WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL

DRAFT

Amendment to the Fishery Ecosystem Plan for the Precious Coral Fisheries of the Western Pacific Region Including an Environmental Assessment

Refinement of Precious Coral Essential Fish Habitat in the Hawaiian Archipelago

Regulatory Identification Number (RIN) XXXX-XXXX

May 24, 2019

<u>Timeline for Precious Coral EFH Revisions Amendment</u>

June 2018	Council Recommends Staff to Develop Options Paper (173rd Meeting)
October 2018	Council Initial Action (174th Meeting)
June 2019	Council Final Action (178th Meeting)
August 2019	Proposed Transmittal to NMFS; NOA/Proposed Rule Published
September 2019	Public Comment Period Ends
October 2019	Final Rule Published
December 2019	Final Rule Effective

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Draft Regulatory Amendment to the Fishery Ecosystem Plan for the Precious Coral Fisheries of the Western Pacific Region
Including a Draft Environmental Assessment

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Regulatory Identification Number (RIN) XXXX-XXXX

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ABSTRACT

The Western Pacific Regional Fishery Management Council is considering whether new information warrants an update of its essential fish habitat (EFH) descriptions for precious coral species in the Western Pacific region. New observations of precious corals have occurred throughout the region, with research concentrated in the Hawaii Archipelago. While visual survey observations in the territories and of the larval phase of precious corals are rare or nonexistent, new information exists to refine the habitat characteristics and geographic extent of deep- and shallow-water precious coral EFH in the Hawaii Archipelago. Narrative information on which the EFH designations are based and information to fulfill the EFH requirements of fishery management plans may be updated in the archipelagic FEPs. The redefinition of precious coral EFH is framed in three separate actions: refinement of deep-water species complex EFH; refinement of shallow-water precious coral species complex EFH; and update of the narrative information.

EFH for deep-water precious coral species in the main Hawaiian Islands (MHI) is six known beds of precious corals: at Keāhole Point, Makapuʻu, Kaʻena Point, Westpac Bed, Brooks Bank, and 180 Fathom Bank. Observations and research since 1999 show that additional precious coral beds exist throughout the Hawaiian Archipelago, and new research indicates that corals are found in more narrow depth ranges than previously thought. Available alternatives are to keep the same EFH designation; describe EFH as all hard substrate within the 200 to 600 m isobaths throughout the Exclusive Economic Zone (EEZ) of the MHI; update the current designation with the best available scientific information on the geographic extent of the beds; or update the current designations and add newly discovered beds to the EFH designation. The alternatives, other than the No Action alternative, include identical descriptions of precious coral EFH habitat characteristics, with definitions of the habitat types that promote precious coral settlement and growth.

EFH for shallow-water precious corals is between Miloliʻi and South Point on Hawaiʻi, ʻAuʻau Channel between Maui and Lānaʻi and the southern border of Kauaʻi. Mapping data in the depth range of shallow-water black corals, 20 and 120 m, is limited. However, new research indicates that the mapping data may be incomplete and in need of refinement to fully capture precious coral EFH throughout the MHI. The alternatives for update of EFH are to either keep the same EFH designation or provide habitat characteristics and the geographic extent of EFH.

At the 173rd Council Meeting held on June 10-13, 2018 (83 FR 23640), the Council directed staff to develop alternatives to redefine EFH and any habitat areas of particular concern (HAPC) for precious corals in Hawaii for Council consideration for a Fishery Ecosystem Plan (FEP) amendment. The Council prepared this draft Environmental Assessment (EA) to evaluate potential environmental impacts of the following alternatives considered:

Action 1 – Update EFH for deep-water precious coral species:

1) No change (status quo);
2) Revise EFH by depth range;
3) Refine the geographic boundary of existing precious coral beds;
4) Refine the geographic boundary of existing beds and add new beds.

Action 2 – Update EFH for shallow-water precious coral species:

1) No change (status quo);
2) Update geographic extent and habitat characteristics.

Action 3 – Update EFH narrative information:

1) Update the FEP narrative information on EFH;
2) Do not update the FEP narrative information on EFH.

At its 174th meeting held on October 23-27, 2018 (83 FR 49364), the Council took initial action on refining the EFH of precious corals in the MHI, and directed staff to prepare an amendment to the Hawaii FEP to revise the precious corals EFH using the following preliminarily preferred alternatives for further analysis:

Action 1 – Alternative 4: Revise existing beds and designate new beds as EFH.

Action 2 – Alternative 2: Update geographic extent and habitat characteristics.

Action 3 – Alternative 1: Update the FEP narrative information on EFH.

The MSA requires that FMPs identify both fishing and non-fishing impacts to EFH and suggest conservation recommendations to minimize the effects. This regulatory amendment does not identify new conservation recommendations, and the existing activities and recommendations currently in the FEPs remain unchanged.

How to Comment

Instructions on how to comment on this document and the associated proposed rule can be found by searching for RIN XXXX-XXXX at www.regulations.gov or by contacting the responsible Council at the above address. Comments are due on the date specified in the instructions.

If you need assistance with this document, please contact NMFS at 808-725-5000.

ACRONYMS AND ABBREVIATIONS

ABC	Acceptable Biological Catch
ACL	Annual Catch Limit
AM	Accountability Measure
CMM	Conservation and Management Measure
CPUE	Catch per Unit of Effort
Council	Western Pacific Regional Fishery Management Council
DLNR	State of Hawaii Department of Land and Natural Resources
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EPO	Eastern Pacific Ocean
ESA	Endangered Species Act
FAD	Fish Aggregating Device
FEP	Fishery Ecosystem Plan
FMP	Fishery Management Plan
FONSI	Finding of No Significant Impacts
FR	Federal Register
HAPC	Habitat Areas of Particular Concern
MHI	Main Hawaiian Islands
MMPA	Marine Mammal Protection Act
MSY	Maximum Sustainable Yield
MUS	Management Unit Species
NMFS	National Marine Fisheries Service
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NS	National Standard
NWHI	Northwestern Hawaiian Islands
OFL	Overfishing Limit
OY	Optimum Yield
PCMUS	Precious Coral Management Unit Species
PIFSC	Pacific Islands Fisheries Science Center
PIRO	Pacific Islands Regional Office
RFMO	Regional Fishery Management Organization
ROV	Remotely Operated Vehicle
SAFE	Stock Assessment and Fishery Evaluation (Report)
SSC	Scientific and Statistical Committee
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

1.1 Background Information

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) requires every fishery management plan (FMP) or fishery ecosystem plan (FEP) to describe and identify essential fish habitat (EFH) for federally-managed species, minimize to the extent practicable adverse effects on such habitats caused by fishing, and identify other actions to encourage the conservation and enhancement of EFH. According to the MSA, EFH is defined as “those waters and substrate necessary to fish for spawning, breeding or growth to maturity”. Additionally, to the extent practicable, FMPs should also analyze how the cumulative impacts of fishing and non-fishing activities influence the function of EFH on an ecosystem or watershed scale and list major prey species for the species in the fishery management unit and discuss location of prey species’ habitat.

Regulations implementing the EFH provision of the MSA set forth four broad tasks for the Council and NMFS to jointly complete:

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

Additionally, to the extent practicable, FMPs should also analyze how the cumulative impacts of fishing and non-fishing activities influence the function of EFH on an ecosystem or watershed scale and list major prey species for the species in the fishery management unit and discuss location of prey species’ habitat.

1.1.1 Precious Corals in the Main Hawaiian Islands (MHI)

Fishing Sectors

Precious coral in Hawaii is targeted for the jewelry trade and the fishery is split between shallow-water black coral species and deep-water pink, red, bamboo, and gold corals. Domestic vessels harvested *Pleurocorallium secundum* (formerly *Corallium secundum*) using tangle net dredges off Makapu‘u, Hawaii between 1966 and 1969. The second commercial deep-water operation harvested precious coral between 1979 and 1979 using a manned submersible at the same bed (Grigg, 2002). The last bout of commercial activity in the deep-water fishery occurred between 1999 and 2000, with harvests occurring at Makapu‘u Bed and in an exploratory area off Kailua-Kona using submersibles (Grigg, 2002). The high operating cost of submersibles and safety concerns have limited the precious coral fishery in the Hawaiian Islands, along with limited exploratory potential associated with the Coral Reef Ecosystem Reserve closure in the Northwestern Hawaiian Islands (NWHI; Grigg, 2002).

The shallow-water black coral fishery began in 1958 with the discovery of the resource in the ‘Au‘au Channel. Harvesters use SCUBA to dive and collect coral in lift bags, which they release and the boat collects without anchoring. Divers decompress and ascend with their last bag.

During the 1960s, about a dozen small companies participated in the fishery, valued at 2 million dollars in jewelry sales. Precious coral jewelers began importing more black coral from Taiwan and using less raw product in the jewelry pieces in the 1980s, which decreased the demand on the local resource. Importation from Taiwan continued throughout the 1990s. Harvest was concentrated at the bed in the ‘Au‘au Channel with only sporadic harvesting occurring in the beds off Kauai and Hawaii Island (Grigg, 2001). In the past decade, however, the precious corals fishery in the MHI has generally been inactive, with less than three permits allocated each year creating issues in data confidentiality (Table 1).

Table 1. Western Pacific Precious Coral Permits active in the MHI from 2009-2018

Year	Precious Coral Permits
2009	2
2010	2
2011	2
2012	2
2013	1
2014	1
2015	1
2016	1
2017	1
2018	1

Management Provisions

The Precious Coral FMP instituted permits and reporting requirements, a 10-inch size minimum, and a bed-based management structure with quotas defined from the size of the beds (WPRFMC 1979). The beds are classified as established, conditional, exploratory, or refugia (Figure 1). Established beds are those which have a history of harvest and for which firm optimum yields have been determined on the basis of scientific data. Established beds include the ‘Au‘au Channel and Makapu‘u Bed. Conditional beds are those for which locations and approximate area are known and for which estimates of optimum yield were extrapolated from comparison with established beds. Conditional beds include 180 Fathom Bank, Brooks Bank, Kaena Point, and Keāhole Point.

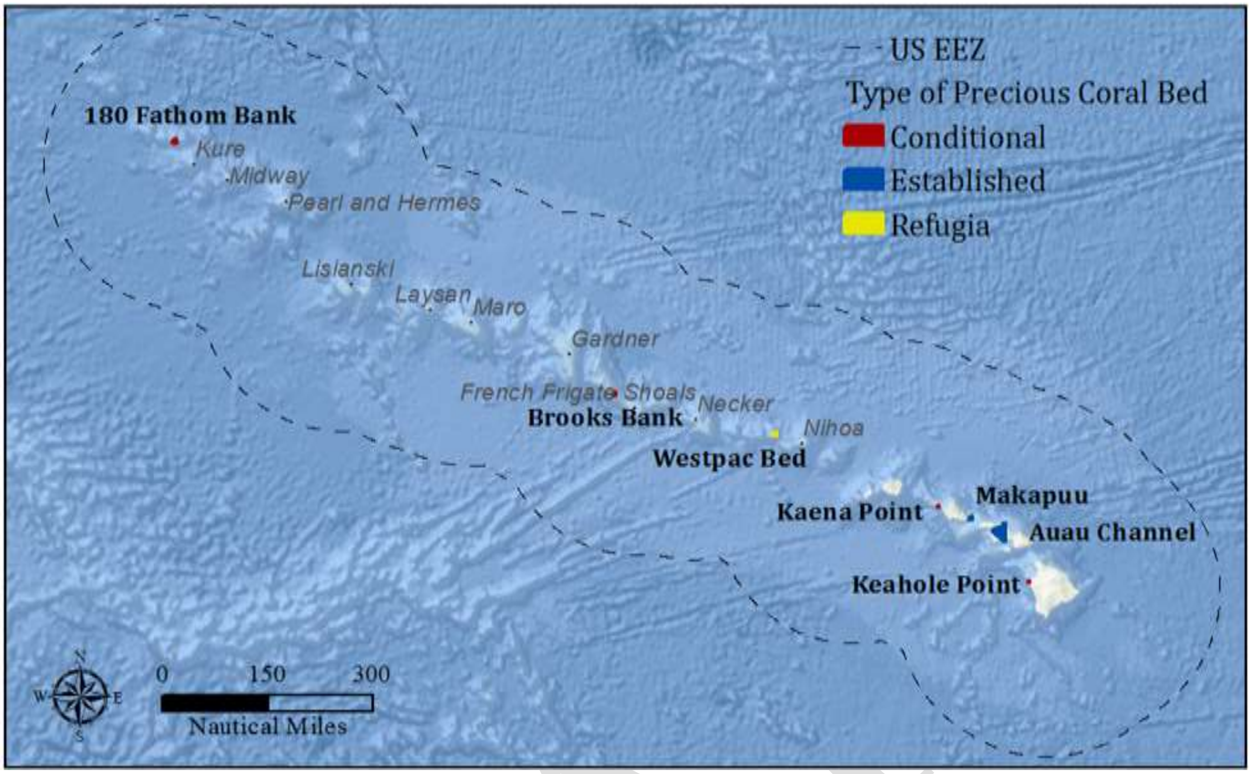

Figure 1. Regulated precious coral beds in the MHI

The exploratory areas, which include any other beds found in the rest of the EEZ, had an optimum yield limited to 1,000 kilograms, which was considered enough to incentivize exploration to find additional beds that could then be delineated, surveyed for abundance, and permitted as conditional or established beds. In addition, the Council also designated Westpac bed in the NWHI as refugia where harvest is prohibited within a 2-nm radius because refugia areas are set aside for baseline studies and possible reproductive reserves (WPRFMC, 1998)

The three species of economic interest – *P. secundum*, or pink; *Hemicorralium laauense*, red, formerly *C. regale* or *C. laauense;* and *Kulamanamana haumeaae*, gold, formerly *Gerardia* spp. – as well as a species thought to be of immediate commercial interest, *Lepidisis* spp., bamboo, were included as the managed fishery species in the plan, along with other species which had been observed to grow in communities with the precious corals.

Life History Parameters

Precious corals are characterized by great longevity, slow growth, and relatively low rates of mortality and recruitment (Grigg, 1976). Unfished coral populations are relatively stable from year to year and moderate changes in vital rates should have comparatively small effects on total abundance. Pink, red, gold, bamboo, and black corals all have larval planktonic and sessile adult stages. Larvae settle on solid substrata, where they form colonial branching colonies. Gold coral planula settle on hosts, and are only found as parasitic overgrowths of bamboo or other non-gorgonian deep sea corals.

Precious corals are found growing in communities, or beds, with other associated organisms, including octocorals, zooanthids, and sometimes scleractinians (Parrish et al., 2015; Parrish and Baco, 2007). Makapuʻu Bed appears to be unique, in that the bed contains most species of the precious corals of various sizes, suggesting that recruitment and mortality are in a steady state (Grigg, 1993). Long and Baco (2014) observed 55 species or morphotypes of corals, hydrocorals, and sponges in the Makapuʻu bed, with *Pleurocorallium secundum* as the most abundant species. Based on more recent observation of the *Okeanos Explorer* dives, deep sea coral communities appear to be recruitment limited, occurring mostly in beds instead of as individuals, with individuals of the same size in a bed (Michael Parke, pers. comm.). With the exception of Makapuʻu Bed, the former harvest area off of Kailua Kona, and those beds potentially harvested by foreign fishermen in the NWHI, if any, all other precious coral beds within the US EEZ are believed to be in an unexploited or virgin state. The EEZ of the Western Pacific Region has not been surveyed for precious corals across their range.

EFH Designation

The Council designated EFH for the post-settlement stage of precious coral deep- and shallow-water species assemblages in the omnibus amendment implementing the Sustainable Fisheries Act provisions (WPRFMC, 1998). To reduce the complexity and the number of EFH identifications required for individual species, the Council originally designated EFH for precious coral assemblages. The species complex designations are deep- and shallow-water complexes. The designation of these complexes is based on the ecological relationships among the individual species and their preferred habitat.

The Council considered using the known depth range of individual precious coral species to designate EFH, but rejected this alternative because of the rarity of the occurrence of suitable habitat conditions. Instead, the Council designated the six known beds of deep-water precious corals and three known beds of shallow-water precious corals as EFH. The Council believed that the narrow EFH designation will facilitate the consultation process.

EFH for the deep-water precious corals includes the six known beds of precious corals defined as follows (50 CFR § 665.261 (1-3)):

1) Established beds.
   i. Makapu'u (Oahu), Permit Area E-B-1, includes the area within a radius of 2.0 nm of a point at 21°18.0′ N. lat., 157°32.5′ W. long.

2) Conditional beds.
   i. Keāhole Point (Hawaii), Permit Area C-B-1, includes the area within a radius of 0.5 nm of a point at 19°46.0′ N. lat., 156°06.0′ W. long.
   ii. Kaʻena Point (Oahu), Permit Area C-B-2, includes the area within a radius of 0.5 nm of a point at 21°35.4′ N. lat., 158°22.9′ W. long.
   iii. Brooks Bank, Permit Area C-B-3, includes the area within a radius of 2.0 nm of a point at 24°06.0′ N. lat., 166°48.0′W. long.
   iv. 180 Fathom Bank, Permit Area C-B-4, N.W. of Kure Atoll, includes the area within a radius of 2.0 nm of a point at 28°50.2′ N. lat., 178°53.4′ W. long.

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.

Three black coral beds in the MHI were designated as EFH for the shallow-water species: between Miloli‘i and South Point on Hawaii, ‘Au‘au Channel between Maui and Lāna‘i and the southern border of Kaua‘i (WPRFMC, 1998). The boundaries of the ‘Au‘au Channel bed were codified in the implementation of Amendment 7 to the FMP for the Precious Coral Fisheries of the Western Pacific Region (50 CFR § 665.261 (1)(ii)):

ii. Au'au Channel (Maui), Permit Area E-B-2, includes the area west and south of a point at 21°10′ N. lat., 156°40′ W. long., and east of a point at 21° N. lat., 157° W. long., and west and north of a point at 20°45′ N. lat., 156°40′ W. long.

The WPRFMC estimated the location of EFH between Miloli‘i and South Point on Hawaii and the southern border of Kauai as the seabed bounded by the 20 and 100 m isobaths, as depicted in maps appended to the 1998 EFH amendments (Figure 2 and Figure 3; WPRFMC, 1998).

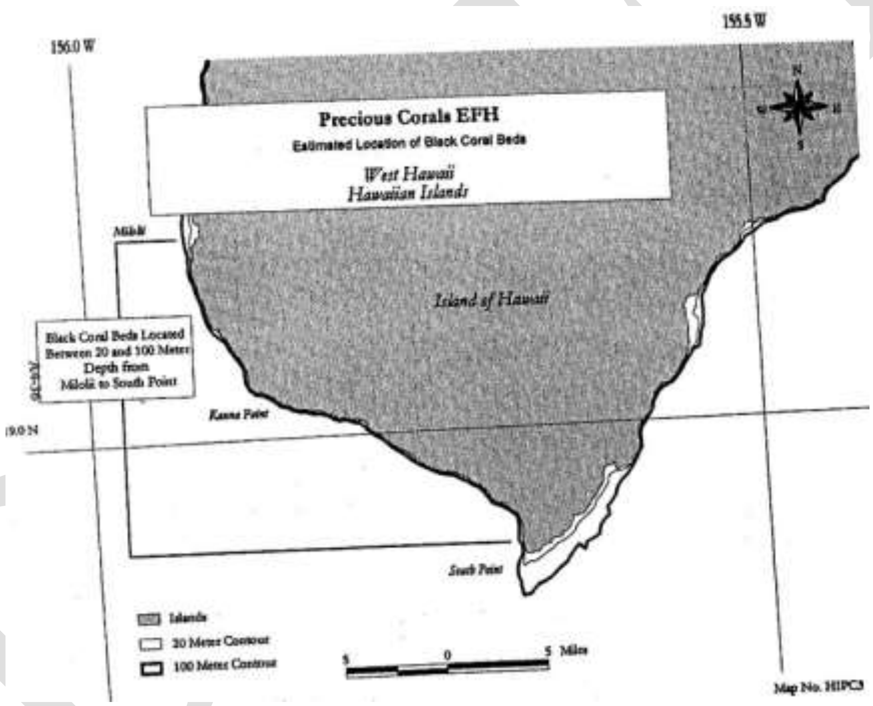

Figure 2. Estimated location of shallow-water precious coral EFH between Miloli‘i and South Point, Hawaii

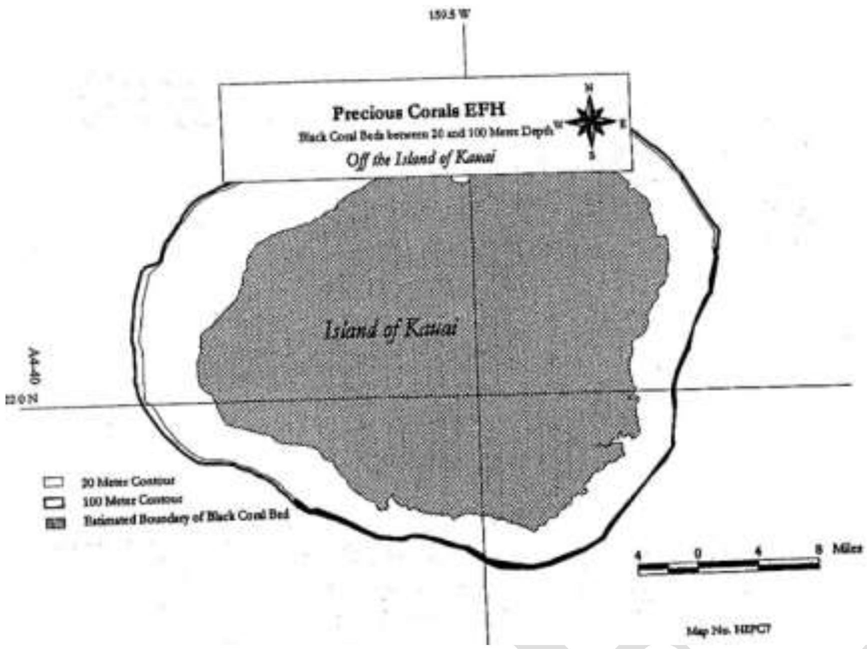

Figure 3. Estimated location of shallow-water precious coral EFH south of Kauai

The Council designates habitat areas of particular concern (HAPC) based on the following criteria: ecological function of the habitat is important, habitat is sensitive to anthropogenic degradation, development activities are or will stress the habitat, or the habitat type is rare. Makapuʻu, Wespac, and Brooks Bank were designated as HAPC for deep-water species (WPRFMC, 1998). These three were designated as HAPC because of the ecological function they provide, the rarity of the habitat type, and their possible importance as monk seal foraging habitat. Makapuʻu bed was designated as HAPC because of the ecological function it provides, the rarity of the habitat type and its sensitivity to human-induced environmental degradation. The potential commercial importance and the amount of scientific information that has been collected on Makapuʻu bed were also considered. Makapuʻu Bank is also considered to be relatively unique among the known coral agglomerations in the MHI because of the diversity and density of precious corals found in a relatively small area (Parrish et al., 2015). Additional information regarding the geographic extent of the coral beds at Makapuʻu has become available (Long and Baco, 2014), but we still lack data on the eastern boundary of the Makapuʻu bed.

The Wespac bed was designated as HAPC because of the ecological function it provides and the rarity of the habitat type. Its refugia status was also considered. Brooks Bank was designated HAPC because of the ecological function it provides and the rarity of the habitat type. Its possible importance as foraging habitat for the Hawaiian monk seal was also considered.

For shallow-water precious corals, the Council designated the ʻAuʻau Channel as HAPC 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.

1.1.2 EFH Review

EFH Identification Guide

EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, and growth to maturity", as defined by the MSA. NMFS issued an interim final rule in 1997 and a final rule in 2002 to implement regulatory guidelines for the EFH provisions of the MSA. The guidelines, codified at 50 CFR Part 600 Subpart J, interpret "waters" to include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle.[1]

Councils must identify EFH in text that clearly states the habitats or habitat types determined to be EFH for each life stage of the managed species and must identify the geographic extent of this EFH.[2] The description of EFH must be based on the best scientific information available (BSIA). The guidelines recommended that each Council prepare a preliminary inventory of available environmental and fisheries information on each managed species. Such an inventory is useful in describing and identifying EFH, as it also helps to identify missing information about the habitat utilization patterns of particular species. The guidelines note that a wide range of basic information is needed to identify EFH. This includes data on current and historic stock size, the geographic range of the managed species, the habitat requirements by life history stage, and the distribution and characteristics of those habitats. Because EFH has to be identified for each major life history stage, information about a species' distribution, density, growth, mortality, and production within all of the habitats it occupies, or formerly occupied, is also necessary. The guidelines strongly recommend Councils organize data used to describe and identify EFH using the following four levels:

1. Distribution data are available for some or all portions of the geographic range of the species.
2. Habitat-related densities of the species are available.
3. Growth, reproduction, or survival rates within habitats are available.
4. Production rates by habitat are available.

The guidelines provide directives for designation based on the level of information available for each life stage of each managed species. Councils are able to infer EFH based on the habitat distributions of where the species has been found and on information about its habitat requirements and behavior, in the circumstance that distribution data are available only for portions of the geographic area occupied by a species. Councils are allowed to infer habitat from a similar species or life stage in describing EFH.[3]

If distribution data are available, the Council should evaluate the data to identify EFH as those habitat areas most commonly used by the species. If those distribution data are not available across the whole range of the species, the Council is still able to infer EFH as appropriate. If higher levels of EFH information are available, Councils should identify EFH as the habitat

[1] 50 CFR §600.10
[2] 50 CFR §600.815(a)(1)(i)
[3] 50 CFR §600.815(a)(1)(iii)(A)(1)

supporting the highest relative abundance; growth, reproduction, or survival rates; and/or production rates within the geographic range of a species and explain the analysis conducted to distinguish EFH from all habitats potentially used by a species.[4]

Levels of Information

The updated levels of available information for precious coral species are found in Table 2.

Table 2. Level of EFH information available for Hawaii PCMUS

Species	Pelagic phase (larval stage)	Benthic phase	Source(s)
Pink Coral (*Corallium*)			
Pleurocorallium secundum (prev. *Corallium secundum*)	0	1 - Distribution	Figueroa and Baco (2014) Kelley and Drysdale (2012), unpublished data NOAA Deep Sea Coral Database
		1 - Abundance	Parrish (2007)
C. regale	0	1	Kelley and Drysdale (2012), unpublished data NOAA Deep Sea Coral Database
Hemicorallium laauense (prev. *C. laauense*)	0	1 – Distribution	Kelley and Drysdale (2012), unpublished data NOAA Deep Sea Coral Database
	0	1 – Abundance	Parrish (2007)
Gold Coral			
Kulamanamana haumeaae (prev. *Gerardia* spp.)	0	1 - Distribution	Sinniger et al., (2013) Kelley and Drysdale, 2012, unpublished data NOAA Deep Sea Coral Database
		1 - Abundance	Parrish (2007) Parrish and Roark (2015)
Callogorgia gilberti	0	1	Kelley and Drysdale (2012), unpublished data NOAA Deep Sea Coral Database
Narella spp.	0	1	HURL Database NOAA Deep Sea Coral Database
Bamboo Coral			
Lepidisis olapa	0	1 - Distribution	Kelley and Drysdale (2012), unpublished data NOAA Deep Sea Coral Database
		1 - Abundance	Parrish (2015)
Acanella spp.	0	1	Kelley and Drysdale (2012), unpublished data NOAA Deep Sea Coral Database
		1 - Abundance	Parrish (2015)
Black Coral			

[4] 50 CFR §600.815(a)(1)(iv)(A)

Species	**Pelagic phase (larval stage)**	**Benthic phase**	**Source(s)**
Antipathes griggi (prev. *Antipathes dichotoma*)	0	2	Opresko (2009) Kelley and Drysdale (2012), unpublished data NOAA Deep Sea Coral Database
A. grandis	0	1	Kelley and Drysdale (2012), unpublished data NOAA Deep Sea Coral Database
Myriopathes ulex (prev. *A. ulex*)	0	1	Opresko (2009) Kelley and Drysdale (2012), unpublished data NOAA Deep Sea Coral Database

Kelley and Drysdale's synthesis of precious coral observations from the HURL database, for all HURL dives through 2012, excludes duplicate observations from the same coral bed (Figure 4). This dataset is considered the most robust distribution dataset available for MHI precious corals, but does not include observations in the NWHI or at Cross Seamount. Sampling effort compared to the depth range of precious corals is again expected to be very low. This dataset contains 4,532 unique observations of deep-water corals and 685 observations of shallow-water corals for a total of 5,217 unique observations. HURL dives have taken place since 2012, but videos are not actively annotated so observations since 2012 are not considered available for the purposes of this EA. The dives since 2012 have mostly taken place in areas with precious corals that have been previously recorded (Chris Kelley, pers. comm., October 3, 2017).

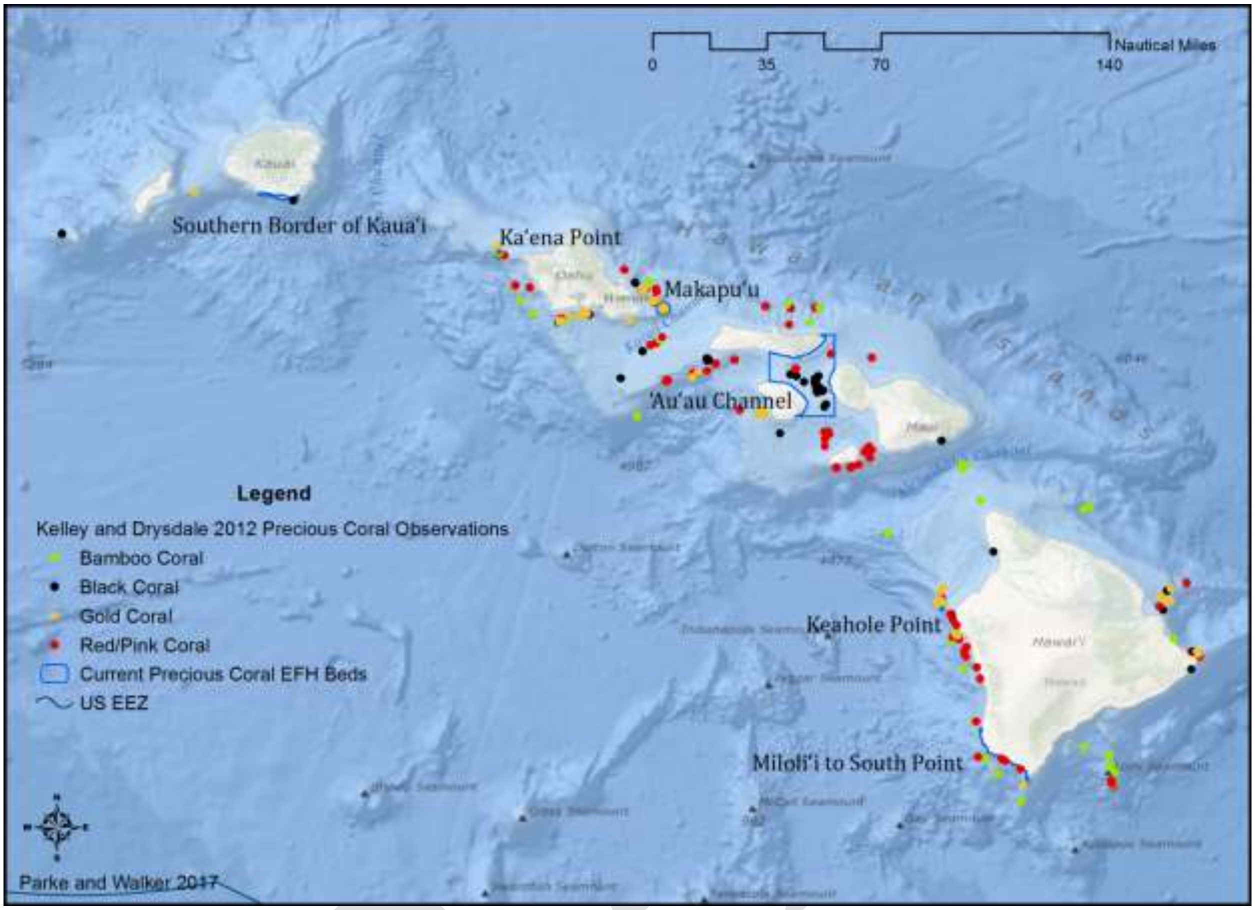

Figure 4. Precious coral observations in Kelley and Drysdale 2012, unpublished data

The NOAA Deep Sea Coral Research and Technology Program developed a national database of coral and sponge observation below depths of 50 m to fulfill the agency's obligations under the MSA and inform Council management of deep sea corals and sponges. This dataset, which does not include observations of absence, is the most comprehensive compilation of precious coral observations and includes data from HURL dives (NOAA, 2015; Figure 5). However, the database is a compilation of contributions from many different expeditions and has not been quality controlled to remove duplicate observations of the same corals. Sampling effort, compared to the depth range of precious corals, is low.

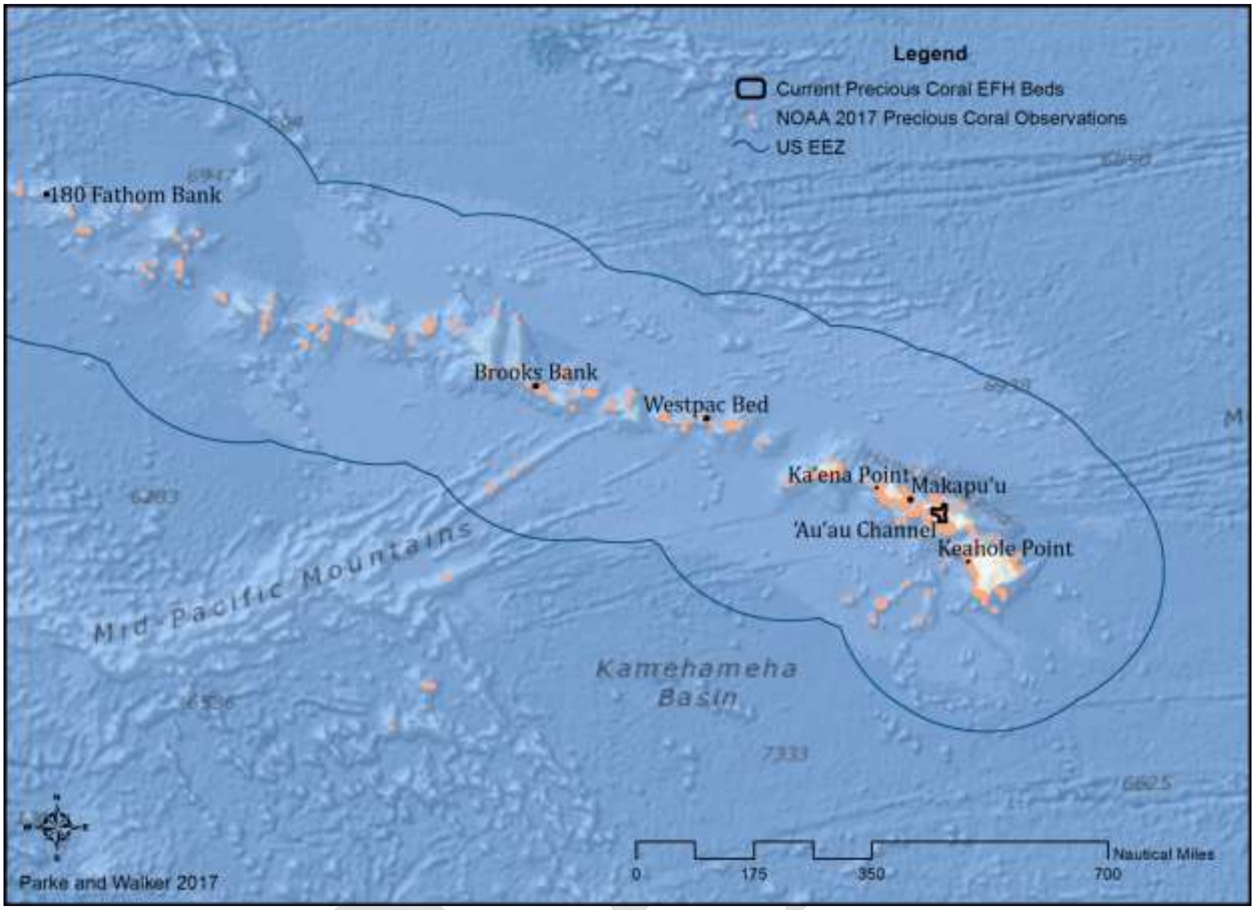

Figure 5. Precious coral observations in NOAA's National Database for Deep-sea Corals and Sponges

The State of Hawaii's commercial marine license database includes catch of species reported by grid. This fishery-dependent dataset is confidential for all years that the deep-water precious coral fishery was active, due to the low number of fishers, and is confidential for many years of the shallow-water fishery. The sizes of the reporting grids are too large to be useful in describing the distribution of precious corals (Figure 6).

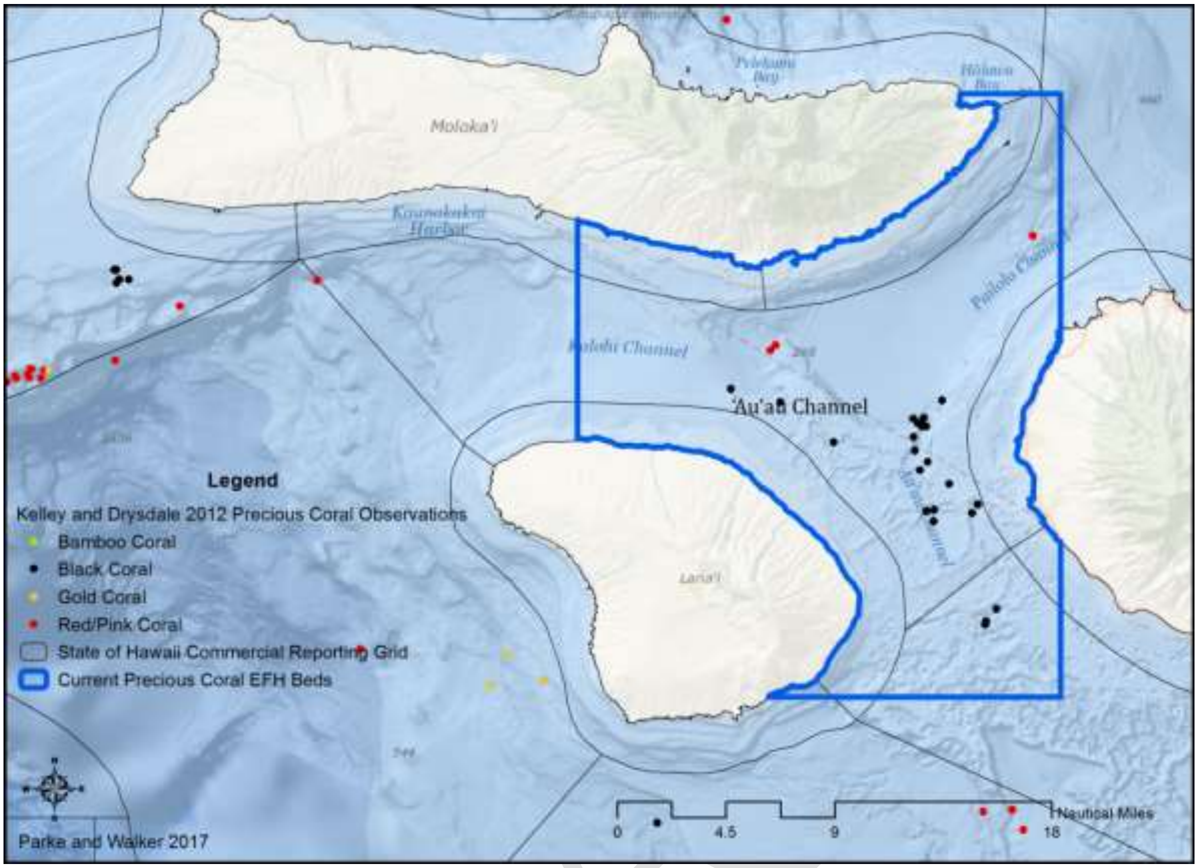

Figure 6. ‘Au‘au Channel bed with the State of Hawai‘i commercial reporting grid

Advances in geographic positioning have made it difficult to rely on position information collected for the Council’s original precious coral FMP, which defined the six known beds of deep-water precious corals for permitting purposes. No observations in the Kelley and Drysdale 2012 dataset occur within the Keāhole beds and only one occurs within the Ka‘ena Point beds. Observations from PIFSC dives at WestPac bed included within NOAA’s deep sea corals database cluster southwest of the regulatory bed, while dives at Brooks Bank and Baby Brooks Bank cluster southeast of the regulatory bed location. Grigg and Baco’s three observations included in NOAA’s database occur within the regulatory boundary of 180 Fathom Bank, northwest of Kure Atoll in the NWHI. The locality for Grigg’s observations is reported as “academician Berg Seamount” in the Emperor Seamounts while the Baco observation is referred to as North Kure Bank. The regulatory boundaries of Makapu‘u do capture the cluster of observations from the bed, but this bed has been surveyed such that there are now reasonable boundaries for its location with the exception of the eastern border (Long and Baco, 2014).

