



**WESTERN
PACIFIC
REGIONAL
FISHERY
MANAGEMENT
COUNCIL**

**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, and Bed Classifications**

**Including an Environmental Assessment and
Regulatory Impact Review/Final Regulatory Flexibility Analysis**

March 15, 2001

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

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

2.0 Summary

The domestic fishery for pink, gold and bamboo precious corals in the EEZ of the Western Pacific region has been nearly dormant for two decades. However, a number of firms have recently expressed interest in participating in the precious coral fishery in the EEZ around Hawaii using selective gear. In addition, recent research and surveys have provided new information on precious corals in the waters around the Hawaiian Islands, including information on the size and condition of certain classified precious coral beds, potential increases in fishing pressure on black corals, the presence of a new precious coral bed near French Frigate Shoals and the possible importance of precious coral beds as foraging areas for the endangered Hawaiian monk seal (*Monachus schauinslandi*). Based on these recent research and survey findings and the prospect of a renewal of the fishery, the Council recommends the following adjustments to the regulations governing the precious coral fisheries in the EEZ of the Western Pacific region:

- 1) Suspend the harvest quota for gold coral at the Makapu'u Bed until additional information is available on the impact of harvesting on subsequent recruitment of gold coral at the Makapu'u Bed.
- 2) Redefine live precious coral as precious coral that has live coral polyps or tissue. Redefine dead precious coral as precious coral that no longer has any live coral polyps or tissue.
- 3) Apply size limits to live coral only.
- 4) Prohibit the harvest of black coral unless it has attained either a minimum stem diameter of 1 inch, measured no less than 1 inch from the top of the living holdfast, or a minimum height of 48 inches, measured from the base to the greatest distal extremity of the colony. Persons who reported a landing of black coral to the State of Hawaii within 5 years before the effective date of the final rule would qualify for an exemption which allows the hand harvest of black coral that has attained a minimum base diameter of 3/4 inches, measured on the widest portion of the skeleton at a location just above the holdfast.
- 5) Allow only selective gear to harvest precious corals from all permit areas.
- 6) Apply the current size limit for pink coral to all permit areas.
- 7) Revise the boundaries of Brooks Bank, Permit Area C-B-3, to include the area within a radius of 2.5 nautical miles of a point at 23° 58.8' N and 166° 42' W. At Brooks Bank change the harvest quota for pink coral to 200 kg and suspend the harvest quota for gold coral until additional scientific information becomes available on the impact of harvesting gold coral on monk seal foraging habitat.
- 8) Classify the newly-discovered FFS-Gold Pinnacles Bed as a conditional bed, Permit Area C-B-5, which includes the area within a radius of 0.25 nautical miles of a point at 23° 55' N and 165° 23.11' W. At the FFS-Gold Pinnacles Bed set the annual harvest quota for all types of

precious coral at zero until additional information becomes available on the impact of harvesting gold coral on monk seal foraging habitat.

In addition to the above regulatory measures, the Council recommends that 1) all managed species of precious corals be listed on the NMFS Daily Precious Coral Harvest Log and Precious Coral Sales Trip Report; and 2) the NMFS Daily Precious Coral Harvest Log include the following fishing information: (i) Beginning and ending time, and date, of all dives, including the dives when no harvest is made; (ii) Beginning and ending position in degrees latitude and longitude of each dive and distance traveled; (iii) Maximum and minimum depth of each dive; (iv) Number of live and dead colonies harvested on each dive by species; (v) Weight of harvested coral on each dive by species, to the nearest tenth of a kilogram (landed weight air dried for at least 24 hours); (vi) Number of live and dead colonies damaged but not harvested on each dive by species. Any video tapes made during harvest operations shall be made available to NMFS upon request. The video recording should continuously display date and time. This is a non-regulatory change as the current regulations already require harvesters to fill out logs as supplied by NMFS.

During the preparation of this document, President Clinton issued Executive Orders 13178 (December 4, 2000) and 13196 (January 18, 2001), which together establish conservation measures for the newly formed Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve. Under these orders, commercial fishing effort and take in the reserve are capped at each permittee's take in the year preceding December 4, 2000. Since there were no Federal precious coral permits issued for any harvestable Northwestern Hawaiian Islands (NWHI) beds (Brooks Banks and 180 Fathom Beds), the Executive Orders place a permanent zero harvest cap on these beds (despite their existent harvest quotas). The effect of this cap on the single Hawaii exploratory area (permit area X-P-H which includes waters around both the NWHI and the main Hawaiian Islands) is less clear as, although there was some harvest of precious corals from the main Hawaiian Islands portion of this area in 2000, there was no harvest from the NWHI portion. How this historical take will now be allocated within the Hawaii exploratory area remains unresolved. The Precious Corals Fishery Management Plan will be revised to reflect these measures as they are clarified by the Reserve Operating Plan which is now being developed by the National Ocean Service. This Operating Plan is anticipated to contain implementing regulations as well as a complete analysis of the impacts of those regulations on the human environment.

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4.0 Introduction

4.1 Responsible agencies

The Western Pacific Regional Fishery Management Council (Council or WPRFMC) was established by the Magnuson Fishery Conservation and Management Act to develop fishery management plans (FMPs) for fisheries operating in the US Exclusive Economic Zone (EEZ) around American Samoa, Guam, Hawaii, the Northern Mariana Islands and the remote US Pacific Island possessions.¹ Once an FMP is approved by the Secretary of Commerce (Secretary), it is implemented by Federal regulations which are enforced by the National Marine Fisheries Service (NMFS) and the US Coast Guard, in cooperation with state agencies.

For further information, contact:

Kitty M. Simonds
Executive Director
WPRFMC
1164 Bishop St., #1400
Honolulu, HI 96813
Telephone: (808) 522-8220
Fax: (808) 522-8226

Charles Karnella
Administrator
NMFS Pacific Islands Area Office
1601 Kapiolani Blvd., #1110
Honolulu, HI 96814-0047
Telephone: (808) 973-2937
Fax: (808) 973-2941

4.2 Public review process and schedule

Prior to the 16-18 June 1999 Council meeting an information document was circulated to all interested parties. This document outlined the nature of the problem and alternative solutions. At the Council meeting in June the Council considered recommendations made by the Precious Corals Standing Committee and other advisory groups such as the Precious Coral Fishery Plan Team and Scientific and Statistical Committee. The Council agreed to proceed with further action under the framework process, and the issue was placed on the agenda for the 18-22 October 1999 Council meeting. A document describing the issue, alternative ways to resolve the issue, the preferred action and the anticipated impacts of the management alternatives was prepared and distributed to the public with a request for comments. A notice was published in the Federal Register summarizing the Council's deliberations and preferred action and indicating the time and place for the Council meeting to take final action. The Council took final action at the Council meeting on October 18-20, 1999. A proposed rule was published in the Federal Register on September 5, 2000, with a 30 day public comment period.

¹ Howland Island, Baker Island, Jarvis Island, Johnston Atoll, Midway Island, Kingman Reef, Palmyra Atoll, and Wake Island.

4.3 List of preparers

This document was prepared by:

Donald Schug, Staff Economist
Western Pacific Regional Fishery Management Council

Marcia Hamilton, Fishery Program Specialist
National Marine Fisheries Service, Pacific Islands Area Office

and the following members of the WPRFMC Precious Coral Fishery Plan Team and Advisory Panel:

Richard Grigg, Marine Biologist (Plan Team Chair)
University of Hawaii, Department of Oceanography, Honolulu, Hawaii

Isaac Harp, Fisherman
Lahaina, Hawaii

David Jolley, Consultant (Advisory Panel Chair)
American Deepwater Engineering, Ltd., Honolulu, Hawaii

James Maragos, Coral Reef Biologist
US Fish and Wildlife Service, Honolulu, Hawaii

Francis Oishi, Aquatic Biologist
Hawaii Division of Aquatic Resources, Honolulu, Hawaii

Samuel Pooley, Industry Economist
NMFS, Southwest Region, Honolulu Laboratory

Frank Parrish, Fishery Biologist
NMFS, Southwest Region, Honolulu Laboratory

Clifford Slater, President, and Carl Marsh, Senior Vice President
Maui Divers of Hawaii, Ltd., Honolulu, Hawaii

5.0 Purpose and Need for Action

The domestic fishery for deep water (pink, gold and bamboo) precious corals in the EEZ of the Western Pacific region has been nearly dormant for two decades, with limited harvest of black corals taken from EEZ waters. During the late 1980s, non-selective tangle nets harvested about 450 kg of pink coral in the waters off the NWHI, but most of the colonies harvested were dead and of poor quality (Grigg 1993). However, a number of firms have recently expressed interest in participating in the precious coral fishery in the EEZ around Hawaii using selective gear. One of these firms has received a NMFS permit to harvest precious corals at the Makapu'u Bed and completed an exploratory survey of the bed. In addition, recent research and surveys have provided new information on precious corals in the waters around Hawaii, including information on the size and condition of certain classified precious coral beds, potential increases in fishing pressure on black corals, the presence of a new precious coral bed near French Frigate Shoals and the possible importance of precious coral beds as foraging areas for the endangered Hawaiian monk seal (*Monachus schauinslandi*). As a result of discussions of these research and survey findings and the prospects of a renewed fishery, the Council identified a number of problems for resolution. These can be grouped into eight areas as follows: potential overfishing of gold coral at the Makapu'u Bed; concerns that some gold coral stands may provide foraging habitat for the endangered Hawaiian monk seal; a possibility that the current definitions of live and dead coral may be inappropriate; a need to update the MSY and resultant harvest quota for pink coral at the Brooks Bank Bed; concerns for minimum size limits for black and pink corals; a possible need to limit all harvesters to selective gear types only; classification of a new bed discovered in the NWHI; and a need for greater details on the harvesting activities of fishery participants.

6.0 Existing Management Measures

6.1 Overview

The FMP for precious corals in the Western Pacific region was approved by the US Secretary of Commerce on May 20, 1980. The FMP covers domestic and foreign fishing for precious corals in the US EEZ of the Western Pacific region. Precious coral means any coral of the genus *Corallium*, including the following coral species:

- Pink coral (also known as red coral), *Corallium secundum*
- Pink coral (also known as red coral), *Corallium regale*
- Pink coral (also known as red coral), *Corallium laeueense*
- Gold coral, *Gerardia* spp.
- Gold coral, *Narella* spp.
- Gold coral, *Calyptrophora* spp.
- Bamboo coral, *Lepidisis olapa*
- Bamboo coral, *Acanella* spp.
- Black coral, *Antipathes dichotoma*
- Black coral, *Antipathes grandis*
- Black coral, *Antipathes ulex*

The FMP for precious corals in the Western Pacific region identifies the problem of managing a resource of unknown dimensions characterized by slow growth, low rates of mortality and low rates of recruitment.

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 US Pacific Island possessions, but virtually nothing is known of their distribution and abundance in those areas. To date, beds of pink, gold and/or bamboo coral have been found at seven locations in the Council's jurisdiction, all in the EEZ around Hawaii. This number includes a recently discovered bed near French Frigate Shoals in the Northwestern Hawaiian Islands (NWHI). There are also two known major beds of black coral in the Council's area, as well as several minor beds (Grigg 1998a). Most of these are located in Hawaii's state waters, however the largest (the Au'au Channel Bed) extends into the EEZ.

6.2 Definition of Beds

The plan treats separate precious coral beds as distinct management units because of their widely-separated patchy distribution and the sessile nature of individual colonies. There are two known major black coral beds in Hawaii's EEZ, these are not identified by regulation and to date have not been actively managed by this FMP. There are currently six identified deep water (pink, gold, bamboo) precious coral beds which are classified as established, conditional, refugia or exploratory. Established beds are ones for which appraisals of the MSY are reasonably precise. To date, only the Makapu'u Bed has been studied adequately enough to be classified as established. Lacking other data, the FMP assumes that ecological conditions at the Makapu'u Bed are representative of conditions at all other beds.

Conditional beds are ones for which optimum yields are estimated on the basis of bed characteristics relative to established beds. Four beds of precious corals are classified as conditional. Refugia beds are areas set aside for baseline studies and possible reproductive reserves. No harvesting of any type is allowed in those areas. The single refugium bed that has been designated - the Westpac Bed - is also located in the EEZ surrounding Hawaii. Exploratory areas are the unexplored portions of the EEZ. Separate exploratory permit areas are established for Hawaii, American Samoa, Guam and the remote US Pacific Island possessions. The classification and bounds of each bed are described in the FMP as follows in Table 1.

6.3 Gear Restrictions

Only selective gear is permitted in the EEZ around the main Hawaiian Islands, i.e., south and east of a line midway between Niihau and Nihoa Islands. Selective gear is defined in the FMP as gear used for harvesting precious corals that can discriminate or differentiate between types, size, quality or characteristics of living or dead corals. Use of both selective and non-selective gear is permitted on the conditional beds of Brooks Bank and the 180 Degree Fathom Bank and throughout the exploratory area around the NWHI.

6.4 Harvest Quotas and Rationale

The FMP contains an estimate of maximum sustainable yield (MSY) for pink coral at the Makapu'u Bed of 1,185 kg per year. This estimate is derived using an approximation of Gulland (1970) based on the assumption of a stable annual recruitment of 5,277 colonies, the observed density of colonies per unit of area, the known area of the bed, an estimated annual instantaneous mortality rate of 0.066, and an estimated maximum yield per recruit of 237 gm at an age of 31.4 years. This level of yield can be sustained only if a minimum limit for harvestable colony size is enforced at a size approximating that at which yield per recruit is greatest, which is possible only when selective harvesting methods are used. For pink coral, the minimum size limit is set at a colony height of 10 inches.

Table 1. Classification and bounds of precious coral beds identified in the FMP.

Bed	Location And Bounds	Area in km ²
Makapu'u (established)	Main Hawaiian Islands - the area within a radius of 2.0 nautical miles (nm) of a point at 21° 18.0 N lat., 157°32.5 W. long.	3.60
Keahole Point (conditional)	Main Hawaiian Islands - the area within a radius of 0.5 nm of a point at 19° 46.0 N. lat, 156° 06.0W. long.	0.24
Kaena Point (conditional)	Main Hawaiian Islands - the area within a radius of 0.5 nm of a point at 21° 35.4 N lat, 155° 22.9 W. long.	0.24
Brooks Bank (conditional)	Northwestern Hawaiian Islands - the area within a radius of 2.0 nm of a point at 24° 06.0N lat, 166° 48.0W. long.	1.6
180 Fathom Bank (conditional)	Northwestern Hawaiian Islands - the area within a radius of 2.0 nm of a point at 28° 50.2N. lat, 178° 53.4W.long	0.8
Westpac Bed (refugium)	Northwestern Hawaiian Islands - the area within a radius of 2.0 nm of a point at 28° 50.2N lat, 162° 35.0W long	0.8
Exploratory permit area X-P-H	Hawaii - all coral beds, other than established beds, conditional beds, or refugia, in the EEZ seaward of the State of Hawaii.	unknown
Exploratory permit area X-P-AS	American Samoa - all coral beds, other than established beds, conditional beds, or refugia, in the EEZ seaward of American Samoa.	unknown
Exploratory permit area X-P-G	Guam - all coral beds, other than established beds, conditional beds, or refugia, in the EEZ seaward of Guam.	unknown
Exploratory permit area X-P-PI	Pacific Island Possessions - all coral beds, other than established beds, conditional beds, or refugia, in the EEZ seaward of the U.S. Pacific Island Possessions	unknown

The optimum yield prescribed for the pink coral fishery on the Makapu'u Bed represents a modification of the MSY by reference to economic considerations affecting the coral harvesting industry. The 10 inch minimum colony height limit is approximately 1 inch shorter than the minimum size which would produce the theoretically highest yield per recruit. The departure from the ideal size limit is made to accommodate current practice in the fishery, where it is considered that a colony height of about 10 inches is the minimum below which harvest of the small, lower valued colonies is not an economically efficient use of the harvesting equipment. The lowered size limit is believed to slightly improve catch rates and the analyses presented in the FMP indicate that the effect on the MSY is negligible. To compensate for this relaxation of the theoretically most productive limit, and to provide a conservative buffer against the possibility of errors of over-estimation in the production analyses, the optimum yield is obtained by rounding the MSY figure downward to 1,000 kg per year.

The major difference between the MSY of 1,000 kg of pink coral per annum and the optimum yield is that the latter is established as 2,000 kg to be taken during any part of a 2-year period rather than 1,000 kg to be harvested each year. The reason for this biennial quota rule is that it is, according to industry sources, economically infeasible to tie up the expensive, specialized equipment required for selective harvesting of precious coral for only a part of each year on one coral bed, whereas the more flexible biennial schedule permits productive employment of the submersible craft for a greater part of the available time making it easier to deploy it in other areas after the quota for the Makapu'u Bed is taken. The analyses presented in the FMP indicate that any lowering of the long-term MSY by strategy would be negligible. Optimum yields for Makapu'u gold coral, based on an MSY of 300 kg per year, and Makapu'u bamboo coral, based on an MSY of 250 kg per year, have been determined by analogy with the case of pink coral and on the same rationale.

Optimum yields of pink, gold, and bamboo stocks on beds other than Makapu'u, for which there is no information available beyond the approximate gross area of the bed, are calculated by considering them to bear the same relation to the optimum yields of the Makapu'u stocks that the areas of the beds bear to the area of the Makapu'u Bed as follows:

$$\frac{\text{MSY for Makapu'u Bed}}{\text{Area of Makapu'u Bed}} = \frac{\text{MSY for Conditional Bed}}{\text{Area of Conditional Bed}}$$

Based on the discussion above, the FMP prescribes methods of harvest for each category of coral bed and harvest quotas for individual beds (Table 2). There are no quotas or size limits for the harvest of black corals. If non-selective gear is employed on conditional beds, the harvest quota is 20 percent of that allowed for selective harvesting because of the loss of potential growth of the undersized colonies that are harvested and failure of the gear to recover all of the coral colonies that it knocks down. The FMP defines non-selective gear as any gear used for harvesting corals that cannot discriminate or differentiate between types, size, quality or characteristics of living or dead corals

Table 2. Harvest quotas for precious coral beds.

Name of Bed	Type of Bed	Harvest Quota	Number of Years	Gear Restriction
Makapuu Bed	Established	Pink --- 2,000 kg Gold --- 600 kg Bamboo --- 600 kg	2	Selective only
Ke-ahole Point	Conditional	Pink --- 67 kg Gold --- 20 kg Bamboo --- 17 kg	1	Selective only
Kaena Point	Conditional	Pink --- 67 kg Gold --- 20 kg Bamboo --- 17 kg	1	Selective only
Brooks Bank	Conditional	Pink --- 444 kg (see Note 1 below) Gold --- 133 kg Bamboo -- 111 kg	1	Selective or Non-Selective (see Note 2 below)
180 Fathom Bank	Conditional	Pink --- 222 kg Gold --- 67 kg Bamboo --- 56 kg	1	Selective or Non-Selective (see Note 2 below)
Westpac Bed	Refugium	Zero (0 kg)	N/A	N/A
Hawaii, American Samoa, Guam, US Pacific Island possessions	Exploratory	1,000 kg per area, all species combined (except black corals)	1	Selective or Non-Selective (see Notes 2 and 3 below)

Note 1: The final rule implementing the FMP published on 20 August 1983 lists the harvest quota for pink coral at Brooks Bank as 17 kg. This is a typographical error. The correct harvest quota is 444 kg.

Note 2: Only 1/5 of the indicated quota amount is allowed if non-selective gear is used; that is, the non-selective harvest will be multiplied by 5 and counted against the quota. If both selective and non-selective methods are used, the bed will be closed when $S + 5N = Q$, where S = selective harvest amount, N = non-selective harvest amount and Q = total harvest quota, for any single species on that bed.

Note 3: Only selective gear may be used to harvest coral from the EEZ seaward of the main Hawaiian Islands.

During the preparation of this document, President Clinton issued Executive Orders 13178 (December 4, 2000) and 13196 (January 18, 2001), which together establish conservation measures for the newly formed Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve. Under these orders, commercial fishing effort and take in the reserve are capped at each permittee's take in the year preceding December 4, 2000. Since there were no Federal precious coral permits issued for any harvestable Northwestern Hawaiian Islands (NWHI) beds (Brooks Banks and 180 Fathom Beds), the Executive Orders place a permanent zero harvest cap on these

beds (despite their existent harvest quotas). The effect of this cap on the single Hawaii exploratory area (permit area X-P-H which includes waters around both the NWHI and the main Hawaiian Islands) is less clear as, although there was some harvest of precious corals from the main Hawaiian Islands portion of this area in 2000, there was no harvest from the NWHI portion. How this historical take will now be allocated within the Hawaii exploratory area remains unresolved. The Precious Corals Fishery Management Plan will be revised to reflect these measures as they are clarified by the Reserve Operating Plan which is now being developed by the National Ocean Service. This Operating Plan is anticipated to contain implementing regulations as well as a complete analysis of the impacts of those regulations on the human environment.

6.5 Other Regulations

Related to the issue of gear restriction is the application of the current size limit for pink coral. A minimum size limit of 10 inches (tree height) was implemented in order to help ensure that the estimated MSY for these precious coral species is not exceeded. However, this size limit can only be applied to pink coral at beds where the use of non-selective gear is prohibited because this gear by definition is non-selective for colony size. At present the size limit only applies to pink coral harvested from the Makapu'u, Keahole Point, and Kaena Point Beds. There are no size limits for pink coral at other beds since the use of non-selective gear is allowed everywhere else, except the EEZ around the Main Hawaiian Islands. This size limit applies to both live and dead pink coral.

The FMP defines dead coral as any precious coral that contains holes from borers or is discolored or encrusted at the time of removal from the seabed. According to this definition, coral that is only slightly bored or encrusted and still partially covered with live coral polyps or tissue is regarded as dead. The harvest quotas apply only to live coral, which is defined as any precious coral that is free of holes from borers, and has no discoloration or encrustation on the skeleton at the time of removal from the seabed.

Recordkeeping and reporting requirements in the FMP require that operators of vessels fishing for precious corals provide only the following fishing information: 1) date of harvest; 2) fishing effort in hours; 3) method of harvest; 4) area fished; 5) depth of water; 6) weight of coral harvested by species; and 7) observations that may be made about the habitat. Amendment 1 to the FMP placed all species *Corallium* harvested by the fishery within the management unit. However, only three species of *Corallium* are listed in the NMFS Daily Precious Coral Harvest Log and Precious Coral Sales Trip Report. In addition, the NMFS Daily Precious Coral Harvest Log and Precious Coral Sales Trip Report do not list the three managed species of black coral.

The FMP also includes a procedure for re-classifying coral beds from exploratory to conditional and from conditional to established as new beds are located and more catch and effort data become available which will allow more precise determinations of sustainable yields.

6.6 Amendments to the FMP

The FMP has been amended four times. The first amendment, implemented by a rule published at 50 FR 27519 on 21 July 1988, applied the management measures of the FMP to US Pacific Insular Areas other than Guam, American Samoa and the Northern Mariana Islands by incorporating them into a single exploratory permit area; expanded the managed species to include any coral of the genus *Corallium*; and outlined provisions for experimental fishing permits designed to stimulate the domestic fishery.

