percent. A bit less than half of that (10.2 percent) was generated in Waikiki. Total visitor expenditures in Hawaii were $9,993,775,000. Tourism's direct and indirect contribution to Hawaii's Gross State Product in 2002 was estimated at $7,974,000,000, or 17.3 percent of the total. Directly and indirectly, tourism accounted for 22.3 percent of all civilian jobs, and 26.4 percent of all local and state taxes.

Also important to Hawaii's economy are Department of Defense expenditures. Defense expenditures in Hawaii are expected to increase significantly in the near future due to the pending arrival of the Stryker force and the renovation and construction of military housing. As of late July 2004, Hawaii expected to receive $496.7 million in defense-related spending. When combined with funds earmarked for construction that are contained in a measure before the Senate, Hawaii stands to receive more than $865 million in defense dollars, which do not include funds for day to day operations or payroll (Inouye 2004).

Agricultural products include sugarcane, pineapples, nursery stock, livestock, and macadamia nuts. In 2002, agriculture generated a total of $510,672,000 in sales. Agricultural employment decreased from 7,850 workers in 2000 to 6,850 in 2003.

Table 4: Statistical Summary of Hawaii's Economy, 1995-1999, 2002
(source: DBEDT 1999, 2002; BOH 1999a)

CATEGORY	UNITS	1995	1996	1997	1998	1999	2002
Civilian Labor Force	Number	576400	590200	592000	595000	594800	582200
Unemployment	Percent	5.9	6.4	6.4	6.2	5.6	4.2
Gross state product in 1996 dollars	$ Millions	37963	37517	37996	38015	38047	38,839 (2001)
Manufacturing Sales	$ Millions	2045	1724.1	1468.8	NA	NA	NA
Agriculture (all crops and livestock)	$ Millions	492.7	494.6	486.5	492.6	512992	510672
Construction completed	$ Millions	3153.3	3196.4	2864.9	NA	NA	NA
Retail sales	$ Millions	15693.3	16565	16426	NA	NA	NA
Defense expenditures	$ Millions	3782.5	3883.5	4074.9	4103.7	4174.2	4293459

Median household income in Hawaii was calculated to be $30,040, or 97 percent of the national average in 2002. Hawaii per capita income as a percentage of the national average has fallen steadily since 1970 (DBEDT 2003). In 1999, 8 percent of Hawaii's families were below poverty level, compared to 9 percent nationally according to the 2000 Census. Civilian employment decreased from 411,250 in 1991 to 396,050 in 2002, which is a decrease from a 98 percent employment rate to a 96 percent rate.

For several decades Hawaii benefited from the strength of regional economies around the Pacific that supported the state's dominant economic sector and principal source of external receipts – tourism (BOH 1999a). In addition, industries of long-standing importance in Hawaii, such as the Federal military sector and plantation agriculture, also experienced significant growth. However, Hawaii's economic situation changed dramatically in the 1990s. The state's main tourist market, Japan, entered a long period of economic malaise that caused the tourism industry in Hawaii to stagnate. The post-Cold War era brought military downsizing. Tens of thousands of acres of plantation lands, along with downstream processing facilities, were idled by the end of the decade due to high production costs. Employment in Hawaii sugar production fell by 20 percent between 1990 and 1993 and by an additional 50 percent from 1994 to 1995 (Yuen et al. 1997). Net out-migration became the norm in Hawaii, notwithstanding the state's appeal as a place to live. In 1998, the state-wide unemployment rate was 6.2 percent, and unemployment on the island of Molokai reached 15 percent (DBEDT 1999).

As a consequence of the economic upheaval of the 1990s and the extensive bankruptcies, foreclosures and unemployment, Hawaii did not enter the period of economic prosperity that many U.S. mainland states experienced. Between 1998 and 2000, Hawaii's tourism industry recovered substantially, mainly because the strength of the national economy promoted growth in visitor arrivals from the continental U.S. (Brewbaker 2000).

By 2002, an improving economy resulted in a statewide unemployment rate of 4.4%, with Molokai down to 8.6 percent (DBEDT 2003). Despite downswings in tourism in the last few years due to the events of September 11, 2001, the SARS scare, Japanese economic issues, and world political conditions, tourism in Hawaii is improving to the point that there were fears that there would not be enough hotel rooms to accommodate all the Japanese tourists who wanted to come for O Bon season in August 2004 (Schafers 2004).

However, efforts to diversify the economy and thereby make it less vulnerable to future economic downturns have met with little success. To date, economic development initiatives such as promoting Hawaii as a center for high-tech industry have attracted few investors and it seems unlikely that any new major industry will develop in Hawaii in the near future to significantly increase employment opportunities and broaden the state's economy beyond tourism, the military, and construction.

The most recent estimate of the contribution of the commercial, charter and recreational fishing sectors to the state economy indicated that in 1992, these sectors contributed $118.79 million of output (production) and $34.29 million of household income and employed 1,469 people (Sharma et al. 1999). These contributions accounted for 0.25 percent of total state output ($47.4 billion), 0.17 percent of household income ($20.2 billion) and 0.19 percent of employment (757,132 jobs). In contrast to the sharp decline in some traditional mainstays of Hawaii's economy such as large-scale agriculture the fishing industry has been fairly stable during the past decade. Total revenues in Hawaii's pelagic, bottomfish and lobster fisheries in 1998 were about 10 percent higher than 1988 revenues (adjusted for inflation) in those fisheries.

The Hawaii longline fishery is by far the most economically important fishery in Hawaii, accounting for 77 percent of the estimated ex-vessel value of the total commercial fish landings in the state in 2003 (WPRFMC 2004).

3.4.5 Pacific Remote Island Areas

The Pacific Remote Island Areas (PRIAs) of Howland, Baker, Jarvis, Kingman Reef, and Palmyra have been basically unoccupied for all of modern times, while Midway Atoll, Johnston Atoll, and Wake Island have had varying levels of military populations for most of the 20^{th} century.

CHAPTER 4: DESCRIPTION OF PACIFIC PELAGIC FISHERIES

4.1 Introduction

Chapter 3 describes the environment and resources included within the Pelagic FEP. This chapter describes the pelagic fisheries of the Western Pacific Region and provides background on the history of fishing by the residents of the area, including information on catches, landings and bycatch. For more information please see the Council's annual reports.

4.2 American Samoa-based Pelagic Fisheries

The harvest of pelagic fish has been a part of the way of life in the Samoan archipelago since the islands were first settled some 3,500 years ago (Severance and Franco, 1989). Subsistence fishing continues to the present but the importance of pelagic fisheries as a source of income and employment is increasing. Commercial ventures are diverse, ranging from small-scale vessels having very limited range to large-scale vessels catching tuna in the EEZ and distant waters and delivering their catches to canneries based in American Samoa. Total pelagic landings by American Samoa-based longline, troll, and handline vessels were approximately 11 million pounds in 2003 (Figure 11) with longline landings comprising nearly 99% of this total (WPFMC 2004). During 2003, nearly 90% of these longline landings were albacore, with yellowfin, bigeye and skipjack tuna making up the majority of the remainder (WPFMC 2004).

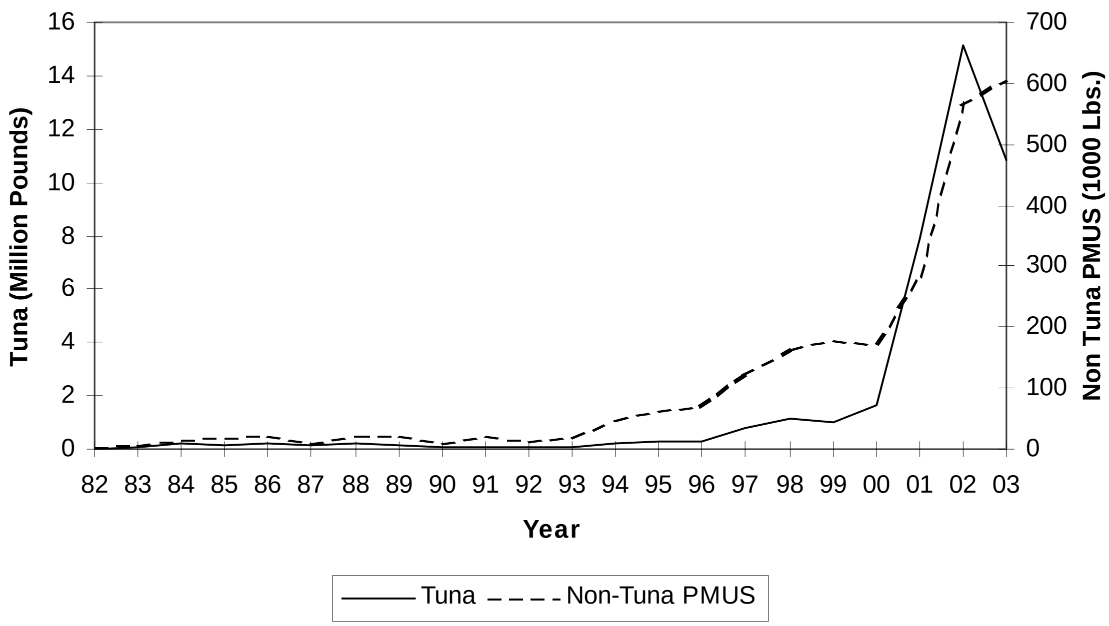

Figure 11: Tuna and Non-Tuna PMUS Landings in American Samoa 1982-2003
(source: WPRFMC 2004)

Small-scale longline: Most participants in the small-scale domestic longline fishery are indigenous American Samoans with vessels under 50 ft in length, most of which are alia boats under 40 ft in length. The stimulus for American Samoa's commercial fishermen to shift from troll or handline gear to longline gear in the mid-1990s (see Figure 11) was the fishing success of 28' alia catamarans that engaged in longline fishing in the EEZ around Independent Samoa. Following this example, the fishermen in American Samoa deploy a short monofilament longline, with an average of 350 hooks per set, from a hand-powered reel (WPRFMC, 2000). An estimated 90 percent of the crews working in the American Samoa small-scale alia longline fleet are believed to be from Independent Samoa. The predominant catch is albacore tuna, which is marketed to the local tuna canneries (DMWR, 2001b).

Large-scale longline**:** American Samoa's domestic longline fishery expanded rapidly in 2001. Much of the recent (and anticipated future) growth is due to the entry of monohull vessels larger than 50 ft in length. The number of permitted longline vessels in this sector increased from three in 2000 to 30 by March 21, 2002 (DMWR, unpub. data). Of these, five permits (33 percent of the vessel size class) for vessels between 50.1 ft - 70 ft and five permits (33 percent of the vessel size class) for vessels larger than 70 ft were believed to be held by indigenous American Samoans as of March 21, 2002 (T. Beeching, DMWR, pers. comm to P. Bartram, March 2002). Economic barriers have prevented more substantial indigenous participation in the large-scale sector of the longline fishery. To date, lack of capital appears to be the primary constraint to substantial indigenous participation in this sector (DMWR, 2001b).

While the smallest (less than or equal to 40 ft) vessels average 350 hooks per set, a vessel over 50 ft can set 5-6 times more hooks and has a greater fishing range and capacity for storing fish (8-40 mt as compared to 0.5-2 mt on a small-scale vessel). Larger vessels are also outfitted with hydraulically-powered reels to set and haul mainline, and modern electronic equipment for navigation, communications and fish finding. Most are presently being operated to freeze albacore onboard, rather than to land chilled fish. Three vessels that left Hawaii after the swordfish longline fishery closure are operating in the American Samoa tuna longline fishery under new ownership. It does not appear that large numbers of longliners from Hawaii are relocated in American Samoa. Instead, large vessels have participated in the American Samoa longline fishery from diverse ports and fisheries, including the US west coast (6), Gulf of Mexico (3), and foreign countries (4 now under US ownership) (O'Malley and Pooley, 2002).

Distant-water purse seine fishery: The US purse seine fleet operating in the central and western Pacific uses large nets to capture skipjack, yellowfin and bigeye tuna near the ocean surface, in free-swimming schools and around fish aggregation devices (FADs) deployed by the fleet. These vessels often land their catches at canneries based in American Samoa. These large vessels (200-250 ft length) could not be economically operated for longline fishing but some former participants in the US purse seine fishery have acquired more suitable vessels and participated in the American Samoa-based longline fishery.

Distant-water jig albacore fishery: Domestic albacore jig vessels also supply tuna to the canneries in American Samoa. Since 1985, about 50-60 US vessels have participated in the high-seas troll fishery for albacore. This fishery occurs seasonally (December through April) in international waters at 35°-40° S latitude. The vessels range in length from 50 to 120 feet, with the average length about 75 feet (Heikkila, 2001). They operate with crews of 3-5 and are capable of freezing 45-90 tons of fish (WPRFMC, 2000).

Troll and handline fishery: From October 1985 to the present, catch and effort data in American Samoa fisheries have been collected through a creel survey that includes subsistence and recreational fishing, as well as commercial fishing. However, differentiating commercial troll fishing activity from non-commercial activity can be difficult.

Recreational fishing purely for sport or pleasure is uncommon in American Samoa. Most fishermen normally harvest pelagic species for subsistence or commercial sale. However tournament fishing for pelagic species began in American Samoa in the 1980s, and between 1974 and 1998, a total of 64 fishing tournaments were held in American Samoa (Tulafono, 2001). Most of the boats that participated were alia catamarans and small skiffs. Catches from tournaments are often sold, as most of the entrants are local small-scale commercial fishermen. In 1996, three days of tournament fishing contributed about one percent of the total domestic landings. Typically, 7 to 14 local boats carrying 55 to 70 fishermen participated in each tournament, which were held 2 to 5 times per year (Craig et al. 1993).

The majority of tournament participants have operated 28-foot alia, the same vessels that engage in the small-scale longline fishery. With more emphasis on commercial longline fishing since 1996, interest in the tournaments has waned (Tulafono, 2001) and pelagic fishing effort has shifted markedly from trolling to longline (see Figure 12). Catch and release recreational fishing is virtually unknown in American Samoa. Landing fish to meet cultural obligations is so important that releasing fish would generally be considered a failure to meet these obligations (Tulafono, 2001). Nevertheless, some pelagic fishermen who fish for subsistence release fish that are surplus to their subsistence needs (S. Steffany, pers. comm. to Paul Bartram, Sept. 15, 2001).