In addition to the established, conditional, and shallow-water EFH beds of precious corals, many other sites have been discovered that sustain populations of precious corals (Parrish and Baco, 2007; Parrish et al., 2015; Wagner et al., 2015; Kelley and Drysdale, 2012, unpublished data; Putts and Kahng, 2016, unpublished data). Given the number of observations and the wide distribution of deep-water precious corals in the MHI, it is almost certain that undiscovered beds of precious corals exist in the EEZ waters of the region managed by the WPRFMC, with the densest beds limited to hard substrates between the depths of 200 and 600 meters. Whether these beds would contain organisms at sufficient densities and size distributions to support commercial harvests is yet to be determined. It is also likely that many of the areas that meet these depth and hardness criteria will not have coral agglomerations, because precious corals also need hard substrates, temporally reliable current flow, and relatively low sedimentation, among other undetermined water quality conditions to thrive (Parrish et al., 2015). Gold corals are likely host-limited; the habitat characteristics are more critical to the settlement of the host, which *K. haumeaae* later settles on (Parrish, 2007).

EFH Review

The review of precious coral EFH began in conjunction with development of the 2015 archipelagic Stock Assessment and Fishery Evaluation (SAFE) reports, which included a draft update of the precious coral species descriptions. This draft was completed in the 2016 SAFE reports, and the Hawaii Archipelago FEP SAFE report supplemented the species descriptions with approaches for refining EFH, research and information needs, and an updated inventory on EFH levels of information (Table 2). Several factors make the identification of EFH for precious coral management unit species (PCMUS) a difficult and unique question, including low survey effort, poorly understood habitat characteristics, the sessile nature of these extremely long lived species, and the management regime.

The Precious Coral FMP and subsequent FEP manage the fishery through bed classifications. There is no indication in the record of what density of organisms, characteristics of the habitat, or other guidance to assist in the delineation of a precious coral bed. NMFS guidance to refine EFH encourages the identification of a threshold value that limits EFH to a portion of all habitats potentially used by a species. Higher levels of information may justify more restrictive thresholds, while overfished species or species with reduced yields may warrant broader thresholds. Precious coral communities may be described by species assemblages, density, or substrate limits. Currently, communities with greater than one organism per square meter may be considered a dense deep sea community (Michael Parke, pers. comm. September 20, 2017). Most surveys of precious coral beds, however, were not designed to provide estimates of density but to examine relative abundance of coral types (Parrish 2007), describe community succession (Parrish et al., 2015, Putts and Kahng, 2015 unpublished data), or answer other questions. The delineation of a precious coral bed, given its implications on estimates of MSY, OY, and the scientific debate surrounding deep sea coral communities, is primarily a scientific question and so alternatives are not examined here.

Precious coral EFH designations in the Hawaiian Islands are not currently based on the known depth ranges or other habitat requirements of PCMUS, but instead have been delineated based on known coral beds with a certain amount of habitat complexity. Previous assertions that all of these corals have limited distribution throughout their respective depth ranges may merely be an artifact of limited sampling and observation efforts. The WPRFMC rejected the alternative of designating EFH based on the depth range of individual precious corals MUS because of the perceived rarity of occurrence of suitable habitat conditions (WPRFMC, 1998), but surveys by HURL and other research entities over the last 20 years have found precious corals throughout the Hawaiian archipelago on hard substrate at the suitable depth ranges.

Although more than 75 percent of antipatharian black coral species worldwide are found at depths below 50 m (Cairns, 2007), the two species that are most commonly harvested in Hawaii (*Antipathes griggi* and *Antipathes grandis*) both occur in waters shallower than 120 meters, and require hard substrates, temporally reliable current flow, and relatively low sedimentation (Parrish and Baco, 2007; Wagner, 2014). The same environmental conditions, but greater depths, are needed for the settlement and growth of the pink, gold and bamboo corals that have been commercially harvested in Hawaiian waters. These corals are often found in mixed aggregations, but they are also observed as more monotypic stands (Parrish, 2007). Gold corals are parasitic on bamboo corals, but large stands of bamboo corals have been found with no gold coral colonization (Parrish and Roark, 2009). It is still appropriate to distinguish between the shallow and deep-water species complexes, because the harvested species of black corals clearly inhabit the shallower depth ranges, while the red/pink, gold, and bamboo corals are only found at greater depths, with no overlap in the depth ranges. The pattern of distribution of precious coral beds is extremely patchy (Grigg, 1976).

Precious corals are sessile, have unusually low rates of recruitment, natural mortality, and great longevity, which makes management of these species unique. During surveys of lava flows off the western flanks of Hawaii Island(Putts, pers. comm., 2017) found that Corallidae dominated the early successional stages of the community at this bed, and using dates established for those flows, determined that a mature Corallidae community can be established within 150 years. Communities progress from relatively short-lived species such as bamboo and other soft corals to an assemblage dominated by gold corals (Parrish, 2015). The composition of the community is likely determined more by the effect of time than environmental variables such as current flow, particulate fluxes, and productivity (Parrish, 2015).

There are now comprehensive, high-resolution bathymetry and backscatter data collected by a number of government agencies and research institutions that delineate sea bottom areas with the appropriate depth and hardness characteristics required by precious corals, but these data do not include comprehensive oceanographic data (ex. current flows, dissolved oxygen, particulate matter) that may be necessary to accurately predict optimum precious coral habitats. John Smith (2016, unpublished data) from the University of Hawaii has synthesized the backscatter data into a product that can be used to create maps of hard substrate between the relevant depths for certain precious corals (200-600 meters). Shallow-water bathymetry maps can also be generated for the black coral complex (20-120 meters), but there are substantial gaps in backscatter data for the depths shallower than 60 meters. NMFS PIFSC has used these data to generate maps that could be used to define potential deep coral habitat. It is known that precious corals require hard substrate and are only found in certain depth ranges (Parrish et al., 2015), so these maps could serve to create a much more comprehensive representation of potential habitat to inform the Council’s decision on what is essential. Kelley and Drysdale (2012, unpublished data) have used the Hawaii Undersea Research Lab (HURL) database of precious coral observations to demonstrate that the current EFH definitions exclude more than 44 percent of precious coral observations in the MHI.

1.2 Proposed Action

The Council is proposing to revise and refine the EFH descriptions of the Hawaii Archipelago FEP for shallow-water and deep-water precious corals complexes based on new observations and other information throughout the Hawaiian Archipelago. New information exists allowing the Council to refine the habitat characteristics and geographic extent of shallow-water and deep-water precious coral EFH in the region.

After thorough deliberations, the Council recommended that the FEP be amended to reflect refinements to existing deep-water precious corals EFH in the Hawaiian Archipelago that included consideration of all the alternatives and new EFH designations at two sites around Hawaii Island. The Council also recommended the FEP be amended to reflect refinements to existing shallow-water precious corals EFH at existing precious coral beds.

1.3 Purpose and Need for Action

Since the original PCMUS designations in the MHI were approved, there is more known about the benthic stage of the precious corals life cycles. For example, the vast majority of shallow-water precious corals occur between 20 and 120 meters depth, and are comprised of a few species of black corals (Grigg, 1993; Kelley and Drysdale, unpublished data, 2012; Wagner et al., 2015). Most deep-water precious corals in the MHI are found between 200 and 600 meters and include the pink, red, gold, and bamboo corals, though some commercially insignificant bamboo, pink, and black corals have been observed as deep as 1,800 meters (Parrish, et al., 2015). New survey information in the MHI led the Council to prioritize precious corals for EFH review in its Program Plan.

The purpose of the proposed action is to conform with the requirement to review EFH in the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), as well as to support the Hawaii Archipelago FEP objective adopted by the Council at its 165th meeting in March 2016:

- Review and update EFH and Habitat Areas of Particular Concern (HAPC) designations and update such designations based on the best available scientific information, when available. This is the main focus of the proposed action.
- Identify and prioritize research to: assess adverse impacts to EFH and HAPC from fishing (including aquaculture) and non-fishing activities, including, but not limited to, offshore energy developments, and mining; and activities that introduce non-point source pollution into the coastal environment. This component of the Council's action is not included in the proposed action, but include activities that would follow from completing the EFH review and update.

The need for action is the requirement for the Council to review EFH every 5 years and the need to update the Hawaii Archipelago FEP based on best available scientific information including new information about distribution information for precious corals. The proposed action was recommended by the Council based on guidelines implemented by NMFS in a final rule in 2002 and codified at 50 CFR Part 600 Subpart J which recommend that EFH descriptions be based on the best scientific information available. The Magnuson Stevens Act defines EFH as waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity, or the habitat required to support a sustainable fishery and managed species' contribution to a heathy ecosystem (50 CFR Part 600 Subpart A).

1.4 Action Area

The action area for this EA occurs in State and Federal waters of the MHI where the precious coral fishery operates around the precious coral beds, and especially those areas designated as EFH for PCMUS. The PCMUS beds most typically occur in the benthic environment between 200 and 600 meters depth for deep-water species, however shallow-water species such as black corals occur from the 20 meter to the 100 meter isobaths.

1.5 Decision(s) to be Made

This document will support a decision by the Regional Administrator (RA) of the NMFS Pacific Island Region, on behalf of the Secretary of Commerce, whether to approve, disapprove, or partially approve the Council's recommendation. The RA will use the information in this EA to make a determination about whether the proposed action would constitute a major federal action that has the potential to significantly affect the quality of the environment. If NMFS determines the action would *not* significantly affect the quality of the environment, NMFS will prepare a Finding of No Significant Impact (FONSI). If NMFS determines the proposed action is a major federal action that would significantly affect the quality of the environment, NMFS would prepare an environmental impact statement (EIS) before taking action.

1.6 List of Preparers

Preparers:
Thomas Remington – Western Pacific Regional Fishery Management Council
Joshua DeMello – Western Pacific Regional Fishery Management Council

Reviewers:
Michael Parke – NMFS Pacific Islands Fisheries Science Center
Sarah Ellgen – NMFS Pacific Islands Regional Office
Phyllis Ha – NMFS Pacific Islands Regional Office

1.7 Public Involvement

1.7.1 Council and SSC Meetings

At its 130th meeting held on October 15-17, 2017 (83 FR 23640), the Council's Science and Statistical Committee (SSC) discussed and generally favored re-specification of precious coral EFH that accounts for newer data and higher resolution bathymetry from recent research in the Hawaiian Archipelago.

At its 173rd meeting held on June 10-13, 2018 (83 FR 23640), the Council directed staff to develop alternatives to redefine EFH and HAPC for precious corals in the MHI for Council consideration for a FEP amendment. The Council prepared this draft EA to evaluate potential environmental impacts of the following alternatives considered.

At its 174th meeting held on October 23-27, 2018 (83 FR 49364), the Council took initial action on refining the EFH of MHI precious corals, and directed staff to prepare an amendment to the

Hawaii FEP to revise the precious corals EFH using the preliminarily preferred alternatives identified in this report.

1.7.2 Coordination with Others and the Public

Various other federal and local government agencies are represented on the Council. Agencies that participate in the deliberations include: NMFS, State of Hawaii Department of Land and Natural Resources (DLNR), U.S. Coast Guard (USCG), U.S. Fish and Wildlife Service (USFWS), and U.S. Department of State.

The development of the proposed action has taken place in public meetings of Advisory Panels, the Science and Statistical Committee, and the Council. In addition, the Council has provided notice of the rulemaking in local media releases, newsletter articles, and on the Council's website at http://www.wpcouncil.org. Moreover, NMFS will be soliciting public comment on the proposed action described in this draft EA. Instructions on how to comment on the proposed specification can be found by searching for RIN XXXX at www.regulations.gov, or by contacting the responsible official or Council listed at the beginning of this EA. NMFS must receive comments by the deadline specified in the proposed rule to be considered.

2 DESCRIPTION OF THE ALTERNATIVES CONSIDERED

2.1 Development of the Alternatives

This section describes the alternatives that the Council considered at its 174th meeting in October 2018 for initial action on amending the FEP to refine the EFH for PCMUS. The redefinition of precious corals EFH is framed in three separate actions: refinement of deep-water species complex EFH, refinement of shallow-water precious coral species complex EFH, and update of the narrative information.

EFH designations are composed of habitat characteristics and the geographic extent of habitat. The habitat characteristics are based on the best available scientific information. The management question is the geographic extent of EFH, or how much habitat is necessary to maintain a sustainable fishery and the managed species' contribution to a healthy ecosystem. For deep-water precious corals, the alternatives have been framed as considering the entire depth range as the geographic extent; the current geographic extent of EFH with updated spatial information; or the current extent plus additional EFH beds based on new distribution information. Fewer data are available for the shallow-water black corals, and so alternatives include no change and updating the habitat characteristics and geographic extent of existing beds.

Distribution data are used for aid in defining the locations of precious coral beds and evaluating the alternatives, not for framing the alternatives. For example, some Councils with survey information throughout their EEZ have framed EFH alternatives around the geographic extent encompassing 70 percent of observations; 80 percent of observations; 90 percent of observations; etc. This approach is inappropriate for precious corals because observational data are available only from a very small portion of the depth range of precious coral species.

Table 3 below describes the distribution data included and excluded in the designated precious coral EFH areas of the MHI for both deep- and shallow-water species from Kelley and Drysdale (2012, unpublished data) given the actions and alternatives presented in this EA.

Table 3. Anticipated distribution data in the designated precious coral EFH areas of the MHI from Kelley and Drysdale unpublished dataset for each of the alternatives considered

Deep-Water Corals (>200 meters)	**4,532 unique observations**		
	Distribution Data Included in Area	**Distribution Data Excluded in Area**	**EFH Area (km^2)**
No Action – Current Beds	40.2%	59.8%	178
200-600 m Hard Substrate	75.2%	24.8%	1540
Current Beds, Updated Geographic Information	40.6%	59.4%	105*
Current Beds with Update Geographic Information and New Beds	65.2%	34.8%	266*
Shallow-Water Corals (<200 meters)	**685 unique observations**		
No Action – ‘Au‘au channel and two other beds	70.6%	29.4%	Unknown ‘Au‘Au Channel: 942
Current Beds, Updated Geographic Information	75.9%	24.1%	989

*subject to change based on expert input

2.2 Description of the Alternatives for Action 1

There are four alternatives for update of the geographic extent of deep-water precious coral EFH designations, based on the original EFH alternatives for designation of precious corals in the Western Pacific Region and advances in mapping technology:

- Alternative 1: No action (Maintain current EFH designations)
- Alternative 2: Revise EFH designation based on depth range;
- Alternative 3: Refining the geographic extent of current EFH beds using Kelley and Drysdale’s distribution data and NOAA’s National Database for Deep-sea Corals and Sponges; and
- Alternative 4: Refining the geographic extent of current EFH beds and adding additional beds where precious corals have recently been surveyed using Kelley and Drysdale’s distribution data and NOAA’s National Database for Deep-sea Corals and Sponges.

2.2.1 Alternative 1: No action (maintain current EFH designations)

This alternative for no action would retain the current definitions of EFH. EFH for the deep-water precious corals includes the six known beds of precious corals at Makapu‘u, Keāhole point, Ka‘ena Point, Brooks Bank, 180 Fathom Bank, and Westpac. The Makapu‘u, Westpac, and Brooks Bank beds are also designated as HAPC. Figure 7 shows the existing EFH beds for deep-water precious corals; maps for island areas with Kelley and Drysdale 2012, unpublished data, observations can be found in Appendix B. Maps

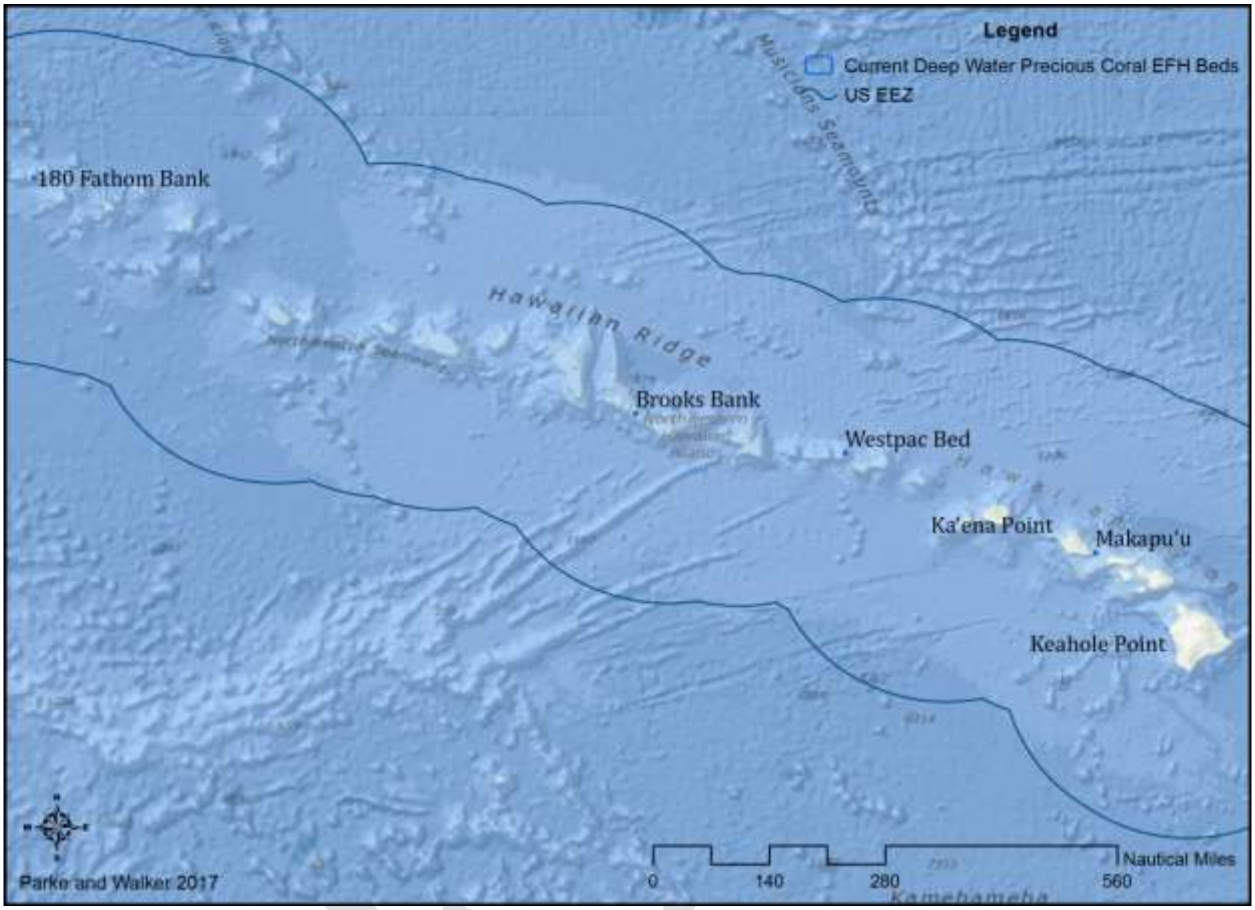

Figure 7. Deep-water precious coral EFH beds

<u>Expected Fishery Outcomes</u>

Given the updated scientific information available for PCMUS in the MHI, there is no benefit for selecting the No Action alternative. While the No Action alternative maintains EFH in deep-water species assemblages, the EFH descriptions and identification are inconsistent with the best available scientific data in some cases, and therefore inadequate. The No Action alternative is not expected to impact the general location, gear used, catch, effort, intensity, number of participants, seasonality, timing, number of sets or trips, target species, permits required, or other salient features of precious coral fisheries in the MHI in any notable manner. The fishery would continue operating as it has in recent years.

2.2.2 Alternative 2: Revise EFH of MHI deep-water precious coral beds by depth range

The full EFH description for deep-water precious coral species under this alternative is as follows:

EFH for the benthic phase of *Pleurocorallium secundum*, *Hemicorallium laauense,* and *Acanella* sp. is natural, stable, hard substrates between the 200 and 600 m isobaths in areas with higher current velocities, low sedimentation, and where precious corals are clustered, throughout the EEZ in the MHI.

EFH for the benthic phase of *Kulamanamana haumeaae* is the tissue or skeleton of bamboo coral colonies, particularly *Acanella* sp., the preferred hosts of the parasitic *K. haumeaae* in depths between 200 and 600 m, throughout the EEZ in the MHI.

In the future, better understanding of the water quality characteristics necessary to optimize precious coral growth (such as dissolved oxygen, particulate organic matter), along with more complete measurements, may be included to provide more specificity to these definitions.

This change would increase the percentage of precious coral observations within the EFH areas of the MHI from 40.2 percent to 75.2 percent, using precious coral observation data from the HURL database (Kelley and Drysdale, 2012, unpublished data*).* This alternative would designate EFH in most of the potential habitat areas of the precious coral species, as an MUS complex. The areas that meet these criteria, to the extent that they can be mapped, are shown in Figure 8.

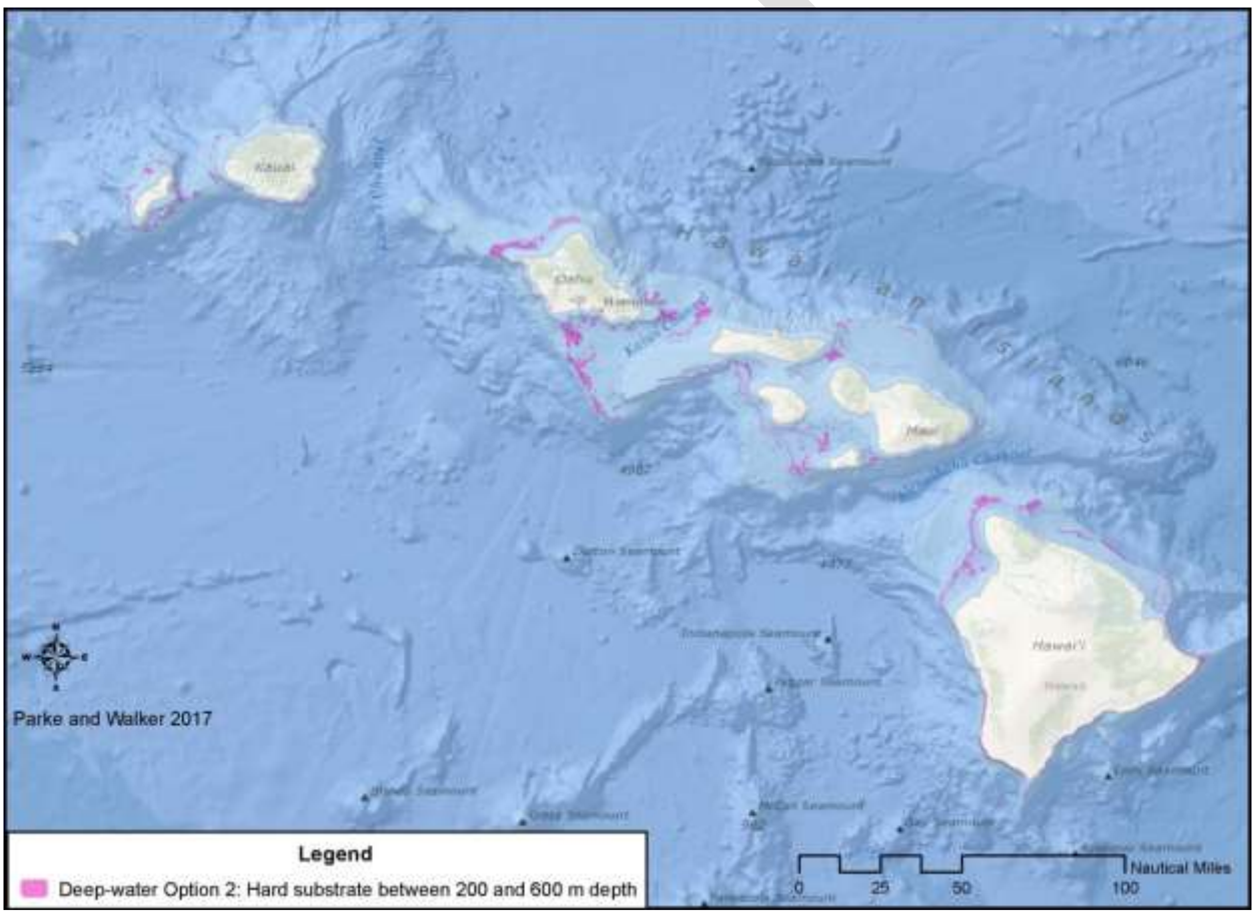

Figure 8. Hard substrate in the 200 m and 600 m depth range in the MHI

This alternative would include the most amount of habitat within the EFH definition and would also likely include habitat which is not suitable for the growth of precious corals. The Council rejected this alternative in its first consideration of precious coral EFH, because of the rarity of the occurrence of suitable habitat conditions.

Expected Fishery Outcomes

There are no fishery outcomes to the MHI precious coral fishery expected with the refinement of EFH based on depth range in the FEP. The ultimate outcome of refining the EFH of deep-water precious coral species would be to improve management of precious coral assemblages through improved documentation and understanding of their habitat descriptions. Impacts to the fishery are not expected to impact because of low participation to the point of the fisheries being considered inactive. Refining the EFH designations in the FEP allows for the protection of more habitat where precious coral species are known to occur.

Features Common to All Other Alternatives

The habitat characteristics of the EFH textual descriptions that differ from the status quo but are the same for Alternatives 2, 3, and 4 are provided below:

> EFH for the benthic phase of *Pleurocorallium secundum, Hemicorallium laauense,* and *Acanella* sp. is natural, stable, hard substrates between the 200 and 600 m isobaths in areas with higher current velocities, low sedimentation, and where precious corals are clustered.
>
> EFH for the benthic phase of *Kulamanamana haumeaae* is the tissue or skeleton of bamboo coral colonies, particularly *Acanella* sp., the preferred hosts of the parasitic *K. haumeaae* in depths between 200 and 600 m.
>
> The following definitions are included to assist managers and the public with determining the scope of EFH and the potential impacts to that habitat.
>
> Precious coral beds include the precious corals themselves, the specific biological hosts needed for settlement by gold corals, and may include a wide variety of commensal organisms that live within and upon the corals, and the various vertebrate and invertebrate organisms that are typically found among these corals, such as fish, asteroids, shrimp, squat lobsters, barnacles, holothurians and others. These communities have yet to be comprehensively catalogued, but are composed of a wide variety of taxa that demonstrate a level of complexity and co-dependence commensurate with shallow-water coral reef communities.
>
> Natural stable, hard substrates include any hard bottoms that are not of artificial origin, such as bedrock, large boulders, slabs, blocks, etc. Parrish found that precious coral taxa colonize both carbonate and basalt/manganese substrates (2007). *H. laauense* grows in an intermediate relief of outcrops; and *K. haumaae* is most commonly seen growing in high relief areas on pinnacles, walls, and cliffs.

Higher current velocities refer to the accelerated or localized, enhanced flow necessary to sweep away sediment and increase the flux of organic matter (Genin et al., 1992). While the particular current velocity that promotes precious coral settlement and growth is unknown, Grigg (1974) estimated corals preferred areas of solid substrate swept clean by currents faster than 0.25 m/s and based on initial modeling of tidal flow (Carter et al 2008) it is hypothesized deep corals prefer velocities ranging somewhere between 5 and 0.85 m/s (Parrish et al., 2017). While the particular current velocity that promotes precious coral settlement and growth is unknown, Carter et al. 2008 hypothesized that deep-sea corals prefer areas with current velocities 0.5 – 0.85 m/s while Grigg (1974) determined that precious corals prefer solid substrate in areas that are swept relatively clean by currents faster than 0.25 m/s. Recent work in the Hawaiian Islands indicates that previously hypothesized numbers may be too high, based on mean values. Parrish found that the some precious corals favor areas where bottom relief enhances or modifies flow characteristics that may improve the colony's feeding success (Parrish 2007). Strong currents help prevent the accumulation of sediments, which would smother young coral colonies and prevent settlement of new larvae. Grigg (1984) notes that, in Hawai'i, large stands of *Corallium* are only found in areas where sediments almost never accumulate, and *P. secundum* appears in large numbers in areas of high flow over carbonate pavement (Parrish et al., 20175; Parrish and Baco, 2007).

2.2.3 Alternative 3: Refine the geographic boundary of existing deep-water precious coral beds in the MHI

Alternative 3 would define the geographic extent of precious coral EFH based on the existing EFH beds. The location of beds which have been surveyed recently, including Makapu'u, Keāhole, Westpac and Brooks Bank is known, although the extent of the beds is not generally known. Expert judgement was used to identify boundaries, guided by John Smith's substrate and depth data, available distribution data, and margins of error for locational offsets and guesses about the edges of beds. This alternative is shown in general locations across the MHI in Figure 9.

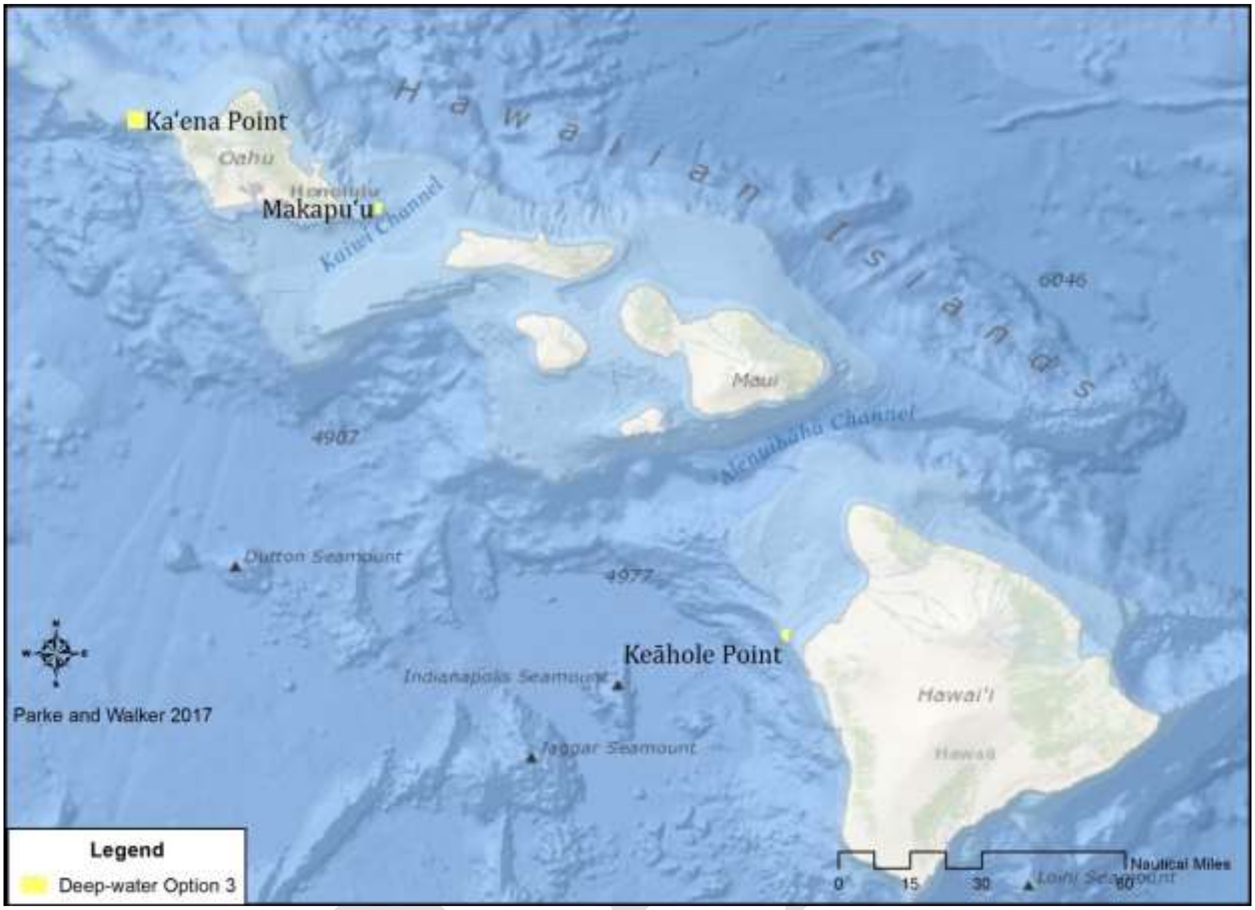

Figure 9. Regulatory beds in the MHI updated with BSIA

The full EFH description for deep-water precious coral species under Alternative 4 is as follows:

> EFH for the benthic phase of *Pleurocorallium secundum*, *Hemicorallium laauense*, and *Acanella* sp. is natural, stable, hard substrates between the 200 and 600 m isobaths in areas with higher current velocities, low sedimentation, and where precious corals are clustered in the six beds as defined below:

1. Makapuʻu Bed: includes the area bounded by geodesic lines connecting the following coordinates in the order listed:

Point Identifier	Longitude	Latitude
1	157° 33' 00.00" W	21° 19' 06.37" N
2	157° 32' 48.70" W	21° 18' 58.98" N
3	157° 32' 13.21" W	21° 18' 55.28" N
4	157° 31' 30.00" W	21° 18' 56.76" N
5	157° 31' 30.00" W	21° 16' 30" N
6	157° 33' 00.00" W	21° 16' 30" N
1	157° 33' 00.00" W	21° 19' 06.37" N

This bed is the most studied in the MHI, although its eastern extent is unexplored. The end of hard substrate bounds the bed in the north.

Rationale: The northern end of the bed is clearly defined by the end of hard substrate. The north, south, and west borders were those outlined in Long and Baco 2014. Participants noted that in subsequent dives, the vehicle traveled further south than in Long and Baco 2014, confirming that the bed does not continue to the south. The eastern extent of the bed is unknown, so the observations provide the eastern extent, consistent with Long and Baco 2014.

2. Keāhole Point includes the area bounded by geodesic lines connecting points 1 to 2, 2 to 3, and 3 to 4; the 200 m isobath connecting points 4 to 5; a geodesic line connecting point 5 to 6, and the 600 m isobath connecting point 6 to 1, with the locations for points identified in the following table:

Point Identifier	Longitude	Latitude
1	156° 07' 43.04" W	19° 49' 27.50" N
2	156° 06' 53.40" W	19° 49' 36.41" N
3	156° 06' 00.63" W	19° 49' 28.49" N
4	156° 06' 00.63" W	19° 49' 17.70" N
5	156° 06' 21.37" W	19° 46' 57.98" N
6	156° 06' 55.87" W	19° 46' 56.24" N
1	156° 07' 43.04" W	19° 49' 27.50" N

This bed encloses observations at Keāhole Point and is bounded by the 200 and 600 m depth range.

Rationale: Observations do not occur within the regulatory definition of the Keāhole Point bed. The observations are clustered around a bathymetric feature. The northernmost and southernmost observations provide the latitudinal boundaries, while the 200 m and 600 m isobaths provide the longitudinal boundaries.

3. Ka‘ena Point: includes the area bounded by geodesic lines connecting the following coordinates in the order listed:

Point Identifier	Longitude	Latitude
1	158° 24' 42.46" W	21° 37' 58.47" N
2	158° 21' 10.65" W	21° 37' 58.47" N
3	158° 21' 10.65" W	21° 34' 20.06" N
4	158° 24' 42.46" W	21° 34' 20.06" N
1	158° 24' 42.46" W	21° 37' 58.47" N

The bed at Ka‘ena Point is characterized by high flow.

Rationale: The bed at Ka‘ena Point is defined as EFH currently and has a regulatory boundary. The area is not well studied. The boundaries were drawn to encompass all observations in the area within the depth range of 200 m to 600 m.

4. 180 Fathom Bank – includes the area within a radius of 2.0 nm of a point at 28°50.2′ N. lat., 178°53.4′ W. long.

5. (Baby) Brooks Bank: includes the area within a radius of 2.866 nm of a point at 166° 42' 12.29" W, 23° 58' 49.60" N. This bed encompasses the feature on which precious corals have been observed. This is a dense, diverse bed similar to Makapuʻu characterized by black corals on the northeast and northwest sides of the bank.

6. Westpac Bed: includes the area within a radius of 2.253 nm of a point at 162° 36' 57.90" W, 23° 15' 33.10" N. This bed encompasses the feature on which precious corals have been observed; their distribution is patchy throughout the bed.

   Rationale: A circular shape is fitting because the bed is located on a high point with observations in a circle around the high point. The central coordinate was updated from the regulatory definition to encompass the observation on the feature. The bed could extend deeper than the observations, but its extent is unknown at this time.

   EFH for the benthic phase of *Kulamanamana haumeaae* is the tissue or skeleton of bamboo coral colonies, particularly *Acanella* sp., the preferred hosts of the parasitic *K. haumeaae* in depths between 200 and 600 m, in the six beds defined above.

   The following definitions are included to assist managers and the public with determining the scope of EFH and the potential impacts to that habitat:

   Precious coral beds include the precious corals themselves, the specific biological hosts needed for settlement by gold corals, and may include a wide variety of commensal organisms that live within and upon the corals, and the various vertebrate and invertebrate organisms that are typically found among these corals, such as fish, asteroids, shrimp, squat lobsters, barnacles, holothurians and others. These communities have yet to be comprehensively catalogued, but are composed of a wide variety of taxa that demonstrate a level of complexity and co-dependence commensurate with shallow-water coral reef communities.

   Natural stable, hard substrates include any hard bottoms that are not of artificial origin, such as bedrock, large boulders, slabs, blocks, etc. Parrish found that precious coral taxa colonize both carbonate and basalt/manganese substrates (2007). *H. laauense* grows in an intermediate relief of outcrops; and *K. haumaae* is most commonly seen growing in high relief areas on pinnacles, walls, and cliffs.