Amendment 2, implemented by a rule published at 56 FR 3072 on 28 January 1991, defined overfishing with respect to 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 percent 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, implemented by a rule published at 63 FR 55809 on 19 October 1998, established a framework procedure for adjustment of management measures. Established measures that are in place via rule-making procedures for the fishery include fishing seasons, classification of coral beds, harvest quotas for all managed species, size restrictions, area restrictions, gear restrictions, incidental catches and permit conditions.

Amendment 4, implemented by rules published at 50 FR part 660 on 19 April 1998, identifies and describes essential fish habitat for managed species of precious corals, discusses measures to minimize bycatch and bycatch mortality in the precious coral fishery and provides criteria for identifying when overfishing has occurred in the fishery. Amendment 4 designated the established bed of Makapu'u as a habitat area of particular concern² for the precious coral fishery because of the ecological function it provides, the rarity of the habitat type and its sensitivity to human-induced environmental degradation. Amendment 4 designated the Au'au Channel as a second habitat area of particular concern for the precious coral 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.

7.0 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 in the western Pacific but limit the fishery so as to achieve the Optimum Yield on a continuing basis;

² Habitat areas of particular concern are areas of fish habitat that are particularly important to the long-term productivity of populations of one or more managed species, or are particularly vulnerable to degradation.

- 2) Prevent overfishing and wastage of resources;
- 3) Encourage the use of selective harvesting methods;
- 4) Minimize the harvest of colonies of coral which are immature;
- 5) Minimize the harvest of colonies of coral which have not reached their full potential for growth; and
- 6) Encourage the acquisition and analysis of new information concerning the distribution, abundance and ecology of precious corals.

8.0 Description of Alternatives

Eight management measures are proposed to address the new developments and potential problems presented above. These are discussed by issue below, and each includes a preferred alternative as well as several rejected alternatives.

Issue 1 - Conservation of gold coral

Alternative 1: No action

Alternative 2 (Preferred): Suspend the harvest quota for gold coral at the Makapu'u Bed until additional information is available on the impact of harvesting on subsequent recruitment of gold coral at this bed.

Alternative 3: Suspend the harvest quota for gold coral at all established and conditional beds.

Alternative 4: Implement a minimum size limit for gold coral.

Issue 2 - Definitions of live and dead coral

Alternative 1: No action.

Alternative 2 (Preferred): Redefine live precious coral as precious coral that has live coral polyps or tissue. Redefine dead precious coral as precious coral that no longer has any live coral polyps or tissue.

Alternative 3: Redefine live precious coral as precious coral that is standing upright. Redefine dead precious coral as precious coral that is no longer standing upright.

Issue 3 - Application of size limits

Alternative 1: No action

Alternative 2(Preferred): Apply size limits to live coral only.

Issue 4 - Conservation of black coral

Alternative 1: No action.

Alternative 2(Preferred): Prohibit the harvest of black coral unless it has attained either a minimum stem diameter of 1 inch, measured no less than 1 inch from the top of the living holdfast, or a minimum height of 48 inches, measured from the base to the greatest distal extremity of the colony. Persons who reported a landing of black coral to the State of Hawaii within 5 years before the effective date of the final rule would qualify for an exemption which

allows the hand harvest of black coral that has attained a minimum base diameter of 3/4 inches, measured on the widest portion of the skeleton at a location just above the holdfast.

Alternative 3: Prohibit the harvest of black coral unless it has attained either a minimum stem diameter of 1 inch, measured no less than 1 inch from the top of the living holdfast, or a minimum height of 48 inches, measured from the base to the greatest distal extremity of the colony.

Alternative 4: Prohibit the harvest of black coral unless it has attained a minimum base diameter of 3/4 inches.

Issue 5 - Gear restrictions

Alternative 1: No action.

Alternative 2(Preferred): Only selective gear may be used to harvest precious corals from all permit areas.

Alternative 3: Only selective gear may be used to harvest precious corals from established and conditional beds.

Issue 6 - Application of size limit for pink coral

Alternative 1: No action.

Alternative 2(Preferred): Apply the current size limit for pink coral to all permit areas.

Alternative 3: Apply the current size limit for pink coral to all established and conditional beds.

Issue 7 - Adjusting Brooks Bank boundaries and harvest quotas

Alternative 1: No action.

Alternative 2 (Preferred): Revise the boundaries of Brooks Bank, Permit Area C-B-3, to include the area within a radius of 2.5 nautical miles of a point at 23° 58.8' N and 166° 42' W. At Brooks Bank change the harvest quota for pink coral to 200 kg and suspend the harvest quota for gold coral until additional scientific information becomes available on the impact of harvesting gold coral on monk seal foraging habitat.

Alternative 3: Increase the boundaries and reclassify the bed as a refugium.

Issue 8 - Classification of newly discovered French Frigate Shoals-Gold Pinnacles Bed

Alternative 1: No action.

Alternative 2.(Preferred): Classify the newly-discovered FFS-Gold Pinnacles Bed as a conditional bed, Permit Area C-B-5, which includes the area within a radius of 0.25 nautical miles of a point at 23° 55' N and 165° 23.11' W. At the FFS-Gold Pinnacles Bed set the annual harvest quota for all types of precious coral at zero until additional information becomes available on the impact of harvesting gold coral on monk seal foraging habitat.

Alternative 3: Classify the bed as a refugium

Alternative 4: Classify the bed as a conditional bed and set the annual harvest quota for gold coral at 80 kg.

In addition to the above regulatory measures, the Council recommends that 1) all managed species of precious corals be listed on the NMFS Daily Precious Coral Harvest Log and Precious Coral Sales Trip Report; and 2) the NMFS Daily Precious Coral Harvest Log include the following fishing information: (i) Beginning and ending time, and date, of all dives, including

the dives when no harvest is made; (ii) Beginning and ending position in degrees latitude and longitude of each dive and distance traveled; (iii) Maximum and minimum depth of each dive; (iv) Number of live and dead colonies harvested on each dive by species; (v) Weight of harvested coral on each dive by species, to the nearest tenth of a kilogram (landed weight air dried for at least 24 hours); (vi) Number of live and dead colonies damaged but not harvested on each dive by species. Any video tapes made during harvest operations shall be made available to NMFS upon request. The video recording should continuously display date and time.

9.0 Affected Environment

9.1 Ecology

Adult pink, gold and bamboo coral are found in deep water (350-1500 m) on solid substrate where bottom currents are strong, while black coral also typically occurs on solid substrate but generally at depths less than 100 m. Precious coral polyps form colonies resembling small trees, and these colonies form aggregations called beds. Asexual reproduction (by fragmentation and reattachment) appears rare.

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

In general western Pacific precious corals share several ecological characteristics: they lack symbiotic algae in tissues (they are ahermatypic) and most are found in deep water below the euphotic zone; they are filter feeders, and many are fan shaped to maximize contact surfaces with particles or microplankton in water column. Most species are uni-sexual or dioecious (sexes are separate) and the age at reproductive maturity is 12-13 years for *secundum* and *dichotoma*, with fertilization appearing to take place in the water column. Western Pacific precious coral larvae are more affected by light and temperature than are adults, with larvae of both *Anipathes* in Hawaii are known to be negatively phototactic which is why they are not found at depths less than 30 meters. The duration of the larval stage is unknown for most species, but Mediterranean studies of *Corallium rubrum* suggest that their larvae remain competent for several weeks. Species of *corallium* exist below the euphotic zone at depths between 350 and 1500 meters where temperature varies between 14 and 3 C. These larvae may avoid settling deeper where lower temperatures may prevent reproduction. Similarly, the lower limit of the *dichotoma* and *grandis* black corals coincides with top of thermocline in the high Hawaii islands (Grigg, 1993).

Little information is available on the ecological associations of the precious corals or their significance to the lives of other organisms. Microzooplankton and particulate organic matter are important in the diets of related *gorgonians*, and like other anthozoan species they are associated

with numerous kinds of commensal invertebrates. They are also associated with many species of other anthozoans. They have not been observed to be consistently associated with any kind of finfish or free-swimming invertebrate. Eucidarid sea urchins are known to prey upon precious corals.

Because of the great depths at which they live, the precious corals would be expected to be insulated from some 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. Nothing is known of 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. The oldest corals observed at Makapu'u are thought to be 75 years old, and it is believed that black corals may live even longer. Hawaii populations of *Corallium secundum* and *A. dichotoma* appear relatively stable implying a balance between recruitment and mortality.

9.2 Distribution

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 US Pacific Island possessions, but virtually nothing is known of their distribution and abundance in these areas. To date, beds of pink, gold and/or bamboo coral have been found only at seven locations in the Council's jurisdiction, all in the EEZ around Hawaii. This number includes a recently discovered bed near French Frigate Shoals in the Northwestern Hawaiian Islands (NWHI). There are also two known major beds of black coral in the Council's area, as well as several minor beds (Grigg 1998a). Most of these are located in Hawaii's state waters, however the largest (the Au'au Channel Bed) extends into the EEZ. The approximate areas of the seven identified beds of precious corals have been determined. These beds are small; only two of them have an area greater than 1 square kilometer, and the largest is 3.6 square kilometers in size. 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 beyond the northwestern extreme of the Leeward Hawaiian Islands, and the large physical area of those banks lead to conjecture that precious corals may at some locations 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 coral beds that is unavailable to U.S. researchers and administrators. It must be said that in general the available information on precious coral occurrence and distribution is fragmentary and very incomplete, and there is a high probability that further surveying and prospecting will reveal significant additional precious coral resources in areas under U.S. jurisdiction.

9.2.1 Makapu'u Bed

This bed has experienced the greatest exploitation and thus is the source of much of the available information about the region's precious corals. Estimates of the densities of occurrence of precious coral colonies in their habitat based on in site observations made at the Makapuu Bed, indicated a sparse, widely separated habit of growth. Surveys of this bed were made in the 1970s, and again in 1997.

In 1971 densities of commercial species were determined in an unexploited section of the bed and the size frequency distribution of pink coral was determined (Grigg, 1976). The average density of pink coral in the Makapu'u Bed was 0.022 colonies per square meter. Extrapolation of this figure to the entire bed (3.6 million square meters) results in a standing crop of 79,200 colonies. The 95% confidence limits of the standing crop are 47,200 to 111,700 colonies. Conversion of standing crop colonies to biomass produced an estimate of 43,500 kg for *C. secundum* in the Makapu'u Bed. The estimates of density for gold coral (*Gerardia* sp.) and bamboo coral (*Lepidisis olapa*) in the Makapu'u Bed were 0.003 colonies/m² and 0.01 colonies/m² respectively. However, the distributional patterns of both of these species were found to be very patchy, much more so than *C. secundum*, and the area where they occurred was only about half that for pink coral, or 1.8 m².

The corresponding estimates of unfished abundance for gold and bamboo colonies were 5,400 and 18,000 colonies respectively. Data for the mean weight of colonies in the populations of gold and bamboo coral in the Makapu'u Bed were lacking, but rough estimates were 2.2 kg for gold coral and 0.6 kg for bamboo coral. Multiplying mean weights by densities led to rough estimates of standing crop of about 11,800 kg for *Gerardia* sp. and 10,800 for *Lepidisis* sp.

An analysis of growth rings in the cross sections of pink coral branches suggests that colony height increases about 0.9 cm/year, at least to an age of about 30 years (Grigg, 1976). The largest colonies of pink gold found at Makapu'u were rarely more than 60 cm in height. Gold coral colonies were seen to reach a height of about 250 cm, while *Lepidisis olapa* was observed at about 300 cm.

The natural mortality rate for pink coral was calculated by first converting the size-frequency distribution of the unfished stock to an age-frequency distribution and then determining the rate of diminution in progressively older age classes (Grigg, 1976). The best estimate of the annual instantaneous mortality rate of *C. secundum* in the Makapu'u Bed is 0.66. This is equivalent to an annual survival rate of about 93% in the absence of fishing. Mortality rates for gold and bamboo coral were not available because their growth rates and age structures were unknown.

Pink corals reach sexual maturity at a height of about 12 cm (13 years), however, the data are not very precise (Grigg, 1976). The reproductive cycle is annual with spawning taking place during June and July. The relationship between parent stock and recruitment in pink coral is unknown. However, because pink coral is long lived, and the population is composed of many year-classes, the standing stock should be relatively stable even with moderate year-to-year

fluctuations in recruitment. An estimate of steady state recruitment of the unexploited Makapu'u stock was obtained by multiplying the virgin stock size (79,200 colonies) by the best estimate of instantaneous mortality (0.066). Given steady state, the instantaneous rate of recruitment should equal the instantaneous rate of natural mortality. This gives an estimate of recruitment to the Makapu'u Bed of 5,277 colonies.

Biomass per recruit as a function of age was calculated in the absence of fishing using a cohort production model (Wetherall and Yong, 1977). In this model, the cohort gains weight until an age is reached where growth gains are overtaken by natural mortality losses. This is the "critical age" at which the cohort reaches its maximum biomass in the absence of fishing. For pink coral the maximum biomass per recruit, attained by a cohort at age 31.4 years is 237 gm.

Under the FMP, the MSYs for precious corals are calculated using a Beverton and Holt (Beverton and Holt, 1957) cohort production model where data is available for *Corallium secundum*, and the Gulland Model ($MSY = 0.4 M B_0$, where m =natural mortality and B_0 is virgin biomass) for *Gerardia* and *Lepidisis*. According to the FMP, the estimated MSY for pink coral at Makapu'u Bed is 1,000 kg/yr, the estimated area of Makapu'u Bed is 3.6 km²

When fishing is done in such a way that all colonies of a cohort are removed at once, then the yield per recruit is identical to the biomass per recruit at the harvest age. Therefore the maximum yield per recruit is achieved by harvesting all survivors in a cohort of pink coral exactly at the critical age of 31.4 years, and in this case the maximum yield per recruit is 237 gm. In practice this would require an infinite instantaneous fishing mortality rate exactly at 31.4 years. Since this is not feasible, the 237 gm/recruit is a theoretical upper limit to the harvest that may actually be obtained. More realistic figures of yield per recruit are obtained by considering a fishery which applies a steady finite fishing mortality rate to all ages in a cohort above a specified minimum harvest age. With a minimum harvest age of 30 years the maximum yield per recruit is essentially equal to the upper limit of 237 gm, whereas with a minimum harvest age of zero years the greatest yield per recruit possible is only 119 gm. Hence, if non-selective measures are employed, the highest yield per recruit that can be expected is only half the maximum yield per recruit theoretically possible under selective harvesting. As long as recruitment is constant or independent of stock size, a fishing policy which maximizes the yield per recruit will also maximize the total yield on a sustained basis, i.e. it will also produce the maximum sustainable yield.

Amendment 4 to the FMP designated the established bed of Makapu'u as a habitat area of particular concern³ for the precious coral fishery 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 of the Makapu'u Bed and the amount of scientific information that has been collected at the bed during the past three decades were also considered. Between 1973 and 1978, a manned submersible was used to harvest 5,953 kg of pink coral and 2,097 kg of gold coral from the Makapu'u Bed.

³ Habitat areas of particular concern are areas of fish habitat that are particularly important to the long-term productivity of populations of one or more managed species, or are particularly vulnerable to degradation.

In August 1997, the Hawaii Underwater Research Laboratory, NOAA used a manned submersible to assess the extent to which the precious corals at the Makapu'u Bed have recovered since the bed was last harvested over 20 years ago (Grigg 1997). During this survey, the number of transects of the Makapu'u Bed made were limited, and only a small area of the bed was surveyed. However, based on the limited data obtained it was concluded that this bed may be at least 15% larger than was indicated by previous data. The survey also showed that the recovery of pink coral has increased from 74% of the virgin biomass in 1978, to 90% in 1997. This finding supports the supposition that recruitment of pink coral is unaffected by harvesting and independent of the density of the standing stock. However, the assessment found that gold coral stocks at the Makapu'u Bed may have experienced little or no recruitment. During the 1997 survey only two or three colonies of gold coral were observed. The number of transects of the Makapu'u Bed made during this assessment were too limited to determine if the stock of gold coral was in an overfished condition, but the data collected suggest that the level of recruitment of gold coral at the Makapu'u Bed has been low. However, it is uncertain if the current scarcity of gold coral colonies at the bed was caused by the 1973-1978 harvests.

9.2.2 Brooks Bank Bed

The current harvest quota listed in the FMP for pink coral at Brooks Bank is 444 kg/yr.⁴ This figure was calculated using the following formula provided in the FMP for setting the quota for conditional beds for which site specific data is unavailable.

$$\frac{\text{MSY for Makapu'u Bed}}{\text{Area of Makapu'u Bed}} = \frac{\text{MSY for Conditional Bed}}{\text{Area of Conditional Bed}}$$

According to the FMP, the estimated MSY for pink coral at Makapu'u Bed is 1,000 kg/yr, the estimated area of Makapu'u Bed is 3.6 km² and the estimated area of Brooks Bank is 1.6 km².

The only survey of this bed was done in September of 1998. Transects on this survey were 2.1 kilometers in length, and conducted at a depth of 350-505 meters. Red coral (*C. regale*) was observed to be very abundant with thousands of colonies present. Colonies occurred in patches from one to five square meters in size, and were located in waters between 430-517 meters deep. These colonies were up to 50 cm in height and averaged 1 cm in diameter. Extrapolation of this data suggests that a conservative standing crop of 8,000 kg of *C. regale* exists at this bed (Grigg 1998b). If it is assumed that this species of precious coral has the same natural mortality rate as *C. secundum* at the Makapu'u Bed (6.6%), an estimate of the MSY can be derived from the formula provided by Gulland (1970): $MSY = 0.4MB$, where M is the natural mortality rate and B is the standing crop biomass. Rounding down, it is estimated that 200 kg of *C. regale* could be harvested annually on a sustainable basis based on these data and

⁴ The final rule implementing the FMP published on 20 August 1983 lists the harvest quota for pink coral at Brooks Bank as 17 kg. This is a typographical error.

assumptions. Pink coral (*C. secundum*) was observed to be moderately abundant on the east side of the bank at depths of 363-427 meters, but were generally small (less than 20 cm in height). Gold coral was abundant with 250 large colonies found between 392-467 meters. It was estimated that there was a standing stock of 2,000 kg of live gold coral, with an equal amount observed dead. Observations of finfish in the area were rare, and there was no evidence of predation by sea urchins at this bed.

9.2.3 Wespac Bed

This bed was also surveyed in 1998. Transects of 3.2 km were made between depths of 360-500 meters. No red coral was observed, however pink coral was abundant, with thousands of colonies in patches ranging from 0.3 to 1.0 square meters in size. Gold coral was rare, with only 2 colonies observed. Finfish (mostly *Polymixia*) were abundant, and there was high predation by *Eucidarid* sea urchins, with 50% of colonies showing signs of predation.

9.2.4 French Frigate Shoals-Gold Pinnacles Bed

Using monk seal telemetry, the 1998 survey also located a previously unknown bed near French Frigate Shoals which has been named the FFS-Gold Pinnacles Bed. Transects 2.9 km in length at a depth of 360-575 meters found no red coral (*C. regale*), and a low abundance of pink coral (*C. secundum*). The pink coral which was observed was generally small, averaging less than 12 cm in height (Grigg 1998b). Both live and dead gold coral were found in abundance, and 300 colonies were observed in scattered patches at depths of 365-406 meters. Extrapolation of the transect data suggests that a standing crop of 3,000 kg of gold coral exists at the FFS-Gold Pinnacles Bed. If it is assumed that this species of precious coral has the same natural mortality rate as *C. secundum* at the Makapu'u Bed (6.6%), an estimate of the MSY can be derived from the formula provided by Gulland (1970): $MSY = 0.4MB$, where M is the natural mortality rate and B is the standing crop biomass. Rounding down, it is estimated that 80 kg of gold coral could be harvested annually on a sustainable basis based on these data and assumptions. Few finfish were observed at this bed, no arrowtooth eels were seen.

9.2.5 Black coral beds

Oishi (1990) and Grigg (1998a) summarized available information on Hawaii's black coral resources as follows⁵: 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, *Anthipathes 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 may extend up to the Northwestern Hawaiian Islands. *A. dichotoma* exists at depths from 30 to 110 meters while *A. grandis* exists at depths from 45 to 110 meters. Within their depth ranges, both species can be found highly aggregated on, or under, vertical dropoffs, 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

⁵ Much of this information is drawn from Grigg, 1976.

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 Council's area (the Au'au Channel Bed and the Kauai Bed), as well as several minor beds. Most of these are located in Hawaii's state waters, however the largest (the Au'au Channel Bed) extends into the EEZ and thus Hawaii shares jurisdiction of this bed.

The commercial harvest of black coral has occurred in the waters around Hawaii for more than three decades. Significant commercial harvest of black coral has occurred in the Au'au Channel Bed in the Kauai Bed. By 1976, Grigg had determined the areal coverage of these beds to be 1.7 km² and 0.4 km² respectively and maximum sustainable yields (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 recommended MSYs of 5,000 kg/yr and 1,250 kg/year 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 bed located in the Au'au Channel. Most of this harvest has been confined to State waters. Although a substantial portion 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 (Hawaii DLNR 1979), perhaps because gear constraints have restricted divers for black coral to relatively shallow waters (75 m or less) (Grigg 1998a). Amendment 4 to the FMP designated the Au'au Channel as a habitat area of particular concern for the precious coral 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.

A recent assessment of the biological condition of the black coral in the Au'au Channel was conducted in July 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, the black coral resources in other areas of State waters (for example, "Stonewall" off Lahaina, Maui) which 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 the condition of the Au'au Channel Bed is generally good, there are a number of potential factors that could result in greater harvesting pressure on black coral resources in the near future. The first is the possible introduction of new coral harvesting technology (Grigg 1998a). 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 75 m. However, the introduction of mixed-gas diving methods and re-breathers would enable scuba divers to dive to the maximum depth (about 110 m) at which colonies of black coral are known to occur. The segment of the population between 80 m and 110 m, which currently may represent a reservoir for recruitment, would be exposed to fishermen. These new diving methods also allow harvesters to extend the length of time which they can safely spend underwater. The cost of this equipment has declined in recent years, making it financially feasible for many divers to purchase the gear. For example, the price of a re-breather is about \$20,000, not including the training expenses that use of this diving equipment may entail. Although this new diving gear is not yet being used to harvest black coral in Hawaii, some harvesters are experimenting with towed underwater camera systems and other new technology that could increase the output from old harvest areas and lead to the discovery of new beds.

An even greater increase in the level of black coral harvested is likely if vessels equipped with manned submersibles and remotely operated vehicles 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 remotely operated vehicles have become more affordable. A number of firms in Hawaii are currently examining the feasibility of harvesting precious corals using these gear types, and these firms may decide to target black coral as well as other precious corals. 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.

An increase in the demand for black coral could also result in greater harvesting pressure on black coral resources. 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). 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 significantly if out-of-state markets for raw black coral are aggressively pursued by Hawaii coral processors or if current imports of cut and polished black coral from Taiwan into Hawaii decrease (Grigg 1998a).