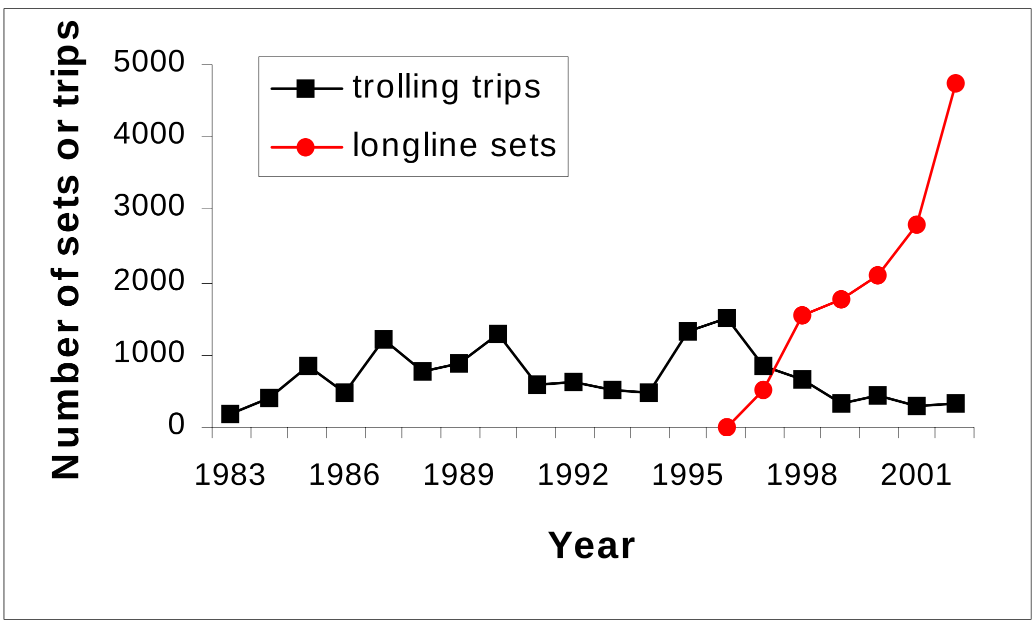

Figure 12: Distribution of Pelagic Effort Between Trolling and Longlining in American Samoa
(Source: WPRFMC in prep)

American Samoa has been unable to develop a significant tourist industry that could support charter fishing (Territorial Planning Commission/Dept. of Commerce, 2000). Nor is American Samoa known for producing large game fish. Few, if any, charter boats are in operation (Tulafono 2001), so no data are collected specifically for the charter fishing sector.

4.3 CNMI-based Pelagic Fisheries

The CNMI's pelagic fisheries occur primarily from the island of Farallon de Medinilla south to the island of Rota. Trolling is the primary fishing method utilized in the pelagic fishery. The pelagic fishing fleet consists primarily of vessels less than 24 ft in length which usually have a limited 20-mile travel radius from Saipan.

The primary target and most marketable species for the pelagic fleet is skipjack tuna (67% of 2004 commercial landings). Yellowfin tuna and mahimahi are also easily marketable species but are seasonal. During their runs, these fish are usually found close to shore and provide easy targets for the local fishermen. In addition to the economic advantages of being near shore and their relative ease of capture, these species are widely accepted by all ethnic groups which has kept market demand fairly high. Figure 13 presents historical data on pelagic landings in CNMI. It is estimated that in 2004, 68 fishery participants made 235,382 lbs of commercial landings of pelagic species with a total ex-vessel value of $466,490 (WPRFMC 2005b).

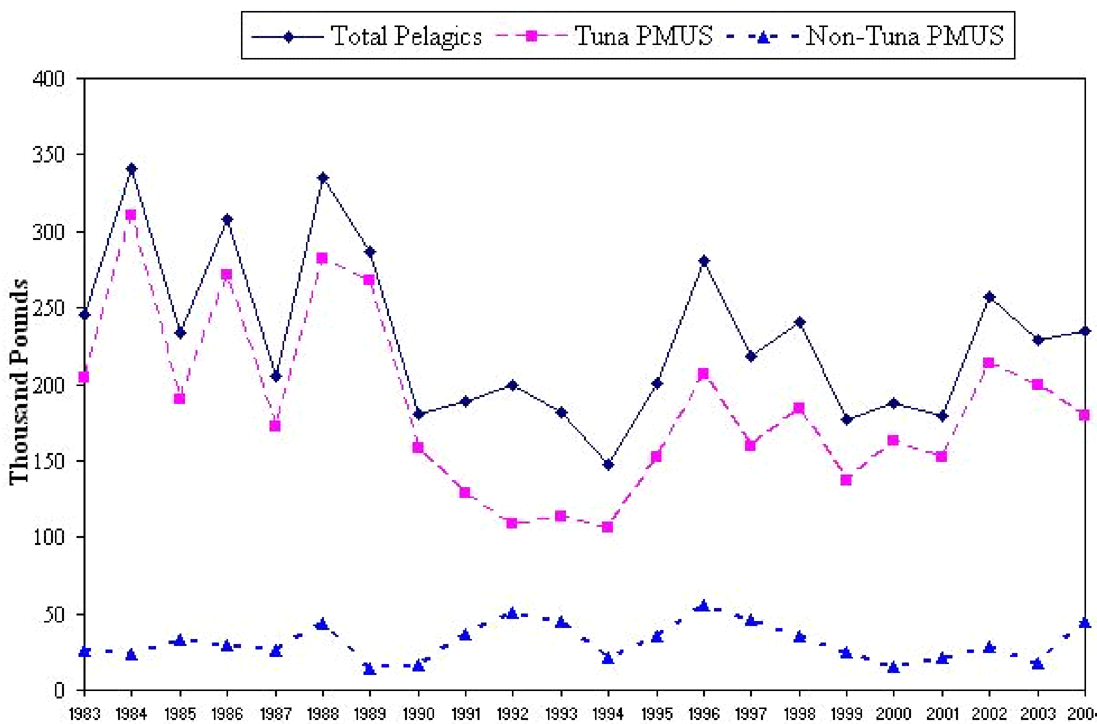

Figure 13: Pelagic Landings in CNMI 1983-2004
(Source: CNMI DLNR-DFW)

4.4 Guam-based Pelagic Fisheries

Guam's pelagic fisheries consist of primarily small, recreational, trolling boats that are either towed to boat launch sites or berthed in marinas and fish only within local waters, either within EEZ waters around Guam or on some occasions in the adjacent EEZ waters around the Northern Mariana Islands.

Domestic annual pelagic landings in Guam have varied widely, ranging between 322,000 and 937,000 lbs in the 23-year time series. The 2004 total pelagic landings were approximately 691,366 lbs, an increase of 36% compared with 2003. Of this total, it is estimated that 285,545 lbs were sold for a total ex-vessel revenue of $433,911 (WPRFMC 2005).

Landings consisted primarily of five major species: mahimahi (*Coryphaena hippurus*), wahoo (*Acanthocybium solandri*), bonita or skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*), and Pacific blue marlin (*Makaira mazara*). Other minor pelagic species caught include rainbow runner (*Elagatis bipinnulatus*), great barracuda (*Sphyraena barracuda*), kawakawa (*Euthynnus affinis*), dogtooth tuna (*Gymnosarda unicolor*), double-lined mackerel *(Grammatorcynus bilineatus*), oilfish (*Ruvettus pretiosus*), and three less common species of barracuda. Sailfish and sharks were also known to be caught during 2004 but these species were not encountered during offshore creel surveys.

There are wide year-to-year fluctuations in the estimated landings of the five major species. 2004 mahimahi catch increased more than 134% from 2003, and reached the highest level since 1998. Wahoo catch totals increased 83% from 2003, and were the sixth highest total during the 23 year recording period. Pacific blue marlin landings decreased 28% from 2003, and were 24% below the 23 year average. Supertyphoon Pongsona's direct hit on Guam in December 2002 and subsequent negative impact on fishing during the first quarter of 2003 probably account for the low numbers of mahimahi caught during 2003. Participation and effort generally increased in 2004 with the number of trolling boats up by eight percent (WPRFMC 2005).

The number of boats involved in Guam's pelagic or open ocean fishery gradually increased from 193 in 1983 to 469 in 1998. This number decreased until 2001, but then began increasing, and has been increasing since. There were 401 boats active in Guam's domestic pelagic fishery in 2004. A majority of the fishing boats are less than 10 meters (33 feet) in length and are usually owner-operated by fishermen who earn a living outside of fishing. Most fishermen sell a portion of their catch at one time or another and it is difficult to make a distinction between recreational, subsistence, and commercial fishers. A small, but significant, segment of Guam's pelagic fishery is made up of marina-berthed charter boats that are operated primarily by full-time captains and crews. These operations were responsible for 22 percent of all domestic pelagic fishing trips from Guam in 2004 (WPRFMC 2005). Figure 14 provides the estimated annual total domestic pelagics catch in Guam.

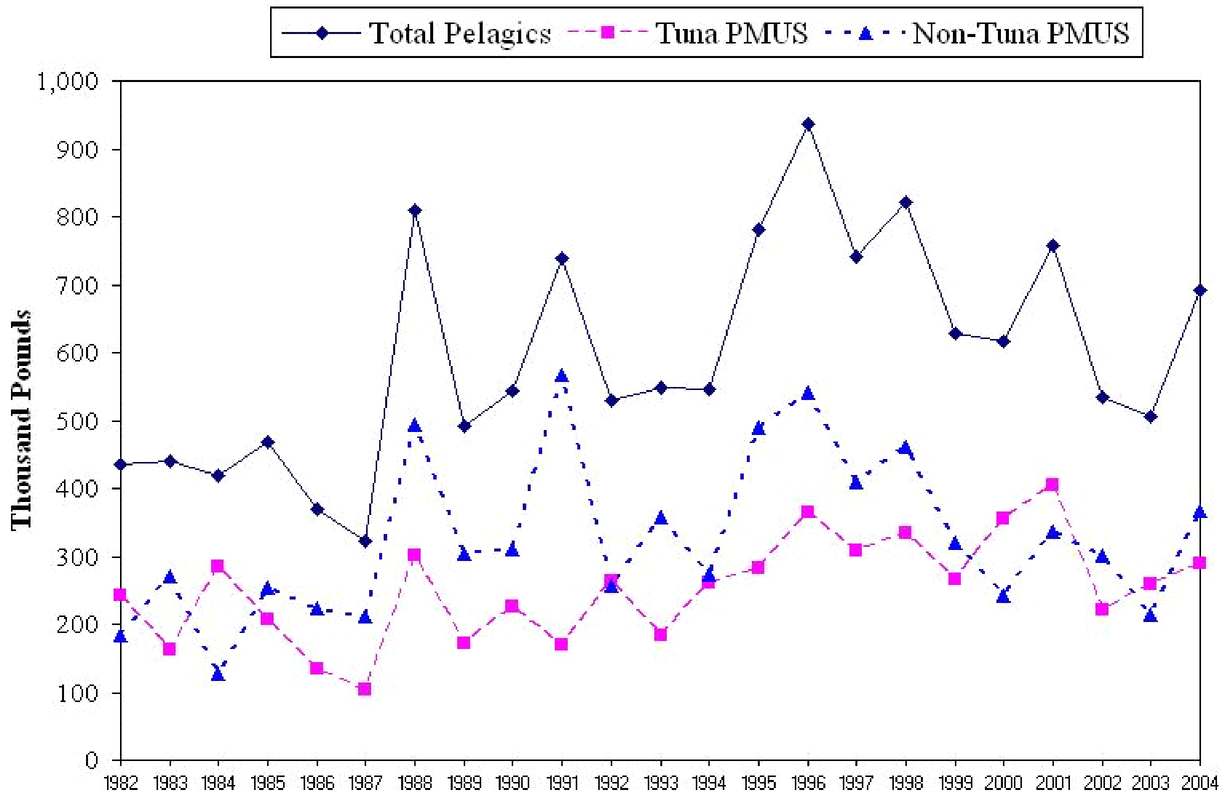

Figure 14: Estimated Annual Total Domestic Pelagics Catch in Guam 1982-2004
(source: WPFMC 2004)

4.5 Hawaii-based Pelagic Fisheries

Hawaii's pelagic fisheries, which include the longline, Main Hawaiian Islands troll and handline, offshore handline, and the aku boat (pole and line) fisheries; are the state's largest and most valuable fishery sector. The target species are tunas and billfish, but a variety of other species are also important. Collectively, these pelagic fisheries made approximately 23 million lbs of commercial landings with a total ex-vessel value of $48 million in 2003 (WPFMC 2003).

The largest component of pelagic catch in 2003 was tunas. Bigeye tuna was the largest component and has increased almost five-fold from its 1987 catch. Swordfish was the largest component of the billfish catch from 1990 through 2000, but was replaced by blue marlin in the next two years, and followed by striped marlin in 2003. Mahimahi was the largest component of the non-tuna and non-billfish catch though ono (wahoo) and moonfish catches rose to comparable levels.

Table 5: Hawaii Commercial Pelagic Catch, Revenue, and Average Price 2002-2003 (source: WPFMC 2003 Report)

	2002			2003		
Species	**Pounds caught (1000 lbs)**	**Ex-vessel revenue ($1000)**	**Average price ($/lb)**	**Pounds caught (1000 lbs)**	**Ex-vessel revenue ($1000)**	**Average price ($/lb)**
Tuna PMUS						
Albacore	1,670	$1,930	$1.17	1,340	$1,560	$1.16
Bigeye tuna	10,970	$28,480	$2.68	8,350	$25,780	$3.12
Bluefin tuna	2	$4	$8.22	1	$5	$9.64
Skipjack tuna	1,160	$1,210	$1.27	1,580	$1,330	$1.00
Yellowfin tuna	2,680	$5,960	$2.27	3,420	$8,620	$2.52
Other tunas	10	$9	$1.01	10	$4	$1.02
Tuna PMUS subtotal	**16,500**	**$37,600**	**$2.37**	**14,700**	**$37,300**	**$2.60**
Billfish PMUS						
Swordfish	720	$1,380	$1.96	320	$690	$2.22
Blue marlin	1,040	$1,020	$1.17	1,160	$820	$0.86
Striped marlin	610	$980	$1.60	1,370	$1,160	$0.84
Other marlins	390	$290	$0.88	580	$270	$0.52
Billfish PMUS subtotal	**2,800**	**$3,700**	**$1.45**	**3,400**	**$2,900**	**$0.93**
Other PMUS						
Mahimahi	1,420	$2,620	$1.91	1,340	$2,910	$2.22
Ono (wahoo)	690	$1,450	$2.20	1,000	$1,900	$1.94
Opah (moonfish)	920	$1,220	$1.34	1,090	$1,510	$1.38
Pomfrets	500	$680	$1.38	460	$780	$1.69
Oilfish	200	$290	$1.43	280	$420	$1.50
Sharks (whole weight)	350	$110	$0.41	340	$110	$0.37
Other pelagics	20	$10	$0.85	20	$20	$0.88
Other PMUS subtotal	**4,100**	**$6,400**	**$1.63**	**4,500**	**$7,700**	**$1.72**
Total pelagics	**23,400**	**$47,700**	**$2.14**	**22,600**	**$47,900**	**$2.18**

4.6 PRIA-based Pelagic Fisheries

There are no known pelagic fisheries based in the PRIA.

4.7 Fishing Communities

Each of the inhabited Hawaiian Islands (Niihau, Kauai, Oahu, Maui, Molokai, Lanai and Hawaii) has been defined as a fishing community under the MSA. Also defined as fishing communities are the American Samoa islands, Guam, and the Commonwealth of the Northern Mariana Islands. For further information on these areas and communities, please see the Council's demersal FEPs.

CHAPTER 5 HAWAIIAN ISLANDS FISHERY ECOSYSTEM PLAN MANAGEMENT PROGRAM

5.1 Introduction

This chapter describes the Council's management program for pelagic fisheries of the Western Pacific Region. A description of the management measures intended to meet the objectives of the FEP, prevent overfishing, and achieve optimum yield are provided, as well as the criteria used to assess the status of managed stocks.

5.2 Permits and Reporting Requirements

All U.S. vessels must be registered for use under a valid Hawaii longline limited access permit if that vessel is used to fish for Pacific pelagic MUS using longline gear in the EEZ around the Hawaiian Archipelago; or to land or transship, shoreward of the outer boundary of the EEZ around the Hawaiian Archipelago, Pacific pelagic MUS that were harvested using longline gear. Also, any vessel that is going to fish on the high seas must be registered for use with a valid permit under the High Seas Fishing Compliance Act.

