WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL

Regulatory Amendment

Fishery Management Plan for the Precious Coral Fisheries of the Western Pacific Region

Regarding Minimum Harvest-Size Limits of Black Coral

Including an Environmental Assessment

June 27, 2007

Western Pacific Regional Fishery Management Council
1164 Bishop St., Suite 1400
Honolulu, HI 96813

Telephone (808) 522-8220
Fax (808) 522-8226

Photos by: Rick Grigg and Sam Kahng

2.0 Summary

Since 1980, virtually all of the black coral harvested in the Western Pacific Region has been taken from the Auau Channel Bed located near Maui, Hawaii. Most of this harvest has been confined to State waters. Although a substantial part of this bed is located in the Exclusive Economic Zone (EEZ), the Hawaii Department of Land and Natural Resources estimates that about 85% of the black coral harvested is collected within three miles of the shoreline (DLNR 1979), perhaps because gear constraints have restricted divers for black coral to relatively shallow waters (less than 230 ft or 70 m) (Grigg 1998a).

While it appears the harvest from the Auau Channel Bed has not had a significant effect on black coral recruitment, competition with an invasive soft coral in this area may impact black coral recruitment in the future. *Carijoa riisei,* or snowflake coral, was first observed in Hawaii (Pearl Harbor) in 1972 and off of Maui in 1990. In a recent survey of the Auau Channel Bed by the Hawaii Undersea Research Laboratory and University of Hawaii scientists, *Carijoa* was observed overgrowing and killing up to 70% of the black coral trees at depth between 223-374 ft (68-114 m). Although the fishery primarily harvests black coral at depths to 230 ft (70 m) due to conventional scuba safety concerns, the potentially devastating effect of snowflake coral combined with fishing pressure warrants further research on recruitment of black corals in the Auau Channel.

Recent research on black corals has shown that biomass of the black coral populations in the Auau Channel have decreased almost 25% between 1976 and 2001 (Grigg 2004). Comparisons of recent research to earlier surveys shows declines in both older and younger colonies, meaning that there are fewer recruits available. The cause of the reduction in biomass is still being debated, but a combination of fishing impacts and the invasion of *C. riisei* overgrowing populations at deeper sites may be having an effect upon the black coral resource.

In response to these concerns, the Western Pacific Regional Fishery Management Council examined a range of alternatives and took final action to recommend that all harvests of black corals in EEZ waters of the Auau Channel be limited to those colonies that are at least 48 inches (122 cm) in height or have a one inch (2.54 cm) base diameter (Alternative 4). A total of seven alternatives were considered by the Council to maintain the sustainability of Auau Channel black coral resources. These alternatives are summarized below and analyzed in detail in this document.

Table 1: Summary of Alternatives

Alternative	Description
1	**No Action**-Do not change existing regulations. Continue minimum size requirements (48 inch (122 cm) height or 1 inch (2.54 cm) base) as well as existing exemptions allowing harvest at ¾ inch base by persons who reported harvest to the State of Hawaii within five years prior to April 17, 2002.
2	**Remove minimum height requirement** for harvest of black coral. (Maintain base diameter requirement and exemption)
3 (preferred)	**Remove base diameter exemption** for harvest of black coral (Maintain height and base diameter requirements)
4	**Remove base diameter requirement and base diameter exemption** for the harvest of black corals (Maintain height requirement)
5	**Remove height requirement and base diameter exemption** for the harvest of black corals (Maintain base diameter requirement)
6	**Moratorium –** prohibit the harvest of black corals in the Auau Channel until recruitment has recovered

3.0 Table of Contents

3.1 List of Tables

3.2 List of Figures

3.3 List of Acronyms

CFR	Code of Federal Regulations
CNMI	Commonwealth of the Northern Mariana Islands
CRE	Coral Reef Ecosystems
DBEDT	Department of Business, Economic Development and Tourism
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FMP	Fishery Management Plan
HAPC	Habitat Area of Particular Concern
HINWR	Hawaiian Islands National Wildlife Refuge
MHI	Main Hawaiian Islands
MPA	Marine Protected Area
MMPA	Marine Mammal Protection Act
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MUS	Management Unit Species
NAO	NOAA Administrative Order
NEPA	National Environment Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NWHI	Northwestern Hawaiian Islands
OY	Optimum Yield
PIFSC	Pacific Islands Fishery Science Center
PIRO	Pacific Islands Regional Office
PMUS	Pelagic Management Unit Species
PRA	Paperwork Reduction Act
PRIA	Pacific Remote Island Areas
RFA	Regulatory Flexibility Act
ROV	Remotely Operated Vehicle
SPR	Spawning Potential Ratio
WPRFMC	Western Pacific Regional Fishery Management Council

4.0 Introduction

4.1 Responsible Agencies

The Council was established by the Magnuson-Stevens Fishery and Conservation Management Act (MSA) to develop Fishery Management Plans (FMPs) for fisheries operating in the US Exclusive Economic Zone (EEZ) around American Samoa, Guam, Hawaii and Commonwealth of the Northern Mariana Islands and the US possessions in the Pacific.[1] Once an FMP is approved by the Secretary of Commerce, it is implemented by federal regulations which are enforced by the National Marine Fisheries Service and the US Coast Guard, in cooperation with state, territorial and commonwealth agencies. For further information contact:

Kitty M. Simonds
Executive Director
Western Pacific Regional Fishery Management Council
1164 Bishop St., Suite 1400
Honolulu, HI 96813
(808) 522 8220

William L. Robinson
Regional Administrator
National Marine Fisheries Service
Pacific Islands Regional Office
1601 Kapiolani Blvd., Suite 1110
Honolulu, HI 96814
(808) 944 2207

4.2 Overview of Precious Corals Fishery Management Plan and Amendments

The Fishery Management Plan (FMP) for the precious corals fisheries of the western Pacific region was implemented in September 1983 (48 FR 39229). It established the plan's management unit species and management area, as well as classifying several known beds.

Amendment 2 to the FMP became effective January 22, 1991 (56 FR 3072, January 28, 1991) and defined overfishing for Established beds as follows: An Established bed shall be deemed overfished with respect to recruitment when the total spawning biomass (all species combined) has been reduced to 20% of its unfished condition. This definition applies to all species of precious corals and is based on cohort analysis of the pink coral, *Corallium secundum*.

Amendment 3 to the FMP became effective November 18, 1998 (63 FR 55809, October 19, 1998) and established a framework procedure for adjusting management measures in the fishery.

Framework Measure 1 to the FMP became effective April 17, 2002 (67 FR 11941, March 18, 2002) and revised the definitions of "live coral" and "dead coral," suspended the harvest of gold coral at Makapuu Bed, applied minimum size restrictions only to live precious corals prohibited the use of non-selective fishing gear to harvest precious corals, applied the minimum size restrictions for pink coral to all permit areas, and prohibited the harvest of black coral with a base diameter of less than one inch or a height of less than 48 inches (122 cm). Exemptions allowing harvests of black corals of 0.75 inches (1.9 cm) in base diameter were provided to fishermen who had reported black corals harvests to the State of Hawaii in the five years prior to April 17, 2002. The framework measure included additional proposed measures that would have applied only to

[1] Howland, Baker, Jarvis, Wake and Johnston Islands, Palmyra and Midway Atolls and Kingman Reef.

the Northwestern Hawaiian Islands (NWHI), but they were not approved because they were determined to be inconsistent with the management regime of the NWHI Coral Reef Ecosystem Reserve (see below).

Amendment 4 addressed new requirements under the 1996 Sustainable Fisheries Act (SFA). Portions of the amendment that were immediately approved included designations of essential fish habitat, definitions of overfishing and descriptions of bycatch and of some fishing communities. Those provisions became effective on February 3, 1999 (64 FR 19067, April 19, 1999). Remaining portions that were approved on July 3, 2003 (68 FR 46112, August 5, 2003) were provisions regarding Hawaii fishing communities.

Of relevance to the management of the NWHI precious corals fishery is the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve, established December 4, 2000 through Executive Order (EO) 13178 (65 FR 76903, December 7, 2000), as modified by EO 13196 on January 18, 2001 (66 FR 7395, January 23, 2001). The Reserve is managed by the Department of Commerce under the National Marine Sanctuaries Act. The EO includes prohibitions on commercial and recreational fishing, including the taking of living coral and dead coral, in certain "Reserve Preservation Areas" within the Reserve. It also includes provisions that cap the number of permits and the "annual aggregate take" for particular types of fishing based on historical levels of permit issuance and "take." These numbers and takes have not yet been determined. The EO also calls for the Secretary of Commerce to initiate the process to designate the Reserve as a National Marine Sanctuary. On June 15, 2006, President George W. Bush announced a Presidential Proclamation that established the Northwestern Hawaiian Islands as a National Monument.

Amendment 5 to the FMP was prepared and transmitted to NMFS for approval in parallel with the FMP for Coral Reef Ecosystems of the Western Pacific Region. This amendment prohibits the harvest of Precious Coral Management Unit Species in the no-take marine protected areas established under the Coral Reef Ecosystems FMP. The Coral Reef Ecosystems establishes such areas around Rose Atoll in American Samoa, Kingman Reef, Jarvis Island, Howland Island, and Baker Island. No-take areas were also proposed for the NWHI, but all measures proposed in the Coral Reef Ecosystems FMP that would have applied to the waters around the NWHI (including Midway) were disapproved because of possible conflict and duplication with the management regime of the NWHI Coral Reef Ecosystem Reserve. Accordingly, NMFS issued a Record of Decision on June 14, 2002 that partially approved the Coral Reef Ecosystems FMP and Amendment 5 to the Precious Corals FMP. A final rule implementing the Coral Reef Ecosystem FMP (including Amendment 5 to the Precious Corals FMP) was published on February 24, 2004 (69 FR 8336).

Amendment 6 included the federal waters around the Commonwealth of the Northern Mariana Islands (CNMI) within the FMP's management area, and became effective September 12, 2006 (71 FR 53605).

Following reports of the increasing presence of *Carijoa riisei* coupled with a declining biomass, at its 123rd meeting, the Council directed its staff to draft a background document analyzing the impacts of the potential removal of the base diameter exemption implemented under Framework

Measure 1. At its 124th Meeting, the Council deferred taking action until the State of Hawaii research on black corals could be reviewed by the Council's Precious Corals Plan Team and SSC. The Council took initial action at its 127th meeting and after reviewing the available information and listening to public testimony by black coral fishermen and scientists chose to remove the base diameter exemption as its preliminary preferred alternative. At its 129th Meeting, the Council took final action to recommend removing this exemption as its final preferred alternative.

4.3 Public Review Process and Schedule

A summary of this document was mailed to all individuals who hold federal permits for fisheries in the Western Pacific Region, as well as to all holders of Hawaii Commercial Marine Licenses. This document is also posted in full on the Council's website (www.wpcouncil.org) and was made available at the Council's 127th Council meeting (May 31 – June 2, 2005, Honolulu, HI). Following a public hearing at that meeting the Council reviewed this and other relevant information and took initial action by selecting a preliminarily preferred alternative. Final action was taken at the 129th Council meeting (November 8 – 11, 2005, Tumon Bay, Guam) where the Council again reviewed the information and took final action to recommend a preferred alternative. Notice of the Council's meetings, public hearings, and intent to take initial action and final action was provided in the Federal Register as well as in local newspapers.

4.4 List of Preparers

This document was prepared by (in alphabetical order):

Joshua DeMello, Fishery Analyst
Western Pacific Regional Fishery Management Council

Marcia Hamilton, Economist
Western Pacific Regional Fishery Management Council

Karla Gore
National Marine Fisheries Service, Pacific Islands Regional Office

Eric Kingma, NEPA Coordinator
Western Pacific Regional Fishery Management Council

5.0 Purpose and Need for Action

Under the Magnuson-Stevens Fishery Conservation and Management Act (MSA), the United States has exclusive fishery management authority over all fishery resources found within the Exclusive Economic Zone (EEZ). The inner boundary of the EEZ extends from the seaward boundary of each coastal state to a distance of 200 nautical miles (nm, 370 km) from the baseline from which the breadth of the territorial sea is measured. The management of these fishery resources is vested in the Secretary of Commerce (Secretary) and in eight Regional Fishery Management Councils. The Western Pacific Regional Fishery Management Council (Council) has the responsibility to prepare a fishery management plan (FMP) for any fishery requiring conservation and management in the EEZ surrounding the State of Hawaii, Territory of

American Samoa, Territory of Guam, the Commonwealth of the Northern Mariana Islands and the U.S. Pacific Remote Island Areas (PRIA) of the Western Pacific Region.

Under the MSA, FMPs, in addition to other requirements, must contain measures necessary and appropriate for the conservation and management of the fishery to prevent overfishing and rebuild overfished stocks, and to protect, restore and promote the long-term health and stability of the fishery. These measures must be consistent with national standards set forth in the MSA, regulations implementing recommendations by international organizations in which the U.S. participates and any other applicable law.

In 1980, the Council prepared, and the Secretary approved, an FMP for the precious corals fishery in the Western Pacific Region. Regulations for the fishery issued under the authority of the MSA appear at 50 CFR Part 665.

Since 1980, virtually all of the black coral harvested in the Western Pacific Region has been taken from the Auau Channel Bed near the island of Maui. Most of this harvest has been confined to State waters. Although a substantial part of this bed is located in the EEZ, the Hawaii Department of Land and Natural Resources estimates that about 85% of the black coral harvested is collected within three miles of the shoreline (DLNR 1979), perhaps because gear constraints have restricted divers for black coral to relatively shallow waters (less than 230 ft, 70 m) (Grigg 1998a).

According to a July 1998 assessment of the biological condition of the black coral in the Auau Channel, the age frequency distributions of sample populations in 1975 and 1998 are very similar (Grigg 1998a). This suggests that harvesting during the intervening years has had no significant effect on recruitment. However, the black coral resources in other areas of State waters (for example, “Stonewall” off Lahaina, Maui) that are easily accessible with conventional scuba gear were intensely harvested in the 1970s and have not recovered significantly under the relatively light fishing pressure they are now experiencing.

While it appears the harvest from the Auau Channel Bed has not had a significant effect on black coral recruitment, competition with an invasive soft coral in this area may impact black coral recruitment in the future. *Carijoa riisei*, or snowflake coral, was first observed in Hawaii (Pearl Harbor) in 1972, and off of Maui in 1990. Snowflake coral is native to the western Atlantic Ocean and Caribbean and prefers relatively shallow water (shallower than 70 ft, 21.3 m), hard substrata, and areas of moderate current flow. In a recent survey of the Auau Channel Bed by the Hawaii Undersea Research Laboratory and University of Hawaii scientists, *Carijoa* was observed overgrowing and killing up to 70% of the black coral trees at depth between 223-374 ft (68-114 m). Although the fishery primarily harvests black coral at depths to 230 ft (70 m) due to conventional scuba safety concerns, the potentially devastating effect of snowflake coral combined with fishing pressure warrants further research on recruitment of black corals in the Auau Channel.

Recent research on black corals has shown that biomass of the black coral populations in the Auau Channel have decreased almost 25% between 1976 and 2001 (Grigg 2004). Comparisons of recent research to earlier surveys shows declines in both older and younger colonies, meaning

that there are fewer recruits available. The cause of the reduction in biomass is still being debated, but a combination of fishing impacts and the invasion of *C. riisei* overgrowing populations at deeper sites may be having an effect upon the black coral resource.

The biomass of black coral has declined in the Auau Channel, Hawaii. There are uncertainties regarding the causes of the decline in the Auau Channel, but evidence suggests that a combination of factors, including impacts from fishing, is contributing to this decline.

The purpose of this action is to sustain the population of black coral in the Auau Channel by reducing the impacts of fishing. With recognition that there is likely a combination of factors, including the presence of *C. riisei*, that is contributing to the decline of black coral in the Auau Channel, the need is for revisions to the minimum size regulations of black coral under the Precious Corals Fishery Management Plan (FMP) to address the contribution of fishing impacts to this decline.

6.0 Management Objectives

The recommended adjustments to management measures in the FMP would help achieve the following objectives:

1. Allow a fishery for precious coral in the EEZ;

2. Prevent overfishing and wastage of the resource;

3. Minimize the harvest of immature colonies of coral;

4. Minimize the harvest of colonies of coral which have not reached their full potential for growth;

7.0 Management Alternatives

Seven management alternatives are proposed to address the issue of threats to the sustainability of black coral resources in the western Pacific.. These alternatives are described below.

7.1 Description of the Alternatives

7.1.1 Alternative 1- No Action

Under this alternative, the precious corals fishery would continue to be conducted according to existing management measures contained in the FMP. EEZ harvests of black coral would continue to be limited to those with either a height of at least 48 inches (122 cm) or a base diameter of at least 1 inch (2.54 cm), with the exception of Hawaii EEZ harvests of black corals that have a base diameter of at least ¾ inch (1.9 cm) by exempted fishermen.

7.1.2 Alternative 2-Remove minimum height requirement

Under this alternative, the Precious Corals FMP management measures would be adjusted to remove the minimum height requirement. The base diameter exemption would remain in effect. This alternative would limit EEZ black coral harvests to those with a base diameter of at least 1

inch (2.54 cm), with the exception of harvests of Hawaii EEZ black corals with a base diameter of at least ¾ inch (1.9 cm) by exempted fishermen.

7.1.3 Alternative 3-Remove minimum base diameter exemption (Preferred)

Under this alternative, the Precious Corals FMP management measures would be adjusted to remove the base diameter exemption. This alternative would limit EEZ black coral harvests to those that either have a height of at least 48 inches (122 cm) or a base diameter of at least 1 inch (2.54 cm).

7.1.4 Alternative 4- Remove minimum base diameter requirement and minimum base diameter exemption

Under this alternative, the Precious Corals FMP management measures would be adjusted to remove the minimum base diameter requirement and to remove the base diameter exemption. This alternative would limit EEZ black coral harvests to those with a height of at least 48 inches (122 cm).

7.1.5 Alternative 5-Remove minimum height requirement and minimum base diameter exemption

Under this alternative, the Precious Corals FMP management measures would be adjusted to remove the minimum height requirement and to remove the base diameter exemption. This alternative would limit EEZ black coral harvests to those with base diameter of at least 1 inch (2.54 cm).

7.1.6 Alternative 6-Institute a moratorium for black coral harvest in the Auau Channel until recruitment is recovered

Under this alternative, black coral harvest in the Auau Channel of Hawaii would be prohibited for a five-year period, during which scientific research would monitor black coral resources. The fishery may be re-opened after five-years if scientific research suggests that recruitment of black coral populations has increased. If scientific research suggests that recruitment has not recovered, the moratorium would continue until research shows that recruitment has recovered.

7.2 Alternatives Considered But Not Analyzed

Limiting the number of fishery participants

To date the fishery has been self-limiting due to the dangers of deepwater diving, large predators, and a small market for jewelry quality black coral. These factors have kept participation in this fishery low, and it currently employs less than three commercial fishermen. Due to these reasons, a limit on participation does not appear necessary at this time.

Seasonal Closures

Seasonal closures to ensure that corals could spawn and recruit were not considered because virtually nothing is known about the life cycle and reproduction of black corals in Hawaii and there is not enough research to accurately predict spawning seasons or the flow of recruitment.

Area Closures

Black corals are found in deep water and highly aggregated on, or under, vertical drop-offs, terraces, or undercut notches. Closing an area with this type of habitat, however, does not necessarily mean closing an area with black corals. The black coral resources are not confined to one area, but are found in outcrops in many different areas. One area closure solution would include closing off the entire EEZ area in the Auau Channel to black coral harvest. This idea is represented as Alternative 6. Smaller closed areas would not be effective because the majority of the harvest is being done in State of Hawaii waters. The Council is currently working with the State of Hawaii, fishermen, and other stakeholders in developing an area that would be off-limits to harvesting, but open to research.

8.0 Affected Environment

This section provides information on the environment in which the precious corals fishery is managed under the FMP. Where possible, trends in the condition of resources, ecosystems and human communities have been identified. This information will provide the baseline and historical context needed to evaluate the environmental consequences and cumulative effects of the proposed alternatives.

8.1 TARGET SPECIES

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 suspension feeders (i.e. they feed on suspended particles but do not filter the water as a tunicate, sponge, or bivalve might do); 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 substrates, 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 natural 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 over exploitation. First, the response of the population to over exploitation is drawn out over many years. Second, because of the 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 should be insulated from short-term drastic changes in the physical environment. For the same reason, it is difficult to imagine circumstances in which man-made pollution would affect their environment, except in the unlikely event that large quantities of heavy material, such as waste from manganese nodule refining, were dumped directly on a bed. There is little available information on the long-term effects of changes in environmental conditions, such as water temperature or current velocity, on the reproduction, growth, or other life activities of the precious corals.