   Higher current velocities refer to the accelerated or localized, enhanced flow necessary to sweep away sediment and increase the flux of organic matter (Genin et al., 1992). While the particular current velocity that promotes precious coral settlement and growth is unknown, Grigg (1974) estimated corals preferred areas of solid substrate swept clean by currents faster than 0.25 m/s and based on initial modeling of tidal flow (Carter et al 2008) it is hypothesized deep corals prefer velocities ranging somewhere between 5 – 0.85 m/s (Parrish et al. 2017). While the particular current velocity that promotes precious coral settlement and growth is unknown, Carter et al. 2008 hypothesized that deep-sea corals prefer areas with current velocities 0.5 – 0.85 m/s while Grigg (1974) determined that precious corals prefer solid substrate in areas that are swept relatively clean by currents faster than 0.25 m/s. Recent work in the Hawaiian Islands indicates that previously hypothesized numbers may be too high, based on mean values. Parrish found that the some precious corals favor areas where bottom relief enhances or modifies flow characteristics that may improve the colony's feeding success (Parrish 2007). Strong currents help prevent the accumulation of sediments, which would smother young coral colonies and prevent settlement of new larvae. Grigg (1984) notes that, in Hawaiʻi, large stands of *Corallium* are only found in areas where sediments almost never accumulate, and *P. secundum* appears in large numbers in areas of high flow over carbonate pavement (Parrish et al., 20175; Parrish and Baco, 2007).

This alternative more accurately delineates the potential geographic extent of the existing precious coral beds. Because Brooks Bank does not contain precious coral observations, the bank has been moved to Baby Brooks Bank. 180 Fathom Bank only includes three observations.

This alternative does not consider beds discovered since 1999 as necessary to support a sustainable fishery and its contribution to a healthy ecosystem. Harvest of precious corals has been limited to fewer than three fishers in the last twenty years (Stefanie Dukes, WPacFIN, pers. comm.). This alternative would maintain habitat conservation attention on established, conditional, and refugia precious coral beds.

<u>Expected Fishery Outcomes</u>

There are no anticipated impacts to the MHI precious coral fishery associated with the refinement of EFH based on geographic boundaries in the FEP. The ultimate outcome of refining the EFH of deep-water precious coral species would be to improve management of precious coral assemblages through improved documentation and understanding of their habitat descriptions. Impacts to the fishery are not expected because of low participation to the point of the fisheries being considered inactive. Refining the EFH designations in the FEP allows for the protection of more habitat where precious coral species are known to occur. Refining the designations based on observation data will be more accurate than doing so based on depth range, where large swatch of habitat may be designated despite no precious coral species occurring.

2.2.4 Alternative 4: Refine the geographic boundary of existing deep-water precious coral beds and add new precious coral beds (preferred)

Alternative 4 would define the geographic extent of precious coral EFH based on the existing EFH beds and the newly identified beds. Expert judgement, guided by John Smith's depth and substrate data would be used to create polygon boundaries around the existing EFH beds and new precious coral observations, based on survey data, in addition to the known beds. Precious coral beds have also been found in the deep inter-island channels such as ʻAuʻau, Alalakeiki, and Kolohi channels off of Maui, around the edges of Penguin Banks, off promontories such as Keāhole Point, on older lava flows south from Keāhole to Ka Lae, and off of Hilo Harbor, and off of Cape Kumukahi on Hawaii Island (Oishi, 1990; Grigg, 2001, 2002; Putts, pers. comm., 2017). On Oahu, there is a bed off Kaʻena Point, and multiple precious coral observations have been made from offshore Barber's Point extending to offshore Pearl Harbor, Oahu. On Kauai, a bed of black corals has been identified offshore of Po'ipu (WPRFMC, 1979).

A dense bed has been located on the summit of Cross Seamount, southwest of the island of Hawaii. This bed covers a pinnacle feature on the top of the summit, but does not contain numbers of corals large enough to sustain commercial harvests (Kelley, pers. comm., 2015).

In the NWHI, a small bed of deep-water precious corals have been found on WestPac bed, between Nihoa and Necker Islands and east of French Frigate Shoals. This bed is not large enough to sustain commercial harvests. Precious coral beds have also been discovered at Brooks Banks, Pioneer Bank, Bank 8, Seamount 11, Laysan, and French Frigate Shoals (Parrish and Baco, 2007; Parrish et al., 2015). Precious coral beds have been discovered at Pioneer Bank, Bank 8, Seamount 11, Laysan, and French Frigate Shoals in the NWHI. This alternative is shown by general location across the MHI in Figure 10; maps for island areas can be found in Appendix B.

For this alternative, new beds were defined via an expert working group. Working group participants were provided with a draft list of potential beds with boundary descriptions, developed from observational data of precious corals and the current EFH designations. Participants were directed to confirm whether or not the draft beds should be considered a bed, and if so, provide boundaries. Rationale must be provided for determining the geographic extent of the beds. Participants were prompted with several approaches, such as referencing the scientific literature, falling back on the regulatory definitions of the beds, using a circle boundary with a defined radius and central coordinate, or using bathymetric and substrate data to guide boundaries around observations. Participants moved through a geographic information system (GIS) to determine bed boundaries, using the draft beds, HURL unpublished data, NOAA's Deep-sea Corals and Sponges database filtered for relevant taxa, bathymetry, and backscatter data for reference.

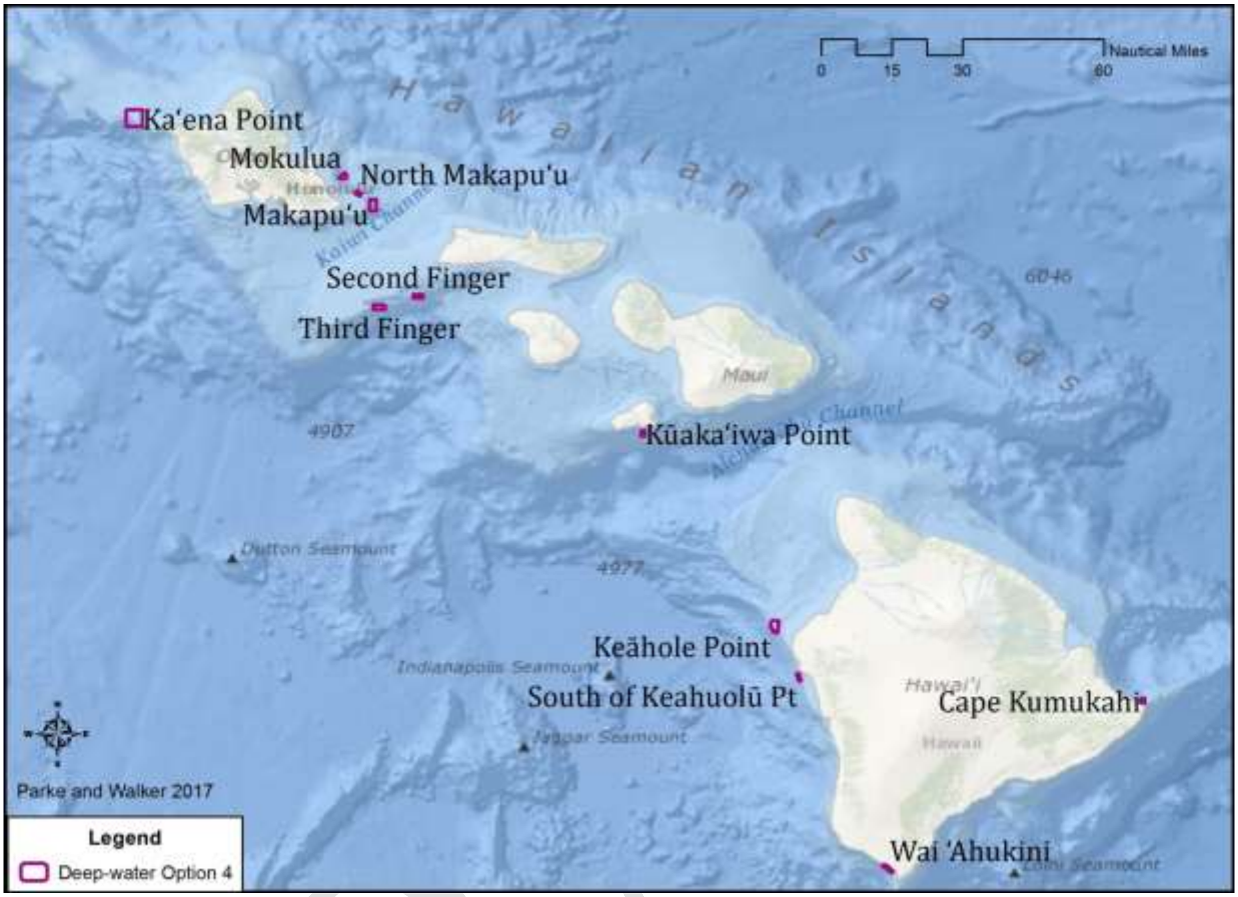

Figure 10. Precious coral beds in the MHI based on BSIA

The full EFH description for deep-water precious coral species under this alternative is as follows:

> EFH for the benthic phase of *Pleurocorallium secundum*, *Hemicorallium laauense*, and *Acanella* sp. is natural, stable, hard substrates between the 200 and 600 m isobaths in areas with higher current velocities, low sedimentation, and where precious corals are clustered in the nineteen beds as defined below:

1. Wai ʻAhukini (Pōhue Bay to Ka Lae) includes the area bounded by a geodesic line connecting points 1 and 2, the 200 m isobath connecting points 2 to 3, a geodesic lines connecting points 3 to 4, and the 600 m isobath connecting points 4 to 1, with the locations for points identified in the following table:

Point Identifier	Longitude	Latitude
1	155° 44' 06.81" W	18° 57' 23.19" N
2	155° 43' 36.79" W	18° 57' 46.13" N
3	155° 41' 49.73" W	18° 56' 24.39" N
4	155° 41' 58.68" W	18° 56' 00.56" N
1	155° 44' 06.81" W	18° 57' 23.19" N

Lava flows mark the longitudinal edges of this bed, while the 200 and 600 m isobaths bound the bed to the north and south.

Rationale: The bed has been surveyed to the western edge, where suitable habitat ends at the edge of the flow. To the east, the bed likely continues to the edge of the flow. This bed has been surveyed twice with HURL dive and once with the Okeanos Explorer. A polygon more accurately captures the observations and flow features than a circle.

2. South of Keahuolū Pt.: includes the area bounded by a geodesic line connecting points 1 and 2, the 200 m isobath connecting points 2 and 3, a geodesic line connecting point 3 to 4, and the 600 m isobath connecting points 4 to 1, with the locations for points identified in the following table:

Point Identifier	Longitude	Latitude
1	156° 02' 15.99" W	19° 38' 15.16" N
2	156° 01' 49.49" W	19° 38' 15.25" N
3	156° 01' 19.60" W	19° 36' 49.65" N
4	156° 01' 50.32" W	19° 36' 36.91" N
1	156° 02' 15.99" W	19° 38' 15.16" N

This bed encompasses several ridges on which precious corals have been observed.

Rationale: The boundary in the north was matched to the last ridge dip, and the last observation in the south. The longitudinal boundaries are the 200 m to 600 m depth range. Participants noted that along the West Hawaii coastline, stable, hard substrates within the 200 m to 600 m depth range are likely to support red corals.

3. Keāhole Point includes the area bounded by geodesic lines connecting points 1 to 2, 2 to 3, and 3 to 4; the 200 m isobath connecting points 4 to 5; a geodesic line connecting point 5 to 6, and the 600 m isobath connecting point 6 to 1, with the locations for points identified in the following table:

Point Identifier	Longitude	Latitude
1	156° 07' 43.04" W	19° 49' 27.50" N
2	156° 06' 53.40" W	19° 49' 36.41" N
3	156° 06' 00.63" W	19° 49' 28.49" N
4	156° 06' 00.63" W	19° 49' 17.70" N
5	156° 06' 21.37" W	19° 46' 57.98" N
6	156° 06' 55.87" W	19° 46' 56.24" N
1	156° 07' 43.04" W	19° 49' 27.50" N

This bed encloses observations at Keāhole Point and is bounded by the 200 and 600 m depth range.

Rationale: Observations do not occur within the regulatory definition of the Keāhole Point bed. The observations are clustered around a bathymetric feature. The northernmost and southernmost observations provide the latitudinal boundaries, while the 200 m and 600 m isobaths provide the longitudinal boundaries.

4. Cape Kumukahi: includes the area bounded by geodesic lines connecting the following coordinates in the order listed:

Point Identifier	Longitude	Latitude
1	154° 49' 12.87" W	19° 32' 58.53" N
2	154° 48' 20.32" W	19° 32' 58.53" N
3	154° 48' 20.32" W	19° 31' 57.47" N
4	154° 49' 12.87" W	19° 31' 57.47" N
1	154° 49' 12.87" W	19° 32' 58.53" N

Rationale: The bed was discovered on geologic dives of the Makaliʻi vehicle. Positioning of the vehicle includes only a single point, does not cover a lot of ground, and is limited to 366 m. Because multiple dives (points in the observations) resulted in coral observations, the area is probably a bed, though not well studied. The bathymetry surrounding the observations would promote current acceleration necessary for precious corals. The bed is limited to most of the observations, not all, given the positioning limitations of the vehicle. Participants noted that the bathymetry is interesting in this area, and the southern, unexplored half may have more corals. The entire point is likely good habitat for corals.

5. Kūakaʻiwa Pt. (Kahoʻolawe) includes the area bounded by geodesic lines connecting the following coordinates in the order listed:

Point Identifier	Longitude	Latitude
1	156° 35' 23.36" W	20° 29' 48.07" N
2	156° 34' 29.74" W	20° 29' 48.07" N
3	156° 34' 29.74" W	20° 28' 40.74" N
4	156° 35' 23.36" W	20° 28' 40.74" N
1	156° 35' 23.36" W	20° 29' 48.07" N

The bed at Kūakaʻiwa Pt. encompasses a promontory.

Rationale: The bed is bounded by the extreme observations, because the dives associated with these observations were transect dives around the promontory. Precious corals were not seen on either side of the recorded observations. The participants noted that the cluster of observations to the west of this bed did not contain PCMUS.

6. Second Finger (Penguin Bank East): includes the area bounded by geodesic lines connecting the following coordinates in the order listed:

Point Identifier	Longitude	Latitude
1	157° 23' 46.25" W	20° 58' 46.94" N
2	157° 21' 38.10" W	20° 58' 46.94" N
3	157° 21' 38.10" W	20° 57' 59.63" N
4	157° 23' 46.25" W	20° 57' 59.63" N

1	157° 23' 46.25" W	20° 58' 46.94" N

The bed is named after the bathymetric feature on which it occurs.

Rationale: The observations occur over a bathymetric feature – the second finger – and so the feature serves as the limits of the bed.

7. Third Finger (Penguin Bank West): includes the area bounded by geodesic lines connecting the following coordinates in the order listed:

Point Identifier	Longitude	Latitude
1	157° 32' 14.79" W	20° 56' 29.52" N
2	157° 29' 39.20" W	20° 56' 29.52" N
3	157° 29' 39.20" W	20° 55' 32.10" N
4	157° 32' 14.79" W	20° 55' 32.10" N
1	157° 32' 14.79" W	20° 56' 29.52" N

The bed is named after the bathymetric feature on which it occurs.

Rationale: The observations occur over a bathymetric feature – the third finger – and so the feature serves as the limits of the bed.

8. Makapu‘u Bed: includes the area bounded by geodesic lines connecting the following coordinates in the order listed:

Point Identifier	Longitude	Latitude
1	157° 33' 00.00" W	21° 19' 06.37" N
2	157° 32' 48.70" W	21° 18' 58.98" N
3	157° 32' 13.21" W	21° 18' 55.28" N
4	157° 31' 30.00" W	21° 18' 56.76" N
5	157° 31' 30.00" W	21° 16' 30" N
6	157° 33' 00.00" W	21° 16' 30" N
1	157° 33' 00.00" W	21° 19' 06.37" N

This bed is the most studied in the MHI, although its eastern extent is unexplored. The end of hard substrate bounds the bed in the north.

Rationale: The northern end of the bed is clearly defined by the end of hard substrate. The north, south, and west borders were those outlined in Long and Baco (2014). Participants noted that in subsequent dives, the vehicle traveled further south than in Long and Baco (2014), confirming that the bed does not continue to the south. The eastern extent of the bed is unknown, so the observations provide the eastern extent, consistent with Long and Baco (2014).

9. North Makapu‘u Bed: includes the area bounded by geodesic lines connecting the following coordinates in the order listed:

Point Identifier	Longitude	Latitude
1	157° 36' 04.69" W	21° 20' 12.00" N
2	157° 35' 40.43" W	21° 20' 51.89" N
3	157° 34' 42.04" W	21° 20' 20.64" N
4	157° 35' 06.30" W	21° 19' 38.70" N
1	157° 36' 04.69" W	21° 20' 12.00" N

The bed at north Makapuʻu encompasses two pancake dome features.

Rationale: The observations are clustered around two pancake dome features found within the depth range of the species. The features served as a guide for the boundaries.

10. Mokulua Islands: includes the area bounded by geodesic lines connecting the following coordinates in the order listed:

Point Identifier	Longitude	Latitude
1	157° 39' 35.62" W	21° 23' 30.19" N
2	157° 38' 38.88" W	21° 24' 27.75" N
3	157° 38' 13.80" W	21° 24' 36.80" N
4	157° 37' 55.71" W	21° 24' 24.87" N
5	157° 37' 52.83" W	21° 24' 04.73" N
6	157° 37' 51.18" W	21° 23' 32.24" N
7	157° 39' 05.19" W	21° 23' 14.97" N
1	157° 39' 35.62" W	21° 23' 30.19" N

The bed off Mokulua Islands encompasses a promontory and offshore pinnacle characterized by large gold corals occurring on the eastern side of the pinnacle and other corals on the edges of the promontory.

Rationale: The observations are found on the promontory and pinnacle. The boundaries are tightened to the edges of the feature, as the habitat is not found adjacent to the features.

11. Kaʻena Point: includes the area bounded by geodesic lines connecting the following coordinates in the order listed:

Point Identifier	Longitude	Latitude
1	158° 24' 42.46" W	21° 37' 58.47" N
2	158° 21' 10.65" W	21° 37' 58.47" N
3	158° 21' 10.65" W	21° 34' 20.06" N
4	158° 24' 42.46" W	21° 34' 20.06" N
1	158° 24' 42.46" W	21° 37' 58.47" N

The bed at Kaʻena Point is characterized by high flow.

Rationale: The bed at Ka‘ena Point is defined as EFH currently and has a regulatory boundary. The area is not well studied. The boundaries were drawn to encompass all observations in the area within the depth range of 200 m to 600 m.

12. Cross Seamount: includes the area bounded by geodesic lines connecting the following coordinates in the order listed:

Point Identifier	Longitude	Latitude
1	158° 17' 13.06" W	18° 42' 32.92" N
2	158° 15' 10.67" W	18° 45' 09.71" N
3	158° 14' 16.23" W	18° 42' 49.90" N
4	158° 16' 45.18" W	18° 41' 45.01" N
1	158° 17' 13.06" W	18° 42' 32.92" N

The bed at Cross Seamount encompasses a few pinnacles with dense precious coral communities. The corals are concentrated only on the pinnacle features and are not found between the pinnacles.

Rationale: Corals are very concentrated in a few areas across Cross Seamount, and some features which contain what is considered good habitat do not have coral growth. Coral distribution is patchy across the seamount. This bed contrasts with those found in West Hawaii, which are fairly dense throughout the depth range instead of patchy and concentrated on pinnacle features.

NWHI

1. Westpac Bed: includes the area within a radius of 2.253 nm of a point at 162° 36' 57.90" W, 23° 15' 33.10" N. This bed encompasses the feature on which precious corals have been observed; their distribution is patchy throughout the bed.

   Rationale: A circular shape is fitting because the bed is located on a high point with observations in a circle around the high point. The central coordinate was updated from the regulatory definition to encompass the observation on the feature. The bed could extend deeper than the observations, but its extent is unknown at this time.

2. French Frigate Shoals East: includes the area bounded by geodesic lines connecting the following coordinates in the order listed:

Point Identifier	Longitude	Latitude
1	165° 50' 11.04" W	23° 53' 40.56" N
2	165° 47' 52.82" W	23° 53' 40.56" N
3	165° 47' 52.82" W	23° 50' 58.76" N
4	165° 50' 11.04" W	23° 50' 58.76" N
1	165° 50' 11.04" W	23° 53' 40.56" N

The bed east of French Frigate Shoals is defined by a bathymetric feature.

Rationale: The observations at this bed are reliably located at the edges of the bed. The bed occurs on pinnacles on the bathymetric feature.

3. Laysan: includes the area within a radius of 1.706 nm of a point at 171° 57' 37.69" W, 25° 51' 44.11" N. This bed encompasses the feature on which red corals have been observed.

   Rationale: A circular shape is fitting because it encompasses all the observations on the feature.

4. Pioneer Bank: includes the area within a radius of 2.580 nm of a point at 173° 27' 56.34" W, 25° 49' 15.02" N. This bed encompasses the feature on which precious corals have been observed.

   Rationale: A circular shape is fitting because it encompasses all the observations on the feature.

5. Bank 8: includes the area within a radius of 1.136 nm of a point at 174° 30' 34.01" W, 26° 13' 34.21" N. This bed encompasses the feature on which precious corals have been observed.

   Rationale: A circular shape is fitting because it encompasses all the observations on the feature.

6. Helsley Seamount: includes the area within a radius of 1.684 km of a point at 179° 34' 01.80" W, 28° 52' 04.36" N. This bed encompasses the feature on which precious corals have been observed.

   Rationale: A circular shape is fitting because it encompasses all the observations on the feature.

7. Baby Brooks Bank: includes the area within a radius of 2.866 nm of a point at 166° 42' 12.29" W, 23° 58' 49.60" N. This bed encompasses the feature on which precious corals have been observed. This is a dense, diverse bed similar to Makapuʻu characterized by black corals on the northeast and northwest sides of the bank.

EFH for the benthic phase of *Kulamanamana haumeaae* is the tissue or skeleton of bamboo coral colonies, particularly *Acanella* sp., the preferred hosts of the parasitic *K. haumeaae* in depths between 200 and 600 m, in the nineteen beds defined above.

The following definitions are included to assist managers and the public with determining the scope of EFH and the potential impacts to that habitat.

Precious coral beds include the precious corals themselves, the specific biological hosts needed for settlement by gold corals, and may include a wide variety of commensal organisms that live within and upon the corals, and the various vertebrate and invertebrate organisms that are typically found among these corals, such as fish, asteroids, shrimp, squat lobsters, barnacles, holothurians and others. These communities have yet to be comprehensively catalogued, but are composed of a wide variety of taxa that demonstrate a level of complexity and co-dependence commensurate with shallow-water coral reef communities.

Natural stable, hard substrates include any hard bottoms that are not of artificial origin, such as bedrock, large boulders, slabs, blocks, etc. Parrish found that precious coral taxa colonize both carbonate and basalt/manganese substrates (2007). *H. laauense* grows in an intermediate relief of outcrops; and *K. haumaae* is most commonly seen growing in high relief areas on pinnacles, walls, and cliffs.

Higher current velocities refer to the accelerated or localized, enhanced flow necessary to sweep away sediment and increase the flux of organic matter (Genin et al., 1992). While the particular current velocity that promotes precious coral settlement and growth is unknown, Grigg (1974) estimated corals preferred areas of solid substrate swept clean by currents faster than 0.25 m/s and based on initial modeling of tidal flow (Carter et al 2008) it is hypothesized deep corals prefer velocities ranging somewhere between 5 – 0.85 m/s (Parrish et al. 2017). While the particular current velocity that promotes precious coral settlement and growth is unknown, Carter et al. (2008) hypothesized that deep-sea corals prefer areas with current velocities 0.5 – 0.85 m/s while Grigg (1974) determined that precious corals prefer solid substrate in areas that are swept relatively clean by currents faster than 0.25 m/s. Recent work in the Hawaiian Islands indicates that previously hypothesized numbers may be too high, based on mean values. Parrish found that the some precious corals favor areas where bottom relief enhances or modifies flow characteristics that may improve the colony’s feeding success (Parrish, 2007). Strong currents help prevent the accumulation of sediments, which would smother young coral colonies and prevent settlement of new larvae. Grigg (1984) notes that, in Hawai‘i, large stands of *Corallium* are only found in areas where sediments almost never accumulate, and *P*. *secundum* appears in large numbers in areas of high flow over carbonate pavement (Parrish et al., 2017; Parrish and Baco, 2007).

Alternative 4 includes additional, unharvested beds within the definition of essential habitat. This alternative would focus habitat conservation efforts on existing and newly discovered beds. Non-fishing adverse impacts to these beds would be evaluated through the EFH consultation mechanism, theoretically reserving the beds for fisheries harvest or refugia, should the fishery develop. Some of the new beds have been surveyed for density of precious corals, but most do not have metrics of density; the Council could therefore consider some of these for bed reclassification in a later action. Because of the long recovery time of precious corals, the Precious Coral FMP elucidated the prudent policy of permitting commercial exploitation in Exploratory Areas only after assessments of the virgin stocks are made. The assessment should at least include total area of the bed and estimates of density of various species present (WPRFMC, 1979).

<u>Expected Fishery Outcomes</u>

There are no expected fishery outcomes to the MHI precious coral fishery associated with the refinement and addition of EFH based on geographic boundaries of precious coral beds in the

FEP. The ultimate outcome of refining the EFH of deep-water precious coral species would be to improve management of precious coral assemblages through improved documentation and understanding of their habitat descriptions. Impacts to the fishery are not expected to impact because of low participation to the point of the fisheries being considered inactive. Refining the EFH designations in the FEP allows for the protection of more habitat where precious coral species are known to occur. Refining the designations based on observation data will be more accurate than doing so based on depth range, where large swaths of habitat may be designated despite no precious coral species occurring. Adding new beds to the EFH designations will improve understanding of species distribution in the archipelago.

2.3 Description of the Alternatives for Action 2

The shallow-water precious corals inhabit depths between 20 m and 120 m (Wagner, 2015). There are two alternatives for update of the geographic extent of shallow-water precious coral EFH designations: no action or updating the habitat characteristics and geographic extent of existing EFH.

2.3.1 Alternative 1: No action (Status Quo/Current Management)

Alternative, No Action, would retain the current definitions of EFH.

Three black coral beds in the MHI were designated as EFH for the shallow-water species: between Miloli‘i and South Point on Hawaii, ‘Au‘au Channel between Maui and Lana‘i and the southern border of Kauai (WPRFMC, 1998). The bed at ‘Au‘au Channel is defined in the FEP implementing regulations, and is also designated as HAPC.

This alternative excludes 29.4 percent of the shallow-water black coral observations in the Hawaiian Archipelago. This designation only provides the geographic extent of EFH for one of the designated areas, as inferred from the implementing regulations, without providing any habitat characteristics of the waters and substrate necessary to the species for spawning, feeding, or growth to maturity. While maps are provided of the estimated beds between Miloli‘i and South Point and the southern border of Kaua‘i, these beds are not geographically described in the FEP implementing regulations or in text descriptions within the EFH or bed definitions sections of the FEP. FMPs must identify the specific geographic location or extent of habitats described as EFH.[5]

[5] 50 CFR § 600.815(a)(1)

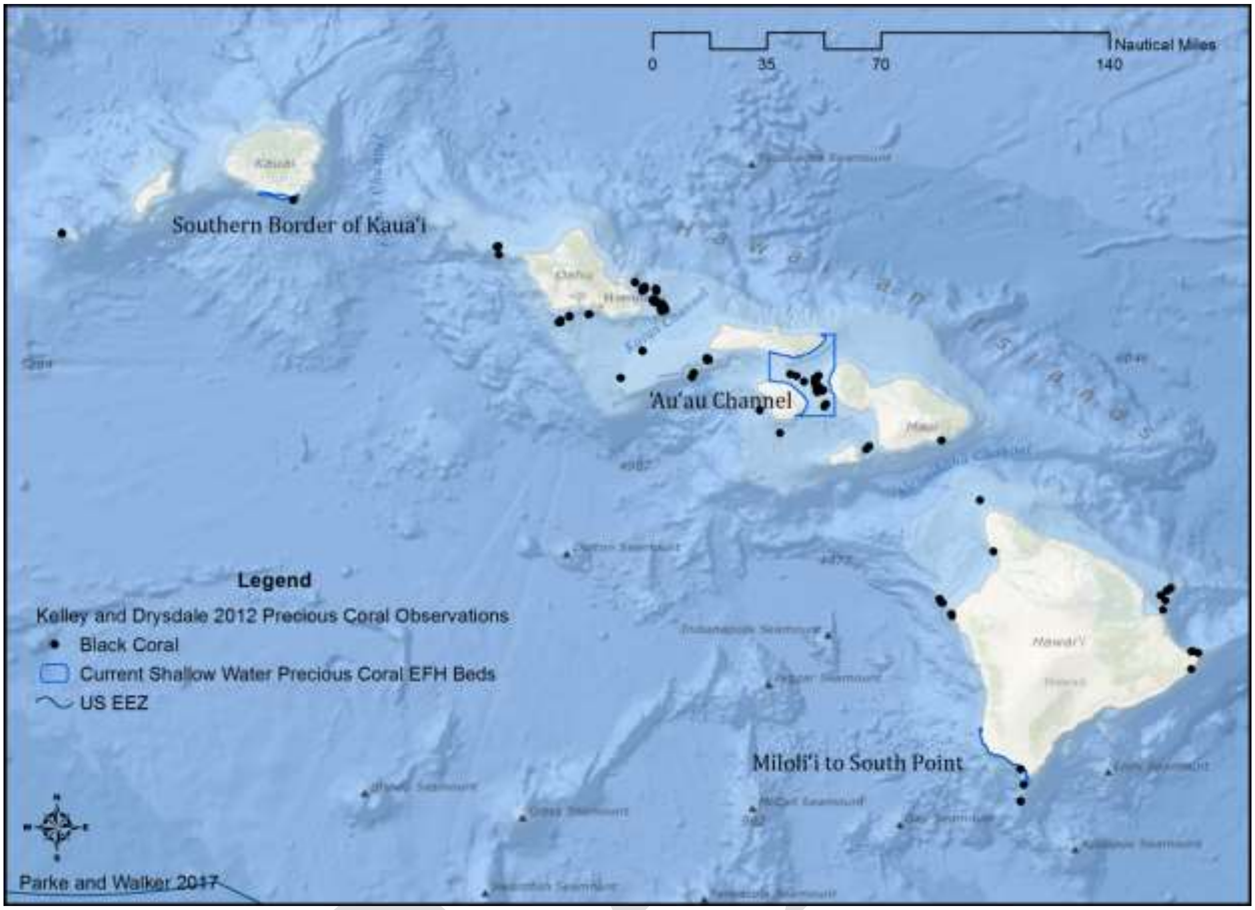

Figure 11. Current shallow-water EFH beds from Kelley and Drysdale (2012)

<u>Expected Fishery Outcomes</u>

Given the updated scientific information available for PCMUS in the MHI, there is no benefit for selecting the No Action alternative. While the No Action alternative maintains EFH in shallow-water species assemblages, the EFH descriptions and identification are inconsistent with the best available scientific data in some cases, and therefore inadequate. The No Action alternative is not expected to impact the general location, gear used, catch, effort, intensity, number of participants, seasonality, timing, number of sets or trips, target species, permits required, or other salient features of precious coral fisheries in the MHI in any notable manner. The fishery would continue operating as it has in recent years.

2.3.2 Alternative 2: Refine the geographic boundary and habitat characteristics of existing deep-water precious coral beds in the MHI (preferred)

Alternative 2 would refine the geographic boundary and habitat characteristics of existing shallow-water precious coral beds in the MHI. Based on new information, the geographic boundary and habitat characteristics would be updated to reflect the boundaries for the beds between Miloliʻi and South Point on Hawaii Island and the south shore of Kauai, and updates the ʻAuʻau Channel bed.

Habitat Characteristics

The habitat characteristics of the EFH textual descriptions are provided below. Because there is no information on the larval life stage of shallow-water precious coral species other than they are negatively phototaxic[6], EFH alternatives are not presented.

> EFH for the benthic phase of *Antipathes griggi*, *A. grandis* and *Myriopathes ulex* is natural, stable, hard substrates between the 20 and 120 m isobaths along steep drop-offs in areas with higher current velocities, low sedimentation, and where precious corals are clustered.
>
> The following definitions are included to assist managers and the public with determining the scope of EFH and the potential impacts to that habitat.
>
> Precious coral beds include the precious corals themselves, and may include a wide variety of commensal organisms that live within and upon the corals, and the various vertebrate and invertebrate organisms that are typically found among these corals, such as fishes, asteroids, shrimp, squat lobsters, barnacles, holothurians, and others. These communities have yet to be comprehensively catalogued, but are composed of a wide variety of taxa that demonstrate a level of complexity and co-dependence commensurate with shallow-water coral reef communities.
>
> Natural stable, hard substrates include any hard bottoms that are not of artificial origin, such as bedrock, large boulders, slabs, blocks, etc.
>
> Higher current velocities refer to the accelerated or localized, enhanced flow necessary to sweep away sediment and increase the flux of organic matter (Genin et al., 1992). Grigg (1974) determined that precious corals prefer solid substrate in areas that are swept relatively clean by currents faster than 0.25 m/s. Strong currents help prevent the accumulation of sediments, which would smother young coral colonies and prevent settlement of new larvae.

Geographic Extent

This alternative would also provide an estimate of the geographic extent of the shallow-water precious coral beds, facilitating the consultation process and meeting the requirement for the description and identification of EFH. This alternative provides boundaries for the beds between Miloli‘i and South Point on Hawaii Island and the south shore of Kauai, and updates the ‘Au‘au Channel bed. The EFH designation under this alternative is as follows.

> EFH for the benthic phase of *Antipathes griggi*, *A. grandis* and *Myriopathes ulex* is natural, stable, hard substrates between the 20 and 120 m isobaths along steep drop-offs in areas with higher current velocities, low sedimentation, and where precious corals are clustered in the three beds defined as follows:

[6] 50 CFR Part 600.815(a)(iii)(B)

1. ‘Au‘au Channel: includes the area bounded by geodesic lines connecting the following coordinates in the order listed:

Point Identifier	Longitude	Latitude
1	156° 49' 25.31" W	20° 57' 30.91" N
2	156° 42' 28.66" W	20° 57' 30.91" N
3	156° 42' 28.66" W	20° 50' 28.77" N
4	156° 49' 25.31" W	20° 50' 28.77" N
1	156° 49' 25.31" W	20° 57' 30.91" N

The bed in ‘Au‘au Channel contains ridges and solution basins within the given boundaries. The bed is limited to these characteristic bathymetric features surrounding observations of black corals. Densities of *A. grandis* peak around 80 m while *A. griggi* density declines around 80 m.

Rationale: The existing ‘Au‘au Channel bed extends north to Moloka‘i and west into the Kalohi Channel, into areas which to not contain black coral habitat. To the south, the solution basins characteristic of the channel are too deep to support black corals. The EFH bed boundaries are limited to ridges and solution basins around black coral observations which are considered good habitat for black coral. The drowned land bridge in the channel is unique in the Pacific, and that the offshore area does not receive sedimentation from agriculture. Harvest of black corals likely does not occur below scuba diving depths.

2. Miloli‘i to Ka Lae: includes the area bounded by a geodesic line connecting points 1 and 2, the 20 m isobath connecting points 2 to 3, a geodesic lines connecting points 3 to 4, and the 120 m isobath connecting points 4 to 1, with the locations for points identified in the following table:

Point Identifier	Longitude	Latitude
1	155° 45' 43.13" W	18° 59' 38.62" N
2	155° 41' 01.17" W	18° 54' 22.73" N
3	155° 41' 11.22" W	18° 54' 22.79" N
4	155° 45' 43.13" W	18° 59' 38.62" N
1	155° 45' 43.13" W	18° 59' 38.62" N

The bed between Miloli‘i and Ka Lae (South Point) is less studied. *A. grandis* dominates but *A. griggi* occurs in some areas. The bed slopes fairly continuously from the shallow end of the black coral depth range to the deep end.

Rationale: A slope specification or bathymetric features cannot constrict this bed like the other shallow-water beds, because it is not as well studied. Submersible dives have observed the lower limit of the bed, because *A. grandis* occurs to the 120 m depth range. The northern boundary is marked by the limits of a scuba diving survey, which is about halfway between Ka Lae and Kaunā Point. Habitat is not present past Ka Lae to the east.

3. South Shore Kauai: includes the areas with slopes greater than 9 degrees, buffered at 10 meters, bounded by a geodesic line connecting points 1 and 2, the 20 m isobath connecting points 2 to 3, a geodesic lines connecting points 3 to 4, and the 120 m isobath connecting points 4 to 1, with the locations for points identified in the following table:

Point Identifier	Longitude	Latitude
1	159° 36' 03.50" W	21° 53' 11.79" N
2	159° 23' 14.38" W	21° 54' N
3	159° 23' 01.93" W	21° 52' 02.57" N
4	159° 36' 03.50" W	21° 52' 46.01" N
1	159° 36' 03.50" W	21° 53' 11.79" N

The bed on the south shore of Kauai is on old seashore stands that are near vertical in slope. *A. grandis* dominates, but *A. griggi* occurs in some areas.

Rationale: Where the black corals are found, they occur in high densities, but the ledge on which the corals grow is not a continuous feature across the given depth range within the bounding coordinates. Slope was used to restrict the bed to the preferred habitat for this bed only. A 9 degree slope covers more area that is known to be optimal habitat for producing geographic boundaries; the real slope of the habitat may be greater than 30 degrees but this threshold does not translate well to the bathymetric data source. Surveys have been conducted as far north as Kipu Kai in the east, and corals were not found in this location. Hanapēpē is the edge of the survey effort in the west.

This alternative provides the geographic extent of EFH for the existing shallow-water EFH beds based on the BSIA. No new beds of the same density of black corals are known to exist in the management area of the FEP.

<u>Expected Fishery Outcomes</u>

There are no anticipated impacts to the MHI precious coral fishery associated with the refinement of EFH geographic areas in the FEP. The ultimate outcome of refining the EFH of shallow-water precious coral species would be to improve management of precious coral assemblages through improved documentation and understanding of their habitat descriptions. Impacts to the fishery are not expected because of low participation to the point of the fisheries being considered inactive. Refining the EFH designations in the FEP allows for improved protection of more habitat where precious coral species are known to occur.

2.4 Description of the Alternatives for Action 3

This action provides for updating the narrative requirements for the EFH portions of FEPs. Fishery management plans must include information about fishing activities that may adversely affect EFH, prey species of the managed fish, non-fishing impacts, cumulative impacts, actions to encourage the conservation and enhancement of EFH and research and information needs for describing EFH. The fishing gear types used in the Western Pacific federally and territorially-managed fisheries have not changed since the approval of the EFH designations in 1999, and are therefore not updated in this review. A review of non-fishing impacts provisions of the Council's FEPs are undergoing a separate process.

2.4.1 Alternative 1: Update the FEP narrative information on EFH (preferred)

The Council-preferred alternative with respect to updating narrative information on EFH in the FEP is to update the FEPs based on the new information. Because National Standard 2 (NS2) requires that conservation and management measures be based on the BSIA, this alternative is reasonable. The Council's ecosystem component species amendment does affect the requirements of the FEPs, and species which are in the ecosystem component species complex do not require EFH provisions.

<u>Expected Fishery Outcomes</u>

There are no anticipated impacts to the MHI precious coral fishery associated with the updated of narrative information in the FEP. The ultimate outcome of updating the narratives would be improving management of precious coral assemblages through improved documentation and understanding of their habitat descriptions.

Prey Species

There has been very little research conducted concerning the food habits of precious corals. Precious corals are filter feeders (Grigg, 1984; Grigg, 1993). The sparse research available suggests that particulate organic matter and microzooplankton are important in the diets of pink and bamboo coral (Grigg, 1970). Many species of pink coral, gold coral (*Kulamanamana haumeaae (*prev. *Gerardia* sp.*)* and black coral (*Antipathes*) form fan shaped colonies (Grigg, 1984; Grigg, 1993). This type of morphological adaption maximizes the total area of water that is filtered by the polyps (Grigg, 1984; Grigg, 1993). Bamboo coral (*Lepidisis olapa*), unlike other species of precious corals, is unbranched (Grigg, 1984). Long coils that trail in the prevailing currents maximize the total amount of seawater that is filtered by the polyps (Grigg, 1984). While clearly, the presence of strong currents is a vital factor determining habitat suitability for precious coral colonies, their role to date is not fully understood.