9.3 History of the precious corals fishery

The FMP for precious corals in the Western Pacific region was approved by the US Secretary of Commerce on May 20, 1980. The FMP covers domestic and foreign fishing for precious corals in the US EEZ of the Western Pacific region. Most of the information in this section pertains only to the precious corals fishery occurring around the Hawaiian Archipelago. No precious coral harvester has received a federal permit to fish in the EEZ surrounding American Samoa or Guam since the implementation of the FMP in 1980.

There exists two distinct and separate precious coral fisheries in Hawaii. One fishery focuses on the harvest of deepwater (400 to 1,500 m) pink, gold and bamboo corals using tangle net dredges or manned and unmanned submersibles. The other fishery involves the hand harvest

of black coral by SCUBA divers at depths of 30 to 100 m.

9.3.1 Deep water precious corals

In 1965, Japanese coral fishermen discovered a large bed of pink coral (*Corallium* spp.) on the Milwaukee Banks in the Emperor Seamount Chain near the northwestern end of the Hawaiian Archipelago (Grigg 1993). Intermittently, over the next two decades dozens of foreign vessels employed tangle-net dredges to harvest precious corals in the waters around the NWHI. During the 1980s, Japanese and Taiwanese coral vessels frequently fished illegally in the EEZ near the Hancock Seamounts (Grigg 1993). In 1985, Taiwanese vessels reportedly poached about 100 tons of pink coral from north of Gardner Pinnacles and Laysan Island (Grigg 1993). The discontinuation of poaching in the late 1980s probably indicated that the resources in those areas were reduced to the point that the fishery was no longer economically viable. (Carleton 1987).

In 1966 researchers at the University of Hawaii located a small bed of pink coral off Makapu'u, Oahu. Over the next three years, a small group of fishermen harvested this bed using tangle net dredges. By 1969, the precious coral industry in Hawaii was producing about \$2 million in retail sales. Part of these sales consisted of pink coral jewelry imported from Taiwan and Japan. Further research on precious corals conducted by the University of Hawaii led to the development of a selective harvesting system using a manned submersible. Starting in 1973, Maui Divers of Hawaii, Inc., the leading manufacturer and retailer of precious coral jewelry in Hawaii, adopted this system for the commercial harvest of pink, gold and bamboo coral at the Makapu'u Bed. However, harvest operations were discontinued in 1978 because of high operating costs.

In 1988, the domestic vessel *Kilauea* used a tangle net dredge to harvest beds at Hancock Seamount. The owners of the *Kilauea* received a federal Experimental Fishing Permit that allowed them to collect an amount of precious coral in excess of the harvest quotas that had been established by the WPRFMC in 1980. However, their catch consisted mostly of dead or low quality pink coral, and the operation was soon discontinued (Grigg 1993). One company in Hawaii has recently been experimenting with manned submersibles and remotely operated vehicles (ROVs). These technologically advanced devices are equipped with spotlights, cameras and a variety of maneuverable tools. It is possible to harvest individual colonies, place the cut material in collecting cages and bring them to the surface in a highly controlled and efficient manner (Carleton 1987). While this fishing gear is still very expensive, innovations in submersible technology within the petroleum and defense industries during the past two decades have significantly reduced the capital and operating costs. In particular, the expense of operating manned submersibles has declined, one reason being that the submersibles are smaller and, consequently, the tender vessels can be smaller. In addition, it is likely that participants in the deep-water precious coral fishery will attempt to defray the costs of using selective gear by finding other lucrative uses for the gear, such as salvage and research.

Recently, the firm of American Deepwater Engineering, a division of the Hawaii-based American Marine Services Group, received a federal permit to gather precious corals in the waters around Hawaii. The firm is using two one-person submersibles capable of diving as deep as 2,000 ft. Harvests of precious corals have been made at the Makapu'u Bed and in the

exploratory area of the EEZ. The harvest levels of this operation can not be reported here because of NOAA confidentiality restrictions. Other firms have expressed an interest in harvesting deep-water precious corals in Hawaii using selective gear, but have delayed entry into the fishery because of uncertainty about the fishery's profitability. It is too early to determine if this fishery will be profitable. The ex-vessel value of precious coral varies widely according to color and size. It is uncertain whether the coral harvested by the current firm will be of sufficient quality to receive the high prices required to offset the high fishing costs.

The worldwide glut of *Corallium* produced during the boom years of the early 1980s caused the market value of pink coral to fall even below breakeven prices for Taiwanese and Japanese coral fishermen (Grigg 1993). Consequently, many fishermen dropped out of the fishery and the worldwide supply of deep-water precious corals has dwindled. For the past 20 years Hawaii businesses engaged in the manufacture of deep-water precious coral jewelry have relied on local stockpiles of gold coral and imports of pink coral from foreign suppliers. Prices for precious corals gradually increased, and specimens of the highest quality pink coral currently sell for \$5,000/lb in international auctions. However, changes in the jewelry industry during the past decade may have diminished the demand for precious corals. Products such as black pearls have captured a substantial share of the market formerly held by precious corals (C. Marsh, Maui Divers of Hawaii, Inc., pers. comm.). In 1993 Hawaii's precious coral jewelry industry was valued at about \$25 million at the retail level (Grigg 1993).

9.3.2 Harvest of black corals

Before European explorers first visited the Hawaiian Islands the indigenous people of the islands used *ekaha ku moana* (black coral) medicinally to treat various respiratory and childhood diseases and may have collected the coral with hook and line (Iversen et al. 1990). The commercial harvest of black coral did not begin until the late-1950s when sport divers discovered beds of *Antipathes dicomata* and *A. gradis* about 4.8 km west of Lahaina, Maui at an area now known as "Stonewall" (Grigg 1993). A cottage industry producing curios and black coral jewelry soon developed in Lahaina.

The collection of black coral has continued in Hawaii since the inception of the fishery although harvest levels have fluctuated with changes in demand. In the 1960s and early 70s, as much as 10,000 kg were harvested annually from black coral beds off Kauai and Maui. During the 1970s, the State drafted a regulation requiring a minimum size limit (height) of 48 inches, which corresponded to the recommended MSY levels. This regulation was never codified, however divers and jewelry makers have voluntarily complied with it. A recent (1998) survey of the Au'au Channel Bed reexamined five areas first studied in 1975. In summary, there was no difference between the two time periods in the age structure of colonies less than 19 years old, which represents the recommended size limit of 48 inches. This indicates excellent compliance by the divers with this management guideline. The study also found that the population had almost completely replaced itself since 1975. In fact, 97% of the colonies surveyed in 1998 were less than 23 years old. This means that the regeneration time of the bed is equivalent to the age of its oldest colonies and that the bed is experiencing undiminished recruitment (Grigg 1998a).

Between 1990 and 1997, the annual harvest of black coral in Hawaii varied from a low of

864 lbs to a high of 6,017 lbs, with a yearly average of 3,084 lbs. As noted above, the harvest of black coral has occurred mainly in State of Hawaii waters. Since 1980, virtually all of the black coral harvested around the Hawaiian Islands has been taken from the bed located in the Au'au Channel. Most of the Au'au Channel harvest has occurred in State of Hawaii waters, and no black coral diver has ever received a federal permit to harvest precious coral. However, a substantial portion of the black coral bed in the Au'au Channel is located in the EEZ. The annual

harvests have consistently been well below the recommended MSY for this bed of 5,000 kg/yr (11,000 lb/year).

Table 3. Volume and value of black coral landings in Hawaii.

Year	Harvested (lbs.)	Sold (lbs.)	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

Variations between pounds harvested and pounds sold are primarily due to stockpiling by both divers and jewelry makers.

To date, black coral in Hawaii has been hand harvested by a small group of divers using conventional scuba gear with compressed air. The maximum depth to which divers using this gear can safely descend is less than 75 m. However, it is likely that in the new future black coral divers in Hawaii will be using mixed-gas diving methods or re-breathers that enable divers to increase the depth at which they can safely dive as well as their bottom time. Already, some harvesters are experimenting with towed underwater camera systems and other devices that may increase the output from old harvest areas and lead to the discovery of new beds.

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. Currently, there are probably less than five active commercial black coral harvesters in Hawaii.

Today, considerably less black coral is required by the industry because the jewelry items produced are smaller and of higher quality and because modern cutting procedures have become much more efficient (Carleton 1987). Recently, the demand for small, immature black coral colonies has increased with the growing popularity of household marine aquaria.

In 1999, despite the voluntary compliance with the 48 inch minimum size limit, concern about the potential for greater harvesting pressure on black coral resources led the State of Hawaii to prohibit the harvest of black coral with a base diameter of less than 3/4 inches from state waters.

9.4 Relationship with protected species

Concerns about the harvest of gold coral have been also raised by an array of recent studies on foraging and feeding behavior of the endangered Hawaiian monk seal (Parrish 1998). The studies have focused on the monk seal population at French Frigate Shoals in the NWHI where the species' largest breeding colony resides. In 1998, a total of 410 seals were identified at French Frigate Shoals (Johanos and Baker 1998). This breeding colony has experienced a high juvenile mortality during the past several years which could place the future of the Hawaiian monk seal in grave jeopardy (Laurs 1999). A significant decline in prey availability might explain the observed changes in condition and survival of immature seals (Johanos and Baker 1998).

Until recently, no species of either threatened or endangered wildlife was known to occur at depths where deep-water precious corals are found in the Western Pacific region. However, a multi-year/season study of the movements of the Hawaiian monk seal population at French Frigate Shoals using satellite tags found seals (34 males and females) to range between Gardner Pinnacles and Necker Bank (Abernathy and Siniff 1998). Depth-of-dive records from the study show that a small percentage of the diving by seals occurred at depths (350-500 m) where precious corals are found. The time spent by seals at these depths ranged from occasional visits to as much as half the seals' sea-going effort. Based on this sample of deep-foraging seals, it is estimated that 25 seals in the French Frigate Shoals population dive to these depths.

A study of the diving behavior of the monk seal population at French Frigate Shoals using video cameras harnessed to 24 adult male seals found that these seals preferred to forage outside the atoll (Parrish et al., 2000). Three seals carrying video cameras dove below 350 m. The seals were heard to make feeding sounds at these depths, and one seal was observed ascending with a deep-water bottomfish in its mouth. The video camera data indicate that the foraging male seals prefer to exploit habitats which afford improved prey density or accessibility. Studies of the diet of Hawaiian monk seals show that deep-water bottomfish and eels may be a significant component (Goodman-Lowe 1998). In summary, the data collected by these various studies suggest that some monk seals from the resident population on French Frigate Shoals do a significant amount of concentrated foraging at the depths where precious corals occur.

In September 1998, submersibles were used by NMFS to survey the ocean floor at two sites around French Frigate Shoals where previous studies showed monk seals focused their deep

dive activity. The survey found an abundance of live and dead colonies of gold coral at both sites, one of which was located at the southeast portion of Brooks Bank and the other on the east ridge of French Frigate Shoals. The latter was a previously unknown bed of precious corals and has been named the FFS-Gold Pinnacles Bed. Submarine surveys of nearby sites, where there were no records of monk seal foraging activity, found no precious corals indicating that monk seals may specifically target precious coral beds.

Many of the gold coral colonies observed at Brooks Bank and the FFS-Gold Pinnacles Bed were greater than 40 inches in height. These coral trees may provide enough vertical relief and structure that they constitute an important element of fish habitat/cover. The shelter afforded by these beds of precious corals may aggregate monk seal prey and improve the seals' foraging success. Amendment 4 to the FMP designated Brooks Bank as a habitat area of particular concern for the precious coral fishery because of the ecological function it provides, the rarity of the habitat type and its possible importance as a foraging habitat for the Hawaiian monk seal. If the gold coral were harvested from these beds, the fish habitat and monk seal foraging area on these beds may be lost or significantly diminished for several decades. It is unlikely that pink coral at Brooks Bank or the FFS-Gold Pinnacles Bed provide habitat for monk seal prey items, as most of the pink coral colonies at these beds are small in height (less than 19 inches). Nor is there any evidence that monk seals residing in other areas of the Hawaiian Islands are using precious coral beds as foraging habitat.

Observations of monk seal foraging behavior near French Frigate Shoals suggest that live precious coral would be more important foraging habitat for monk seals that are diving to depths at which precious corals occur. Monk seal prey, such as eels, have not been observed congregating around fallen or standing coral that is devoid of live coral polyps or tissue. It is speculated that the presence of galatheid shrimps that are commensal on living gold coral colonies is what attracts the eels. In addition, a dead coral colony is rarely standing. Dead precious coral is found mainly as rubble lying on the seabed and generally does not provide sufficient vertical relief to attract significant numbers of fish. This information suggests that the harvest of dead coral may not have a significant adverse effect on monk seal foraging habitat.

However, the definition of dead coral in the FMP is any precious coral that contains holes from borers or is discolored or encrusted at the time of removal from the seabed. According to this definition, coral that is only slightly bored or encrusted and still partially covered with live coral polyps or tissue is regarded as dead. The harvest quota only applies to live coral, which is defined as any precious coral that is free of holes from borers, and has no discoloration or encrustation on the skeleton at the time of removal from the seabed. With no restriction on the quantity of dead coral that can be harvested, the current definition of dead coral could result in the unrestricted harvest of coral that is standing upright and partially covered with living tissue as long as it contains holes from borers or is discolored or encrusted. It is possible that colonies of such coral near French Frigate Shoals may provide foraging habitat for monk seals.

9.5 Cultural and socio-economic environment

The precious corals do not, in the living state, form an overt part of the human environment in the region, in part because of the great depths which they inhabit and the isolated

locations of most of the known beds. They are not within the range of observation of recreational or commercial free divers, and are seen in vivo only by the operators of the submersible vessel employed to harvest them in Hawaii, and occasionally by research scientists. It should be noted however, that precious corals, like any species of wildlife, have scientific values apart from socio-economic considerations.

The handling and processing of the product, which is a small volume of an inert mineral skeletal material, does not obtrude itself on the public notice as the analogous operations in other fisheries often do, through cannery odors or localized pollution of harbor waters. Probably the majority of the inhabitants of the Hawaiian Islands and elsewhere in the region are unaware that there are precious coral resources in the surrounding waters, except as that fact is brought to their attention by the advertisement and display of coral jewelry on the local market.

Precious corals are rarely, if ever, harvested accidentally by any type of domestic commercial or recreational fishery practiced in the region nor has there been indication that any group of fishermen in the region consider the precious corals in any way related to the success of their fishing operations. It is probably that foreign fishers, who from time to time carry on deep trawling for finfish in some areas of the fishery conservation zone, occasionally encounter incidentally harvested precious corals in their trawls.

The element of the human population of the region which is aware of and concerned about the precious corals resources, aside from a few scientists and administrators, primarily comprises the persons employed in the precious corals fishery and the associated processing industry, and members of environmental groups. The largest firm in the precious corals industry employs about 308 persons, including 35 involved directly in fishing and/or processing of locally harvested coral. It is reported that there are about 15 other firms in Hawaii engaged in making jewelry from imported coral and is estimated that as many as 500 retail outlets the State handle coral jewelry, among other types, of which an unknown portion is made of locally harvested coral. In total, around 800 to 1000 persons, from fishermen to retail sales clerks are employed in the coral industry in Hawaii. In other island groups, of the region, the involvement of the local population is much less, although most curio shops and airport terminal duty-free shops sell coral jewelry.

In considering the human environment of the precious coral fishery in the Western Pacific Region, attention must be paid to the possibility that people of other islands than those of Hawaii may become involved in the future in precious coral harvesting and perhaps in the processing of precious coral into jewelry. There is no such involvement at present, although a basis for its development may exist in that small quantities of black corals (*Anitipathes* spp.) are reported to be collected by local divers at some of the islands from time to time. It is generally agreed that the people of American Samoa, Guam and the Northern Mariana Islands need the development of a variety of new economic activities in order to become self-supporting, and they must look to ocean resources for the basis for such development because of the general paucity of land and terrestrial natural resources. Coral harvesting by simple methods such as dredging would be relatively easy for the island people to take up, if organized surveys by government agencies or private prospecting should reveal the existence of significant beds of coral in locations accessible to them. On the other hand, dredging as practiced on the Makapuu Bed in Hawaii in the 1960s

was apparently not efficient enough to be profitable, and there is some question whether it could be made to pay in American Samoa, Guam or the Marianas.

From the inception of the black coral fishery in Hawaii in the late 1950s, generally fewer than five individuals have been active in the fishery during any one year. Between 1990 and 1997, the annual harvest of black coral in Hawaii varied from a low of 864 lbs to a high of 6,017 lbs, with a yearly average of 3,084 lbs (Table 2). This average harvest level is substantially lower than the MSY for the Au'au Channel black coral population, which is estimated to be about 11,000 lbs/yr (Grigg 1976). The 415 lbs of black coral sold in 1997 had a dockside value of about \$10,394, assuming a price of \$25/lb.

10.0 Analysis of Beneficial and Adverse Impacts of Management Alternatives

The Council identified various management options to address the problems described in Section 5.0 and achieve the objectives listed in Section 7.0. This section provides an analysis of the relative ecological, economic and social impacts of the alternative management measures considered by the Council. The generally poor understanding of the status of deep-water precious coral stocks and biology and population dynamics of most precious coral species, together with uncertainty about the level of private sector interest in renewing the fishery, preclude a detailed quantification of the impacts of alternative management measures. However, the analysis presented provides an adequate basis for making management decisions.

Table 4 summarizes the management alternatives and their impacts on fisheries for precious corals in the Western Pacific. These alternatives and analyses of their impacts are discussed in greater detail in Sections 10.1-10.9.

During the preparation of this document, President Clinton issued Executive Orders 13178 (December 4, 2000) and 13196 (January 18, 2001), which together establish conservation measures for the newly formed Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve. Under these orders, commercial fishing effort and take in the reserve are capped at each permittee's take in the year preceding December 4, 2000. Since there were no Federal precious coral permits issued for any harvestable Northwestern Hawaiian Islands (NWHI) beds (Brooks Banks and 180 Fathom Beds), the Executive Orders place a permanent zero harvest cap on these beds (despite their existent harvest quotas). The effect of this cap on the single Hawaii exploratory area (permit area X-P-H which includes waters around both the NWHI and the main Hawaiian Islands) is less clear as, although there was some harvest of precious corals from the main Hawaiian Islands portion of this area in 2000, there was no harvest from the NWHI portion. How this historical take will now be allocated within the Hawaii exploratory area remains unresolved. The Precious Corals Fishery Management Plan will be revised to reflect these measures as they are clarified by the Reserve Operating Plan which is now being developed by the National Ocean Service. This Operating Plan is anticipated to contain implementing regulations as well as a complete analysis of the impacts of those regulations on the human environment.

Table 4. Summary of management alternatives and their impacts.

Alternative	Ecological Impacts	Economic and Social Impacts
<i>Conservation of gold coral</i>		
No action	May delay or prevent recovery of the gold coral stock at the Makapu'u Bed.	Minimal impact in the short term because the stock of gold coral at the Makapu'u Bed is low. Long-term negative impacts on harvest levels and gross revenues are potentially large if overfishing occurs.
Suspend the harvest quota at Makapu'u Bed (Preferred Alternative)	May increase the probability that a recovery in the gold coral stock at the Makapu'u Bed occurs.	Minimal economic impact because the stock of gold coral at the Makapu'u Bed is low.
Suspend the harvest quota for gold coral at all established and conditional beds	Minimizes the possibility that overfishing of the gold coral stock could occur.	Could result in between \$158,400 to \$356,400 in foregone potential gross revenues every two years.
Implement a minimum size limit for gold coral	Could be negative if the lack of reliable biological information results in the establishment of a size limit that is too small to prevent overfishing.	Uncertain, but there may be some cost if any coral is avoided or discarded because of the size limit.
<i>Definitions of live and dead coral</i>		
No action	Unrestricted harvest of dead coral may result in a decrease in Hawaiian monk seal foraging habitat in the NWHI. Impact is expected to be small, as most dead coral colonies do not attract seal prey items.	The negative impacts could be substantial if NMFS implements measures to mitigate interactions with protected species.
Redefine live precious coral as precious coral that has live coral polyps or tissue. Redefine dead precious coral as precious coral that no longer has any live coral polyps or tissue (Preferred Alternative)	Would reduce the risk of harvesting coral which could be providing foraging habitat for the Hawaiian monk seal.	Some adverse impacts are possible, but unlikely. Could facilitate monitoring and enforcement of harvest quotas by more clearly differentiating live coral from dead coral.
Redefine live precious coral as precious coral that is standing upright. Redefine dead precious coral as precious coral that is no longer standing upright	The impacts would be similar to those of above alternative.	Could increase the difficulty of monitoring and enforcing harvest quotas if harvesters intentionally "knock down" coral colonies.

<i>Application of size limits</i>		
No action	May reduce incentive to collect dead coral since it is less valuable than live coral. From the standpoint of conservation, it is more desirable to harvest dead coral than live coral.	Would have a negative impact because it prohibits the harvest of dead coral colonies that are below the minimum size.
Apply size limits to live coral only (Preferred Alternative)	No impact is expected, as dead coral generally decays from erosion and chemical weathering.	Impact is likely to be positive, as dead coral of any size would be allowed to be harvested.
<i>Conservation of black coral</i>		
No action	Overfishing of stocks could result if fishing pressure increases.	Minimal impact in the short term, but long-term negative impacts on harvest levels and gross revenues are potentially large if overfishing occurs.
Prohibit the harvest of black coral unless it has attained either a minimum stem diameter of 1 inch, measured no less than 1 inch from the top of the living holdfast, or a minimum height of 48 inches, measured from the base to the greatest distal extremity of the colony. Persons who reported a landing of black coral to the State of Hawaii within 5 years before the effective date of the final rule would qualify for an exemption which allows the hand harvest of black coral that has attained a minimum base diameter of 3/4 inches, measured on the widest portion of the skeleton at a location just above the holdfast (Preferred Alternative)	Would prevent the harvest of colonies which are immature and have not reached their full potential for growth, thereby contributing towards maintenance of black coral stocks at OY levels.	The impact on harvesters could be significant, as only about half of the colonies currently being harvested are larger than this size limit. Could have a negative impact on human safety by inducing harvesters to dive deeper and stay submerged longer in search of coral colonies that are of a legal size. Would be difficult to enforce since the size limit is inconsistent with State regulations. Recommended exemption is intended to reduce the negative economic impacts on current black coral harvesters, mitigate the negative impacts on the safety of human life at sea and facilitate enforcement.
Prohibit the harvest of black coral unless it has attained either a minimum stem diameter of 1 inch, measured no less than 1 inch from the top of the living holdfast, or a minimum height of 48 inches, measured from the base to the greatest distal extremity of the colony.	Impacts would be similar to those of above alternative.	Impacts would be similar to those of Alternative 2, except no exemption is provided that would reduce the negative economic impacts on current black coral harvesters, mitigate the negative impacts on the safety of human life at sea and facilitate enforcement.
Prohibit the harvest of black coral unless it has attained a minimum base diameter of 3/4 inches	May result in overfishing if fishing pressure increases.	Minimal impact in the short term, but long-term negative impacts on harvest levels and gross revenues are potentially large if overfishing occurs.