All U.S. vessels must be registered for use under a valid American Samoa longline limited access permit if that vessel is used to fish for Pacific pelagic MUS using longline gear in the EEZ around American Samoa; or to land shoreward of the outer boundary of the EEZ around American Samoa Pacific pelagic MUS that were harvested using longline gear in the EEZ around American Samoa; or to transship shoreward of the outer boundary of the EEZ around American Samoa Pacific pelagic MUS that were harvested using longline gear in the EEZ around American Samoa or on the high seas.

All U.S. vessels must be registered for use under a valid Western Pacific general longline permit, American Samoa longline limited access permit, or Hawaii longline limited access permit if that vessel is used to fish for Pacific pelagic MUS using longline gear in the EEZ around Guam, the Northern Mariana Islands, or the Pacific remote island areas (with the exception of Midway Atoll); or to land or transship shoreward of the outer boundary of the EEZ around Guam, the Northern Mariana Islands, or the Pacific remote island areas (with the exception of Midway Atoll), Pacific pelagic MUS that were harvested using longline gear.

A receiving vessel of the U. S. must be registered for use with a valid receiving vessel permit if that vessel is used to land or transship, within the Western Pacific Fishery Management Area, Pacific pelagic MUS that were harvested using longline gear.

All U.S. vessels must be registered for use with a valid PRIA pelagic troll and handline fishing permit if that vessel is used to fish for Pacific pelagic MUS using pelagic handline or trolling fishing methods in the EEZ around the PRIA.

Any required permit must be valid and on board the vessel and available for inspection by an authorized agent, except that, if the permit was issued (or registered to the vessel) during the fishing trip in question, this requirement applies only after the start of any subsequent fishing trip.

A permit is valid only for the vessel for which it is registered. A permit not registered for use with a particular vessel may not be used. To obtain a permit an application must be submitted to PIRO. General requirements governing application information, issuance, fees, expiration, replacement, transfer, alteration, display, and sanctions for permits issued under this section, as applicable, are contained in the regulations at 50 CFR §660.13.

A Hawaii longline limited access permit may be transferred as follows:

The owner of a Hawaii longline limited access permit may apply to transfer the permit:

- To a different person for registration for use with the same or another vessel; or
- For registration for use with another U.S. vessel under the same ownership.

In addition, a Hawaii longline limited access permit will not be registered for use with a vessel that has a LOA greater than 101 ft (30.8 m), and only a person eligible to own a documented vessel under the terms of 46 U.S.C. 12102(a) may be issued or may hold (by ownership or otherwise) a Hawaii longline limited access permit.

To appeal a permit decision related to the granting, denial, conditioning, suspension, or transfer of a permit or requested permit the applicant must submit the appeal in writing to the Regional Administrator. The appeal must state the action(s) appealed, and the reasons therefore, and must be submitted within 30 days of the action(s). The appellant may request an informal hearing on the appeal.

Upon receipt of an appeal authorized by this section, the Regional Administrator may request additional information. Upon receipt of sufficient information, the Regional Administrator will decide the appeal in accordance with the criteria set out in this part for qualifying for, or renewing, limited access permits. The Regional Administrator will notify the appellant of the decision and the reasons, in writing, normally within 30 days of the receipt of sufficient information, unless additional time is needed for a hearing.

If a hearing is requested, or if the Regional Administrator determines that one is appropriate, the Regional Administrator may grant an informal hearing before a hearing officer designated for that purpose. Within 30 days of the last day of the hearing, the hearing officer shall recommend, in writing, a decision to the Regional Administrator who may adopt the hearing officer's recommended decision, in whole or in part, or may reject or modify it. In any event, the Regional Administrator will notify the appellant, and interested persons, if any, of the decision, and the reason(s) , in writing, within 30 days of receipt of the hearing officer's recommended decision

In the case of a timely appeal from an American Samoa longline limited access permit initial permit decision, the Regional Administrator will issue the appellant a temporary American Samoa longline limited access permit. A temporary permit will expire 20 days after the Regional Administrator's final decision on the appeal. In no event will a temporary permit be effective for longer than 60 days. With the exception of temporary permits issued under paragraph (n)(4) of this section, any time limit prescribed in this section may be extended for a period not to exceed 30 days by the Regional Administrator for good cause, either upon his/her own motion or upon written request from the appellant stating the reason(s).

5.3 Notifications

The permit holder for any vessel registered for use under a Hawaii longline limited access permit or for any vessel greater than 40 ft (12.2 m) in length overall that is registered for use under an American Samoa longline limited access permit, or a designated agent, shall provide a notice to the Regional Administrator at least 72 hours (not including weekends and Federal holidays) before the vessel leaves port on a fishing trip, any part of which occurs in the EEZ around the Hawaiian Archipelago or American Samoa. The notice must provide the official number of the vessel, the name of the vessel, the intended departure date, time, and location, the name of the operator of the vessel, and the name and telephone number of the agent designated by the permit holder to be available between 8 a.m. and 5 p.m. (local time) on weekdays for NMFS to contact to arrange observer placement. Permit holders for vessels registered for use under Hawaii longline limited access permits must also provide notification of the trip type (either deep-setting or shallow-setting).

The operator of any vessel in the Pacific pelagic who does not have on board a VMS unit while transiting the protected species zone must notify the NMFS Special-Agent-In-Charge immediately upon entering and immediately upon departing the protected species zone. The notification must include the name of the vessel, name of the operator, date and time (GMT) of access or exit from the protected species zone, and location by latitude and longitude to the nearest minute.

The permit holder for any American Samoa longline limited access permit, or an agent designated by the permit holder, must notify the Regional Administrator in writing within 30 days of any change to the permit holder's contact information or any change to the vessel documentation associated with a permit registered to an American Samoa longline limited access permit. Complete changes in the ownership of the vessel registered to an American Samoa longline limited access permit must also be reported to PIRO in writing within 30 days of the change. Failure to report such changes may result in a delay in processing an application, permit holders failing to receive important notifications, or sanctions pursuant to the Magnuson-Stevens Act.

5.4 Gear Identification

The operator of each permitted vessel in the fishery management area must ensure that the official number of the vessel be affixed to every longline buoy and float, including each buoy and float that is attached to a radar reflector, radio antenna, or flag marker, whether attached to a deployed longline or possessed on board the vessel. Markings must be legible and permanent, and must be of a color that contrasts with the background material.

Longline gear not marked and found deployed in the EEZ will be considered unclaimed or abandoned property, and may be disposed of in any manner considered appropriate by NMFS or an authorized officer.

5.5 Vessel Monitoring Systems

Only a VMS unit owned by NMFS and installed by NMFS complies with the requirement. After a Hawaii longline limited access permit holder or size Class C or D American Samoa longline limited access permit holder has been notified by the SAC of a specific date for installation of a VMS unit on the permit holder's vessel, the vessel must carry the VMS unit after the date scheduled for installation.

During the experimental VMS program, a Hawaii longline limited access permit holder or size Class C or D American Samoa longline permit holder with a size Class D or D permit shall not be assessed any fee or other charges to obtain and use a VMS unit, including the communication charges related directed to requirements under this section. Communication charges related to any additional equipment attached to the VMS unit by the owner or operator shall be the responsibility of the owner or operator and not NMFS.

The holder of a Hawaii longline limited access permit or a size Class C or D American Samoa longline permit and master of the vessel must:

- Provide opportunity for the SAC to install and make operational a VMS unit after notification.
- (2) Carry the VMS unit on board whenever the vessel is at sea.
- (3) Not remove or relocate the VMS unit without prior approval from the SAC.

The SAC has authority over the installation and operation of the VMS unit. The SAC may authorize the connection or order the disconnection of additional equipment, including a computer, to any VMS unit when deemed appropriate by the SAC.

5.4 Longline Fishing Prohibited Areas

Longline fishing shall be prohibited in the longline fishing prohibited areas. The protected species zone is 50 nm from the center geographical positions of Nihoa Island, Necker Island, French Frigate Shoals, Gardner Pinnacles, Maro Reef, Laysan Island, Lisianski Island, Pearl and Hermes Reef, Midway Islands, and Kure Island In the main Hawaiian Islands from February 1 through September 30 each year, the longline fishing prohibited area around the main Hawaiian Islands is the portion of the EEZ seaward of Hawaii in the specific areas delineated in the Federal Register.

There are specific exemptions permitting a person to use longline gear to fish in a portion(s) of the Hawaii longline fishing prohibited area which will be issued to a person who can document that he or she:

- Currently owns a Hawaii longline limited access permit issued under this part and registered for use with his or her vessel.
- Before 1970, was the owner or operator of a vessel when that vessel landed Pacific pelagic management unit species taken on longline gear in an area that is now within the Hawaii longline fishing prohibited area.
- Was the owner or operator of a vessel that landed Pacific pelagic management unit species taken on longline gear in an area that is now within the Hawaii longline fishing prohibited area, in at least 5 calendar years after 1969, which need not be consecutive.
- In any one of the 5 calendar years, was the owner or operator of a vessel that harvested at least 80 percent of its total landings, by weight, of longline-caught Pacific pelagic management unit species in an area that is now in the Hawaii longline fishing prohibited area.

Each exemption specifies the portion(s) of the Hawaii longline fishing prohibited area, bounded by longitudinal and latitudinal lines drawn to include each statistical area, as appearing on Hawaii State Commercial Fisheries Charts, in which the exemption holder made the harvest documented for the exemption application. Each exemption is valid only within the portion(s) of the Hawaii longline fishing prohibited area specified on the exemption.

To obtain an exemption one must submit an application and supporting documentation to the PIRO at least 15 days before the desired effective date of the exemption. If the Regional Administrator determines that a gear conflict has occurred and is likely to occur again in the Hawaii longline fishing prohibited area between a vessel used by a person holding an exemption under this section and a non-longline vessel, the Regional Administrator may prohibit all longline fishing in the Hawaii longline fishing prohibited area around the island where the conflict occurred, or in portions thereof, upon notice to each holder of an exemption who would be affected by such a prohibition.

The Council will consider information provided by persons with Hawaii longline limited access permits issued under this part who believe they have experienced extreme financial hardship resulting from the Hawaii longline area closure, and will consider recommendations of the Pelagic Advisory Review Board to assess whether exemptions under this section should continue to be allowed, and, if appropriate, revise the qualifying criteria to permit additional exemptions. If additional exemptions are needed, the Council will advise the Regional Administrator in writing of its recommendation, including criteria by which financial hardships will be mitigated, while retaining the effectiveness of the longline fishing prohibited area. The Regional Administrator may reject or concur with the Council's recommendation.

5.5 At-sea Observer Coverage

NMFS shall advise the permit holder or the designated agent of any observer requirement at least 24 hours (not including weekends and Federal holidays) before any trip for which NMFS received timely notice. When NMFS notifies the permit holder or designated agent of the obligation to carry an observer the vessel may not engage in the fishery without taking the observer. The NMFS observer must arrive at the observer's assigned vessel 30 minutes before the time designated for departure in the notice or the notice as modified, and will wait 1 hour for departure. A permit holder must accommodate a NMFS observer assigned under these regulations. The Regional Administrator's office, and not the observer, will address any concerns raised over accommodations.

The permit holder, vessel operator, and crew must cooperate with the observer in the performance of the observer's duties, including:

- Allowing for the embarking and debarking of the observer.
- Allowing the observer access to all areas of the vessel necessary to conduct observer duties.
- Allowing the observer access to communications equipment and navigation equipment as necessary to perform observer duties.
- Allowing the observer access to VMS units to verify operation, obtain data, and use the communication capabilities of the units for official purposes.
- Providing accurate vessel locations by latitude and longitude or loran coordinates, upon request by the observer.
- Providing sea turtle, marine mammal, or sea bird specimens as requested.
- Notifying the observer in a timely fashion when commercial fishing operations are to begin and end.

The permit holder, operator, and crew must comply with other terms and conditions to ensure the effective deployment and use of observers that the Regional Administrator imposes by written notice. The permit holder must ensure that assigned observers are provided living quarters comparable to crew members and are provided the same meals, snacks, and amenities as are normally provided to other vessel personnel. A mattress or futon on the floor or a cot is not acceptable if a regular bunk is provided to any crew member, unless other arrangements are approved in advance by the Regional Administrator.

Upon observer verification of vessel accommodations and the number of assigned days on board, NMFS will reimburse vessel owners a reasonable amount for observer subsistence as determined by the Regional Administrator. If requested and properly documented, NMFS will reimburse the vessel owner for the following:

- Communications charges incurred by the observer.
- Lost fishing time arising from a seriously injured or seriously ill observer, provided that notification of the nature of the emergency is transmitted to the Observer Program, NMFS at the earliest practical time. NMFS will reimburse the owner only for those days during which the vessel is unable to fish as a direct result of helping the NMFS employee who is seriously injured or seriously ill. Lost fishing time is based on time traveling to and from the fishing grounds and any documented out-of-pocket expenses for medical services. Payment will be based on the current target fish market prices and that vessel's average target fish catch retained per day at sea for the previous 2 years, but shall not exceed $5,000 per day or $20,000 per claim.

If a vessel normally has cabins for crew members, female observers on a vessel with an all-male crew must be accommodated either in a single person cabin or, if NMFS concludes that adequate privacy can be ensured by installing a curtain or other temporary divider, in a two-person shared cabin. If the vessel normally does not have cabins for crew members, alternative accommodations must be approved by NMFS. If a cabin assigned to a female observer does not have its own toilet and shower facilities that can be provided for the exclusive use of the observer, or if no cabin is assigned, then arrangements for sharing common facilities must be established and approved in advance by NMFS.

5.6 Sea Turtle Mitigation Measures

Possession and use of required mitigation gear— Owners and operators of vessels registered for use under a Hawaii longline limited access permit must carry aboard their vessels line clippers meeting the minimum design, dip nets meeting the minimum standards, and dehookers meeting the minimum design and performance standards. These items must be used to disengage any hooked or entangled sea turtles with the least harm possible to the sea turtles, and if it is done by cutting the line, the line must be cut as close to the hook as possible. Any hooked or entangled sea turtle must be handled, resuscitated, and released in accordance with the requirements.

Line clippers. Line clippers are intended to cut fishing line as close as possible to hooked or entangled sea turtles. NMFS has established minimum design standards for line clippers. The Arceneaux line clipper (ALC) is a model line clipper that meets these minimum design standards and may be fabricated from readily available and low-cost materials. The minimum design standards are as follows:

- *A protected cutting blade.* The cutting blade must be curved, recessed, contained in a holder, or otherwise afforded some protection to minimize direct contact of the cutting surface with sea turtles or users of the cutting blade.
- *Cutting blade edge.* The blade must be capable of cutting 2.0–2.1 mm monofilament line and nylon or polypropylene multistrand material commonly known as braided mainline or tarred mainline.
- *An extended reach holder for the cutting blade.* The line clipper must have an extended reach handle or pole of at least 6 ft (1.82 m).
- *Secure fastener.* The cutting blade must be securely fastened to the extended reach handle or pole to ensure effective deployment and use.
- *Dip nets.* Dip nets are intended to facilitate safe handling of sea turtles and access to sea turtles for purposes of cutting lines in a manner that minimizes injury and trauma to sea turtles. The minimum design standards for dip nets that meet the requirements of this section nets are:
- *An extended reach handle.* The dip net must have an extended reach handle of at least 6 ft (1.82 m) of wood or other rigid material able to support a minimum of 100 lbs (34.1 kg) without breaking or significant bending or distortion.
- *Size of dip net.* The dip net must have a net hoop of at least 31 inches (78.74 cm) inside diameter and a bag depth of at least 38 inches (96.52 cm). The bag mesh openings may be no more than 3 inches × 3 inches (7.62 cm 7.62 cm).