Research and Information Needs

The WPRFMC would be able to more effectively address the EFH provisions for PCMUS if the following information were available:

- Statistically sound estimates of distribution, abundance, and condition of precious corals throughout the MHI. Targeted surveys of areas that meet the depth and hardness criteria could provide very accurate estimates.
- Environmental conditions necessary for precious coral settlement, growth, and reproduction. The same surveys used for abundance and distribution could collect these data as well.
- Quantitative measures of growth and productivity.

- Taxonomic investigations to ascertain if the *H. laauense* that is commonly observed between 200 and 600 meters depth is the same species as those *H. laauense* observed below 1000 meters in depth.
- Continuous backscatter or *LIDAR* data in depths shallower than 60 m.
- Annotation of HURL videos collected since 2012, converted to a GIS format.
- Annotation of Okeanos Explorer.
- Aging of samples collected from the Okeanos missions, and annotation of the videos collected, converted to a GIS format with attributes.

Precious Corals Species Descriptions

The final part of this action includes updating the precious coral species descriptions, or narrative information which is the justification for the EFH text description. The original species descriptions are found in Appendix A. Species Descriptions for Precious Corals to the FEPs; the updated species descriptions can be found in Appendix A. Species Descriptions for Precious Corals of this document.

2.4.2 Alternative 2: Do not update the FEP narrative information on EFH

This alternative for no action would retain the current narrative information on precious coral EFH in the FEP. Because NS2 requires that conservation and management measures be based on the BSIA, this alternative is not reasonable.

<u>Expected Fishery Outcomes</u>

Given the updated scientific information available for PCMUS in the MHI, there is no benefit for selecting the No Action alternative. While the No Action alternative maintains EFH in shallow-water species assemblages, the EFH descriptions and identification are inconsistent with the best available scientific data in some cases, and therefore inadequate. The No Action alternative is not expected to impact the general location, gear used, catch, effort, intensity, number of participants, seasonality, timing, number of sets or trips, target species, permits required, or other salient features of precious coral fisheries in the MHI in any notable manner. The fishery would continue operating as it has in recent years.

3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

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

3.1 Affected Physical Resources

The precious coral fishery operating in the Hawaiian Archipelago is not known to impact air noise, water quality, view planes, or other associated physical resources given the offshore and benthic nature of the fishery and its relatively low amount of activity over the past two decades (see Section 1.1.1).

3.2 Affected Biological Resources

3.2.1 Target Species – Precious Corals

The managed species associated with the proposed action and its alternatives are precious coral species occurring in the waters surrounding the MHI. Precious corals management unit species (PCMUS) refers to any coral of the genus *Corallium* in addition to the following species of corals:

- Pink coral, *Pleurocorallium secundum*
- Red coral, *Hemicorallium laauense*
- Gold coral, *Kulamanamana haumeaae*
- Gold coral, *Narella* sp.
- Gold coral, *Calyptrophora* sp.
- Gold coral, *Callogorgia gilberti*
- Bamboo coral, *Lepidisis olapa*
- Bamboo coral, *Acanella* sp.
- Black coral, *Antipathes griggi*
- Black coral, *Antipathes grandis*
- Black coral, *Myriopathes ulex*

Some progress has also been made toward clarifying some of the taxonomic challenges presented by these species. First, the name of the most important species of gold coral, *Gerardia* sp., has been updated to *Kulamanamana haumeaae* by Sinniger, et al. (2013). Second, two of the most important species in the family Coralliidae, *Corallium secundum* (pink coral) and *Corallium regale* (red coral) have been placed into separate genera, the latter also becoming a different species (Figueroa and Baco, 2014). Their new names are now *Pleurocorallium secundum* and *Hemicorallium laauense*, respectively. Third, two changes have taken place in the black corals. *Antipathes dichotoma* is now *Antipathes griggi* and *Antipathes ulex* has been moved to a different genus and is now *Myriopathes ulex* (Opresko, 2009).

This action is not expected to change the status or involvement of the precious coral fishery in any way, but rather it looks to make available information on the EFH of precious coral species more accurate. There are no available catch or effort data for the fishery, and current designations of EFH for precious coral species are incomplete. Due to the inherent lack of data on precious corals and their habitat in the Central Pacific Ocean, previous EFH designations relied on information such as depth and wide swaths of benthic habitat was deemed EFH for precious corals despite the lack of precious coral species there. However, impacts to the fishery are not expected because of low participation to the point of the fisheries being considered inactive.

While there are no anticipated adverse impacts from this action on vulnerable marine or coastal ecosystems, the action does designate new beds of deepwater coral. There are no non-target or bycatch species associated with the MHI precious coral fishery. There are no expected adverse impacts from the proposed action or its alternatives on biodiversity or ecosystem function. See Section 2.4.1 for additional information on precious coral prey species and associated research and information needs. Additional information on individual precious coral species descriptions is available in Appendix A. Species Descriptions for Precious Corals.

General Distribution

Precious corals (with currently accepted species names) are known to exist in American Samoa, Guam, Hawaii and the Northern Mariana Islands, as well as throughout the other US islands in the Pacific, but the only detailed assessments of precious corals have been in Hawaii (Parrish and Baco, 2007, Parrish et al., 2015; Wagner, et al., 2015). In the Hawaiian Archipelago there are seven legally-defined beds of pink, gold and bamboo corals.. In the MHI, the Makapuʻu bed is located off Makapuʻu, Oahu, at depths of between 250 and 575 meters. Discovered in 1966, it the precious coral bed that has been most extensively surveyed in the Hawaiian chain. Its total area is about 4.5 km^2. Its substrate consists largely of hard limestone (Grigg, 1988). Careful examination during numerous dives with submersibles has determined that about 20% of the total area of the Makapuʻu bed is comprised of irregular lenses of thin sand, sediments and barren patches (WPRFMC, 1979). These sediment deposits are found primarily in low lying areas and depressions (Grigg, 1988). Thus, the total area used for extrapolating coral density is 3.6 km^2, or 80% of 4.5 km^2 (WPRFMC, 1979).

Precious coral beds have also been found in the deep inter-island channels such as ʻAuʻau, Alalakeiki, and Kolohi channels off of Maui, around the edges of Penguin Banks, off promontories such as Keāhole Point, on older lava flows south from Keāhole to Ka Lae, off of Hilo Harbor, and off of Cape Kumukahi on the Big Island of Hawaii (Oishi, 1990; Grigg, 2001, 2002; Putts, *pers. comm*., 2017). On Oahu, there is a bed off Kaʻena Point, and multiple precious coral observations have been made from offshore Barber's Point extending to offshore Pearl Harbor, Oahu. On Kauai, a bed of black corals has been identified offshore of Poipu (WPRFMC, 1979). A dense bed has been located on the summit of Cross Seamount, southwest of the island of Hawaii. This bed covers a pinnacle feature on the top of the summit, but does not contain numbers of corals large enough to sustain commercial harvests (Kelley, pers. comm., 2015).

Using a rough estimate for the mean weights of gold and bamboo coral colonies (2.2 kg and 0.6 kg), a standing crop of about 11,880 kg of gold coral and 10,800 kg for bamboo for Makapuʻu bed was obtained.

In the NWHI, a small bed of deep-water precious corals have been found on WestPac bed, between Nihoa and Necker Islands and east of French Frigate Shoals. This bed is not large enough to sustain commercial harvests. Precious coral beds have also been discovered at Brooks Banks, Pioneer Bank, Bank 8, Seamount 11, Laysan, and French Frigate Shoals (Parrish and Baco, 2007; Parrish et al., 2015). ROV surveys conducted throughout the NWHI by the Okeanos Explorer during 2015 discovered multiple places that had dense colonies of deep-sea corals. Few of these colonies were precious corals, but these dives were mostly conducted in waters deeper than normal distributions of precious corals (>1500 meters). However, large areas of potential habitat exist in the NWHI on seamounts and banks near 400 m depth. Based on the abundance of potential habitat, it is thought that stocks of precious corals may be more abundant in the northwestern end of the island chain. All precious coral stocks within the boundaries of the

Papahānaumokuākea National Marine Monument or Coral Reef Ecosystem Reserve are reserved from harvest, and most habitat suitable for precious corals growth falls within the boundaries of the monument.

Precious corals have also been discovered at the 180 Fathom Bank, north of Kure Island. The extent of this bed is not known. Precious corals have been observed during submersible and ROV dives throughout the Northwestern Hawaiian Islands, and in EEZ waters surrounding Johnston, Jarvis, Palmyra, and Kingman atolls, but little can be definitively said about the overall distribution and abundance of precious corals in the central Pacific region.

In addition to these legally defined areas of precious corals, many other sites have been discovered that sustain populations of precious corals (Parrish and Baco, 2007; Parrish et al., 2015; Wagner et al., 2015). The map below (Figure 12) provides a color-coded illustration of some of these 5,217 observations (Kelley and Drysdale, 2012, unpublished data). Given the number of observations and the wide distribution of precious corals in the main Hawaiian Islands, it is almost certain that undiscovered beds of precious corals exist in the EEZ waters of the region managed by the WPRFMC. Whether these beds would contain organisms at sufficient densities and size distributions to support commercial harvests is yet to be determined.

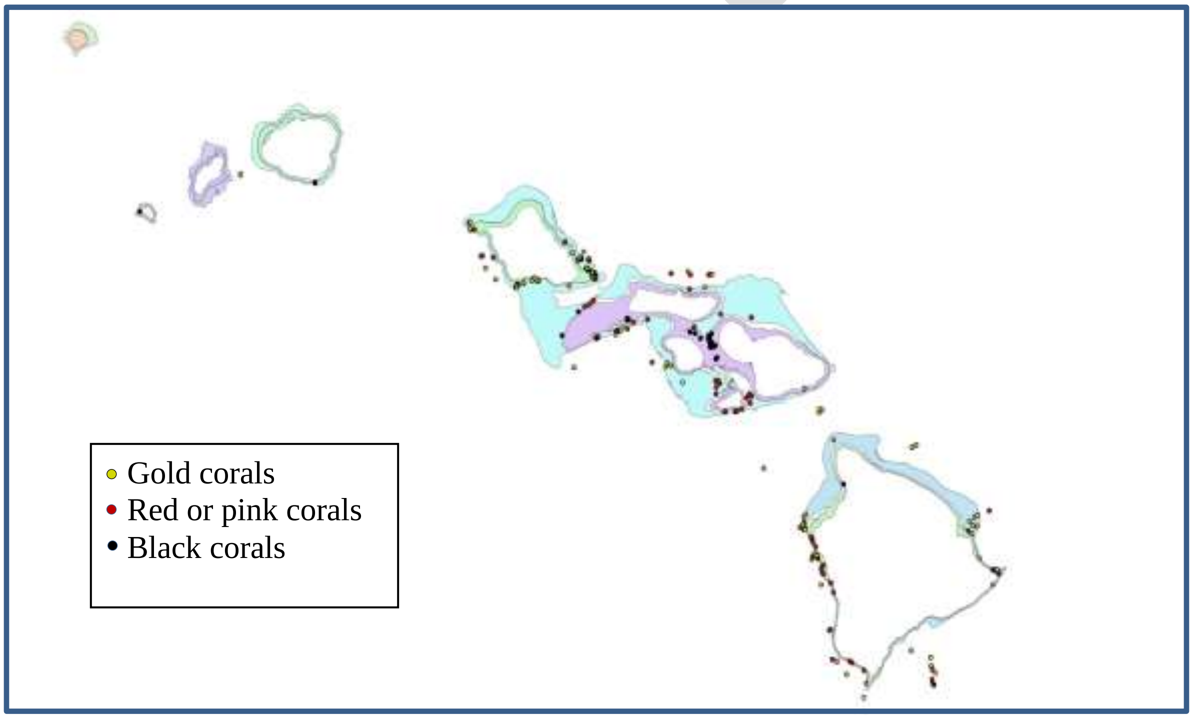

Figure 12. Observations of precious corals in the MHI

Biology and Life History

There has been little work done directed at evaluating the growth and life history parameters of PCMUS.

Studies by Gleason et al. (2006) and Waller and Baco (2007) indicate that the gold coral *Kulamanamana haumaae* may have seasonal reproduction, and that two pink coral species have a periodic or quasi-continuous reproductive periodicity. Recent mesophotic coral reef ecosystem studies provide an outline of essential knowledge for the limited deep-water coral ecosystem (Kahng et al., 2010). Slow-growing deep-water coral ecosystems are sensitive to many disturbances, such as temperature change, invasive species and destructive fishing techniques.

While different species of precious corals inhabit distinct depth zones, their habitat requirements are strikingly similar. Grigg (1984) noted that these corals are non-reef building and inhabit depth zones below the euphotic zone. In an earlier study, Grigg (1974) determined that precious corals are found in deep-water on solid substrate in areas that are swept relatively clean by moderate to strong bottom currents (>25 cm/sec). Precious corals are known to grow on a variety of bottom substrate types. Precious coral yields, however, tend to be higher in areas of shell sandstone, limestone and basaltic or metamorphic rock with a limestone veneer. The habitat sustaining precious corals is generally in pristine condition.

There has been very little research conducted concerning the food habits of precious corals. Precious corals are filter feeders (Grigg, 1984; 1993). The sparse research available suggests that particulate organic matter and microzooplankton are important in the diets of pink and bamboo coral (Grigg, 1970). Many species of pink coral, gold coral (*Kulamanamana haumeaae (*prev. *Gerardia* sp.*)* and black coral (*Antipathes*) form fan shaped colonies (Grigg, 1984; 1993). This type of morphological adaption maximizes the total area of water that is filtered by the polyps (Grigg, 1984; 1993). Light is one of the most important determining factors of the upper depth limit of many species of precious corals (Grigg, 1984).The larvae of two species of black coral, *Antipathes grandis* and *A. griggi*, are negatively phototaxic**.** Grigg (1984) stated that temperature does not appear to be a significant factor in delimiting suitable habitat for precious corals.

Growth rates for several species of precious corals found in the western Pacific region have been estimated. Grigg (1976) stated that the height of pink coral (*P. secundum*) colonies increases about 0.9 cm/year up to about 30 years of age. These growth rates are probably overestimated, and should be revisited using modern methodologies, such as radiometric dating (Roark et al., 2006). As noted in the FMP for precious corals, the height of the largest colonies of *Pleurocorallium secundum* at Makapu‘u bed rarely exceed 60 cm. Colonies of gold coral are known to grow up to 250 cm tall while bamboo corals may reach 300 cm. The natural mortality rate of pink coral at Makapu‘u bed is believed to be 0.066, equivalent to an annual survival rate of about 93%.

Pink, bamboo and gold corals all have planktonic larval stages and sessile adult stages. Larvae settle on solid substrate where they form colonial branching colonies. Grigg (1993) notes that the lengths of the larval stage of all deep-water species of precious corals is unknown. Clean swept areas exposed to strong currents provide important sites for settlement of the larvae, Grigg adds.

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 dumerili*) and deep-water shrimp (*Heterocarpus ensifer*). These species do not seem to depend on the coral for shelter or food.

Precious corals may be divided primarily into two groups of species based on their depth ranges: the deep-water species (200-600m) and the shallow-water species (20-120m). Other precious corals can be found in depths down to 2000 m, but these species are not exploited in the United States for commercial purposes. Deep-sea corals are found on hard substrates on seamounts and continental margins worldwide at depths of 300 to 3,000 m.

Deep Corals

The Pacific Islands deep-water precious coral species include pink coral, *Pleurocorallium secundum* (prev. *Corallium secundum*), red coral, *Hemicorallium laauense* (prev. *C. regale or C. laauense*), gold coral, *Kulamanamana haumeaae (*prev. *Gerardia sp*.) and bamboo coral, *Lepidistis olapa*. As previously discussed, the most valuable precious corals are gorgonian octocorals (Grigg, 1984). There are seven varieties of pink and red precious corals in the western Pacific region, six of which used to be recognized as distinct species of *Corallium* (Grigg, 1981), but have been reclassified (Parrish *et al.*, 2015). The two species of commercial importance in the EEZ around the Hawaiian Islands are the pink coral *Pleurocorallium secundum* (prev. *Corallium secundum*), and the red coral, *Hemicorallium laauense* (prev. *C. laauense*). The Gorgonian octocorals are by far the most abundant and diverse corals in the Hawaiian Archipelago. Two species, *Pleurocorallium secundum* and *Hemicorallium laauense* are known to occur at depths of 300-600 m on islands and seamounts throughout the Hawaiian Archipelago (Grigg 1974, 1993; Parrish *et al.*, 2015; Parrish and Baco, 2007). Parrish (2007) surveyed *Pleurocorallium secundum* and *Hemicorallium laauense* at 6 precious coral beds in the lower Hawaiian chain, from Brooks Bank to Keāhole Point, Hawaii, in depths ranging from 350m to 500m. He found corals on summits, flanks, and shallow banks, with bottom substrate and relief at these sites ranging from a homogenous continuum of one type to a combination of many types at a single site. The survey results show that all three coral taxa colonize both carbonate and basalt/manganese substrates, and the corals favor areas where bottom relief enhances or modifies flow characteristics that may improve the colony's feeding success.

These corals can grow to more than 30 cm in height, and are often found in large beds with other octocorals, zoanthids, and sometimes scleractinians (Parrish *et al.*, 2015; Parrish and Baco, 2007). These species are relatively long lived, with some of the oldest colonies observed within Makapuʻu Bed about 0.7 m in height and at least 80 years old (Grigg, 1988b, Roark, 2006). Populations of *P. secundum* appear to be recruitment limited, although in favorable environments (e.g., Makapuʻu Bed) populations are relatively stable, suggesting that recruitment and mortality are in a steady state (Grigg, 1993). During surveys of lava flows off the western flanks of Hawaii Island, Putts (*pers. comm*., 2017) found that Coralliidae dominated the early successional stages, and using dates established for those flows, determined that a mature Corallidae community can be established within 150 years. A study by Roark et al. (2006) showed that the radial growth rate for specimens of *P. secundum* in the Hawaiian Islands is ~170 µm/year and average age is 67 to 71 years, older than previously calculated. Individual colonies have been measured as tall as 28 cm. Bruckner (2009) suggested that the minimum allowable size for genus *Corallium* for harvest should be increased, and supported a potential listing for *Corallium* within the Appendices of the Convention on International Trade in Endangered Species (CITES). The current size restriction in the 2010 Code of Federal Regulations for Pacific Islands Region is 10 in (25.4 cm).

Shallow Corals

The second group of precious coral species is found in shallow-water between 20 and 120 m (Grigg, 1993; Kelley and Drysdale, *unpublished data*, 2012; Wagner et al., 2015). The shallow-water fishery is comprised of three species of black coral, *Antipathes griggi*, *A. grandis* and *Myriopathes ulex,* which have historically been harvested in Hawaii (Oishi 1990), but over 90% of the coral harvested by the fishery consists of *A. griggi* (Oishi 1990; Parrish et al., 2015; Wagner et al., 2015). Other black coral species are found in the NWHI in a wider depth range (20m to 1,400m), but with lower colony density (Wagner et al., 2011). Surveys performed in depths of 40-110 meters in the Au‘au Channel in 1975 and 1998, suggested stability in both recruitment and growth of commercially valuable black coral populations, and thus indicated that the fishery had been sustainable over this time period (Grigg, 2001). Subsequent surveys performed in the channel in 2001 indicated a substantial decline in the abundance of black coral colonies, with likely causes including increases in harvesting pressure and overgrowth of black coral colonies by the invasive octocoral *Carijoa sp.* and the red alga, *Acanthophora spicifera*, especially on reproductively mature colonies at mesophotic depths (Grigg, 2003; Grigg, 2004; Kahng and Grigg 2005; Kahng, 2006). Together, these factors renewed scrutiny on the black coral fishery and raised questions about whether regulations need to be redefined in order to maintain a sustainable harvest (Grigg, 2004). In addition to these challenges, Wagner has suggested that taxonomic misidentification has led to the mistaken belief that there is a depth refuge that exists for certain harvested species (Wagner et al., 2012; Wagner, 2011). All of these uncertainties and lack of basic life history information regarding black corals complicates effective management of the resource (Grigg, 2004).

In Hawaii, *A. griggi* accounts for around 90% of the commercial harvest of black coral (Oishi 1990). *A. grandis* accounts for 9% and *M. ulex* 1% of the total black corals harvested. In Hawaii, roughly 85% of all black coral harvested are taken from within state waters (WPRFMC 1979). Black corals are managed jointly by the State of Hawai‘i and the Council. Within state waters (0–3 nmi), black corals are managed by the State of Hawai‘i (Grigg, 1993).

A new name for the Hawaiian species of antipatharian coral previously identified as *Antipathes dichotoma* (Grigg and Opresko, 1977) is described as *Antipathes griggi* (Opresko, 2009). The shallow-water black coral *A. dichotoma* (*A. griggi*) collected at 50 m exhibited growth rates of 6.42 cm/year over a 3.5 year study.

3.2.2 Non-Target Species

Traditionally, foreign fisheries for precious corals utilized non-selective dredges and tangle nets. The Precious Corals FEP estimated that when non-selective gear is used, 40% of the corals that are “knocked down” during the harvesting process are recovered. The existing FEP, however, only allows selective gear to harvest corals from any precious corals permit area. Selective gear means any gear used for harvesting corals that can discriminate or differentiate between type, size, quality, or characteristics of living or dead corals. Black coral are collected with SCUBA gear, and deep-water species of precious corals are harvested using manned submersibles or remotely-operated vehicles (ROVs). The use of manned submersibles is a highly selective method of harvest. Minimal bycatch is also expected with the use of ROVs, although the ROV tether may damage precious corals if not carefully tended.

3.2.3 Protected Species

Protected species include those species listed as endangered or threatened under the ESA, all marine mammals, listed or not, as they are protected under the MMPA, and seabirds, listed or not, as they are protected under the MBTA. A number of protected species are documented as occurring in the waters around the Hawaiian Islands including sea turtles, marine mammals, and seabirds. While extremely unlikely, there exists potential for interactions with the relatively inactive MHI precious coral fishery. This fishery has been evaluated for impacts on protected resources and is managed in compliance with the requirements of the Magnuson-Stevens Act, the Marine Mammal Protection Act (MMPA), the Endangered Species Act (ESA), the Migratory Bird Treaty Act, and other applicable statutes.

Species Protected under the ESA

Table 4 lists endangered or threatened species occurring around Hawaii including five sea turtles, the Hawaiian monk seal, five whales, four seabirds, and two fishes.

Table 4. Endangered and threatened marine species and seabirds with the possibility to interact with the MHI precious coral fishery

Common name (*Scientific name*)	ESA listing status in Hawaii	Occurrence in Hawaii
Listed Sea Turtles		
Green sea turtle (*Chelonia mydas*)	Threatened Distinct Population Segment (DPS) in Hawaii	Most common turtle in the Hawaiian Islands. Most nesting occurs in the northwestern Hawaiian Islands. Foraging and hauling out in the MHI.
Hawksbill sea turtle (*Eretmochelys imbricata*)	Endangered	Small population foraging around Hawaii and low level nesting on Maui and Hawaii Islands.
Leatherback sea turtle (*Dermochelys coriacea*)	Endangered	No nesting or foraging grounds in Hawaii. Rarely sighted while traveling between nesting and foraging habitats.
Olive riddle sea turtle (*Lepidochelys olivacea*)	Threatened	No nesting or foraging grounds in Hawaii. Infrequently sighted while traveling between nesting and foraging habitats.
North Pacific loggerhead (*Caretta caretta*)	Endangered DPS in Hawaii	No nesting or foraging grounds in Hawaii. Infrequently sighted while traveling between nesting and foraging habitats.
Listed Marine Mammals		

Common name (*Scientific name*)	**ESA listing status in Hawaii**	**Occurrence in Hawaii**
Hawaiian monk seal (*Neomonachus schauinslandi*)	Endangered	Endemic tropical seal. Occurs throughout the archipelago. Population trend uncertain; no mortality or serious injuries attributed to MHI bottomfish fishery (Carretta, et al. 2017).
Blue whale (*Balaenoptera musculus*)	Endangered	No sightings or strandings reported in Hawaii but acoustically recorded off Oahu and Midway Atoll. No record of interactions with the MHI Bottomfish Fishery.
Fin whale (*B. physalus*)	Endangered	Infrequent sightings in Hawaii waters.
Sei whale (*B. borealis*)	Endangered	Worldwide distribution. Primarily found in cold temperate to subpolar latitudes. Rare in Hawaii.
Sperm whale (*Physeter macrocephalus*)	Endangered	Found in tropical to polar waters worldwide. Sighted off the NWHI and the MHI.
MHI insular false killer whale (*Pseudorca crassidens*)	Endangered DPS in Hawaii	Found in waters within 140 km (60 nm) of the MHI.
Listed Sea Birds		
Newell's shearwater (*Puffinus auricularis newelli*)	Threatened	Rare. Breeds only in colonies on the MHI where it is threatened by predators and urban development.
Hawaiian petrel (*Pterodroma phaeopygia*)	Endangered	Rare.
Band-rumped storm-petrel (*Oceanodroma castro*)	Endangered DPS in Hawaii	Rare.
Short-tailed albatross (*Phoebastria albatrus*)	Endangered	Nest in small numbers on Midway Atoll in the NWHI.
Listed Fish		
Giant manta ray (*Manta birostris*)	Threatened	Found worldwide in tropical, subtropical, and temperate bodies of water and is commonly found offshore, in oceanic waters, and near productive coastlines.

Common name (*Scientific name*)	ESA listing status in Hawaii	Occurrence in Hawaii
Oceanic whitetip shark (*Carcharhinus longimanus*)	Threatened	Found worldwide in tropical and sub-tropical waters. They live from the surface of the water to at least 498 feet deep.
Critical Habitat		
Monk seal critical habitat	Endangered	Includes the seafloor and marine habitat to 10 m above the seafloor from the 200 m depth contour through the shoreline, and extending into terrestrial habitat 5 m inland from the shoreline between identified boundary points around all islands in the MHI*.
Insular False killer whale critical habitat	Endangered DPS in Hawaii	Extends from the 45-m depth contour to the 3,200-m depth contour around the MHI from Niihau east to Hawaii.

Source: https://www.fisheries.noaa.gov/species-directory/threatened-endangered, accessed December 3, 2018.
*Details of specific areas are available through the following webpage:
http://www.fpir.noaa.gov/Library/PRD/Hawaiian%20monk%20seal/Hawaiian_monk_seal_critical_habitat_Main_Hawaiian_Islands_Coastal_Habitat_Points.pdf, accessed December 3, 2018.

Species Protected under the MMPA

Several non-ESA listed whales, dolphins, and porpoises occur in waters around Hawaii. All marine mammal species are protected under provisions of the MMPA. Table 5 provides a list of non-ESA listed marine mammals known to or reasonably expected to occur in waters around the Hawaiian Archipelago, thought they are unlikely to interact with MHI precious coral fisheries.

The precious coral fisheries in the MHI are not known to have adverse effects on non-ESA listed marine mammals (Table 5). Although all species occur in the EEZ where the fisheries operate, there are no interactions documented between the fishery and the marine mammals listed in Table 5. The species listed in Table 5 may be found within the action area and could theoretically interact with precious fisheries in the MHI, however, no incidental takes of these species have been reported in the fishery.

Table 5. Non-ESA-listed marine mammals occurring in waters around the MHI

Common Name	Scientific Name	Interactions with MHI bottomfish fishery
Blainville's beaked whale	*Mesoplodon densirostris*	No interactions observed or reported.
Bottlenose dolphin	*Tursiops truncatus*	Some interactions observed or reported.
Bryde's whale	*Balaenoptera edeni*	No interactions observed or reported.
Common dolphin	*Delphinus delphis*	No interactions observed or reported.

Common Name	Scientific Name	Interactions with MHI bottomfish fishery
Cuvier's beaked whale	*Ziphius cavirostris*	No interactions observed or reported.
Dall's porpoise	*Phocoenoides dalli*	No interactions observed or reported.
Dwarf sperm whale	*Kogia sima*	No interactions observed or reported.
False killer whale (other than MHI Insular DPS)	*Pseudorca crassidens*	No interactions observed or reported.
Fraser's dolphin	*Lagenodelphis hosei*	No interactions observed or reported.
Humpback whale	*Megaptera novaeangliae*	No interactions observed or reported.
Killer whale	*Orcinus orca*	No interactions observed or reported.
Longman's beaked whale	*Indopacetus pacificus*	No interactions observed or reported.
Melon-headed whale	*Peponocephala electra*	No interactions observed or reported.
Minke whale	*B. acutorostrata*	No interactions observed or reported.
Pantropical spotted dolphin	*Stenella attenuate*	No interactions observed or reported.
Pygmy killer whale	*Feresa attenuata*	No interactions observed or reported.
Pygmy sperm whale	*K. breviceps*	No interactions observed or reported.
Risso's dolphin	*Grampus griseus*	No interactions observed or reported.
Rough-toothed dolphin	*Steno bredanensis*	No interactions observed or reported.
Short-finned pilot whale	*Globicephala macrorhynchus*	No interactions observed or reported.
Spinner dolphin	*Stenella longirostris*	No interactions observed or reported.
Spotted dolphin	*Stenella attenuata*	No interactions observed or reported.
Striped dolphin	*Stenella coeruleoalba*	No interactions observed or reported.

Source: Council website, http://www.wpcouncil.org, accessed 12/4/2018.

Seabirds of the Hawaiian Archipelago

Seabirds forage in both state and federal waters, but are not known, and are unlikely to interact with the MHI precious coral fishery. Interactions with the precious coral fishery are unlikely because of the methods used to harvest these benthic, sessile species. Precious coral fishermen typically utilize a submersible that does not impact seabirds. There have been no reports of interactions between the MHI precious coral fishery and seabirds.

Table 6 lists all of the seabirds found on and around Hawaii that could potentially interact with fisheries. The short-tailed albatross, an endangered species, is a migratory seabird that nests in low numbers in the NWHI and has been seen flying over the waters around Hawaii. Other listed seabirds found in the region are the endangered Hawaiian petrel, the Band-rumped storm-petrel, and the threatened Newell's shearwater. Non-ESA-listed seabirds known to be present in Hawaii include the black-footed albatross, Laysan albatross, wedge-tailed, Audubon's, short-tailed and Christmas shearwaters, as well as the masked, brown, and red-footed boobies (or gannets), and a number of petrels and terns, frigate birds, and tropicbirds.

Table 6. Non-ESA-listed sea birds occurring in waters around the MHI

Seabirds of the Hawaiian Archipelago (R= Resident/Breeding; V= Visitor/Migrant)		
R/V	**Common name**	***Scientific name***
R	Hawaiian petrel	*Pterodroma phaeopygia* (ESA: Endangered)
R	Band-rumped storm-petrel	*Oceanodroma castro* (ESA: Endangered)
R	Newell's shearwater	*Puffinus auricularis newelli* (ESA: Threatened)
V	Short-tailed albatross	*Phoebastria albs.atrus* (ESA: Endangered)
R	Black-footed albatross	*Ph. nigripes*
R	Laysan albatross	*Ph. immutabilis*
R	Wedge-tailed shearwater	*Puffinus pacificus*
V	Short-tailed shearwater	*Pu. tenuirostris*
R	Christmas shearwater	*Pu. nativitatis*
V	Leach's storm-petrel	*Oceanodroma leucorhoa*
R	Red-footed booby	*Sula sula*
R	Brown booby	*S. leucogaster*
R	Masked booby	*S. dactylatra*
R	White-tailed tropicbird	*Phaethon lepturus*
R	Red-tailed tropicbird	*Ph. rubricauda*
R	Great frigatebird	*Fregata minor*
R	Sooty tern	*Onychoprion fuscatus,* formerly *Sterna fuscata*
R	Brown noddy	*Anous stolidus pileatus*
R	Black noddy	*A. minutus melanogenys*
R	White tern / Common fairy-tern	*Gygis albs.a rothschildi*

Source: WPRFMC (2009).

3.3 Socio-economic Setting

There are no socio-economic data available for the MHI precious coral fishery due to inactivity and data confidentiality issues. While the general gear used for harvest is known to be SCUBA and submersibles (WPRFMC 2018), there is a lack of participation that has led to inactivity in markets and earnings associated with the fishery. There are no expected impacts to human health or demographics associated with the refinement of precious coral EFH in the MHI, nor are there any anticipated environmental justice issues.

There are no known districts, sites, highways, structures, or objects that are listed in or eligible for listing in the National Register of Historic Places that would be impacted by this action. Additionally, precious coral fishing activities in the MHI are not known to result in adverse impacts to scientific, historic, archeological or cultural resources found on land or near the shoreline (e.g., park lands) of the MHI because fishing activities typically occur offshore in the benthic habitat via submersible; they do not operate within estuarine waters nor have the potential to impact wetlands. The fishery is generally inactive with relatively high barriers of entry.

3.3.1 Fishing Communities

The Magnuson-Stevens Act defines a fishing community as "...a community that is substantially dependent upon or substantially engaged in the harvest or processing of fishery resources to meet social and economic needs, and includes fishing vessel owners, operators, and crew, and fish processors that are based in such communities" (16 U.S.C. 1802 (16)). NMFS further specifies in the National Standard (NS) guidelines that a fishing community is "...a social or economic group whose members reside in a specific location and share a common dependency on commercial, recreational, or subsistence fishing or on directly related fisheries dependent services and industries (for example, boatyards, ice suppliers, tackle shops)". NS8 of the Magnuson-Stevens Act requires that conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and the 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.

In 2002, the Council identified each of the islands of Kauai, Niihau, Oahu, Maui, Molokai, Lanai and Hawaii as a fishing community for the purposes of assessing the effects of fishery conservation and management measures on fishing communities, providing for the sustained participation of such communities, minimizing adverse economic impacts on such communities, and for other purposes under the Magnuson-Stevens Act. The Secretary of Commerce subsequently approved these definitions on August 5, 2003 (68 FR 46112). Though Hawaii is comprised of fishing communities, there exists no supporting community for the precious coral fishery of the MHI, which lacks sustained participation from and economic effects to the communities.

3.3.2 Fishing Gear

Only selective gear may be used to harvest coral from any precious corals permit area. Selective gear means any gear used for harvesting corals that can discriminate or differentiate between type, size, quality, or characteristics of living or dead corals. Black coral are collected with SCUBA gear, and deep-water species of precious corals are harvested using manned submersibles or remotely-operated vehicles (ROVs). The use of manned submersibles is a highly selective method of harvest.

3.4 Management Setting

Currently, regulations require Western Pacific Precious Corals permit for anyone harvesting or landing black, bamboo, pink, red, or gold corals in the EEZ in the western Pacific. Over the past decade, the precious corals fishery in the MHI has generally been inactive, with less than three permits allocated each year creating issues in data confidentiality. In recent years, there has been a single permit given for the fishery (see Table 1). The fishing year for precious corals begins on July 1 and ends on June 30 the following year, except at the Makapu u Bed, which has a two-year fishing period that begins July 1 and ends June 30 two years later. If the NMFS Regional Administrator determines that the harvest quota for any coral bed will be reached prior to the end of the fishing year, or the end of the 2-year fishing period at Makapu#u Bed, NMFS will issue a Federal Register notice closing the bed involved by publication of an action in the Federal Register and through appropriate news media

The Papahānaumokuākea Marine National Monument prohibits precious coral harvests in the monument (Federal Register notice of final rule, 71 FR 51134, August 29, 2006). Regulations governing this fishery are in the CFR, Title 50, Part 665, Subpart F, and Title 50, Part 404 (Papahānaumokuākea Marine National Monument).

Fishing for coral on the WestPac Bed is not allowed. The specific area closed to fishing is all waters within a 2-nm radius of the midpoint of 23E18.0' N latitude, 162E35.0' W longitude.

It is unlawful for any person to:
(1) Use any vessel to fish for, take, retain, possess or land precious coral in any precious corals permit area, unless a permit has been issued for that vessel and area and that permit is on board the vessel.
(2) Fish for, take or retain any species of precious coral in any precious corals permit area by means of gear or methods prohibited; in refugia; or in a bed for which the quota specified has been attained.
(3) Take and retain, possess or land any live pink coral or live black coral from any precious corals permit area that is less than the minimum height.

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

Under the authority of the Magnuson-Stevens Act and the Hawaii FEP, NMFS is responsible for implementing regulations to appropriately manage the precious coral fishery in Federal waters surrounding the MHI. Under this responsibility, NMFS is required to specify annual catch limits (ACLs) and accountability measures (AMs) annually for each stock or stock complex of MUS identified in an FEP. The most recently implemented overfishing limits (OFLs), acceptable biological catch (ABC) levels, and ACLs are listed in Table 7. Catch statistics are not available for 2018 (and several years prior) due to data confidentiality and general fishery inactivity (Table 7). Additional management provisions are discussed in Section 1.1.1.

Table 7. OFLs, ABCs, and ACLs (lbs.) implemented for the MHI precious coral fishery

Precious Coral Management Unit Species	OFL	ABC	ACL	2018 Catch
‘Au‘au Channel - black coral	8,250	7,500	5,512	N.A.
Makapu‘u Bed - pink coral	3,307	3,009	2,205	N.A.
Makapu‘u Bed - bamboo coral	628	571	551	N.A.
180 Fathom Bank - pink coral	734	668	489	N.A.
180 Fathom Bank - bamboo coral	139	126	123	N.A.
Brooks Bank - pink coral	1,470	1,338	979	N.A.
Brooks Bank - bamboo coral	280	256	245	N.A.
Ka‘ena Point Bed - pink coral	220	201	148	N.A.
Ka‘ena Point Bed - bamboo coral	42	37	37	N.A.
Keāhole Bed - pink coral	220	201	148	N.A.
Keāhole Bed - bamboo coral	42	37	37	N.A.
Precious corals in MHI exploratory area	N.A.	2,205	2,205	N.A.

Source: WPRFMC (2018)

There may be potential impacts associated with potentially increased consultation as a result of new designation of EFH. There exists the potential for impacts to agencies working in areas inhabited by newly-designated EFH, though none are known of at this time. The ultimate outcome would be to improve management of precious coral assemblages through improved understanding of their habitat. There are no anticipated impacts to permitting and licensing, administration and enforcement, safety at sea, or associated with invasive species.

3.5 Resources Eliminated from Detailed Study

Considering historical and archaeological resources in federal waters of the MHI, there are no known districts, sites, highways, structures or objects that are listed in or eligible for listing in the National Register of Historic Places. Additionally, precious coral fishing activities in the MHI are not known to result in adverse impacts to scientific, historic, archeological or cultural resources found on land or near the shoreline (e.g., park lands) because fishing activities typically occur offshore; they do not operate within estuarine waters nor have the potential to impact wetlands. The proposed action and potential alternatives would not have large impacts to resources of scientific, historic, cultural, or ecological importance in the area.

4 ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES

This section describes the potential consequences of each alternative on the components of the affected environment or other socio-economic elements identified in Section 3.3 above to evaluate the effects of the considered management alternatives. It also describes potential environmental consequences that could result from the alternatives under consideration.

4.1 Potential Effects of Alternatives for Action 1

There are no known significant impacts to air quality, noise, water quality, view planes, terrestrial resources, or any other physical resources for the proposed action or any of its associated alternatives regarding EFH designation on deep-water precious corals in the MHI. The fishery's minimal fishing effort is not expected to change under any Alternative in a manner that would result in effects on physical resources. Therefore, given the characteristics of the gears used in the fishery and the lack of fishing activity, none of the proposed Alternatives for Action 1 would result in impacts to air quality, noise, water quality, view planes, or terrestrial resources.