Establish a weight quota for black coral	May not be as effective as a size limit in avoiding overfishing, as information is limited on the standing stock and sustainable yield.	May be more difficult to enforce than size limits.
<i>Gear restrictions</i>		
No action	May result in damage to other sessile organisms, waste of coral colonies that are "knocked down," but not harvested and a decrease in Hawaiian monk seal foraging habitat.	Would minimize the costs of harvesting deep-water precious corals and may encourage the discovery and exploration of new beds. The negative impacts could be substantial if NMFS implements measures to mitigate interactions with protected species.
Only selective gear may be used to harvest precious corals from all permit areas (Preferred Alternative)	Would help prevent overfishing and wastage of resources by minimizing bycatch.	The estimated dockside value of the precious coral that would no longer be available for annual harvest by non-selective gear from established and conditional beds is \$62,618.
Only selective gear may be used to harvest precious corals from established and conditional beds	The impacts would be similar to the no action alternative, except the potential adverse impacts of using non-selective gear to harvest precious corals at established and conditional beds would be eliminated.	The impacts would be similar to the no action alternative, except up to 200 kg of precious coral would continue to be available for annual harvest by non-selective gear from each of the exploratory beds.
<i>Application of size limit for pink coral</i>		
No action	Increased risk that the estimated MSY for pink coral will be exceeded at those conditional beds (i.e., Brooks Bank, 180 Fathom Bank and newly discovered FFS-Gold Pinnacles Bed) and exploratory areas where there is no size limit.	Minimal impact in the short term, but long-term negative impacts on harvest levels and gross revenues are potentially large if overfishing occurs.
Apply the current size limit for pink coral to all permit areas (Preferred Alternative)	Would prevent the harvest of colonies which are immature and have not reached their full potential for growth, thereby reducing the potential for overfishing to occur.	Minimal impact because the financial return from harvesting colonies of pink coral that are less than size limit is low.
Apply the current size limit for pink coral to all established and conditional beds	Impacts would be similar to those of above alternative, except beds of pink coral occurring in exploratory areas would not receive the protection from overfishing provided by a minimum size limit.	Impacts would be similar to those of above alternative.

<i>Adjusting Brooks Bank boundaries and harvest quotas</i>		
No action	Maintaining the current harvest quota for pink coral could result in the overfishing of these species. Harvest of live gold coral may result in a decrease in Hawaiian monk seal foraging habitat in the NWHI.	Positive impact in the short term, but long-term negative impacts on harvest levels and gross revenues are potentially large if overfishing occurs. The negative impacts could also be substantial if NMFS implements measures to mitigate interactions with protected species.
Increase the boundaries; change the harvest quota for pink coral to 200 kg; and suspend the harvest quota for gold coral (Preferred Alternative)	Would protect pink coral stock from overfishing by setting harvest quota at the estimated MSY. Would reduce the risk of harvesting coral which could be providing foraging habitat for the Hawaiian monk seal.	Potential gross revenues from the harvest of pink and gold coral would be reduced by \$190,200. However, the impact over the long term would be positive, as the productivity of the bed would be maintained and the conservation goals of the FMP achieved.
Increase the boundaries and re-classify the bed as a refugium	Would eliminate the risk of overfishing and interactions with Hawaiian monk seals. However, the positive impact is likely to be minimal.	Potential gross revenues from the sustainable harvest of pink, bamboo and gold coral would be reduced by \$190,200. This figure may underestimate the potential economic loss, as the harvest of dead coral would also be prohibited.
<i>Classification of newly discovered FFS-Gold Pinnacles Bed</i>		
No action	Harvest of live gold coral may result in a decrease in Hawaiian monk seal foraging habitat in the NWHI. In the absence of a harvest quota, precious coral stocks could be harvested at a level that exceeds the estimated MSY.	Positive impact in the short term, but long-term negative impacts on harvest levels and gross revenues are potentially large if overfishing occurs. The negative impacts could also be substantial if NMFS implements measures to mitigate interactions with protected species.
Classify bed as a conditional bed and set the annual harvest quota for all types of precious coral at zero (Preferred Alternative)	Would protect stock of pink coral from overfishing and reduce risk of interactions with protected species.	Potential gross revenues from the harvest of gold coral would be reduced by \$26,400.
Classify bed as a refugium	Would eliminate the risk of overfishing and interactions with protected species. However, the positive impact is likely to be minimal.	Potential gross revenues from the harvest of gold coral would be reduced by \$26,400. This figure may underestimate the potential economic loss, as the harvest of dead coral would also be prohibited.
Classify bed as a conditional bed and set the annual harvest quota for gold coral at 80 kg.	Would protect stock of gold coral from overfishing, but may result in a decrease in Hawaiian monk seal foraging habitat in the NWHI.	The negative impacts could be substantial if NMFS implements measures to mitigate interactions with protected species

10.1 Conservation of gold coral

10.1.1 Alternative 1: No action

Ecological Impacts

A recent assessment of the recovery and current status of precious corals at the Makapu'u Bed found that the recruitment of gold coral at that bed is very low even though it has been over 20 years since gold coral was harvested at this bed (Section 9.2.1). The current biennial harvest quota of 600 kg of gold coral at the Makapu'u Bed was based on the best scientific information available. However, at the time the quota was set only a limited amount of information was available on the impact of harvesting on subsequent recruitment of gold coral at the Makapu'u Bed. At present, there is still insufficient information on the biology of gold coral to quantify the impacts of management alternatives on the recruitment of these coral species, including the alternative of taking no action. Nevertheless, given the low standing stock of gold coral indicated by the most recent survey, it is likely that maintaining the harvest quota for gold coral at Makapu'u Bed would increase the risk that the recovery of the gold coral stock at Makapu'u Bed is delayed or prevented. It is likely that the Makapu'u Bed will be harvested for commercial purposes in the near future. A number of firms have recently expressed interest in participating in the precious coral fishery in the EEZ around Hawaii using selective gear. One of these firms has received a NMFS permit to harvest precious corals at the Makapu'u Bed and completed an exploratory survey of the bed.

Economic and Social Impacts

According to Maui Divers, Ltd., the principal processor of precious corals in Hawaii, the ex-vessel price of gold coral is \$330/kg (\$150/lb). Maintaining the current biennial harvest quota of 600 kg for gold coral at Makapu'u Bed would continue to make available to prospective harvesters a quantity of gold coral worth \$198,000 if the actual stock is of sufficient size to support such a harvest. However, a recent survey of the Makapu'u Bed revealed that the current standing stock of gold coral is low and, in fact, might be so low that there is actually less gold coral in the bed than the harvest quota of 600 kg. In addition, the adverse economic impacts over the long term would be significant if further harvesting diminishes the number of colonies to the point that no recovery is possible.

10.1.2 Alternative 2 (Preferred Alternative): Suspend the harvest quota for gold coral at the Makapu'u Bed until additional information is available on the impact of harvesting on subsequent recruitment of gold coral at this bed

Ecological Impacts

The benefits of this alternative cannot be quantified due to the poor understanding of the biology and population dynamics of gold coral. However, suspending the quota for gold coral at Makapu'u Bed until additional scientific information is available on the reasons for the low recruitment of gold coral at this bed would be a precautionary measure expected to increase the probability that a recovery in the number of gold coral colonies at the Makapu'u Bed eventually

occurs. Amendment 4 to the FMP designated the Makapu'u Bed as a habitat area of particular concern for the precious coral fishery 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 of the Makapu'u Bed and the amount of scientific information that has been collected at the bed during the past three decades were also considered.

Economic and Social Impacts

A suspension of the quota would likely have a minimal adverse economic impact on prospective harvesters, as the density of gold coral at the Makapu'u Bed is currently very low. Should harvest effort at the Makapu'u Bed occur, it is likely that it will be directed mainly toward pink coral because this coral is relatively abundant at the bed and has a higher market value than gold coral (\$440/kg for pink coral (*C. secundum*) vs. \$330/kg for gold coral according to Maui Divers of Hawaii, Ltd.).

A suspension of the quota is not expected to have an adverse economic impact on processors of precious corals in Hawaii. The fishery in the EEZ around Hawaii for deep-water species of precious coral, including pink, gold and bamboo coral, has been dormant for nearly two decades. Consequently, the processors of these corals in Hawaii have relied exclusively on imported material.

10.1.3 Alternative 3: Suspend the harvest quota for gold coral at all established and conditional beds until additional information is available on the impact of harvesting on subsequent recruitment of gold coral

Ecological Impacts

Suspending the quota for gold coral at all established and conditional beds would be a precautionary measure that would minimize the possibility that overfishing of known gold coral stocks could occur. Because it is highly uncertain whether harvesters will be able to find new beds to exploit, it is important to ensure that existing established and conditional beds are able to rebuild after being harvested. However, it is uncertain if the low recovery rate of gold coral at Makapu'u Bed would also occur at other established or conditional beds. Recruitment rates are dependent on the specific biological and physical conditions of each precious corals bed. It likely that information on the recruitment of gold coral and other species of precious coral at various beds will only be obtained by allowing commercial harvesting of these beds subject to harvest restrictions and monitoring coral recovery rates. Suspending all harvest quotas for gold coral

would eliminate this important source of information on the population dynamics of these coral species.

Economic and Social Impacts

The adverse economic impacts could be significant. The current total harvest quota for gold coral at all established and conditional beds is 1,080 kg every two years, with an estimated dockside value of \$356,400. However, the gold coral quota at the Makapu'u Bed accounts for more than half of this total. As noted in Section 10.1.1, the current standing stock of gold coral at the Makapu'u

Bed may not yield the current biennial harvest quota of 600 kg. If no gold coral is harvested from the Makapu'u Bed the amount of potential gross revenues foregone by suspending the harvest quota at all established and conditional beds would be about \$158,400 every two years

10.1.4 Alternative 4: Implement a minimum size limit for gold coral at Makapu'u Bed

Ecological, Economic and Social Impacts

Estimates of growth rates, mortality rates and size at reproductive maturity are necessary before a size limit can be reliably set. These data are lacking for gold coral. Without this information the size limit established may be too low, thereby insufficiently protecting the coral from overfishing, or be too high, thereby resulting in an overly conservative size limit that reduces the potential economic return from the fishery. There will be some cost if any coral is actually avoided or discarded because of the size limit.

10.2 Definitions of live and dead coral

10.2.1 Alternative 1: No action

Ecological Impacts

The harvest quotas in the FMP do not apply to dead coral, which is defined in the FMP as any precious coral that contains holes from borers or is discolored or encrusted at the time of removal from the seabed. With no restriction on the quantity of dead coral that can be harvested, the current definition of dead coral allows the unrestricted harvest of coral that is standing upright and partially covered with living tissue as long as it contains holes from borers or is discolored or encrusted. It is possible that colonies of such coral near French Frigate Shoals in the NWHI may provide foraging habitat for the endangered Hawaiian monk seal (Section 9.4). The possible reduction in foraging habitat that may result from the harvest of dead standing coral partially covered with living tissue could intensify the problems related to food-stress which the monk seal population at French Frigate Shoals is experiencing. However, the negative impact on monk seal foraging habitat is likely to be small, as most coral colonies that contain holes from borers or are discolored or encrusted also no longer have any living polyps or tissue.

Economic and Social Impacts

If the Council does not develop management measures to ensure the protection of monk seal foraging habitat or does not develop measures that are considered adequate by NMFS, NMFS would likely initiate an Endangered Species Act section 7 consultation on the precious coral fishery. Management measures that could be imposed include emergency closures of specific sites or alteration of fishing operations. The economic impact of closures or other measures would depend on the length of time that these measures are in effect.

10.2.2 Alternative 2 (Preferred Alternative): Redefine live precious coral as precious coral that has live coral polyps or tissue. Redefine dead precious coral as precious coral that no longer has any live coral polyps or tissue

Ecological Impacts

This alternative would reduce the risk of harvesting coral in the waters around the Northwestern Hawaiian Islands which could be providing foraging habitat for the Hawaiian monk seal. However, the added protection to monk seal foraging habitat may be small, as most coral colonies that contain holes from borers or are discolored or encrusted also no longer have any living polyps or tissue.

Economic and Social Impacts

This alternative may have some adverse economic impacts. Only live coral is counted toward the quotas limiting the amount of precious coral that may be taken in any permit area during the fishing year. It is possible that some of the coral at a given bed that was regarded as dead under the current definition would be regarded as live under the alternative definition, and therefore be subject to the harvest quota for that bed. However, the amount of additional coral that would be subject to the quota is likely to be small, as coral colonies that contain holes from borers or are discolored or encrusted generally no longer have any living polyps or tissue.

This alternative would facilitate monitoring and enforcement of harvest quotas by more clearly distinguishing between live coral and dead coral. Members of the Precious Coral Fishery Plan Team state that the presence or absence of live tissue or polyps on coral colonies is easier to detect and less ambiguous than the presence or absence of holes from borers or discoloration or encrustation. Further, the definitions of live and dead coral proposed by this alternative are the same as the definitions of live and dead coral adopted by the Hawaii Department of Land and Natural Resources. Consistent definitions would assist the enforcement of State and Federal precious coral fishery regulations.

10.2.3 Alternative 3: Redefine live precious coral as precious coral that is standing upright. Redefine dead precious coral as precious coral that is no longer standing upright

Ecological Impacts

This alternative would reduce the risk of harvesting coral in the waters around the Northwestern Hawaiian Islands which could be providing foraging habitat for the Hawaiian monk seal. However, the added protection to monk seal foraging habitat is likely to be small, as most coral colonies that contain holes from borers or are discolored or encrusted also are no longer standing upright.

Economic and Social Impacts

This alternative may have some adverse economic impacts. Only live coral is counted

toward the quotas limiting the amount of precious coral that may be taken in any permit area during the fishing year. It is possible that some of the coral at a given bed that was regarded as dead under the current definition would be regarded as live under the alternative definition, and therefore be subject to the harvest quota for that bed. However, the amount of additional coral that would be subject to the quota is likely to be small, as coral colonies that contain holes from borers or are discolored or encrusted are often no longer standing upright.

This alternative could increase the difficulty of enforcing harvest quotas, as there would be an incentive for fishery participants to intentionally “knock down” standing coral colonies during harvesting operations, thereby changing some “live coral” to “dead coral” and decreasing the quantity of harvested coral that is counted toward the quota.

10.3 Application of size limits

10.3.1 Alternative 1: No action

Ecological Impacts

As noted in Section 5, the current minimum size limit for pink coral applies to dead coral as well as live coral. Applying a minimum size to dead coral is inconsistent with the model for developing an appropriate minimum size limit, which is based on an estimated growth rate, mortality rate and size at reproductive maturity for live coral. Further, the application of a minimum size limit to dead coral may remove any incentive for harvesters to collect dead coral since it is less valuable than live coral. From the standpoint of conservation, it is more desirable to harvest dead coral than live coral.

Economic and Social Impacts

This alternative has a negative economic impact because it prohibits the harvest of dead pink coral colonies that are below the minimum size. There is insufficient information on the quantity of dead pink coral at different beds to evaluate the economic impact.

Applying size limits to both live and dead coral would facilitate enforcement of size limits by eliminating the need for enforcement officers to distinguish between live and dead coral.

10.3.2 Alternative 2 (Preferred Alternative): Apply size limits to live coral only

Ecological Impacts

The taking of dead pink coral of any size is not likely to have any adverse ecological effects. Fallen dead coral generally decays from erosion and chemical weathering in about 50 years. It is unlikely that the harvest of dead pink coral at Brooks Bank or the newly discovered FFS-Gold Pinnacles Bed would have an adverse effect on the monk seal population at French Frigate Shoals, as most of the pink coral trees at these beds are of insufficient size to provide habitat for monk seal prey items (Section 9.4).

Economic and Social Impacts

The economic impacts of this alternative are likely to be positive, as dead pink coral of any size would be allowed to be harvested. As noted in Section 10.3.1, there is insufficient information on the quantity of dead pink coral at different beds to evaluate the economic impact.

10.4 Conservation of black coral

10.4.1 Alternative 1: No action

Ecological Impacts

The present status of 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 (Section 9.2.3). However, emerging harvesting technologies that render black coral occurring at greater depths more accessible to harvesters and improve the efficiency of harvesting operations may intensify the fishing pressure on black coral resources. Black coral harvesters in Hawaii are currently experimenting with towed underwater camera systems and other new technology that could increase the output from old harvest areas and lead to the discovery of new beds. Furthermore, firms in Hawaii that are examining the feasibility of harvesting precious corals using manned and unmanned submersibles may decide to target black corals. Market factors could also lead to depletion of black coral resources. For example, in Hawaii the demand for small, immature black coral colonies is likely to increase in the near future as the popularity of household marine aquaria grows. In summary, in the absence of restrictions on the harvest of black coral, increased fishing pressure and the harvest of immature colonies could lead to the overfishing of black coral resources at targeted beds.

In July 1999, recognition of the potential for greater harvesting pressure on black coral resources led the State of Hawaii to prohibit the harvest of black coral with a base diameter of less than 3/4 inches from State marine waters. A black coral colony with a basal stem diameter of 3/4 inches corresponds to an age of about 15 years, which is approximately 5 to 2.5 years after which colonies reach sexual maturity. A reproductive cushion of 5 to 2.5 years may be too short a period to sustain the recruitment of black coral species if fishing pressure on the resource increases.

Economic and Social Impacts

Over the short run maintaining the status quo would have a positive economic impact, as the harvesting of black coral colonies could proceed without restriction. However, if fishing pressure increases to the point at which black coral resources become overfished, the fishery could become economically unviable. As noted above, some current black coral divers in Hawaii are experimenting with new technology that will increase the efficiency of harvesting operations and intensify the fishing pressure on black coral beds with the highest commercial importance, including those in the Au'au Channel.

10.4.2 Alternative 2 (Preferred Alternative): Prohibit the harvest of black coral unless it has attained either a minimum stem diameter of 1 inch,

measured no less than 1 inch from the top of the living holdfast, or a minimum height of 48 inches, measured from the base to the greatest distal extremity of the colony. Persons who reported a landing of black coral to the State of Hawaii within 5 years before the effective date of the final rule would qualify for an exemption which allows the hand harvest of black coral that has attained a minimum base diameter of 3/4 inches, measured on the widest portion of the skeleton at a location just above the holdfast

Ecological Impacts

This alternative would prevent the harvest of colonies which are immature and 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 (Grigg 1976). A coral colony that has attained a height of 48 inches or basal stem diameter of 1 inch corresponds to an age of about 20 years, which is approximately 8 to 10 years after black coral colonies reach sexual maturity. Hence, this alternative 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 is the minimum acceptable harvesting size limit for sustaining maximum yield (Grigg 1998a).

A coral colony with a 3/4 inch base diameter is estimated to be about 15 years old, which is approximately 5 to 2.5 years after which black coral colonies reach sexual maturity. Allowing individuals who reported a landing of black coral to the State of Hawaii within 5 years before the effective date of the final rule tend to promote conservation of the resource. While the reproductive cushion provided by a size limit of 3/4 inches is significantly smaller than that provided by a 1 inch base diameter/48 inch tree height size limit, the expected harvest level of the divers who potentially could qualify for an exemption is substantially lower than the MSY for the Au'au Channel bed, which is estimated to be about 11,000 lbs/yr (Section 9.2.3). Between 1990 and 1997, the annual harvest of black coral in Hawaii varied from a low of 864 lbs to a high of 6,017 lbs, with a yearly average of 3,084 lbs. An assessment of the biological condition of the black coral bed in the Au'au Channel conducted in July 1998 showed that 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.

Economic and Social Impacts

The "either/or" provision provides flexibility for harvesters by allowing the taking of stunted colonies less than 48 inches in height but having a 1 inch or greater basal stem diameter, and slender colonies less than 1 inch in diameter but 48 inches or more in height. However, the estimated economic impact of this size limit on current black coral harvesters in Hawaii could be significant if divers extend their harvesting operations into the EEZ. The State of Hawaii Division of Aquatic Resources estimates that only about 50 percent of the black coral colonies currently being harvested are either at least 48 inches in height or have a base diameter of 1 inch or greater.

This alternative takes into account present participation in the fishery; historical fishing practices in, and dependence on, the fishery; and the economics of the fishery. It would mitigate the negative economic impacts of a minimum size limit on those black coral divers who currently have the greatest economic dependence on the fishery by allowing them to continue to harvest coral with a 3/4 inch or larger base diameter. Persons who reported a landing of black coral to the State of Hawaii within 5 years before the effective date of the final rule would qualify for the exemption. The negative economic impacts of a size limit of 3/4 inches are likely to be small, as most of the black coral that is currently being harvested is larger than this minimum size. The State of Hawaii Division of Aquatic Resources estimates that nearly 83 percent of the black coral harvested has a base diameter of 3/4 inches or greater. According to Maui Divers of Hawaii, Ltd., processors of precious coral prefer to purchase black coral colonies which are at least 1 inch in diameter near the base because these colonies are the most suitable size and weight for the manufacture of black coral jewelry. However, black coral processors will purchase smaller colonies in order to ensure adequate supplies of raw material.

This alternative takes into account the cultural and social framework relevant to the fishery and any affected fishing communities. The commercial harvest of black coral using hand harvest methods has occurred in the waters around Hawaii for more than three decades (Grigg 1993). By allowing active participants in the fishery to continue to harvest coral with a 3/4 inch or larger base diameter the exemption is expected to mitigate the negative impacts of a size limit for black coral on enjoyment of the fishery and social or cultural activity in the fishery. This alternative is not expected to adversely affect the capability of fishing vessels used in the fishery to engage in other fisheries.

This alternative is not expected to provide any particular individual, corporation or other entity with an excessive share of fishing privileges. It is estimated that 3 to 5 individuals in Hawaii would qualify for the exemption. From the inception of the black coral fishery in Hawaii in the late 1950s, generally fewer than 5 individuals have been active in the fishery during any one year.

A minimum size limit could induce harvesters to dive deeper and stay submerged longer in search of coral colonies that are of a legal size. Diving to great depths for extended periods of time exposes harvesters of black coral to nitrogen narcosis and decompression sickness, both of which can result in injury or death. Over the years, many black coral harvesters in Hawaii have died or become permanently disabled from diving accidents. To the extent that a 1 inch base diameter/48 inch tree height size limit creates pressures on harvesters to dive to depths that they would otherwise avoid, this alternative could have a negative impact on the safety of human life at sea. However, the exemption included in this alternative would mitigate these negative impacts on human safety by allowing qualifying harvesters to collect coral with a base diameter of 3/4 inches.

To the extent that only individuals who receive an exemption participate in the black coral fishery, this alternative would facilitate enforcement by applying Federal regulations for the harvest of black coral that are consistent with those of the State of Hawaii. As noted in Section 9.2.3, the Hawaii Department of Land and Natural Resources recently implemented a minimum size limit of 3/4 inches for black coral. However, if harvesters who don't qualify for an exemption enter the fishery State and Federal enforcement office would be faced with the difficulty of enforcing conflicting regulations. An inconsistency between State and Federal regulations may be particularly problematic if harvesters collect black coral from beds which lie in areas over which both the State

and Federal governments claim jurisdiction. Specifically, the State claims the authority to manage and control the marine, seabed and other resources within "archipelagic waters." In some areas, including the Au'au Channel, these archipelagic waters extend into the EEZ.⁶ It is not possible to predict how the conflicting claims to jurisdiction will be reconciled.