Dehookers— Long-handled dehooker for ingested hooks. This item is intended to be used to remove ingested hooks from sea turtles that cannot be boated, and to engage a loose hook when a turtle is entangled but not hooked and line is being removed. One long-handled dehooker for ingested hooks is required on board. The minimum design and performance standards are as follows:

- *Hook removal device.* The hook removal device must be constructed of 5/16–inch (7.94 mm) 316 L stainless steel and have a dehooking end no larger than 1 7/8 inches (4.76 cm) outside diameter. The device must be capable of securely engaging and controlling the leader while shielding the barb of the hook to prevent the hook from re-engaging during removal. It must not have any unprotected terminal points (including blunt ones), as these could cause injury to the esophagus during hook removal. The device must be of a size capable of securing the range of hook sizes and styles used by the vessel.
- *Extended reach handle.* The hook removal device must be securely fastened to an extended reach handle or pole with a length equal to or greater than 150 percent of the vessel's freeboard or 6 ft (1.83 m), whichever is greater. It is recommended that the handle be designed so that it breaks down into sections. The handle must be sturdy and strong enough to facilitate the secure attachment of the hook removal device.

Dehookers— Long-handled dehooker for external hooks. This item is intended to be used to remove externally-hooked hooks from sea turtles that cannot be boated. The long-handled dehooker for ingested hooks meets this requirement. The minimum design and performance standards are as follows:

- *Construction.* The device must be constructed of 5/16–inch (7.94 mm) 316 L stainless steel rod. A 5–inch (12.70–cm) tube T-handle of 1–inch (2.54–cm) outside diameter is recommended, but not required. The dehooking end must be blunt with all edges rounded. The device must be of a size capable of securing the range of hook sizes and styles used by the vessel.
- *Handle.* The handle must have a length equal to or greater than the vessel's freeboard or 3 ft (0.91 m), whichever is greater.

Long-handled device to pull an "inverted V". This item is intended to be used to pull an "inverted V" in the fishing line when disentangling and dehooking entangled sea turtles. One long-handled device to pull an "inverted V" is required on board. The long-handled dehooker for external hooks described in paragraph (a)(4)(ii) of this section meets this requirement. The minimum design and performance standards are as follows:

- *Hook end.* It must have a hook-shaped end, like that of a standard boat hook or gaff, which must be constructed of stainless steel or aluminum.
- *Handle.* The handle must have a length equal to or greater than 150 percent of the vessel's freeboard or 6 ft (1.83 m), whichever is greater. The handle must be sturdy and strong enough to allow the hook end to be effectively used to engage and pull an "inverted V" in the line.

Tire. This item is intended to be used for supporting a turtle in an upright orientation while it is on board. One tire is required on board, but an assortment of sizes is recommended to accommodate a range of turtle sizes. The tire must be a standard passenger vehicle tire and must be free of exposed steel belts.

Short-handled dehooker for ingested hooks. This item is intended to be used to remove ingested hooks, externally hooked hooks, and hooks in the front of the mouth of sea turtles that can be boated. One short-handled dehooker for ingested hooks is required on board. The minimum design and performance standards are as follows:

- *Hook removal device.* The hook removal device must be constructed of 1/4–inch (6.35–mm) 316 L stainless steel, and the design of the dehooking end must be such to allow the hook to be secured and the barb shielded without re-engaging during the hook removal process. The dehooking end must be no larger than 1 5/16 inch (3.33 cm) outside diameter. It must not have any unprotected terminal points (including blunt ones), as this could cause injury to the esophagus during hook removal. The dehooking end must be of a size appropriate to secure the range of hook sizes and styles used by the vessel.
- *Sliding plastic bite block.* The dehooker must have a sliding plastic bite block, which is intended to be used to protect the sea turtle's beak and facilitate hook removal if the turtle bites down on the dehooker. The bite block must be constructed of a 3/4–inch (1.91–cm) inside diameter high impact plastic cylinder (for example, Schedule 80 PVC) that is 10 inches (25.40 cm) long. The dehooker and bite block must be configured to allow for 5 inches (12.70 cm) of slide of the bite block along the shaft of the dehooker.
- *Shaft and handle.* The shaft must be 16 to 24 inches (40.64 - 60.69 cm) in length, and must have a T-handle 4 to 6 inches (10.16 - 15.24 cm) in length and 3/4 to 1 1/4 inches (1.90 - 3.18 cm) in diameter.

Short-handled dehooker for external hooks. This item is intended to be used to remove externally hooked hooks from sea turtles that can be boated. One short-handled dehooker for external hooks is required on board. The short-handled dehooker for ingested hooks required to comply with paragraph (a)(4)(v) of this section meets this requirement. The minimum design and performance standards are as follows:

- *Hook removal device.* The hook removal device must be constructed of 5/16–inch (7.94–cm) 316 L stainless steel, and the design must be such that a hook can be rotated out without pulling it out at an angle. The dehooking end must be blunt, and all edges rounded. The device must be of a size appropriate to secure the range of hook sizes and styles used by the vessel.
- *Shaft and handle*. The shaft must be 16 to 24 inches (40.64 - 60.69 cm) in length, and must have a T-handle 4 to 6 inches (10.16 - 15.24 cm) in length and 3/4 to 1 1/4 inches (1.90 - 3.18 cm) in diameter.

Long-nose or needle-nose pliers. This item is intended to be used to remove deeply embedded hooks from the turtle's flesh that must be twisted in order to be removed, and also to hold in place PVC splice couplings when used as mouth openers. One pair of long-nose or needle-nose pliers is required on board. The minimum design standards are as follows: The pliers must be 8 to 14 inches (20.32 - 35.56 cm) in length. It is recommended that they be constructed of stainless steel material.

Wire or bolt cutters. This item is intended to be used to cut through hooks in order to remove all or part of the hook. One pair of wire or bolt cutters is required on board. The minimum design and performance standards are as follows: The wire or bolt cutters must be capable of cutting hard metals, such as stainless or carbon steel hooks, and they must be capable of cutting through the hooks used by the vessel.

Monofilament line cutters. This item is intended to be used to cut and remove fishing line as close to the eye of the hook as possible if the hook is swallowed or cannot be removed. One pair of monofilament line cutters is required on board. The minimum design standards are as follows: Monofilament line cutters must be 6 to 9 inches (15.24 - 22.86 cm) in length. The blades must be 1 3/4 (4.45 cm) in length and 5/8 inches (1.59 cm) wide when closed.

Mouth openers and gags. These items are intended to be used to open the mouths of boated sea turtles, and to keep them open when removing ingested hooks in a way that allows the hook or line to be removed without causing further injury to the turtle. At least two of the seven different types of mouth openers and gags described below are required on board. The seven types and their minimum design standards are as follows.

- *A block of hard wood.* A block of hard wood is intended to be used to gag open a turtle's mouth by placing it in the corner of the jaw. It must be made of hard wood of a type that does not splinter (for example, maple), and it must have rounded and smoothed edges. The dimensions must be 10 to 12 inches (24.50 - 30.48 cm) by 3/4 to 1 1/4 inches (1.90 - 3.18 cm) by 3/4 to 1 1/4 inches (1.90 - 3.18 cm).
- *A set of three canine mouth gags.* A canine mouth gag is intended to be used to gag open a turtle's mouth while allowing hands-free operation after it is in place. A set of canine mouth gags must include one of each of the following sizes: small (5 inches) (12.7 cm), medium (6 inches) (15.2 cm), and large (7 inches) (17.8 cm). They must be constructed of stainless steel. A 1 3/4–inch (4.45 cm) long piece of vinyl tubing (3/4 inch (1.91 cm) outside diameter and 5/8 inch (1.59 cm) inside diameter) must be placed over the ends of the gags to protect the turtle's beak.
- *A set of two sturdy canine chew bones.* A canine chew bone is intended to be used to gag open a turtle's mouth by placing it in the corner of the jaw. They must be constructed of durable nylon, zylene resin, or thermoplastic polymer, and strong enough to withstand biting without splintering. To accommodate a variety of turtle beak sizes, a set must include one large (5 1/2 - 8 inches (13.97 - 20.32 cm) in length) and one small (3 1/2 - 4 1/2 inches (8.89 - 11.43 cm) in length) canine chew bones.
- *A set of two rope loops covered with hose.* A set of two rope loops covered with a piece of hose is intended to be used as a mouth opener and to keep a turtle's mouth open during hook and/or line removal. A set consists of two 3–foot (0.91–m) lengths of poly braid rope, each covered with an 8–inch (20.32–cm) section of 1/2–inch (1.27–cm) or 3/4–inch (1.91–cm) light-duty garden hose, and each tied into a loop.
- *A hank of rope.* A hank of rope is intended to be used to gag open a sea turtle's mouth by placing it in the corner of the jaw. A hank of rope is made from a 6–foot (1.83–m) lanyard of braided nylon rope that is folded to create a hank, or looped bundle, of rope. The hank must be 2 to 4 inches (5.08 - 10.16 cm) in thickness.

- *A set of four PVC splice couplings.* PVC splice couplings are intended to be used to allow access to the back of the mouth of a turtle for hook and line removal by positioning them inside a turtle's mouth and holding them in place with long-nose or needle-nose pliers. The set must consist of the following Schedule 40 PVC splice coupling sizes: 1 inch (2.54 cm), 1 1/4 inches (3.18 cm), 1 1/2 inches (3.81 cm), and 2 inches (5.08 cm).
- *A large avian oral speculum.* A large avian oral speculum is intended to be used to hold a turtle's mouth open and control the head with one hand while removing a hook with the other hand. It must be 9 inches (22.86 cm) in length and constructed of 3/16–inch (4.76–mm) wire diameter surgical stainless steel (Type 304). It must be covered with 8 inches (20.32 cm) of clear vinyl tubing (5/16–inch (7.94–mm) outside diameter, 3/16–inch (4.76–mm) inside diameter).

Handling requirements. All incidentally hooked or entangled sea turtles must be handled in a manner to minimize injury and promote post-hooking or post-entangling survival. When practicable, comatose sea turtles must be brought on board immediately, with a minimum of injury, and handled in accordance with the procedures specified. If a sea turtle is too large or hooked or entangled in a manner as to preclude safe boarding without causing further damage/injury to the turtle, the line must be cut and as much line as possible removed prior to releasing the turtle.

Resuscitation. If the sea turtle brought aboard appears dead or comatose, the sea turtle must be placed on its belly (on the bottom shell or plastron) so that the turtle is right side up and its hindquarters elevated at least 6 inches (15.24 cm) for a period of no less than 4 hours and no more than 24 hours. The amount of the elevation depends on the size of the turtle; greater elevations are needed for larger turtles. A reflex test, performed by gently touching the eye and pinching the tail of a sea turtle, must be administered by a vessel operator, at least every 3 hours, to determine if the sea turtle is responsive. Sea turtles being resuscitated must be shaded and kept damp or moist but under no circumstance may be placed into a container holding water. A water-soaked towel placed over the eyes, carapace, and flippers is the most effective method in keeping a turtle moist.

Those that revive and become active, those that fail to revive within the 24–hour period, and all live turtles must be returned to the sea. Release of turtles should be done by putting the vessel engine in neutral gear so that the propeller is disengaged and the vessel is stopped, and releasing the turtle away from deployed gear; and by observing that the turtle is safely away from the vessel before engaging the propeller and continuing operations.

5.7 Longline Fishing Restrictions

Annual Effort Limit on shallow-setting by Hawaii longline vessels. A maximum annual limit of 2,120 is established on the number of shallow-set certificates that will be made available each calendar year to vessels registered for use under Hawaii longline limited access permits. The Regional Administrator will divide the 2,120–set annual effort limit each calendar year into equal shares such that each holder of a Hawaii longline limited access permit who provides notice of interest to the Regional Administrator no later than November 1 prior to the start of the calendar year receives one share for each permit held. If such division would result in shares containing a fraction of a set, the annual effort limit will be adjusted downward such that each share consists of a whole number of sets.

Any permit holder who provides notice is eligible to receive shallow-set certificates. In order to be eligible to receive shallow-set certificates for a given calendar year, holders of Hawaii longline limited access permits must provide written notice to the Regional Administrator of their interest in receiving such certificates no later than November 1 prior to the start of the calendar year, except for 2004, the notification deadline for which is May 1, 2004. No later than December 1 of each year, the Regional Administrator will send shallow-set certificates valid for the upcoming calendar year to all holders of Hawaii longline limited access permits, as of the just previous November 1, that provided notice of interest to the Regional Administrator. The Regional Administrator will send shallow-set certificates valid for 2004 no later than June 1, 2004, based on permit holders as of May 1, 2004.

Limits on sea turtle interactions. Maximum annual limits are established on the numbers of physical interactions that occur each calendar year between leatherback and loggerhead sea turtles and vessels registered for use under Hawaii longline limited access permits while shallow-setting. The limits are based on the annual numbers of the two turtle species expected to be captured in the shallow-set component of the Hawaii-based fishery, as indicated in the incidental take statement of the biological opinion issued by the National Marine Fisheries Service pursuant to section 7 of the Endangered Species Act. If the numbers in the incidental take statement are modified or if a new biological opinion is issued, new rule-making will be undertaken to change the interaction limits accordingly. The current limits are as follows:

- The annual limit for leatherback sea turtles (*Dermochelys coriacea*) is sixteen (16).
- The annual limit for loggerhead sea turtles (*Caretta caretta*) is seventeen (17).

Upon determination by the Regional Administrator, based on data from NMFS observers, if either of the two sea turtle interaction limits has been reached during a given calendar year:

- A notification of the sea turtle interaction limit having been reached will be filed for publication at the Office of the Federal Register (OFR). The notification will include an advisement that the shallow-set component of the longline fishery shall be closed and shallow-setting north of the equator by vessels registered for use under Hawaii longline limited access permits will be prohibited beginning at a specified date, not earlier than 7 days after the date of filing of the notification of the closure for public inspection at the OFR, until the end of the calendar year in which the sea turtle interaction limit was reached. Coincidental with the filing of the notification of the sea turtle interaction limit having been reached at the OFR, the Regional Administrator will also provide notice that the shallow-set component of the longline fishery shall be closed and shallow-setting north of the equator by vessels registered for use under Hawaii longline limited access permits will be prohibited beginning at a specified date, not earlier than 7 days after the date of filing of a notification of the closure for public inspection at the OFR, to all holders of Hawaii longline limited access permits via electronic mail, facsimile transmission, or post.

- Beginning on the fishery closure date indicated in the notification published in the Federal Register until the end of the calendar year in which the sea turtle interaction limit was reached, the shallow-set component of the longline fishery shall be closed.

Owners and operators of vessels registered for use under a Hawaii longline limited access permit may engage in shallow-setting north of the equator (0° lat.) providing that there is on board one valid shallow-set certificate for every shallow-set that is made north of the equator (0° lat.) during the trip. For each shallow-set made north of the equator (0° lat.) vessel operators must submit one valid shallow-set certificate to the Regional Administrator. The certificate must be attached to the original logbook form that corresponds to the shallow-set and that is submitted to the Regional Administrator within 72 hours of each landing of pelagic MUS.

Vessels registered for use under a Hawaii longline limited access permit may not have on board at any time during a trip for which notification to NMFS indicated that deep-setting would be done any float lines less than 20 meters in length or light sticks. "Float line" means a line used to suspend the main longline beneath a float and "light stick" means any type of light emitting device, including any fluorescent "glow bead", chemical, or electrically powered light that is affixed underwater to the longline gear.