Hawaii populations of *Corallium secundum* and *A. dichotoma* appear relatively stable, implying a balance between recruitment and mortality.

8.1.1 Taxonomy, Biology and Ecology of Precious Corals

The Precious Corals FMP Management Unit Species (MUS) are taxonomically classified as members of the phylum Cnidaria, which includes all of the corals, hydroids, jellyfish and sea anemones. Its members are characterized by the presence of:

- a sac-like body with only one opening for the gut;
- only two tissue layers, an outer protective layer of epidermis and an inner digestive layer, the gastrodermis, lining the gut cavity;
- an intermediate layer called the "mesoglea" or "middle jelly" consisting mostly of protein fibers and generally lacking cells; and
- stinging devices called nematocysts used in either prey capture or defense.

Within the Cnidaria, precious corals are placed in the class Anthozoa, which includes the corals, soft corals and sea anemones, all characterized by having a relatively complicated gut compared with other cnidarians. Living tissues are composed of polyps, each with a mouth surrounded by tentacles. Some species are composed of a single polyp while others are colonies of many polyps.

Within the Anthozoa, precious corals are members of three orders in two subclasses: 1) subclass Octocorallia (or Alcyonaria), order Gorgonacea, and 2) subclass Hexacorallia (or Zoantharia), orders Zoanthidae and Antipathidae.

Other anthozoans have their tentacles in multiples of six and are thus termed the Hexacorallia, or hexacorals. Hexacoral MUS include gold corals of the order Zoanthidea and black corals of the order Antipathidae.

Antipatharia contain the well known precious black or "thorny" coral. These tree-like corals have a thin axial skeleton with distinctive small thorns. A thin veneer of animal tissue, called the cenosarc, secretes the tightly-layered central skeleton of horn-like protein. Depending upon the species, the living tissue may be black, red, orange, brown, green, yellow or white. The gelatinous polyps located in this living "bark" are short and cylindrical, their six, non-retractable tentacles are armed with stinging cells.

More than 150 species of black corals have been described worldwide. Some, like the wire corals, grow as a single, spiral coil. Many others have a dendritic growth form, creating a fan shape or elaborate tangle of tree-like branches. At least 14 species of black corals are currently known from Hawaii.

Relatively little is known about the life cycle and reproduction of black corals. Like other cnidarians, black corals have life cycles that include both asexual and sexual reproduction. Asexual reproduction (budding) builds the colony by adding more living tissue that, in turn, secretes more skeleton. Regular growth rings laid down as the skeleton thickens can be used to estimate the age of the colony. Sexual reproduction involves the production of eggs and sperm to create young that can disperse and settle new areas. The larvae of several black coral species are

negatively phototactic (Grigg 1965), and are most abundant in dimly lit areas, such as beneath overhangs and ledges in waters deeper than 98 ft (30 m). All species require firm, hard substrates free of sediment. Polyps are either male or female. The larval stage, called a planula, can drift with currents until a suitable surface is found. Once the larva settles, it metamorphoses into a polyp form and secretes skeletal material that attaches it to the seafloor. Then it begins budding, creating more polyps that will form a young colony. In one Hawaiian species that has been studied (*Antipathes dichotoma*, an MUS), the colony may grow about 2.5 inches (6.4 cm) per year. The age at reproductive maturity is 12-13 years for *Antipathes dichotoma*. Reproduction may occur annually. A large six-foot (1.8 m) tall coral tree is estimated to be between 30 and 40 years old. The oldest corals observed in the Maui Auau Channel Bed are thought to be 75 years old, and it is believed that black corals may live even longer.

Western Pacific precious coral larvae are more affected by light and temperature than are adults. Larvae of *Antipathes* species occurring in Hawaii are known to be negatively phototactic, which is why they are not found shallower than 98 ft (30 m). The lower limit of the *A. dichotoma* and *A. grandis* black corals coincides with the top of the thermocline in the high Hawaiian Islands (Grigg 1993).

8.1.2 Distribution of Precious Corals in the Western Pacific Region

Precious corals are known to exist in the EEZ around Hawaii and very likely exist in the EEZ around American Samoa, Guam, the Northern Mariana Islands and the remote U.S. Pacific Island possessions, but virtually nothing is known of their distribution and abundance in these areas outside of Hawaii. In America Samoa, there are three known areas with pink coral: near Upolu and Falealupo, and at Tupuola Bank (Carleton and Philipson 1987). In the Northern Mariana Islands, Japanese fishermen have reported pink coral north of Pagan Island and near Rota and Saipan. Since these areas remain unsurveyed, no information is available regarding the abundance of coral present.

There are three known major black coral beds in the Western Pacific Region, in addition to several minor beds (Grigg 1998a). Most of these are located in Hawaii's state waters (0-3 nm, 0-5.5 km). However the largest (the Auau Channel Bed) extends into federal waters of the EEZ. There are undocumented and unconfirmed reports that precious corals have been observed or exploited in widely scattered locations in the Western Pacific Region: off American Samoa, Guam, the Northern Mariana Islands, and Wake Island, but no details are available. In some cases attempts at scientific surveys in areas referred to in such reports have failed to turn up any evidence of precious corals. Undocumented reports of large past commercial production by Japanese vessels on the Milwaukee Banks, some 500 miles (804 km) beyond the northwestern extreme of the NWHI, and the large physical area of those banks, lead to conjecture that at some locations precious corals may occur in much larger aggregations than have as yet been demonstrated by scientific surveys. Asian coral fishers, who have roamed the western and central Pacific for decades, undoubtedly have undocumented and unorganized information on precious corals beds which has yet to be revealed to US researchers and or resource managers. In general, the available information on precious corals occurrence and distribution is fragmentary and very incomplete, and there is a high probability that further surveying and prospecting will reveal significant additional precious corals resources in areas under US jurisdiction. The beds described below are shown on Figure 1.

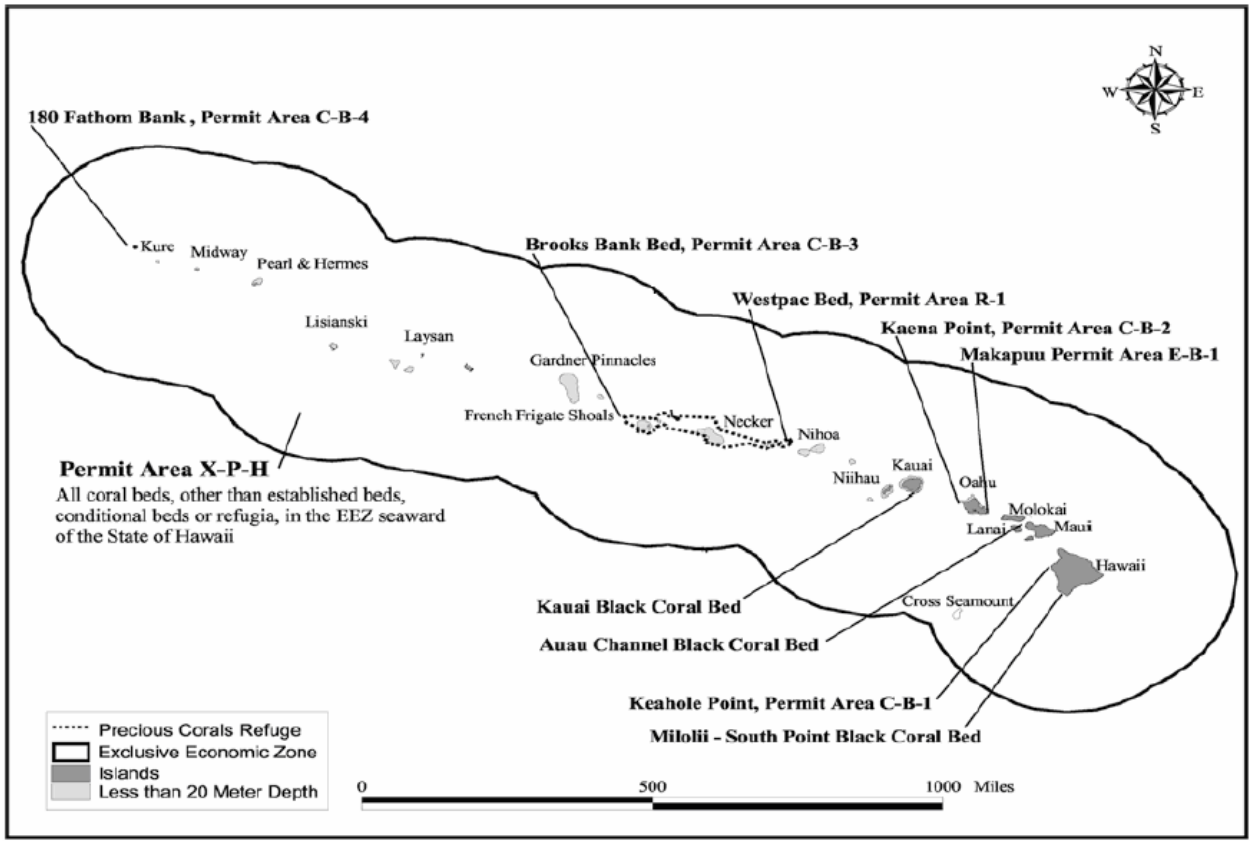

Figure 1: Precious Coral Beds in Hawaii

8.1.2.1 Black Coral Beds

Oishi (1990) and Grigg (1998b) summarized available information on Hawaii's black coral resources as follows:[8] Grigg and Opresko (1977) reported 14 species of black coral known to occur in Hawaiian waters. Historically, however, commercial fishermen have harvested only three species, *Antipathes dichotoma* (almost 90% of commercial harvest), *A. grandis* (10%), and *A. ulex* (1%). The two major species (*A. dichotoma* and *A. grandis*) are found in coastal waters from Hawaii to Niihau and their range may extend into the NWHI. *A. dichotoma* is found at depths from 30 to 110 m while *A. grandis* occurs at depths from 45 to 110 m. Within their depth ranges, both species can be found highly aggregated on, or under, vertical drop-offs, terraces, or undercut notches. The growth rates for *A. dichotoma* and *A. grandis* have been estimated to be 6.42 cm per year and 6.12 cm per year respectively. Plotting gonad diameter versus colony height, Grigg (1976) estimated the size of reproductively mature *A. dichotoma* colonies to range from 64 to 80 cm. This implies an age at reproduction of 10 to 12.5 years.

There are two known major beds of black coral in the Western Pacific Region (the Auau Channel Bed and the Kauai Bed), and several minor beds. Most of these are located in Hawaii's state waters. However, the largest (the Auau Channel Bed) extends into the EEZ, and thus the Council and Hawaii share jurisdiction over this bed.

[8] Much of this information is drawn from Grigg (1976).

The commercial harvest of black coral has occurred in the waters around Hawaii for more than three decades. Commercial harvest of black coral has occurred in the Auau Channel Bed and in the Kauai Bed. By 1976, Grigg had determined the aerial coverage of these beds to be 1.7 km^2 and 0.4 km^2 respectively, and MSY (calculated using a Beverton and Holt yield production model) for the two beds were estimated to be 6,174 kg/yr and 1,480 kg/yr (Grigg 1976).

These values were adjusted downwards by about 20% to recommend MSY of 5,000 kg/yr and 1,250 kg/yr, respectively. These values correspond to a minimum size limit of 1.2 m (48 inches) for both species and thus allow smaller but fewer colonies to be harvested, which is consistent with economic considerations (optimum yield) and traditional fishing practices (Grigg 1998a).

Since 1980, virtually all of the black coral harvested around the Hawaiian Islands has been taken from the Auau Channel Bed. Most of this harvest has been confined to State waters. Although a substantial part of this bed is located in the EEZ, the Hawaii Department of Land and Natural Resources estimates that about 85% of the black coral harvested is collected within three miles of the shoreline (DLNR 1979), perhaps because gear constraints have restricted divers for black coral to relatively shallow waters (70 m or less) (Grigg 1998a). Amendment 4 to the FMP designated the Auau Channel as a habitat area of particular concern for the precious corals fishery because of the ecological function it provides, the rarity of the habitat type, and its sensitivity to human-induced environmental degradation. Its commercial importance was also considered.

According to a July 1998 assessment of the biological condition of the black coral in the Auau Channel, the age frequency distributions of sample populations in 1975 and 1998 are very similar (Grigg 1998a). This suggests that harvesting during the intervening years has had no significant effect on recruitment. However, the black coral resources in other areas of State waters (for example, “Stonewall” off Lahaina, Maui) that are easily accessible with conventional scuba gear were intensely harvested in the 1970s and have not recovered significantly under the relatively light fishing pressure they are now experiencing.

While it appears the harvest from the Auau Channel Bed has had not had a significant effect on black coral recruitment, competition with an invasive soft coral may impact black coral recruitment in the future. *Carijoa riisei* or snowflake coral, was first observed in Hawaii (Pearl Harbor) in 1972. Snowflake coral is native to the western Atlantic Ocean and Caribbean and prefers relatively deeper water (> 230 ft or 70 m), hard substrata, and areas of moderate current flow. In a recent survey of the Auau Channel Bed by the Hawaii Undersea Research Laboratory using its Pisces submersible, *Carijoa* was observed overgrowing and killing up to 70% of the black coral trees at depth between 223-374 ft (68-114 m). Although the fishery primarily harvests black coral at depths to 230 ft (70 m) due conventional scuba safety concerns, the potentially devastating effect of snowflake coral combined with fishing pressure warrants further research on recruitment of black corals in the Auau Channel. The effects of *Carijoa riisei* on the black coral beds in the Auau Channel are uncertain at this time and research is continuing to determine these effects.

To date, black coral in Hawaii has been hand harvested by a small group of divers using conventional scuba gear with compressed air. As noted above, the maximum depth to which divers using this gear can safely descend is less than 246 ft (75 m). However, mixed-gas diving methods and re-breathers would enable scuba divers to dive to the maximum depth (about 361 ft, 110 m) at which colonies of black coral are known to occur. The segment of the population between 262-361 ft (80-100 m), which currently may represent a reservoir for recruitment, would be exposed to fishermen. These diving methods also allow harvesters to extend the length of time that they can safely spend underwater. The cost of this equipment has declined in recent years, making it somewhat financially feasible for many divers to purchase the gear. Although rebreathers are not yet being used to harvest black coral in Hawaii, some harvesters are experimenting with towed underwater camera systems and other technology that could increase the output from old harvest areas and lead to the discovery of new beds.

An increase in the level of black coral harvested is likely if vessels equipped with manned submersibles and remotely operated vehicles (ROV) enter the fishery. These gear types are far more efficient than the hand harvest techniques described above, in terms of locating and harvesting black coral beds. In recent years, the capital and operating costs of manned submersibles and ROV have become more affordable. Although the ex-vessel price of black coral is low compared to that of other precious corals, the cost of harvesting black coral is also lower because of the relatively shallow depths at which black coral occurs.

Increased demand for black coral could also result in greater harvesting pressure on black coral resources. In the past, the market for black coral colonies small enough to fit inside the typical curio display case or household aquarium was small in comparison to the market for the larger trees that are processed for jewelry (Oishi 1990). However, according to the Hawaii Division of Aquatic Resources, the demand in Hawaii for small, immature black coral colonies may increase in the near future as the popularity of marine aquaria grows. The demand for coral harvested in the waters around Hawaii could also increase if out-of-state markets for raw black coral are pursued by Hawaii coral processors, or if current imports of cut and polished black coral from Taiwan into Hawaii decrease (Grigg 1998a).

The number of people participating in the commercial black coral fishery in Hawaii has typically been restricted to a small group of experienced divers because of the considerable danger involved in harvesting the coral. This select group has been getting smaller in recent years as veterans retire and no new divers take their place. Currently, only about three individuals are still active in the fishery. This attrition within the fishery may limit the quantity of black coral harvested.

8.1.3 Maximum Sustainable Yield of Precious Corals Stocks

According to the FMP, if recruitment is constant or independent of stock size, then the maximum sustainable yield (MSY) can be determined from controlling the fishing mortality rate (F) to maximize the yield per recruit (MYPR), i.e., MSY=MYPR (g/recruit) x R (recruits/yr). MYPR is a function of area of the bed, average colony density and natural mortality. If a stock-recruitment relationship exists, recruitment is reduced as a function of reduced stock size, and MSY will also be reduced. The assumption of constant recruitment

appears to be reasonable based on the robust recovery and verification of annual growth rings from a previous survey (Grigg 1977).

MSY has also been estimated to correspond to a 30% spawning potential ratio (SPR) level to maintain 30% of the spawning stock biomass. The Council currently manages at the MSY level. The present status of the Auau Channel bed, the major black coral bed in Hawaii that is currently being commercially harvested, can be described as good, particularly with regard to levels of recruitment and a rate of harvest that has not exceeded the estimated MSY. An assessment of the biological condition of the black coral beds in the Auau Channel was conducted in 1998 (Grigg 1998a). The age frequency distributions of sample populations in 1975 and 1998 are very similar, suggesting that harvesting during the intervening years has had no significant effect on recruitment. However, more accessible black coral resources in other areas of state waters (for example, "Stonewall" off Lahaina, Maui) that were intensely harvested in the 1970s, have not completely recovered. MSY for black coral in the Auau coral bed has been estimated at 5,000 kg or 11,023 lb/yr (Grigg 1976).

The current minimum size limit for black coral prevents the harvest of colonies which have not reached their full potential for growth, thereby reducing the potential for overfishing to occur. Black coral colonies reach sexual maturity at 10 to 12.5 years of age, corresponding to a tree height of 25 to 31 inches (63.5-78.7 cm) (Grigg 1976). A coral colony that has attained a height of 48 inches (122 cm) or basal stem diameter of 1 inch (2.54 cm) corresponds to an age of about 20 years, which is approximately 8 to 10 years after black coral colonies reach sexual maturity. Hence, the size limit provides an adequate reproductive cushion (the difference between age at reproductive maturity and the age at first capture) for recruitment and reduces the risk of overfishing black coral resources. Data on the estimated MSY and growth rates indicate that 48 inches (122 cm) is the minimum acceptable harvesting size limit for sustaining maximum yield (Grigg 1998a).

The minimum size is currently exempt for fishers who meet the exemption allowing harvest of black corals with a minimum base diameter of ¾ inch (1.9 cm) by persons who reported harvest to the State of Hawaii within five years prior to April 17, 2002. The recent discovery of *Carijoa riisei* in the Auau Channel is an added pressure to this resource. First discovered in Pearl Harbor in 1972, *C. riisei* has been observed overgrowing and killing up to 70% of the reproductive black coral in the Auau Channel is an added pressure to the black coral resources in the area. While the current minimum size limit of 48 inches (122 cm) is an adequate reproduction cushion, the current harvest minimum size for those exempt fishermen provides less of a cushion.

8.2 NON-TARGET SPECIES

Traditionally, foreign fisheries for precious corals utilized non-selective dredges and tangle nets. The Precious Corals FMP estimated that if non-selective gear is used, only 40% of the corals that are "knocked down" during the harvesting process are recovered. The existing FMP, however, only allows selective gear to harvest corals from any precious corals permit area. Selective gear means any gear used for harvesting corals that can discriminate or differentiate between type, size, quality, or characteristics of living or dead corals. Black coral are collected with scuba gear, and deep-water species of precious corals are harvested

using manned submersibles or ROVs. The use of manned submersibles is a highly selective method of harvest. Minimal bycatch is also expected with the use of ROVs, although the ROV tether may damage precious corals if not carefully tended.

8.3 RELATIONSHIP WITH PROTECTED SPECIES

Protected species include those species listed as endangered or threatened under the Endangered Species Act (ESA), all marine mammals, listed or not, as they are protected under the Marine Mammal Protection Act (MMPA), and seabirds. Appropriate information on the species' life history, habitat and distribution, and other factors necessary to its survival, is included to provide background for analyses in other sections of this document.

8.3.1 Marine Mammals

Protected marine mammals fall into two categories: species listed under the ESA and those species which are not listed, but otherwise protected under the MMPA. Cetaceans and pinnipeds are discussed separately in the sections below.

8.3.1.1 Listed Cetaceans

There are six species of cetaceans listed under the ESA that are known to occur within the Western Pacific Region. These species are the blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), sei whale (*Balaenoptera borealis*), sperm whale (*Physeter macrocephalus*), and right whale (*Eubalaena glacialis*).

Although these whales may be found within the action area and could interact with the U.S. fisheries of the Western Pacific Region, no reported or observed interactions of these species have occurred in the black coral fishery. There could be some indirect impacts from routine vessel operations such as a low-level risk of behavioral disturbances, collisions, or entanglements with fishing gear, however no such impacts have been reported or observed.