4.1.1 Potential Effects of Alternative 1: No Action (Status Quo)

The boundaries of the precious coral beds are codified in the Fishery Ecosystem Plan (FEP) for the Hawai‘i Archipelago implementing regulations. This alternative excludes 59.8 percent of precious coral observations (Level 1 distribution data) within the US EEZ around the MHI. This designation only provides the geographic extent of EFH, inferred from the bed definitions in the implementing regulations, without providing any habitat characteristics of the waters and substrate necessary to the species for spawning, feeding, or growth to maturity.

Maintaining the same EFH definitions is not responsive to the Council's management objective for refining EFH using the BSIA. Distribution data from Kelley and Drysdale, 2012, unpublished data; Putts and Kahng, 2016, unpublished data, shows that the bed at Keāhole supports dense agglomerations of precious coral. The Keāhole bed definition does not contain any precious coral observations from the HURL dataset, and the Ka‘ena Point bed only contains one observation. The locations of the beds in the FEP have not been updated to reflect advances in positional accuracy.

Additionally, the current EFH designations are not consistent with the EFH Final Rule or agency guidance to refine EFH. The text descriptions are not geographically explicit and instead are inferred from the regulatory bed definitions. The text description does not include any habitat characteristics which are known to influence the distribution of precious corals. Agency guidance dictates that the geographic extent and the habitat characteristics, however, make up EFH.

Effects on Biological Resources

There are no anticipated adverse effects on biological resources in the management area expected from the No Action alternative for Action 1, as the MHI deep-water precious coral fishery would likely operate as it has in recent decades. Due to issues with data confidentiality and general inactivity, there is a lack of information regarding operations fishery in general.

However, because the general inactivity, there are no expected impacts to target, non-target, or protected species. There are no expected impacts to marine ecosystems nor their biodiversity or function from the lack of action. Even if relatively more active, the fishery operates using gear types at depths not known to interact with other fisheries or protected species.

Effects on Socio-economic Setting

There are no anticipated adverse effects on the socioeconomic setting of the MHI precious coral fishery expected from the No Action alternative for Action 1, as it would likely operate as it has in recent decades. Due to issues with data confidentiality and general inactivity, there exists no reliable information on deep-water precious coral markets or earnings in the MHI. There are no anticipated changes to health, demographics, human safety, or environmental issues associated with taking no action on refining the EFH of deep-water precious coral species around the Hawaii Archipelago. Because this alternative stipulates no updates to the EFH designations of Hawaii deep-water precious coral, no changes associated with the socioeconomic setting of the fishery are expected overall.

Effects on Management Setting

There are no anticipated effects from the No Action alternative of Action 1 on the management setting of the deep-water precious coral fishery in the Hawaii Archipelago, as current EFH designations would remain as they are currently. There are no expected changes to relevant administrative processes such as relevant fishery permitting or licensing, as this alternative enacts no change. There are no additional known impacts related to marine protected areas, enforcement, or fisher safety at sea.

Other Effects

The No Action alternative is not expected to have either beneficial or adverse impacts that might result in a significant effect, as the current EFH designations for deep-water precious coral species in the MHI would be maintained. The alternative may be controversial only in that not refining the EFH designations would go against NS2 ensuring BSIA is used in managing US fisheries. This alternative would likely not establish a precedent, given that NS2 requires BSIA. The impacts of the No Action alternative are not uncertain, as the fishery would continue to operate as it has in recent years into the near future.

4.1.2 Potential Effects of Alternative 2

The guidance to refine EFH states that the “EFH regulatory guidelines provide clear direction that it is not appropriate to identify wide swaths of the ocean and nearshore areas as EFH for a single species or life stage without considerable justification” (NMFS 2006). NMFS strongly recommends the analysis of EFH levels of information in order to distinguish EFH from all habitats potentially used by a species in its implementing guidelines, and emphasizes this need in its guidance to refine EFH (NMFS, 2006). EFH must be reviewed on a five year schedule, theoretically allowing the Council to reevaluate its decision based on new distribution data and fishery information.

Effects on Biological Resources

For Action 1, there are no known effects of Alternative 2 on biological resources in the management area, including target, non-target, and protected species. The refinement of deep-water precious coral species in the MHI based on depth range will only serve to change the EFH designations to include areas within a certain depth range and a certain substrate. While the new designation of EFH would likely be gratuitous, there are no expected impacts associated with the refinement. Alternative 2 has no known effects on marine ecosystems, their biodiversity, or their function. Under this alternative, the harvest of deep-water precious corals would continue as it has in recent years and is not expected to result in negative impacts.

Effects on Socio-economic Setting

Alternative 2 would have no known impacts on the socioeconomic setting associated with the MHI deep-water precious coral fishery. Refining the deep-water precious coral EFH designations in the MHI is not anticipated to have adverse effects on local fishing communities, human health, or demographics. No information is available on the markets or earnings associated with the MHI deep-water precious coral fishery due to issues with data confidentiality and general activity over time. Additionally, in the action area, there are no districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places, significant scientific, cultural, or historical resources or areas with unique characteristics of the geographic area, such as proximity to historic or cultural resources, or parklands.

Effects on Management Setting

Refining deep-water precious coral EFH using recently obtained depth and substrate information around the MHI has no likely effects on the management setting of the associated fishery. However, there exists the possibility that consultation efforts may increase associated with the increase of EFH area when generating the designations based on general depth range and substrate data as opposed to first-hand observations. While all of these areas are offshore, relatively deep, and associated with the benthic habitat, there is the potential that future activities utilizing these regions would have to consider the wide swaths of EFH for deep-water precious coral species. However, there are no administrative processes impacted by this action, included permitting and licensing. There are no adverse effects on marine protected areas, other EFH designations, or other enforcement factors. ACLs would continue to be implemented as they have been in recent years. All other regulations implemented by other federal agencies and the State of Hawaii would continue to apply. Administrative costs would likely remain at the same levels under Alternative 2 as the No Action alternative except in the irresolute case of increased consultation efforts necessitated by increased EFH area.

Other Effects

Alternative 2 for Action 1 is not expected to have either beneficial or adverse impacts that might result in a significant general effect, as the current EFH designations for deep-water precious coral species in the MHI would simply be updated to include areas recently discovered with appropriate substrate and depth range. The alternative may only be controversial in that the use of depth ranges does not constitute the BSIA with the availability of recent survey observations. Alternative 2 is not expected to establish a precedent, given that NS2 ultimately requires BSIA.

The impacts of Alternative 2 are contain no uncertainty regarding the MHI precious coral fishery, as the fishery would continue to operate as it has in recent years into the near future.

4.1.3 Potential Effects of Alternative 3

Effects on Biological Resources

There are no known effects to target species, non-target species, or protected species from Alternative 3 of the proposed Action 1. Refining EFH designations for deep-water precious corals in the MHI is not expected to change the activity of the fishery in anyway, which has been relatively inactive for the past two decades with less than three fishers annually. There are no known impacts to vulnerable marine ecosystems, their biodiversity, or their function from the description of more accurate EFH designations for deep-water precious coral species beds by refining their geographic boundaries. The updated geographic boundaries of deep-water precious coral beds in the MHI would increase the understanding of habitat essential to these species and augment how they are managed going forward.

Effects on Socio-economic Setting

Alternative 3, the preferred alternative, for Action 1 has no known impacts on the socioeconomic setting associated with the collection of MHI deep-water precious corals. There are no known negatively effects to the local fishing community from more accurately describing the geographic boundaries of these deep-water precious coral beds. While there is no available information on markets or earnings associated with the fishery, there are no adverse impacts expected from this preferred alternative on these socioeconomic factors. Alternative 3 is not known to have any impacts on districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places, significant scientific, cultural, or historical resources or areas with unique characteristics of the geographic area, such as proximity to historic or cultural resources, or parklands, as there are none present in the action area.

Effects on Management Setting

Refining deep-water precious coral EFH geographic boundaries around the MHI has no likely effects on the management setting of the associated deep-water precious coral fishery. Updating the geographic boundaries of known precious coral beds to more accurately describe the habitat they utilize will only serve to better manage the species going forward. While all of these areas are offshore, relatively deep, and associated with the benthic habitat, there is the potential that future activities utilizing these regions would have to consider the wide swaths of EFH for deep-water precious coral species. There are no administrative processes impacted by this action, included permitting and licensing. There are no adverse effects on marine protected areas, other EFH designations, or other enforcement factors. ACLs would continue to be implemented as they have been in recent years. All other regulations implemented by other federal agencies and the State of Hawaii would continue to apply. Administrative costs would likely remain at the same levels under Alternative 3 as the No Action alternative.

Other Effects

Alternative 3 for Action 1 is not expected to have either beneficial or adverse impacts that might result in a significant general effect, as the current EFH designations for deep-water precious coral species in the MHI would simply be updated to include areas recently discovered with appropriate substrate and depth range. The alternative may only be controversial in that the use of depth ranges does not constitute the BSIA with the availability of recent survey observations. Alternative 3 is not expected to establish a precedent, given that NS2 ultimately requires BSIA. The impacts of Alternative 3 contain no uncertainty regarding the MHI precious coral fishery, as the fishery would continue to operate as it has in recent years into the near future.

4.1.4 Potential Effects of Alternative 4 (preferred)

Effects on Biological Resources

There are no known effects to target species, non-target species, or protected species from Alternative 4 of the proposed Action 1. Refining EFH designations for deep-water precious corals in the MHI is not expected to change the activity of the fishery in anyway, which has been relatively inactive for the past two decades with less than three fishers annually. There are no known impacts to vulnerable marine ecosystems, their biodiversity, or their function from the description of more accurate EFH designations for deep-water precious coral species beds by refining their geographic boundaries. The updated geographic boundaries of deep-water precious coral beds in the MHI would increase the understanding of habitat essential to these species and augment how they are managed going forward. Adding the locations of new beds to the EFH designations ensures that the Council is adhering to NS2 by using the best available information to understand the habitat utilized by these species.

Effects on Socio-economic Setting

Alternative 4 for Action 1, the preferred alternative, has no known impacts on the socioeconomic setting surrounding the harvest of deep-water precious corals in the MHI. There are no known adverse effects to the local fishing community from more accurately describing the geographic boundaries of precious corals and adding new beds where they occur. While there is no available information on markets or earnings associated with the fishery, there are no negative consequences expected from this preferred alternative due to the lack of participation in the fishery and high barrier to entry. Alternative 4 is not known to have impacts to districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places, significant scientific, cultural, or historical resources or areas with unique characteristics of the geographic area, such as proximity to historic or cultural resources, or parklands as none of these are present in the action area.

Effects on Management Setting

Refining deep-water precious coral EFH geographic boundaries around the MHI has no likely effects on the management setting of the associated deep-water precious coral fishery. Updating the geographic boundaries of known precious coral beds to more accurately describe the habitat they utilize will only serve to better manage the species going forward. Adding new beds to these EFH designations will help increase understanding for future management to an even greater extent. While all of these areas are offshore, relatively deep, and associated with the benthic habitat, there is the potential that future activities utilizing these regions would have to consider the specific patches of substrate designated as EFH for deep-water precious coral species. There are no administrative processes impacted by this action, included permitting and licensing. There are no adverse effects on marine protected areas, other EFH designations, or other enforcement factors. ACLs would continue to be implemented as they have been in recent years. All other regulations implemented by other federal agencies and the State of Hawaii would continue to apply. Administrative costs would likely remain at the same levels under Alternative 4 as the No Action alternative.

Other Effects

Alternative 4 for Action 1 is not expected to have either beneficial or adverse impacts that might result in a significant general effect, as the current EFH designations for deep-water precious coral species in the MHI would simply be updated to include areas recently discovered with appropriate substrate and depth range. The alternative may only be controversial in that the use of depth ranges does not constitute the BSIA with the availability of recent survey observations. Alternative 4 is not expected to establish a precedent, given that NS2 ultimately requires BSIA. The impacts of Alternative 4 contain no uncertainty regarding the MHI precious coral fishery, as the fishery would continue to operate as it has in recent years into the near future.

4.1.5 Potential Cumulative Effects of the Alternatives

Cumulative effects refer to the combined effects on the human environment that result from the incremental impact of the proposed action, and its alternatives, when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-federal) or person undertakes such other actions. Further, cumulative effects can result from individually minor but collectively significant actions taking place over a period of time. The cumulative effects analysis examines whether the direct and indirect effects of the alternatives considered on a given resource interacts with the direct and indirect effects of other past, present and reasonably foreseeable actions on that same resource to determine the overall, or cumulative effects on that resource.

There are no known cumulative effects on physical resources, biological resources, socioeconomic setting, or management setting in the action area resulting from the refinement of EFH designations in the Hawaii FEP associated with MHI deep-water precious coral species, including the addition of newly discovered beds around the archipelago. Action 1 and its alternatives likely have no significant relationship to the identifiable effects of past, present, and reasonably foreseeable actions on elements of the affected environment, as the action proposes to simply alter the current geographic boundaries precious coral EFH to ones that are more accurate and include newly discovered areas. There are no anticipated effects to the precious coral resource stemming from a change in spatial habitat description due to the general inactivity of the fishery over time, the high barrier to entry into the fishery, and inherent lack of additional fishery participation and information. Since many water column impacts are temporary in nature, benthic alteration associated with laying cables and anchoring energy and aquaculture facilities are most likely to have an adverse impact and pose the greatest threat to EFH for post-settlement, sub-adult and adult life stages of precious corals. Large-scale impacts such as global climate change that affect ocean temperatures, currents, and potentially food chain dynamics can also threaten EFH for precious coral species.

Future analyses will seek to analyze cumulative impact of habitat conversion and the impacts of the MHI precious coral fishery in order to evaluate the cumulative impacts on EFH. Information and techniques that are developed for this process will be used to supplement future revisions of these EFH provisions as the information becomes available.

4.2 Potential Effects of Alternatives for Action 2

4.2.1 Potential Effects of Alternative 1: No Action (Status Quo)

There are no anticipated effects to physical resources, biological resources, socioeconomic setting, and management setting in the action area due to the No Action alternative associated with refining shallow-water precious coral EFH designations by geographic boundary in the Hawaii FEP (i.e. Action 2, the Council's preferred alternative). NS 2 requires that conservation and management measures be based on the BSIA, making the No Action alternative unreasonable. The No Action alternative is not expected to have either beneficial or adverse impacts that might result in a significant effect, as the current EFH designations for shallow-water precious coral species in the MHI would simply not be updated. The alternative may be controversial only in that not refining the EFH designations would go against NS2 ensuring BSIA is used in managing US fisheries. The No Action alternative for Action would likely not establish a precedent, given that NS2 requires BSIA. The impacts of the No Action alternative are not uncertain, as the fishery would continue to operate as it has in recent years into the near future if nothing notable were to change.

4.2.2 Potential Effects of Alternative 2 (preferred)

Effects on Physical Resources

There are no known significant impacts to air quality, noise, water quality, view planes, terrestrial resources, or any other physical resources for the proposed action or any of its associated alternatives regarding EFH designation on shallow-water precious corals in the MHI. The fishing activity experienced in the fishery is not expected to change under Alternative 2 in a manner that would result in effects on physical resources. Therefore, given the characteristics of the gears used to harvest shallow-water precious coral species in the MHI, the benthic nature of the fishery, and the severe lack of data, Alternative 2 would not result in impacts to air quality, noise, water quality, view planes, or terrestrial resources.

Effects on Biological Resources

There are no known effects to target species, non-target species, or protected species from Alternative 2 of the proposed Action 2. Refining EFH designations for shallow-water precious corals in the MHI is not expected to change the activity of the fishery in anyway, which is been minimal for over two decades. There are no known impacts to vulnerable marine ecosystems, their biodiversity, or their function from the description of more accurate EFH designations for shallow-water precious coral species. The updated geographic boundaries of shallow-water precious coral beds in the MHI would increase the understanding of habitat utilized by these species and ultimately enhance their management going forward.

Effects on Socio-economic Setting

Alternative 2 for Action 2, the preferred alternative, has no known impacts on the socioeconomic setting surrounding the harvest of shallow-water precious corals in the MHI. There are no known adverse effects to the local fishing community from more accurately describing the geographic boundaries of precious corals. While there is no available information on markets or earnings associated with the fishery, there are no negative consequences expected from this preferred alternative. Alternative 2 is not expected to have any impacts to districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places, significant scientific, cultural, or historical resources or areas with unique characteristics of the geographic area, such as proximity to historic or cultural resources, or parklands, as none of these are present in the action area.

Effects on Management Setting

There are no known impacts to the management setting associated with the refinement of EFH designations on the shallow-water precious coral bed in the waters surrounding the MHI. The proposed action and its associated Alternative 2 is an attempt to improve understanding surrounding preferred habitat for shallow-water precious coral species in the MHI. There are no administrative processes impacted by this action, included permitting and licensing. There are no adverse effects on marine protected areas, other EFH designations, or other enforcement factors. ACLs would continue to be implemented as they have been in recent years. All other regulations implemented by other federal agencies and the State of Hawaii would continue to apply. Administrative costs would likely remain at the same levels under Alternative 2.

Other Effects

This alternative is not expected to have either beneficial or adverse impacts that might result in a significant general effect, as the current EFH designations for shallow-water precious coral species in the MHI would be updated to more accurately capture precious coral beds recently refined through visual observations. This alternative is not expected to be controversial, as it would utilize BSIA and promote and improved management through increased understanding surrounding the habitat of shallow-water precious coral species in the MHI. Alternative 2 is not expected to establish a precedent, given that NS2 ultimately requires BSIA. The impacts of Alternative 2 are contain no uncertainty regarding the MHI precious coral fishery, as even with the refining of geographic boundaries for the MHI shallow-water coral beds, the fishery would be expected to continue to operate as it has in recent years into the near future.

4.2.3 Potential Cumulative Effects of the Alternatives

Cumulative effects refer to the combined effects on the human environment that result from the incremental impact of the proposed action, and its alternatives, when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-federal) or person undertakes such other actions. Further, cumulative effects can result from individually minor but collectively significant actions taking place over a period of time. The cumulative effects analysis examines whether the direct and indirect effects of the alternatives considered on a given resource interacts with the direct and indirect effects of other past, present and reasonably foreseeable actions on that same resource to determine the overall, or cumulative effects on that resource.

Similar to the cumulative effects associated with Action 1, there are no known cumulative effects on physical resources, biological resources, socioeconomic setting, or management setting in the action area resulting from the refinement of EFH designations in the Hawaii FEP associated with MHI shallow-water precious coral species. Action 2 and its alternatives likely have no significant relationship to the identifiable effects of past, present, and reasonably foreseeable actions on elements of the affected environment, as the action proposes to simply alter the current geographic boundaries precious coral EFH to ones that are more accurate. There are no anticipated effects to the precious coral resource stemming from a change in spatial habitat description due to the general inactivity of the fishery over time and inherent lack of additional fishery participation and information. Since many water column impacts are temporary in nature, benthic alteration associated with laying cables and anchoring energy and aquaculture facilities are most likely to have an adverse impact and pose the greatest threat to EFH for post-settlement, sub-adult and adult life stages of precious corals. Nearshore impacts associated with development have the potential to impact shallow water species. Large-scale impacts such as global climate change that affect ocean temperatures, currents, and potentially food chain dynamics can also threaten EFH for precious coral species.

4.3 Potential Effects of Alternatives for Action 3

There are no known effects to physical resources, biological resources, socioeconomic setting, and management setting in the action area due to updating or not updating the narrative information the Hawaii FEP associated with MHI precious coral EFH designation. NS 2 requires that conservation and management measures be based on the BSIA, making updating the FEP narratives associated with the MHI precious coral designations the Council-preferred alternative for this action. The fishery has been generally inactive in recent years, and is not expected to change based on the refinement of EFH or narrative descriptions thereof. There exist no data on markets or earnings associated with the MHI precious coral fishery, nor are there expected to be any relative differences due to this action. The management setting is not expected to change given either of these alternatives, either, as permitting requirements and ACL implementation processes are likely to remain the same going forward into the near future.

4.3.1 Potential Cumulative Effects of the Alternatives

Cumulative effects refer to the combined effects on the human environment that result from the incremental impact of the proposed action, and its alternatives, when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-federal) or person undertakes such other actions. Further, cumulative effects can result from individually minor but collectively significant actions taking place over a period of time. The cumulative effects analysis examines whether the direct and indirect effects of the alternatives considered on a given resource interacts with the direct and indirect effects of other past, present and reasonably foreseeable actions on that same resource to determine the overall, or cumulative effects on that resource.

There are no known cumulative effects to physical resources, biological resources, socioeconomic setting, and management setting in the action area due to updating or not updating the narrative information the Hawaii FEP associated with MHI precious coral EFH designation. The proposed action and its alternatives likely have no significant relationship to the identifiable effects of past, present, and reasonably foreseeable actions on elements of the affected environment, as the action simply requires updating FEP text based on new EFH designations.

5 APPLICABLE LAWS

Section 303 of the Magnuson Stevens Act requires that any fishery management plan prepared by any Council or by the Secretary of Commerce contain conservation and management measures that are consistent with the National Standards of the Act, other provisions of the Act, regulations implementing recommendations by international fishery management organizations and any other applicable law. This section identifies provisions of the Magnuson Stevens Act, and other applicable laws that the Council has identified the proposed action must comply with, and rational for why the Council believes this action is consistent with each applicable law.

5.1 Magnuson Stevens Fishery Conservation and Management

5.1.1 Section 303(a) Required Provisions

Conservation and Management Measures

This amendment does not add new conservation and management measures.

Fishery Descriptions

This amendment does not amend the description of the associated fisheries described in the FEPs.

MSY and OY Estimates

This amendment does not change the current specification of MSY or OY for any species. Descriptions of MSY and OY can be found for associated fisheries in the FEPs.

Domestic Capacity to Harvest and Process OY

This proposed action does not change the specification of the capacity to harvest OY. A description of the capacity for associated fisheries to harvest OY can be found in the FEPs.

Fishery Data Requirements

This amendment will not affect fishery data requirements as it is administrative in nature, refining EFH and HAPC designations for fisheries of the Western Pacific region.

Temporary Adjustments to Fishery Access

This action is not proposing any adjustments to fishery access due to inclement weather conditions.

Description of EFH

This action proposes to modify EFH designations to clarify the extent of EFH for precious coral management unit species in the main Hawaiian Islands. Under the EFH final rule, fishery management councils are advised to conduct a review and revision of the EFH components of FMPs every five years (600-815, Section 10). This is consistent with requirements of the MSA to identify EFH for managed species.

Scientific Data Needs

Scientific data necessary for effective implementation of the FEP, in this case regarding the refinement of EFH and HAPC designations for managed precious coral species, can be found in Section 2 with maps presented in Appendix B.

Fishery Impact Statement

This action is not expected to have any impact on fishers. It is administrative in nature, refining EFH and HAPC designations for fisheries of the Western Pacific region.

Status Determination Criteria

This amendment does not establish any new or change existing status determination criteria (SDC) for any species in the Western Pacific region. SDC, which are used to determine when a fishery is overfished or approaching an overfished condition, can be found in the FEPs.

Bycatch Reporting

The proposed action does not require any new bycatch reporting or provisions to assess bycatch in fisheries of the Western Pacific region.

Recreational Catch and Release

There are no catch and release fishery management programs authorized under the FEPs of the Western Pacific region, and no such programs are proposed in this action.

Description of Fishing Sectors

Descriptions of the commercial, recreational, and charter fishery sectors throughout the Western Pacific region can be found in the FEPs.

Allocation Considerations

The proposed action does not allocate harvest in any fishery; it solely provides alternatives for refinement of EFH and HAPC designations.

Annual Catch Limits and Accountability Measures

The proposed action does not establish any ACL or AM for any fishery; it solely provides alternatives for refinement of EFH and HAPC designations.

5.1.2 National Standards for Fishery Conservation and Management

National Standard 1 – Optimum Yield

Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry.

The reference points and control rules for precious corals in the Hawaiian Archipelago are not changed with this amendment, as the reference points and control rules are designed to achieve optimum yield through annual catch limits.

National Standard 2 – Scientific Information

Conservation and management measures shall be based upon the BSIA.

The proposed changes to EFH and HAPC for Hawaii precious coral beds are consistent with National Standard (NS) 2 because the alternatives incorporate the best scientific information available to update the EFH and HAPC designations and supporting narrative information.

National Standard 3 – Management Units

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.

To the extent practicable, precious coral species and beds are managed as units.

National Standard 4 – Allocations

Conservation and management measures shall not discriminate between residents of different States. If it becomes necessary to allocate or assign fishing privileges among various United States fishermen, such allocation shall be (A) fair and equitable to all such fishermen; (B) reasonably calculated to promote conservation; and (C) carried out in such manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges.

The measures in this FEP amendment are consistent with NS 4 because they do not discriminate between residents of different states or allocate fishing privileges among fishery participants.

National Standard 5 – Efficiency

Conservation and management measures shall, where practicable, consider efficiency in the utilization of fishery resources; except that no such measure shall have economic allocation as its sole purpose.

The measures in this FEP amendment are consistent with NS 5 because they do not require or promote inefficient fishing practices nor is economic allocation among fishery participants their sole purpose.

National Standard 6 – Variations and Contingencies

Conservation and management action shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches.

The measures in this FEP amendment are consistent with NS 6 because they allow for differences in EFH specifications. While an overall EFH designation is maintained, this amendment allows variation in the precious coral EFH and HAPC designations.

National Standard 7 – Costs and Benefits

Conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.

The measures in this amendment are not inconsistent with NS 7. The measures presented detail more specific EFH and HAPC designations for precious coral, but the overall EFH and HAPC remains the same, which requires consultation on behalf of other agencies when doing activities within the EFH and HAPC designated areas. There is no duplicity in the measures.

National Standard 8 – Communities

Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.

The measures in this amendment are consistent with NS 8 because they provide protections to precious coral EFH through required consultations with NMFS for activities that may impact the designated areas. This ensures the maintenance of the precious coral habitat, takes into account the precious coral fishery as a community resource, and provides for sustained participation in the fishery through maintaining the PCMUS beds.

National Standard 9 – Bycatch

Conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided minimize the mortality of such bycatch.

This amendment is not inconsistent with NS 9, although it does not specifically address bycatch. This amendment solely amends the EFH designations for the precious corals of the Hawaiian Archipelago.

National Standard 10 – Safety of Live at Sea

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

The measures in this amendment are consistent with NS 10 because they do not require or promote any changes to current fishing practices that would result in increased risks to fishery participants.

5.2 National Environmental Policy Act

NOAA Administrative Order (NAO) 216-6, Environmental Review Procedures for Implementing the National Environmental Policy Act, in accordance with the National Environmental Policy Act (NEPA), requires the consideration of effects of proposed agency actions and alternatives on the human environment and allows for involvement of interested and affected members of the public before a decision is made. The NMFS Regional Administrator will use the analysis in this draft EA to consider a range of alternatives, allow for public involvement in the agency's decision, and to determine whether the proposed action would have a significant environmental impact, which, if so, would require the preparation of an environmental impact statement.

5.3 Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) requires a determination that a recommended management measure has no effect on the land or water uses or natural resources of the coastal zone or is consistent to the maximum extent practicable with the enforceable polices of an affected state's approved coastal zone management program. A copy of this document will be submitted to the appropriate state government agencies for review and concurrence with a determination that the recommended measures are consistent, to the maximum extent practicable, with the state coastal zone management program. Refining the EFH and HAPC of precious coral species in the MHI with new data available is not expected to affect use of land, water, and natural resources in the coastal zone environment.

5.4 Endangered Species Act

The ESA requires that any action authorized, funded, or carried out by a federal agency ensure its implementation would not jeopardize the continued existence of listed species or adversely modify their critical habitat. Pursuant to Section 7 of the ESA, the fisheries managed by the Council have been analyzed and found to not jeopardize or adversely affect any populations or habitats of species listed as endangered or threatened under the ESA. The Council believes that the proposed action to refine precious coral EFH in the MHI is not likely to jeopardize the continued existence of any threatened or endangered species under NMFS's jurisdiction or destroy or adversely modify critical habitat.

5.5 Marine Mammal Protection Act

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

The MHI precious coral fishery is listed as a Category III fishery under Section 118 of the MMPA (79 FR 77927, December 29, 2014). The Council believes that the proposed action would not modify fishery operations in any manner affecting marine mammals not previously considered or authorized by the commercial taking exemption under Section 118 of the Marine Mammal Protection Act.

Therefore, no increased impacts on marine mammals that occur in the waters around the Hawaiian Archipelago are expected under the proposed action.

5.6 Executive Order 12866 (Regulatory Impact Review)

In order to meet the requirements of Executive Order 12866 (E.O. 12866), NMFS requires that a Regulatory Impact Review is prepared for all regulatory actions that are of public interest. This review provides an overview of the problem, policy objectives, and anticipated impacts of the proposed action, and ensures that management alternatives are systematically and comprehensively evaluated such that the public welfare can be enhanced in the most efficient and cost effective way. In accordance with E.O. 12866, the following is set forth by the Council:

1) This action is not likely to have an annual effect on the economy of more than 100 million dollars 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 action is not likely to create any serious inconsistencies or otherwise interfere with any action taken or planned by another agency;
3) This action 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 action is not likely to raise novel or policy issues arising out of legal mandates, or the principles set forth in the Executive Order; and
5) This action is not controversial.

5.7 Executive Order 13132 (Federalism)

The objective of E.O. 13132 is to guarantee the Constitution's division of governmental responsibilities between the federal government and the states. Federalism implications are defined as having substantial direct effects on states or local governments (individually or collectively), on the relationship between the national government and the states, or on the distribution of power and responsibilities among the various levels of government. NMFS and the Council do not expect that this action would impact or alter the relationship between the federal government and the government of the State of Hawaii.

5.8 Information Quality Act

This amendment complies with the Information Quality Act and NOAA standards (NOAA Information Quality Guidelines, September 30, 2002) that recognize information quality is composed of three elements: utility, integrity, and objectivity. Central to the preparation of this amendment is objectivity that consists of presentation and substance. Presentation includes whether disseminated information is presented in an accurate, clear, complete, and unbiased manner and in a proper context. Substance involves a focus on ensuring accurate, reliable, and unbiased information. To the extent feasible, the information in this document is current. Much of the information was made available to the public during the deliberative phases of developing the amendment during Council meetings. The information was also improved based on the guidance and comments from the Council's advisory groups. Additional comments are expected to be received during the comment period for the amendment.

The document was prepared by Council and NMFS staff based on information provided by NMFS PIFSC and NMFS PIRO. The document will be reviewed by PIRO and NMFS Headquarters staff (including the Office of Sustainable Fisheries). Legal review is expected from NOAA General Counsel Pacific Islands and General Counsel for Enforcement and Litigation for consistency with applicable laws, including but not limited to the Magnuson-Stevens Act, National Environmental Policy Act, Administrative Procedure Act, Paperwork Reduction Act, Coastal Zone Management Act, Endangered Species Act, Marine Mammal Protection Act, and Executive Orders 13132 and 12866.

5.9 Paperwork Reduction Act

The purpose of the Paperwork Reduction Act (PRA) is to minimize the burden on the public by ensuring that any information requirements are needed and are carried out in an efficient manner (44 U.S.C. 350191(1)). None of the measures contained in this amendment have any new public regulatory compliance or other paperwork requirements and all existing requirements were lawfully approved and have been issued the appropriate OMB control numbers.

5.10 Regulatory Flexibility Act

In order to meet the requirements of the Regulatory Flexibility Act (RFA), 5 U.S.C. 601 et seq. requires government agencies to assess the impact of their regulatory actions on small businesses and other small entities via the preparation of regulatory flexibility analyses. The RFA requires government agencies to assess the impact of significant regulatory actions on small businesses and other small organizations. The basis and purpose of the measures contained in this amendment are described in Section 2.0 and the alternatives considered are discussed in the amendment prepared for this action. Because none of the alternatives contain any regulatory compliance or paperwork requirements, the Council believes that this action is not significant (i.e., it will not have a significant impact on a substantial number of small entities) for the purposes of the RFA, and no Initial Regulatory Flexibility Analysis has been prepared.

5.11 Executive Order 12898 (Environmental Justice)

Executive Order 12898 ("Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations") requires each Federal agency to achieve environmental justice by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories. A Presidential memorandum that accompanied Executive Order 12898 specified that Agencies should look to the National Environmental Policy Act to determine when to analyze an action's potential health, economic effects. The Executive Order also directed Federal agencies to develop agency-specific approaches to assessing environmental justice under NEPA.

In 1997, the White House Council on Environmental Quality (CEQ) suggested that Federal agencies more closely examine the following issues when considering environmental justice:

- The composition of the affected community or population to determine whether low income or minority communities are present;
- Relevant public health data or projects concerning the potential for cumulative exposure to health or environmental hazards;
- Cultural, social, occupational, or economic factors that may amplify the effects of the proposed action;
- Public participation strategies; and
- Community or tribal representation in the process.

The current (2013) Department of Commerce Environmental Justice Strategy is non-prescriptive in terms of analysis considerations and procedures. For fisheries, it simply echoes the MSA's instruction to Councils and NMFS to account for potential social and economic impacts of fishing community members, as well as to provide for the sustained participation of these communities in fisheries and to, the extent practicable, minimize adverse economic impacts on such communities.

Regulations that implement NEPA state that potential social and economic effects of an action are not intended by themselves to compel the Agency to prepare an environmental impact statement or environmental assessment. Further, these regulations limit consideration of social and economic effects in such documents to situations where they are connected to effects on the physical or natural environment. Therefore, NEPA requires as a prerequisite that an action be likely to have a significant effect on the physical environment before the Agency or Council evaluates social and economic effects.

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WPRFMC, 1979. Fishery Management Plan for the Precious Coral Fisheries of the Western Pacific Region.

APPENDIX A. SPECIES DESCRIPTIONS FOR PRECIOUS CORALS

Precious Coral Species

This section is an update of Appendix 1 to the Western Pacific FEPs, "Essential Fish Habitat Species Descriptions for Western Pacific Archipelagic, and Remote Island Areas Fishery Ecosystem Plan Management Unit Species" for precious corals. Important new references and data points have been added to the original documentation. Many older observations continue to be cited because no newer studies have been completed, with a few notable exceptions. While the original sources are still relevant, new research has revealed important distribution, life history, growth rate, age, and abundance information that is relevant to precious coral management. Some progress has also been made toward clarifying some of the vexing taxonomic challenges presented by these organisms. First, the name of the most important species of gold coral, *Gerardia* sp., has been updated to *Kulamanamana haumeaae* by Sinniger, et al. (2013). Second, two of the most important species in the family Coralliidae, *Corallium secundum* (pink coral) and *Corallium regale* (red coral) have been placed into separate genera, the latter also becoming a different species (Figueroa and Baco, 2014). Their new names are now *Pleurocorallium secundum* and *Hemicorallium laauense*, respectively. Third, two changes have taken place in the black corals. *Antipathes dichotoma* is now *Antipathes griggi* and *Antipathes ulex* has been moved to a different genus and is now *Myriopathes ulex* (Opresko, 2009). These changes are shown in Table 8.

General Distribution of Precious Corals

Most research related to precious corals has been limited to the Hawaiian archipelago, and the majority of the more recent efforts have been directed at taxonomy or simply documenting species distributions, with a few works on growth and life history (Parrish et al., 2015). However, significant new insights have been gained into the genetics (Baco and Cairns, 2012; Sinniger et al., 2013; Figueroa and Baco, 2014), reproductive biology (Waller and Baco, 2007; Wagner et al., 2011; Wagner et al., 2012; Wagner et al., 2015), growth and age (Parrish and Roark 2009; Roark et al., 2009; Putts, pers. comm., 2017), and community structure (Kahng *et al*., 2010; Long and Baco, 2014; Parrish, 2015; Wagner, et al., 2015; Putts, pers. comm., 2017) of precious coral and black coral species.

The U.S. Pacific Islands Region under jurisdiction of the Western Pacific Regional Fisheries Management Council consists of more than 50 oceanic islands, including the Hawaiian and Marianas archipelagos, American Samoa, Johnston, Wake, Palmyra, Kingman, Jarvis, Baker and Howland, and numerous seamounts in proximity to each of these groups. These islands fall under a variety of political jurisdictions, and include the State of Hawaii, CNMI, and the territories of Guam and American Samoa, as well as nine sovereign Federal territories—Midway Atoll, Johnston Atoll, Kingman Reef, Palmyra Atoll, Jarvis Island, Howland Island, Baker Island, Rose Atoll, and Wake Island. Precious corals (with currently accepted species names) are known to exist in American Samoa, Guam, Hawaii and the Northern Mariana Islands, as well as throughout the other US islands in the Pacific (Table 8 and Table 9), but the only detailed assessments of precious corals have been in Hawaii (Parrish and Baco, 2007, Parrish et al., 2015; Wagner, et al., 2015). Over the last 10 years, we have begun to better understand the distribution and abundance of these corals, but many areas remain unexplored, and conditions which lead to their settlement, growth and distribution are still uncertain. Modelling efforts have provided some insight into the global distribution and habitat requirements of deep-water corals (Rogers et al., 2007; Tittensor et al., 2009, Clark et al., 2011, Yesson et al., 2012, Schlacher et al., 2013), but have provided little certainty regarding localized distribution or the specific conditions required for growth of precious corals. Antipatharians, commonly known as black corals, have been exploited for years, but are still among the taxonomic groups containing precious corals that have been inadequately surveyed, as evidenced by the high rates of species discoveries from deep-water surveys around the Hawaiian Islands (Opresko 2003b; Opresko 2005a; Baco 2007; Parrish and Baco 2007; Parrish et al., 2015; Roark, 2009; Wagner et al., 2011; Wagner et al., 2015; Wagner, 2011; Wagner, 2013). Despite this ongoing research, only a few places are known to have dense agglomerations of precious corals. A summary of the known distribution and abundance of precious corals in the central and western Pacific Islands region follows.

Table 8. PCMUS with updated species names

Species	**Common name**
Pleurocorallium secundum (prev. *Corallium secundum*)	Pink coral
Hemicorallium laauense (prev. *C. regale*)	Red coral
Kulamanamana haumeaae (prev. *Gerardia* sp.)	Gold coral
Narella sp.	Gold coral
Calyptrophora sp.	Gold coral
Callogorgia gilberti	Gold coral
Lepidisis olapa	Bamboo coral
Acanella sp.	Bamboo coral
Antipathes griggi (prev. *A. dichotoma)*	Black coral
Antipathes grandis	Black coral
Myriopathes ulex (prev. *Antipathes ulex*)	Black coral

<u>American Samoa</u>

There is little information available for the deep-water species of precious corals in American Samoa. Much of the information available comes from the personal accounts of fishermen. In the South Pacific there are no known commercial beds of pink coral (Carleton and Philipson, 1987). Survey work begun in 1975 by the Committee for Co-ordination of Joint Prospecting for Mineral Resources in South Pacific Offshore Areas identified three areas of *Corallium* off Western Samoa: off eastern Upolu, off Falealupo and at Tupuola Bank (Carleton and Philipson 1987). Pink coral has been reported off Cape Taputapu, but no information concerning the quality or quantity of these corals or the depths where they occur is available. Unidentified precious corals have also been reported in the past off Fanuatapu at depths of around 90 m. Precious corals are known to occur at an uncharted seamount, about three-fourths of a mile off the northwest tip of Falealupo Bank at depths of around 300 m (WPRFMC, 1979). Only nine records of precious coral species in American Samoa exist in the NOAA Deep Sea Coral and Sponges database (NOAA, 2015).

Commercial quantities of one or more species of black coral are known to exist at depths of 40 m and deeper within the territorial waters of American Samoa (WPRFMC, 1979). Wagner (pers. comm., 2015) has tentatively identified as many as 12 species (not previously catalogued in

American Samoa) of black corals in depths between 50 m and 90 m, with 6 of these potential new species exhibiting growth forms that could lead to harvestable sizes. However, Wagner did not find any locations with the types of densities and sizes that would support any commercial harvest of these corals.