Shallow-set certificates may be transferred only to holders of Hawaii longline limited access permits.

Owners and operators of vessels registered for use under a Hawaii longline limited access permit must use only offset circle hooks sized 18/0 or larger, with 10° offset, when shallow-setting north of the equator (0° lat.). As used in this paragraph, an offset circle hook sized 18/0 or larger is one whose outer diameter at its widest point is no smaller than 1.97 inches (50 mm) when measured with the eye of the hook on the vertical axis (y-axis) and perpendicular to the horizontal axis (x-axis). As used in this paragraph, a 10° offset is measured from the barbed end of the hook and is relative to the parallel plane of the eyed-end, or shank, of the hook when laid on its side.

Owners and operators of vessels registered for use under a Hawaii longline limited access permit must use only mackerel-type bait when shallow-setting north of the equator (0° lat.). Mackerel-type bait means a whole fusiform fish with a predominantly blue, green, or grey back and predominantly grey, silver, or white lower sides and belly.

Owners and operators of vessels registered for use under a Hawaii longline limited access permit may make sets only of the type (shallow-setting or deep-setting) indicated in the notification to NMFS. Vessels registered for use under Hawaii longline limited access permits may not be used to engage in shallow-setting north of the equator (0° lat.) any time during which the shallow-set component of the longline fishery is closed.

Owners and operators of vessels registered for use under a Hawaii longline limited access permit may land or possess no more than 10 swordfish from a fishing trip for which the permit holder notified NMFS that the vessel would engage in a deep-setting trip.

5.8 Protected Species Workshops

Each year both the owner and the operator of a vessel registered for use under a Hawaii longline limited access permit must attend and be certified for completion of a workshop conducted by NMFS on mitigation, handling, and release techniques for turtles and seabirds and other protected species. A protected species workshop certificate will be issued by NMFS annually to any person who has completed the workshop.

An owner of a vessel registered for use under a Hawaii longline limited access permit must maintain and have on file a valid protected species workshop certificate issued by NMFS in order to maintain or renew their vessel registration. An operator of a vessel registered for use under a Hawaii longline limited access permit and engaged in longline fishing must have on board the vessel a valid protected species workshop certificate issued by NMFS or a legible copy thereof.

5.9 Pelagic Longline Seabird Mitigation Measures

Seabird mitigation techniques. Owners and operators of vessels registered for use under a Hawaii longline limited access permit must ensure that the following actions are taken when fishing north of 23° N. lat.:

- Employ a line setting machine or line shooter to set the main longline when making deep sets using monofilament main longline;
- Attach a weight of at least 45 g to each branch line within 1 m of the hook when making deep sets using monofilament main longline;
- When using basket-style longline gear, ensure that the main longline is deployed slack to maximize its sink rate;
- Use completely thawed bait that has been dyed blue to an intensity level specified by a color quality control card issued by NMFS;
- Maintain a minimum of two cans (each sold as 0.45 kg or 1 lb size) containing blue dye on board the vessel;
- Discharge fish, fish parts (offal), or spent bait while setting or hauling longline gear, on the opposite side of the vessel from where the longline gear is being set or hauled;
- Retain sufficient quantities of fish, fish parts, or spent bait, between the setting of longline gear for the purpose of strategically discharging it;
- Remove all hooks from fish, fish parts, or spent bait prior to its discharge; Remove the bill and liver of any swordfish that is caught, sever its head from the trunk and cut it in half vertically, and periodically discharge the butchered heads and livers; and
- When shallow-setting north of 23° N. lat., begin the deployment of longline gear at least one hour after local sunset and complete the deployment no later than local sunrise, using only the minimum vessel lights necessary for safety.

Short-tailed albatross handling techniques. If a short-tailed albatross is hooked or entangled by a vessel registered for use under a Hawaii longline limited access permit, owners and operators must ensure that the following actions are taken:

- Stop the vessel to reduce the tension on the line and bring the bird on board the vessel using a dip net;
- Cover the bird with a towel to protect its feathers from oils or damage while being handled;
- Remove any entangled lines from the bird;
- Determine if the bird is alive or dead. If dead, freeze the bird immediately with an identification tag attached directly to the specimen listing the species, location and date of mortality, and band number if the bird has a leg band. Attach a duplicate identification tag to the bag or container holding the bird. Any leg bands present must remain on the bird. Contact NMFS, the Coast Guard, or the U.S. Fish and Wildlife Service at the numbers listed on the Short-tailed Albatross Handling Placard distributed at the NMFS protected species workshop, inform them that you have a dead short-tailed albatross on board, and submit the bird to NMFS within 72 hours following completion of the fishing trip. If alive, handle the bird in accordance with these regulations.
- Place the bird in a safe enclosed place;
- Immediately contact NMFS, the Coast Guard, or the U.S. Fish and Wildlife Service at the numbers listed on the Short-tailed Albatross Handling Placard distributed at the NMFS protected species workshop and request veterinary guidance;
- Follow the veterinary guidance regarding the handling and release of the bird.
- Complete the short-tailed albatross recovery data form issued by NMFS.
- If the bird is externally hooked and no veterinary guidance is received within 24–48 hours, handle the bird in accordance with these regulations, and release the bird only if it meets the following criteria:

  (1) Able to hold its head erect and respond to noise and motion stimuli;

  (2) Able to breathe without noise;

  (3) Capable of flapping and retracting both wings to normal folded position on its back;

  (4) Able to stand on both feet with toes pointed forward; and

  (5) Feathers are dry.

- If released under the guidance of a veterinarian or otherwise in accordance with these regulations, all released birds must be placed on the sea surface.
- If the hook has been ingested or is inaccessible, keep the bird in a safe, enclosed place and submit it to NMFS immediately upon the vessel's return to port. Do not give the bird food or water.
- Complete the short-tailed albatross recovery data form issued by NMFS.

Non-short-tailed albatross seabird handling techniques. If a seabird other than a short-tailed albatross is hooked or entangled by a vessel registered for use under a Hawaii longline limited access permit owners and operators must ensure that the following actions are taken:

- Stop the vessel to reduce the tension on the line and bring the seabird on board the vessel using a dip net;
- Cover the seabird with a towel to protect its feathers from oils or damage while being handled;
- Remove any entangled lines from the seabird;
- Remove any external hooks by cutting the line as close as possible to the hook, pushing the hook barb out point first, cutting off the hook barb using bolt cutters, and then removing the hook shank;
- Cut the fishing line as close as possible to ingested or inaccessible hooks;
- Leave the bird in a safe enclosed space to recover until its feathers are dry; and
- After recovered, release seabirds by placing them on the sea surface.

5.10 American Samoa Longline Limited Entry Program

Certain U.S. vessels are required to be registered for use under a valid American Samoa longline limited access permit. With the exception of reductions in permits in vessel size, the maximum number of permits will be capped at the number of initial permits actually issued under the existing regulations.

Terminology. For purposes of this section, the following terms have these meanings:

(1) *Documented participation* means participation proved by, but not necessarily limited to, a properly submitted NMFS or American Samoa logbook, an American Samoa creel survey record, a delivery or payment record from an American Samoa-based cannery, retailer or wholesaler, an American Samoa tax record, an individual wage record, ownership title, vessel registration, or other official documents showing:

- Ownership of a vessel that was used to fish in the EEZ around American Samoa, or
- Evidence of work on a fishing trip during which longline gear was used to harvest Pacific pelagic management unit species in the EEZ around American Samoa. If the applicant does not possess the necessary documentation of evidence of work on a fishing trip based on records available only from NMFS or the Government of American Samoa (e.g., creel survey record or logbook), the applicant may request PIRO to obtain such records from the appropriate agencies, if available. The applicant should provide sufficient information on the fishing trip to allow PIRO to retrieve the records.

(2) *Family* means those people related by blood, marriage, and formal or informal adoption.

(c) *Vessel size classes.* The Regional Administrator shall issue American Samoa longline limited access permits in the following size classes:

(1) Class A: Vessels less than or equal to 40 ft (12.2 m) length overall. The maximum number will be reduced as Class B–1, C–1, and D–1 permits are issued under paragraph (e) of this section.

(2) Class B: Vessels over 40 ft (12.2 m) to 50 ft (15.2 m) length overall.

(3) Class B–1: Maximum number of 14 permits for vessels over 40 ft (12.2 m) to 50 ft (15.2 m) length overall, to be made available according to the following schedule:

(i) Four permits in the first calendar year after the Regional Administrator has issued all initial permits in Classes A, B, C, and D (initial issuance),

(ii) In the second calendar year after initial issuance, any unissued, relinquished, or revoked permits of the first four, plus four additional permits,

(iii) In the third calendar year after initial issuance, any unissued, relinquished, or revoked permits of the first eight, plus four additional permits, and

(iv) In the fourth calendar year after initial issuance, any unissued, relinquished, or revoked permits of the first 12, plus two additional permits.

(4) Class C: Vessels over 50 ft (15.2 m) to 70 ft (21.3 m) length overall.

(5) Class C–1: Maximum number of six permits for vessels over 50 ft (15.2) to 70 ft (21.3 m) length overall, to be made available according to the following schedule:

(i) Two permits in the first calendar year after initial issuance,

(ii) In the second calendar year after initial issuance, any unissued, relinquished, or revoked permits of the first two, plus two additional permits, and

(iii) In the third calendar year after initial issuance, any unissued, relinquished, or revoked permits of the first four, plus two additional permits.

(6) Class D: Vessels over 70 ft (21.3 m) length overall.

(7) Class D–1: Maximum number of 6 permits for vessels over 70 ft (21.3 m) length overall, to be made available according to the following schedule:

(i) Two permits in the first calendar year after initial issuance,

(ii) In the second calendar year after initial issuance, any unissued, relinquished, or revoked permits of the first two, plus two additional permits, and

(iii) In the third calendar year after initial issuance, any unissued, relinquished, or revoked permits of the first four, plus two additional permits.

A vessel subject to this section may only be registered with an American Samoa longline limited access permit of a size class equal to or larger than the vessel's length overall.

Initial permit qualification. Any U.S. national or U.S. citizen or company, partnership, or corporation qualifies for an initial American Samoa longline limited access permit if the person, company, partnership, or corporation, on or prior to March 21, 2002, owned a vessel that was used during the time of their ownership to harvest Pacific pelagic management unit species with longline gear in the EEZ around American Samoa and that fish was landed in American Samoa prior to March 22, 2002, or prior to June 28, 2002, provided that the person or business provided to NMFS or the Council, prior to March 22, 2002, a written notice of intent to participate in the pelagic longline fishery in the EEZ around American Samoa.

Initial permit issuance. (1) Any application for issuance of an initial permit must have been submitted to the Pacific Islands Regional Office no later than 120 days after the effective date of the final rule. (2) Only permits of Class A, B, C, and D were made available for initial issuance. Permits of Class B–1, C–1, and D–1, will be made available in subsequent calendar years.

Additional permit issuance. (1) If the number of permits issued in Class A, B, C, or D, falls below the maximum number of permits, the Regional Administrator shall publish a notice in the Federal Register, send notices to persons on the American Samoa pelagics mailing list, and use other means to notify prospective applicants of any available permit(s) in that class. Any application for issuance of an additional permit must be submitted to PIRO no later than 120 days after the date of publication of the notice on the availability of additional permits in the Federal Register. A complete application must include documented participation in the fishery. The Regional Administrator shall issue permits to persons according the following priority standard:

(1) First priority accrues to the person with the earliest documented participation in the pelagic longline fishery in the EEZ around American Samoa on a Class A sized vessel.

(2) The next priority accrues to the person with the earliest documented participation in the pelagic longline fishery in the EEZ around American Samoa on a Class B size, Class C size, or Class D size vessel, in that order.

(3) In the event of a tie in the priority ranking between two or more applicants, then the applicant whose second documented participation in the pelagic longline fishery in the EEZ around American Samoa is first in time will be ranked first in priority. If there is still a tie between two or more applicants, the Regional Administrator will select the successful applicant by an impartial lottery.

Class B–1, C–1, and D–1 Permits. (1) Permits of Class B–1, C–1, and D–1 will be initially issued only to persons who hold a Class A permit and who, prior to March 22, 2002, participated in the pelagic longline fishery around American Samoa. The Regional Administrator shall issue permits to persons for Class B–1, C–1, and D–1 permits based on each person's earliest documented participation, with the highest priority given to that person with the earliest date of documented participation. A permit holder who receives a Class B–1, C–1, or D–1 permit must relinquish his or her Class A permit and that permit will no longer be valid. The maximum number of Class A permits will be reduced accordingly. If a Class B–1, C–1, or D–1 permit is relinquished, revoked, or not renewed, the Regional Administrator shall make that permit available according to the procedure set forth in the regulations.

Permit transfer. The holder of an American Samoa longline limited access permit may transfer the permit to another individual, partnership, corporation, or other entity as described in this section. Applications for permit transfers must be submitted to the Regional Administrator within 30 days of the transferral date.

Permits of all size classes except Class A. An American Samoa longline limited access permit of any size class except Class A may be transferred (by sale, gift, bequest, intestate succession, barter, or trade) to the following persons only:

(i) A Western Pacific community located in American Samoa that meets the criteria set forth in section 305(I)(2) of the Magnuson-Stevens Act, 16 U.S.C. 1855(I)(2), and its implementing regulations, or

(ii) Any person with documented participation in the pelagic longline fishery in the EEZ around American Samoa.

(2) *Class A Permits.* An American Samoa longline limited access permit of Class A may be transferred (by sale, gift, bequest, intestate succession, barter, or trade) to the following persons only:

- A family member of the permit holder,
- A Western Pacific community located in American Samoa that meets the criteria set forth in section 305(I)(2) of the Magnuson-Stevens Act, 16 U.S.C. 1855(I)(2), and its implementing regulations, or
- Any person with documented participation in the pelagic longline fishery on a Class A size vessel in the EEZ around American Samoa prior to March 22, 2002.

Class B–1, C–1, and D–1 Permits. Class B–1, C–1, and D–1 permits may not be transferred to a different owner for 3 years from the date of initial issuance, except by bequest or intestate succession if the permit holder dies during those 3 years. After the initial 3 years, Class B–1, C–1, and D–1 permits may be transferred only in accordance with the restrictions in paragraph (I)(1) of this section.

Permit renewal and registration of vessels—(1) *Use requirements.* An American Samoa longline limited access permit will not be renewed following 3 consecutive calendar years (beginning with the year after the permit was issued in the name of the current permit holder) in which the vessel(s) to which it is registered landed less than:

- For permit size Classes A or B: a total of 1,000 lb (455 kg) of Pacific pelagic management unit species harvested in the EEZ around American Samoa using longline gear, or
- For permit size Classes C or D: a total of 5,000 lb (2,273 kg) of Pacific pelagic management unit species harvested in the EEZ around American Samoa using longline gear.

Concentration of ownership of permits. No more than 10 percent of the maximum number of permits, of all size classes combined, may be held by the same permit holder. Fractional interest will be counted as a full permit for the purpose of calculating whether the 10–percent standard has been reached.

Three year review. Within 3 years of the effective date of this final rule the Council shall consider appropriate revisions to the American Samoa limited entry program after reviewing the effectiveness of the program with respect to its biological and socioeconomic objectives, concerning gear conflict, overfishing, enforceability, compliance, and other issues.

5.11 American Samoa Pelagic Fishery Area Management

Large vessel prohibited areas. A large vessel of the United States may not be used to fish for Pacific pelagic management unit species in the American Samoa large vessel prohibited areas except as allowed pursuant to an exemption.