A Biological Opinion (BiOp) was issued on October 4, 1978, for the Precious Coral FMP, which determined the fishery does not constitute a threat to endangered marine mammals (humpback whale, sperm whale, and Hawaiian monk seal) and endangered and threatened sea turtles (leatherback and green turtle) or destroy or adversely modify their critical habitat. On August 15, 2000, an informal consultation was initiated an a Letter of Concurrence was issued on December 20, 2000, which determined proposed regulatory changes to the Precious Coral FMP were not likely to adversely affect green turtles, hawksbill turtles, humpback whales, and Hawaiian monk seals.

8.3.1.2 Other Cetacea

Species of marine mammals that are not listed under the ESA but are protected under the MMPA and occur in the areas of the Western Pacific Region where precious corals fisheries may operate are as follows:

- Blainsville beaked whale *(Mesoplodon densirostris*)
- Bottlenose dolphin (*Tursiops truncatus)*
- Bryde's whale (*Balaenoptera edeni*)
- Cuvier's beaked whale (*Ziphius cavirostris*)

- Dwarf sperm whale (*Kogia simus*)
- False killer whale (*Pseudorca crassidens*)
- Killer whale (*Orcinus orca*)
- Melon-headed whale (*Peponocephala electra*)
- Pygmy killer whale (*Feresa attenuata*)
- Pygmy sperm whale (*Kogia breviceps*)
- Risso's dolphin *(Grampus griseus*)
- Rough-toothed dolphin (*Steno bredanensis*)
- Short-finned pilot whale (*Globicephala macrorhynchus*)
- Spinner dolphin (*Stenella longirostris*)
- Spotted dolphin (*Stenella attenuata*)
- Striped dolphin (*Stenella coeruleoalba*)
- Pacific white-sided dolphin (*Lagenorhynchus obliquidens*)

Although the species listed above may be found within the action area and could interact with black coral fishery in the Western Pacific Region, there have been no reported or observed interactions between these species and the black coral fishery. There is no current expectation of future interactions between these species and the black coral fishery and therefore, they will not be described in greater detail in this document.

8.3.1.3 Listed Pinniped: The Hawaiian Monk Seal

In 1976, the Hawaiian monk seal was listed as endangered under the ESA following a 50% decline in beach counts from the late 1950s to the mid-1970s. It was also designated a depleted species in 1976 under the MMPA. The Hawaiian monk seal is the most endangered pinniped in U.S. waters and is second only to the northern right whale as the nation's most endangered marine mammal (Marine Mammal Commission 1999). The Hawaiian monk seal is also the only endangered marine mammal that exists wholly within the jurisdiction of the United States.

There have been no reported interactions between monk seals and the black coral fishery.

8.3.2 Sea Turtles

All sea turtles are designated as either threatened or endangered under the Endangered Species Act. The five species of sea turtles known to be present in the western Pacific region where the precious coral fisheries operate are: the leatherback (*Dermochelys coriacea*), the olive ridley (*Lepidochelys olivacea*), the hawksbill *(Eretmochelys imbricata*), the loggerhead (*Caretta caretta*), and the green turtle (*Chelonia mydas*).

There have been no reported interactions between sea turtles and the black coral fishery.

8.3.3 Seabirds

Although there are several seabird colonies in the MHI, the NWHI colonies harbor more than 90% of the total Hawaiian Archipelago seabird population. The NWHI provide most of the nesting habitat for more than 14 million Pacific seabirds. More than 99% of the world's Laysan albatross (*Phoebastria immutabilis*) and 98% of the world's black-footed albatross

(*P. nigripes*) return to the NWHI to reproduce. Of the 18 species of seabirds recorded in the NWHI, only the short-tailed albatross (*P. albatrus*) is listed as endangered under the ESA. The short-tailed albatross population is the smallest of any of the albatross species occurring in the North Pacific. A few short-tailed albatrosses have also been observed attempting to breed, although unsuccessfully, at Midway Atoll in the NWHI. The primary threats to the species are destruction of breeding habitat by volcanic eruption or mud- and landslides, reduced genetic variability, limited breeding distribution, plastics ingestion, contaminants, airplane strikes, and incidental capture in longline fisheries.

There have been no reported interactions between seabirds and the precious corals fisheries.

8.4 ESSENTIAL FISH HABITAT, BIODIVERSITY AND ECOSYSTEMS

The MSA identifies essential fish habitat (EFH) as those waters and substrate necessary to fish for spawning, breeding, feeding, and growth to maturity. This includes the marine and aquatic areas and their chemical and biological properties that are utilized by the organism. Substrate includes sediment, hard bottom, and other structural relief underlying the water column along with their associated biological communities.

The NMFS produced guidelines to assist in the implementation of the EFH requirements of the MSA. These guidelines state that the quality of the available data should be rated using a four level system as follows:

•**Level 1**: All that is known is the occurrence of a species based on distribution data for all or part of the geographic range of the species.

•**Level 2**: Data on habitat related densities or relative abundance of the species where available.

•**Level 3**: Data on growth, reproduction, or survival rates within habitats where available.

•**Level 4**: Data on production rates by habitat.

At present there are not enough data on relative productivity of various habitats for precious corals within the region to develop EFH designations based on Level 2, 3 or 4 data. To address the requirements in section 303(a)(7) of the MSA, the Council drafted Amendment 4 to the Precious Corals FMP. To reduce the complexity and number of EFH identifications required for individual species and life stages, the Council designated EFH for precious corals species assemblages (Table 2). The designation of these assemblages is based on the ecological relationships among species and their preferred habitat.

Table 2: Species Groups for Precious Coral Management Unit Species

SPECIES ASSEMBLAGE	INCLUDED SPECIES
Deep-Water (300-1500 m)	*Corallium secundum, C. regala, C. laauense, C.* sp. nov., *Gerardia* sp., *Calligorgia gilberti, Narella* spp., *Calyptrophora* spp., *Lepidisis olapa, Acanella* spp.
Shallow-Water (30-100 m)	*Antipathes dichomata, A. grandis, A. ulex*

Precious corals are known to exist in Hawaii, American Samoa, Guam, the Northern Mariana Islands, and other US possessions in the Pacific, but very little is known about the distribution or abundance of the precious corals in the region.

In America Samoa, there are three known areas with pink coral: near Upolu and Falealupo, and at Tupuola Bank (Carleton and Philipson 1987). In the Northern Mariana Islands, Japanese fishermen have reported pink coral north of Pagan Island and near Rota and Saipan. Since these areas remain unsurveyed, no information is available regarding the abundance of coral present.

In the Hawaiian archipelago, precious corals beds are found only in deep inter-island channels with depths of 300 - 1500 m (984-4921 ft), and off promontories at depths of 30-100 m (98-328 ft) for black coral. Currently, pink, gold, and bamboo coral are known to occur in seven beds: Keahole Point, Makapuu, Kaena Point, Westpac, Brooks Bank, 180 Fathom Bank, and the recently discovered FFS-Gold Pinnacles bed near French Frigate Shoals (Figure 1). The Westpac Bed, located in the NWHI between Necker and Nihoa Islands, has been set aside for baseline studies and as a reproductive reserve. Harvesting of precious corals is prohibited in the Westpac Bed.

8.4.1 Essential Fish Habitat for Precious Corals MUS

The designation by the Council of EFH for precious corals was based on the best available scientific information, which was obtained through an iterative process consisting of a series of public meetings, and through scientific, industry, and FMP panel meetings. In addition, the Council worked in close cooperation with scientists from the NMFS Southwest Fisheries Science Center, NMFS Pacific Islands Fisheries Science Center (PIFSC), NMFS Pacific Islands Regional Office (PIRO), and the NMFS Southwest Region Office (WPRFMC 1998). Careful judgment was used in determining the extent of EFH that should be designated to ensure that sufficient habitat in good condition is available to maintain a sustainable fishery and the managed species contribution to a healthy ecosystem. Because there are large gaps in scientific knowledge about life histories and habitat requirements of many of the managed species in the Western Pacific Region, the Council adopted a precautionary approach in designating EFH to ensure that enough habitat is protected to sustain the managed species. Under this precautionary approach, the Council designated the six previously known beds as EFH for precious corals. The FFS-Gold Pinnacles Bed was undiscovered at the time of the designations. Additionally, three black coral beds in the MHI are designated as EFH: - a bed between Milolii and South Point off the Island of Hawaii, a bed in the Auau Channel between Maui and Lanai; and a bed off the southern coast of Kauai (Figure 1).

8.4.2 Habitat Areas of Particular Concern for Precious Corals MUS

The Council designates Habitat Area of Particular Concern (HAPC) based on the following criteria: ecological function of the habitat is important, habitat is sensitive to anthropogenic degradation, development activities are or will stress the habitat, or the habitat type is rare. Three of the six beds in the Hawaiian Archipelago are designated as HAPC - Makapuu, Westpac, and Brooks Bank. Makapuu bed was designated as HAPC because of the ecological function it provides, the rarity of the habitat type and its sensitivity to human-induced environmental degradation. The potential commercial importance and the amount of scientific information that has been collected on Makapuu bed were also considered. Westpac bed was designated as HAPC because of the ecological function it provides and the rarity of the habitat type. Its refugia status was also considered. Brooks Bank was designated HAPC because of the ecological function it provides and the rarity of the habitat type. Its possible importance as foraging habitat for the Hawaiian monk seal was also considered. An additional area, the Auau Channel, was designated as HAPC for black coral because of its ecological function, the rarity of the habitat type, and its sensitivity to human-induced environmental degradation.

8.4.2.1 Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC) for all Western Pacific FMPs

Table 3: Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC) for all Western Pacific FMPs

FMP	EFH (Juveniles and Adults)	EFH (Eggs and Larvae)	HAPC
Precious Corals	Keahole Point, Makapuu, Kaena Point, Westpac, Brooks Bank, 180 Fathom Bank deep water precious corals beds and Milolii, FFS-Gold Pinnacles Bed, Auau Channel and S. Kauai black coral beds	Not applicable	Makapuu, Westpac, and Brooks Bank deep water precious corals beds and the Auau Channel black coral bed

Note: All areas are bounded by the shoreline and the outer boundary of the EEZ, unless otherwise indicated.

8.5 COMMERCIAL, RECREATIONAL AND CHARTER FISHING SECTORS

Most of the information in this section pertains only to the black coral fishery occurring in Auau Channel off Maui, as currently, it is the only fishery harvesting precious corals MUS in the EEZ (with the majority of harvest occurring in State of Hawaii waters). In 2001, American Marines Services Group received federal permits to harvest deep-water precious corals at the Makapuu Bed and in the Hawaii Exploratory Area. The company did not renew its permit. No precious corals harvester has received a federal permit to fish in the EEZ surrounding American Samoa or Guam since the implementation of the FMP in 1980.

8.5.1 Harvests

Between 1990 and 1997, the annual harvest of black coral in Hawaii varied from a low of 864 lb (392 kg) to a high of 6,017 lb (2729 kg), with a yearly average of 3,084 lb (1399 kg). As noted above, the harvest of black coral has occurred mainly in State of Hawaii waters.

Table 6 provides historical landings and value of the black corals harvest between 1990-1997. Annual landings and value of the black corals recently harvested in Hawaii cannot be presented due to the State of Hawaii's statutory data confidentiality requirements. However, black coral fishery landings from 1985-2005 were aggregated into seven year bins that included multiple fishers to meet the confidentiality policy. During this time period, black coral landings overall increased, with the bulk of the landings occurring in the last seven years. It is believed that the majority, if not all, of the catch is caught from the Auau Channel (WPRFMC 2006). The landings from that period of 1999-2005 were more than the double the previous time period (see Figure 3).

Table 4: Weight and Value of Black Coral Landings in Hawaii 1990-97 (Conversion 2.2 lb = 1 kg).

YEAR	HARVESTED (LB)	SOLD (LB)	VALUE ($)
1990	2,349	2,169	31,575
1991	2,305	2,250	35,080
1992	2,398	2,328	46,560
1993	864	769	15,380
1994	4,354	4,209	84,180
1995	6,017	5,912	122,765
1996	4,865	1,703	41,325
1997	1,520	415	10,394

Source: Hawaii Division of Aquatic Resources

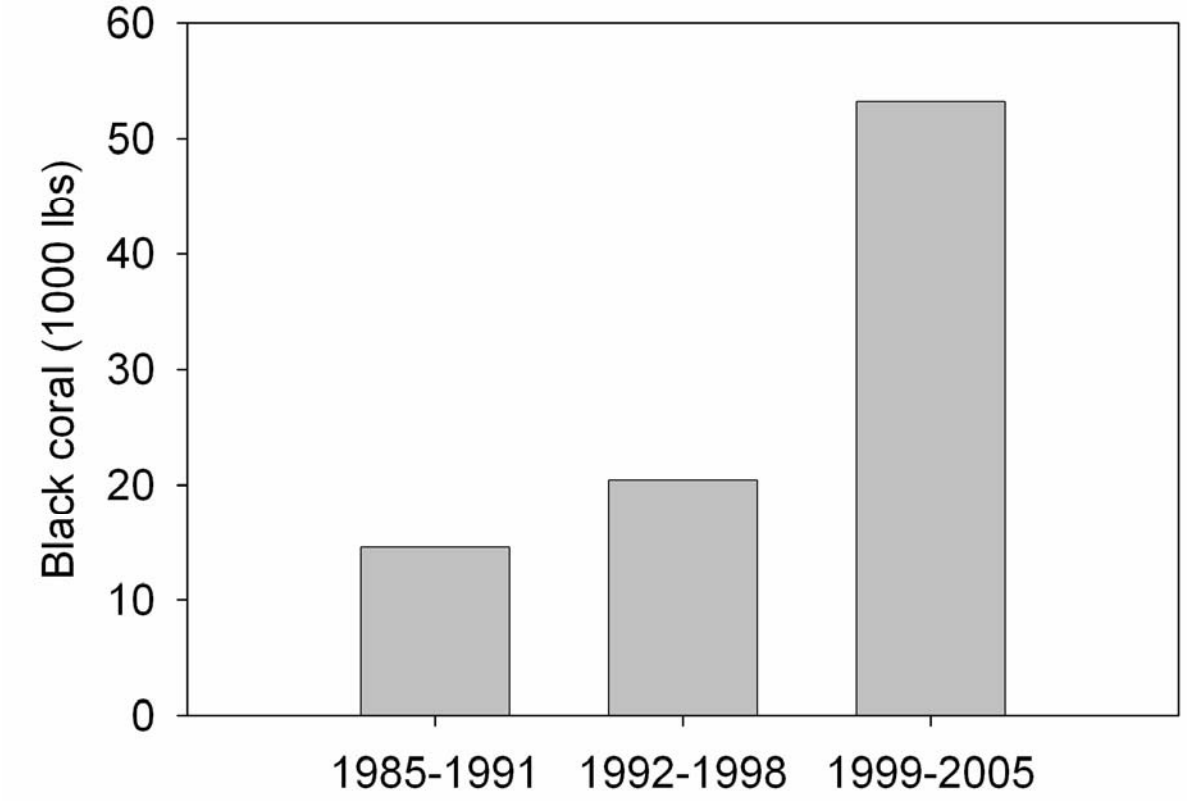

Figure 2: Weight of Black Coral Landed in Hawaii, 1985-2005 (Conversion 2.2 lb = 1 kg). Source: WPRFMC 2006

8.5.2 Participation

Since the inception of the black coral fishery in Hawaii in the late 1950s, generally fewer than ten individuals have been active in the fishery at any one time. Participation has probably been limited by the relatively small market for black coral in Hawaii and the extreme physical danger of harvesting operations. In 2007, there are less than three active commercial black coral harvesters in Hawaii reporting their catch to the State of Hawaii, and less than three active commercial black coral harvester with a Federal permit.

8.5.3 Markets

The naming of black coral as the Hawaii state "gem" in 1987 increased consumer interest in this precious coral (Grigg 1993). However, the quantity of black coral required by jewelry manufactures in Hawaii has dropped considerably because the jewelry items produced are smaller and of higher quality and because modern cutting procedures have become much more efficient (Carleton and Philipson 1987). In addition, inexpensive black coral imported from the Philippines and elsewhere fills the demand for low quality, high volume jewelry products. Maui Divers of Hawaii, Inc., the leading manufacturer and retailer of precious corals jewelry in Hawaii, buys exclusively black coral harvested in the state.

In the past, the market for colonies of black coral small enough to fit inside the typical curio display case or household aquarium was small in comparison to the market for larger trees that are processed for jewelry (Oishi 1990). According to the Hawaii Division of Aquatic Resources, however, the demand for small, immature black coral colonies has increased with the growing popularity of household marine aquaria.

8.5.4 Economic Performance

The ex-vessel value of precious corals varies widely according to color and size. It is uncertain whether the corals harvested by the sole currently permitted divers in federal waters of the precious corals fishery will be of sufficient quality to receive the high prices required to offset the high fishing costs.

8.6 REGIONAL ECONOMY

8.6.1 Hawaii

The State of Hawaii lies 2,500 miles (4,023 km) southwest of North America, the nearest continental land mass. The eight main islands are part of a 137-island archipelago stretching 1,523 miles (2,451 km) from Kure Atoll in the northwest to the island of Hawaii in the southwest. The total land area of the archipelago is 6,423 square miles (16,635 square km) . The main islands include Oahu, Maui, Kauai, Niihau, Hawaii, Molokai, Kahoolawe and Lanai. Hawaii was established as a territory of the United States in 1900 and became the 50th state in 1959.

8.6.1.1 Overview of the Economy

Income generation in Hawai‘i is characterized by tourism, federal defense spending and, to a lesser extent, agriculture (Table 13). Tourism is by far the leading industry in Hawai‘i in terms of generating jobs and contributing to gross state product. The World Travel and Tourism Council (1999) estimates that tourism in Hawai‘i directly generated 134,300 jobs in 1999. This figure represents 22.6 % of the total workforce.

For 2002, Hawaii Department of Business, Economic Development and Tourism (DBEDT) estimates that direct and indirect visitor contribution to the state economy was 22.3%. A bit less then half of that (10.2 %) 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% of the total. Directly and indirectly, tourism accounted for 22.3 % of all civilian jobs, and 26.4% of all local and state taxes.

Department of Defense expenditures in Hawaii in 2002 were $4,293,459,000. Defense expenditures in Hawaii are expected to increase significantly in the near future. These expenditures fall into two broad categories: monies for the pending arrival of the Stryker force, which requires changes in facilities and additional facilities; and the renovation of old military housing as well as the construction of new military housing. As of late July 2004, Hawaii is expected to receive $496.7 million in defense-related spending. When combined with funds earmarked for constructions that are 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 (which together brought in $269.2 million in 1997), 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. This change may be due to the increasing use of lots zoned for agriculture for construction of high-end homes, a trend which is evident throughout the state.

Table 5: Statistical Summary of Hawaii's Economy, 1995-99, 2002

CATEGORY	UNITS	1995	1996	1997	1998	1999	2002
Civilian Labor Force	Number	576,400	590,200	592,000	595,000	594,800	582,200
Unemployment	Percent	5.9	6.4	6.4	6.2	5.6	4.2
Gross state product in 1996 dollars	$ Millions	37,963	37,517	37,996	38,015	38,047	38,839 (2001)
Manufacturing Sales	$ Millions	2,045.0	1,724.1	1,468.8	NA	NA	NA
Agriculture (all crops and livestock)	$ Millions	492.7	494.6	486.5	492.6	512,992	510,672
Construction completed	$ Millions	3,153.3	3,196.4	2,864.9	NA	NA	NA
Retail sales	$ Millions	15,693.3	16,565.0	16,426.0	NA	NA	NA
Defense expenditures	$ Millions	3,782.5	3,883.5	4,074.9	4,103.7	4,174.2	4,293,459

Source: DBEDT 1999, 2002; BOH 1999a

Median household income in Hawai‘i was calculated to be $40,827 in 1990, rising to $49,820 in 1999. Statewide per capita income in 1989 was calculated to be $15,770, rising to $25,684 in 1995 and $27,544 in 1999. The figure for 2002 is $30,040, or 97% of the national average. Hawaii per capital income as a percentage of the national average figure has fallen steadily since 1970 (DBEDT 2003). The poverty rate in Hawai‘i grew more over the 1990s than in the nation as a whole. Despite this growth, Hawaii’s poverty rate, which increased from 11.2 % in 1988-89 to 12.4 % in 1997-98, remained lower than the national rate (13.0 % in 1997-98). In 1999, 8% of Hawaii’s families were below poverty level, compared to 9% nationally according to the 2000 Census. Hawai‘i employment growth was virtually nil for most of the 1990s, continuing through to the end of 1998. Civilian employment has decreased from 411,250 in 1991 to 396,050 in 2002, which is a decrease from 98% of all civilian labor force having employment, to 96%.