Guam and CNMI

There are no known commercial quantities of precious corals in the Northern Mariana Islands archipelago (Grigg and Eldredge, 1975). In the past, Japanese fishermen claimed to have taken some *Corallium* north of Pagan Island and off Rota and Saipan (WPRFMC, 1979). Preliminary results from surveys conducted throughout the Marianas in 2016 indicate a scattered distribution with no areas of large agglomerations of precious corals found in waters deeper than 250 m. The NOAA Deep Sea Coral and Sponges database includes only 15 records of black coral species around the islands of Aguijan, Saipan, and Rota from Grigg's observations in 1973-74.

U.S. Pacific Island Remote Areas

There are no known commercial quantities of precious corals in the remote Pacific Island areas, though individual colonies of precious corals have been seen at Jarvis, Palmyra, Kingman (Parrish and Baco, 2007) and Johnston Atoll, and planned surveys in 2017 may provide more information about abundance and distribution of precious corals found in waters deeper than 250 meters in these areas. There are 206 records in the EEZ around Palmyra and Kingman, three at Johnston, and 116 records at Jarvis in the NOAA Deep Sea Coral and Sponge database.

Hawaii

In the Hawaiian Archipelago there are seven legally-defined beds of pink, gold and bamboo corals, which are shown in Table 9. In the MHI, the Makapu‘u bed is located off Makapu‘u, Oahu, at depths of between 250 and 575 meters. Discovered in 1966, it the precious coral bed that has been most extensively surveyed in the Hawaiian chain. Its total area is about 4.5 km^2. Its substrate consists largely of hard limestone (Grigg, 1988). Careful examination during numerous dives with submersibles has determined that about 20 percent of the total area of the Makapu‘u bed is comprised of irregular lenses of thin sand, sediments and barren patches (WPRFMC, 1979). These sediment deposits are found primarily in low lying areas and depressions (Grigg, 1988). Thus, the total area used for extrapolating coral density is 3.6 km^2, or 80 percent of 4.5 km^2 (WPRFMC, 1979).

Table 9. Location of Hawaii FEP precious coral beds

Area Name	Description

Area Name	Description
Makapu'u (Oahu)	includes the area within a radius of 2.0 nm of a point at 21°18.0′ N. lat., 157°32.5′ W. long.
‘Au‘au Channel, Maui	includes the area west and south of a point at 21°10′ N. lat., 156°40′ W. long., and east of a point at 21° N. lat., 157° W. long., and west and north of a point at 20°45′ N. lat., 156°40′ W. long.
Keāhole Point, Hawaii	includes the area within a radius of 0.5 nm of a point at 19°46.0′ N. lat., 156°06.0′ W. long.
Ka‘ena Point, Oahu	includes the area within a radius of 0.5 nm of a point at 21°35.4′ N. lat., 158°22.9′ W. long.
Brooks Banks	includes the area within a radius of 2.0 nm of a point at 24°06.0′ N. lat., 166°48.0′ W. long.
180 Fathom Bank, north of Kure Island	N.W. of Kure Atoll, includes the area within a radius of 2.0 nm of a point at 28°50.2′ N. lat., 178°53.4′ W. long.
WesPac Bed, between Nihoa and Necker Island	includes the area within a radius of 2.0 nm of a point at 23°18′ N. lat., 162°35′ W. long.

Precious coral beds have also been found in the deep inter-island channels such as ‘Au‘au, Alalakeiki, and Kolohi channels off of Maui, around the edges of Penguin Banks, off promontories such as Keāhole Point, on older lava flows south from Keāhole to Ka Lae, and off of Hilo Harbor, and off of Cape Kumukahi on the Big Island of Hawaii (Oishi, 1990; Grigg, 2001, 2002; Putts, pers. comm., 2017). On Oahu, there is a bed off Ka‘ena Point, and multiple precious coral observations have been made from offshore Barber’s Point extending to offshore Pearl Harbor, Oahu. On Kauai, a bed of black corals has been identified offshore of Poipu (WPRFMC, 1979).

A dense bed has been located on the summit of Cross Seamount, southwest of the island of Hawaii. This bed covers a pinnacle feature on the top of the summit, but does not contain numbers of corals large enough to sustain commercial harvests (Kelley, pers. comm., 2015).

In the NWHI, a small bed of deep-water precious corals have been found on WestPac bed, between Nihoa and Necker Islands and east of French Frigate Shoals. This bed is not large enough to sustain commercial harvests. Precious coral beds have also been discovered at Brooks Banks, Pioneer Bank, Bank 8, Seamount 11, Laysan, and French Frigate Shoals (Parrish and Baco, 2007; Parrish et al., 2015). Remotely operated vehicle (ROV) surveys conducted throughout the NWHI by the Okeanos Explorer during 2015 discovered multiple places that had dense colonies of deep-sea corals. Few of these colonies were precious corals, but these dives were mostly conducted in waters deeper than normal distributions of precious corals (>1500 meters). However, large areas of potential habitat exist in the NWHI on seamounts and banks near 400 m depth. Based on the abundance of potential habitat, it is thought that stocks of precious corals may be more abundant in the northwestern end of the island chain. All precious coral stocks within the boundaries of the Papahānaumokuākea National Marine Monument or Coral Reef Ecosystem Reserve are reserved from harvest, and most habitat suitable for precious corals growth falls within the boundaries of the monument.

Precious corals have also been discovered at the 180 Fathom Bank, north of Kure Island. The extent of this bed is not known. Precious corals have been observed during submersible and ROV dives throughout the Northwestern Hawaiian Islands, and in EEZ waters surrounding Johnston, Jarvis, Palmyra, and Kingman atolls, but little can be definitively said about the overall distribution and abundance of precious corals in the central Pacific region.

In addition to these legally defined areas of precious corals, many other sites have been discovered that sustain populations of precious corals (Parrish and Baco, 2007; Parrish et al., 2015; Wagner et al., 2015). The map below (Figure 13) provides a color-coded illustration of some of these 5217 observations (Kelley and Drysdale, 2012, unpublished data). Given the number of observations and the wide distribution of precious corals in the main Hawaiian Islands, it is almost certain that undiscovered beds of precious corals exist in the EEZ waters of the region managed by the WPRFMC. Whether these beds would contain organisms at sufficient densities and size distributions to support commercial harvests is yet to be determined.

Systematics of the Deep-water Coral Species

Published records of deep corals from the Hawaiian Archipelago include more than 137 species of gorgonian octocorals and 63 species of azooxanthellate scleractinians (Parrish and Baco, 2007). A total of six new genera and 20 new species of octocorals, antipatharians, and zoanthids have been discovered in Hawaii since the 2007 report (Parrish et al., 2015). These are either new to science or new records for the Hawaiian Archipelago (Cairns and Bayer 2008, Cairns 2009, Opresko 2009, Cairns 2010, Wagner et al., 2011a, Opresko et al., 2012, Sinniger et al., 2013). Taxonomic revisions currently underway for several groups of corals (e.g., isidids, coralliids, plexaurids and paragorgiids) are also likely to yield additional species new to science and new records for Hawaii (Parrish et al., 2015). Only a handful of these deep coral species are considered economically precious and have any history of exploitation.

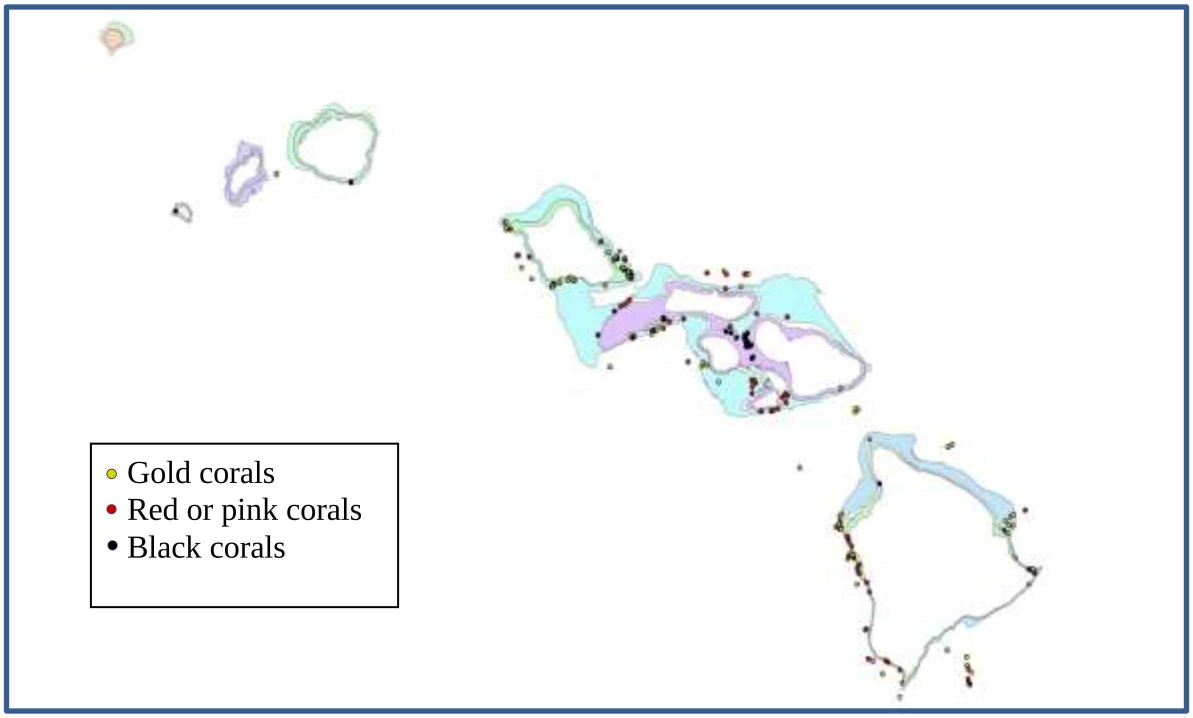

Figure 13. Observations of precious corals in the MHI

Recent molecular phylogenetic and morphologic studies of the family Coralliidae, including Hawaiian precious corals, have illuminated taxonomic relationships. These studies synonymized *Paracorallium* into the genus *Corallium,* and resurrected the genera *Hemicorallium* (Ardila et al., 2012; Figueroa and Baco, 2014; Tu et al., 2015) and *Pleurocorallium* (Figueroa and Baco, 2014; Tu et al., 2015) for several species, including several species in the precious coral trade. A molecular and morphological analysis of octocoral-associated zoanthids collected from the deep slopes in the Hawaiian Archipelago revealed the presence of at least five different genera including the gold coral (Sinniger et al., 2013). This study describes the five new genera and species and proposes a new genus and species for the Hawaiian gold coral, *Kulamanamana haumeaae*, a historically important species harvested for the jewelry trade and the only Hawaiian zoanthid that appears to create its own skeleton.

Precious corals are found principally in three orders of the class Anthozoa: Gorgonacea, Antipatharia, and Zoanthiae (Grigg, 1984). In the western Pacific region, pink coral (*Pleurocorallium secundum*), red coral (*Hemicorallium laauense*), gold coral (*Kulamanamana haumeaae*), black coral (*Antipathes* sp.) and bamboo coral (*Lepidisis olapa*) are the primary species/genera of commercial importance. Of these, the most valuable precious corals are species of the genera *Pleurocorallium* and *Hemicorallium,* the pink and red corals (Grigg, 1984). Pink coral (*P. secundum*) and Midway deep-sea coral (*Corallium* sp.) are two of the principal species of commercial importance in the Hawaiian and Emperor Seamount chain (Grigg, 1984). *P. secundum* is found in the Hawaiian archipelago from Milwaukee Banks in the Emperor Seamounts (36^{o}N) to the Island of Hawaii (18^{o}N); *Corallium* sp. nov. is found between 28^{o}–36^{o}N, from Midway to the Emperor Seamounts (Grigg, 1984). In addition to the pink corals, the bamboo corals, *Lepidistis olapa* and *Acanella* sp., are commercially important precious corals in the western Pacific region (Grigg, 1984). Pink coral and bamboo coral are found in the order

Gorgonacea in the subclass Octocorallia of the class Anthozoa, in the Phylum Coelenterata (Grigg, 1984).

The final two major groups of commercially important precious corals, gold coral and black coral, are found in separate orders, Zoanthidea and Antipatharia, in the subclass Hexacorallia, in the class Anthozoa and the phylum Coelenterata. The gold coral, *Kulamanamana haumeaae* (prev. *Gerardia* sp.) (Sinneger et al., 2013), is endemic to the Hawaiian and Emperor Seamount chain (Grigg 1984). It inhabits depths ranging from 300–400 m (Grigg 1974; Grigg, 1984). In Hawaii, gold coral, *Kulamanamana haumeaae*, grows mostly on bamboo hosts (e.g., *Acanella, Keratoisis*) as a parasitic overgrowth (Brown, 1976; Grigg, 1984; Parrish, 2015). Gold coral is, therefore, only found growing in areas that were previously inhabited by colonies of *Acanella* (Grigg, 1993) and possibly other bamboo corals (Parrish, 2015). Despite its ecological significance and long history of exploitation, the Hawaiian gold coral has never been subject to taxonomic studies or a formal species description. As a result of this, the nomenclature concerning the Hawaiian gold coral has been relatively confused. Symptomatic of the order, a suite of other zoanthids, besides the Hawaiian gold coral, have been observed and collected in Hawaii, but far less is known of their biology and ecology and they have not been described taxonomically (Sinnegar et al., 2013).

Grigg (1984) classified black corals in the order *Antipatharia*, and identified fourteen genera of black corals reported from the Hawaii-Pacific region with species found in both shallow and deep habitats Grigg, 1965). Wagner (2015) noted that there are over 235 known species of black coral that occur in the oceans of the world, and of this total, only about 10 species are of commercial importance (Grigg, 1984). Wagner (2011) confirmed 8 species of black corals in Hawaii, including (1) *Antipathes griggi* Opresko, 2009, (2) *Antipathes grandis* Verrill, 1928, (3) *Stichopathes echinulata* Brook, 1889, (4) an undescribed *Stichopathes* sp., (5) *Cirrhipathes* cf. *anguina* Dana, 1846, (6) *Aphanipathes verticillata* Brook, 1889, (7) *Acanthopathes undulata* (Van Pesch, 1914), and (8) *Myriopathes* cf. *ulex* Ellis and Solander, 1786. A new name for the Hawaiian species of antipatharian coral previously identified as *Antipathes dichotoma* (Grigg and Opresko, 1977) is described as *Antipathes griggi* (Opresko, 2009).

Many species of gorgonian corals are known to occur within the habitat of pink, gold and bamboo corals in the Hawaiian Islands. At least 37 species of corals in the order Gorgonacea have been identified from the Makapuʻu bed (Grigg and Bayer, 1976). In addition, 18 species of black coral (order Antipatharia) have been reported to occur in Hawaiian waters (Grigg and Opresko, 1977; Oishi, 1990; Wagner, 2011.), but only three of these species have been subject to commercial harvest (Oishi, 1990; Wagner et al., 2015).

Biology and Life History

The management and conservation of deep-sea coral communities is challenged by international harvest with non-selective gear types for the jewelry trade and the paucity of information to inform management strategies. In light of their unusual vulnerability, a better understanding of deep-sea coral ecology and their interrelationships with associated benthic communities is needed to inform coherent international conservation strategies for these important deep-sea habitat-forming species (Bruckner, 2013). Millennia are probably required for a precious coral community to form with full diversity, high evenness, and mature size structure (Putts, pers.

comm., 2017). Most of the interior of the global ocean remains unobserved. This leaves questions of trophic connectivity, longevity, and population dynamics of many deep-sea communities unanswered. Deep-sea megafauna provide a complex, rich, and varied habitat that promotes high biodiversity and provides congregation points for juvenile and adult fish (Freiwald et al., 2004; Husebo et al., 2002; Smith et al., 2008).

Precious corals may be divided primarily into two groups of species based on their depth ranges: the deep-water species (200-600m) and the shallow-water species (20-120m). Other precious corals can be found in depths down to 2000 m, but these species are not exploited in the United States for commercial purposes. Deep-sea corals are found on hard substrates on seamounts and continental margins worldwide at depths of 300 to 3,000 m.

Deep Corals

The Pacific Islands deep-water precious coral species include pink coral, *Pleurocorallium secundum* (prev. *Corallium secundum*), red coral, *Hemicorallium laauense* (prev. *C. regale* or *C. laauense*), gold coral, *Kulamanamana haumeaae (*prev. *Gerardia* sp.) and bamboo coral, *Lepidistis olapa*. As previously discussed, the most valuable precious corals are gorgonian octocorals (Grigg, 1984). There are seven varieties of pink and red precious corals in the western Pacific region, six of which used to be recognized as distinct species of *Corallium* (Grigg, 1981), but have been reclassified (Parrish *et al.*, 2015). The two species of commercial importance in the EEZ around the Hawaiian Islands are the pink coral *Pleurocorallium secundum* (prev. *Corallium secundum*), and the red coral, *Hemicorallium laauense* (prev. *C. laauense*). The Gorgonian octocorals are by far the most abundant and diverse corals in the Hawaiian Archipelago. Two species, *Pleurocorallium secundum* and *Hemicorallium laauense* are known to occur at depths of 300-600 m on islands and seamounts throughout the Hawaiian Archipelago (Grigg 1974; Grigg, 1993; Parrish et al., 2015; Parrish and Baco, 2007). Parrish (2007) surveyed *Pleurocorallium secundum* and *Hemicorallium laauense* at six precious coral beds in the lower Hawaiian chain, from Brooks Bank to Keāhole Point, Hawaii, in depths ranging from 350m to 500m. He found corals on summits, flanks, and shallow banks, with bottom substrate and relief at these sites ranging from a homogenous continuum of one type to a combination of many types at a single site. The survey results show that all three coral taxa colonize both carbonate and basalt/manganese substrates, and the corals favor areas where bottom relief enhances or modifies flow characteristics that may improve the colony’s feeding success.

These corals can grow to more than 30 cm in height, and are often found in large beds with other octocorals, zoanthids, and sometimes scleractinians (Parrish et al., 2015; Parrish and Baco, 2007). These species are relatively long lived, with some of the oldest colonies observed within Makapu‘u Bed about 0.7 m in height and at least 80 years old (Grigg, 1988b, Roark, 2006). Populations of *P. secundum* appear to be recruitment limited, although in favorable environments (e.g., Makapu‘u Bed) populations are relatively stable, suggesting that recruitment and mortality are in a steady state (Grigg, 1993). During surveys of lava flows off the western flanks of Hawaii Island, Putts (pers. comm., 2017) found that Coralliidae dominated the early successional stages, and using dates established for those flows, determined that a mature Corallidae community can be established within 150 years. A study by Roark et al. (2006) showed that the radial growth rate for specimens of *P. secundum* in the Hawaiian Islands is ~170 µm/year and average age is 67 to 71 years, which is older than previously calculated. Individual colonies have been measured as tall as 28 cm. Bruckner (2009) suggested that the minimum allowable size for genus *Corallium* for harvest should be increased, and supported a potential listing for *Corallium* within the Appendices of the Convention on International Trade in Endangered Species (CITES). The current size restriction in the 2010 Code of Federal Regulations for Pacific Islands Region is 10 inches (25.4 cm).

In Cairn's reviews (2008; 2009; 2010), he summarized the research conducted on Hawaiian Octocorallia taxa, including three gold coral PCMUS genuses, *Narella*, *Calyptrophora* and *Callogorgia*. Octocorallia are distributed over all ocean basins, found in depths ranging from shallow (~ 50m) to deep (~4,600) in Alaska. All gold PCMUS in Hawaii were collected in deep-water (> 270m), throughout the Hawaiian archipelago and adjacent seamounts. Although these octocorals are managed as PCMUS, the only commercially exploited gold coral is the zoantharian, *Kulamanamana haumeaae* (prev. *Gerardia* sp.). It is probably the most common and largest of the zoanthids in Hawaii, and is widely distributed throughout the Hawaiian Archipelago and into the Emperor Seamount Chain at depths of 350–600 meters (Parrish et al., 2015; Parrish and Baco, 2007), and has been sampled from Wake Island and in the Phoenix Islands Protected Area (i.e., Okeanos Explorer samples). While subject to commercial exploitation from the 1970's until 2001 with an interruption between 1979 and 1999 (Grigg, 2001), the gold coral is not currently exploited in Hawaii due to a moratorium on the fishery. The Hawaiian gold coral is one of the largest and numerically dominant benthic macro-invertebrates in its depth range on hard substrate habitats of the Hawaiian Archipelago, and plays an important ecological role in Hawaiian seamount benthic assemblage (Parrish, 2006; Parrish and Baco, 2007; Parrish et al., 2015). The Hawaiian gold coral has also been found to be one of the longest-lived species on earth. Earlier ageing attempts on the gold coral focused on ring counts (Grigg, 1974; Grigg, 2002) and led to a maximal estimated age of 70 years and a radial growth rate (increase in branch diameter) of 1 mm/year. Recent studies using radiometric data suggest colonies of Hawaiian gold coral are as old as 2740 year with a radial growth rate of only 15 to 45 µm/year (Roark et al., 2006; Roark et al., 2009; Parrish and Roark, 2009).

Parrish (2015) has found the host of the parasitic *Kulamanamana haumeaae* to be primarily the bamboo corals (e.g., *Acanella*, *Keratoisis*). *K. haumeaae* secretes a protein skeleton that over millennia can grow and more than double the original mean size of the host colony. It is relatively common and even dominant at geologically older sample sites, but recruitment is probably infrequent (Parrish, 2015). Although it can be relatively common compared to some other deep corals, it grows very slowly. Parrish and Roark (2009) determined that the Hawaiian gold coral *Kulamanamana haumeaae* has a mean life span of 950 years with an overall radial growth of ~41 µm/year, and a gross radiocarbon linear growth rate of 2.2 ± 0.2 mm/year. This is a much slower growth rate and longer life span than given in previous studies. Grigg (2002) reported a 1 mm/year radial growth rate, equivalent to a 6.6 cm/year linear growth for a maximum life span of roughly 70 years. This means these corals are growing much slower than previously thought, and have much longer life spans if undisturbed. Newly applied radiocarbon age dates from the deep-water proteinaceous corals *Gerardia* and *Leiopathes* show that radial growth rates are as low as 4 to 35 micrometers per year and that individual colony longevities are on the order of thousands of years (Roark *et al.*, 2009, 2006). The longest-lived *Gerardia* sp. and *Leiopathes* specimens were estimated to be 2,742 years old and 4,265 years old, respectively. *Gerardia* sp. is a colonial zoanthid with a hard skeleton of hard proteinaceous matter that forms tree-like structures with heights of several meters and basal diameters up to tens of centimeters.

Black corals of *Leiopathes* sp. also have a hard proteinaceous skeleton and grow to heights in excess of 2 m. In Hawaiian waters, these corals are found at depths of 300 to 500 m on hard substrates, such as seamounts and ledges.

The two bamboo coral PCMUS in the Pacific Islands Region are classified under two genera, *Acanella* and *Lepidistis*. Not much work has been done specifically on these genera, but Parrish (2015) identified branched bamboo colonies such as *Acanella* as a preferred host for *Kulamanamana haumeaae*. Because of the long colony life span of >3000 years and the bony hard bodied calcareous internodes of bamboo corals (family Isididae), geochemists are interested in using them to analyze paleo-oceanographic events and long-term climate change (Hill et al., 2011), while biologists use them to size and age deep-sea coral populations. Recent studies show that the subfamily Keratoisidinae (family Isididae) consists of four genera (*Acanella*, *Isidella*, *Lepidistis*, and *Keratoisis*), with two genera (*Tenuisis* and *Australisis*) perhaps belonging elsewhere in the Isididae family (Etnoyer, 2008; France, 2007). Bamboo corals commonly colonize intermediate to deep-water depths (400m to >3000m) of continental slopes and seamounts in the Pacific Ocean.

Shallow Corals

The second group of precious coral species is found in shallow-water between 20 and 120 m (Grigg, 1993; Kelley and Drysdale, unpublished data, 2012; Wagner et al., 2015). The shallow-water fishery is comprised of three species of black coral, *Antipathes griggi*, *A. grandis* and *Myriopathes ulex*, which have historically been harvested in Hawaii (Oishi, 1990), but over 90 percent of the coral harvested by the fishery consists of *A. griggi* (Oishi, 1990; Parrish et al., 2015; Wagner et al., 2015). Other black coral species are found in the NWHI in a wider depth range (20m to 1,400m), but with lower colony density (Wagner et al., 2011). Surveys performed in depths of 40-110 meters in the Au'au Channel in 1975 and 1998, suggested stability in both recruitment and growth of commercially valuable black coral populations, and thus indicated that the fishery had been sustainable over this time period (Grigg, 2001). Subsequent surveys performed in the channel in 2001 indicated a substantial decline in the abundance of black coral colonies, with likely causes including increases in harvesting pressure and overgrowth of black coral colonies by the invasive octocoral *Carijoa sp.* and the red alga, *Acanthophora spicifera*, especially on reproductively mature colonies at mesophotic depths (Grigg, 2003; Grigg, 2004; Kahng and Grigg 2005; Kahng, 2006). Together, these factors renewed scrutiny on the black coral fishery and raised questions about whether regulations need to be redefined in order to maintain a sustainable harvest (Grigg, 2004). In addition to these challenges, Wagner has suggested that taxonomic misidentification has led to the mistaken belief that there is a depth refuge that exists for certain harvested species (Wagner et al., 2012; Wagner, 2011). All of these uncertainties and lack of basic life history information regarding black corals complicates effective management of the resource (Grigg, 2004).

In Hawaii, *A. griggi* accounts for around 90 percent of the commercial harvest of black coral (Oishi 1990). *A. grandis* accounts for 9 percent and *M. ulex* 1 percent of the total black corals harvested. In Hawaii, roughly 85 percent of all black coral harvested are taken from within state waters (WPRFMC 1979). Black corals are managed jointly by the State of Hawai'i and the Council. Within state waters (0–3 nmi), black corals are managed by the State of Hawai'i (Grigg, 1993).

A new name for the Hawaiian species of antipatharian coral previously identified as *Antipathes dichotoma* (Grigg and Opresko, 1977) is described as *Antipathes griggi* Opresko, n. sp. (Opresko, 2009). The shallow-water black coral *A. dichotoma* (*A. griggi*) collected at 50 m exhibited growth rates of 6.42 cm/year over a 3.5-year study.

Table 10. Depth zonation of precious corals in the Western Pacific. (Source: Grigg, 1993; Baco-Taylor, 2007; HURL and Drysdale, 2012)

Species and Common Name	Depth Range (m)
Paracorallium secundum Angle skin coral	250–575
Hemicorallium laauense Red coral *Corallium* sp. nov. Midway deep-sea coral	250–575 1,000–1,500
Kulamanamana haumeaae (prev. *Gerardia* sp.) Hawaiian gold coral	350–575
Lepidisis olapa, *Acanella* spp. bamboo coral	250–1800
Antipathes griggi (prev. *A. dichotoma*), black coral	20–120
Antipathes grandis, pine black coral	20–120
Cirrhipathes cf. *anguina* (prev. *Antipathes anguina*), wire black coral	20–120
Myriopathes ulex (prev. *Antipathes ulex*), fern black coral	20–220

1.4 Growth and Reproduction

There is very limited published literature regarding coral spawning of the PCMUS in the Pacific Islands Region. However, studies by Gleason et al. (2006) and Waller and Baco (2007) indicate that the gold coral *Kulamanamana haumaae* may have seasonal reproduction, and that two pink coral species have a periodic or quasi-continuous reproductive periodicity. Although limited studies about growth rates and life spans of adult PCMUS in the Pacific Islands Region are available, early life history data on larvae, polyps, and juvenile colonies of the PCMUS are unavailable. Many other questions related to genetic connectivity and spatial distribution across the Pacific also remain unanswered. Recent mesophotic coral reef ecosystem studies provide an outline of essential knowledge for the limited deep-water coral ecosystem (Kahng et al., 2010). Slow-growing deep-water coral ecosystems are sensitive to many disturbances, such as temperature change, invasive species and destructive fishing techniques.

While different species of precious corals inhabit distinct depth zones, their habitat requirements are strikingly similar. Grigg (1984) noted that these corals are non-reef building and inhabit depth zones below the euphotic zone. In an earlier study, Grigg (1974) determined that precious corals are found in deep-water on solid substrate in areas that are swept relatively clean by moderate to strong bottom currents (>25 cm/sec). Strong currents help prevent the accumulation of sediments, which would smother young coral colonies and prevent settlement of new larvae. Grigg (1984) notes that, in Hawaii, large stands of *Corallium* are only found in areas where sediments almost never accumulate, and *P. secundum* appears in large numbers in areas of high flow over carbonate pavement (Parrish et al., 2015; Parrish and Baco, 2007). *Hemicorallium laauense* grows in an intermediate relief of outcrops; and *Kulamanamana haumaae* is most commonly seen growing in high relief areas on pinnacles, walls, and cliffs. These habitat differences may reflect preferred flow regimes for the different corals (e.g., laminar flow for *P. secundum*, alternating flow for *Kulamanamana haumaae*) (Parrish *et al.*, 2015).

Surveys of all potential sites for precious corals in the MHI conducted using a manned submersible show that most shelf areas in the MHI near 400 m are periodically covered with a thin layer of silt and sand (Grigg, 1984). Precious corals are known to grow on a variety of bottom substrate types. Precious coral yields, however, tend to be higher in areas of shell sandstone, limestone and basaltic or metamorphic rock with a limestone veneer. Grigg (1988) concludes that the concurrence of oceanographic features (strong currents, hard substrate, low sediments) necessary to create suitable precious coral habitat are rare in the MHI. Depth clearly influences the distribution of different coral taxa and certainly there is patchiness associated with the presence of premium substrate and environmental conditions (flow, particulate load, etc.). The environmental suitability for colonization and growth is likely to differ among coral taxa.

The habitat sustaining precious corals is generally in pristine condition. There are no known areas that have sustained damage due to resource exploitation, notwithstanding the alleged heavy foreign fishing for corals in the Hancock Seamounts area. Although unlikely, if future development projects are planned in the proximity of precious coral beds, care should be taken to prevent damage to the beds. Projects of particular concern would be those that suspend sediments or modify water-movement patterns, such as deep-sea mining or energy-related operations.

There has been very little research conducted concerning the food habits of precious corals. Precious corals are filter feeders (Grigg, 1984; 1993). The sparse research available suggests that particulate organic matter and microzooplankton are important in the diets of pink and bamboo coral (Grigg, 1970). Many species of pink coral, gold coral (*Kulamanamana haumeaae (*prev. *Gerardia* sp.*)* and black coral (*Antipathes*) form fan shaped colonies (Grigg, 1984; 1993). This type of morphological adaption maximizes the total area of water that is filtered by the polyps (Grigg, 1984; 1993). Bamboo coral (*Lepidisis olapa*), unlike other species of precious corals, is unbranched (Grigg, 1984). Long coils that trail in the prevailing currents maximize the total amount of seawater that is filtered by the polyps (Grigg, 1984). While clearly, the presence of strong currents is a vital factor determining habitat suitability for precious coral colonies, their role to date is not fully understood.

Light is one of the most important determining factors of the upper depth limit of many species of precious corals (Grigg, 1984).The larvae of two species of black coral, *Antipathes grandis* and *A. griggi*, are negatively phototaxic**.**

Grigg (1984) stated that temperature does not appear to be a significant factor in delimiting suitable habitat for precious corals. In the Pacific Ocean, species of *Corallium* are found in temperature ranges of 8^{o} to 20^{o}C, he observes. Temperature may determine the lower depth limits of some species of precious coral, including two species of black corals in the MHI. In the MHI, the lower depth range of two species of black corals (*A.griggi* and *A. grandis*) coincides with the top of the thermocline (about 100 m). Although, *A. griggi* can be found to depths of 100 m, it is rare below the 75 m depth limit at which commercial harvest occurs in Hawai‘i. Thus, the supposed depth refuge from harvest does not really exist, and was probably based on taxonomic misidentification, thereby calling into question population models used for the management of the Hawaiian black coral fishery (Wagner *et al.*, 2012; Wagner, 2011).

In pink coral (*P. secundum*), the sexes are separate (Grigg, 1993). Based on the best available data, it is believed that *P. secundum* becomes sexually mature at a height of approximately 12 cm (13 years) (Grigg, 1976). Pink coral reproduce annually, with spawning occurring during the summer, during the months of June and July. Coral polyps produce eggs and sperm. Fertilization of the oocytes is completed externally in the water column (Grigg, 1976; 1993). The resulting larvae, called planulae, drift with the prevailing currents until finding a suitable site for settlement.

Pink, bamboo and gold corals all have planktonic larval stages and sessile adult stages. Larvae settle on solid substrate where they form colonial branching colonies. Grigg (1993) notes that the lengths of the larval stage of all deep-water species of precious corals is unknown. Clean swept areas exposed to strong currents provide important sites for settlement of the larvae, Grigg adds. The larvae of several species of black coral (*Antipathes*) are negatively photoactic, he notes. They are most abundant in dimly lit areas, such as beneath overhangs in waters deeper than 30 m. In an earlier study, Grigg (1976) found that "within their depth ranges, both species are highly aggregated and are most frequently found under vertical drop-offs. Such features are commonly associated with terraces and undercut notches relict of ancient sea level still stands. Such features are common off Kauai and Maui in the MHI. Both species are particularly abundant off of Maui and Kauai, suggesting that their abundance is related to suitable habitat." Off of Oahu, many submarine terraces that otherwise would be suitable habitat for black corals are covered with sediments (Grigg, 1976).

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 dumerili*) and deep-water shrimp (*Heterocarpus ensifer*). These species do not seem to depend on the coral for shelter or food.

Densities of pink, gold and bamboo coral have been estimated for an unexploited section of the Makapuʻu bed (Grigg, 1976). As noted in the FMP for precious corals, the average density of pink coral in the Makapuʻu bed is 0.022 colonies/m^2. This figure was extrapolated to the entire bed (3.6 million m^2), giving an estimated standing crop of 79,200 colonies. At the 95 percent confidence limit, the standing crop is 47,500 to 111,700 colonies. The standing crop of colonies was converted to biomass ($3N_iW_i$), resulting in an estimate of 43,500 kg of pink coral in the Makapuʻu bed.

In addition to coral densities, Grigg (1976) determined the age-frequency distribution of pink coral colonies in Makapuʻu bed. He applied annual growth rates to the size frequency to calculate the age structure of pink coral at Makapuʻu Bed (Table 11). More recent work by Roark et al. (2006) suggests that annual growth ring dating may underestimate the ages of many species of deep-water corals, and that most of the colonies that have been dated using the ring method are probably older and slower growing than first estimated.

Estimates of density were also made for bamboo (*Lepidisis olapa*) and gold coral (*Kulamanamana haumeaae* (prev. *Gerardia* sp.) for Makapuʻu bed. The distributions of both these species are patchy. As noted in the FMP, the area where they occur comprises only half of that occupied by pink coral (1.8 km^2). Estimates of the unexploited abundance of bamboo and gold coral were 18,000 and 5,400 colonies, respectively. Estimates of density for the unexploited bamboo coral and gold coral in the Makapu‘u bed are 0.01 colonies/m^2 and 0.003 colonies/m^2.

Using a rough estimate for the mean weights of gold and bamboo coral colonies (2.2 kg and 0.6 kg), a standing crop of about 11,880 kg of gold coral and 10,800 kg for bamboo for Makapu‘u bed was obtained.

Growth rates for several species of precious corals found in the western Pacific region have been estimated. Grigg (1976) stated that the height of pink coral (*P. secundum*) colonies increases about 0.9 cm/year up to about 30 years of age. These growth rates are probably overestimated, and should be revisited using modern methodologies, such as radiometric dating (Roark et al., 2006). As noted in the FMP for precious corals, the height of the largest colonies of *Pleurocorallium secundum* at Makapu‘u bed rarely exceed 60 cm. Colonies of gold coral are known to grow up to 250 cm tall while bamboo corals may reach 300 cm. The natural mortality rate of pink coral at Makapu‘u bed is believed to be 0.066, equivalent to an annual survival rate of about 93 percent.