10.4.3 Alternative 3: Prohibit the harvest of black coral unless it has attained either a minimum stem diameter of 1", measured no less than 1" from the top of the living holdfast, or a minimum height of 48 inches, measured from the base to the greatest distal extremity of the colony

Ecological Impacts

The ecological impacts are expected to be similar to those of Alternative 2.

Economic and Social Impacts

The economic and social impacts would be similar to those of Alternative 2, except no exemption is provided that would reduce the negative economic impacts on current black coral harvesters, mitigate the negative impacts on the safety of human life at sea and facilitate enforcement of Federal and State of Hawaii black coral regulations.

10.4.4 Alternative 4: Prohibit the harvest of black coral unless it has attained a minimum base diameter of 3/4 inches

Ecological Impacts

A coral colony with a basal stem diameter of 3/4 inches corresponds to an age of about 15 years, which is approximately 5 to 2.5 years after which black coral colonies reach sexual maturity. A reproductive cushion of 5 to 2.5 years may be too short a period to sustain the recruitment of black coral species if fishing pressure on the resource increases.

Economic and Social Impacts

The adverse economic impacts would be small in the short run, as most of the black coral that is currently being harvested has a base diameter larger than 3/4 inches. The State of Hawaii Division of Aquatic Resources estimates that nearly 83 percent of the black coral harvested has a base diameter of 3/4 inches or greater. However, if a minimum size of 3/4 inches inadequately protects black coral resources from overfishing if fishing pressure increases, the fishery may be unsustainable and economically unviable over the long term.

By implementing a smaller minimum size limit this alternative would be expected to have

⁶ An October 24, 1997 memorandum from NOAA/GCSW to the WPRFMC Chairman states that, despite any contentions by the State of Hawaii to the contrary, for purposes of Federal fishery management State waters do not extend beyond three miles from the coast.

less of a negative impact on human safety in terms of inducing harvesters to dive deeper and stay submerged longer in search of coral colonies that are of a legal size. On the other hand, if the size limit inadequately protects stocks from overfishing, the gradual depletion of the resource would also encourage divers to take more risks in order to maintain harvest levels.

This alternative would facilitate enforcement by establishing Federal regulations that are consistent with State of Hawaii regulations for black coral.

10.4.5 Alternative 5: Establish a weight quota for black coral

Ecological, Economic and Social Impacts

A weight quota may not be as effective as a size limit in avoiding overfishing of the resource. Information is limited on the standing stock and sustainable yield of managed species of black coral. The use of minimum size limits based on knowledge of the reproductive biology of precious corals is the preferred basis for management of the fishery when selective harvesting is expected to be economically feasible. In addition, weight quotas may be more difficult to enforce than size limits (Grigg 1998a).

10.5 Gear restrictions

10.5.1 Alternative 1: No action

Ecological Impacts

To the extent that the use of non-selective gear is destructive to essential fish habitat, allowing the continued use of this gear is inconsistent with Magnuson-Stevens Act obligations to minimize to the extent practicable adverse effects on such habitat caused by fishing. The FMP states that it is probable that the use of non-selective gear such as dredges (pieces of netting dragged across the ocean floor at slow speed) may damage other sessile organisms on the bed, especially those which, like the precious corals, form colonies which rise some distance off the bottom. The benthic animals that occur at these depths tend to be long-lived with slow re-colonization and growth rates. Consequently, it will take an extended period of time for populations of these animals to recover from any damage that the use of non-selective gear may cause.

A variety of invertebrates and fish are known to utilize the same habitat as precious corals including onaga (*Etelis coruscans*), kahala (*Seriola dumerallii*) and deep-water pandalid shrimp (*Heterocarpus ensifer*). There is no evidence that these species depend on the coral for shelter or food, but the functional significance for the ecosystem and fisheries of these deep-water communities is poorly understood.

The use of non-selective gear may also be wasteful, as some coral dislodged from the bottom may not be recovered. The FMP indicates that dredges only recover about 40 percent of the precious coral that is "knocked down." Much of the remainder slowly dies, becomes prone to attack from parasites and encrusting organisms and quickly deteriorates (Carleton 1987).

The damage to precious coral beds and associated benthic communities caused by the use of non-selective gear may have an indirect adverse impact on Hawaiian monk seals. As noted in Section 9.2.4, precious coral beds in the vicinity of French Frigate Shoals in the NWHI may constitute important foraging habitat for monk seals. The foraging success of monk seals may be adversely affected if the use of non-selective gear damages these beds. However, the point at which the use of non-selective gear might have an adverse effect on monk seals is uncertain.

Economic and Social Impacts

This alternative minimizes the capital and operating costs of harvesting deep-water precious corals. However, non-selective gear has not been used to harvest precious corals in the EEZ since 1989 when a coral-dredging operation in Hawaii made at least three trips to areas around the NWHI. Most of the coral harvested was dead and of poor quality, and the revenue generated during these trips was insufficient to cover vessel operating costs. As a result of large financial losses the firm ceased operations.

The use of non-selective gear to harvest precious corals may not be an efficient use of fishery resources. The value of precious coral colonies is dependent on its size, color and condition. Large, completely intact trees of color have the greatest value. Non-selective gear such as dredges land pieces of broken coral knocked down by the dredge stone and entangled in the nets as the dredge is pulled along the sea floor. Breakage may reduce a coral's value by as much as 80 percent.

Allowing the continued use of non-selective gear in exploratory areas may encourage the discovery and exploration of new beds. However, the use of this gear is unlikely to provide sufficient data to develop reliable estimates of the standing stock and MSY for newly discovered beds because this gear cannot discriminate or differentiate between types, size, quality or characteristics of living or dead corals.

If the Council does not develop management measures to ensure the protection of monk seal foraging habitat or does not develop measures that are considered adequate by NMFS, NMFS would likely initiate an Endangered Species Act section 7 consultation on the precious coral fishery. Management measures that could be imposed include emergency closures of specific sites, including Brooks Bank, or alteration of fishing operations. The economic impact of closures or other measures would depend on the length of time that these measures are in effect.

10.5.2 Alternative 2 (Preferred Alternative): Only selective gear may be used to harvest precious corals from all permit areas.

Ecological Impacts

Allowing only selective gear for the harvest of precious corals would help prevent overfishing and wastage of resources by minimizing bycatch. By employing selective gear, harvest quotas and size limits could be more strictly adhered to, thereby minimizing the possibility of adversely impacting the long-term health of these precious coral beds. The use of selective gear would also minimize adverse impacts on habitat and other living organisms.

Because non-selective gear by definition is non-selective for colony size, the imposition of a size limit for managed precious corals is precluded in those permit areas where the use of non-selective is allowed. Prohibiting the use of non-selective gear would allow the current size limit for pink coral to be applied to all permit areas. A broader application of the size limit would help ensure the conservation of pink coral.

The Council's Precious Coral Fishery Plan Team noted that even the use of non-selective gear for scientific research activity could result in ecological damage, although the damage is likely to be relatively slight because the amount of precious corals taken and the portion of a precious coral bed that would be adversely affected during such activity is generally small. The Plan Team stated that the use of non-selective gear is unnecessary to assess the abundance and distribution of precious corals at established beds. By definition established beds are those which are sufficiently documented that optimum yields have already been established on the basis of biological stock assessment techniques. On the other hand, the Plan Team also noted that allowing the use of non-selective gear for scientific research activity may have a beneficial ecological impact to the extent that it increases the incentive to collect scientific data on precious corals at conditional beds and in exploratory areas which are needed for effective implementation of the FMP. For example, non-selective gear can be used to collect data on precious corals taxonomy, genetic composition and zoogeography. At present, the level of Federal and State funds for such scientific studies is low because of the lack of activity in the precious coral fishery. Permitting the use of non-selective gear provides a relatively inexpensive method of conducting research on precious corals. However, the type of scientific information that can be collected with non-selective gear is limited because this gear by definition cannot discriminate or differentiate between types, size, quality or characteristics of living or dead corals.

Economic and Social Impacts

The estimated dockside value of the precious coral that would no longer be available for annual harvest by non-selective gear from established and conditional beds is \$62,618 (Table 5). This figure is based on a harvest quota that is 20 percent of the quota allowed for selective harvesting (Table 1). According to Maui Divers of Hawaii, Ltd., the largest processor of precious coral jewelry in Hawaii, the ex-vessel price of all species of gold coral, *C. secundum*, *C. regale* and both species of bamboo coral is \$330/kg (\$150/lb), \$440/kg (\$200/lb), \$600/kg (\$270/lb) and \$18/kg (\$8/lb), respectively.

In addition, up to 200 kg of precious coral would no longer be available for annual harvest by non-selective gear from each of the exploratory beds around Hawaii, American Samoa, Guam and the remote US Pacific Island possessions.

Prohibiting the use of non-selective gear may inhibit the development of the precious coral fishery by making it uneconomical for some firms to enter the fishery. However, as noted in Section 10.5.1, the most recent venture attempting to harvest precious corals with non-selective gear in the EEZ around the Hawaiian Islands proved to be economically unviable.

Table 5. Estimated quantity and value of precious coral available for harvest by non-selective gear under current regulations.

Name of Bed	Harvest Quota	Total Value
Brooks Bank	Pink 40.0 kg (see Note 1 below) Gold 26.6 kg Bamboo 22.2 kg	\$33,178
180 Fathom Bank	Pink 44.4 kg (see Note 2 below) Gold 13.4 kg Bamboo 11.2 kg	\$24,160
FFS-Gold Pinnacles (note 3)	Gold 16.0 kg	\$5,280
		\$62,618

Note 1: Pink coral assumed to be *C. regale*. Based on revised harvest quota (Section 9.2.2).

Note 2: Pink coral assumed to be *C. secundum*.

Note 3: Newly discovered bed (Section 9.2.4).

According to industry representatives, technological innovations during the last decade have significantly reduced the costs of purchasing and operating selective gear. In particular, the costs of operating manned submersibles have declined over the years. One reason that costs have declined is that the size of these submersibles has decreased substantially and, consequently, tender vessels are smaller. The capital cost of a manned submersible has also decreased as much as 50 percent since the 1970s. The cost of purchasing an unmanned submersible (i.e., remotely operated vehicle) has also declined significantly. The price may be as low as \$50,000, which is approximately equal to the capital investment in gear required to initiate a non-selective harvest operation using tangle nets.

Although the capital and operating costs of manned submersibles are still high in comparison to those of non-selective gear, they are not economically prohibitive, as is evidenced by the recent interest of two firms in using this type of selective gear to harvest precious corals in the waters around Hawaii. In addition, it is likely that some harvesters of precious coral will be able to defray the costs of using selective gear by finding other lucrative uses for the gear, such as salvage and research.

As noted in Section 10.5.1, the use of non-selective gear to harvest precious corals may be an inefficient use of fishery resources. Non-selective gear tends to damage the precious coral trees as it harvests them, thereby greatly reducing the value of the coral. In contrast, selective gear harvests coral so that it retains its highest value.

10.5.3 Alternative 3: Only selective gear may be used to harvest precious corals from established and conditional beds

Ecological Impacts

The ecological impacts would be similar to those of Alternative 1, except the potential adverse impacts of using non-selective gear to harvest precious corals at established and conditional beds would be eliminated. Allowing the continued use of this relatively inexpensive gear in exploratory areas may encourage the discovery and exploration of new beds. However, as noted in Section 10.5.1, the use of non-selective gear is unlikely to provide sufficient data to develop reliable estimates of the standing stock and MSY for newly discovered beds because this gear cannot discriminate or differentiate between types, size, quality or characteristics of living or dead corals.

Economic and Social Impacts

The economic impacts would be similar to those of Alternative 1, except up to 200 kg of precious coral would continue to be available for annual harvest by non-selective gear from each of the exploratory beds around Hawaii, American Samoa, Guam and the remote US Pacific Island possessions.

10.6 Application of size limit for pink coral

10.6.1 Alternative 1: No action

Ecological Impacts

A minimum colony height size limit of 10 inches for pink coral was implemented in order to help ensure that the estimated MSY for these species of precious corals is not exceeded (Section 10.5). However, the size limit for pink coral applies only to the Makapu'u Bed, Keahole Point Bed and Kaena Point Bed because the use of non-selective gear is allowed everywhere else (except in the EEZ seaward of the main Hawaiian Islands). Under the no action alternative there is increased risk that the estimated MSY for pink coral will be exceeded at those conditional beds (i.e., Brooks Bank, 180 Fathom Bank and newly discovered FFS-Gold Pinnacles Bed) and exploratory areas where there is no size limit.

Economic and Social Impacts

The impact in the short term is minimal. However, long-term negative impacts on harvest levels and gross revenues could be potentially large if the MSY is exceeded. Given the life-history characteristics of pink coral, such as slow growth and long generation time, overfishing of these species could degrade the productivity of precious coral beds for many years. On the other hand, the deep-water precious coral fishery in Hawaii has been dormant for several years, and the interest of industry in harvesting the corals at those beds where there is no size limit is uncertain.

10.6.2 Alternative 2 (Preferred Alternative): Apply the current size limit for pink coral to all permit areas

Ecological, Economic and Social Impacts

The feasibility of this alternative is contingent on a prohibition on the use of non-selective gear to harvest precious corals for commercial purposes in all permit areas (Section 10.5.2). The alternative would prevent the harvest of colonies which are immature and have not reached their full potential for growth, thereby reducing the potential for overfishing to occur.

Applying the size limit for pink coral to additional permit areas is unlikely to have a significant negative economic impact because the financial return from harvesting colonies of pink coral that are less than 10 inches in height is low. According to Maui Divers of Hawaii, Ltd., harvesting colonies less than 10 inches is not economically practical, because the return does not justify the time spent harvesting.

Enforcement of any size limit for pink coral is difficult because much of the pink coral is unavoidably broken during collection. Breakage varies depending on handling which itself is a variable due to weather, size of the load and chance. The FMP states that this difficulty may be reduced by calculating an average weight and stem diameter for colonies 10 inches in height. The weight of the load could be divided by the average weight of a 10-inch colony. This division

would produce a number that would equal the minimum number of pieces equal to or larger than the stem diameter equivalent to 10 inches in height.

10.6.3 Alternative 3: Apply the current size limit for pink coral to all established and conditional beds

Ecological, Economic and Social Impacts

The ecological impacts would be similar to those of Alternative 2, except beds of pink coral occurring in exploratory areas would not receive the protection from overfishing provided by the preferred alternative.

The economic and social impacts would be similar to those of Alternative 2.

10.7 Adjusting Brooks Bank boundaries and harvest quotas

10.7.1 Alternative 1: No action

Ecological Impacts

A September 1998 survey of precious coral beds around the Northwestern Hawaiian Islands revealed that the size of Brooks Bank is larger than previously specified. However, maintaining the current harvest quota of 444 kg for pink coral could result in the overfishing of these species of precious coral at Brooks Bank. Recent estimates of the standing crop of precious coral at Brooks Bank suggests that 200 kg of pink coral can be harvested annually from this bed on a sustainable basis (Section 9.2.2).

It is unlikely that the harvest of the current quota for pink coral at Brooks Bank would have an adverse effect on the Hawaiian monk seal population at French Frigate Shoals, as most of the pink coral trees at this bed are of insufficient size to provide habitat for monk seal prey items (Section 9.2.2).

The harvest of the existing quota of 133 kg for gold coral at Brooks Bank could have an adverse impact on the Hawaiian monk seal population at French Frigate Shoals by reducing the function of the precious coral beds to aggregate monk seal prey species and thereby reducing the seals' foraging success. One reason that Brooks Bank is designated as a habitat area of particular concern for the precious coral fishery is its possible importance as a foraging habitat for the monk seal. However, the point at which harvesting of gold coral at Brooks Bank might have an diverse effect on monk seals is uncertain.

The effect of harvesting the current precious coral quotas at Brooks Bank is unlikely to have an adverse impact on habitat and related marine organisms. 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.

Economic and Social Impacts

Maintaining the current harvest quota for pink coral at Brooks Bank would have a positive economic impact over the short term. According to Maui Divers of Hawaii, Ltd., the ex-vessel price of *C. regale* is \$600/kg. Hence, the potential gross revenues obtained from harvesting the current quota of 444 kg for pink coral is about \$266,400. However, the long-term economic effects may be negative if the stock of pink coral at Brooks Bank is overfished. Given the life-history characteristics of precious corals, such as slow growth and long generation time, overfishing could degrade the productivity of the bed for many years. On the other hand, the deep-water precious coral fishery in Hawaii has been dormant for several years, and the interest of industry in harvesting the corals at Brooks Bank or any other bed in the waters around the Northwestern Hawaiian Islands is uncertain.

Maintaining the current quota for gold coral at Brooks Bank harvest is likely have a positive economic impact over the short term. According to Maui Divers of Hawaii, Ltd., the ex-vessel price of gold coral is \$330/kg. Hence, the potential gross revenues obtained from harvesting the current quota of 133 kg for gold coral is about \$43,890. However, if the Council does not develop management measures to ensure the protection of monk seal foraging habitat or does not develop measures that are considered adequate by NMFS, NMFS would likely initiate an Endangered Species Act section 7 consultation on the precious coral fishery. Management measures that could be imposed include emergency closures of specific sites, including Brooks Bank, or alteration of fishing operations. The economic impact of closures or other measures would depend on the length of time that these measures are in effect.

10.7.2 Alternative 2 (Preferred Alternative): Revise the boundaries of Brooks Bank, Permit Area C-B-3, to include the area within a radius of 2.5 nautical miles of a point at 23° 58.8' N and 166° 42' W. At Brooks Bank

change the harvest quota for pink coral to 200 kg and suspend the harvest quota for gold coral until additional scientific information becomes available on the impact of harvesting gold coral on monk seal foraging habitat.

Ecological Impacts

The proposed revision in the boundaries of Brooks Bank simply reflects new information on the size of the bed collected during a survey of selected precious coral beds around the Northwestern Hawaiian Islands conducted by NMFS in September 1998. The adjustment in the coordinates of the bed is not expected to have any ecological impacts.

The ecological impacts of adjusting the harvest quota for pink coral at Brooks Bank are expected to be positive, as a harvest quota of 200 kg is the estimated MSY for pink coral at this bed based on the best scientific information available.

By suspending the harvest of gold coral this alternative eliminates the possible adverse effects that the harvest of this coral could have on the Hawaiian monk seal population at French Frigate Shoals. The potential benefits to monk seals cannot be quantified because of the generally poor understanding of the dietary importance to monk seals of fish and other organisms inhabiting beds of gold coral and the effects of gold coral harvesting at Brooks Bank on monk seal prey resources. For example, deep-water bottomfish and eels are known components of monk seal diets, but their relative importance is uncertain. In the absence of data, a precautionary approach would be to suspend the harvest quota of gold coral.

It is unlikely that the harvest of the revised quota for pink coral at Brooks Bank would have an adverse effect on the Hawaiian monk seal population at French Frigate Shoals, as most of the pink coral trees at this bed are of insufficient size to provide habitat for monk seal prey items (Section 7.1.2).

Economic and Social Impacts

The short-term economic impacts are likely to be negative, as the harvest quota for pink coral at Brooks Bank would be reduced by 244 kg. Assuming an ex-vessel price for *C. regale* of \$600/kg, this reduction in the harvest quota would decrease potential gross revenues by about \$146,400. However, this alternative is likely to have a positive economic benefit over the long term if the revised harvest quota protects the productivity of the bed from degradation through overfishing.

The potential adverse economic impacts of suspending the harvest of gold coral are significant. As noted in Section 10.7.1, the quantity of gold coral that could be harvested from Brooks Bank on a sustainable basis is worth about \$43,890. On the other hand, the deep-water precious coral fishery in Hawaii has been dormant for several years, and the interest of industry in harvesting the corals at Brooks Bank or any other bed in the waters around the Northwestern Hawaiian Islands is uncertain.

Under this alternative the harvest of dead gold coral would continue to be allowed. The September 1998 survey of Brooks Bank found an abundance of dead gold coral at the bed (Section 9.2.4).

10.7.3 Alternative 3: Revise the boundaries of Brooks Bank to include the area within a radius of 2.5 nautical miles of a point 23° 58.8' N and 166° 42' W. Re-classify the bed as a refugium

Ecological Impacts

The risk of adversely impacting the foraging habitat of the monk seal by harvesting precious corals is eliminated. However, it is unlikely that prohibiting the harvest of pink coral at Brooks Bank would have a beneficial effect on the Hawaiian monk seal population at French Frigate Shoals, as most of the pink coral trees at this bed are of insufficient size to provide habitat for monk seal prey items (Section 9.2.4). Furthermore, it is unlikely that prohibiting the harvest of dead precious coral of any species would have a beneficial effect on monk seals. Observations of monk seal foraging behavior near French Frigate Shoals indicate that it is live precious coral that constitutes the most important foraging habitat for monk seals that are diving to depths at which precious corals occur (Section 9.4). Monk seal prey, such as eels, have not been observed congregating around dead coral.

Another refugium would provide an additional reserve for possible reproductive replenishment of other beds. However, the deep-water precious coral fishery in Hawaii has been dormant for nearly two decades. Although some firms have expressed interest in renewing the fishery, the number of fishery participants is likely to remain low because of the high capital and operating expenses. Therefore, there does not appear to be a need for a second reproductive reserve for enhancement of recruitment into adjacent areas at this time.

Economic and Social Impacts

This alternative is likely to have a pronounced adverse negative economic effect, as 200 kg of pink coral, 133 kg of gold coral and 111 kg of bamboo coral which could be harvested on a sustainable basis would be foregone. Assuming the ex-vessel price of all species of gold coral is \$330/kg (\$150/lb), price of *C. regale* is \$600/kg (\$270/lb) and price of both species of bamboo coral is \$18/kg (\$8/lb), the total dockside value of this coral is about \$166,000. This figure underestimates the potential economic loss, as the harvest of dead coral would also be prohibited. A September 1998 survey of the precious corals bed at Brooks Bank recorded an abundance of dead gold coral colonies (Section 9.2.4).

10.8 Classification of newly discovered FFS-Gold Pinnacles Bed

10.8.1 Alternative 1: No action

Ecological Impacts

The newly discovered FFS-Gold Pinnacles Bed is currently classified as part of the

exploratory permit area X-P-H. The only harvest quota which applies to this bed is the 1,000 kg annual quota which may be taken from the entire X-P-H area. The 1998 survey of the FFS-Gold Pinnacles Bed revealed that colonies of pink or bamboo coral were sparse or absent (Section 9.2.4). It is uncertain if the stocks of these corals at the FFS-Gold Pinnacles Bed are capable of supporting any level of harvest on a sustainable basis. Harvesting of the few pink or bamboo colonies that occur at the bed could have a significant adverse ecological impact on the stocks of these species.

The 1998 survey of the FFS-Gold Pinnacles Bed recorded an abundance of live and dead gold coral colonies in scattered patches (Section 9.2.4). Based on survey data it estimated that the MSY for gold coral at this bed is 80 kg/yr. In the absence of a harvest quota, the stock of gold coral at the FFS-Gold Pinnacles Bed could be harvested at a level that exceeds the estimated MSY. The negative impacts on the stock could be especially significant if a harvest operation used the entire 1,000 kg quota for the exploratory area around the State of Hawaii (Permit Area X-P-H) to harvest the gold coral at the FFS-Gold Pinnacles Bed.