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% between 1990 and 1993 and by an

additional 50% 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%, and unemployment on the island of Molokai reached 15% (DBEDT 1999).

By 2002, an improving economy showed a statewide unemployment rate of 4.4%, with Molokai down to 8.6% (DBEDT 2003). Despite downswings in tourism in the last few years due to the events of 9/11, the SARS scare, Japanese economic issues, and world political conditions, tourism in Hawaii is improving to the point that there are fears that there will not be enough hotel rooms to accommodate all the Japanese tourists who want to come for O Bon season in August 2004 (Schafers 2004).

As a consequence of the economic upheaval of the 1990s and extensive bankruptcies, foreclosures and unemployment, Hawaii never entered 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). 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. It is 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.

8.6.1.2 Fishing Related Economic Activities

The harvest and processing of fishery resources play a minor role in Hawaii's economy. 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 only 0.25% of total state output ($47.4 billion), 0.17% of household income ($20.2 billion) and 0.19% of employment (757,132 jobs). However, 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% higher than 1988 revenues (adjusted for inflation) in those fisheries.

Hawaii's commercial fishing sector includes a wide array of fisheries. The Hawaii longline fishery is by far the most important economically, accounting for 76 % of the ex-vessel value of the total commercial fish landings in the state in 2002 (Table 14).

Table 6: Volume and Value of Commercial Fish Landings in Hawaii by Fishery, 2002

FISHERY	POUNDS LANDED (1,000s)	PERCENT OF TOTAL POUNDS LANDED	EX-VESSEL VALUE ($1,000s)	PERCENT OF TOTAL EX-VESSEL VALUE
Pelagic longline	17,160	73%	37,500	76%
Troll	1,840	8%	2,950	6%
Pelagic handline	1,870	8%	2,700	6%
Aku pole and line	530	2%	750	5%
MHI bottomfish handline	363	1.5%	1,364	3%
NWHI bottomfish handline	243	1%	759	1.5%
NWHI lobster trap	0	0%	0	0%
All other fisheries	1,650	7%	3,330	7%
Total	23,656	100%	49,353	100%

Source: PIFSC annual reports.

For the period 1996-1999, the fleet-wide ex-vessel value of annual landings in the NWHI lobster fishery averaged about $1,349,000 (Kawamoto and Pooley 2000). However, this value reflects only the gross revenues that accrue to fishery participants from direct sales. It does not take into account that employment and income are also generated indirectly within the state when the NWHI lobster fishery operates. The fishery has an economic impact on businesses whose goods and services are used as inputs in the fishery such as fuel suppliers, chandlers, gear manufacturers, boatyards, tackle shops, ice plants, bait shops and insurance brokers. In addition, the fishery has an impact on businesses that use fishery products as inputs for their own production of goods and services. Firms that buy, process, or distribute fishery products include seafood wholesale and retail dealers, restaurants, hotels and retail markets. Both the restaurant and hotel trade and the charter fishing industry are closely linked to the tourism base that is so important to Hawaii's economy. Finally, people earning incomes directly or indirectly from the fishery make expenditures within the economy as well, generating additional jobs and income.

In terms of precious corals, the precious coral fishery is worth nearly 50 million dollars (R. Grigg pers comm.). The black coral fishery alone is worth $33 million. There are over 1,000 people involved in the fishery from the coral divers to the manufacturers to the salespeople. Black coral will generally sell for nearly $35/pound while pink/red and gold coral sells for over $500/pound (R. Grigg pers. comm.)

8.7 FISHING COMMUNITY

In Hawaii the residential distribution of individuals who are substantially dependent on or substantially engaged in the harvest or processing of fishery resources approximates the total population distribution. These individuals are not set apart—physically, socially, or economically—from island populations as a whole.

Key findings with respect to the identification of fishing communities in Hawaii include the following: (a) Fishery resources have played a central role in shaping the social, cultural, and

economic fabric of Hawaii society. A large number of Hawaii's residents are substantially dependent on or substantially engaged in fishing or fishing-related activities and industries to meet social and economic needs. (b) Fishery participants tend to shift often among gear types and fisheries. Participation in multiple fisheries and the ability to switch gear types and fisheries are fundamental aspects of fisheries in Hawaii and are important to the viability of fishing operations and industries. (c) Fishery participants often reside in one area, moor or launch their vessels in other areas, fish offshore of other areas, and land their fish in yet other areas, and they tend to move among these areas according to the gear types used, weather conditions, and fishing conditions. (d) The shore-side activities associated with the large-vessel fisheries, particularly the longline fishery, are mostly concentrated in the vicinity of Honolulu. Although many people participate in those fisheries and related activities, Honolulu is a large city with a large economy, so its dependency on those fisheries is relatively small. Activities associated with the small-vessel fisheries, in contrast, are fairly widely dispersed within and among islands. Participants in these fisheries do not, generally, stand out geographically from the population as a whole, but there are certain locations in each of the seven inhabited islands in which relatively large concentrations of fishery participants reside or where there are relatively large concentrations of fishing activities or related services. (e) Because of the geographical barriers between Hawaii's islands, social and economic interactions among fishery participants occur primarily at the island level. For the same reason, fishery participants' engagement in fisheries management, such as through public meetings and outreach programs of state and federal agencies, occurs primarily at the island level. (e) The lowest level of government in Hawaii is the county. Each of Hawaii's major four counties includes one, two, or three inhabited islands.

Given the economic importance of fishery resources to the island areas within the western Pacific region and taking into account these islands' distinctive geographic, demographic, and cultural attributes, the Council concluded that it is appropriate to characterize each of the inhabited Hawaiian Islands (Kauai, Niihau, Oahu, Maui, Molokai, Lanai, and Hawaii) as a fishing community. Defining the boundaries of the fishing communities broadly helps to ensure that fishery impact statements analyze the economic and social impacts on all segments of island populations that are substantially dependent on or engaged in fishing-related activities.

8.7.1 Hawaii

8.7.1.1 Population Size and Ethnicity

The 1990 census listed the population of Hawaii as 1,108,229. This figure rose to 1,179,198 in 1995 and to 1,211,537 in 2000. The population increased by a rate of 6.9 % between 1990 and 1999.

The state of Hawaii is divided into five counties. The county of Maui includes the islands of Kahoolawe, Lanai, Maui and Molokai. The county of Honolulu encompasses the island of Oahu and the Northwestern Hawaiian Islands excluding Midway Atoll. Kauai County consists of the islands of Kauai and Niihau. The population of each county is provided in Table 9.

Table 7: Hawaii Population by County

AREA	1990 CENSUS	2000 CENSUS
Hawai‘i State	1,108,229	1,211,537
Honolulu County, HI	836,231	876,156
Hawai‘i County, HI	120,317	148,677
Kauai County, HI	51,177	58,463
Maui County, HI	100,374	128,094
Source: U.S. Census Bureau		

The 2000 Census redefined the way race is measured in a number of ways, allowing individuals to identify themselves as one race or a combination of races, as well as having a separate classification system for Hispanic or Latino and race. As a result, describing the makeup of Hawaii's population is more complex. Perhaps the most accurate way to describe Hawaii's population is to report the proportions of race alone or in combination with one or more other races. In 2000, 39.3 % of Hawaii residents described themselves as white, 2.8 % as black or African American, 2.1 % as American Indian or Alaska native, 58 % as Asian, 23.3 % as native Hawaiian and other Pacific Islander, and 3.9% as some other race. These proportions add up to more than 100 % because many individuals reported more than one race. Of the 78.6 % of residents who reported just one race, 24.5 % listed White, 1.8 % Black or African American, 41.6 % Asian (including 4.7% Chinese, 14.1% Filipino, 16.7 % Japanese, 1.9 % Korean, and 0.6 % Vietnamese), and 9.4% Native Hawaiian and other Pacific islander.

In 1995-1996, Hamilton and Huffman (1997) conducted a survey of small-boat owners who engage in Hawaii's commercial and recreational fisheries, including the troll, pelagic handline and bottomfish handline fisheries. The survey found that the three largest ethnic groups represented in the sample were Japanese (33 %), mixed with part-Hawaiian (16 %) and Caucasian (12 %). Hamilton and Huffman speculated that the high proportion of Japanese and part-Hawaiians in the sample reflects the traditional connections that these two ethnic groups have with the sea. These sociocultural connections are discussed further in the following section.

8.7.1.2 Sociocultural Setting

Past and present participants in the precious corals fishery may constitute a recognizable fishing community in the geographical sense, because most if not all of the divers, fishing vessel owners, operators and crew were or are year-round residents of Hawaii. This is most apparent in the black coral fishery off Lahaina, Maui, where all of the participants reside on that island.

In addition, those involved in the harvesting of precious corals may constitute a fishing community in the sense of a social or economic group whose members share a common technology, customs, terminology, attitudes and values related to fishing. While it is the fishermen that benefit directly from the fishing lifestyle, individuals who participate in the marketing of fish or in the provision of fishing supplies may also share in the fishing culture. An integral part of this framework is the broad network of inter-personal social and economic

relations through which the cultural attributes of a fishery are transmitted and perpetuated. The relations that originate from a shared dependence on fishing and fishing-related activities to meet economic and social needs can have far-reaching effects in the daily lives of those involved. For example, they may constitute important forms of social capital, i.e., social resources that individuals and families can draw on to help them achieve desired goals.

The arrival of newcomers from outside the state and increasing ethnic diversity within Hawaii's commercial fishing industry diminished some of the social cohesiveness that existed among Hawaii's early commercial fishermen. Nevertheless, networks of relations among fishery participants are still present and have a significant effect on fishing activity. For example, various groups of fishermen are still represented by a *hui* or organization, and these voluntary associations continue to play an important role in Hawaii's fishing industry. A case in point is the *hui* that permit holders in the NWHI lobster fishery formed in 1998. The members of the association negotiated an agreement whereby some permit holders consented to forego the 1998 season in exchange for a share of the revenues earned by those who would participate in the fishery.

The products of fishing supplied to the community at large may also have socio-cultural significance. For instance, beyond their dietary importance fish may be important items of exchange and gift giving that also help develop and maintain social relationships within the community. Alternatively, at certain celebratory meals various types of seafood may become imbued with specific symbolic meanings. Nearly a century ago Bryan (1915) developed a list of the various fish purchased in the Honolulu market by each of Hawaii's principal "nationalities." With specific regard to spiny lobster, Bryan (1915:469) wrote that the "... lively demand for them, owing to their excellent food qualities, brings large numbers of them fresh and sprawling into the markets every day." He also noted that the slipper lobster was "quite common in the markets" and "is a favorite food of the native people." The ethnic identification of Hawaii's *kamaaina* (long-time residents) with particular species has continued to the present day. The large variety of fish typically offered in Hawaii's seafood markets reflects the diversity of ethnic groups in Hawaii and their individual preferences, traditions, holidays and celebrations. For example, lobster are among the foods that take on a special meaning during *Oshogatsu* (Japanese New Year's), considered the most important cultural celebration for people of Japanese ancestry in Hawaii. According to Japanese tradition, a lobster symbolizes old age because of its bent body, but at the same time it expresses wishes for a youthful spirit and longevity (Clarke 1994).

An insistence on quality, as well as quantity and variety, has also long been a hallmark of Hawaii's seafood markets. For example, the Japanese immigrants in Hawaii came from a society in which fishermen, fish dealers and even cooks typically handle prized fish with considerable care (Joya 1985). A strong preference for high quality fresh fish continues to characterize Hawaii seafood consumers. Both the discriminating tastes of local residents and the symbolic meaning with which some fish are imbued are linked to the importance of fish as gifts from one person or family to another.

The sharing of fish among members of the extended family and community is also an early tradition of the indigenous people of Hawaii. The social responsibility to distribute fish and

other resources among relatives and friends remains a salient feature of the lives of many Native Hawaiians that is enacted on both a regular basis and during special occasions (Glazier 1999). Among Native Hawaiians fish is considered a customary food item for social events such as a wedding, communion, school graduation, funeral or child's first birthday (baby *luau*) (Glazier 1999:107).

Commercial fishing has been part of Hawaii's economy for nearly two centuries. The downtown fish markets, Kewalo Basin mooring area and other long-established fishing-related infrastructure have helped define the character of Honolulu. Moreover, for some major ethnic groups in Hawaii such as the Japanese and Native Hawaiians the role that their forebears played in the establishment of commercial fisheries in the islands remains an important part of their collective memory. In 1999, for example, the Japanese Cultural Center of Honolulu organized an exhibition commemorating the contribution of Japanese immigrants to the development of Hawaii's commercial fishing industry.

Given the historical significance of commercial fishing in Hawaii, it likely that some local residents consider the fishing industry to be important in the cultural identity and heritage of the islands. Individuals who have never fished and do not intend to may nonetheless appreciate that others are fishing and that this activity is continuing to contribute to Hawaii's social, cultural and economic diversity. This existence value may be expressed in various ways. For example, some individuals may engage in vicarious fishing through the consumption of books, magazines and television programs describing the fishing activities that others are pursuing in the waters around Hawaii.

Just as Hawaii's fishing tradition is an integral part of the islands' heritage and character, the image of Hawaii has become linked with some types of locally caught seafood. Among the species that have become closely identified with Hawaii is spiny lobster. The continued availability of these seafoods in Hawaii has important implications for the mainstay of the state economy - tourism.[19] Japanese tourists visiting Hawaii often want to enjoy the traditional foods and symbols of prosperity of Japan while they vacation in Hawaii, including various types of high quality fresh fish (Peterson 1973). Hawaii tourists from the U.S. mainland and other areas where fish is not an integral part of the customary diet typically want to eat seafood because it is perceived as part of the unique experience of a Hawaii vacation. For both Japanese and U.S. mainland tourists, the opportunity to consume fish in Hawaii is likely enriched if the fish eaten is actually caught in the waters around Hawaii. Suryanata (2000) observes that markets within the state for "grown in Hawaii" products have expanded in the past decade through the proliferation of gourmet restaurants that feature "Pacific Rim" and "Hawaii Regional Cuisine." This marketing strategy eschews traditional

[19]Suryanata (2000) notes that many attributes of Hawaii have been constructed in the marketing of Hawaii by the tourist industry, and unusual or exotic food complements the marketed image. In describing the current initiative to revive Hawaii's agricultural sector by diversifying into high-value non-traditional export crops, such as tropical flowers, gourmet coffee and tropical speciality fruits, she writes "None of these products is unique to Hawaii in a true sense to merit a higher price, but marketing strategies seek to define a strong place-association of these products with Hawaii, to capitalize on Hawaii's exotic image and to develop niche markets for speciality products from paradise." This statement is equally true for locally-produced seafood sold in Hawaii.

symbols constructed by the tourism industry in favor of inciting an appreciation of social relationships and physical environment that make up Hawaii as a place.

Suryanata (2000) also notes that place-based specialty food can retain its appeal to buyers beyond a vacation period or even attract buyers who have never been to the place in question. Just like a consumption of organic food may signify a commitment to a certain environmental and social value, a consumption of products from Hawaii can symbolize a partial fulfillment of a desire to experience or relive a Hawaii vacation. According to a national seafood marketing publication, the power of this constructed value to influence prospective buyers has not been lost on Hawaii's seafood dealers:

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

Local production of food as opposed to a reliance on imports also creates opportunities to foster social connections between consumers and their food producers. As noted above, much of the retailing of fish in Hawaii now occurs through supermarkets, and a large quantity of the seafood sold is imported. However, there still exists in Hawaii personal connections between consumers and the individuals who harvest and retail fish. Such connections may have broad public value. For example, a recent article by agricultural researchers identified proximity as one of the key attributes of a sustainable food system:

A sustainable food system is one in which "food is grown, harvested, processed, marketed, sold, [and] consumed as close to home as possible." An emphasis on locally grown food, regional trading associations, locally owned processing, local currency, and local control over politics and regulation is found within a proximate system. A proximate food system will have "grocery stores close to home which carry local items with little or no corporately owned products to compete," and would provide "specialty items that characterize the bioregion" (Kloppenburg et al. 2000:182).

8.8 OTHER BLACK CORAL MANAGEMENT MEASURES

Under State of Hawaii Administrative Rules (HAR 13-91), "No person shall take, destroy or possess any black coral with a base diameter of less than ¾ inches (1.9 cm) from State marine waters." According to HAR 13-91, "black coral" includes the three species of coral *Antipathes dichotoma, Antipathes grandis, and Antipathes ulex* in their raw state. This regulation went into effect on July 23, 1999.

Also, in section 13-91-5, it is noted that the taking of pink, gold, or black coral and the piece of rock attached to the coral shall not be considered a violation of the prohibition on live rock collecting.

In section 13-91-6 of the HAR, a control date is set at July 23, 1999 (the effective date of the section), that would be used if the State of Hawaii intends to limit participation in the Hawaiian Islands commercial precious coral fishery. This is a prior notice to the public in case a limited entry program is established in the future.

The State of Hawaii Department of Land and Natural Resources, Division of Aquatic Resources is now considering options for the future of black coral management. The options being considered include an increase in minimum size as well as area based management, limited entry, and/or limited take. These options are only under consideration and may be phased in gradually.

9.0 ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES

Sections 9.1 through 9.5 describe the anticipated impacts of each alternative on each of the affected components of the human environment. To allow for easy comparisons, the measures contained in each alternative are summarize in Table 8.

Table 8: Regulatory measures contained in each alternative

Alternative	Removes base minimum size requirement?	Removes exemption from base minimum size requirement?	Removes minimum height requirement?
1	No	No	No
2	No	No	Yes
3	No	Yes	No
4	Yes	Yes	No
5	No	Yes	Yes
6	NA	NA	NA

9.1 Impacts of Alternative 1

Alternative 1 is the No-Action or status quo alternative.

9.1.1 Target Species

The growth rates for *A. dichotoma* and *A. grandis* have been estimated to be 6.42 cm per year and 6.12 cm per year respectively. Plotting gonad diameter versus colony height, Grigg (1976) estimated the size of reproductively mature *A. dichotoma* colonies to range from 64 to 80 cm. This implies an age at reproduction of 10 to 12.5 years and corresponds to a tree height of 25-31 inches (Grigg 1976). A coral colony that has attained the height of 48 inches corresponds to an age of about 20 years, which is approximately 8-10 years after black coral colonies reach sexual maturity. Subsequent research by Grigg (2004) on black corals, has shown that biomass of the black coral populations in the Auau Channel has decreased almost 25% between 1976 and 2001. Alternative 1 allows harvesting for exempted fishermen at sizes now believed to be below that necessary to provide an adequate reproductive cushion for black coral resources. It would not prevent the harvest of colonies which are immature

and have not reached their full potential growth, thereby potentially allowing overfishing to occur given increasing fishing pressure and the spread of *C. riisei.*

Traditionally, foreign fisheries for precious corals utilized non-selective dredges and tangle nets. There have been no recent reports of foreign fishing on precious corals in the Western Pacific Region. The Precious Corals FMP estimated that if non-selective gear were used, only 40% of the corals that would be knocked down during the harvesting process would be recovered (with the remaining 60% constituting bycatch). Thus under the FMP only selective gear is permitted to harvest corals from any precious corals permit area, thereby reducing the potential for bycatch. Selective gear means any gear used for harvesting corals that can discriminate or differentiate between type, size, quality, or characteristics of living or dead corals. Black coral are collected with scuba gear, and deep-water species of precious corals are harvested using manned submersibles or remotely-operated vehicles (ROVs). The use of manned submersibles is a highly selective method of harvest. Minimal bycatch of black coral would be expected with the use of ROVs, although the ROV tether could damage precious corals if not carefully tended.

9.1.2 Non-Target Species

A variety of invertebrates and fish are known to utilize the same habitat as precious corals. Such organisms include onaga (*Etelis coruscans*), kahala (*Seriola dumerallii*), and the shrimp *Heterocarpus ensifer*. However, there is no evidence that these species or others significantly depend on precious coral beds for shelter or food. In addition, under the existing FMP only selective gear can be used to harvest precious corals, thereby reducing the potential for bycatch and degradation of habitat. For these reasons, this alternative would have minimal direct or indirect impact on non-target species or their habitat.

9.1.3 Protected Species

9.1.3.1 Marine Mammals

There have been no reported or observed interactions between marine mammals and the black coral fishery. There could be some impact on marine mammals from routine fishing vessel operations (e.g., behavioral or physiological reactions to noise, collisions, or releases of pollutants), however such impacts would be extremely rare and therefore constitute a low-level risk to marine mammals. Under this alternative, this extremely low-level risk to marine mammals would remain.