Table 11. Age-Frequency Distribution of *Pleurocorallium secundum* (Source: Grigg, 1973)

Age Group (years)	Number of Colonies
0–10	44
10–20	73
0–30	22
30–40	12
40–50	7
50–60	0

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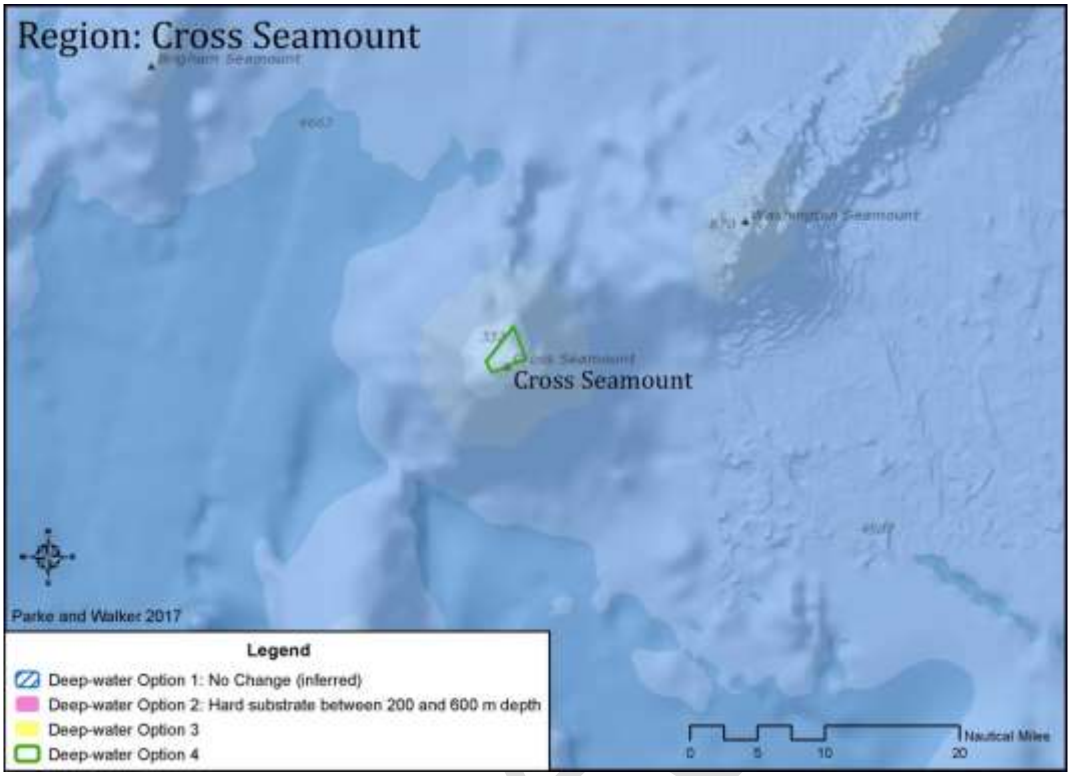
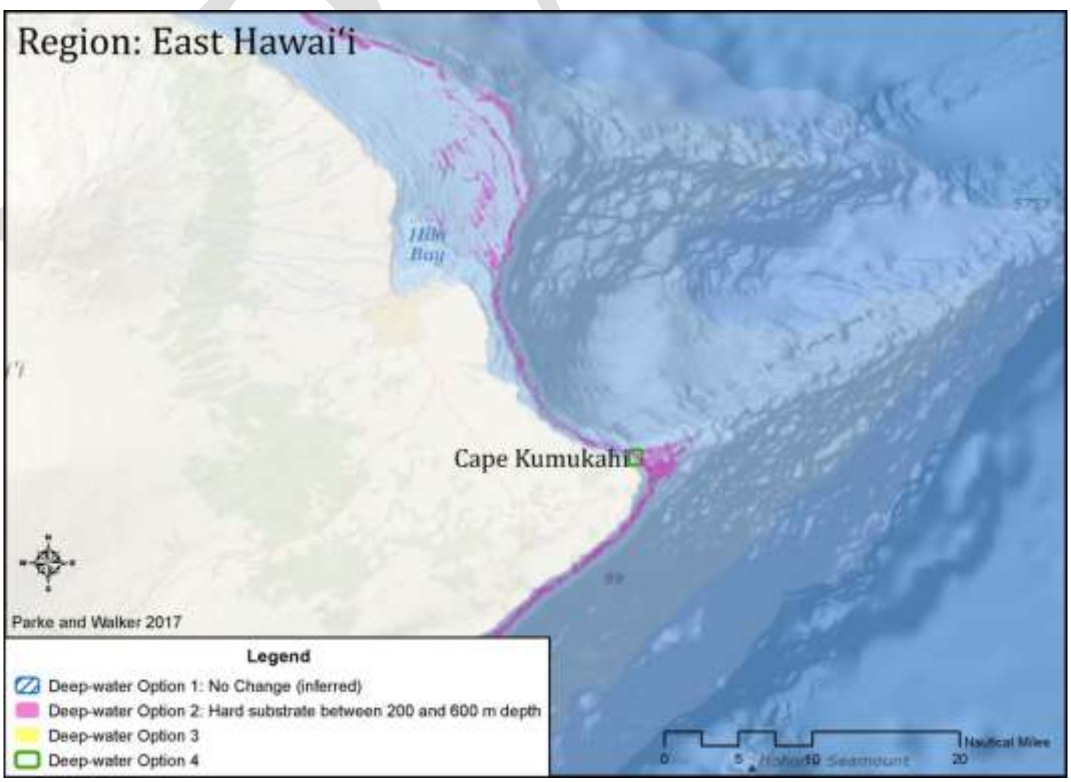
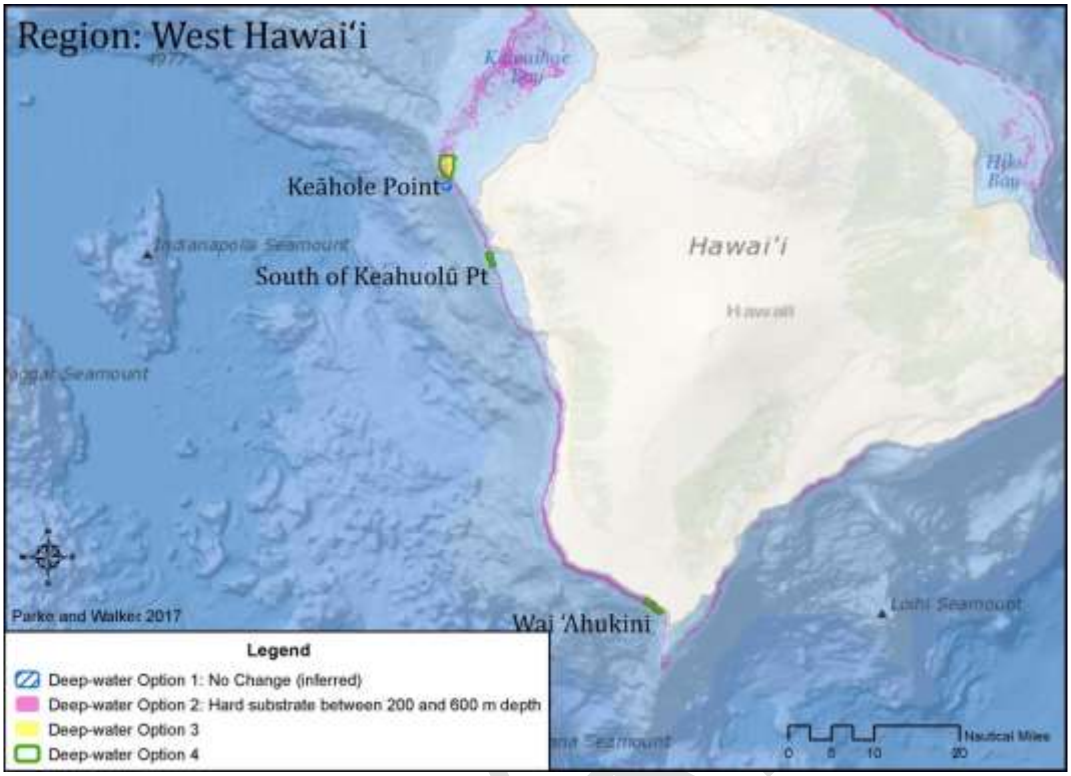
APPENDIX B. MAPS

Deep-Water Coral Alternatives






Region: West Hawai'i
Keāhole Point
South of Keahuolū Pt
Wai 'Ahukini
Hawai'i
Parke and Walker 2017
Legend
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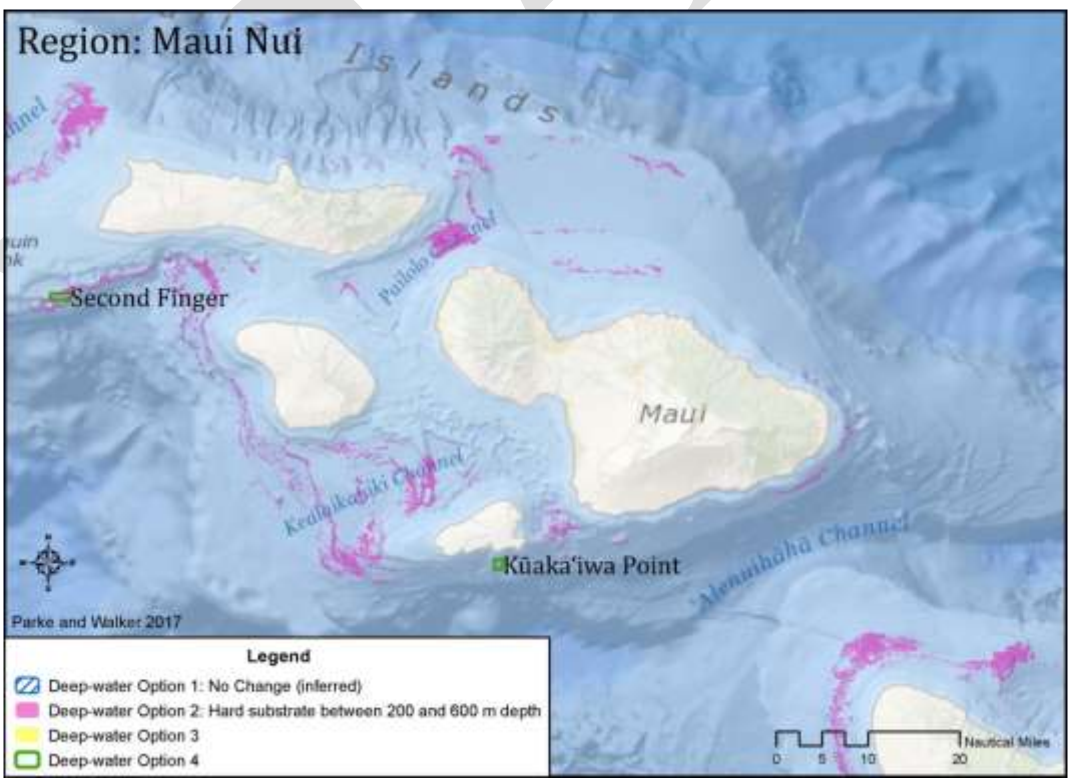
Deep-water Option 2: Hard substrate between 200 and 600 m depth
Deep-water Option 3
Deep-water Option 4
Nautical Miles
0 5 10 20


Region: Maui Nui
Islands
Second Finger
Maui
Kūaka'iwa Point
Parke and Walker 2017
Legend
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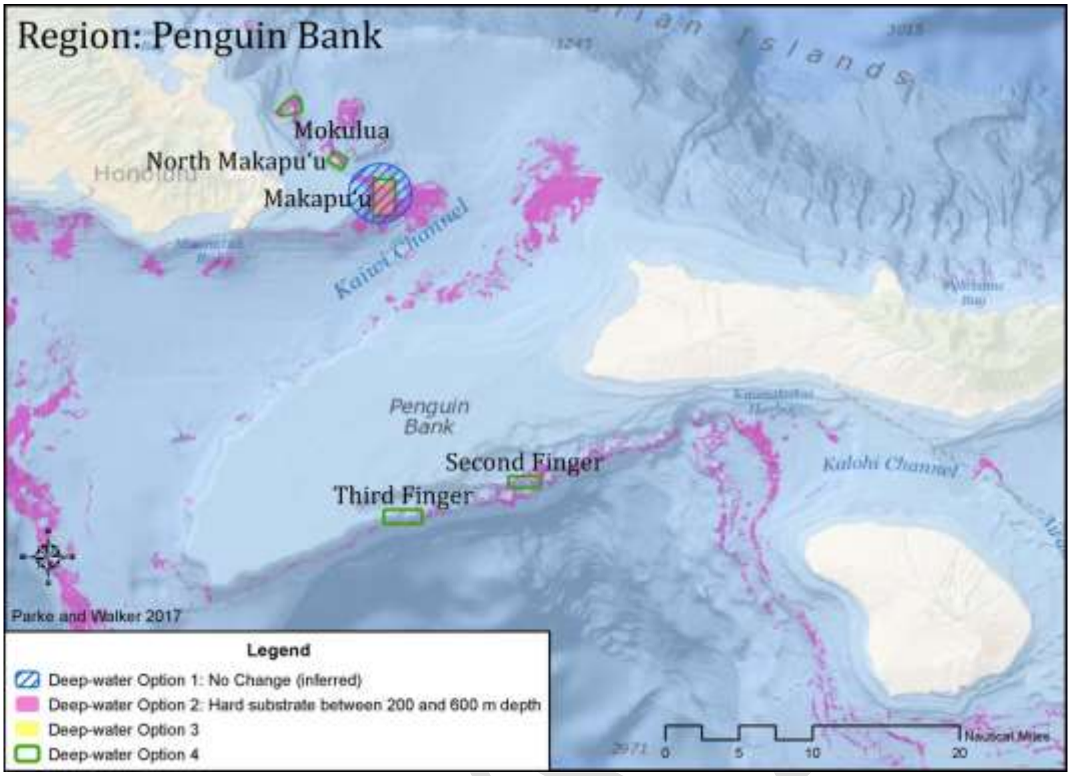
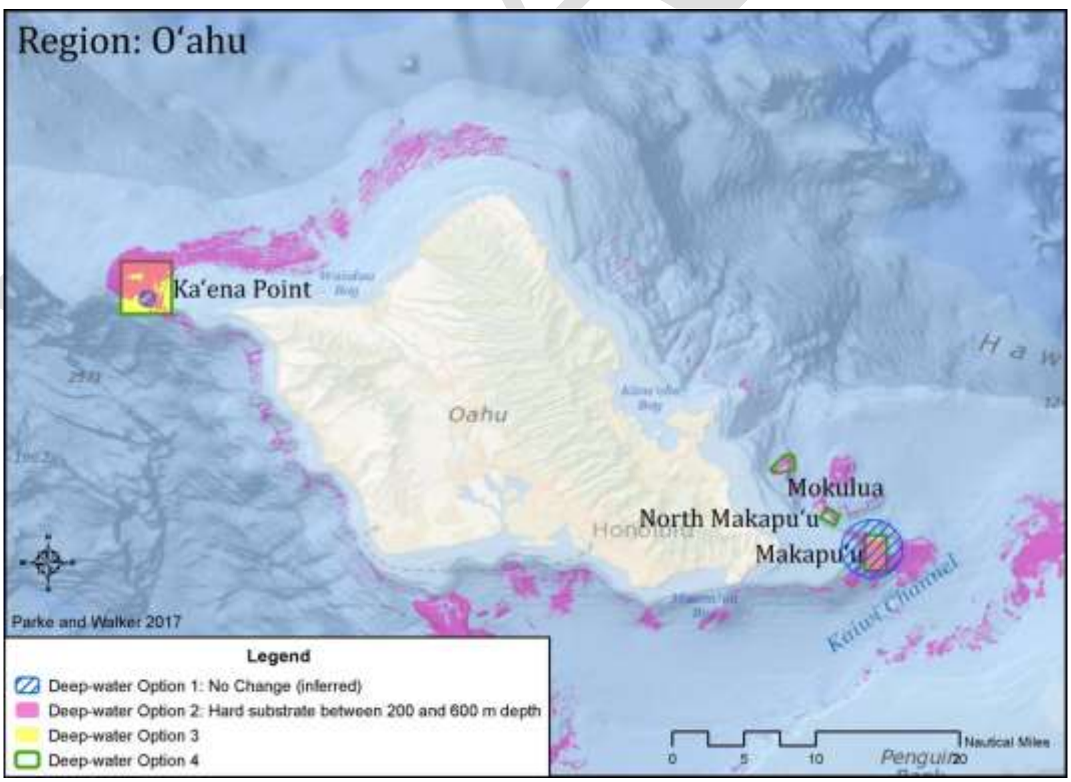
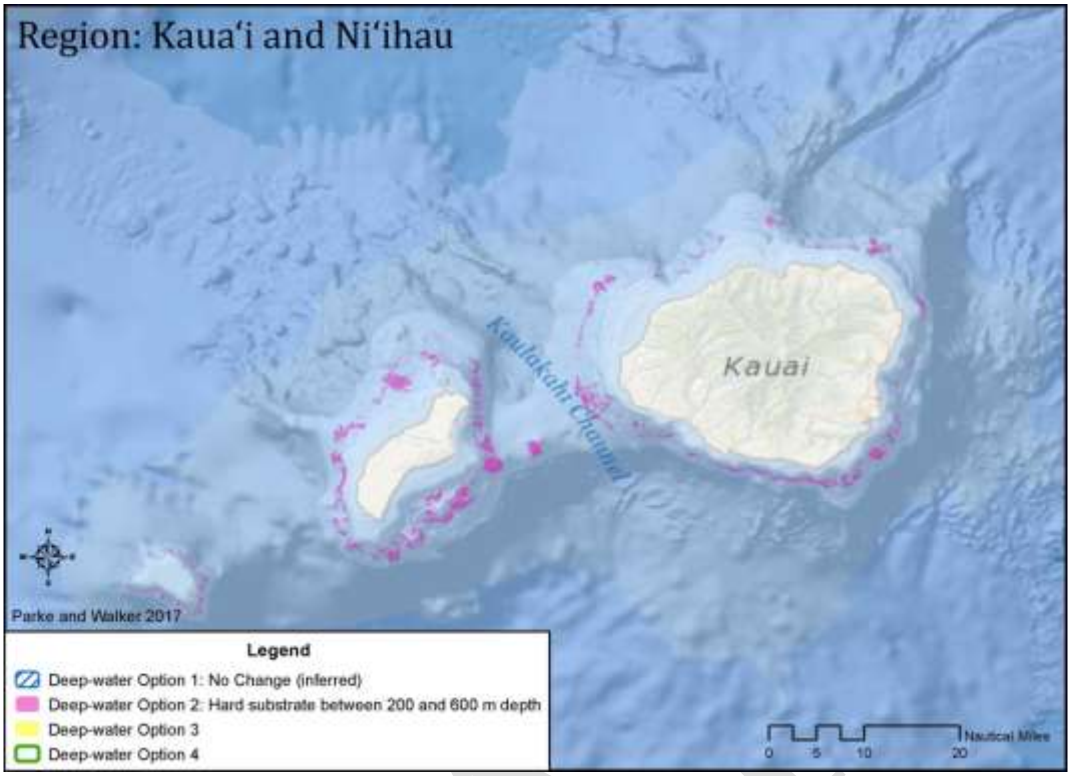
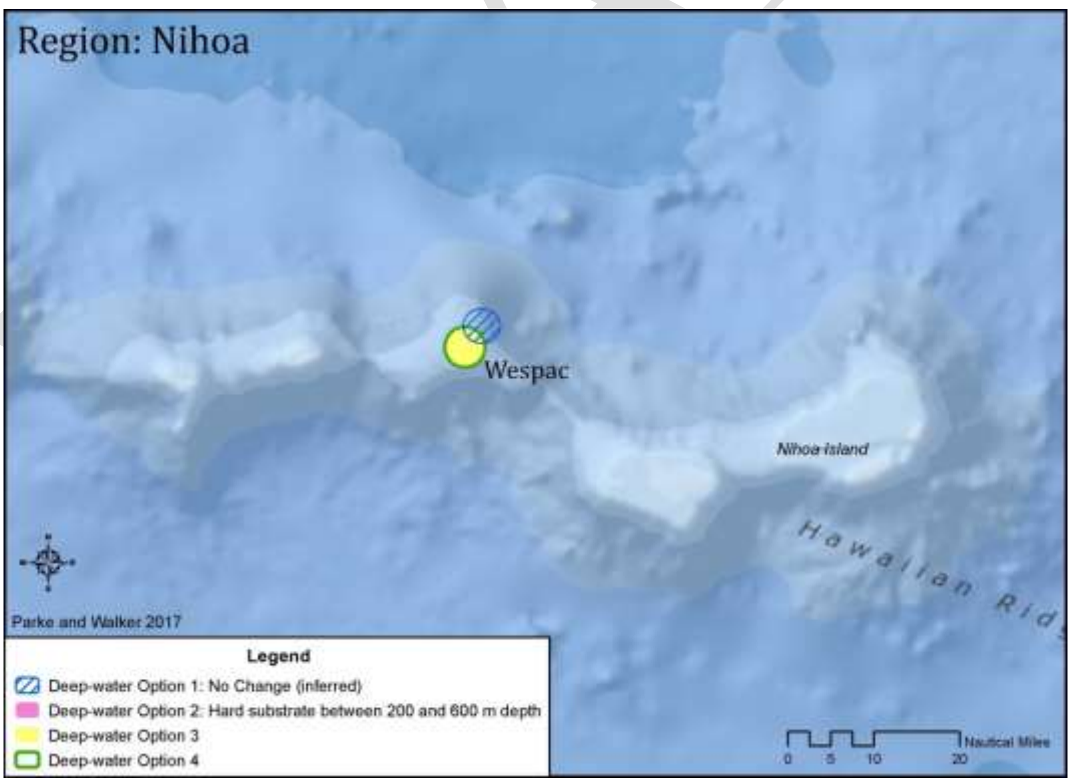
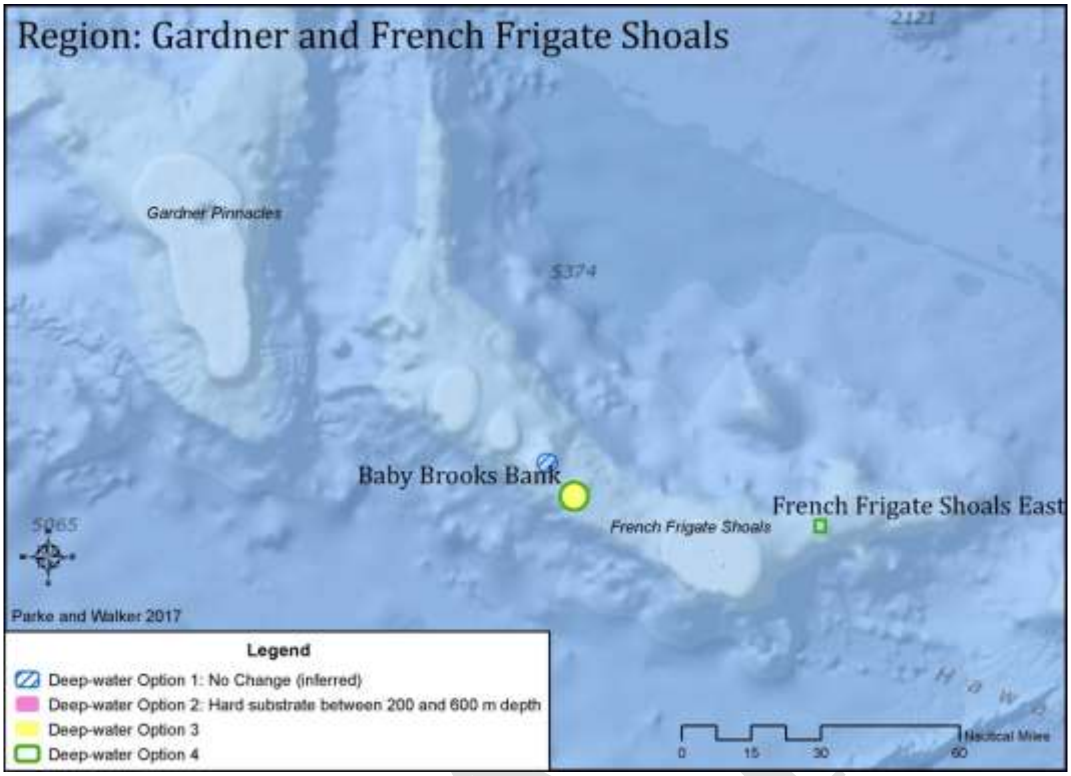
Deep-water Option 2: Hard substrate between 200 and 600 m depth
Deep-water Option 3
Deep-water Option 4
Nautical Miles
0 5 10 20


Region: Penguin Bank
Mokulua
North Makapu'u
Makapu'u
Kaiwi Channel
Penguin
Bank
Second Finger
Third Finger
Kalohi Channel
Parke and Walker 2017
Legend
Deep-water Option 1: No Change (inferred)
Deep-water Option 2: Hard substrate between 200 and 600 m depth
Deep-water Option 3
Deep-water Option 4
0
5
10
20
Nautical Miles

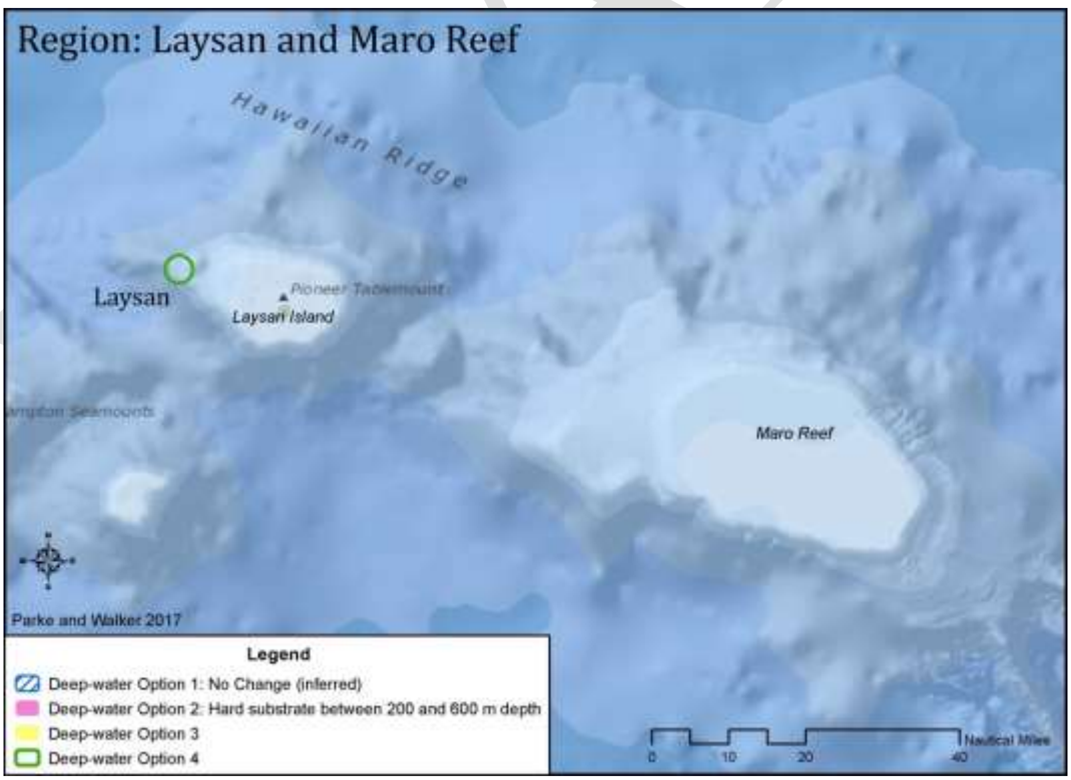

Region: O'ahu
Ka'ena Point
Oahu
Mokulua
North Makapu'u
Makapu'u
Kaiwi Channel
Parke and Walker 2017
Legend
Deep-water Option 1: No Change (inferred)
Deep-water Option 2: Hard substrate between 200 and 600 m depth
Deep-water Option 3
Deep-water Option 4
0
5
10
20
Nautical Miles


Region: Kaua'i and Ni'ihau
Kauai
Kaulakahi Channel
Parke and Walker 2017
Legend
Deep-water Option 1: No Change (inferred)
Deep-water Option 2: Hard substrate between 200 and 600 m depth
Deep-water Option 3
Deep-water Option 4
0 5 10 20 Nautical Miles

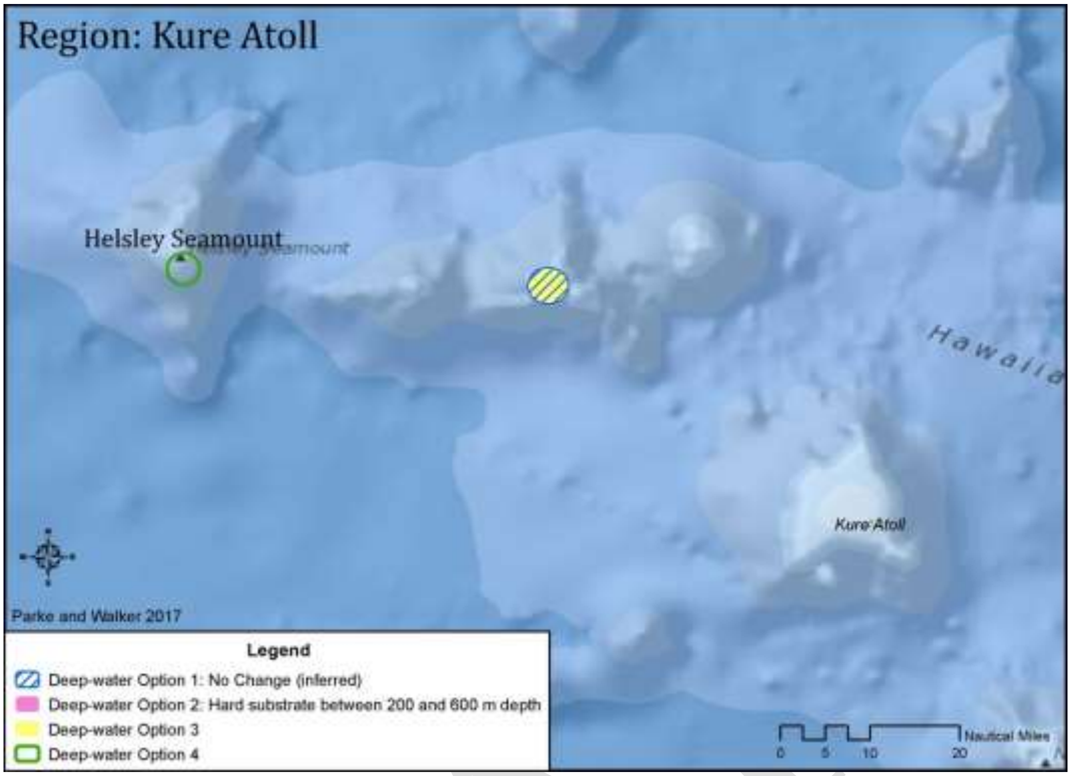

Region: Nihoa
Wespac
Nihoa Island
Hawaiian Rid
Parke and Walker 2017
Legend
Deep-water Option 1: No Change (inferred)
Deep-water Option 2: Hard substrate between 200 and 600 m depth
Deep-water Option 3
Deep-water Option 4
0 5 10 20 Nautical Miles

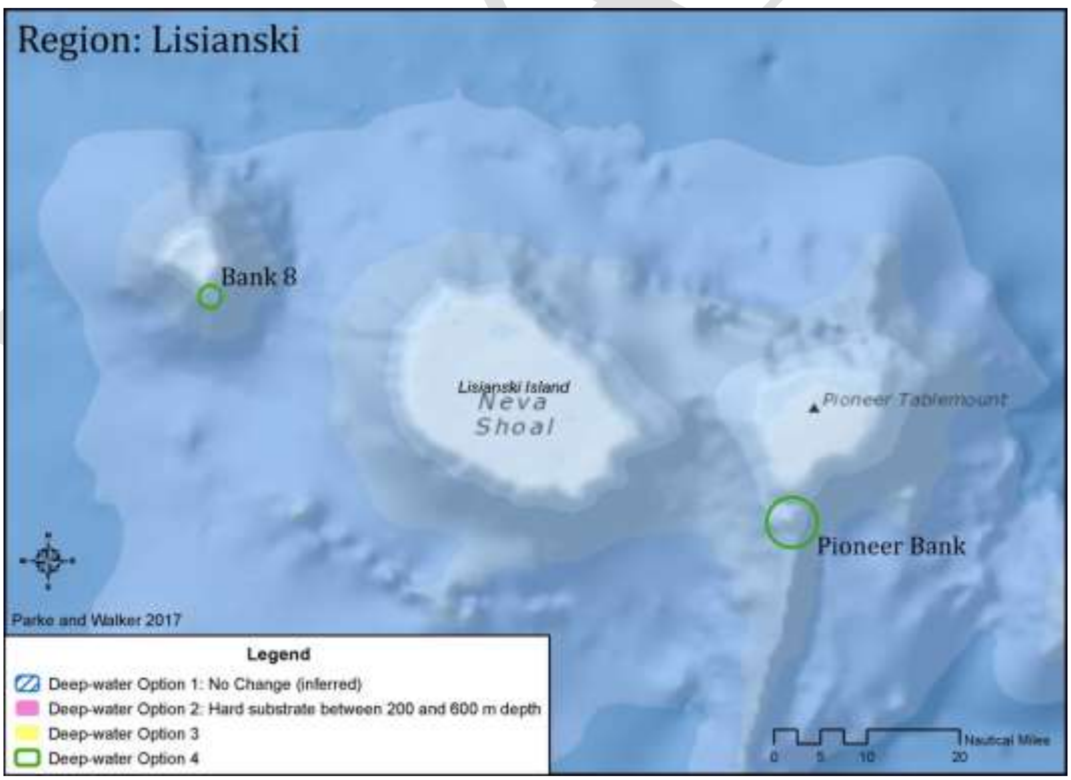


Region: Gardner and French Frigate Shoals
Gardner Pinnacles
Baby Brooks Bank
French Frigate Shoals East
French Frigate Shoals
Parke and Walker 2017
Legend
Deep-water Option 1: No Change (inferred)
Deep-water Option 2: Hard substrate between 200 and 600 m depth
Deep-water Option 3
Deep-water Option 4
0 15 30 60
Nautical Miles

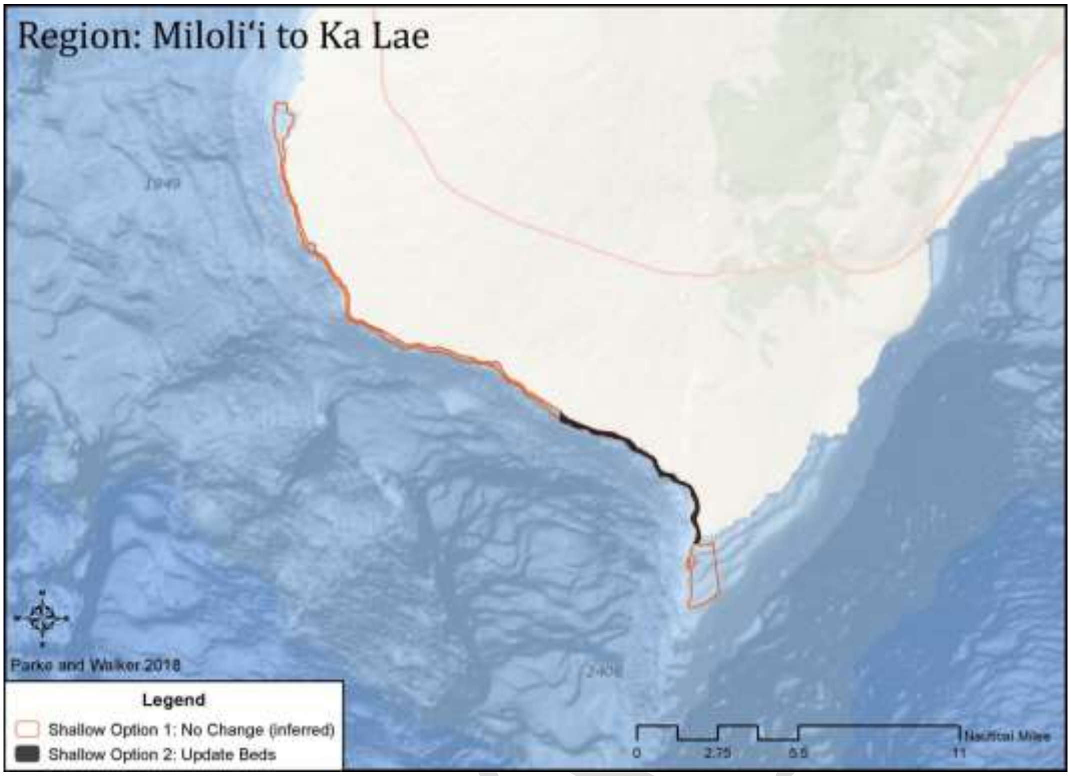


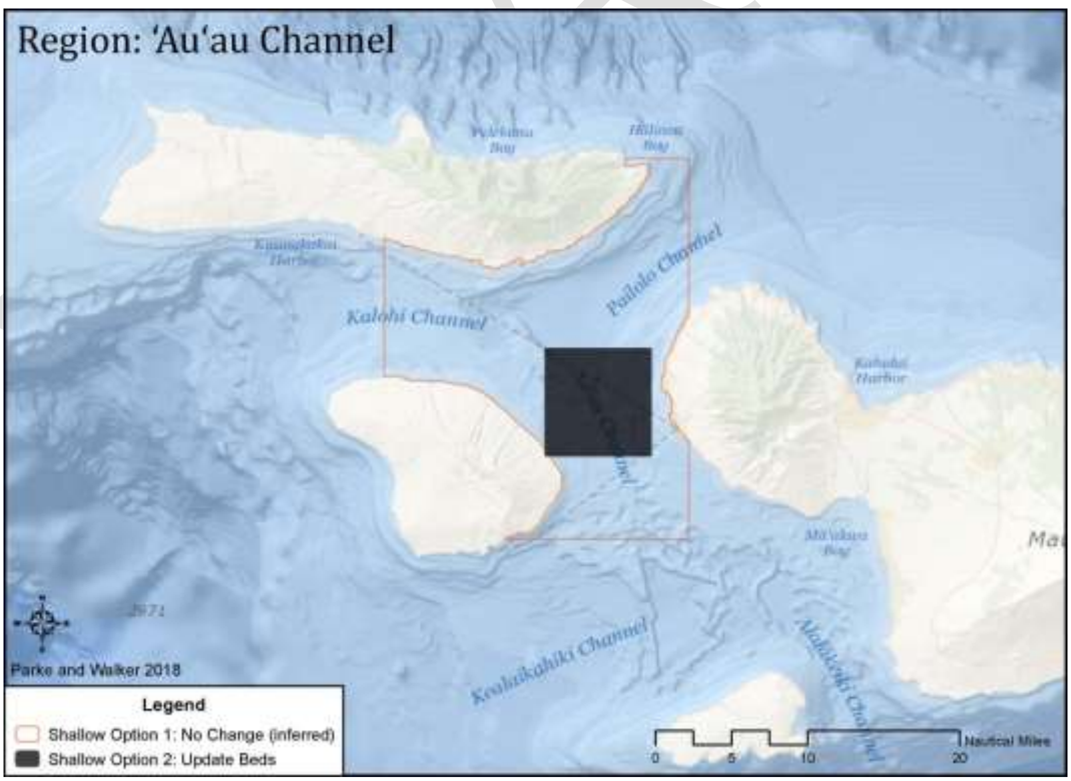
Region: Laysan and Maro Reef
Hawaiian Ridge
Laysan
Laysan Island
Maro Reef
Parke and Walker 2017
Legend
Deep-water Option 1: No Change (inferred)
Deep-water Option 2: Hard substrate between 200 and 600 m depth
Deep-water Option 3
Deep-water Option 4
0 10 20 40
Nautical Miles

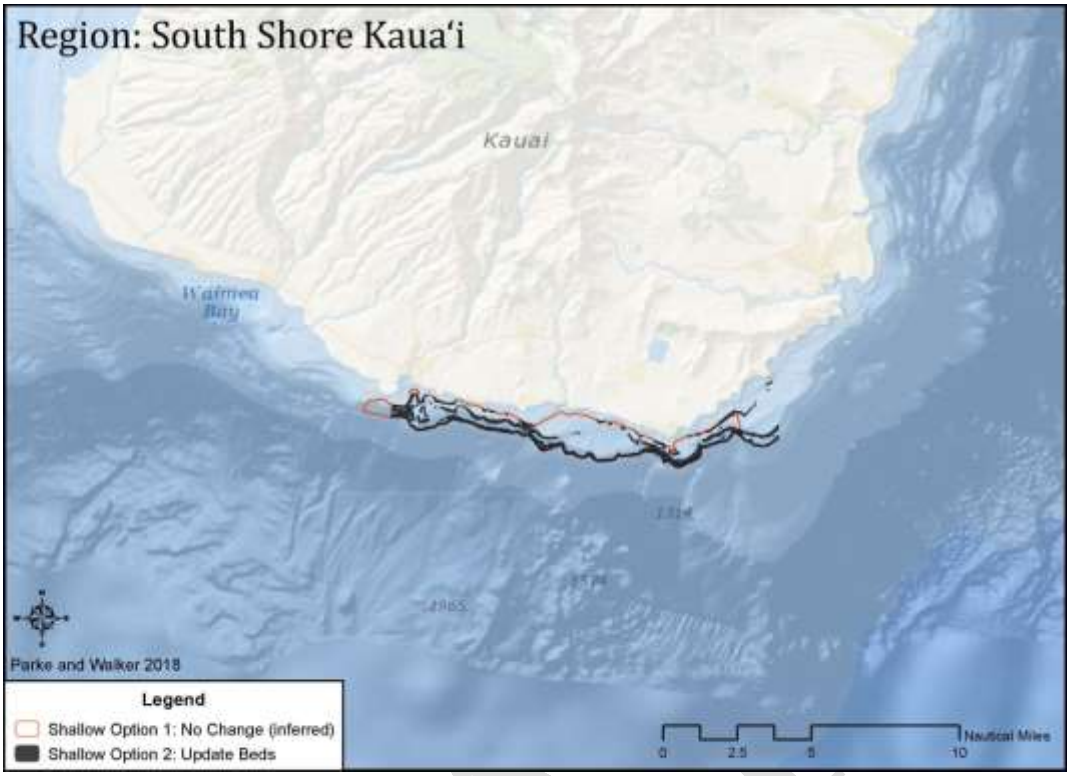

Region: Kure Atoll
Helsley Seamount
Kure Atoll
Parke and Walker 2017
Legend
Deep-water Option 1: No Change (inferred)
Deep-water Option 2: Hard substrate between 200 and 600 m depth
Deep-water Option 3
Deep-water Option 4
0 5 10 20 Nautical Miles


Region: Lisianski
Bank 8
Lisianski Island
Neva Shoal
Pioneer Tablemount
Pioneer Bank
Parke and Walker 2017
Legend
Deep-water Option 1: No Change (inferred)
Deep-water Option 2: Hard substrate between 200 and 600 m depth
Deep-water Option 3
Deep-water Option 4
0 5 10 20 Nautical Miles

Shallow-Water Coral Alternatives






Region: South Shore Kaua'i
Kauai
Waimea
Bay
Parke and Walker 2018
Legend
Shallow Option 1: No Change (inferred)
Shallow Option 2: Update Beds
0
2.5
5
10
Nautical Miles

APPENDIX C. PRECIOUS CORAL BREAKOUT GROUP REPORT

A precious coral management working group meeting was held in early 2018. Participants included: Frank Parrish and Michael Parke, Plan Team and PIFSC; Christopher Kelley and Meagan Putts, HURL; Ryan Okano, Scientific and Statistical Committee and Hawaiʻi Division of Aquatic Resources (DAR); Tony Montgomery, DAR; and Rebecca Walker, Council staff, were present. Stuart Goldberg, Pacific Islands Regional Office (PIRO), was on the teleconference. Participants who were not plan team members were invited to attend based on their expertise in the subject matter.