Tutuila Island, Manu'a Islands, and Rose Atoll (AS-1). The large vessel prohibited area around Tutuila Island, the Manu'a Islands, and Rose Atoll consists of the waters of the EEZ around American Samoa enclosed by straight lines connecting the coordinates as described in the Federal Register.

Exemptions. An exemption will be issued to a person who currently owns a large vessel, to use that vessel to fish for Pacific pelagic management unit species in the American Samoa large vessel prohibited management areas, if he or she had been the owner of that vessel when it was registered for use with a Western Pacific general longline permit and made at least one landing of Pacific pelagic management unit species in American Samoa on or prior to November 13, 1997.

A landing of Pacific pelagic management unit species for the purpose of this section must have been properly recorded on a NMFS Western Pacific Federal daily longline form that was submitted to NMFS.

An exemption is valid only for a vessel that was registered for use with a Western Pacific general longline permit and landed Pacific pelagic management unit species in American Samoa on or prior to November 13, 1997, or for a replacement vessel of equal or smaller LOA than the vessel that was initially registered for use with a Western Pacific general longline permit on or prior to November 13, 1997.

An exemption is valid only for the vessel for which it is registered. An exemption not registered for use with a particular vessel may not be used, nor may an exemption be transferred to another person. If more than one person, e.g., a partnership or corporation, owned a large vessel when it was registered for use with a Western Pacific general longline permit and made at least one landing of Pacific pelagic management unit species in American Samoa on or prior to November 13, 1997, an exemption issued under this section will be issued to only one person.

5.12 Framework Adjustments

Adjustments in management measures may be made through rulemaking if new information demonstrates that there are biological, social, or economic concerns in the fishery. The following framework process authorizes the implementation of measures that may affect the operation of the fisheries, gear, harvest guidelines, or changes in catch and/or effort.

By June 30 of each year, the Council-appointed Pelagics 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 FMP, and for which the impacts have been evaluated in Council/NMFS documents in the context of current conditions. Tthe Council may recommend to the Regional Administrator that established measures be modified, removed, or re-instituted. Such recommendation shall include supporting rationale and analysis, and shall be made after advance public notice, public discussion, and consideration of public comment. NMFS may implement the Council's recommendation by rulemaking if approved by the Regional Administrator.

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. The Council will publicize, including by Federal Register notice, and solicit public comment on, any proposed new management measure. After a Council meeting at which the measure is discussed, the Council will consider recommendations and prepare a Federal Register notice summarizing the Council's deliberations, rationale, and analysis for the preferred action, and the time and place for any subsequent Council meeting(s) to consider the new measure. At subsequent public meeting(s), the Council will consider public comments and other information received to make a recommendation to the Regional Administrator about any new measure. NMFS may implement the Council's recommendation by rulemaking if approved by the Regional Administrator.

5.13 Bycatch Measures

In addition to those measures implemented to minimize bycatch and bycatch mortality of protected species, including sea turtle and seabird mitigation measures and protected species workshops, described in this section, a variety of additional operational and management measures are used to minimize bycatch and bycatch mortality in the Pacific pelagic fishery. The longstanding prohibition on the use of drift gillnets is aimed at reducing bycatch. New area closures and gear restrictions have been successfully implemented to minimize bycatch of sharks and marlins and to decrease protected species interactions. Implementation of the American Samoa limited entry program and longline fishery area management also serve to lessen bycatch rates. Additional measures in the process of being developed that would further reduce bycatch and protected species interactions include restrictions on the use of bottom-set longline gear. There are no regulatory measures directed at bycatch in the recreational fishing sector, however, there exist incentives within the recreational fishing community for fishermen to release fish alive, i.e. employ tag-and-release techniques, which may decrease bycatch mortality.

Bycatch reduction is also being achieved through non-regulatory means, including outreach to fishermen and engagement of fishermen in research activities and the management process. Four types of non-regulatory measures aimed at further reducing bycatch and bycatch mortality and improving bycatch reporting being implemented include: 1) outreach to fishermen and engagement of fishermen in management, including research and monitoring, in order to raise their awareness of bycatch issues and give them incentives to reduce bycatch; 2) research into fishing gear and method modifications to reduce bycatch and bycatch mortality; 3) research into the development of markets for discarded fish species; and 4) improvement of data collection and analysis systems to better measure bycatch.

Data collection systems currently used in the pelagic fisheries yielding information about bycatch vary between the different fishery sectors, and include vessel observer programs, vessel and trip logbook programs, and creel surveys. Fishery-independent sources of information, including experimental fishing studies and tagging studies also provide information on bycatch rates and mortality which may be used to develop additional bycatch minimization measures in the future.

5.14 Port Privileges and Transiting for Unpermitted U.S. Longline Vessels

A U.S. longline fishing vessel that does not have a permit may enter waters of the fishery management area with Pacific pelagic MUS on board, but may not land or transship any management unit species on board the vessel. The vessel's longline gear must be stowed or secured so it is rendered unusable during the time the vessel is in those waters.

5.15 Specification of MSY, OY and Overfishing

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 (50 CFR 600.310) 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. If stock biomass falls below MSST in a given year, the stock or stock complex is overfished. A Council must take remedial action in the form of a new management plan or amendment, or proposed regulations, when it has been determined by the Secretary of Commerce that overfishing is occurring, a stock or stock complex is overfished, either of the two thresholds is being approached,[6] or existing remedial action to end previously identified overfishing 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, and that it "must not exceed the fishing mortality rate or level associated with the relevant MSY control rule" (50 CFR 600.310(d)(2)(i)). The technical 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 15 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, the stock size threshold [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 maximum fishing mortality threshold" (50 CFR 600.310(d)(2)(ii)). The MSST is indicated in Figure 15 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 these amendments 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. Also available is a stock biomass flag (B_{FLAG}) that would be specified at some point above MSST, as indicated in Figure 15. The control rule does not call for any change in F as a result of breaching B_{FLAG} – it would merely serves 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.

Despite the existence of stock assessments for several of the key species, none of the PMUS stocks in the western and central Pacific can be considered data-rich. Many can be considered data-moderate and the rest are considered data-poor, as indicated in Table 6. Species for which there is insufficient data to determine status, such as those in the "other MUS" category, are managed as part of a mixed stock complex.[7]

[6] A threshold is being "approached" when it is projected that it will be reached within two years (50 CFR 600.310 (e)(1)).

[7] 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.

Table 6: Quality of data for pelagic stocks

Stock	Data richness
Bigeye tuna	moderate
Northern Pacific albacore	moderate
Southern Pacific albacore	moderate
Eastern Pacific yellowfin tuna	moderate
Western Pacific yellowfin tuna	moderate
Eastern Pacific skipjack tuna	moderate
Western Pacific skipjack tuna	moderate
Other tunas	poor
Northern Pacific swordfish	moderate
Blue marlin	moderate
Other billfishes	poor
Pelagic sharks	poor
Other MUS	poor

The defaults recommended in the technical guidance for National Standard 1 (Restrepo et al. 1998) for data-moderate species have been used to specify control rules and reference points, as described below. The specifications apply to those stocks for which assessments against the criteria can be performed with available data. Efforts are being made to improve the quality of data on the data-poor stocks so that stock assessments against the specified criteria can be performed.

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 values of M to be used to determine the reference point values are specified, instead the latest estimate for each stock, which would be published annually in the SAFE report, is used, and the value is periodically re-estimated using the best available information.

Also specified is a warning reference point, B_{FLAG}, 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 7.

Table 7: Overfishing threshold specifications for pelagic 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 $c = \max(1\text{-}M, 0.5)$		

To illustrate these specifications of the MSST, for species with natural mortality rates greater than 0.5 (e.g., yellowfin tuna and skipjack tuna) the MSST is 0.5 B_{MSY}. Similarly, the MSST for a species with a natural mortality rate of 0.2 would be 0.8 B_{MSY}.

Where F_{MSY} cannot be reliably estimated, the technical guidance for implementing National Standard 1 (Restrepo et al. 1998) recommends a default specification of $F_{MSY} = 0.8$ M. That specification has been adopted for all stocks for which F_{MSY} cannot be directly estimated.

As with F_{MSY}, some B_{MSY} values can be derived from published or unpublished sources. For other stocks, B_{MSY} is specified as follows:

$$B_{MSY} = MSY/0.8M$$

For some stocks with relatively high fecundity B_{MSY} is specified as suggested in the technical guidance for data-poor stocks:

$B_{MSY} = 0.4\ B_0$, where B_0 is the initial biomass, or carrying capacity

For these stocks, $CPUE_{YEAR}/CPUE_0$ is used as a proxy for B_{YEAR}/B_0, as suggested in the technical guidance for data-poor stocks. In these cases, standardized CPUE time series extending back to the earliest years of the fishery ($CPUE_0$) is used to estimate B_{YEAR}/B_{MSY}:

$$B_{YEAR}/B_{MSY} = (CPUE_{YEAR}/CPUE_0)\ (B_0/B_{MSY})$$

Such estimates based on CPUE time series are periodically recalculated (i.e., re-standardized) to take into account changes in technology or fishing strategy.

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. The National Standard Guidelines further require that fishery councils adopt a precautionary approach to specification of OY. For example, "Target reference points, such as OY, should be set safely below limit reference points, such as the catch level associated with the fishing mortality rate or level defined by the status determination criteria" (50 CFR 600.310(f)(5)).

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. (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 15. 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, the technical guidance for National Standard 1 states that "Target reference points should not be exceeded more than 50% of the time, nor on average" (Restrepo et al. 1998:13).

Rebuilding Control Rule and Reference Points

In the case that it has been determined that overfishing is occurring, a stock or stock complex is overfished, either of the two thresholds is being approached, or existing remedial action to end previously identified overfishing has not resulted in adequate progress, the Council must take remedial action within one year. 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 15, 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 15, 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.

Measures to Prevent Overfishing and Overfished Stocks

Existing measures that serve to limit fishing mortality in the Council-managed pelagic fisheries include the limited access system for the longline fisheries based in Hawaii and American Samoa the prohibition on the use of drift gillnets the prohibition on shark finning, and several longline area closures. In addition, longline vessels in the Western Pacific Region are subject to annual quotas on bigeye tuna caught in the Eastern Pacific Ocean under measures established by the IATTC.

In 2005, it was determined that Pacific wide-overfishing of bigeye tuna was occurring and that overfishing of yellowfin tuna may be occurring. Because the Western Pacific Region's pelagic fisheries (those managed by the Council) make only approximately 2 percent of Pacific-wide bigeye landings and 5 percent of yellowfin landings, the Council has increased its participation in international management fora that are essential to addressing this problem on an international scale. To improve the available information base on bigeye and yellowfin catch and effort, the Council also instituted a federal permitting and reporting system for non-longline pelagic fishing boats based in Hawaii.

If in the future it is determined that overfishing is occurring for other stocks managed under this FEP, or that a stock is overfished, (or approaching either of these conditions), the Council will consider similar remedial management actions.

At the same time, the Council will continue to manage the fisheries within its jurisdiction to achieve localized targets. In the case that it is determined that localized overfishing is occurring, the Council will consider additional management measures using the FEP amendment process. Measures that could be considered include additional area closures, seasonal closures, reductions in the number of available limited entry permits, the establishment of limited access systems in other fisheries, trip limits, effort limits, and fleet-wide limits on catch or effort.

The combination of control rules and reference points is illustrated in Figure 15. Note that the position of the MSST is illustrative only; its value would depend on the best estimate of M at any given time.

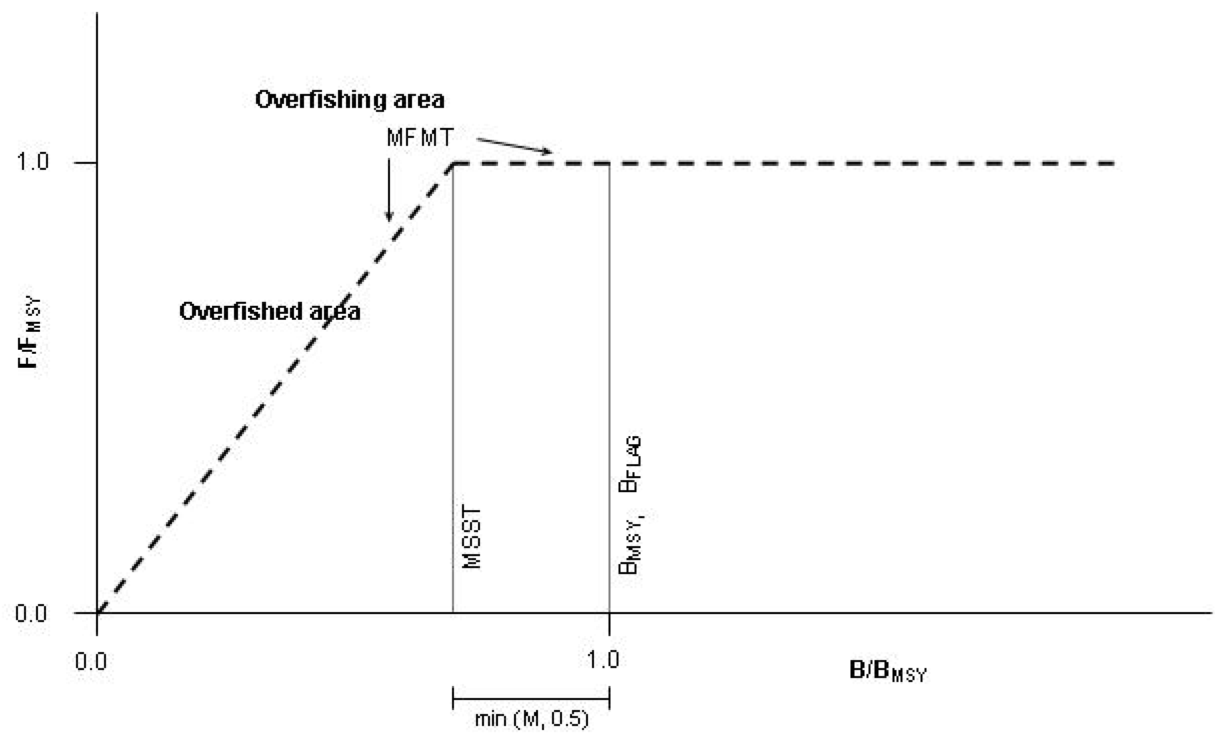

Figure 15: Combination of control rules and reference points for pelagic stocks

CHAPTER 6: IDENTIFICATION AND DESCRIPTION OF ESSENTIAL FISH HABITAT

6.1 Introduction

In 1996 Congress passed the Sustainable Fisheries Act which amended the Magnuson-Stevens Act and added several new FMP provisions. From an ecosystem management perspective, the identification and description of essential fish habitat (EFH) for all federally managed species[1] was among the most important of these additions.

According to the Magnuson-Stevens Act, 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 management unit species' (MUS) ecological role and habitat requirements in managing fisheries, it allowed councils to move beyond the traditional single- or multi-species management to a broader ecosystem-based approach.

In 1999, NMFS issued guidelines intended to assist Councils in implementing the EFH provision of the Magnuson-Stevens Act 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; and
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 recommend each Council to 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. Since EFH has to be identified for each major life history stage, information about a species' distribution, density, growth, mortality and production within all the habitats it occupies, or formerly occupied, is also necessary.

The 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.

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

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 also may be essential, depending on the health of the fish population and the ecosystem. For example, if a species is overfished, and habitat loss or degradation is thought to contribute to its overfished condition, all habitats currently used by the species may be essential.

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, it 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.