9.1.3.1.1 Hawaiian Monk Seal

There have been no reported or observed interactions between monk seals and the black coral fishery. Current management measures for the black coral fishery have no impact on Hawaiian monk seals. On August 15, 2000, an informal consultation was initiated under section 7 of the ESA and a Letter of Concurrence was issued on December 20, 2000, which determined that these proposed regulatory changes to the Precious Coral FMP were not likely to adversely affect green turtles, hawksbill turtles, humpback whales, or Hawaiian monk seals.

9.1.3.2 Sea Turtles

There have been no reported or observed interactions between sea turtles and the black coral fishery. There could be some impact on sea turtles from routine fishing vessel operations (e.g., behavioral or physiological reactions to noise, collisions, or releases of pollutants), however such impacts would be rare therefore constitute a very low-level risk to sea turtles. Under this alternative, this extremely low-level risk to sea turtles would remain.

9.1.3.3 Seabirds

The black coral fishery does not use gear which is likely to cause any interactions with seabirds, and no such interaction have been reported or observed. Consequently, this alternative is not expected to impact any seabird species that occur in the region.

9.1.4 Essential Fish Habitat, Biodiversity and Ecosystems

Under NMFS' guidelines, impacts of an action must consider the EFH and HAPC of all managed species in the region. Therefore, the impact of the black coral fishery under this alternative must also consider EFH and HAPC of species managed under the respective Pelagics, Bottomfish, Crustaceans, and Coral Reef Ecosystem FMPs. EFH or HAPC in the Western Pacific Region fall under two categories: either the water column above the ocean bottom, or the ocean bottom itself. Water column EFH and HAPC have been designated for pelagic, bottomfish and crustacean MUS. Black coral fishing activities do not directly impact the water column.

Indirect impacts to water column EFH or HAPC potential could occur through pollutant discharges from precious corals fishing vessels. The day-to-day operations of a fishing vessel can produce a number of waste products, including oil, sewage and garbage, which if handled improperly could affect marine habitat (WPRFMC 1998).

Areas of ocean bottom have been designated EFH and HAPC for precious corals, crustaceans, bottomfish, and coral re MUS. Allowing only selective gear for the harvest of precious corals minimizes impacts on benthic habitat and other living components of the ecosystem. A variety of invertebrates and fish are known to utilize the same habitat as precious corals. These species of fish include *onaga* (*Etelis coruscans*), *kahala* (*Seriola dumerallii*) and the shrimp *Heterocarpus ensifer*. However, there is no evidence that these species depend on the coral for shelter or food.

Anchor damage can occur to coral reefs and other types of bottom habitat from vessels attempting to maintain position over productive fishing areas. It is not expected that vessels engaged in harvesting of precious corals will routinely anchor in shallow waters.

The accidental grounding of fishing boats can also affect coral reefs and other types of bottom habitat. The impact of a vessel striking the bottom could physically destroy coral colonies in the immediate area, and the possible subsequent break-up of the vessel and release of fuel and oil can result in pollution of habitat and mortality of marine life. Since the harvest of precious corals occurs in deep waters, the likelihood of accidental grounding is unlikely.

Under this alternative, the continuation of the current precious corals fishing management regime would not affect EFH or HAPC for any managed species, as it is 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. However, since the Auau Channel is designated as a HAPC, current management measures may not be sufficient to offset the effects of *Carijoa riisei* on the black corals and the Auau Channel. Current research being done on *C. riisei* may contribute to future management measures.

9.1.5 Commercial, Recreational and Charter Fishing Sectors

In the short-term, this alternative would allow commercial fishermen to continue a flexible fishing strategy thereby maintaining the chances of economic success for some fishing operations. In the longer-term, this alternative could result in overfishing of the resource, followed by reduced harvests and ex-vessel revenues.

The charter and recreational fishing sectors would not be affected under this alternative, as these sectors are not involved in the harvest of black coral in the Western Pacific Region.

9.1.6 Regional Economy

The short-term impact of this alternative on Hawaii's economy would be expected to be positive as it would allow continued harvests of black corals without further regulation. In the longer-term, this alternative could have a negative impact on the regional economy by allowing overfishing to occur, thus threatening opportunities for the future pursuit of a sustainable and profitable black coral fishery. It could also have a negative long-term impact if *C. riisiei* is proven to have a greater effect on black coral recruitment than is currently observed.

9.1.7 Fishing Community

No fishing communities as defined by the MSA would be affected by this alternative because the number of participants in the black coral fishery in each of Hawaii's fishing communities is very small. However this alternative's potential for negative long-term impacts on fishery participants could reduce the social bonds that connect them and decrease their ability to share their harvests with their communities.

9.1.8 Native Hawaiian Community

Under this alternative, Native Hawaiians who are owners, captains or deckhands of fishing vessels would potentially be able to derive income from harvesting precious corals in the Western Pacific Region. It is unknown if there are any Native Hawaiians participating in the black coral fishery, however if there are they would be affected in the same manner as other fishery participants in the commercial sector.

9.1.9 Administration and Enforcement

This alternative would perpetuate the status quo for existing administrative and enforcement procedures without adding or reducing costs or responsibilities to management agencies.

9.2 Impacts of Alternative 2

Under Alternative 2, the minimum height requirement for EEZ harvests of black coral would be removed. The minimum base requirement for black coral harvest would remain in effect, as well Framework 1's base diameter exemption. This alternative would limit EEZ black coral harvests to those with a base diameter of at least 1 inch, with the exception of Hawaii EEZ harvests of black corals with a base diameter of at least ¾ inch by exempted fishermen. The Hawaii DLNR has estimated that 15% of black coral harvests around Hawaii come from EEZ waters.

9.2.1 Target Species

Because this alternative would continue the exemption from the minimum base diameter requirement, it would not be expected to provide an adequate reproductive cushion for black coral resources and could potentially result in overfishing.

9.2.2 Non-target Species

A variety of invertebrates and fish are known to utilize the same habitat as precious corals. Such organisms include *onaga* (*Etelis coruscans*), *kahala* (*Seriola dumerallii*) and the shrimp *Heterocarpus ensifer*. However, there is no evidence that these species or others significantly depend on precious coral beds for shelter or food. In addition, under the existing FMP only selective gear can be used to harvest precious corals, thereby reducing the potential for bycatch and degradation of habitat. For these reasons, this alternative would have minimal direct or indirect impact on non-target species or their habitat.

9.2.3 Protected Species

9.2.3.1 Marine Mammals

There have been no reported or observed interactions between marine mammals and the black coral fishery. There could be some impact on marine mammals from routine fishing vessel operations (e.g., behavioral or physiological reactions to noise, collisions, or releases of pollutants), however such impacts would be extremely rare and therefore constitute a low-level risk to marine mammals. Under this alternative, this extremely low-level risk to marine mammals would remain.

9.2.3.1.1 Hawaiian Monk Seals

There have been no reported or observed interactions between monk seals and the black coral fishery. Elimination of the height exemption under this alternative should have no impact on Hawaiian monk seals.

9.2.3.2 Sea Turtles

There have been no reported or observed interactions between sea turtles and the black coral fishery. There could be some impact on sea turtles from routine fishing vessel operations (e.g., behavioral or physiological reactions to noise, collisions, or releases of pollutants), however such impacts would be rare therefore constitute a very low-level risk to sea turtles. Under this alternative, this extremely low-level risk to sea turtles would remain.

9.2.3.3 Seabirds

The black coral fishery does not use gear which is likely to cause any interactions with seabirds, and no such interactions have been reported or observed. Consequently, this alternative is not expected to impact any seabird species that occur in the region.

9.2.4 Essential Fish Habitat, Biodiversity and Ecosystems

Effects on EFH would be similar to those in Alternative 1. Under this alternative, the continuation of the current precious corals fishing management regime would not affect EFH or HAPC for any managed species, as it is 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. However, since the Auau Channel is designated as an HAPC, allowing harvest of black corals with *either* a 48 inch minimum height *or* 1 inch minimum base diameter in place may not be sufficient to offset the effects of *Carijoa riisei* on the black corals and the Auau Channel. Current research being done on *C. riisei* may contribute to future management measures.

9.2.5 Commercial, Recreational, and Charter Fishing Sectors

In the short-term, this alternative would reduce the flexibility of harvests by commercial fishermen as they would no longer be able to harvest black corals based on height but would instead be held to minimum base diameter requirements.. The proportion of current EEZ harvests that meet the height requirement but not the base diameter requirement is unknown. This could result in reduced harvests and ex-vessel revenues. In the longer-term, this alternative could result in overfishing of the resource, followed by further reduced harvests and ex-vessel revenues.

The charter and recreational fishing sectors would not be affected under this alternative, as these sectors are not involved in the harvest of black coral in the Western Pacific Region.

9.2.6 Regional Economy

The short-term impact of this alternative on Hawaii's economy would be expected to be slightly negative as it would prohibit the harvest of EEZ black corals that meet the height requirement but not the base diameter requirement. In the longer-term, this alternative could have a further negative impact on the regional economy by allowing overfishing to occur, thus threatening opportunities for the future pursuit of a sustainable and profitable black coral fishery.

9.2.7 Fishing Community

No fishing communities as defined by the MSA would be affected by this alternative because the number of participants in the black coral fishery around each of Hawaii's fishing communities is very small. However this alternative's potential for negative long-term impacts on fishery participants could reduce the social bonds that connect them and decrease their ability to share their harvests with their community.

9.2.8 Native Hawaiian Community

Under this alternative, Native Hawaiians who are owners, captains or deckhands of fishing vessels would potentially be able to derive income from harvesting precious corals in the

Western Pacific Region. It is unknown if there are any Native Hawaiians participating in the black coral fishery, however if there are they would be affected in the same manner as other fishery participants in the commercial sector.

9.2.9 Administration and Enforcement

The impacts on enforcement agencies under this alternative would not be expected to be significant, as size restrictions are included in the existing FMP. Impacts on enforcement agencies would be limited to training and educating agents on the changes in minimum size limits. Because fishery participants are known to stockpile their harvests for future sales, enforcement and management agencies would also need to work together to determine if a black coral tree was harvested previous to the change in regulations.

This alternative would otherwise essentially perpetuate the status quo for existing administrative procedures without adding or reducing costs or responsibilities to management agencies.

9.3 Impacts of Alternative 3 (Preferred Alternative)

Under Alternative 3, the base diameter harvesting exemption for EEZ waters around Hawaii would be removed. This alternative would limit black coral harvests throughout the Western Pacific Region's EEZ waters to those that either have a height of at least 48 inches or a base diameter of at least 1 inch. The Hawaii DLNR has estimated that 15% of black coral harvests around Hawaii come from EEZ waters.

9.3.1 Target Species

This alternative would prevent the harvest of colonies which are immature and have not reached their full potential growth, thereby reducing the potential for overfishing to occur. Black coral colonies reach sexual maturity at 10-12.5 years of age, corresponding to a tree height of 25-31 inches (Grigg 1976). A coral colony that has attained the height of 48 inches corresponds to an age of about 20 years, which is approximately 8-10 years after black coral colonies reach sexual maturity and is correlated with a base diameter of 1 inch. This alternative provides an adequate reproduction cushion (the difference between age at reproductive maturity and the age at first capture) for recruitment and reduces the risk of overfishing black coral resources, while providing flexibility in harvesting either at the minimum base size or height.

9.3.2 Non-target Species

A variety of invertebrates and fish are known to utilize the same habitat as precious corals. Such organisms include *onaga* (*Etelis coruscans*), *kahala* (*Seriola dumerallii*) and the shrimp *Heterocarpus ensifer*. However, there is no evidence that these species or others significantly depend on precious coral beds for shelter or food. In addition, under the existing FMP only selective gear can be used to harvest precious corals, thereby reducing the potential for bycatch and degradation of habitat. For these reasons, this alternative would have minimal direct or indirect impact on non-target species or their habitat.

9.3.3 Protected Species

9.3.3.1 Marine Mammals

There have been no reported or observed interactions between marine mammals and the black coral fishery. There could be some impact on marine mammals from routine fishing vessel operations (e.g., behavioral or physiological reactions to noise, collisions, or releases of pollutants), however such impacts would be extremely rare and therefore constitute a low-level risk to marine mammals. Under this alternative, this extremely low-level risk to marine mammals would remain.

9.3.3.1.1 Hawaiian Monk Seals

There have been no reported or observed interactions between monk seals and the black coral fishery. Elimination of the height and base diameter exemptions under this alternative should have no impact on Hawaiian monk seals.

9.3.3.2 Sea Turtles

There have been no reported or observed interactions between sea turtles and the black fishery. There could be some impact on sea turtles from routine fishing vessel operations (e.g., behavioral or physiological reactions to noise, collisions, or releases of pollutants), however such impacts would be rare therefore constitute a very low-level risk to sea turtles. Under this alternative, this extremely low-level risk to sea turtles would remain.

9.3.3.3 Seabirds

The black coral fishery does not use gear which is likely to cause any interactions with seabirds, and no such interaction have been reported or observed. Consequently, this alternative is not expected to impact any seabird species that occur in the region.

9.3.4 Essential Fish Habitat, Biodiversity and Ecosystems

Effects on EFH would be similar to those in Alternative 1. Under this alternative, the continuation of the current precious corals fishing management regime would not affect EFH or HAPC for any managed species, as it is 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.

9.3.5 Commercial, Recreational, and Charter Fishing Sectors

In the short-term, this alternative would reduce the flexibility of harvests by exempted commercial fishermen as they would no longer be able to harvest EEZ black corals that have a ¾ base diameter but would instead be held to the 1 inch base size or 48 inch height requirements. The proportion of current EEZ harvests that meet the lower requirements but not the higher ones is unknown. This could result in reduced harvests and ex-vessel revenues. In the longer-term, this alternative would be expected to reduce the risk of overfishing of the resource, thus avoiding a fishery collapse or closure and associated loss of revenues.

The charter and recreational fishing sectors would not be affected under this alternative, as these sectors are not involved in the harvest of black coral in the Western Pacific Region.

9.3.6 Regional Economy

The short-term impact of this alternative on Hawaii's economy would be expected to be slightly negative as it would prohibit the harvest of EEZ black corals that do not meet the ¾ inch base diameter requirement. In the longer-term, this alternative would be expected to have a positive impact on the regional economy by reducing the risk of overfishing, thus allowing the future pursuit of a sustainable and profitable black coral fishery.

9.3.7 Fishing Community

No fishing communities as defined by the MSA would be affected by this alternative because the number of participants in the black coral fishery around each of Hawaii's fishing communities is very small. However this alternative's potential for positive long-term impacts on fishery participants would be expected to maintain the social bonds that connect them, as well as their ability to share their harvests with their community.

9.3.8 Native Hawaiian Community

Under this alternative, Native Hawaiians who are owners, captains or deckhands of fishing vessels would potentially be able to derive income from harvesting precious corals in the Western Pacific Region. It is unknown if there are any Native Hawaiians participating in the black coral fishery, however if there are they would be affected in the same manner as other fishery participants in the commercial sector.

9.3.9 Administration and Enforcement

The impacts on enforcement agencies under this alternative would not be expected to be significant, as size restrictions are included in the existing FMP. Impacts on enforcement agencies would be limited to training and educating agents on the changes in revised minimum size limits. Because fishery participants are known to stockpile their harvests for future sales, enforcement and management agencies would also need to work together to determine if a black coral tree was harvested previous to the change in regulations.

This alternative would otherwise essentially perpetuate the status quo for existing administrative procedures without adding or reducing costs or responsibilities to management agencies.

9.4 Impacts of Alternative 4

Under this alternative, the Precious Corals FMP management measures would be adjusted to remove the minimum base diameter requirement and to remove the base diameter exemption. This alternative would limit EEZ black coral harvests to those with a height of at least 48 inches. The Hawaii DLNR has estimated that 15% of black coral harvests around Hawaii come from EEZ waters.

9.4.1 Target Species

This alternative would prevent the harvest of colonies which are immature and have not reached their full potential growth, thereby reducing the potential for overfishing to occur. Black coral colonies reach sexual maturity at 10-12.5 years of age, corresponding to a tree height of 25-31 inches (Grigg 1976). A coral colony that has attained the height of 48 inches corresponds to an age of about 20 years, which is approximately 8-10 years after black coral

colonies reach sexual maturity. This alternative provides an adequate reproduction cushion (the difference between age at reproductive maturity and the age at first capture) for recruitment and reduces the risk of overfishing black coral resources, but does not provide for a flexibility in harvesting at either the base diameter or height.

9.4.2 Non-target Species

A variety of invertebrates and fish are known to utilize the same habitat as precious corals. Such organisms include *onaga* (*Etelis coruscans*), *kahala* (*Seriola dumerallii*) and the shrimp *Heterocarpus ensifer*. However, there is no evidence that these species or others significantly depend on precious coral beds for shelter or food. In addition, under the existing FMP only selective gear can be used to harvest precious corals, thereby reducing the potential for bycatch and degradation of habitat. For these reasons, this alternative would have minimal direct or indirect impact on non-target species or their habitat.

9.4.3 Protected Species

9.4.3.1 Marine Mammals

There have been no reported or observed interactions between marine mammals and the black coral fishery. There could be some impact on marine mammals from routine fishing vessel operations (e.g., behavioral or physiological reactions to noise, collisions, or releases of pollutants), however such impacts would be extremely rare and therefore constitute a low-level risk to marine mammals. Under this alternative, this extremely low-level risk to marine mammals would remain.

9.4.3.1.1 Hawaiian Monk Seals

There have been no reported or observed interactions between monk seals and the black coral fishery. Elimination of the minimum base diameter and the exemptions that allow for qualified fishers to harvest black corals below the minimum height of 48 inches should have no impact on Hawaiian monk seals.

9.4.3.2 Sea Turtles

There have been no reported or observed interactions between sea turtles and the black coral fishery. There could be some impact on sea turtles from routine fishing vessel operations (e.g., behavioral or physiological reactions to noise, collisions, or releases of pollutants), however such impacts would be rare therefore constitute a very low-level risk to sea turtles. Under this alternative, this extremely low-level risk to sea turtles would remain.

9.4.3.3 Seabirds

The black coral fishery does not use gear which is likely to cause any interactions with seabirds, and no such interaction have been reported or observed. Consequently, this alternative is not expected to impact any seabird species that occur in the region.

9.4.4 Essential Fish Habitat, Biodiversity and Ecosystems

Effects on EFH would be similar to those in Alternative 1. Under this alternative, the continuation of the current precious corals fishing management regime would not affect EFH or HAPC for any managed species, as it is 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.

9.4.5 Commercial, Recreational, and Charter Fishing Sectors

In the short-term, this alternative would further reduce the flexibility of harvests by exempted commercial fishermen as they would no longer be able to harvest EEZ black corals that have a ¾ base diameter. In addition both they and non-exempted fishermen would also be prohibited from harvesting EEZ black corals with a base diameter of 1 inch and would instead be held to the 48 inch height requirement. The proportion of current EEZ harvests that meet the lower requirements but not the higher ones is unknown. This could result in reduced harvests and ex-vessel revenues. In the longer-term, this alternative would be expected to reduce the risk of overfishing of the resource, thus avoiding a fishery collapse or closure and associated loss of revenues.

The charter and recreational fishing sectors would not be affected under this alternative, as these sectors are not involved in the harvest of black coral in the Western Pacific Region.

9.4.6 Regional Economy

The short-term impact of this alternative on Hawaii's economy would be expected to be slightly negative as it would prohibit the harvest of black corals that do not meet the 48 inch height requirement. In the longer-term, this alternative would be expected to have a positive impact on the regional economy by reducing the risk of overfishing, thus allowing the future pursuit of a sustainable and profitable black coral fishery.

9.4.7 Fishing Community

No fishing communities as defined by the MSA would be affected by this alternative because the number of participants in the black coral fishery around each of Hawaii's fishing communities is very small. However this alternative's potential for positive long-term impacts on fishery participants would be expected to maintain the social bonds that connect them, as well as their ability to share their harvests with their community.

9.4.8 Native Hawaiian Community

Under this alternative, Native Hawaiians who are owners, captains or deckhands of fishing vessels would potentially be able to derive income from harvesting precious corals in the Western Pacific Region. It is unknown if there are any Native Hawaiians participating in the black coral fishery, however if there are they would be affected in the same manner as other fishery participants in the commercial sector.

9.4.9 Administration and Enforcement

The impacts on enforcement agencies under this alternative would not be expected to be significant, as size restrictions are included in the existing FMP. Impacts on enforcement agencies would be limited to training and educating agents on the changes in revised minimum size limits. Because fishery participants are known to stockpile their harvests for future sales, enforcement and management agencies would also need to work together to determine if a black coral tree was harvested previous to the change in regulations.

This alternative would otherwise essentially perpetuate the status quo for existing administrative procedures without adding or reducing costs or responsibilities to management agencies.