The harvest of live gold coral may have an adverse impact on the Hawaiian monk seal population at French Frigate Shoals by reducing the availability of monk seal prey species. The point at which precious corals harvesting at the FFS-Gold Pinnacles Bed might have an adverse effect on monk seals is uncertain.

The effect of harvesting gold coral from the FFS-Gold Pinnacles Bed is unlikely to have an adverse impact on habitat and related marine organisms. 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.

Economic and Social Impacts

Allowing the entire 1,000 kg quota for the exploratory area around the State of Hawaii (Permit Area X-P-H) to be used to harvest the precious coral at the FFS-Gold Pinnacles Bed could have a positive economic impact over the short term. Given that only gold coral is abundant at the FFS-Gold Pinnacles Bed, the value of a 1,000 kg harvest at this bed is more than \$300,000, assuming the ex-vessel price of gold coral is \$330/kg (\$150/lb). However, a harvest of 1,000 kg would exceed the estimated MSY for gold coral at the FFS-Gold Pinnacles Bed by 920 kg and would likely deplete the gold coral stock at this bed such that it would be unable to support any further harvest for many years.

In addition, if the Council does not develop management measures to ensure the protection of monk seal foraging habitat or does not develop measures that are considered adequate by NMFS, NMFS would likely initiate an Endangered Species Act section 7 consultation on the precious coral fishery. Management measures that could be imposed include emergency closures of specific sites or alteration of fishing operations. The economic impact of closures or other measures would depend on the length of time that these measures are in effect.

10.8.2 Alternative 2 (Preferred Alternative): Classify the newly-discovered FFS-Gold Pinnacles Bed as a conditional bed, Permit Area C-B-5, which

includes the area within a radius of 0.25 nautical miles of a point at 23° 55' N and 165° 23.11' W. At the FFS-Gold Pinnacles Bed set the annual harvest quota for all types of precious coral at zero until additional information becomes available on the impact of harvesting gold coral on monk seal foraging habitat.

Ecological Impacts

As noted in Section 10.8.1, colonies of pink or bamboo coral are sparse or absent at the FFS-Gold Pinnacles Bed, and it is uncertain if the stocks of these corals are capable of supporting any level of harvest on a sustainable basis. Setting the conditional harvest quota for pink and bamboo coral at zero would protect the stocks of these species from possible overfishing, should the precious corals fishery off the NWHI recommence.

Setting the conditional harvest quota for gold coral at zero until additional scientific information becomes available on the impact of harvesting this coral on Hawaiian monk seal foraging habitat reduces the likelihood that a resumption of the precious corals fishery off the NWHI would have an adverse impact on the monk seal population at French Frigate Shoals. The importance to monk seal foraging habitat of colonies of gold coral is uncertain. In the absence of data, a precautionary approach would be to set the harvest quota of gold coral at zero. Setting the conditional harvest quota for gold coral at zero would also protect the stock of this species from overfishing.

Economic and Social Impacts

The adverse economic impacts of setting the conditional harvest quota for gold coral at zero are likely to be significant. It is estimated that about 80 kg of gold coral could be annually harvested from the FFS-Gold Pinnacles Bed on a sustainable basis. Assuming an ex-vessel price of \$330/kg (\$150/lb) for gold coral, about \$26,400 in potential gross revenues would be foregone. However, fishing ventures would be allowed to harvest dead gold coral, which, according to existing survey data (Section 9.0), is abundant at this bed.

10.8.3 Alternative 3: Classify newly discovered FFS-Gold Pinnacles Bed as a refugium, Permit Area R-2, which includes the area within a radius of 0.25 nautical miles of a point at 23° 55' N and 165° 23.11' W.

Ecological Impacts

Prohibiting the harvest of any live or dead coral minimizes the possibility of interactions between Hawaiian monk seals and the precious coral fishery. However, prohibiting the harvest of pink coral at this bed is expected to have little beneficial effect on monk seals, as most of the pink coral trees at this bed are of insufficient size to provide habitat for monk seal prey items (Section 9.4). Nor is a prohibition on the harvest of dead coral of any species expected to have a significant beneficial effect on monk seals. Observations of monk seal foraging behavior near French Frigate Shoals indicate that it is live precious coral that constitutes the most important foraging habitat for

monk seals that are diving to depths at which precious corals occur (Section 9.4). Monk seal prey, such as eels, have not been observed congregating around dead coral.

Another refugium would provide an additional reserve for possible reproductive replenishment of other beds. However, the deep-water precious coral fishery in Hawaii has been dormant for nearly two decades. Although a small number of firms have expressed interest in renewing the fishery, the number of fishery participants is always likely to be low because of the high capital and operating expenses. Therefore, there is no need for a second reproductive reserve for enhancement of recruitment into adjacent areas at this time.

Economic and Social Impacts

The adverse economic impacts of prohibiting the harvest of live or dead coral are likely to be significant. As noted in Section 10.8.2, it is estimated that a quantity of live gold coral worth about \$26,400 could be annually harvested from the FFS-Gold Pinnacles Bed on a sustainable basis. This figure underestimates the potential economic loss, as the harvest of dead coral would also be prohibited if the bed is classified as a refugium. Existing survey data indicates that dead colonies of gold coral are abundant at this bed (Section 9.2.4).

10.8.4 Alternative 4: Classify newly discovered FFS-Gold Pinnacles Bed as a conditional bed, Permit Area C-B-5, which includes the area within a radius of 0.25 nautical miles of a point at 23° 55' N and 165° 23.11' W. Set the annual harvest quota for gold coral at 80 kg.

Ecological Impacts

This alternative would have a positive ecological impact on precious coral resources, as the amount of precious corals that may be taken would be set at a level that equals the estimated MSY for the FFS-Gold Pinnacles Bed (Section 9.2.4).

However, the harvest of live gold coral at the FFS-Gold Pinnacles Bed may have an adverse impact on the Hawaiian monk seal population at French Frigate Shoals by reducing the availability of monk seal prey species. There is insufficient information available to determine the point at which the harvest of gold coral at the FFS-Gold Pinnacles Bed might have an adverse effect on monk seal survival. The potential impact of harvesting gold coral on monk seals if a harvest quota for gold coral is established is likely to be less than the impact if no quota is set (no action).

Economic and Social Impacts

This alternative would impose a cost on harvesters over the short term, as it restricts the amount of precious coral that is allowed to be harvested. However, 80 kg of gold coral worth about \$26,400 would be allowed to be harvested annually. Further, a quota would help ensure that harvest activity at the FFS-Gold Pinnacles Bed is sustainable and economically viable over the long term.

As noted above, the harvest of live gold coral at the FFS-Gold Pinnacles Bed may have an adverse impact on the Hawaiian monk seal population at French Frigate Shoals by reducing the availability of prey species. If the Council does not develop management measures to ensure the protection of monk seal foraging habitat or does not develop measures that are considered adequate by NMFS, NMFS would likely initiate an Endangered Species Act section 7 consultation on the precious coral fishery. Management measures that could be imposed include emergency closures of specific sites or alteration of fishing operations. The economic impact of closures or other measures would depend on the length of time that these measures are in effect.

10.9 Recommended changes to recordkeeping and reporting requirements

Current recordkeeping and reporting requirements provide the Council and NMFS with important information about the precious corals fishery (Section 6.0). However, the data may be insufficient to accurately assess the recovery and current status of known precious coral beds and determine the location and productive potential of new beds.

The recommended changes to the current recordkeeping and reporting requirements are expected to have significant beneficial impacts. Given the high costs of conducting biological surveys of precious coral resources, it is likely that the Council and NMFS will depend on fishermen to be the principle collectors of data on these resources. The additional data which will be collected under these recommended changes will enable the Council and NMFS to identify the most cost-effective way to ensure the long-term productivity of precious coral beds, maintain an economically viable fishery and minimize fishery interactions with protected species in the NWHI or adverse impacts on essential fish habitat. Furthermore, additional information on the distribution, abundance and potential yields of precious coral could provide an impetus for growth of the domestic precious corals industry.

11.0 Consistency with National Standards for Fishery Conservation and Management

National Standard 1 states that conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry. The recommended measures help reduce the risk of overfishing in the precious coral fishery by 1) suspending the harvest of gold coral at the Makapu'u Bed until additional information is available on the impact of harvesting on subsequent recruitment of this species (Section 10.1.2); 2) establishing a minimum size limit for black coral that reduces the risk of overfishing (Section 10.4.2); 3) prohibiting the use of non-selective gear in the harvest of precious coral in all permit areas (Section 10.5.2); 4) applying the current size limit for pink coral to all permit areas (Section 10.6.2); 5) modifying the estimated MSY for pink coral at Brooks Bank based on new information (Section 10.7.2); and 6) estimating the MSY for precious coral at the newly discovered FFS-Gold Pinnacles Bed (Section 10.8.2).

National Standard 2 states that conservation and management measures shall be based upon the best scientific information available. The Council recommends revised reporting and recordkeeping requirements that would expand the information base for assessing the recovery and current status of known precious coral beds and determining the location and productive potential of

new beds (Section 10.9.2).

National Standard 3 states that, to the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination. The FMP for precious corals treats separate precious coral beds as distinct management units because of their widely-separated patchy distribution and the sessile nature of individual colonies.

National Standard 4 states that conservation and management measures shall not discriminate between residents of different States. If it becomes necessary to allocate or assign fishing privileges among various United States fishermen, such allocation shall be (A) fair and equitable to all such fishermen; (B) reasonably calculated to promote conservation; and (C) carried out in such manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges. The proposed measures will not discriminate between residents of different States. The recommended allocation of fishing privileges with respect to the harvest of black coral is consistent with this standard (Section 10.4.2).

National Standard 5 states that conservation and management measures shall, where practicable, consider efficiency in the utilization of fishery resources; except that no such measure shall have economic allocation as its sole purpose. The recommended prohibition on the use of non-selective gear takes into account the efficient utilization of precious coral resources. Technological advances have reduced the costs of using remotely operated vehicles to harvest precious corals to a level comparable to the costs of using non-selective gear. Although the capital and operating costs of a manned submersible are still high in comparison to those for non-selective gear, they are not economically prohibitive, as is evidenced by the recent interest expressed by two firms in entering the fishery using this type of selective gear (Section 10.5.2).

National Standard 6 states that conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources and catches. The recommended measures take into account uncertainties in precious coral resources. Suspending the quota for gold coral at Makapu'u Bed until additional scientific information is available on the reasons for the low recruitment of gold coral at this bed would be a precautionary measure expected to increase the probability that a recovery in the number of gold coral colonies at the Makapu'u Bed eventually occurs (Section 10.1.2).

National Standard 7 states that conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication. The establishment of a minimum size limit for black coral that is inconsistent with the State of Hawaii size limit may increase the difficulty of enforcing both Federal and State regulations. However, the best scientific information available suggests that the recommended minimum size is required to prevent overfishing, should harvest levels increase (Section 10.4.2). Furthermore, the recommended exemption which would allow qualifying persons to harvest black coral that has attained a 3/4 inch base diameter is expected to facilitate enforcement (Section 10.4.2). The recommended reporting and recordkeeping requirements are not expected to impose a significant economic burden on participants in the precious coral fishery (Section 10.9.2).

National Standard 8 states that conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities. There have been no harvesters of deep-water species of precious coral, including pink, gold and bamboo coral, in the EEZ around Hawaii for nearly two decades. Current processors of these corals in Hawaii rely on imported material. Consequently, the recommended measures pertaining to these deep-sea corals are not expected to have a negative impact on processors. The recommended minimum size limit for black coral is also not expected to have a significant economic or social impact on precious coral processors in Hawaii. Nor is it expected to have a negative impact on the three to five individuals in Hawaii currently participating in the fishery for black coral in terms of employment, enjoyment of the fishery, social or cultural activity in the fishery or other social factors. The recommended exemption which would allow qualifying persons to harvest black coral that has attained a 3/4 inch base diameter is expected to reduce the negative economic impacts of establishing a size limit (Section 10.4.2).

National Standard 9 states that conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch. By prohibiting the use of non-selective gear in the commercial harvest of precious corals, the proposed management measures would minimize damage to other sessile organisms on the bed and minimize the amount of coral which is dislodged from the bottom during harvesting operations and not recovered (Section 10.5.2). The Council recommends that the NMFS Daily Precious Coral Harvest Log be revised to include the number of live and dead colonies damaged but not harvested on each dive by species (Section 10.9).

National Standard 10 states that conservation and management measures shall, to the extent practicable, promote the safety of human life at sea. Establishing a minimum size limit for black coral could induce harvesters using scuba gear to dive deeper and stay submerged longer in search of coral colonies that are of a legal size. On the other hand, depletion of the resource as a result of overfishing would also encourage divers to take more risks in order to maintain harvest levels. Furthermore, the recommended exemption which would allow qualifying persons to harvest black coral that has attained a 3/4 inch base diameter is expected to mitigate the negative impacts on human safety that result from establishing a size limit (Section 10.4.2).

12.0 Relationship to Other Applicable Laws and Provisions of the Magnuson-Stevens Act

12.1 National Environmental Policy Act (NEPA)

This document has been prepared in accordance with the requirements of the National Environmental Policy Act (NEPA) of 1969 to assess the impacts on the human environment that may result from the proposed action. The Environmental Assessment (EA) provided in this document presents a brief analysis of the environmental impacts of the proposed action and its alternatives. NEPA requires preparation of an Environmental Impact Statement if the EA does not support a finding of no significant impact.

The purpose and need for action is described in Section 5.0 of this document. A discussion of the proposed action and alternatives and their impacts is presented in Section 10.0. A description of the affected environment is provided in Section 9.0. Updated information on the essential fish habitat and habitat areas of particular concern for the precious corals fishery is provided in Amendment 4 to the FMP.

12.1.1 Conclusions and determination

- a. The proposed action is not expected to jeopardize the sustainability of any target species that may be affected by the action. The recommended measures help reduce the risk of overfishing in the precious coral fishery by 1) suspending the harvest of gold coral at the Makapu'u Bed until additional information is available on the impact of harvesting on subsequent recruitment of this species (Section 10.1.2); 2) establishing a minimum size limit for black coral that reduces the risk of overfishing (Section 10.4.2); 3) prohibiting the use of non-selective gear in the commercial harvest precious coral in all permit areas (Section 10.5.2); 4) applying the current size limit for pink coral to all permit areas (Section 10.6.2); 5) modifying the estimated MSY for pink coral at Brooks Bank based on new information (Section 10.7.2); and 6) estimating the MSY for precious coral at the newly discovered FFS-Gold Pinnacles Bed (Section 10.8.2).
- b. The proposed action is not expected to jeopardize the sustainability of any non-target species that may be affected by the action. By prohibiting the use of non-selective gear in the commercial harvest of precious corals, the proposed management measures would minimize damage to other sessile organisms on the bed and minimize the amount of non-target coral which is dislodged from the bottom during harvesting operations and not recovered (Section 10.5.2).
- c. The proposed action is not expected to cause substantial damage to the ocean or coastal habitats and/or essential fish habitat as defined under the Magnuson-Stevens Act and identified in FMPs. By prohibiting the use of non-selective gear in the commercial harvest of precious corals, the proposed management measures would minimize damage to other sessile organisms on the bed and minimize the amount of coral which is dislodged from the bottom during harvesting operations and not recovered (Section 10.5.2).
- d. The proposed action is not expected to have a substantial adverse impact on public health or safety. Establishing a minimum size limit for black coral could induce harvesters using scuba gear to dive deeper and stay submerged longer in search of coral colonies that are of a legal size. On the other hand, depletion of the resource as a result of overfishing would also encourage divers to take more risks in order to maintain harvest levels (Section 10.4.2). Furthermore, the recommended exemption which would allow qualifying persons to harvest black coral that has attained a 3/4 inch base diameter is expected to mitigate the negative impacts on human safety that result from establishing a size limit (Section 10.4.2).
- e. The proposed action is not expect to adversely affect endangered or threatened species, marine mammals, or the critical habitat of these species. The likelihood that the harvest of precious corals would have an adverse impact on monk seal foraging habitat is expected to

be negligible because the recommended measures suspend the harvest quota for gold coral at Brooks Bank and set the harvest quota for gold coral at the FFS-Gold Pinnacles Bed at zero (Section 10.7.2).

- f. The proposed action is not expected to have cumulative adverse impacts that could have a substantial effect on the target species or non-target species. The recommended measures help reduce the risk of overfishing in the precious coral fishery by 1) suspending the harvest of gold coral at the Makapu'u Bed until additional information is available on the impact of harvesting on subsequent recruitment of this species (Section 10.1.2); 2) establishing a minimum size limit for black coral that reduces the risk of overfishing (Section 10.4.2); 3) prohibiting the use of non-selective gear in the harvest of precious coral in all permit areas (Section 10.5.2); 4) applying the current size limit for pink coral to all permit areas (Section 10.6.2); 5) modifying the estimated MSY for pink coral at Brooks Bank based on new information (Section 10.7.2); and 6) estimating the MSY for precious coral at the newly discovered FFS-Gold Pinnacles Bed (Section 10.8.2). The proposed action is not expected to have a substantial impact on biodiversity and ecosystem function within the affected area (e.g. benthic productivity, predator-prey relationships etc.)
- g. The proposed action is not expected to have significant social or economic impacts which are interrelated with adverse natural or physical environmental effects.
- h. The proposed action is non-controversial.

Based on the information contained in this document, I have determined that the proposed action to: suspend the harvest of gold coral at the Makapu'u Bed; redefine live precious coral as any precious coral which has live coral polyps or tissue; apply size limits to live coral only; set minimum sizes for black coral; prohibit the use of non-selective gear to harvest precious corals; apply the current size limit for pink corals to all permit areas; adjust the boundaries and harvest quotas for the Brooks Bank Bed; and classify the newly discovered French Frigate Shoals-Gold Pinnacles Bed as a conditional bed with all harvest quotas set at zero, is consistent with existing national policies and objectives set forth in sections 101 (a) and 101 (b) of the National Environmental Policy Act and will not have a significant on the quality of the human environment. As described in section 5.03c of NOAA Administrative Order 216-6, a Finding of No Significant Impact is supported and appropriate for the proposed action. Therefore, preparation of an environmental impact statement is not required by Section 101 (2) (C) of the National Environmental Policy Act or its implementing regulations.

William Hogarth
NOAA Acting Assistant Administrator for Fisheries

Date

12.2 Executive Order 12866 and Regulatory Flexibility Act

In order to meet the requirements of Executive Order 12866, the National Marine Fisheries Service requires that a Regulatory Impact Review (RIR) be prepared for all regulatory actions that are of public interest. This analysis provides an overview of the problem, policy objectives, and anticipated impacts of the regulatory 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 addition, 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 organizations through the preparation of a Regulatory Flexibility Analysis. These analyses are presented in full in the Appendix to this document. In summary, the analyses concluded that the preferred management measures of 1) suspending the harvest of gold coral at the Makapu'u Bed; 2) applying the existing size limit for pink corals to all permit areas; 3) reducing the harvest of pink coral and suspending the harvest of gold coral from Brooks Bank; 4) and restricting the harvest of all precious corals from the FFS-Gold Pinnacles Bed would most likely have negative impacts on potential fishery revenues. However, these proposed measures are expected to result in positive long-term net benefits to the nation through improved resource management. Further, due to the low level of participation in the precious coral fishery (estimated to be three to five harvesters of black coral at any one time during the past 20 years), aggregate economic impacts resulting from implementation of the proposed measures will be minimal unless there is a significant increase in the number of harvesters of precious coral resources in the EEZ.

Estimated revenues forgone from suspending the quota for gold coral at the Makapu'u Bed, total \$198,000 every two years if the entire biennial harvest quota of 600 kg could be harvested. However, this estimated economic impact is a worst case scenario because the current standing stock of gold coral at the Makapu'u Bed may not yield this harvest level.

Revising the definitions of live and dead coral is not expected to have a significant negative economic impact, as the amount of additional coral that would be subject to the harvest quota as a result of changes in the definitions is likely to be small. Applying size limits to only live coral is expected to have a positive economic impact by allowing greater utilization of dead coral resources and thus increasing potential income to harvesters.

Implementing a size limit for black coral could have a negative economic impact on fishery revenues. However, given that the preferred measure would allow current participants in the fishery who employ hand harvest methods to continue to collect black corals with a base diameter of 3/4 inches or greater, the negative economic impact is expected to be small. Future participants would be prohibited from harvesting black coral unless it has attained either a minimum stem diameter of 1 inch or a minimum height of 48 inches. Additional data on the size composition of black coral resources in the EEZ is needed to accurately estimate the potential impact of this measure on future harvests. It is estimated that 50 percent of the black coral currently harvested meets or exceeds this size limit.

Prohibiting the use of non-selective gear in all permit areas could impose an additional cost on future participants. However, the firms that have recently expressed interest in harvesting pink, gold and bamboo coral in the waters around Hawaii indicate that they intend to use only selective gear. Hand harvesters of black coral would be unaffected by this measure. The additional cost of using selective is not known. However, it is expected to be small, as a remotely operated vehicle can reportedly be purchased at the same cost as a set of tangle nets. Further, the use of selective gear could increase gross revenues by reducing the breakage of precious coral colonies during harvesting. Breakage may reduce a coral's value by as much as 80 percent.

Immediate revenues forgone from applying the size limit for pink coral to all permit areas, are difficult to predict since there are little size composition data on existing coral resources in the EEZ. Nevertheless, it is believed that a minimum size would have positive benefits to potential fishery participants through the long-term maintenance of maximum sustainable yields.

Setting the harvest quota for gold coral at Brooks Bank and the FFS-Gold Pinnacles Bed at zero is considered important to the protection of the foraging habitat of the endangered Hawaiian monk seal. Suspending the harvest quota for gold coral at Brooks Bank would result in up to \$44,000 in forgone revenues, while restrictions on the harvest of all precious corals from the FFS-Gold Pinnacles Bed are projected to result in a short run annual loss of \$26,000, primarily from forgone harvests of gold coral. Reducing the harvest of pink coral at Brooks Bank is expected to result in forgone annual revenues of up to \$146,000 over the short run. However, positive long-term benefits are expected through the long-term maintenance of maximum sustainable yield for the pink coral stock at Brooks Bank.

12.3 Coastal Zone Management Act (CZMA)

The CZMA requires a determination that a FMP or amendment has no effect on the land or water uses or natural resources of the coast zone, or is consistent to the maximum extent practicable with an affected state's approved coastal zone management program. A copy of the proposed amendment was submitted to the appropriate state agencies in Hawaii, American Samoa and Guam for review and concurrence with a determination made by the Council that the amendment is consistent, to the maximum extent practicable, with the states' coastal zone management programs. An affirmative response was received from Hawaii, the lack of response from American Samoa and Guam within 45 days is taken as indication of their concurrence as well.