6.2 EFH Designations for Pelagic MUS

Pelagic MUS (PMUS) under the Council's jurisdiction are found in tropical and temperate waters throughout the Pacific Ocean. Variations in the distribution and abundance of PMUS are affected by ever changing oceanic environmental conditions including water temperature, current patterns and the availability of food. There are large gaps in the scientific knowledge about basic life histories and habitat requirements of many PMUS. The migration patterns of PMUS stocks in the Pacific Ocean are poorly understood and difficult to categorize despite extensive tagging studies for many species. Little is known about the distribution and habitat requirements of the juvenile life stages of tuna and billfish after they leave the plankton until they recruit to fisheries. Since spawning and larvae occur only in tropical temperatures (including temperate summer), the pre-recruit sizes are probably more tropically distributed than recruits, and juvenile tunas of this size (1–15 cm) are only caught in large numbers around tropical archipelagoes. Very little is known about the habitat of different life history stages of PMUS that are not targeted by fisheries (i.e., sharks, Gempylids, etc). For these reasons, the Council has adopted a precautionary approach in designating EFH for PMUS.

To reduce the complexity and the number of EFH identifications required for individual species and life stages, the Council has designated EFH for pelagic species assemblages pursuant to Section 600.805(b) of 62 FR 66551. The species complex designations for the PMUS are temperate species, tropical species and sharks (Table ?). The designation of these complexes is based upon the ecological relationships among species and their preferred habitat. The marketable species complex has been subdivided into tropical and temperate assemblages. The temperate species complex includes those PMUS that are found in greater abundance in higher latitudes such as swordfish and bigeye, bluefin and albacore tuna. In reality all PMUS are tropical. For a broader description of the life history and habitat utilization patterns of individual PMUS see Appendix A.

Because of the uncertainty about the life histories and habitat utilization patterns of many PMUS, the Council has taken a precautionary approach by adopting a 1,000 m depth as the lower bound of EFH for PMUS. Although many of the PMUS are epipelagic, bigeye tuna are abundant at depths in excess of 400 m and swordfish have been tracked to depths of 800 m. One thousand meters is the lower bound of the mesopelagic zone. The vertically migrating mesopelagic fishes and squids associated with the deep scattering layer are important prey organisms for PMUS and are seldom abundant below 1,000 m. This designation is also based on anecdotal reports of fishermen that PMUS aggregate over raised bottom topographical features as deep as 2,000 m (1,000 fathoms) or more. This belief is supported by research that indicates seabed features such as seamounts exert a strong influence over the superadjacent water column. An example of this type of influence is the doming of the thermocline that has been observed over seamounts.

The eggs and larvae of all teleost PMUS are pelagic. They are slightly buoyant when first spawned, are spread throughout the mixed layer and are subject to advection by the prevailing ocean currents. Because the eggs and larvae of the PMUS are found distributed throughout the tropical (and in summer, the subtropical) epipelagic zone, EFH for these life stages has been designated as the epipelagic zone (~200 m) from the shoreline to the outer limit of the EEZ. The only generic variation in this distribution pattern occurs in the northern latitudes of the Hawaii EEZ, which extends farther into the temperate zone than any other EEZ covered by the plan. In these higher latitudes, eggs and larvae are rarely found during the winter months (November–February).

Table 8: Summary of EFH and HAPC designations for Pelagic MUS

Species Complex	EFH	HAPC
Temperate species Striped Marlin (*Tetrapurus audax*); Bluefin Tuna (*Thunnus thynnus*); Swordfish (*Xiphias gladius*); Albacore (*Thunnus alalunga*); Mackeral (*Scomber* spp); Bigeye (*Thunnus obesus*); Pomfret (family Bramidae	**Eggs and larvae:** the (epipelagic zone) water column down to a depth of 200 m (100 fathoms) from the shoreline to the outer limit of the EEZ. **Juvenile/adults:** the water column down to a depth of 1,000 m (500 fathoms) from the shoreline to the outer limit of the EEZ	The water column from the surface down to a depth of 1,000 m (500 fathoms) above all seamounts and banks with summits shallower than 2,000 m (1,000 fathoms) within the EEZ.
Tropical species Yellowfin (*Thunnus albacares*); Kawakawa (*Euthynnus affinis*); Skipjack (*Katsuwonus pelamis*); Frigate and bullet tunas (*Auxis thazard*, *A. rochei*); Blue marlin (*Makaira nigricans*); Slender tunas (*Allothunnus fallai*); Black marlin (*Makaira indica*); Dogtooth tuna (*Gymnosarda unicolor*); Spearfish (*Tetrapturus spp*); Sailfish (*Istiophorus platypterus*); Mahimahi (*Coryphaena hippurus, C. equiselas*); Ono (*Acanthocybium solandri*); Opah (*Lampris* sp)	**Eggs and larvae:** the (epipelagic zone) water column down to a depth of 200 m (100 fathoms) from the shoreline to the outer limit of the EEZ. **Juvenile/adults:** the water column down to a depth of 1,000 m (500 fathoms) from the shoreline to the outer limit of the EEZ	The water column from the surface down to a depth of 1,000 m (500 fathoms) above all seamounts and banks with summits shallower than 2,000 m (1,000 fathoms) within the EEZ.
Sharks Pelagic thresher shark (*Alapias pelagicus);* Bigeye thresher shark (*Alopias___);* Common thresher shark (*Alopias vulpinus);* Silky shark (*Carcharhinus falciformis)* Oceanic whitetip shark (*Carcharhinus longimanus);* Blue shark (*Prionace glauca);* Shortfin mako shark (*Isurus oxyrinchus);* Longfin mako shark (*Isurus paucus);* Salmon shark (*Lamna ditropis)*	**Eggs and larvae:** the (epipelagic zone) water column down to a depth of 200 m (100 fathoms) from the shoreline to the outer limit of the EEZ. **Juvenile/adults:** the water column down to a depth of 1,000 m (500 fathoms) from the shoreline to the outer limit of the EEZ	The water column from the surface down to a depth of 1,000 m (500 fathoms) above all seamounts and banks with summits shallower than 2,000 m (1,000 fathoms) within the EEZ.

6.3 HAPC Designations for Pelagic MUS

The Council designated the water column down to 1,000 m that lies above all seamounts and banks within the EEZ shallower than 2,000 m (1,000 fathoms)as Habitat Areas of Particular Concern (HAPC) for PMUS. The EFH relevance of topographic features deeper than 1,000 m is due to the influence they have on the overlying mesopelagic zone. These deeper features themselves do not constitute EFH, but the waters from the surface to 1,000 m deep superadjacent to these features are designated as HAPC within the EFH. The 2,000-m depth contour captures the summits of most seamounts mentioned by fishermen, and all banks within the EEZ waters under the Councils jurisdiction. The basis for designating these areas as HAPC is the ecological function provided, the rarity of the habitat type, the susceptibility of these areas to human-induced environmental degradation and proposed activities that may stress the habitat type.

As noted above, localized areas of increased biological productivity are associated with seamounts, and many seamounts are important grounds for commercial fishing in the western Pacific region. There have been proposals to mine the manganese rich summits of the off-axis seamounts in the Hawaii EEZ. The possible adverse impacts of this proposed activity on fishery resources are of concern to the Council.

Because the PMUS are highly migratory, the areas outside the EEZ in the western Pacific region are designated by the Council as "important habitat" because they provide essential spawning, breeding and foraging habitat.

6.4 Non-fishing Related Activities that May Adversely Affect EFH

The Council is required to act to prevent, mitigate, or minimize adverse effects from fishing upon evidence that a fishing practice has identifiable adverse effects on EFH for any management unit species covered by a management plan. 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. Management plans must also contain an assessment of the potential adverse effects of all fishing equipment types used in waters described as EFH. This assessment should consider the relative impacts of all fishing equipment types used in EFH on different types of habitat found within EFH.

The predominant fishing gear types—hook-and-line, longline, troll—used in the pelagic fisheries managed by the Council cause few fishing-related impacts to the benthic habitat. 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.

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.

There is also a concern that invasive marine and terrestrial species may be introduced into sensitive environments by fishing vessels transiting from populated islands and grounding on shallow reef areas. Of most concern is the potential for unintentional introduction of rats (*Ratus spp.)* to the remote islands in the NWHI and PRIA that harbor endemic landbirds. Although there are no restrictions that prohibit fishing vessels from transiting near these remote islands areas, no invasive species introductions due to this activity have been documented. However, the Council is concerned that this could occur as fisheries expand and emerging fisheries develop in the future.

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. For a full assessment of potential adverse impacts to EFH from fishing gear currently used in areas designated as EFH see Appendix A.

In modern times, some reefs have been degraded by a range of human activities. Comprehensive lists of human threats to coral reefs in the U.S. Pacific Islands are provided by Maragos *et al*. (1996), Birkeland (1997b), Grigg 1997, and Clark and Gulko (1999). In general, reefs closest to human population centers are more heavily used and are in worse condition than those in remote locations (Green 1997). Nonetheless, it is difficult to generalize about the present condition of coral reefs in the U.S. Pacific Islands because of their broad geographic distribution and the lack of long-term monitoring to document environmental and biological baselines. Coral reef conditions and use patterns vary throughout the U.S. Pacific Islands.

A useful distinction is between coral reefs near inhabited islands of American Samoa, CNMI, Guam, and the main Hawaiian islands and coral reefs in the remote NWHI, PRIAs, and northern islands of the CNMI. Reefs near the inhabited islands are heavily used for small-scale artisanal, recreational, and subsistence fisheries, and those in Hawaii, Saipan (CNMI), and Guam are also the focus for extensive non-consumptive marine recreation. Rather than a relatively few large-scale mechanized operations, many fishermen each deploy more limited gear. The more accessible banks in the main Hawaiian Islands (Penguin Bank, Kaula Rock), Guam (southern banks), and the CNMI (Esmeralda Bank, Farallon de Medinilla) are the most heavily fished offshore reefs in the management area.

The vast majority of the reefs in the management area are remote and, in some areas, they have protected status. Most of these are believed to be in good condition and 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 difficult to detect.

6.5 Non-Fishing Related Impacts that May Adversely Affect EFH

Based on the guidelines established by the Secretary under Section 305 (b)(1)(A) of the MSFCMA, NMFS has developed a set of guidelines to assist councils meet the requirement to describe adverse impacts to EFH from non-fishing activities in their management plans.
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 has 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, this FEP must describe ways to avoid, minimize, or compensate for the adverse effects to EFH. It must also promote the conservation and enhancement of EFH. Generally, non-water dependent actions that may have adverse impacts should not be located in EFH. Activities that may result in significant adverse effects on EFH should be avoided where less environmentally harmful alternatives are available. If there are no alternatives, the impacts of these actions should be minimized. Environmentally sound engineering and management practices should be employed for all actions that may adversely affect EFH. Disposal or spillage of any material (dredge material, sludge, industrial waste, or other potentially harmful materials) that would destroy or degrade EFH should be avoided. If avoidance or minimization is not possible, or will not adequately protect EFH, compensatory mitigation to conserve and enhance EFH should be recommended. Management plans 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. Management plans should describe a variety of options to conserve or enhance EFH, which may include, but are not limited to:

Enhancing rivers, streams, and coastal areas through new federal, state, or local government planning efforts to restore river, stream, or coastal area watersheds.

Improving water quality and quantity through the use of best land management practices to ensure that water quality standards at state and federal levels are met. The practices include improved sewage treatment, disposing of waste materials properly, and maintaining sufficient in-stream flow to prevent adverse effects to estuarine areas.

Restoring or creating habitat, or converting non-EFH to EFH, to replace lost or degraded EFH, if conditions merit. However, habitat conversion at the expense of other naturally functioning systems must be justified within an ecosystem context.

6.5.2 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 MSFCMA will be met through appropriate application of these policies and principles. In assessing the potential impacts of proposed projects, the Council and the NMFS are guided by the following general considerations:

- The extent to which the activity would directly and indirectly affect the occurrence, abundance, health and continued existence of fishery resources.
- The extent to which the potential for cumulative impacts exists.
- The extent to which adverse impacts can be avoided through project modification, alternative site selection or other safeguards.
- The extent to which the activity is water dependent if loss or degradation of EFH is involved.
- The extent to which mitigation may be used to offset unavoidable loss of habitat functions and values.

Seven non-fishing activities have been identified that directly or indirectly affect habitat used by management unit species. Impacts and conservation 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 non-fishing activities on EFH.

<u>Habitat Loss and Degradation</u>

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 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 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.

<u>Pollution and Contamination</u>

Impacts

- Introduction of chemicals.
- Introduction of animal wastes.
- Increased sedimentation.
- Wastewater effluent with high contaminant levels.
- High nutrient levels down-current of outfalls.
- Biocides to prevent biofouling.
- Thermal effects.

- Turbidity plumes.
- Affected submerged aquatic vegetation sites.
- Stormwater runoff.
- Direct physical contact.
- Indirect exposure
- Cleanup.

Conservation Measures

1. Outfall structures should be placed sufficiently far offshore to prevent discharge water from affecting areas designated as EFH. Discharges should be treated using the best available technology, including implementation of up-to-date methodologies for reducing discharges of biocides (*e.g.*, chlorine) and other toxic substances.

2. Benthic productivity should be determined by sampling prior to any construction activity. Areas of high productivity should be avoided to the maximum extent possible. Sampling design should be developed with input from state and federal resource agencies.

3. Mitigation should be provided for the degradation or loss of habitat from placement of the outfall structure and pipeline as well as the treated water plume.

4. Containment equipment and sufficient supplies to combat spills should be on-site at all facilities that handle oil or hazardous substances.

5. Each facility should have a "Spill Contingency Plan," and all employees should be trained in how to respond to a spill.

6. To the maximum extent practicable, storage of oil and hazardous substances should be located in an area that would prevent spills from reaching the aquatic environment.

7. Construction of roads and facilities adjacent to aquatic environments should include a storm-water treatment component that would filter out oils and other petroleum products.

8. The use of pesticides, herbicides and fertilizers in areas that would allow for their entry into the aquatic environment should be avoided.

9. The best land management practices should be used to control topsoil erosion and sedimentation.

<u>Dredging</u>

Impacts

- Infaunal and bottom-dwelling organisms.
- Turbidity plumes.
- Bioavailability of toxic substances.
- Damage to sensitive habitats.

- Water circulation modification.

Conservation Measures

1. To the maximum extent practicable, dredging should be avoided. Activities that require dredging (such as placement of piers, docks, marinas, etc.) should be sited in deepwater areas or designed in such a way as to alleviate the need for maintenance dredging. Projects should be permitted only for water-dependent purposes, when no feasible alternatives are available.

2. Dredging in coastal and estuarine waters should be performed during the time frame when MUS and prey species are least likely to be entrained. Dredging should be avoided in areas with submerged aquatic vegetation and coral reefs.

3. All dredging permits should reference latitude-longitude coordinates of the site so information can be incorporated into Geographic Information Systems (GIS). Inclusion of aerial photos may also be required to help geo-reference the site and evaluate impacts over time.

4. Sediments should be tested for contaminants as per Environmental Protection Agency and U.S. Army Corps of Engineers requirements.

5. The cumulative impacts of past and current dredging operations on EFH should be addressed by federal, state and local resource management and permitting agencies and considered in the permitting process.

6. If dredging needs are caused by excessive sedimentation in the watershed, those causes should be identified and appropriate management agencies contacted to assure action is done to curtail those causes.

7. Pipelines and accessory equipment used in conjunction with dredging operations should, to the maximum extent possible, avoid coral reefs, seagrass beds, estuarine habitats and areas of subaquatic vegetation.