9.5 Impacts of Alternative 5

Under Alternative 5, the Precious Corals FMP management measures would be adjusted to remove the minimum height requirement and to remove the base diameter exemption. This alternative would limit EEZ black coral harvests to those with base diameter of at least 1 inch. The Hawaii DLNR has estimated that 15% of black coral harvests around Hawaii come from EEZ waters.

9.5.1 Target Species

This alternative would prevent the harvest of colonies which are immature and have not reached their full potential growth, thereby reducing the potential for overfishing to occur. This alternative provides an adequate reproduction cushion (the difference between age at reproductive maturity and the age at first capture) for recruitment and reduces the risk of overfishing black coral resources but does not provide the flexibility of harvesting at either base diameter or height.

9.5.2 Non-target Species

A variety of invertebrates and fish are known to utilize the same habitat as precious corals. Such organisms include *onaga* (*Etelis coruscans*), *kahala* (*Seriola dumerallii*) and the shrimp *Heterocarpus ensifer*. However, there is no evidence that these species or others significantly depend on precious coral beds for shelter or food. In addition, under the existing FMP only selective gear can be used to harvest precious corals, thereby reducing the potential for bycatch and degradation of habitat. For these reasons, this alternative would have minimal direct or indirect impact on non-target species or their habitat.

9.5.3 Protected Species

9.5.3.1 Marine Mammals

There have been no reported or observed interactions between marine mammals and the black coral fishery. There could be some impact on marine mammals from routine fishing vessel operations (e.g., behavioral or physiological reactions to noise, collisions, or releases of pollutants), however such impacts would be extremely rare and therefore constitute a low-level risk to marine mammals. Under this alternative, this extremely low-level risk to marine mammals would remain.

9.5.3.1.1 Hawaiian Monk Seals

There have been no reported or observed interactions between monk seals and the black coral fishery. Elimination of the minimum height requirement and exemptions should have no impact on Hawaiian monk seals.

9.5.3.2 Sea Turtles

There have been no reported or observed interactions between sea turtles and the black coral fishery. There could be some impact on sea turtles from routine fishing vessel operations

(e.g., behavioral or physiological reactions to noise, collisions, or releases of pollutants), however such impacts would be rare therefore constitute a very low-level risk to sea turtles. Under this alternative, this extremely low-level risk to sea turtles would remain.

9.5.3.3 Seabirds

The black coral fishery does not use gear which is likely to cause interactions with seabirds, and no such interactions have been reported. Consequently, this alternative is not expected to impact any seabird species that occur in the region.

9.5.4 Essential Fish Habitat, Biodiversity and Ecosystems

Effects on EFH would be similar to those in Alternative 1. Under this alternative, the continuation of the current precious corals fishing management regime would not affect EFH or HAPC for any managed species, as it is 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.

9.5.5 Commercial, Recreational, and Charter Fishing Sectors

In the short-term, this alternative would reduce the flexibility of harvests by exempted commercial fishermen as they would no longer be able to harvest black corals that have a ¾ base diameter. In addition both they and non-exempted fishermen would also be prohibited from harvesting black corals with a height of 48 inches and would instead be held to the 1 inch base diameter requirement. The proportion of current harvests that meet the lower requirements but not the higher ones is unknown but could be substantial. This could result in reduced harvests and ex-vessel revenues. In the longer-term, this alternative would be expected to reduce the risk of overfishing of the resource, thus avoiding a fishery collapse or closure and associated loss of revenues.

The charter and recreational fishing sectors would not be affected under this alternative, as these sectors are not involved in the harvest of black coral in the Western Pacific Region.

9.5.6 Regional Economy

The short-term impact of this alternative on Hawaii's economy would be expected to be slightly negative as it would prohibit the harvest of black corals that do not meet the 1 inch base diameter requirement. In the longer-term, this alternative would be expected to have a positive impact on the regional economy by reducing the risk of overfishing, thus allowing the future pursuit of a sustainable and profitable black coral fishery.

9.5.7 Fishing Community

No fishing communities as defined by the MSA would be affected by this alternative because the number of participants in the black coral fishery around each of Hawaii's fishing communities is very small. However this alternative's potential for positive long-term impacts on fishery participants would be expected to maintain the social bonds that connect them, as well as their ability to share their harvests with their community.

9.5.8 Native Hawaiian Community

Under this alternative, Native Hawaiians who are owners, captains or deckhands of fishing vessels would potentially be able to derive income from harvesting precious corals in the Western Pacific Region. It is unknown if there are any Native Hawaiians participating in the black coral fishery, however if there are they would be affected in the same manner as other fishery participants in the commercial sector.

9.5.9 Administration and Enforcement

The impacts on enforcement agencies under this alternative would not be expected to be significant, as size restrictions are included in the existing FMP. Impacts on enforcement agencies would be limited to training and educating agents on the changes in revised minimum size limits. Because fishery participants are known to stockpile their harvests for future sales, enforcement and management agencies would also need to work together to determine if a black coral tree was harvested previous to the change in regulations.

This alternative would otherwise essentially perpetuate the status quo for existing administrative procedures without adding or reducing costs or responsibilities to management agencies.

9.6 Impacts of Alternative 6

Under this alternative, black coral harvests in EEZ waters of the Auau Channel of Hawaii would be prohibited for a five-year period, during which scientific research would monitor black coral resources. The fishery would be re-opened after five-years if scientific research suggests found recruitment of black coral populations had increased. If scientific research suggests that recruitment has not increased, the moratorium would be extended until this outcome is achieved. When the fishery is reopened, the exemption would still be in effect, and all persons not exempt would continue to be required to limit black coral harvests to those with a minimum height of 48 inches or a 1 inch base diameter. The Hawaii DLNR has estimated that 15% of black coral harvests around Hawaii come from EEZ waters.

9.6.1 Target Species

Alternative 6 would prohibit EEZ harvests of target species for five years, thus allowing for uninterrupted recruitment. This would reduce the risk of overfishing black coral resources and would increase understanding of black coral biology.

9.6.2 Non-target Species

A variety of invertebrates and fish are known to utilize the same habitat as precious corals. Such organisms include *onaga* (*Etelis coruscans*), *kahala* (*Seriola dumerallii*) and the shrimp *Heterocarpus ensifer*. However, there is no evidence that these species or others significantly depend on precious coral beds for shelter or food. For these reasons, this alternative would have minimal direct or indirect impact on non-target species or their habitat.

9.6.3 Protected Species

9.6.3.1 Marine Mammals

There have been no reported or observed interactions between marine mammals and the black coral fishery. There could be some impact on marine mammals from routine fishing vessel operations (e.g., behavioral or physiological reactions to noise, collisions, or releases of pollutants), however such impacts would be extremely rare and therefore constitute a low-level risk to marine mammals. Under this alternative, this extremely low-level risk to marine mammals would remain.

9.6.3.1.1 Hawaiian Monk Seals

There have been no reported or observed interactions between monk seals and the black coral fishery. A moratorium on the fishery should have no impact on Hawaiian monk seals.

9.6.3.2 Sea Turtles

There have been no reported or observed interactions between sea turtles and the black coral fishery. As this alternative closes the fishery, it is not expected to impact any sea turtle species that occur in the region.

9.6.3.3 Seabirds

The black coral fishery does not use gear which is likely to cause interactions with seabirds, and no such interactions have been reported. As this alternative closes the fishery, it is not expected to impact any seabird species that occur in the region.

9.6.4 Essential Fish Habitat, Biodiversity and Ecosystems

This alternative's moratorium on black coral harvest in the Auau channel will not lead to substantial physical, chemical or biological alterations to the habitat, or result in loss of or injury to, these species or their prey.

9.6.5 Commercial, Recreational, and Charter Fishing Sectors

In the short-term Alternative 7 would prohibit all harvests of black corals from EEZ waters of the Auau Channel. The proportion of current harvests that originate in these waters is believed to be approximately 15%. In the longer-term, this alternative would be expected to reduce the risk of overfishing of the resource, thus avoiding a fishery collapse or closure and associated loss of revenues.

The charter and recreational fishing sectors would not be affected under this alternative, as these sectors are not involved in the harvest of black coral in the Western Pacific Region.

9.6.6 Regional Economy

The short-term impact of this alternative on Hawaii's economy would be expected to be negative as it would prohibit all harvests of black corals from EEZ waters of the Auau Channel. In the longer-term, this alternative would be expected to have a positive impact on the regional economy by reducing the risk of overfishing, thus allowing the future pursuit of a sustainable and profitable black coral fishery.

9.6.7 Fishing Community

No fishing communities as defined by the MSA would be affected by this alternative because the number of participants in the black coral fishery around each of Hawaii's fishing communities is very small. However, assuming that they can survive the five-year moratorium, this alternative's potential for positive long-term impacts on fishery participants would be expected to maintain the social bonds that connect them, as well as their ability to share their harvests with their community.

9.6.8 Native Hawaiian Community

Under this alternative, Native Hawaiians who are owners, captains or deckhands of fishing vessels would potentially be able to derive income from harvesting precious corals in the Western Pacific Region. It is unknown if there are any Native Hawaiians participating in the black coral fishery, however if there are they would be affected in the same manner as other fishery participants in the commercial sector.

9.6.9 Administration and Enforcement

The impacts on enforcement agencies under this alternative would not be expected to be significant, but they would need to enforce the closed area (EEZ waters of the Auau Channel). Impacts on enforcement agencies would be limited to training and educating agents on the area boundaries and educating fishery participants regarding the moratorium. Because fishery participants are known to stockpile their harvests for future sales, enforcement and management agencies would also need to work together to determine if a black coral tree was harvested previous to the change in regulations.

This alternative would otherwise essentially perpetuate the status quo for existing administrative procedures, although it would reduce the annual federal permitting burden during the moratorium.

9.6.10 Cumulative Effects

Management Actions

Future management actions may be taken by the Council to manage the black coral fishery in the Auau Channel. The next action that the Council may likely take is restricting the harvest of black corals by placing a harvest quota on the Auau Channel black coral bed. This harvest quota would be based on current estimates of MSY for black corals in the Auau Channel bed. When this harvest quota is reached, the fishery would close until the next fishing year. This action would ensure that the MSY for black corals in the Auau Channel bed was not exceeded by setting the harvest quota below MSY. This action would impact the black coral fishery participants by restricting landings. Current participants may already be fishing at the level of the harvest quota and new participants in the fishery would reduce their catch and revenue.

A second foreseeable action that may be taken by the Council is to limit entry to the fishery. Entry could be limited to current participants or a targeted number of participants with either transferable or non-transferable access permits. Current participants could benefit from a limited entry system by essentially having the fishery to themselves. A transferable permit

would give value to the participants and their permits if they were gifted, traded, or sold. A non-transferable permit would essentially close the fishery because there wouldn't be a mechanism for future participation. The resource would benefit from not having an increase in fishing pressure in a relatively easy startup fishery.

Other foreseeable actions include those taken by the State of Hawaii to make their regulations complimentary to the Federal regulations. They may explore the option of establishing a harvest quota in conjunction with proposed Federal regulations. A measure that the State also may be planning is to create a closed area in the Auau Channel for non-black coral harvest. These regulations would impact the current fishery participants because most of the black coral harvest is believed to come from the areas within the jurisdiction of the State of Hawaii. The resource would greatly benefit from these measures by having greater protection against current harvest pressure.

Other foreseeable impacts

A major impact on the black coral fishery in the Auau Channel continues to be the infestation of *Carijoa riisei*. This invasive snowflake coral may continue to impact black corals by overgrowing colonies at depths which black coral is not harvested. *C. riisei* may be impacting the deeper black corals by affecting the reproduction and recruitment of the resource. This impact, combined with harvesting pressure, may continue to affect fishery participants and the resource in the near future. Recent surveys in 2006 suggest that the impact of *C. riisei* has not worsened in the past five years and it is possible that the situation has stabilized or even improved (Kahng 2007). However, surveys need to continue to see if this is a long-term trend or not.

Current black coral fishery participants are older in age and may be leaving the fishery in the near future due to the hazards of the occupation combined with increased regulations. If the participants leave the fishery, there may be new participants in the fishery or the fishery may go dormant. An influx of new and possibly untrained participants into the fishery may have a negative impact on the black coral resource by underestimating the size of the colony, or potentially overharvesting a particular area in the bed. A dormant fishery may provide additional benefits for the resource, as the pressure of harvest would not affect the black corals.

Potential research on black corals in the near future may provide additional benefits to the resource. Planned research on *C. riisei* and monitoring of black coral size structure may provide additional insight on reproduction, recruitment, and population. A project on the potential of culturing black coral in the bed by outplanting, may provide additional protection to the resource and fishery by providing a future stock of black corals.

10.0 RELATIONSHIP TO OTHER APPLICABLE LAWS AND PROVISIONS OF THE MAGNUSON STEVENS ACT

10.1 Consistency with National Standards for Fishery Conservation and Management

National Standard 1 -- 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 preferred alternative will cause all fishermen to harvest EEZ black corals at the current minimum size, which is a base diameter of 1 inch or a height of 48 inches. It will reduce the risk of overfishing by removing all exemptions to these minimum size limits thereby producing an increased chance for black coral spawning and reproduction. This size restriction will also limit the number colonies that can be harvested, which will further reduce the risk of overfishing.

National Standard 2 -- Conservation and management measures shall be based upon the best scientific information available.

Surveys on the black coral bed in Auau Channel in 2002, 2003, and 2004 indicate that biomass of black coral in the Auau Channel has decreased by about 25% since 1976. These surveys are the main impetus and basis for this action and they are considered the most recent and best available assessments of the status of the resource. Accordingly, the preferred alternative is based on the best scientific information available.

National Standard 3 -- 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 Precious Corals FMP manages EEZ black coral resources throughout their Western Pacific range. While the preferred alternative pertains only to the black coral bed located in the federal portion of the Auau Channel, it does so only because that is the area within the Council's jurisdiction. Further, the preferred alternative does not change the existing FMU, stock designation, or overall management of the stock throughout its entire range. Therefore, the preferred alternative is consistent with National Standard 3 to the extent possible.

National Standard 4 -- 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 restrictions associated with the preferred alternative will apply uniformly to all persons with federal permits to fish for black coral in the Western Pacific region regardless of state

residency and in no way allocates fishing privileges among various fishermen. Therefore, the measures in no way discriminate among residents of different states, and are consistent with National Standard 4.

National Standard 5 -- 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 preferred alternative will require all EEZ fishermen to harvest black coral at the current minimum size of base diameter of 1 inch or a height of 48 inches which is intended solely to promote sustainable harvest of black coral resources. The measures do not substantially affect methods of harvest, or allocate resources among competing users; accordingly, the preferred alternative does not have National Standard 5 implications. To the extent that the measures make legal harvest more difficult, and less efficient, those measures apply uniformly to all EEZ harvesters, and are necessary to sustainably manage the resource.

National Standard 6 -- Conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches.

The Precious Corals FMP manages EEZ black coral resources throughout their Western Pacific range. The preferred alternative is particular to the federal waters in the Auau Channel and has been designed to maintain the biological health and sustainability of this bed. The preferred alternative considers the effect of the fishery as well as the recent invasion of *Carijoa* on this particular coral bed and is in response to variations in harvest and resource status as compared to other areas also subject to harvest. The preferred alternative takes no other action to prevent variable harvest activities in the Auau Channel or other areas subject to the FMP, nor does it prevent future variation in measures for any area where black coral exists. Accordingly, the preferred alternative is consistent with National Standard 6.

National Standard 7 -- Conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.

The preferred alternative will not duplicate any existing regulatory requirements otherwise applicable in the fishery. To the extent that the measures result in increased costs to harvest legal size coral, because it takes more time and money to find the larger coral, such increased costs are a necessary result of promoting sustainable harvest in the fishery, and the avoidance of such costs is not practicable. Therefore, the preferred alternative is consistent with National Standard 7.

National Standard 8 – 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 preferred alternative will affect the activities of fishermen in the Auau Channel who had reported landings before April 17, 2002, and are currently allowed to harvest black corals with a minimum base diameter of ¾ inch. The preferred alternative will require these fishermen to be more selective in their harvest of EEZ black corals and will thus reduce the amount of black coral that can be harvested. Although this will potentially affect the amount of coral harvested in the short-term, and have adverse economic impacts on fishery participants, it is unlikely to have significant effects on any fishing communities as defined under the MSA. In the longer-term the preferred alternative is expected to allows sustained participation in the fishery, and is biologically necessary to protect the long term health and sustainability of Hawaii's EEZ black coral resources Therefore, the preferred alternative is consistent with National Standard 8.

National Standard 9 -- 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.

Only very highly selective methods and gear, such as hand collection by divers, and collection via submersibles, are authorized in the fishery, thus there is essentially no bycatch. The preferred alternative will not alter the methods or gear allowed in the fishery, and will have no effect on the current bycatch rates in the fishery and is therefore consistent with National Standard 9.

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

The Precious Coral fishery requires harvesting by divers and submersibles at considerable depth, which is an inherently dangerous activity, resulting in potentially adverse impacts on the safety of fishermen engaged in such activity. The requirement to use such highly selective gear is necessary to protect the sustainability of the coral resources, avoid bycatch, and prevent the adverse impacts to habitat that result from the use of non selective gear such as bottom trawls. Consequently, avoidance of the adverse impacts by allowing harvest through safer less selective means is not practicable. The preferred alternative could potentially result in Hawaii EEZ fishermen having to spend more time in such dangerous conditions in order to harvest legal size coral, but again these potential impacts are an unavoidable consequence of restricting harvest to sustainable levels. Therefore, the preferred alternative is consistent with National Standard 10.

10.2 National Environmental Policy Act (NEPA)

This section has been prepared in accordance with the requirements of the National Environmental Policy Act of 1969 (NEPA) to assess the impacts on the human environment that may result from the proposed action.

This Environmental Assessment (Sections 8.0 – 10.0) provides a description of the environment that is affected by the proposed action and an assessment of the likely impacts of the proposed action.

10.2.1 Purpose and Need for Action

The purpose and need for action is described in Section 5.

10.2.2 Alternatives

The alternative management measures being considered by the Council is described in Section 7.

10.2.3 Affected Environment Given Cumulative Impacts to Date

The affected environment given cumulative impacts to date is described in Section 8.

10.2.4 Environmental Impacts of the Alternatives

The environmental impacts of the alternatives are described in Section 9.

10.3 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 Regulatory Flexibility Act, 5 U.S.C. 601 *et seq*. (RFA) requires government agencies to assess the impact of regulatory actions on small businesses and other small organizations. The basis and purpose of this rule are described in Section 5.0.

The preferred alternative would potentially affect the 15% of Hawaii's black coral harvests believed to come from EEZ waters. These harvests would not be prohibited but the 3-5 existing exemptions that allow harvests of EEZ colonies with a minimum base diameter of ¾ inch would be rescinded and all participants would have to limit EEZ harvests to colonies with a minimum height of 48 inches or a minimum base diameter of 1 inch. It is not known what proportion of EEZ harvests do not meet these requirements but assuming a worse case scenario would lead to a 15% reduction in short-term fishery landings. In the longer-term it is anticipated that the preferred alternative would protect EEZ resources and result in increased harvests. Based on the minor short-term impact of the preferred alternative on fishery participants, 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 h as been prepared.

10.4 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 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: (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. Based on these findings, this rule is believed not to be significant under E.O. 12866.

None of the alternatives are expected to have significant impacts on effort or catches of fishermen in Hawaii. A change to the minimum size for harvest of EEZ black corals will provide a mechanism for management of the Nation's marine resources at no additional monetary costs to the U.S. government or individuals. In contrast, these measures will provide NMFS with the authority to effectively and sustainably manage the Nation's only black coral fishery for the benefit of fishermen and the industries dependent upon fishing.

10.5 Coastal Zone Management Act

CZMA requires a determination that an FMP or amendment has no effect on the land or water uses or natural resources of the coastal zone, or is consistent to the maximum extent practicable with the enforceable policies of an affected state's coastal zone management program. A copy of this document will be submitted to the appropriate agency in Hawaii for their review and concurrence with the Council determination that the amendments are consistent, to the maximum extent practicable, with the state's coastal zone management program.

10.6 Endangered Species Act

These actions will not adversely affect any of the ESA listed species below or critical habitat necessary for the continued existence of those species. The actions contained in this document are primarily administrative and do not permit any activities beyond those presently occurring. As the actions described in this document do not implement activities that would result in the incidental taking of any ESA listed species, no formal consultation under Section 7 of the ESA is required.