12.4 Endangered Species Act (ESA)

A Biological Opinion was prepared by NMFS in 1983 under an ESA section 7 consultation for the precious coral fishery, and it was determined at that time that the fishery did not constitute a threat to endangered or threatened species. The fishery has been nearly dormant since the implementation of the FMP in 1983, with the exception of a limited harvest of black corals primarily from State waters around the main Hawaiian Islands. During the development of these regulatory adjustments, an informal ESA Section 7 consultation was conducted by NMFS to evaluate the potential impacts of the proposed regulatory measures on threatened and endangered

species known to occur in waters around Hawaii and the likelihood there will be an adverse effect on monk seals or any other threatened or endangered species. This consultation found that the proposed action is not expected to adversely affect any endangered or threatened resources. Section 12.5 of this document discusses the impact of these proposed measures on Hawaiian monk seals. Expected effects on other threatened or endangered species should be negligible as precious coral colonies are not believed to provide important foraging habitat or resources for other marine mammals, turtles or seabirds. The measures in this document are designed to protect precious corals from overfishing or degradation and should thus be protective of any unpredicted relationships between precious corals and endangered or threatened marine species.

12.5 Marine Mammal Protection Act (MMPA)

Although other marine mammals are regularly sighted in the NWHI, research has found that the Hawaiian monk seal is the only species known to potentially be affected by this fishery (Section 9.0). This research was the basis for several regulatory measures in this document specifically intended to protect monk seals through prohibition on the harvest of coral colonies believed to provide foraging habitat for some monk seals in the NWHI. These measures are: (1) suspend harvest of gold coral at the NWHI Brooks Bank Bed; (2) set the harvest quota for gold coral at the FFS-Gold Pinnacles Bed at zero; and (3) redefine dead precious coral as that coral which no longer has any living coral polyps or tissue. The remaining measures in this document (minimum size limits for harvest of pink and black corals, prohibitions on the use of non-selective gear, revised boundaries and new bed classification, and new reporting requirements) are not considered to have any negative impact on Hawaiian monk seals or other marine mammals.

All fisheries in the western Pacific region, which includes the precious coral fishery in the NWHI, are designated as Category 3. Under this category, fishermen are not required to obtain exemption certificates in order to fish. However, they must report all interactions with marine mammals. The proposed measures will not change the MMPA designation of the precious coral fishery.

12.6 Executive Order 13089

Executive Order 13089 on Coral Reef Protection directs Federal agencies to use their authorities to protect coral reef ecosystems and, to the extent permitted by law, prohibits them from authorizing, funding or carrying out any action that will degrade these ecosystems. The regulatory measures in this document are consistent with the objectives and recommendations of this Executive Order.

12.7 Executive Orders 13178 and 13196

During the preparation of this document, President Clinton issued Executive Orders 13178 (December 4, 2000) and 13196 (January 18, 2001), which together establish conservation measures for the newly formed Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve. Under these orders, commercial fishing effort and take in the reserve are capped at each permittee's take in the year preceding December 4, 2000. Since there were no Federal precious coral permits issued for any

harvestable Northwestern Hawaiian Islands (NWHI) beds (Brooks Banks and 180 Fathom Beds), the Executive Orders place a permanent zero harvest cap on these beds (despite their existent harvest quotas). The effect of this cap on the single Hawaii exploratory area (permit area X-P-H which includes waters around both the NWHI and the main Hawaiian Islands) is less clear as, although there was some harvest of precious corals from the main Hawaiian Islands portion of this area in 2000, there was no harvest from the NWHI portion. How this historical take will now be allocated within the Hawaii exploratory area remains unresolved. The Precious Corals Fishery Management Plan will be revised to reflect these measures as they are clarified by the Reserve Operating Plan which is now being developed by the National Ocean Service. This Operating Plan is anticipated to contain implementing regulations as well as a complete analysis of the impacts of those regulations on the human environment.

12.8 Paperwork Reduction Act (PRA)

The operator of a fishing vessel that participates in the precious corals fishery under the FMP is currently required to maintain and complete harvest and sales trip reports, which must be submitted to NMFS within 72 hours following the landing and offloading of precious corals.

The fisherman must record the date of harvest, harvest method, area fished, number of hours fished, depth of water (harvest site), weight of coral harvested (within nearest tenth of a kilogram) by species, and observations/comments about the habitat (current, bottom type, bottom topography, bottom slope, etc.). Also, the required sales information includes the date of landing, port of landing, name of buyer, address of buyer, amount sold (pounds or kilograms), sale price, and date of sale. The amount of time required to compile and record harvest and sales information is estimated to vary from five minutes to two hours per report, with an average of 35 minutes.

The reporting forms used for the precious coral information collections are approved under OMB No. 0648-214, Southwest Region Logbook Family of Forms.

The Council has recommended that NMFS modify its precious coral daily logbook form to enable the collection of the following additional information on the fishery (see Sections 8.0 and 10.9): (1) start and end time of all dives, including the dives when no harvest is made; (2) start and end position in degrees latitude and longitude of each dive and distance traveled; (3) depth of each dive, including the minimum and maximum depth of the harvest locations; (4) number of live and dead colonies harvested on each dive by species; (5) weight of harvested coral on each dive by species (landed weight air dried for at least 24 hours); and (6) by species, the number of unharvested live coral colonies damaged from harvesting operations and unharvested dead coral colonies. Furthermore, the Council recommends that any video tape made during the harvest operations be made available to NMFS upon request.

Although additional information may need to be collected on the sale of precious corals in the future, no change to the trip sales report is recommended at this time.

12.9 Traditional indigenous fishing practices

The Magnuson-Stevens Act requires the Western Pacific Council to take into account traditional fishing practices in preparing any FMP or amendment. No management measures proposed in this document will adversely affect traditional indigenous fishing practices in the western Pacific. Iversen et al. (1990) report that Native Hawaiians traditionally used black coral medicinally to treat various respiratory and childhood diseases and they may have collected the coral with hook and line. Studies of traditional fishing rights and practices in American Samoa (Severance and Franco, 1989), Guam (Amesbury and Hunter-Anderson, 1989) and the Northern Mariana Islands (Amesbury et al., 1989) do not describe any traditional indigenous fishing practices in these island areas related to the precious corals fishery.

Section 305(i) of the Magnuson-Stevens Fishery Conservation and Management Act provides for the establishment of a Western Pacific Community Development Program for any fishery under the authority of the Council. This provision results from concern that communities consisting of descendants of indigenous peoples in the Council's area have not been appropriately sharing in the benefits from the area's fisheries. The Council and the Secretary, respectively, have discretion to develop and to approve programs for eligible communities for the purpose of enhancing access to the fisheries under the authority of the Council. The range of acceptable content of these programs will be determined by the Council and the Secretary working together through the FMP process. If a Western Pacific Community Development Program is established for the precious corals fishery, measures to improve access to the fishery may include setting aside a percentage of specific quotas and area closures. Joint venture agreements for the harvesting and processing of precious corals may also be employed.

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14.0 Proposed Regulations

PART 660 - FISHERIES OFF WEST COAST STATES AND IN THE WESTERN PACIFIC

1. The authority citation for part 660 continues to read as follows:

Authority: 16 U.S.C. 1801 et seq.

2. Section 660.12 is amended by revising the definitions of "dead coral", "live coral" to read as follows:

§ 660.12 Definitions.

* * * * *

Dead coral means any precious coral that no longer has any live coral polyps or tissue.

* * * * *

Live coral means any precious coral that has live coral polyps or tissue.

* * * * *

3. In § 660.12 paragraph (2)(iii) of the definition of "precious corals permit area" is revised to read as follows:

§ 660.12 Definitions.

* * * * *

(2) * * *

(iii) Brooks Bank Bed, Permit Area C-B-3, includes the area within a radius of 2.5 nm of a point 23°58.8' N. lat., 166°42.0' W. long.

* * * * *

4. A new paragraph (2)(v) is added to the definition of "precious corals permit area" to read as follows:

§ 660.12 Definitions.

* * * * *

(2) * * *

(v) FFS-Gold Pinnacles Bed, Permit Area C-B-5, includes the area within a radius of 0.25 nm of a point at 23°55.0' N. lat., 165°23.11' W. long.

* * * * *

5. In § 660.12 paragraph (3) of the definition of "precious corals permit area" is revised to read as follows:

§ 660.12 Definitions.

* * * * *

(3) Refugia. Westpac Bed, Permit Area R-1, includes the area within a radius of 2.0 nm of a point at 23°18' N. lat., 162°35' W. long.

* * * * *

6. In § 660.82 paragraph (c) is revised to read as follows:

§ 660.82 Prohibitions.

* * * * *

(c) Take and retain, possess, or land any live pink coral or live black coral from any precious coral permit area that is less than the minimum height specified in §660.86 unless:

* * * * *

7. Section 660.86 is revised to read as follows:

§ 660.86 Size restrictions.

The height of a live coral specimen shall be determined by a straight line measurement taken from its base to its most distal extremity. The stem diameter of a living coral specimen shall be determined by measuring the greatest diameter of the stem at a point no less than one inch (2.54 cm) from the top surface of the living holdfast.

(a) Live pink coral harvested from any precious coral permit area must have attained a minimum height of 10 inches (25.4 cm).

(b) 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).

(1) An exemption permitting a person to hand harvest black coral from any precious coral permit area which has attained a minimum base diameter of 3/4 inches (1.91 cm), measured on the widest portion of the skeleton at a location just above the holdfast, will be issued to a person who reported a landing of black coral to the State of Hawaii within 5 years before the effective date of the final rule.

(2) A person seeking an exemption under this section must submit a letter requesting an exemption to the NMFS Pacific Islands Area Office.

8. Section 660.88 is amended by removing and reserving paragraph (b) and revising paragraph (a) to read as follows:

§ 660.88 Gear restrictions.

(a) Only selective gear may be used to harvest coral from any precious coral permit area.

* * * * *

6. Table 1 to Part 660. is revised to read as follows:

TABLE 1 TO PART 660.--QUOTAS FOR PRECIOUS CORALS PERMIT AREAS

Name of coral bed	Type of bed	Harvest quota	Number of years
Makapuu	Established	P--2,000 kg	2
		G--Zero (0 kg)	
		B--500 kg	2
Ke-ahole Point	Conditional	P--67 kg	1
		G--20 kg	1
		B--17 kg	1
Kaena Pint	Conditional	P--67 kg	1
		G--20 kg	1
		B--17 kg	1
Brooks Bank	Conditional	P--200 kg	1
		G--Zero (0 kg)	
		B--111 kg	1
180 Fathom Bank	Conditional	P--222 kg	1
		G--67 kg	1
		B--56 kg	1

FFS-Gold Pinnacles Bed	Conditional	P--Zero (0 kg) G--Zero (0 kg) B--Zero (0 kg)	
Westpac Bed	Refugium	Zero (0 kg)	
Hawaii, American Samoa, Guam, U.S. Pacific Island possessions.	Exploratory	X-1,000 kg (all species combined except black corals) per area	1

Notes:

1. Types of corals: P=Pink G=Gold B=Bamboo

2. No authorized fishing for coral in refugia.

APPENDIX

Regulatory Impact Review/Final Regulatory Flexibility Analysis

March 1, 2002

A Framework Adjustment to Measures in the
Precious Corals Fishery Management Plan for the Western Pacific
Regarding Harvest Quotas, Definitions, Size Limits,
Gear Restrictions, and Bed Classifications

INTRODUCTION

In order to meet the requirements of Executive Order 12866 (E.O. 12866) the National Marine Fisheries Service requires that a Regulatory Impact Review (RIR) be prepared for all regulatory actions that are of public interest. This review provides an overview of the problem, policy objectives, and anticipated impacts of the court-ordered regulatory 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 \$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. In addition, 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 organizations via the preparation of Regulatory Flexibility Analyses. A summary of an Initial Regulatory Flexibility Analysis for this action was published with the relevant proposed rule in the Federal Register on September 5, 2000. No comments were received on that Initial Regulatory Flexibility Analysis and no new data has been received since the preparation of that document, thus the discussion of that analysis is unchanged.

PROBLEM STATEMENT AND NEED FOR ACTION

The domestic fishery for pink, gold and bamboo precious corals in the exclusive economic zone (EEZ) of the Western Pacific region has been nearly dormant for two decades. However, two firms have recently expressed interest in using selective gear to harvest these precious corals in the EEZ around Hawaii. One of these firms has received a NMFS permit to harvest the Makapu'u Bed. In addition, recent research and surveys have provided new information on precious corals in the waters around Hawaii, including information on the size and condition of certain classified precious coral beds, presence of a new precious coral bed near French Frigate Shoals (FFS) and the possible importance of precious coral beds as foraging areas for the endangered Hawaiian monk seal. Over the last two decades

black coral has been hand harvested in relatively shallow waters around the main Hawaiian islands by a three to five divers using conventional scuba gear. There is concern that if new types of fishing gear are introduced into the fishery that allow harvesters to dive deeper and for a longer period of time, the harvest pressure on black coral resource could significantly increase. In addition, the demand in Hawaii for small, immature black coral colonies may increase in the near future as the popularity of household marine aquaria grows.

The preferred alternatives within this regulatory action would 1) set the quota for gold coral at zero for the Makapu'u Bed; 2) redefine dead precious coral as having no living coral polyps or tissue, and live coral as having living polyps or tissue; 3) apply size restrictions to live corals only; 4) establish a size limit for black coral; 5) prohibit the use of non-selective gear in all permit areas; 6) apply the existing size limit for pink coral size to all permit areas; 7) enlarge the boundaries of the Brooks Bank Bed and reduce the harvest quotas for pink coral and gold coral at this bed; and 8) classify the newly discovered bed near (FFS) in the Northwestern Hawaiian Islands (NWHI) as a conditional bed and set the harvest quotas at zero for all managed species of precious coral at this bed. NMFS intends to disapprove preferred alternatives number 7 and number 8, which apply only in the NWHI because these are unnecessary in light of Executive Orders 13178 (December 4, 2000) and 13196 (January 18, 2001) [see discussion below] and appear to contemplate active fisheries in the NWHI in contravention of those executive orders. Therefore, the proposed action does not include alternatives number 7 and 8 above.

During the preparation of the IRFA, President Clinton issued Executive Orders 13178 (December 4, 2000) and 13196 (January 18, 2001), which together establish conservation measures for the newly formed Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve. Under these orders, commercial fishing effort and take in the reserve are capped at each permittee's take in the year preceding December 4, 2000. Since there were no Federal precious coral permits issued for any harvestable NWHI beds (Brooks Banks and 180 Fathom Beds), the Executive Orders place a permanent zero harvest cap on these beds (despite their existent harvest quotas). The effect of this cap on the single Hawaii exploratory area (permit area X-P-H which includes waters around both the NWHI and the main Hawaiian Islands) is less clear as, although there was some harvest of precious corals from the main Hawaiian Islands portion of this area in 2000, there was no harvest from the NWHI portion. How this historical take will now be allocated within the Hawaii exploratory area remains unresolved. The Fishery Management Plan for the Precious Corals Fisheries of the Western Pacific Region (FMP) will be revised to reflect these measures when they are clarified by the Reserve Operating Plan which is now being developed by the National Ocean Service. This Operating Plan is anticipated to contain implementing regulations as well as a complete analysis of the impacts of those regulations on the human environment. The following analysis examines only those regulatory measures contained in this document, it does not attempt to address the impacts of the NWHI harvest caps imposed by Executive Orders 13178 and 13196.

CURRENT MANAGEMENT MEASURES

The FMP for the precious coral fisheries of the Western Pacific was approved on May 20, 1980, and has been amended four times. The FMP treats separate precious coral beds as distinct management units

because of their widely-separated patchy distribution and the sessile nature of individual colonies. The beds are classified as established, conditional, refugia or exploratory. Established beds are ones for which appraisals of maximum sustainable yield (MSY) are reasonably precise. To date, only the Makapu'u Bed has been studied adequately enough to be classified as established. Conditional beds are ones for which optimum yields are estimated on the basis of bed characteristics relative to established beds. It is assumed that ecological conditions at the Makapu'u Bed are representative of conditions at all other beds. Four beds of precious corals are classified as conditional, all of them located in the EEZ around Hawaii. These are Keahole Point Bed, Kaena Point Bed, Brooks Bank Bed, and the 180 Fathom Bank Bed. Refugia beds are areas set aside for baseline studies and possible reproductive reserves. No harvesting of any type is allowed in those areas. The single refugium bed that has been designated - the WestPac Bed - is also located in the EEZ surrounding Hawaii. Exploratory areas are the unexplored portions of the EEZ. Separate exploratory permit areas are established for Hawaii, American Samoa, Guam and the remote US Pacific Insular Areas.

The regulations prescribe methods of harvest for each category of coral bed and harvest quotas for individual beds. Quotas have been established for pink, gold and bamboo coral populations in the Makapu'u Bed and conditional beds. Pink coral may not be harvested from the Makapu'u Bed, Keahole Point Bed or Kaena Point Bed unless it has attained a size limit of ten inches. There are no quotas or size limits for the harvest of black corals. Only selective gear is permitted in the EEZ around the main Hawaiian Islands, i.e., south and east of a line midway between Niihau and Nihoa Islands. Use of both selective and non-selective gear is permitted on the conditional beds of Brooks Bank and the 180 Degree Fathom Bank and throughout the exploratory area around the NWHIs. If non-selective gear is employed on conditional beds, the weight quota is 20 percent of that allowed for selective harvesting. Reporting requirements include a daily harvest log and a sales trip report. In addition to regulating harvesting methods and harvest amounts, the FMP establishes a procedure for re-classifying coral beds from exploratory to conditional and from conditional to established as new beds are located and more catch/effort data become available which will allow more precise determinations of sustainable yields.

MANAGEMENT OBJECTIVES

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

- 1) Allow a fishery for precious coral in the EEZ in the western Pacific but limit the fishery so as to achieve the Optimum Yield on a continuing basis;
- 2) Prevent overfishing and wastage of resources;
- 3) Encourage the use of selective harvesting methods;
- 4) Minimize the harvest of colonies of coral which are immature;
- 5) Minimize the harvest of colonies of coral which have not reached their full potential for growth; and

6) Encourage the development of new information concerning the distribution, abundance and ecology of precious corals.

PROPOSED MANAGEMENT MEASURES

Eight management measures are proposed under this regulatory action. Each is described below, along with its alternatives and their estimated economic impacts. The economic analysis compares the estimated costs and returns under the proposed management measure to the costs and returns under the "no action" alternative. Because the fishery for pink, gold and bamboo precious coral in the EEZ of the Western Pacific has been nearly dormant during the past 20 years, much of the economic analysis is qualitative.

Management Objective 1: Reduce the potential for overfishing of gold coral at the Makapu'u Bed.

Rationale: A 1997 survey and assessment of the Makapu'u Bed indicated that recruitment of gold coral there may be low. The renewed harvest of gold coral in this area may prevent or delay its recovery. Suspending the harvest of gold coral until additional scientific information on the recruitment rate of gold coral at the Makapu'u Bed is available is a precautionary measure that will ensure that no further decline in the number of colonies at this bed occurs.

Alternatives:

Alternative 1 (No Action) - Maintain the biennial gold coral quota of 600 kg at the Makapu'u Bed.

Alternative 2 (Preferred) - Suspend the harvest quota for gold coral at the Makapu'u Bed until further information on the impact of harvesting on subsequent recruitment of gold coral is available.

Alternative 3 - Suspend the harvest quota for gold coral at all established and conditional beds until additional information is available on the impact of harvesting on subsequent recruitment of gold coral.

Alternative 4 - Implement a minimum size limit for gold coral at the Makapu'u Bed.

Economic Impacts:

Alternative 1 - According to Maui Divers, Ltd., the principal processor of precious corals in Hawaii, the ex-vessel price of gold coral is \$330/kg (\$150/lb). Maintaining the current biennial harvest quota of 600 kg for gold coral at Makapu'u Bed would continue to make available to prospective harvesters a quantity of gold coral worth \$198,000 every two years (\$99,000 annually) if the actual stock is of sufficient size to support such a harvest. However, a recent survey of the bed revealed that the current standing stock of gold coral is low and may not yield the current harvest quota. In addition, the adverse economic impacts over the long term would be significant if further harvesting diminishes the number of colonies to the point that no recovery is possible.

Alternative 2 - A gold coral quota of zero would likely have some adverse economic impact on potential harvesters. However, the density of gold coral at the Makapu'u Bed is already very low. Should harvest effort at the Makapu'u Bed occur, it is likely that it will be directed mainly toward pink coral

because this coral is relatively abundant at the bed and has a higher market value than gold coral (\$440/kg for pink coral (*C. secundum*) vs. \$330/kg for gold coral according to Maui Divers of Hawaii, Ltd.). A suspension of the quota is not expected to have an adverse economic impact on processors of precious corals in Hawaii. The fishery in the EEZ around Hawaii for deep-water species of precious coral, including pink, gold and bamboo coral, has been nearly dormant for two decades. Consequently, the processors of these corals in Hawaii have relied exclusively on imported material.

Alternative 3 - The adverse economic impacts could be significant. The current total harvest quota for gold coral at all established and conditional beds is 1,080 kg every two years, with an estimated dockside value of \$356,400. However, the gold coral quota at the Makapu'u Bed accounts for more than half of this total. As noted above, the current standing stock of gold coral at the Makapu'u Bed may not yield the current biennial harvest quota of 600 kg. If no gold coral is harvested from the Makapu'u Bed the amount of potential gross revenues foregone by suspending the harvest quota at all established and conditional beds is estimated to be about \$158,400 every two years.

Alternative 4 - The calculation of an appropriate minimum size requires estimates of growth rates, mortality rates and size at reproductive maturity before a size limit can be reliably set. These data are lacking for gold coral. Without this information the size limit established may be too low, thereby insufficiently protecting the coral from overfishing and eventually leading to reduced economic returns, or be too high, thereby resulting in an overly conservative size limit that unnecessarily reduces potential economic returns.

Management Objective 2: Reduce the potential for harvest of coral which has live coral polyps or tissue.

Rationale: The harvest quotas presently in the FMP do not apply to dead coral, which is currently defined as any precious coral that contains holes from borers or is discolored or encrusted at the time of removal from the seabed (whether live polyps or tissue are present or not). With no restriction on the quantity of dead coral that can be harvested, the current definition of dead coral allows the unrestricted harvest of coral that is standing upright and partially covered with living tissue as long as it contains holes from borers or is discolored or encrusted. It is possible that colonies of such upright coral near FFS in the NWHI may provide foraging habitat for the endangered Hawaiian monk seal. The possible reduction in foraging habitat that may result from the harvest of dead standing coral partially covered with living tissue could intensify the problems related to food-stress which the monk seal population at FFS is experiencing.

Alternatives:

Alternative 1 (No Action) - Maintain the current definition of dead precious coral as any precious coral that contains holes from borers or is discolored or encrusted at the time of removal from the seabed.

Alternative 2 (Preferred) - Define dead precious coral as precious coral that no longer has any live coral polyps or tissue, and define live precious coral as precious coral that has live polyps or tissue.

Alternative 3 - Define dead precious coral as precious coral that is no longer standing upright, and define live precious coral as precious coral that is standing upright.

Economic Impacts:

Alternative 1 - Allowing the harvest of coral which may provide foraging habitat to the endangered Hawaiian monk seal may lead to an Endangered Species Act section 7 consultation on the precious coral fishery, which may in turn result in emergency closures of specific sites or alterations of fishing operations. The economic impact of closures or other measures would depend on the length of time that these measures are in effect.