Marine Mining

Impacts

- Loss of habitat function.
- Turbidity plumes.
- Resuspension of fine-grained mineral particles
- Composition of the substrate altered.

Conservation Measures

1. Mining in areas identified as coral reef ecosystem should be avoided.

2. Mining in areas of high biological productivity should be avoided.

3. Mitigation should be provided for loss of habitat due to mining.

Water Intake Structures

Impacts

- Entrapment, impingement, and entrainment.
- Loss of prey species.

Conservation Measures

1. New facilities that rely on surface waters for cooling should not be located in areas where coral reef organisms are concentrated. Discharge points should be located in areas that have low concentrations of living marine resources, or they should incorporate cooling towers that employ sufficient safeguards to ensure against release of blow-down pollutants into the aquatic environment.

2. Intake structures should be designed to prevent entrainment or impingement of MUS larvae and eggs.

3. Discharge temperatures (both heated and cooled effluent) should not exceed the thermal tolerance of the plant and animal species in the receiving body of water.

4. Mitigation should be provided for the loss of EFH from placement of the intake structure and delivery pipeline.

Aquaculture Facilities

Impacts

- Discharge of organic waste from the farms.
- Impacts to the seafloor below the cages or pens.
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Conservation Measures

1. Facilities should be located in upland areas as often as possible. Tidally influenced wetlands should not be enclosed or impounded for mariculture purposes. This includes hatchery and grow-out operations. Siting of facilities should also take into account the size of the facility, the presence or absence of submerged aquatic vegetation and coral reef ecosystems, proximity of wild fish stocks, migratory patterns, competing uses, hydrographic conditions and upstream uses. Benthic productivity should be determined by sampling prior to any operations. Areas of high productivity should be avoided to the maximum extent possible. Sampling design should be developed with input from state and federal resource agencies.

2. To the extent practicable, water intakes should be designed to avoid entrainment and impingement of native fauna.

3. Water discharge should be treated to avoid contamination of the receiving water and should be located only in areas having good mixing characteristics.

4. Where cage mariculture operations are undertaken, water depths and circulation patterns should be investigated and should be adequate to preclude the buildup of waste products, excess feed and chemical agents.

5. Non-native, ecologically undesirable species that are reared may pose a risk of escape or accidental release, which could adversely affect the ecological balance of an area. A thorough scientific review and risk assessment should be undertaken before any non-native species are allowed to be introduced.

6. Any net pen structure should have small enough webbing to prevent entanglement by prey species.

7. Mitigation should be provided for the EFH areas impacted by the facility.

Introduction of Exotic Species

Impacts

- Habitat alteration.
- Trophic alteration.
- Gene pool alteration.
- Spatial alteration.
- Introduction of disease.

Conservation Measures

1. Vessels should discharge ballast water far enough out to sea to prevent introduction of non-native species to bays and estuaries.

2. Vessels should conduct routine inspections for presence of exotic species in crew quarters and hull of the vessel prior to embarking to remote islands (PRIAs, NWHI and northern islands of the CNMI).

3. Exotic species should not be introduced for aquaculture purposes unless a thorough scientific evaluation and risk assessment are performed (see section on aquaculture).

4. Effluent from public aquaria display laboratories and educational institutes using exotic species should be treated prior to discharge.

6.6 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 which indicated the existing level of data for individual MUS in each fishery. These tables are presented in Appendix I.

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 management unit species 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-water and shallow-water bottomfish complexes
- High resolution maps of bottom topography/currents/water masses/primary productivity

Crustaceans species

- Identification of post-larval settlement habitat of all CMUS
- Identification of "source/sink" relationships in the NWHI and other regions (ie, relationships between spawning sites settlement using circulation models, genetic techniques, etc)
- 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, 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 management unit species life history stages.
- Habitat utilization patterns for different life history stages and species.
- Growth, reproduction, and survival rates for management unit species within habitats.
- Inventory of coral reef ecosystem habitats in the EEZ of the Western Pacific Region.
- Location of important spawning sites.
- Identification of post-larval settlement habitat.
- Establishment of baseline parameters (CPUE) for coral reef ecosystem resources.
- High resolution mapping of bottom topography, bathymetry, currents, substrate types, algal beds, and habitat relief.

NMFS guidelines suggest that the Council and NMFS periodically review and update the EFH components of FMPs as new data become available. The Council recommends that new information be reviewed, as necessary, during preparation of the annual reports by the FEP 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: INTEGRATION OF ECOSYSTEM APPROACHES TO FISHERIES MANAGEMENT IN THE MARIANA ARCHIPELAGO FEP

7.1 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 inter-agency cooperation and communication (Schrope 2002 in NOAA 2003). 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.

7.2 Council Panels and Committees

<u>FEP Advisory Panels</u>

Fishery Ecosystem Plan Advisory Panels advise the Council on fishery management issues, provide input to the Council regarding fishery management planning efforts, and advise the Council on the content and likely effects of management plans, amendments, and management measures.

In general each Advisory 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 which has four representatives from each group to represent the combined areas of Guam and the Northern Mariana Islands (see Table 5). The Hawaii FEP Advisory 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 from Hawaii. The FEP Advisory Panels meet at the direction of the Council to provide continuing and detailed participation by members representing various fishery sectors and the general public.

Table 5: FEP Advisory Panel Structure

	Samoa FEP	**Hawaii FEP**	**Mariana FEP**	**Pelagic FEP**
Commercial Representatives	2 members	2 members	4 members	2 members
Recreational Representatives	2 members	2 members	4 members	2 members
Subsistence Representatives	2 members	2 members	4 members	2 members

Ecosystems & Habitat Representatives	2 members	2 members	4 members	2 members

Demersal FEP Plan Team

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

The Demersal Plan Team meets at least once annually and is comprised of 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 Demersal Plan Team's findings and recommendations are reported to the Council at their regular meetings.

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: (1) identify scientific resources required for the development of FEPs and amendments and recommend resources for Plan Teams; (2) provide multi-disciplinary review of management plans or amendments and advise the Council on their scientific content; (3) 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 (4) advise the Council on the composition of both the Demersal and Pelagic Plan Teams.

FEP Standing Committees

The Councils five 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 Demersal and Pelagic Plan Teams and the SSC. The Standing Committees are the 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 Standing Committees, along with the recommendations from all of 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) are comprised of 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 which 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 committee to the Council are advisory, as are recommendations made by the Council to member agencies.

7.3 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 where scientists and fishermen work together to increase both groups' understanding of the interplay of humans and the marine environment, and the Council's Community Development Program and Community Demonstration Projects Program both foster increased fishery participation by indigenous residents of the Western Pacific Region.

In the Mariana Archipelago, the Council has initiated a pilot project to explore strategies for further implementation of the Mariana Archipelago FEP. The project contains three major elements: a) monitoring and forecasting of ecological change; b) community-based participation to foster collaboration and "unprecedented communication" among management partners; and c) options for a specific management experiment at offshore banks in Guam's Exclusive Economic Zone (EEZ) that is intended to generate learning and feedback for adaptive management.

7.4 International Management and Research

The Council is an active participant in the development and implementation of international agreements regarding marine resources. These include agreements made by the Inter-American Tropical Tuna Commission (of which the U.S. is a member) and the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Central and Western Pacific Region (of which the U.S. is a cooperating non-member). 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 they depend (i.e. the Forum Fisheries Agency and the Secretariat of the Pacific Community's Oceanic Fisheries Programme). 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. Federated States of Micronesia).

7.5 Monitoring and Forecasting Ecological Change

Ecosystems show patterns of natural variability that provide benchmarks for assessing change but only if patterning is recognized. Choices have to be made of what to monitor among the many components and interactions in an ecosystem. Measuring and forecasting ecological changes can be simplified by using indices that integrate multiple factors. The chosen indices should have some integrative properties that reflect changes in more than one facet of the system (Garcia and Staples 2000). Indices should not be overly simplistic assumptions about the nature of ecological processes and human or ecosystem behavior. Indices are support tools that need to be used in simple but robust systems of tracking trends. Indicator-based monitoring is not a complete substitute for comprehensive data sets used in fishery management. However, indicator-based systems greatly reduce the constant need for a comprehensive information base for making every resource management decision. Trends in indicators may suggest possible changes in management approach. Carefully selected indicators may also increase the effectiveness of outreach and education efforts (Ablan et al. 2004).

Different types of indicators may be used to: 1) assess the state or condition of a resource; 2) actively know and respond to threats; and 3) evaluate the success-likelihood of management interventions or signal a need for a management adjustment. For indicators to be useful in management, there must be a clear linkage between the indicators themselves and the management objectives. The processes that support or stress ecosystems may transcend the boundaries of local management units, so issues of scale should be considered in indicator-based monitoring (Ablan et al. 2004).

CHAPTER 8: CONSISTENCY WITH THE MSA AND OTHER 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 the MSA's National Standards and other applicable laws.

8.2 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 measures in this Fishery Ecosystem Plan (FEP) are consistent with National Standard 1 because they include no regulatory changes or measures which would influence fishing and lead to increases of fishing mortality or reduction of biomass. The measures in this FEP are a result of the transformation of the Council's previous species-based Pelagic Fishery Management Plan (FMP) into a place-based Pacific Pelagic FEP that explicitly incorporates ecosystem principles. The reference points and control rules for species or species assemblages within the Pelagic FMP are maintained in this FEP without change.

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

The measures in this FEP are consistent with National Standard 2 because they use the best scientific information available to determine its boundaries and management unit species. The Pelagic FEP continues to include all of the management unit species that were in the Pelagic FMP, and the domestic vessels which target them.

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 measures in this FEP are consistent with National Standard 3 because they promote the coordinated management of Pacific pelagic species across their full range.

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 measures in 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.

<u>National Standard 5</u> 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 measures in 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.

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

The measures in this FEP are consistent with National Standard 6 because they establish a management structure that allows consideration of the local factors affecting fisheries, fishery resources and catches.

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

The measures in this FEP are consistent with National Standard 7 because they allow the development of management measures that are tailored for the specific circumstances affecting various Pacific pelagic fisheries.

<u>National Standard 8</u> 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 measures in 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 for Pacific pelagic fisheries.

<u>National Standard 9</u> 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 measures in this FEP are consistent with National Standard 9 because the bycatch provisions contained within the Council's previous Pelagic FMP are maintained in this FEP without change, and no new measures are added that would increase bycatch or bycatch mortality.

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

The measures in this FEP are consistent with National Standard 10 because they do 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 Fishery Ecosystem Plan are expected to have adverse impacts on essential fish habitat (EFH) or habitat areas of particular concern (HAPC) for species managed under the Pacific Pelagics, Hawaii Archipelago, Mariana Archipelago, PRIA, or Samoa Archipelago Fishery Ecosystem Plans (Table ?) because they are not expected to significantly affect the fishing operations or catches any fisheries, and thus they 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. None of the measures will result in a change in fishing gear or strategy that will impact EFH or HAPC and they all maintain the same level of protection to EFH and HAPC as the Pelagics, Bottomfish and Seamount Groundfish, Crustaceans, Precious Corals, and Coral Reef Ecosystems Fishery Management Plans. For the same reason they are not anticipated to cause substantial damage to the ocean and coastal habitat.

Table 9: Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC) for species managed under the Pacific Pelagics, Hawaii Archipelago, Mariana Archipelago, PRIA, or Samoa Archipelago Fishery Ecosystem Plans. 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
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

MUS	EFH (juveniles and adults)	EFH (eggs and larvae)	HAPC
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	Bottom habitat from shoreline to a depth of 100 m	Water column down to 150 m	All banks within the Northwestern Hawaiian Islands with summits less than 30 m
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 Marine Protected Areas identified in the FMP, all PRIAs, 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 an affected state's approved coastal zone management program. A copy of this document will be submitted to the appropriate state government agencies in Hawaii, American Samoa, Guam and the Commonwealth of the Northern Mariana Islands for review and concurrence with a determination that the recommended measures are consistent, to the maximum extent practicable, with the state coastal zone management program.

8.5 Endangered Species Act

Species listed as endangered or threatened under the Endangered Species Act (ESA) that have been observed in the area where fishing vessels managed by the Pelagic FEP operate consist of sea turtles, marine mammals and seabirds.

Sea Turtles

All Pacific sea turtles are designated under the U.S. Endangered Species Act (ESA) as either threatened or endangered. Leatherback, loggerhead, olive ridley, hawksbill and green sea turtles are all known to be present in the Western Pacific Region. Please see Chapter 3 for more information on these species.

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. Please see Chapter 3 for more information on these species.

Seabirds

The endangered short-tailed albatross (Phoebastria immutabilis) and the threatened Newell's shearwater (Puffinus auricularis newelli) are known to occur in the Western Pacific Region. Please see Chapter 3 for more information on these species.

Biological Opinions

A Biological Opinion was issued in February, 2004 by NMFS following a consultation under section 7 of the Endangered Species Act on the ongoing operation of the Western Pacific Region's pelagic fisheries as managed under the Pelagics Fishery Management Plan. That Opinion concluded that the fisheries were not likely to jeopardize the continued existence of any threatened or endangered species under NMFS' jurisdiction, or destroy or adversely modify critical habitat that has been designated for them. Because the management and conservation measures contained in this FEP for vessels targeting pelagic species are identical to those in the Pelagics Fishery Management Plan, the Council believes that their activities under this FEP are not likely to jeopardize the continued existence of any threatened or endangered species under NMFS' jurisdiction or destroy or adversely modify critical habitat that has been designated for them.

8.6 Marine Mammal Protection Act

In addition to the listed marine mammals discussed above, the species appearing in Table 10 are also present in the Western Pacific Region.

Table 10: Non-ESA Listed Marine Mammals of the Western Pacific Region

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*		

With the exception of the Hawaii-based longline fishery (Category I), all Western Pacific Region fisheries are Category III fisheries under Section 118 of the Marine Mammal Protection Act (69 FR 48407, August 10, 2004). This means that interactions between marine mammals and the region's non-longline pelagic fisheries are believed to be rare.

Because the fisheries managed under this FEP are not expected to change their historical fishing operations or patterns, they are not anticipated to have increased impacts on marine mammals that occur in the Western Pacific Region.

8.7 National Environmental Policy Act

A Programmatic Environmental Impact Statement (EIS) is being prepared for the implementation of this FEP. A Notice of Intent to prepare that EIS was published on October 18, 2004 (69 FR 61351).

8.8 Paperwork Reduction Act

The purpose of the Paperwork Reduction Act 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. 3501(1)). None of the measures contained in this FEP have any public regulatory compliance or other paperwork requirements.

8.9 Regulatory Flexibility Act

In order to meet the requirements of the Regulatory Flexibility Act, 5 U.S.C. 601 et seq. (RFA) 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 being 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 Regulatory Flexibility Act and no Initial Regulatory Flexibility Analysis has been prepared.

8.10 Executive Order 12866

In order to meet the requirements of Executive Order 12866 (E.O. 12866) the National Marine Fisheries Service 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 Data Quality Act

To the extent possible, this information complies with the Data 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 regulatory amendment is objectivity which 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, "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

CHAPTER 9: STATE, LOCAL, AND OTHER APPLICABLE LAWS AND POLICIES

In Prep.

CHAPTER 10: DRAFT REGULATIONS FOR THE PELAGIC FEP

In Prep.

CHAPTER 11: REFERENCES

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Appendix I: Fishing Community Descriptions for Western Pacific Region

In Prep.

Appendix II: EFH Descriptions for Pelagic MUS

In Prep.