Marine species listed as endangered or threatened under the Endangered Species Act (ESA) (Public Law 93-205; 87 Stat. 884) that have been observed in the waters around Hawaii are:

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

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

ESA consultations were conducted by NMFS and the U.S. Fish and Wildlife Service (for species under their jurisdiction) to ensure ongoing fisheries operations—including the bottomfish and seamount groundfish fishery, the Hawaiian lobster fishery, and the harvest of

precious corals and coral reef species—are not jeopardizing the continued existence of any listed species or adversely modifying critical habitat. The biological opinions resulting from these consultations are briefly described below. Therefore, the Council believes that there would be no additional impacts to any listed species or habitat.

Biological Opinions

In a biological opinion issued in October 1978, following a consultation under section 7 of the ESA, NMFS concluded that the ongoing operation of the Western Pacific Region's precious coral fisheries was not likely to jeopardize the continued existence of any threatened or endangered species under NMFS's jurisdiction or destroy or adversely modify critical habitat. The management and conservation measures contained in this FMP for targeting precious corals are being carried forth from the Precious Corals FMP. Therefore, the Council believes that the proposed precious coral fishing activities under this FMP not likely to jeopardize the continued existence of any threatened or endangered species under NMFS's jurisdiction or destroy or adversely modify critical habitat.

On August 15, 2000, an informal consultation was initiated and a Letter of Concurrence was issued on December 20, 2000, which determined that these proposed regulatory changes to the Precious Coral FMP were not likely to adversely affect green turtles, hawksbill turtles, humpback whales, and Hawaiian monk seals.

10.7 Marine Mammal Protection Act

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

NMFS uses fishery classification criteria, which consist of a two-tiered, stock-specific approach. This two-tiered approach first addresses the total impact of all fisheries on each marine mammal stock and then addresses the impact of individual fisheries on each stock. This approach is based on the rate, in numbers of animals per year, of incidental mortalities and serious injuries of marine mammals due to commercial fishing operations relative to a stock's Potential Biological Removal (PBR) level.

Tier 1:

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

Tier 2:

Category I: Annual mortality and serious injury of a stock in a given fishery is greater than or equal to 50 % of the PBR level.

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

All of the demersal fisheries conducted in waters around the Hawaii Archipelago are listed as Category III (69 FR 48407, August 10, 2004). Fisheries managed under this FMP are not expected to change their historical fishing operations or patterns as a result of implementation of this amendment. Therefore, no increased impacts on marine mammals that occur in the waters around the Hawaii Archipelago are expected. The regulations governing Category III fisheries (found at 50 CFR 229.5) are listed below:

§ 229.5 Requirements for Category III fisheries.

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

10.8 Paperwork Reduction Act

The purpose of the PRA is to minimize the burden on the public. The Act is intended to ensure that the information collected under the proposed action is needed and collected in an efficient manner (44 U.S.C. 3501(1)). None of the measures contained in this amendment have any public regulatory paperwork requirements.

10.9 Executive Order 12612 (Federalism)

The regulatory measures in this document do not contain policies with federalism implications under E.O. 13132

10.10 Executive Order 13089 (Coral Reef Protection)

The regulatory measures in this document are consistent with E.O.13089, which is intended to preserve and protect the biodiversity, health, heritage, and social and economic value of U.S. coral reef ecosystems and the marine environment.

10.11 Essential Fish Habitat Consultation

Based on the above information, the preferred alternatives are not expected to have adverse impacts on essential fish habitat (EFH) or habitat areas of particular concern (HAPC) for species managed under the Pelagics, Bottomfish and Seamount Groundfish, Precious Corals, Crustaceans, or Coral Reef Ecosystems Western Pacific Fishery Management Plans. EFH and HAPC for these species groups has been defined as presented in Table 3. The preferred alternatives will not adversely affect EFH or HAPC for any managed species as 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. For the same reason, the preferred alternatives are not anticipated to cause substantial damage to the ocean and coastal habitat.

10.12 Information Quality Act

To the extent possible, this information complies with the Information Quality Act and NOAA standards (NOAA Information Quality Guidelines, September 30, 2002) that recognize information quality is composed of three elements - utility, integrity and objectivity. Central to the preparation of this 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, black corals), 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.

10.13 NWHI Marine National Monument

On June 15, 2006, President George W. Bush signed Presidential Proclamation No. 8031 establishing the Northwestern Hawaiian Islands Marine National Monument (NWHI

monument). The proclamation set apart and reserved the Northwestern Hawaiian Islands for the purpose of protecting the historic objects, landmarks, prehistoric structures and other objects of historic or scientific interest that are situated upon lands owned and controlled by the federal Government of the United States. Proclamation No. 8031 directs the Secretary of Commerce and the Secretary of the Interior (the Secretaries) to prohibit access into the NWHI monument unless authorized, and limit or regulate virtually all activities in the area through a permit and zoning system among other measures.

The regulatory measures in this document are consistent with Proclamation No. 8031.

10.14 National Marine Sanctuaries Act

The regulatory measures in this document are consistent with the National Marine Sanctuaries Act.

10.15 Executive Order 12898-Environmental Justice

These actions do not have adverse human health or environmental effects on minority or low-income populations in the U.S., its territories, or its Commonwealths.

10.16 Executive Order 12630 (Takings)

This amendment affects regulations for harvest of black coral under the Precious Corals Fishery Management Plan. The FMP outline restrictions on the use of destructive fishing gears such as non-selective gear. These gears are not currently being used in the areas affected by the proposed these amendments and their prohibition should not be considered a taking under E.O. 12630.

11.0 DRAFT REGULATIONS

§ 665.86 Size Restrictions

(b) *Black Coral***.** 1) Live black coral harvested from any precious coral permit area must have attained either a minimum stem diameter of 1 inch (2.54 cm), or a minimum height of 48 inches (122 cm).

12.0 REFERENCES

Abernathy, K. and D. Siniff. 1998. “Investigations of Hawaiian monk seal, *Monachus schauinslandi*, pelagic habitat use: range and behavior.” University of Minnesota, NOAA SK Report Award No. NA66FD0058.

Aguirre, A., J. Reif and G. Antonelis. 1999. Hawaiian monk seal epidemiology plan: Health assessment and disease status studies. NOAA Tech. Memo. NOAA-TM-NMFSSWFSC-280.

Albers, H., A. Fisher and W. Hanemann. 1996. “Valuation of tropical forests: implications of uncertainty and irreversibility.” *Environmental and Resource Economics 8*:39-61.

Amerson, A. 1971. “The natural history of French Frigate Shoals, Northwestern Hawaiian Islands.” *Atoll Research Bulletin* No. 150.

Anon. 1924. “Midway Island yields $2,000 cargo of fish.” *The Honolulu Advertiser*, 28 February, p.1.

Anon. 1953. “Leeward Isle fishing rules now in effect.” *The Honolulu Advertiser*, 26 July 1953, p.3

Aron, W., W. Burke and M. Freeman. 2000. “The whaling issue.” *Marine Policy 24*(3):179-191

Arrow, K., R. Solow, P. Portney, E. Leamer, R. Radner and H. Schuman. 1993. “Report of the NOAA Panel on Contingent Valuation.” *Federal Register 58*(10):4601-4614.

Baker, J. and T. Johanos. 2000. “Effects of research handling on the endangered Hawaiian monk seal.” Unpublished manuscript. NMFS Southwest Fisheries Science Center Honolulu Laboratory, Honolulu.

Banish, L. and W. Gilmartin. 1992. “Pathological findings in the Hawaiian monk seal.” *Journal of Wildlife Disease 28*:428-34.

Beckley, E. 1883. *Hawaiian Fisheries and Methods of Fishing.* Advertiser Press, Honolulu.

Berrens, R., D. Brookshire, M. McKee and C. Schmidt. 1998. “Implementing the safe minimum standard approach: two case studies from the U.S. Endangered Species Act.” *Land Economics 74*(2)147-161.

Beverton, R. and S. Holt. 1957. “On the dynamics of exploited fish populations. *Fish Invest. Minist. Agric. Fish. Food* (G.B.), Ser II 19:1-553.

Birkeland, C. 1997. “Status of coral reefs in the Marianas.” *In*: R. Grigg and C. Birkeland (eds.), *The Status of Coral Reefs in the Pacific*. Sea Grant College Program, University of Hawaii, Honolulu.

Bishop, R. 1987. “Economic values defined.” *In*: D. Decker and G. Goff (eds.), *Valuing Wildlife: Economic and Social Perspectives.* Westview Press, Boulder, Colorado.

Bishop, R. 1993. “Economic efficiency, sustainability and biodiversity.” *Ambio 22*(2-3):69-73.

Bishop, R. and M. Welsh. 1992. “Existence values in benefit-cost analysis and damage assessments.” *Land Economics 68*(4):405-417.

BOH (Bank of Hawaii). 1999???. “Hawaii 1998, annual economic report.” Vol. 47. Bank of Hawaii, Honolulu.

Boggs, C. and B. Kikkawa. 1993. “The development and decline of Hawaii’s skipjack tuna fishery.” *Marine Fisheries Review 55*(2):61-68.

Brewbaker, P. 2000. “Hawaii economic trends, January 2000.” Bank of Hawaii, Honolulu.

Callicott, J. 1986. “On the intrinsic value of nonhuman species.” *In*: B. Norton (ed.), *The Preservation of Species: The Value of Biological Diversity*. Princeton University Press, Princeton).

Carleton, C. 1987. “Report on a study of the marketing and processing of precious coral products in Taiwan, Japan and Hawaii.” South Pacific Forum Fisheries Agency Report No. 87/13.

Carter, B. 1962. “Sam + pan.” *Honolulu Star-Bulletin and Advertiser*, July 29, 1962, p.12.

Castellini, M. 1994. “Apnea tolerance in the elephant seal during sleeping and diving: physiological mechanisms and correlations.” *In*: B. Le Boeuf and R. Laws (eds.), *Elephant Seals: Population Ecology, Behavior and Physiology.* University of California Press, Berkeley.

CH2M Hill. 2000. “Draft - Ecological Risk Assessment, Former U.S. Coast Guard LORAN Station, Tern Island, French Frigate Shoals, Hawaii.” Contract No. DTCG8799D6XA018.

Chapin, E. 1925. “Descriptions of new internal parasites.” *Proceedings of the U.S. National Museum 68* (Art 2):1-4

Ching, P. 1994. *The Hawaiian Monk Seal.* University of Hawaii Press, Honolulu.

Cobb, J. 1902. “Commercial fisheries of the Hawaiian Islands.” Extracted from the U.S. Fish Commission Report for 1901, U.S. Government Printing Office, Washington, D.C..

Cocheba, D. 1987. “Opportunities for improving wildlife management: an economist’s view.” *In*: D. Decker and G. Goff (eds.), *Valuing Wildlife: Economic and Social Perspectives*. Westview Press, Boulder, Colorado.

Coral Reef Research Foundation. undated. http://www.underwatercolours.com/crrf.html.

Costanza, R., R. d’Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R. O’Neil, J. Paruelo, R. Raskin, P. Sutton and M. van den Belt. 1997. “The value of the world’s ecosystem services and natural capital.” *Nature 387*:253-260.

Council on Environmental Quality. 1993. “Incorporating biodiversity considerations into environmental impact analysis under the National Environmental Policy Act”. Council on Environmental Quality, Executive Office of the President, Washington, D.C.

Council on Environmental Quality. 1997. “Considering cumulative effects under the National Environmental Policy Act.” Council on Environmental Quality, Executive Office of the President, Washington, D.C.

Craig, M. and T. Ragen. 1999. “Body size, survival, and decline of juvenile Hawaiian monk seals, *Monachus schauinslandi*.” *Marine Mammal Science 15*(3):786-809.

DBEDT (Department of Business, Economic Development and Tourism). 1999. *The State of Hawaii Data Book 1998*. State of Hawaii Department of Business, Economic Development and Tourism, Honolulu.

DBEDT. 2003. Department of Business, Economic Development and Tourism. 2002 State of Hawaii State Data Book http://www2.hawaii.gov/dbedt/index.cfm?section=READ_Databook445

Dailey, M., R. Santangelo and W. Gilmartin. 1988. “A coprological survey of helminth parasites of the Hawaiian monk seal from the Northwestern Hawaiian Islands.” *Mar. Mam. Sci. 4*:125-131.

DeLong, R. G. Kooyman, W. Gilmartin and T. Loughlin. 1984. “Hawaiian monk seal diving behavior.” *Acta Zoologica Fennica 172*:129-131.

DeMartini, E. and J. Parrish. 1996. “A reevaluation of shallow reef fish populations at French Frigate Shoals and Midway Atoll in September 1995.” NMFS Southwest Fisheries Center Honolulu Laboratory Administrative Report H-96-10.

DeMartini, E., F. Parrish and J. Parrish. 1996. “Interdecadal change in reef fish populations at French Frigate Shoals and Midway Atoll, Northwestern Hawaiian Islands: Statistical power in retrospect.” *Bulletin of Marine Science 58*(3):804-825.

DeMartini, E. and J. Parrish. 1998. “August 1997 reevaluation of shallow reef fish populations at French Frigate Shoals and Midway Atoll.” NMFS Southwest Fisheries Center Honolulu Laboratory Administrative Report H-98-12.

DeMartini, E., B. Mundy and J. Polovina. 1999. “Status of nearshore sports and commercial fishing and impacts on biodiversity in the tropical insular Pacific.” pp.339-355. *In:* J.

Donohue, M., R. Boland, C. Sramek and G. Antonelis. 2001. “Derelict fishing gear in the Northwestern Hawaiian Islands: Diving surveys and debris removal in 1999 confirm threat to coral reef ecosystems.” *Mar. Poll. Bull.42*(12):1301-1312.

DLNR (Hawaii Department of Land and Natural Resources). 1979. *Hawaii Fisheries Development Plan.* State of Hawaii, Honolulu.

Eckles, H. 1949. “Fishery exploration in the Hawaiian Islands.” *Commercial Fisheries Review 11*(6):1-9.

Ecosystem Principles Advisory Panel. 1999. “Ecosystem-based fisheries management.” http://www.nmfs.gov/sfa/EPAPrpt.pdf.

Ehrlich, P. and A. Ehrlich. 1981. *Extinction.* Random House, New York.

Elschner, C. 1915. “The Leeward Islands of the Hawaiian Group.” Reprinted from *The Sunday Advertiser*, Honolulu.

Emory, K. 1928. “Archaeology of Nihoa and Necker Islands.” B.P. Bishop Museum Bulletin 53, Honolulu.

Fielding, A. and E. Robinson. 1987. *An Underwater Guide to Hawaii.* University of Hawaii Press, Honolulu.

Forney K., J. Barlow, M. Muto, M. Lowry, J. Baker, G. Cameron, J. Mobley, C. Stinchcomb, and J. Carreta. 2000. “Draft U.S. Pacific Marine Mammal Stock Assessments: 2000.” NMFS Southwest Fisheries Science Center, La Jolla.

Furman, D. and M. Dailey. 1980. “The genus Halarachne (Acari: Halarachnidae), with the description of a new species from the Hawaiian monk seal.” *Journal of Medical Entomology 17*: 352-359.

Galtsoff, P. 1933. “Pearl and Hermes Reef, Hawaii hydrographical and biological observations.” Bernice P. Bishop Museum Bulletin 107, Honolulu.

Gilmartin, W. (In cooperation with the Hawaiian Monk Seal Recovery Team). 1983. *Recovery Plan for the Hawaiian Monk Seal,* Monachus schauinslandi. NOAA NMFS SWFSC HL.

Gilmartin, W. 1987. “Hawaiian monk seal die-off response plan, a workshop report.” 2 April 1980, San Diego, CA. NOAA NMFS SWFSC HL AR H-87-19. 7pp.

Gilmartin, W. 1993b. “Hawaiian monk seal work plan, 1994-96.” NOAA NMFS SWFSC HL Admin. Rept. H-93-16. 83pp.

Golvan, Y. 1959. “Acanthocephales du genre *Corynosoma* Luhe 1904. Parasites de mammiferes d’Alaska et de Midway.” *Annales Parasitologie Humaine et Comparee 34*:288-321.

Goodman-Lowe, G., 1998. Diet of the Hawaiian monk seal (*Monachus schauinslandi*) from the Northwestern Hawaiian Islands during 1991 to 1994. Marine Biology 132:535-546.

Goto, A. 1986. “Prehistoric ecology and economy of fishing in Hawaii: an ethnoarchaeological approach.” Ph.D. dissertation, University of Hawaii, Honolulu.

Gov. of Guam. 2001. The Guam Comprehensive Economic Development Strategy, Department of Commerce, June, 2001

Green, A. 1997. “An assessment of the status of the coral reef resources, and their patterns of use, in the U.S. Pacific Islands.” Western Pacific Regional Fishery Management Council, Honolulu.

Grigg, R. 1976. “Fishery management of precious and stony corals in Hawaii.” Sea Grant Tech. Rept. UNIHI-SEAGRANT-TR-77-03, University of Hawaii, Honolulu.

Grigg, R. 1979. “Precious corals: Hawaii’s deep-sea jewels.” *National Geographic 155*(5):719-732.

Grigg, R. 1983. “Community structure, succession and development of coral reefs in Hawaii.” *Mar. Ecol. Prog. Ser. 11*:1-14.

Grigg, R. 1993. “Precious coral fisheries of Hawaii and the U.S. Pacific Islands.” *Marine Fisheries Review 55*(2):50-60.

Grigg, R. 1997. “Resurvey of the Makapuu precious coral bed - August 21-22, 1997.” Unpublished report.

Grigg, R. 1998a. “Status of the black coral fishery in Hawaii - 1998.” Report prepared under contract with Office of Scientific Authority, US Fish and Wildlife Service.

Grigg, R. 1998b. “NWHI precious coral expedition - September 1998.” Unpub. Rept.

Grigg, R. 2004. “Harvesting Impacts and Invasion by an Alien Species Decrease Estimates of Black Coral Yield

Grigg, R. and S. Dollar. 1980. “The status of reef studies in the Hawaiian Archipelago.” *In*: R.Grigg and R. Pfund (eds.), *Proceedings of the Symposium on Status of Resource Investigations in the Northwestern Hawaiian Islands*. University of Hawaii Sea Grant Miscellaneous Report UNIHI-SEAGRANT-MR-80-04.

Grigg, R. and D. Opresko. 1977. “Order Antipatharia: black corals.” Reef and Shore Fauna of Hawaii, B.P. Bishop Mus. Spec. Pub. 64(1):242-261.

Grigg, R. and R. Pfund. 1980. “Preface.” *In*: Grigg, R. and R. Pfund (eds.), *Proceedings of the Symposium on Status of Resource Investigations in the Northwestern Hawaiian Islands*. University of Hawaii Sea Grant Miscellaneous Report UNIHI-SEAGRANT-MR-80-04.

Gulland, J. 1969. *Manual of methods for fish stock assessment. Pt. 1. Fish population analysis*. FAO Man. Fish. Sci. 4.

Gulland, J. 1970. “The fish resources of the ocean.” FAO Tech. Paper 97, Food and Agriculture Organization, Rome.

Guyer, R. undated. “People doing science.” http://scienceeducation.nih.gov/nihHTML/ose/snapshots/multimedia/pds/scientist/science1.html.

Haight, W., D. Kobayashi and K. Kawamoto. 1993. “Biology and management of deepwater snappers of the Hawaiian Archipelago.” *Marine Fisheries Review 55*(2):20-27.

Hale, E. 1964. “Economic investigation of the commercial fishing industry in the State of Hawaii.” Progress report. Hawaii Department of Planning and Economic Development, Honolulu.

Hamamoto, H. 1928. “The fishing industry in Hawaii.” B.Sc. Thesis, University of Hawaii, Honolulu.

Hau, S. 1984. “Economic analysis of deep bottomfishing in the Northwestern Hawaiian Islands.” *In*: Grigg, R. and K. Tanoue (eds.), *Proceedings of the Second Symposium on Resource Investigations in the Northwestern Hawaiian Islands*. University of Hawaii Sea Grant Miscellaneous Report UNIHI-SEAGRANT-MR-84-01.

HDAR (Hawaii Division of Aquatic Resources). 1979. *Hawaii Fisheries Development Plan*. State of Hawaii Department of Land and Natural Resources, Honolulu.

HDAR (Hawaii Division of Aquatic Resources). 1986. *Hawaii Fisheries Plan 1985*. State of Hawaii Department of Land and Natural Resources, Honolulu.

Hida, T. 1984. “Pelagic fisheries resources of the Northwestern Hawaiian Islands.” *In*:

Grigg, R. and K. Tanoue (eds.), *Proceedings of the Second Symposium on Resource Investigations in the Northwestern Hawaiian Islands*. University of Hawaii Sea Grant Miscellaneous Report UNIHI-SEAGRANT-MR-84-01.