The objectives of the working group were to review, add to and approve the habitat characteristics language and definitions for each precious coral species in the management unit, and to review and develop boundaries of precious coral beds and provide rationale for the boundary of each bed. Working group participants received an overview of the EFH review process before stepping through habitat characteristics and bed review exercises for deep-water precious coral species, followed by shallow-water precious coral species. The description of habitat characteristics and geographic extent (bed boundaries) combine to make a complete EFH designation.

Deep-Water Precious Corals – Habitat Characteristics

Participants were provided with a draft habitat characteristics description for the benthic phase of deep-water precious coral species likely to remain in the management unit, reproduced below.

> EFH for the benthic phase of *Pleurocorallium secundum, Hemicorallium laauense,* and *Lepidisis olapa* is natural hard substrates between the 200 and 600 m isobaths in areas with higher current velocities, low sedimentation, and where precious coral and associated communities are found.
>
> EFH for the benthic phase of *Kulamanamana haumeaae* is the tissue or skeleton of bamboo coral colonies, the preferred hosts of the parasitic *K. haumeaae* in depths between 200 and 600 m.
>
> The following definitions are included to assist managers and the public with determining the scope of EFH and the potential impacts to that habitat.
>
> Precious coral and associated communities include the precious corals themselves, the specific biological hosts needed for settlement by gold corals, a wide variety of commensal organisms that live within and upon the corals, and the various vertebrate and invertebrate organisms that are typically found among these coral, such as asteroids, shrimp, squat lobsters, barnacles, holothurians, and others. These communities have yet to be comprehensively catalogued, but are composed of a wide variety of taxa that demonstrate a level of complexity and co-dependence commensurate with shallow-water coral reef communities.
>
> Natural hard substrates include any hard bottoms that are not of artificial origin. Parrish found that precious coral taxa colonize both carbonate and basalt/manganese substrates (2007). *Hemicorallium laauense* grows in an intermediate relief of outcrops; and

Kulamanamana haumaae is most commonly seen growing in high relief areas on pinnacles, walls, and cliffs. These habitat differences may reflect preferred flow regimes for the different corals (e.g., laminar flow for *P. secundum*, alternating flow for *Kulamanamana haumaae*) (Parrish et al., 2015).

Higher current velocities refer to the accelerated or localized, enhanced flow necessary to sweep away sediment and increase the flux of organic matter (Genin et al., 1992). While the particular current velocity that promotes precious coral settlement and growth is unknown, Carter et al. 2008 hypothesized that deep-sea corals prefer areas with current velocities 0.5 – 0.85 m/s while Grigg (1974) determined that precious corals prefer solid substrate in areas that are swept relatively clean by currents faster than 0.25 m/s. Parrish found that the precious corals favor areas where bottom relief enhances or modifies flow characteristics that may improve the colony's feeding success (Parrish, 2007). Strong currents help prevent the accumulation of sediments, which would smother young coral colonies and prevent settlement of new larvae. Grigg (1984) notes that, in Hawaii, large stands of *Corallium* are only found in areas where sediments almost never accumulate, and *P. secundum* appears in large numbers in areas of high flow over carbonate pavement (Parrish et al., 2015; Parrish and Baco, 2007).

Working group participants made nine changes: three changes to the draft habitat characteristics description, five changes to the definitions, and one update to a citation.

1. Changed *Lepidisis olapa* to *Acanella* spp. *L. olapa* are thin, tall corals which would not produce much raw product for jewelry. The potentially targeted species of bamboo should be *Acanella* spp., which have branching morphology similar to pink corals.

2. Inserted "stable" between natural and hard substrates in the habitat characteristics description. Precious corals are generally found on consolidated sediments, not rubble or unstable sediments.

3. Changed "precious coral and associated communities are found" to "precious corals are clustered." The community around precious corals does not make the required habitat or the precious coral bed. Precious coral beds can be found without high biodiversity, in stands of single species.

4. Changed the "precious coral and associated communities" definition to "precious coral beds" and added the caveat that the beds may include a wide variety of commensal organisms. This definition describes a bed without requiring an associated community.

5. Added fish to the description of organisms which are typically found among the precious corals.

6. Changed the "natural, hard substrates" definition to "natural, stable, hard substrates" and added examples, such as bedrock, large boulders, slabs, blocks, etc. Participants noted that these substrates are essential for recruitment, but perhaps not after recruitment once established.

7. Changed a sentence in the "higher current velocities" definition: While the particular current velocity that promotes precious coral settlement and growth is unknown, Grigg (1974) estimated corals preferred areas of solid substrate swept clean by currents faster than 0.25 m/s and based on initial modeling of tidal flow (Carter et al., 2008) it is hypothesized deep corals prefer velocities ranging somewhere between 5 – 0.85 m/s (Parrish et al., 2017). This more accurately reflects the primary source material.

8. Added the following sentence to the "higher current velocities" definition: Recent work in the Hawaiian Islands indicates that previously hypothesized numbers may be too high, based on mean values. 0.5 m/s, the low end of previously hypothesized values, is in the high range of observed mean flow values from measurements taken within and on the edges of precious coral beds. There is some uncertainty around the preferred flow of precious corals; participants noted that some dives have not found corals when expected, and that consistent flow direction may be important for *Pleurocorallium secundum*.

9. Citations to Parrish et al., (2015) were updated to Parrish et al., (2017), as the report is no longer in press.

Working group participants considered broadening the host taxa for *K. haumeaae*, but decided to keep it limited to bamboo coral colonies, particularly *Acanella* spp. Scientists have not yet confirmed whether *K. haumeaae* colonizes hosts in other taxa. The final habitat characteristics description for the benthic phase of deep-water precious coral species is reproduced below.

> EFH for the benthic phase of *Pleurocorallium secundum, Hemicorallium laauense,* and *Acanella* sp. is natural, stable, hard substrates between the 200 and 600 m isobaths in areas with higher current velocities, low sedimentation, and where precious corals are clustered.
>
> EFH for the benthic phase of *Kulamanamana haumeaae* is the tissue or skeleton of bamboo coral colonies, particularly *Acanella sp.*, the preferred hosts of the parasitic *K. haumeaae* in depths between 200 and 600 m.
>
> The following definitions are included to assist managers and the public with determining the scope of EFH and the potential impacts to that habitat.
>
> Precious coral beds include the precious corals themselves, the specific biological hosts needed for settlement by gold corals, and may include a wide variety of commensal organisms that live within and upon the corals, and the various vertebrate and invertebrate organisms that are typically found among these corals, such as fish, asteroids, shrimp, squat lobsters, barnacles, holothurians and others. These communities have yet to be comprehensively catalogued, but are composed of a wide variety of taxa that demonstrate a level of complexity and co-dependence commensurate with shallow-water coral reef communities.
>
> Natural stable, hard substrates include any hard bottoms that are not of artificial origin, such as bedrock, large boulders, slabs, blocks, etc. Parrish found that precious coral taxa colonize both carbonate and basalt/manganese substrates (2007). *H. laauense* grows in an intermediate relief of outcrops; and *K. haumaae* is most commonly seen growing in high

relief areas on pinnacles, walls, and cliffs.

Higher current velocities mean the accelerated or localized, enhanced flow necessary to sweep away sediment and increase the flux of organic matter (Genin et al., 1992). While the particular current velocity that promotes precious coral settlement and growth is unknown, Grigg (1974) estimated corals preferred areas of solid substrate swept clean by currents faster than 0.25 m/s and based on initial modeling of tidal flow (Carter et al 2008) it is hypothesized deep corals prefer velocities ranging somewhere between 5 – 0.85 m/s (Parrish et al. 2017). Recent work in the Hawaiian Islands indicates that previously hypothesized numbers may be too high, based on mean values. Parrish found that some precious corals favor areas where bottom relief enhances or modifies flow characteristics that may improve the colony's feeding success (Parrish, 2007). Strong currents help prevent the accumulation of sediments, which would smother young coral colonies and prevent settlement of new larvae. Grigg (1984) notes that, in Hawai‘i, large stands of *Corallium* are only found in areas where sediments almost never accumulate, and *P. secundum* appears in large numbers in areas of high flow over carbonate pavement (Parrish et al. 2017; Parrish and Baco, 2007).

Deep-Water Precious Corals – Bed Boundaries

Working group participants were provided with a draft list of potential beds with boundary descriptions, developed from observational data of precious corals and the current EFH designations. Participants were directed to confirm whether or not the draft beds should be considered a bed, and if so, provide boundaries. Rationale must be provided for determining the geographic extent of the beds. Participants were prompted with several approaches, such as referencing the scientific literature, falling back on the regulatory definitions of the beds, using a circle boundary with a defined radius and central coordinate, or using bathymetric and substrate data to guide boundaries around observations. Participants moved through a geographic information system (GIS) to determine bed boundaries, using the draft beds, HURL unpublished data, NOAA's Deep-sea Corals and Sponges database filtered for relevant taxa, bathymetry, and backscatter data for reference. The draft list is reproduced below.

1. Pōhue Bay to Ka Lae includes the area within a radius of 1 km of a point at 155° 43.25′ W, 18° 57.114′ N

2. Keāhole Point (and large area north of designated bed): includes the area within a radius of 3 km of a point at 156° 7.015′ W, 19° 47.62′ N

3. Hilo Harbor to Pepe‘ekeo (between 200 and 600 meters depth): includes the area within a radius of 3 km of a point at, 154° 59.02′ W, 19° 47.897′ N

4. Kūaka‘iwa Pt. (Kaho‘olawe) includes the area within a radius of 1 km of a point at 156° 34.8′ W, 20° 29.68′ N

5. ‘Alalākeiki Channel between Ule Pt. and Nukuele Pt. includes the area within a radius of 3 km of a point at 156° 29.7′ W, 20° 34.77′ N

6. Cape Kumukahi: includes the area within a radius of 2 km of a point at 154° 48.78′ W, 19° 32.38′ N

7. Penguin Bank East: includes the area within a radius of 3 km of a point at 157° 22.72′ W, 20° 58.41′ N

8. Penguin Bank West: includes the area within a radius of 3 km of a point at 157° 31.39′ W, 20° 55.77′ N

9. South of Keahuolū Pt.: includes the area within a radius of 2 km of a point at 156° 2.096′ W, 19° 37.74′ N

10. Honolulu International Airport includes the area within a radius of 3 km of a point at 157° 56.025′ W, 21° 16.29′ N

11. Barber's Point NAS includes the area within a radius of 3 km of a point at 158° 3.59′ W, 21° 14.29′ N

12. Makapu'u Bed: includes the area bounded by geodesic lines connecting the following coordinates in the order listed:

Point Identifier	Longitude	Latitude
1	157° 33' 00.00" W	21° 19' 06.37" N
2	157° 32' 48.70" W	21° 18' 58.98" N
3	157° 32' 13.21" W	21° 18' 55.28" N
4	157° 31' 30.00" W	21° 18' 56.76" N
5	157° 31' 30.00" W	21° 16' 30" N
6	157° 33' 00.00" W	21° 16' 30" N
1	157° 33' 00.00" W	21° 19' 06.37" N

13. North Makapu'u Bed: includes the area within a radius of 3 km of a point at 157° 34.98′ W, 21° 21.47′ N

14. Mokulua Islands: includes the area within a radius of 3 km of a point at 157 ° 38.42′ W, 21° 24.04′ N

15. Ka'ena Point: (and 200-600m areas around designated zone) includes the area within a radius of 3 km of a point at 158° 22.93′ W, 21° 36.09′ N

16. Ka'ula: includes the area within a radius of 3 km of a point at 160° 37.17′ W, 21° 41.32′ N

17. Cross Seamount: includes the area within a radius of 3 km of a point at 158°15.63′ W, 18° 43.56 N

18. Middle Bank: includes the area near 21° 45′ and 160° 56′ W

NWHI

1. Westpac Bed: includes the area within a radius of 4 km of a point at 162° 36.88′ W, 23° 15.9′ N

2. East French Frigate Shoals: includes the area within a radius of 4 km of a point at 165° 49.16′ W, 23° 51.95′ N

3. Brooks Bank: includes the area within a radius of 5 km of a point at 166° 42.262′ W, 23° 58.77′ N

4. Laysan: includes the area within a radius of 3 km of a point at 171° 57.585′ W, 25° 51.75′ N

5. Pioneer Bank: includes the area within a radius of 4 km of a point at 173° 29.28′ W, 25° 49.9′ N

6. Bank 8: includes the area within a radius of 2 km of a point at 174° 30.68′ W, 26° 13.56′ N

7. 180 Fathom Bank: includes the area within a radius of 2.0 nm of a point at 28°50.2′ N. lat., 178°53.4′ W. long

8. Seamount 11 (Helsley): includes the area within a radius of 3 km of a point at 179° 34.05′ W, 28° 52.15′ N

9. (Beds identified using some GIS method or predictive modeling method)

Participants recognized that while the regulatory beds were defined using a central coordinate and a radius, generally straight line boundaries are easier for fishers and the public to use to determine where a boundary is. However, in some circumstances, circles were more suitable shapes to cover a bed than boxes. Another consideration present throughout the exercise was that bed areas, under the precious coral fishery management plan, may be used to estimate abundance of corals within the beds, so including areas which may not have corals could inflate the estimate. Bathymetric features, observation data, and expert judgement from dive participation were used to define the bed boundaries. Expert participation was crucial for this exercise.

Precious coral beds are diverse in their composition and distribution of corals. On the sheltered western coast of Hawai'i Island, much more suitable habitat occurs than has been explored. Dense beds of Coralliids are found here; while in other areas, corals may be limited to pinnacles atop a feature and patchily distributed. Participants defined some of these patchier areas as beds, specifying that the bed description should characterize these beds as patchy. While recent dives have discovered other areas where precious corals grow, participants focused on the available data. Observation data from the Okeanos cruises may be available before the next five year EFH review.

Participants noted that the regulatory beds were originally defined before GPS was available. Richard Grigg performed dredging surveys, and when precious coral species were present in the dredged material, a bed was marked. Data from dredges which did not return precious corals have not been analyzed and may be lost. Limitations in geographic positioning and the sampling mechanism may explain why newer observations of several regulatory beds do not overlap with the regulatory beds, or the regulatory beds do not have enough observation to be considered beds for the purposes of EFH designation.

The final list of beds is reproduced below. Council GIS staff produced the final boundaries from direction received during the working group meeting.

1. Wai ‘Ahukini (Pōhue Bay to Ka Lae) includes the area bounded by a geodesic line connecting points 1 and 2, the 200 m isobath connecting points 2 to 3, a geodesic lines connecting points 3 to 4, and the 600 m isobath connecting points 4 to 1, with the locations for points identified in the following table:

Point Identifier	Longitude	Latitude
1	155° 44' 06.81" W	18° 57' 23.19" N
2	155° 43' 36.79" W	18° 57' 46.13" N
3	155° 41' 49.73" W	18° 56' 24.39" N
4	155° 41' 58.68" W	18° 56' 00.56" N
1	155° 44' 06.81" W	18° 57' 23.19" N

Lava flows mark the longitudinal edges of this bed, while the 200 and 600 m isobaths bound the bed to the north and south.

Rationale: The bed has been surveyed to the western edge, where suitable habitat ends at the edge of the flow. To the east, the bed likely continues to the edge of the flow. This bed has been surveyed twice with HURL dive and once with the Okeanos Explorer. A polygon more accurately captures the observations and flow features than a circle.

2. South of Keahuolū Pt.: includes the area bounded by a geodesic line connecting points 1 and 2, the 200 m isobath connecting points 2 and 3, a geodesic line connecting point 3 to 4, and the 600 m isobath connecting points 4 to 1, with the locations for points identified in the following table:

Point Identifier	Longitude	Latitude
1	156° 02' 15.99" W	19° 38' 15.16" N
2	156° 01' 49.49" W	19° 38' 15.25" N
3	156° 01' 19.60" W	19° 36' 49.65" N
4	156° 01' 50.32" W	19° 36' 36.91" N
1	156° 02' 15.99" W	19° 38' 15.16" N

This bed encompasses several ridges on which precious corals have been observed.

Rationale: The boundary in the north was matched to the last ridge dip, and the last observation in the south. The longitudinal boundaries are the 200 m to 600 m depth range. Participants noted that along the West Hawai‘i coastline, stable, hard substrates within the 200 m to 600 m depth range are likely to support red corals.

3. Keāhole Point includes the area bounded by geodesic lines connecting points 1 to 2, 2 to 3, and 3 to 4; the 200 m isobath connecting points 4 to 5; a geodesic line connecting point 5 to 6, and the 600 m isobath connecting point 6 to 1, with the locations for points identified in the following table:

Point Identifier	Longitude	Latitude
1	156° 07' 43.04" W	19° 49' 27.50" N
2	156° 06' 53.40" W	19° 49' 36.41" N
3	156° 06' 00.63" W	19° 49' 28.49" N
4	156° 06' 00.63" W	19° 49' 17.70" N
5	156° 06' 21.37" W	19° 46' 57.98" N
6	156° 06' 55.87" W	19° 46' 56.24" N
1	156° 07' 43.04" W	19° 49' 27.50" N

This bed encloses observations at Keāhole Point and is bounded by the 200 and 600 m depth range.

Rationale: Observations do not occur within the regulatory definition of the Keāhole Point bed. The observations are clustered around a bathymetric feature. The northernmost and southernmost observations provide the latitudinal boundaries, while the 200 m and 600 m isobaths provide the longitudinal boundaries.

4. Cape Kumukahi: includes the area bounded by geodesic lines connecting the following coordinates in the order listed:

Point Identifier	Longitude	Latitude
1	154° 49' 12.87" W	19° 32' 58.53" N
2	154° 48' 20.32" W	19° 32' 58.53" N
3	154° 48' 20.32" W	19° 31' 57.47" N
4	154° 49' 12.87" W	19° 31' 57.47" N
1	154° 49' 12.87" W	19° 32' 58.53" N

Rationale: The bed was discovered on geologic dives of the Makaliʻi vehicle. Positioning of the vehicle includes only a single point, does not cover a lot of ground, and is limited to 366 m. Because multiple dives (points in the observations) resulted in coral observations, the area is probably a bed, though not well studied. The bathymetry surrounding the observations would promote current acceleration necessary for precious corals. The bed is limited to most of the observations, not all, given the positioning limitations of the vehicle. Participants noted that the bathymetry is interesting in this area, and the southern, unexplored half may have more corals. The entire point is likely good habitat for corals.

5. Kūakaʻiwa Point (Kahoʻolawe): includes the area bounded by geodesic lines connecting the following coordinates in the order listed:

Point Identifier	Longitude	Latitude
1	156° 35' 23.36" W	20° 29' 48.07" N
2	156° 34' 29.74" W	20° 29' 48.07" N
3	156° 34' 29.74" W	20° 28' 40.74" N

4	156° 35' 23.36" W	20° 28' 40.74" N
1	156° 35' 23.36" W	20° 29' 48.07" N

The bed at Kūakaʻiwa Point encompasses a promontory.

Rationale: The bed is bounded by the extreme observations, because the dives associated with these observations were transect dives around the promontory. Precious corals were not seen on either side of the recorded observations. The participants noted that the cluster of observations to the west of this bed did not contain precious coral management unit species.

6. Second Finger (Penguin Bank East): includes the area bounded by geodesic lines connecting the following coordinates in the order listed:

Point Identifier	Longitude	Latitude
1	157° 23' 46.25" W	20° 58' 46.94" N
2	157° 21' 38.10" W	20° 58' 46.94" N
3	157° 21' 38.10" W	20° 57' 59.63" N
4	157° 23' 46.25" W	20° 57' 59.63" N
1	157° 23' 46.25" W	20° 58' 46.94" N

The bed is named after the bathymetric feature on which it occurs.

Rationale: The observations occur over a bathymetric feature – the second finger – and so the feature serves as the limits of the bed.

7. Third Finger (Penguin Bank West): includes the area bounded by geodesic lines connecting the following coordinates in the order listed:

Point Identifier	Longitude	Latitude
1	157° 32' 14.79" W	20° 56' 29.52" N
2	157° 29' 39.20" W	20° 56' 29.52" N
3	157° 29' 39.20" W	20° 55' 32.10" N
4	157° 32' 14.79" W	20° 55' 32.10" N
1	157° 32' 14.79" W	20° 56' 29.52" N

The bed is named after the bathymetric feature on which it occurs.

Rationale: The observations occur over a bathymetric feature – the third finger – and so the feature serves as the limits of the bed.

8. Makapuʻu Bed: includes the area bounded by geodesic lines connecting the following coordinates in the order listed:

Point Identifier	Longitude	Latitude
1	157° 33' 00.00" W	21° 19' 06.37" N
2	157° 32' 48.70" W	21° 18' 58.98" N

3	157° 32' 13.21" W	21° 18' 55.28" N
4	157° 31' 30.00" W	21° 18' 56.76" N
5	157° 31' 30.00" W	21° 16' 30" N
6	157° 33' 00.00" W	21° 16' 30" N
1	157° 33' 00.00" W	21° 19' 06.37" N

This bed is the most studied in the MHI, although its eastern extent is unexplored. The end of hard substrate bounds the bed in the north.

Rationale: The northern end of the bed is clearly defined by the end of hard substrate. The north, south, and west borders were those outlined in Long and Baco (2014). Participants noted that in subsequent dives, the vehicle traveled further south than in Long and Baco (2014), confirming that the bed does not continue to the south. The eastern extent of the bed is unknown, so the observations provide the eastern extent, consistent with Long and Baco (2014).

9. North Makapuʻu Bed: includes the area bounded by geodesic lines connecting the following coordinates in the order listed:

Point Identifier	Longitude	Latitude
1	157° 36' 04.69" W	21° 20' 12.00" N
2	157° 35' 40.43" W	21° 20' 51.89" N
3	157° 34' 42.04" W	21° 20' 20.64" N
4	157° 35' 06.30" W	21° 19' 38.70" N
1	157° 36' 04.69" W	21° 20' 12.00" N

The bed at north Makapuʻu encompasses two pancake dome features.

Rationale: The observations are clustered around two pancake dome features found within the depth range of the species. The features served as a guide for the boundaries.

10. Mokulua Islands: includes the area bounded by geodesic lines connecting the following coordinates in the order listed:

Point Identifier	Longitude	Latitude
1	157° 39' 35.62" W	21° 23' 30.19" N
2	157° 38' 38.88" W	21° 24' 27.75" N
3	157° 38' 13.80" W	21° 24' 36.80" N
4	157° 37' 55.71" W	21° 24' 24.87" N
5	157° 37' 52.83" W	21° 24' 04.73" N
6	157° 37' 51.18" W	21° 23' 32.24" N
7	157° 39' 05.19" W	21° 23' 14.97" N
1	157° 39' 35.62" W	21° 23' 30.19" N

The bed off Mokulua Islands encompasses a promontory and offshore pinnacle characterized by large gold corals occurring on the eastern side of the pinnacle and other corals on the edges of the promontory.

Rationale: The observations are found on the promontory and pinnacle. The boundaries are tightened to the edges of the feature, as the habitat is not found adjacent to the features.

11. Ka‘ena Point: includes the area bounded by geodesic lines connecting the following coordinates in the order listed:

Point Identifier	Longitude	Latitude
1	158° 24' 42.46" W	21° 37' 58.47" N
2	158° 21' 10.65" W	21° 37' 58.47" N
3	158° 21' 10.65" W	21° 34' 20.06" N
4	158° 24' 42.46" W	21° 34' 20.06" N
1	158° 24' 42.46" W	21° 37' 58.47" N

The bed at Ka‘ena Point is characterized by high flow.

Rationale: The bed at Ka‘ena Point is defined as EFH currently and has a regulatory boundary. The area is not well studied. The boundaries were drawn to encompass all observations in the area within the depth range of 200 m to 600 m.

12. Cross Seamount: includes the area bounded by geodesic lines connecting the following coordinates in the order listed:

Point Identifier	Longitude	Latitude
1	158° 17' 13.06" W	18° 42' 32.92" N
2	158° 15' 10.67" W	18° 45' 09.71" N
3	158° 14' 16.23" W	18° 42' 49.90" N
4	158° 16' 45.18" W	18° 41' 45.01" N
1	158° 17' 13.06" W	18° 42' 32.92" N

The bed at Cross Seamount encompasses a few pinnacles with dense precious coral communities. The corals are concentrated only on the pinnacle features and are not found between the pinnacles.

Rationale: Corals are very concentrated in a few areas across Cross Seamount, and some features which contain what is considered good habitat do not have coral growth. Coral distribution is patchy across the seamount. This bed contrasts with those found in West Hawaii, which are fairly dense throughout the depth range instead of patchy and concentrated on pinnacle features.

NWHI

13. Westpac Bed: includes the area within a radius of 2.253 nm of a point at 162° 36' 57.90" W, 23° 15' 33.10" N. This bed encompasses the feature on which precious corals have been observed; their distribution is patchy throughout the bed.

Rationale: A circular shape is fitting because the bed is located on a high point with observations in a circle around the high point. The central coordinate was updated from the regulatory definition to encompass the observation on the feature. The bed could extend deeper than the observations, but its extent is unknown at this time.

14. French Frigate Shoals East: includes the area bounded by geodesic lines connecting the following coordinates in the order listed:

Point Identifier	Longitude	Latitude
1	165° 50' 11.04" W	23° 53' 40.56" N
2	165° 47' 52.82" W	23° 53' 40.56" N
3	165° 47' 52.82" W	23° 50' 58.76" N
4	165° 50' 11.04" W	23° 50' 58.76" N
1	165° 50' 11.04" W	23° 53' 40.56" N

The bed east of French Frigate Shoals is defined by a bathymetric feature.

Rationale: The observations at this bed are reliably located at the edges of the bed. The bed occurs on pinnacles on the bathymetric feature.

15. Laysan: includes the area within a radius of 1.706 nm of a point at 171° 57' 37.69" W, 25° 51' 44.11" N. This bed encompasses the feature on which red corals have been observed.

Rationale: A circular shape is fitting because it encompasses all the observations on the feature.

16. Pioneer Bank: includes the area within a radius of 2.580 nm of a point at 173° 27' 56.34" W, 25° 49' 15.02" N. This bed encompasses the feature on which precious corals have been observed.

Rationale: A circular shape is fitting because it encompasses all the observations on the feature.

17. Bank 8: includes the area within a radius of 1.136 nm of a point at 174° 30' 34.01" W, 26° 13' 34.21" N. This bed encompasses the feature on which precious corals have been observed.

Rationale: A circular shape is fitting because it encompasses all the observations on the feature.

18. Helsley Seamount: includes the area within a radius of 1.684 km of a point at 179° 34' 01.80" W, 28° 52' 04.36" N. This bed encompasses the feature on which precious corals have been observed.

Rationale: A circular shape is fitting because it encompasses all the observations on the feature.

19. Baby Brooks Bank: includes the area within a radius of 2.866 nm of a point at 166° 42' 12.29" W, 23° 58' 49.60" N. This bed encompasses the feature on which precious corals have been observed. This is a dense, diverse bed similar to Makapuʻu characterized by black corals on the northeast and northwest sides of the bank.

Several potential beds were removed from the draft list. The explanations follow.

1. Hilo Harbor to Pepeʻekeo (between 200 and 600 meters depth): includes the area within a radius of 3 km of a point at, 154° 59.02′ W, 19° 47.897′ N.

   Rationale: The precious coral observations here are scattered and do not constitute a bed.

2. ʻAlalākeiki Channel between Ule Pt. and Nukuele Pt. includes the area within a radius of 3 km of a point at 156° 29.7′ W, 20° 34.77′ N

   Rationale: The precious coral observations here are scattered and do not constitute a bed.

3. Honolulu International Airport includes the area within a radius of 3 km of a point at 157° 56.025′ W, 21° 16.29′ N

   Rationale: A lot of the hard substrate here is dredge spoil, particularly in front of the airport, and not suitable habitat. The precious coral observations here are scattered and do not constitute a bed.

4. Barber's Point NAS includes the area within a radius of 3 km of a point at 158° 3.59′ W, 21° 14.29′ N

   Rationale: The precious coral observations here are scattered and do not constitute a bed. One pinnacle in the region to the east of the area defined above contains a handful of corals, and one block contains a nice stand of corals. The density is not high enough to consider the area a bed. Participants noted that perhaps with additional surveys, a bed could be defined.

5. Kaʻula: includes the area within a radius of 3 km of a point at 160° 37.17′ W, 21° 41.32′ N

   Rationale: The precious coral observations here occur in waters shallower than 200 m and are not deep-water corals.

6. Middle Bank: includes the area near 21° 45′ and 160° 56′ W

   Rationale: While recent Okeanos dives discovered dense corals on a pinnacle and several other dives have observed corals on cones on the bank, the observations are not yet published and a bed definition is premature at this time.

7. Brooks Bank: includes the area within a radius of 5 km of a point at 166° 42.262′ W, 23° 58.77′ N

Rationale: Brooks Bank, though a regulated as a conditional bed, was dismissed as a bed because there were not many observations.

8. 180 Fathom Bank: includes the area within a radius of 2.0 nm of a point at 28°50.2′ N. lat., 178°53.4′ W. long

   Rationale: This bed, though regulated as a conditional bed, was dismissed as a bed because there were only three observations.

Two seamounts in the NWHI were also considered for defining as a bed. Participants recognized that while precious corals had been observed at both Northhampton Seamount and South Northhampton Seamount, the corals were not present in a high enough density to warrant a bed definition.

Shallow-Water Precious Corals – Habitat Characteristics

Participants repeated the habitat characteristics exercise from a draft habitat characteristics description for the benthic phase of shallow-water precious coral species likely to remain in the management unit, reproduced below.

> EFH for the benthic phase of *Antipathes griggi, A. grandis* and *Myriopathes ulex* is natural, hard substrates between the 20 and 120 m isobaths along steep topographic drop-offs in areas with higher current velocities, low sedimentation, and where precious coral and associated communities are found.
>
> The following definitions are included to assist managers and the public with determining the scope of EFH and the potential impacts to that habitat.
>
> Precious coral and associated communities include the precious corals themselves, a wide variety of commensal organisms that live within and upon the corals, and the various vertebrate and invertebrate organisms that are typically found among these coral, such as asteroids, shrimp, squat lobsters, barnacles, holothurians, and others. These communities have yet to be comprehensively catalogued, but are composed of a wide variety of taxa that demonstrate a level of complexity and co-dependence commensurate with shallow-water coral reef communities.
>
> Natural hard substrates include any hard bottoms that are not of artificial origin.
>
> Higher current velocities mean the accelerated or localized, enhanced flow necessary to sweep away sediment and increase the flux of organic matter (Genin et al., 1992). Grigg (1974) determined that precious corals prefer solid substrate in areas that are swept relatively clean by currents faster than 0.25 m/s. Strong currents help prevent the accumulation of sediments, which would smother young coral colonies and prevent settlement of new larvae.

Participants made five changes: two to the habitat characteristics description, and three to the definitions.

1. Changed “precious coral and associated communities are found” to “precious corals are clustered.” The community around black coral does not make the required habitat or the black coral bed.

2. Inserted “stable” between natural and hard substrates in the habitat characteristics description. Precious corals are generally found on consolidate sediments, not rubble or unstable sediments.

3. Changed the “precious coral and associated communities” definition to “precious coral beds” and added the caveat that the beds may include a wide variety of commensal organisms. This definition describes a bed without requiring an associated community.

4. Added fish to the description of organisms which are typically found among the black corals.

5. Changed the “natural, hard substrates” definition to “natural, stable, hard substrates” and added examples, such as bedrock, large boulders, slabs, blocks, etc. Participants noted that these substrates are essential for recruitment, but perhaps not after recruitment once established.

The final description is reproduced below.

> EFH for the benthic phase of *Antipathes griggi*, *A. grandis* and *Myriopathes ulex* is natural, stable, hard substrates between the 20 and 120 m isobaths along steep drop-offs in areas with higher current velocities, low sedimentation, and where precious corals are clustered.
>
> The following definitions are included to assist managers and the public with determining the scope of EFH and the potential impacts to that habitat.
>
> Precious coral beds include the precious corals themselves, and may include a wide variety of commensal organisms that live within and upon the corals, and the various vertebrate and invertebrate organisms that are typically found among these corals, such as fishes, asteroids, shrimp, squat lobsters, barnacles, holothurians, and others. These communities have yet to be comprehensively catalogued, but are composed of a wide variety of taxa that demonstrate a level of complexity and co-dependence commensurate with shallow-water coral reef communities.
>
> Natural stable, hard substrates include any hard bottoms that are not of artificial origin, such as bedrock, large boulders, slabs, blocks, etc.
>
> Higher current velocities mean the accelerated or localized, enhanced flow necessary to sweep away sediment and increase the flux of organic matter (Genin et al., 1992). Grigg (1974) determined that precious corals prefer solid substrate in areas that are swept relatively clean by currents faster than 0.25 m/s. Strong currents help prevent the accumulation of sediments, which would smother young coral colonies and prevent settlement of new larvae.

Shallow-Water Precious Corals – Bed Boundaries

Working group participants repeated the bed delineation exercise from a draft list of potential beds with boundary descriptions, developed from observational data of precious corals and the current EFH designations. The draft list is reproduced below.

1. ‘Au‘au Channel: includes the area west and south of a point at 21°10′ N. lat., 156°40′ W. long., and east of a point at 21° N. lat., 157° W. long., and west and north of a point at 20°45′ N. lat., 156°40′ W. long.

2. Miloli‘i to Ka Lae: includes the area bounded by geodesic lines connecting the following coordinates in the order listed:

Point Identifier	Longitude	Latitude
1	155° 45' 43.13" W	18° 59' 38.62" N
2	155° 41' 01.17" W	18° 54' 22.73" N
3	155° 41' 11.22" W	18° 54' 22.79" N
4	155° 45' 43.13" W	18° 59' 38.62" N
1	155° 45' 43.13" W	18° 59' 38.62" N

3. South of Lā‘au Pt., Moloka‘i: includes the area bounded by geodesic lines connecting the following coordinates in the order listed:

Point Identifier	Longitude	Latitude
1		
2		
3		
4		
1		

4. South Shore Kaua‘i: includes the area bounded by geodesic lines connecting the following coordinates in the order listed:

Point Identifier	Longitude	Latitude
1	159° 36' 03.50" W	21° 53' 11.79" N
2	159° 23' 14.38" W	21° 54' N
3	159° 23' 01.93" W	21° 52' 02.57" N
4	159° 36' 03.50" W	21° 52' 46.01" N
1	159° 36' 03.50" W	21° 53' 11.79" N

Participants recognized that only three beds meeting the criteria for EFH designations have been discovered in the Hawaiian Archipelago, which are the beds already identified as EFH. The final list of beds is reproduced below.

1. ‘Au‘au Channel: includes the area bounded by geodesic lines connecting the following coordinates in the order listed:

Point Identifier	Longitude	Latitude
1	156° 49' 25.31" W	20° 57' 30.91" N
2	156° 42' 28.66" W	20° 57' 30.91" N
3	156° 42' 28.66" W	20° 50' 28.77" N
4	156° 49' 25.31" W	20° 50' 28.77" N
1	156° 49' 25.31" W	20° 57' 30.91" N

The bed in ‘Au‘au Channel contains ridges and solution basins within the given boundaries. The bed is limited to these characteristic bathymetric features surrounding observations of black corals. Densities of *A. grandis* peak around 80 m while *A. griggi* density declines around 80 m.

Rationale: The existing ‘Au‘au Channel bed extends north to Moloka‘i and west into the Kalohi Channel, into areas which to not contain black coral habitat. To the south, the solution basins characteristic of the channel are too deep to support black corals. The EFH bed boundaries are limited to ridges and solution basins around black coral observations which are considered good habitat for black coral. Participants noted that the drowned land bridge in the channel is unique in the Pacific, and that the offshore area does not receive sedimentation from agriculture. Harvest of black corals likely does not occur below scuba diving depths.

2. Miloli‘i to Ka Lae: includes the area bounded by a geodesic line connecting points 1 and 2, the 20 m isobath connecting points 2 to 3, a geodesic lines connecting points 3 to 4, and the 120 m isobath connecting points 4 to 1, with the locations for points identified in the following table:

Point Identifier	Longitude	Latitude
1	155° 45' 43.13" W	18° 59' 38.62" N
2	155° 41' 01.17" W	18° 54' 22.73" N
3	155° 41' 11.22" W	18° 54' 22.79" N
4	155° 45' 43.13" W	18° 59' 38.62" N
1	155° 45' 43.13" W	18° 59' 38.62" N

The bed between Miloli‘i and Ka Lae (South Point) is less studied. *A. grandis* dominates but *A. griggi* occurs in some areas. The bed slopes fairly continuously from the shallow end of the black coral depth range to the deep end.

Rationale: A slope specification or bathymetric features cannot constrict this bed like the other shallow-water beds, because it is not as well studied. Sub dives have observed the lower limit of the bed, because *A. grandis* occurs to the 120 m depth range. The northern boundary is marked by the limits of a scuba diving survey, which is about halfway between Ka Lae and Kaunā Point. Habitat is not present past Ka Lae to the east.

3. South Shore Kaua‘i: includes the areas with slopes greater than 9 degrees, buffered at 10 meters, bounded by a geodesic line connecting points 1 and 2, the 20 m isobath connecting points 2 to 3, a geodesic lines connecting points 3 to 4, and the 120 m isobath connecting points 4 to 1, with the locations for points identified in the following table:

Point Identifier	Longitude	Latitude
1	159° 36' 03.50" W	21° 53' 11.79" N
2	159° 23' 14.38" W	21° 54' N
3	159° 23' 01.93" W	21° 52' 02.57" N
4	159° 36' 03.50" W	21° 52' 46.01" N
1	159° 36' 03.50" W	21° 53' 11.79" N

The bed on the south shore of Kaua‘i is on old seashore stands that are near vertical in slope. *A. grandis* dominates but *A. griggi* occurs in some areas.

Rationale: Where the black corals are found, they occur in high densities, but the ledge on which the corals grow is not a continuous feature across the given depth range within the bounding coordinates. Slope was used to restrict the bed to the preferred habitat for this bed only. A nine degree slope covers more area that is known to be optimal habitat for producing geographic boundaries; the real slope of the habitat may be greater than 30 degrees but this threshold does not translate well to the bathymetric data source. Surveys have been conducted as far north as Kipu Kai in the east, and corals were not found in this location. Hanapēpē is the edge of the survey effort in the west.

The bed south of Lā‘au Pt., Moloka‘i, identified through observations, was dismissed from the list. This potential bed is not well explored and is not considered a bed by experts. No additional beds were added to the list. Participants noted that it is clear that highly developed stands of black coral only occur in sheltered areas, and their distribution may be related to wave energy.

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