Alternative 2 - This alternative may have some adverse economic impacts. Only live coral is counted toward the quotas limiting the amount of precious coral that may be taken in any permit area during the fishing year. It is possible that some of the coral at a given bed that was regarded as dead under the current definition would be regarded as live under the alternative definition, and therefore be subject to the harvest quota for that bed. However, the amount of additional coral that would be subject to the quota is likely to be small, as coral colonies that contain holes from borers or are discolored or encrusted generally no longer have any living polyps or tissue. There is insufficient information on the amount of coral meeting this definition at different beds to quantify this economic impact.

Alternative 3 - This alternative may have some adverse economic impacts. Only live coral is counted toward the quotas limiting the amount of precious coral that may be taken in any permit area during the fishing year. It is possible that some of the coral at a given bed that was regarded as dead under the current definition would be regarded as live under the alternative definition, and therefore be subject to the harvest quota for that bed. However, the amount of additional coral that would be subject to the quota is likely to be small, as coral colonies that contain holes from borers or are discolored or encrusted are often no longer standing upright. There is insufficient information on the amount of coral meeting this definition at different beds to quantify this economic impact.

Management Objective 3: Allow greater utilization of dead coral resources.

Rationale: The current minimum size limit for pink coral applies to dead coral as well as live coral. Applying a minimum size to dead coral is inconsistent with the model for developing an appropriate minimum size limit, which is based on an estimated growth rate, mortality rate and size at reproductive maturity for live coral. The application of a minimum size limit to dead coral reduces potential income to harvesters without providing any additional conservation benefits.

Alternatives:

Alternative 1 (No Action) - Maintain the application of minimum size limits to both live and dead coral.

Alternative 2 (Preferred) - Apply size limits to live coral only.

Economic Impacts:

Alternative 1 - This alternative has a negative economic impact because it prohibits the harvest of dead coral that is below the minimum size. There is insufficient information on the quantity of dead coral at different beds to quantify this economic impact.

Alternative 2 - This alternative would allow greater utilization of dead coral resources and thus increase potential income to harvesters. There is insufficient information on the quantity of dead coral at different beds to quantify this economic impact.

Management Objective 4: Regulate the harvest of black coral.

Rationale: The present status of the major black coral beds in Hawaii that are 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. However, emerging harvesting technologies that render black coral occurring at greater depths more accessible to harvesters and improve the efficiency of harvesting operations may intensify the fishing pressure on black coral resources. Some black coral harvesters in Hawaii have already begun to experiment with towed underwater camera systems and other new technology that could increase output from old harvest areas and lead to the discovery of new beds. In addition, the demand in Hawaii for small, immature black coral colonies may increase in the near future as the popularity of household marine aquaria grows. In the absence of restrictions on the harvest of black coral, increased fishing pressure and the harvest of immature colonies could lead to the overfishing of black coral resources at targeted beds.

Alternatives:

Alternative 1 (No Action) - Maintain the current situation of no restrictions on the harvest of black coral.

Alternative 2 (Preferred) - Prohibit the harvest of black coral unless it has attained either a minimum stem diameter of 1 inch, measured no less than 1 inch from the top of the living holdfast, or a minimum height of 48 inches, measured from the base to the greatest distal extremity of the colony. Persons who reported a landing of black coral to the State of Hawaii within 5 years before the effective date of the final rule may apply for an exemption which allows the hand harvest of black coral that has attained a 3/4 inch base diameter, measured on the widest portion of the skeleton at a location just above the holdfast.

Alternative 3 - Prohibit the harvest of black coral unless it has attained a minimum base diameter of 3/4 inch.

Alternative 4 - Establish a weight quota for black coral.

Economic Impacts:

Alternative 1 - Over the short run maintaining the status quo would have a positive economic impact, as the harvesting of black coral colonies could proceed without restriction. However, if fishing pressure increases to the point at which black coral resources become overfished, the fishery could become economically unviable.

Alternative 2 - The economic impact on future black coral harvesters or buyers could be substantial. The "either/or" provision provides flexibility for harvesters by allowing the taking of stunted colonies less than 48 inches in height but having a 1 inch or greater basal stem diameter, and slender colonies greater than 48 inches in height but having a less than 1 inch basal stem diameter. In addition, this alternative would exempt current participants in the fishery from this size limit and allow them to continue to harvest coral with a 3/4 inch or larger base diameter. However, future participants would be prohibited from harvesting black coral unless it has attained either a minimum stem diameter of 1 inch or a minimum height of 48 inches. It is estimated that only 50 percent of black coral currently harvested in the waters around Hawaii meets this size limit. Additional data on the size composition of black coral resources in the EEZ is needed to accurately determine the potential impact of this measure on future harvests and revenues.

Alternative 3 - The adverse economic impacts are expected to be small in the short run, as most of the

black coral that has been harvested in the past has been larger than this size. The State of Hawaii Division of Aquatic Resources estimates that 83 percent of the black coral harvested has a base diameter of 3/4 inch or greater. However, if a minimum size of 3/4 inch inadequately protects black coral resources from overfishing as fishing pressure increases, the fishery may be unsustainable and economically unviable over the long term.

Alternative 4 - A weight quota may not be as effective as a size limit in avoiding overfishing of the resource. Information on the standing stock and sustainable yield of managed species of black coral is limited. The use of minimum size limits based on knowledge of the reproductive biology of precious corals is the preferred basis for management of the fishery when selective harvesting is expected to be economically feasible.

Management Objective 5: Protect precious coral resources and essential fish habitat from the effects of ecologically destructive and wasteful harvest gear.

Rationale: Current regulations allow the use of non-selective gear on the conditional beds at Brooks Bank and the 180 Fathom Bank, as well as throughout the exploratory permit area around the NWHI. Selective gear must be in used in all other areas. The FMP defines non-selective gear as any gear used for harvesting corals that cannot discriminate or differentiate between types, size, quality or characteristics of living or dead corals. The disadvantage of non-selective gear is that it may be ecologically destructive, as habitat and other species may be disturbed as the gear is pulled across the sea floor. The damage to precious coral beds and associated benthic communities could have an adverse impact on Hawaiian monk seal foraging habitat. Non-selective gear may also be wasteful, as some coral dislodged from the bottom may not be recovered. Historically, the principal disadvantage of selective gear has been the high capital and operating costs. However, recent innovations in manned and unmanned submersibles have significantly reduced the capital and operating expenses of utilizing selective gear in the harvest of precious corals.

Alternatives:

Alternative 1 (No Action) - Maintain the current regulations requiring selective gear only at the Makapu'u, Keahole Point, and Kaena Point Beds.

Alternative 2 (Preferred) - Require that selective gear be used to harvest precious corals from all permit areas.

Alternative 3 - Require that selective gear be used to harvest precious corals from all established and conditional beds.

Economic Impacts:

Alternative 1 - This alternative minimizes the capital and operating costs of harvesting deep-water precious corals. However, the use of non-selective gear to harvest precious corals may not be an efficient use of fishery resources. The value of precious coral colonies is dependent on its size, color and condition. Large, completely intact trees of color have the greatest value. Non-selective gear such as dredges harvest pieces of broken coral knocked down by the dredge stone and entangled in the nets as the dredge is pulled along the sea floor. Breakage may reduce a coral's value by as much as 80 percent. Allowing the continued use of this relatively inexpensive gear in exploratory areas may

encourage the discovery and exploration of new beds. However, the use of non-selective gear is unlikely to provide sufficient data to develop reliable estimates of the standing stock and MSY for newly discovered beds because this gear cannot discriminate or differentiate between types, size, quality or characteristics of living or dead corals. Further, if the Council does not develop management measures to ensure the protection of monk seal foraging habitat, NMFS would likely initiate an Endangered Species Act (ESA) section 7 consultation on the precious coral fishery. Management measures that could be imposed include emergency closures of specific sites, including Brooks Bank, or alteration of fishing operations. The economic impact of closures or other measures would depend on the length of time that these measures are in effect.

Alternative 2 - The cost of purchasing an unmanned submersible (i.e., remotely operated vehicle) may be as low as \$50,000, which is roughly equal to the capital investment in gear required to initiate a non-selective harvest operation using tangle nets. Although the capital and operating costs of manned submersibles may be high, they are not economically prohibitive, as is evidenced by the recent interest of two firms in using this type of selective gear to harvest precious corals in the waters around Hawaii. In addition, it is likely that some harvesters of precious coral will be able to defray the costs of using selective gear by finding other lucrative uses for the gear, such as salvage and research. The use of non-selective gear to harvest precious corals is an inefficient use of fishery resources. Non-selective gear tends to damage the precious coral trees as it harvests them, thereby greatly reducing the value of the coral. In contrast, selective gear harvests coral so that it retains its highest value.

Alternative 3 - The economic impacts would be similar to those of Alternative 1, except up to 200 kg of precious coral would continue to be available for annual harvest by non-selective gear from each of the exploratory beds around Hawaii, American Samoa, Guam and the remote US Pacific Island possessions.

Management Objective 6: Reduce the potential for overfishing of pink coral at conditional beds and in exploratory areas.

Rationale: The size limit for pink coral applies only to the Makapu'u Bed, Keahole Point Bed and Kaena Point Bed because the use of non-selective gear is allowed everywhere else (except in the EEZ seaward of the main Hawaiian Islands). There is increased risk that the estimated MSY for pink coral will be exceeded at those conditional beds (i.e., Brooks Bank, 180 Fathom Bank and newly discovered FFS-Gold Pinnacles Bed) and exploratory areas where there is no size limit.

Alternatives:

Alternative 1 (No Action) - Maintain the application of the 10 inch size limit for pink coral at the established Makapu'u, Keahole Point, and Kaena Point Beds only.

Alternative 2 (Preferred) - Apply the current 10 inch size limit for pink coral to all established beds, conditional beds and exploratory areas.

Alternative 3 - Apply the current 10 inch size limit for pink coral to all established and conditional beds.

Economic Impacts:

Alternative 1 - The impact in the short term is minimal. However, long term negative impacts on harvest levels and gross revenues could be potentially large if the resources are overfished. Given the life-

history characteristics of pink coral, such as slow growth and long generation time, overfishing could degrade the productivity of affected precious coral beds for many years.

Alternative 2 - The feasibility of this alternative is contingent on a prohibition on the use of non-selective gear to harvest precious corals for commercial purposes in all permit areas. Applying the size limit for pink coral to all permit areas is unlikely to have a significant negative economic impact because the potential financial return from harvesting colonies of pink coral that are less than 10 inches in height is low. According to Maui Divers of Hawaii, Ltd., harvesting colonies less than 10 inches is not economically practical, because the return does not justify the time spent harvesting.

Alternative 3 - The economic impacts would be similar to those of Alternative 2.

Management Objective 7: Revise boundaries and harvest quotas for Brooks Bank based on new information.

Rationale: A September 1998 survey of precious coral beds around the NWHI revealed that the size of Brooks Bank is larger than previously specified. However, maintaining the current harvest quota of 444 kg for pink coral could result in the overfishing of these species of precious coral at Brooks Bank. Recent estimates of the standing crop of precious coral at Brooks Bank suggests that 200 kg of pink coral can be harvested annually from this bed on a sustainable basis (Section 7.1.4). In addition, the harvest of the existing quota of 133 kg for gold coral at Brooks Bank could have an adverse impact on the Hawaiian monk seal population at FFS by reducing the function of the precious coral bed to aggregate monk seal prey species, thereby reducing the seals' foraging success.

Alternatives:

Alternative 1 (No Action, Current proposed action) - Take no additional action to manage the precious coral fishery at Brooks Bank.

Alternative 2 (Original preferred action) - Enlarge the boundaries of Brooks Bank to include the area within a radius of 2.5 nautical miles of a point at 23° 58.8' N and 166° 42' W. Change the harvest quota for pink coral to 200 kg and suspend the harvest quota for gold coral.

Alternative 3 - Enlarge the boundaries of Brooks Bank to include the area within a radius of 2.5 nautical miles of a point 23° 58.8' N and 166° 42' W. Re-classify the bed as a refugium, thereby prohibiting the harvest of all live and dead coral.

Economic Impacts:

Alternative 1 - Not altering the current regulations for Brooks Bank precious coral bed has no impact because no precious coral harvest is allowed in the NWHI Coral Reef Ecosystem Reserve. The decision to take no action clarifies that NMFS no longer intends to manage the NWHI as an active precious corals fishery under the Reserve.

Alternative 2 - This alternative would also have no impact because no precious coral harvest is allowed in the NWHI Coral Reef Ecosystem Reserve.

Alternative 3 - This alternative would also have no impact because no precious coral harvest is allowed in the NWHI Coral Reef Ecosystem Reserve.

Management Objective 8: Protect the newly discovered bed near FFS from overfishing and loss of monk seal foraging habitat.

Rationale: The FFS-Gold Pinnacles Bed is currently categorized as part of the exploratory permit area X-P-H. As such, the harvest quota which applies is the 1,000 kg for the entire exploratory area. The 1998 survey of the FFS-Gold Pinnacles Bed revealed that colonies of pink or bamboo coral were sparse or absent. It is uncertain if the stocks of these corals are capable of supporting any level of harvest on a sustainable basis. Harvesting of the few pink or bamboo colonies that occur at the bed could have a significant adverse ecological impact on the stocks of these species. The 1998 survey also recorded an abundance of live and dead gold coral colonies in scattered patches. Based on survey data it estimated that the MSY for gold coral at this bed is 80 kg/yr. In the absence of a harvest quota, the stock of gold coral could be harvested at a level that exceeds the estimated MSY. The negative impacts on the stock could be especially significant if a harvest operation used the entire 1,000 kg quota for the exploratory permit area to harvest the gold coral at the FFS-Gold Pinnacles Bed. The harvest of live gold coral may also have an adverse impact on the Hawaiian monk seal population at FFS by reducing the availability of monk seal prey species which rely on gold coral for habitat.

Alternatives:

Alternative 1 (No Action, Current proposed action) - Maintain the status of the FFS-Gold Pinnacles Bed as a part of exploratory permit area X-P-H.

Alternative 2 (Original preferred action) - Classify the FFS-Gold Pinnacles Bed as a conditional bed with boundaries set as the perimeter of the area within a radius of 0.25 nautical miles of the point at 23° 55' N and 165° 23.11' W. Set the annual harvest quota for all types of precious coral at zero.

Alternative 3 - Classify the FFS-Gold Pinnacles Bed as a refugium, thereby prohibiting the harvest of all live and dead coral, with boundaries set as the perimeter of the area within a radius of 0.25 nautical miles of a point at 23° 55' N and 165° 23.11' W.

Alternative 4 - Classify the FFS-Gold Pinnacles Bed as a conditional bed with boundaries set as the perimeter of the area within a radius of 0.25 nautical miles of a point at 23° 55' N and 165° 23.11' W. Set the annual harvest for gold coral at 80 kg and set annual harvest quotas of zero for all other species.

Economic Impacts:

Alternative 1 - Not altering the current regulations to designate a new permit area has no impact because no precious coral harvest is allowed in the NWHI Coral Reef Ecosystem Reserve. The decision to take no action clarifies that NMFS no longer intends to manage the NWHI as an active precious corals fishery under the Reserve.

Alternative 2 - This alternative would also have no impact because no precious coral harvest is allowed in the NWHI Coral Reef Ecosystem Reserve.

Alternative 3 - This alternative would also have no impact because no precious coral harvest is allowed in the NWHI Coral Reef Ecosystem Reserve.

Alternative 4 - This alternative would also have no impact because no precious coral harvest is allowed in the NWHI Coral Reef Ecosystem Reserve.

DESCRIPTION OF SMALL BUSINESSES TO WHICH THE RULE WOULD APPLY

The proposed management measures could potentially affect five to seven small businesses. There are three to five small-boat fishermen who harvest black coral using scuba gear in beds overlapping State of Hawaii and Federal waters. Between 1990 and 1997, the total annual harvest of black coral in Hawaii varied from a low of 864 lbs to a high of 6,017 lbs, with a yearly average of 3,084 lbs. The 415 lbs of black coral sold in 1997 had a dockside value of about \$10,394, assuming a price of \$25/lb. Current data does not discriminate whether this coral was harvested from State or Federal waters. However, as Figure 1 illustrates, the majority of black coral resources lie inside State waters (state water boundaries are indicated by solid lines around each island). Table 1 presents a summary of total reported black coral landings and gross revenues from 1990 through 1997.

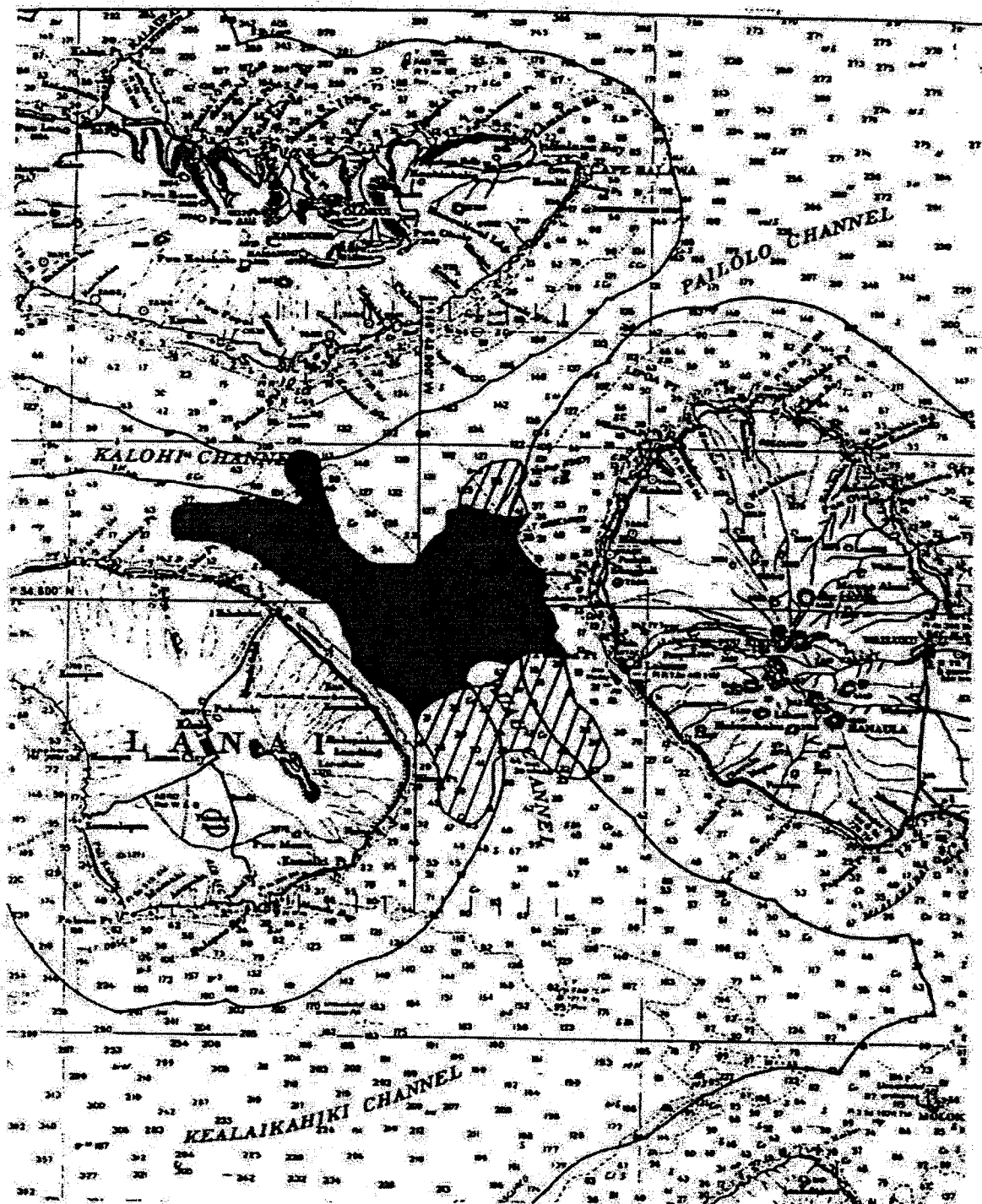
Table 1. Volume and value of black coral landings in Hawaii.

Year	Harvested (lbs.)	Sold (lbs.)	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

The proposed management measures also potentially affect two companies who have expressed interest in harvesting pink, gold and bamboo precious coral in the EEZ around Hawaii EEZ using manned submersibles or remotely operated vehicles.

Figure 1. Location of major black coral beds around the Hawaiian Islands.



MEASURES TAKEN TO MINIMIZE ECONOMIC IMPACTS ON SMALL BUSINESSES

Impacts to small businesses were identified in an Initial Regulatory Flexibility Analysis and summarized in a Federal Register notice published on September 5, 2000. NMFS believes that the proposed management measures offer the most cost-effective means for meeting the goals and objectives of the precious corals fishery management plan. In addition, the proposed measures are superior to those rejected in terms of minimizing impacts on small businesses.

CHANGES TO REPORTING REQUIREMENTS ARISING FROM THE PROPOSED MEASURES

The proposed measures would not impose any additional reporting requirements on fishery participants or associated entities.

COST/BENEFIT ANALYSIS OF ALTERNATIVES

Considering the low level of fishing activity in this fishery over the past twenty years, the proposed actions may be viewed as precautionary in terms of protecting coral resources. Due to a lack of information on the long term effects of alternative management measures on coral stocks, harvest effort or catch rates, a detailed quantitative analysis of the costs and benefits of alternative management measures is not possible.

Although long term data are unavailable, analysis of this fishery is ongoing, and may lead to simulation models capable of predicting the biological (and economic) effects of each alternative. From a conceptual point of view, the precious corals fishery represents a difficult economic analysis. Although standard bioeconomic theory suggests that the harvest rate should be no more than the growth rate of the coral population at its maximum sustainable yield (accounting for economic production cost relationships and the discount rate), the growth rate of coral is so slow that a mining approach might be considered preferable, i.e., that the resource might be allowed to be over-fished in the short-term, and then harvesting prohibited for the many years which would be required for it to be fully restored. Because National Standard 1 does not allow biological over-fishing, this strategy is precluded from operational possibility. However, it is anticipated that by allowing the coral populations to maintain their long-term sustainability, there will be larger standing stock of corals which will optimize harvest rates and reduce the relative costs of harvesting (due to increased density). By limiting the harvest rates to those allowed by maximum sustainable yield, the likelihood that long-term benefits exceed their costs is increased. In addition, these restrictions may preclude excessive entry into the fishery, therefore improving social benefits (i.e., avoiding over-capacity). To the extent that these initial explorations are successful in identifying additional coral resources for harvesting, and as new economic information is acquired, a re-evaluation of the relative benefits and costs of these management measures would be warranted.

With regard to the proposed measures intended to minimize the risk of fishery interactions with the Hawaiian monk seal, current public policy suggests that the preservation of this endangered species provides a significant benefit to the nation. Government expenditures related to the protection and recovery of monk seals amount to several million dollars annually. The implication is that the economic value of providing the Hawaiian monk seal with additional protection by mitigating fishery interactions with this species outweighs the costs.

None of the alternatives considered is expected to have significant social impacts on fishery participants or Hawaii fishing communities in terms of employment, enjoyment of the fishery, vessel and crew safety, social or cultural activity in the fishery or other social factors.