Hollyer, J. 1987. “Economic Allocation of the 10-20 Fathom Range of the Northwestern Hawaiian Islands: Lobster Fishery or Hawaiian Monk Seal Critical Habitat?” Master’s Thesis, University of Hawaii, Honolulu.

HMSRT (Hawaiian Monk Seal Recovery Team). 1999. Hawaiian Monk Seal Recovery Team Meeting, December 6-7, 1999. Unpublished manuscript.

Hunter, C. 1995. “Review of coral reefs around American Flag Pacific Islands and assessment of need, value and feasibility of establishing a coral reef fishery management plan for the Western Pacific Region.” Western Pacific Regional Fishery Management Council, Honolulu.

Inouye. 2004. "Congress passes bill with nearly half-billion dollars for defense related initiatives in Hawaii," http://inouye.senate.gov/(accessed July 30, 2004).

Iversen, R., T. Dye and L. Paul. 1990. “Native Hawaiian fishing rights. Phase 2: Main Hawaiian Islands and the Northwestern Hawaiian Islands.” Western Pacific Regional Fishery Management Council, Honolulu.

Iverson, S. 2000. “Hawaiian monk seals and prey species in the Northwestern Hawaiian Islands: Report on quantitative fatty acid signature analysis.” Department of Biology, Dalhousie University, Halifax, Nova Scotia.

Japanese Consulate. 1913. Annual report on trade in Hawaii for the period July 1, 1912 through June 30, 1913, as was submitted to the Japanese Foreign Office by the Japanese Consulate under date of September 30, 1913.

Johanos, T. 2000. “Monk seals in the Main Hawaiian Islands.” *The Monachus Guardian 3*(1):57-59.

Johanos, T. and T. Ragen. 1996a. “The Hawaiian monk seal in the Northwestern Hawaiian Islands, 1993.” NOAA Tech. Memo NMFS. NOAA-TM-NMFS-SWFSC-227. 141pp.

Johanos, T. and T. Ragen. 1996b. “The Hawaiian monk seal in the Northwestern Hawaiian Islands, 1994.” NOAA Tech. Memo NMFS. NOAA-TM-NMFS-SWFSC-229. 111pp.

Johanos, T. and T. Ragen. 1997. “The Hawaiian monk seal in the Northwestern Hawaiian Islands, 1995.” NOAA Tech. Memo NMFS. NOAA-TM-NMFS-SWFSC-241. 121pp.

Johanos, T. and T. Ragen. 1999a. “The Hawaiian monk seal in the Northwestern

Hawaiian Islands, 1996." NOAA Tech. Memo NMFS. NOAA-TM-NMFS-SWFSC-259. 134pp.

Johanos, T. and T. Ragen. 1999b. "The Hawaiian monk seal in the Northwestern Hawaiian Islands, 1997." NOAA Tech. Memo NMFS. NOAA-TM-NMFS-SWFSC-62. 131pp.

Johanos, T. and J. Baker. 2001. "The Hawaiian monk seal in the Northwestern Hawaiian Islands, 1993." NOAA Tech. Memo NMFS. NOAA-TM-NMFS-SWFSC-310. 130pp.

Johnson, B. and P. Johnson. 1981. "The Hawaiian monk seal on Laysan Island: 1978." Final report to the U.S. Marine Mammal Commission in fulfillment of contract MM7AC009, Rept. No. MMC-77/05. U.S. Dept. Comm., NTIS, Springfield, VA. PB-285-428. 38pp

June, F. 1950. "The Hawaiian long-line fishery." *Commercial Fisheries Review 12*(1):1-23.

Kahaulelio, A., 1902. "Fishing lore." *Ka Nupepa Kuokoa.* Trans. M. Pukui.

Kahng, S. 2007. "Ecological impacts of *Carijoa riisei* on black coral habitat." *Western Pacific Regional Fishery Management Council*. 5 pp.

Kamakau, S. 1976. The Works of the People of Old, *Na Hana a ka Po e Kahiko*. Bishop Museum Press.

Kameeleihiwa, L. 1992. Native Land and Foreign Desires, *Pehea La E Pono Ai?*. Bishop Museum.

Kellert, S. 1986. "Social and perceptual factors in the preservation of animal species." *In*: B. Norton (ed.), *The preservation of Species*. Princeton University Press, Princeton, New Jersey.

Kenyon, K. 1980. "No man is benign: The endangered monk seal." *Oceans 13*(3):48-54.

Kenyon, K. and D. Rice. 1959. "Life history of the Hawaiian monk seal." *Pacific Science 13*(3):215-252.

Konishi, O. 1930. "Fishing industry of Hawaii with special reference to labor." Unpublished manuscript, Hamilton Library Pacific Collection, University of Hawaii.

Kooyman, G. 1981. *Weddell Seal: Consumate Diver*. Cambridge University Press, New York.

Kosaki, R. 1954. "Konohiki Fishing Rights." Legislative Reference Bureau Report No. 1, Honolulu.

Kretzmann, M. 1998. “Conservation genetics of the Hawaiian monk seal (*Monachus schauinslandi*).” Ph.D. dissertation, University of California, Santa Cruz.

Kubota, G. 1996. “Black coral, blue death.” *Honolulu Star-Bulletin*, March 14, p.A-1.

Kuykendall, R. 1953. *The Hawaiian Kingdom, 1854-1870, Twenty Critical Years. Vol. 2*. University of Hawaii Press, Honolulu.

Kuokoa Home Rula. 1908. “*Ka Moolelo Ka ao o Hi iakaikapoliopele*.”April 17.

Laurs, M. 2000. “2000 External Program Review.” NOAA NMFS SWFSC HL.

Laurs, M. 2002. Report of NMFS Honolulu Laboratory research activities made to the 112th meeting of the Western Pacific Regional Fishery Management Council.

Lavigne, D. 1999. “The Hawaiian monk seal: Management of an endangered species.” *In*: J. Twiss and R. Reeves (eds.), *Conservation and Management of Marine Mammals.* Smithsonian Institution Press, Washington, D.C.

Look, M. and K. Braun. 1995. “A Mortality Study of the Hawaiian People 1910-1990.” The Queens’s Health Systems, Honolulu.

Loomis, J. and D. White. 1996. “Economic benefits of rare and endangered species: summary and meta-analysis.” *Ecological Economics 18*:197-206.

MacDonald, C. 1982. “Predation by Hawaiian monk seals on spiny lobsters.” *Journal of Mammalogy 63*:700.

Malo, D. 1951. *Hawaiian Antiquities*. B.P. Bishop Museum Special Publication 2, Bishop Museum Press, Honolulu.

Maragos, J. and P. Holthus. 1995. “A status report on the coral reefs of the insular tropical Pacific.” *In*: L. Eldridge, J. Maragos, P. Holthus and H. Takeuchi (eds.), *Marine and Coastal Biodiversity in the Tropical Island Pacific Region. Volume 2*. East-West Center and Bishop Museum, Honolulu.

Maragos, M. Peterson, L.Eldredge, J. Bardach and H. Takeuchi (editors). *Proceedings of the Workshop on Marine/Coastal Biodiversity in the Tropical Island Pacific Region*. East-West Center and Pacific Science Association, Honolulu, Hawaii.

Marine Mammal Commission. 1999. Annual Report to Congress, 1998. Marine Mammal Commission, Bethesda, Maryland.

Marine Mammal Commission. 2000. Annual Report to Congress, 1999. Marine Mammal Commission, Bethesda, Maryland.

Markowski, S. 1952. “The cestodes of pinnipeds in the Arctic and other regions.” *J.*

Helminthol. 26:171-214.

Mendelsohn, R. 1985. “The benefits of preserving endangered species: with special attention to the humpback whale (including comments and response).” NMFS Southwest Fisheries Center Honolulu Laboratory Administrative Report H-85-9.

Metrick, A. and M. Weitzman. 1996. “Patterns of behavior in endangered species preservation.” *Land Economics 72*(1):1-16.

Miao, X., L. Woodard, C. Swenson and Q. Li. in press. “Comparative concentrations of metals in marine species from French Frigate Shoals, North Pacific Ocean.” *Mar. Poll. Bull.*
Miao, X., L. Woodard, C. Swenson and Q. Li. 2000. “Distribution of polychlorinated biphenyls in marine species from French Frigate Shoals, North Pacific Ocean.” *The Science of the Total Environment 257*:17-28.

Midway Phoenix Corporation. undated. http://www.midwayisland.com/home.html.

Mitchell, R. and R. Carson. 1989. “Using Surveys to Value Public Goods: The Contingent Valuation Method.” Resources for the Future, Washington, D.C.

Mundy, B. undated. “Hawaiian monk seal.” http://biology.usgs.gov/s+t/SNT/noframe/mr194.htm.

Murakami, A. and B. Freitas. 1987. “Native Hawaiian claims concerning ocean resources.” Presented to the Hawaii Ocean Affairs Conference, East-West Center, Honolulu. Aug. 7.

Myers, R. 1997. “Assessment of coral reef resources of Guam with emphasis on waters of federal jurisdiction.” Western Pacific Regional Fishery Management Council, Honolulu.

Nakashima, L. 1934. “Little known jobs of Hawaii: Capt. Sakuyo Otani, veteran Hawaii fisherman.” *Honolulu Star Bulletin*, 24 March, p.4.

Nash, R. 1989. *The Rights of Nature: A History of Environmental Ethics.* University of Wisconsin Press, Madison.

Nitta, G. and J. Henderson. 1993. “A review of interactions between Hawaii’s fisheries and protected species.” *Marine Fisheries Review 55*(2):83-92.

NMFS (National Marine Fisheries Service). 1997. “Hawaiian Monk Seal (*Monachus schauinslandi*). Stock definition and geographic range.” http://swfc.ucsd.edu/sars/HI_Monk.htm. Revised 1 August 1997.

NMFS. 1998. “Hawaiian monk seal mortalities.” NMFS Honolulu Laboratory. November 1998. NMFS Southwest Fisheries Center Honolulu Laboratory, Honolulu.

NMFS. 1999. “Informal Section 7 Consultation regarding establishment of permanent lobster fishing areas and allocation of the 1999 Harvest Guideline for the commercial lobster fishery in the Northwestern Hawaiian Islands.” Southwest Fishery Science Center. Long Beach.

NMFS. 2004. WPacFIN web site http://www.pifsc.noaa.gov/wpacfin/ accessed 7/6/2004.

Norwood, W. 1937. “Harvest of the sea: the story of Oahu’s fishermen.” *Honolulu Star Bulletin*, 18 December, section 3, p.1.

OHA (Office of Hawaiian Affairs). 1998. *The Native Hawaiian Data Book*. State of Hawaii Office of Hawaiian Affairs, Honolulu.

Oishi, F. 1990. “Black coral harvesting and marketing activities in Hawaii - 1990.” State of Hawaii Division of Aquatic Resources, Honolulu.

Okamoto, H. 1982. “Deep bottom fish surveys – Hawaii.” State of Hawaii Division of Aquatic Resources, Honolulu.

Parrish, F., K. Abernathy, G. Marshall and B. Buhleier. 2002. “Hawaiian monk seals *(Monachus schauinslandi*) foraging in deep-water coral beds.” *Marine Mammal Science 18*(1):244-258.

Parrish. F., M. Craig, T. Ragen, G. Marshall and B. Buhleir. 2000. “Identifying diurnal foraging habitat of endangered Hawaiian monk seals using a seal-mounted video camera.” *Marine Mammal Science 16*(2):3922-412.

Pearce, D. and D. Moran 1994. *The Economic Value of Biodiversity*. Earthscan Publications, Ltd., London.

Polovina, J. 1993. “The lobster and shrimp fisheries in Hawaii.” *Marine Fisheries Review 55*(2):28-33.

Polovina, J. and W. Haight. 1999. “Climate variation, ecosystem dynamics, and fisheries management in the Northwestern Hawaiian Islands.” Ecosystem Approaches for Fisheries Management, Alaska Sea Grant College Program AK-SG.

Polovina, J., G. Mitchum, N. Graham, M. Craig, E. DeMartini and E. Flint. 1994. “Physical and biological consequences of a climate event in the Central North Pacific.” *Fisheries Oceanography 3*(1):15-21.

Polovina, J., G. Mitchum and G. Evans. 1995. “Decadal and basin-scale variation in mixed layer depth and the impact on biological production in the Central and North Pacific, 1960-88.” *Deep-Sea Research 42*(10):1701-1716.

Pooley, S. 1993. “Hawaii’s marine fisheries: some history, long-term trends and recent developments.” *Marine Fisheries Review 55*(2):7-19.

Pukui, M., 1983. *Olelo Noeau: Hawaiian Proverbs and Poetical Sayings.* Bishop Museum Press, Honolulu.

Ragen, T. and D. Lavigne. 1999. "The Hawaiian monk seal: Biology of an endangered species." *In*: J. Twiss and R. Reeves (eds.), *Conservation and Management of Marine Mammals.* Smithsonian Institution Press, Washington, D.C.

Randall, A. 1986. Human preferences, economics, and the preservation of species. In B. Norton (ed.), The Preservation of Species, Princeton University Press, Princeton, New Jersey.

Rausch, R. 1969. "Diphyllobothriid cestodes from the Hawaiian monk seal, *Monachus schauinslandi* Matschie, from Midway Atoll." *Journal of Fisheries Resources Board of Canada 26*:947-956.

Rauzon, M. 2001. *Isles of Refuge: Wildlife and History of the Northwestern Hawaiian Islands*. University of Hawaii Press, Honolulu.

Rice, D. 1964. "The Hawaiian monk Seal." *Natural History 73*:48-55.

Rutka, J. 1984. "Management plans for fishery resources in the Northwestern Hawaiian Islands." *In*: Grigg, R. and K. Tanoue (eds.), *Proceedings of the Second Symposium on Resource Investigations in the Northwestern Hawaiian Islands*. University of Hawaii Sea Grant Miscellaneous Report UNIHI-SEAGRANT-MR-84-01

Samples, K. and J. Hollyer. 1990. "Contingent valuation of wildlife resources in the presence of substitutes and complements." *In*: R. Johnson and G. Johnson (eds.), *Economic Valuation of Natural Resources*, Westview Press, Boulder, Colorado.

Schafers, A. 2004. "Room shortages might slow Japanese tourism," Honolulu Star-Bulletin, July 4, 2004, http://starbulletin.com/2004/08/04/news/index2.htm.

Schlexer, F. 1984. "Diving patterns of the Hawaiian monk seal, Lisianski Island, 1982." NMFS Tech. Memo. NOAA-TM-NMFS-SWFSC-41

Scobie, R. 1949. "The technology and economics of fishing in relationship to Hawaiian culture." M.A. Thesis, London School of Economics, London.

Shallenberger, R. 1980. "Management of the Hawaiian Islands National Wildlife Refuge." *In*: Grigg, R. and R. Pfund (eds.), *Proceedings of the Symposium on Status of Resource Investigations in the Northwestern Hawaiian Islands*. University of Hawaii Sea Grant Miscellaneous Report UNIHI-SEAGRANT-MR-80-04.

Sharma, K., A. Peterson, S. Pooley, S. Nakamoto and P. Leung. 1999. "Economic contributions of Hawaii's fisheries." SOEST 99-08/JIMAR Contribution 99-327, Pelagic Fisheries Research Program, Joint Institute of Marine and Atmospheric Research, University of Hawaii, Honolulu.

Shinsato, H. 1973. Letter to Regional Director, U.S. Bureau of Sport Fisheries and Wildlife dated 9 May 1973.

Shomura, R. 1987. “Hawaii’s marine fishery: yesterday and today.” NMFS SWFSC Honolulu Laboratory Administrative Report H-87-21.

Smith, O. and M. Schaefer. 1949. “Fishery exploration in the western Pacific.” *Commercial Fisheries Review 11*(3):1-18.

Spalding, S. 2000. “What’s ailing the Hawaiian monk seals?” *Hawaii Fishing News* (March):20-21.

Stannard, D. 1989. *Before the Horror: The Population of Hawaii on the Eve of Western Contact.* SSRI, University of Hawaii, Honolulu.

Stevens, T., J. Echeverria, R. Glass, T. Hager and T. More. 1991. “Measuring the existence value of wildlife: what do CVM estimates really show?” *Land Economics 67*(4):390-400).

Stewart, B. 1998. “Foraging ecology of Hawaiian monk seals (*Monachus schauinslandi*) at Pearl and Hermes Reef, northwestern Hawaiian Islands: 1997-1998.” HSWRI Technical Report No. 98-281:1-83.

The Gallup Organization. 2000. “Guest scholar poll review, April 18, 2000.” http://www.gallup.com/poll/guest_scholar/gs000418.asp.

The Working Groups of the U.S. Coral Reef Task Force. 1999. “Draft of the National Action Plan to Conserve Coral Reefs.” Presented to the U.S. Coral Reef Task Force, 2 November 1999, U.S. Virgin Islands.

The World Travel and Tourism Council, 1999. “WTTC tourism report 1999: How travel and tourism affects Hawaii’s economy.” World Travel and Tourism Council, New York.

Thurston, L., 1927. “Honolulu faces fish fight to a finish; Fish Trust is arrogant!” The Honolulu Advertiser, 29 May.

Uchida, R. and D. Tagami. 1984. “Biology, distribution, population structure, and preexploitation abundance of spiny lobster, *Panulirus marginatus* (Quoy and Gaimard 1825), in the Northwestern Hawaiian Islands.” *In*: R. Grigg and K. Tanoue (eds.), *Proceedings of the Second Symposium on Resource Investigations in the Northwestern Hawaiian Islands*. University of Hawaii Sea Grant Miscellaneous Report UNIHISEAGRANT-MR-84-01.

Uchiyama, J. 1980. “Survey of the pelagic fishes of the Northwestern Hawaiian Islands.” In Grigg, R. and R. Pfund (eds.), *Proceedings of the Symposium on Status of Resource Investigations in the Northwestern Hawaiian Islands*. University of Hawaii Sea Grant Miscellaneous Report UNIHI-SEAGRANT-MR-80-04.

U.S. Coral Reef Task Force. 2000. “The National Action Plan to Conserve Coral Reefs.” March 2, 2000, Washington, D.C. http://coralreef.gov/.

USFWS (U.S. Fish and Wildlife Service), 1986. *Hawaiian Islands National Wildlife Refuge Final Master Plan/Environmental Impact Statement.* FES#86/11. U.S. Fish and Wildlife Service, Honolulu.

USFWS (U.S. Fish and Wildlife Service). 1997. *Draft supplemental environmental assessment for the proposed public use program at Midway Atoll National Wildlife Refuge.* U.S. Fish and Wildlife Service, Honolulu.

Wetherall, J. A. and M. Y. Yong. 1977. Computer simulation of pink coral population dynamics and analyses of harvest policies. Part 1: Preliminary Studies. Southwest Fisheries Center Admin. Rept. 21 H, 1977 (computer printout).

Whittow, G. G. Balazs and G. Schmidt. 1979. “Parasitic ulceration of the stomach in a Hawaiian monk seal (*Monachus schauinslandi*).” *Elepaio 39*:83-84.

WPRFMC (Western Pacific Regional Fishery Management Council). 1980. *Fishery Management Plan for the Precious Corals of the Western Pacific Region.* Western Pacific Regional Fishery Management Council. Honolulu.

WPRFMC (Western Pacific Regional Fishery Management Council). 1998. “Magnuson-Stevens Act definitions and required provisions. Amendment 6 to the Bottomfish and Seamount Groundfish Fishery Management Plan, Amendment 8 to the Pelagic Fishery Management Plan, Amendment 10 to the Crustaceans Fishery Management Plan, Amendment 4 to the Precious Corals Fishery Management Plan.” Western Pacific Regional Fishery Management Council. Honolulu.

WPRFMC (Western Pacific Regional Fishery Management Council). 1999. “A framework adjustment to measures in the fishery management plan for the precious coral fisheries of the Western Pacific Region regarding harvest quotas, definitions, size limits, gear restrictions, bed classifications and reporting and recordkeeping requirements.” Western Pacific Regional Fishery Management Council, Honolulu.

WPRFMC (Western Pacific Regional Fishery Management Council). 2000. “Draft fishery management plan for coral reef ecosystems of the Western Pacific Region (and regulations)”. Volume 1. Western Pacific Regional Fishery Management Council, Honolulu.

WPRFMC (Western Pacific Regional Fishery Management Council). 2002. “2002 Pelagics Annual Report.” Western Pacific Regional Fishery Management Council, Honolulu.

Yamamoto, T. (ed.). 1970. *The Rainbow: A History of the Honolulu Japanese Chamber of Commerce*. Japanese Chamber of Commerce, Honolulu.1970.

Yuen, S., B. DeBaryshe and I. Stern. 1997. “Family adaptation to occupational loss, final report.” Center on the Family, University of Hawaii, Honolulu.