UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
PROGRAM PLANNING AND INTEGRATION
Silver Spring, Maryland 20910

DEC 1 6 2011

To All Interested Government Agencies and Public Groups:

Under the National Environmental Policy Act, an environmental review was performed on the following action.

TITLE: RIN 0648-XA674: Annual Catch Limit Specifications and Accountability Measures for Pacific Islands Coral Reef Ecosystem Fisheries in 2012 and 2013

LOCATION: U.S. EEZ around American Samoa, Guam, the CNMI, and Hawaii

SUMMARY: NMFS proposes to specify an annual catch limit (ACL) and accountability measures (AM) for each coral reef ecosystem stock and stock complex in American Samoa, Guam, the Commonwealth of the Northern Mariana Islands, and Hawaii. The ACLs and AMs will be applicable in fishing years 2012 and 2013, which run from January 1 to December 31. The purpose of this action is to comply with provisions of the fishery ecosystem plans (FEP) for American Samoa, the Mariana Archipelago, and Hawaii which require NMFS to specify an ACL for each stock and stock complex in the western Pacific coral reef ecosystem fisheries and implement AMs that prevent ACLs from being exceeded, and correct or mitigate overages should they occur. The ACL specifications and AMs were developed by the Council using the best available scientific information and were coordinated with the public. The ACLs and AMs are intended to provide for long-term sustainability of the coral reef fisheries of the western Pacific.

NMFS prepared an environmental assessment (EA) to consider the effects of the proposed specifications on the environment. The ACL specifications are not accompanied by in-season closures, but rather, by AMs that call for a post-season fishery review of the fishery to determine whether an ACL was exceeded, and, if so, additional consideration of whether stocks were adversely affected, and the possibility of adjusting the ACL. Because there is no in-season management measure (such as a fishery closure should an ACL be reached), the manner in which the coral reef fisheries of the region are conducted is not likely to change. Future evaluations of the fishery and ACL adjustments are expected to prevent any of the fish stocks from being subject to overfishing or becoming overfished.

The EA and proposed specifications, identified by RIN 0648-XA674, are available from www.regulations.gov; or by mail from the following:

RESPONSIBLE OFFICIAL:

Michael D. Tosatto
Regional Administrator, Pacific Islands Region
National Marine Fisheries Service, NOAA
1601 Kapiolani Blvd. 1110
Honolulu, HI 96814
Tel (808) 944-2200; Fax (808) 973-2941

The environmental review process led us to conclude that the proposed action will not have a significant impact on the environment. Therefore, an environmental impact statement was not prepared. A copy of the finding of no significant impact (FONSI), including the environmental assessment, is enclosed for your information.

Although NOAA is not soliciting comments on this completed EA/FONSI, we will consider any comments submitted that would assist us in preparing future NEPA documents. Please submit any written comments to the Responsible Official named above.

Sincerely,

Patricia A. Montanio
NOAA NEPA Coordinator

Enclosure

U.S. DEPARTMENT OF COMMERCE
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Environmental Assessment
for
Annual Catch Limit Specifications and Accountability Measures for Pacific Islands Coral Reef Ecosystem Fisheries in 2012 and 2013

Including a Regulatory Impact Review

December 13, 2011

Responsible Agency: Pacific Islands Regional Office (PIRO)
National Marine Fisheries Service (NMFS)
National Oceanic and Atmospheric Administration (NOAA)

Responsible Official: Michael D. Tosatto
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Responsible Council: Western Pacific Fishery Management Council
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Abstract

NMFS proposes to specify an annual catch limit (ACL) and accountability measures (AM) for each coral reef ecosystem stock and stock complex of management unit species (MUS) in American Samoa, Guam, the Northern Mariana Islands, and Hawaii. The ACLs and AMs would be applicable in fishing years 2012 and 2013 which begin January 1 and end December 31, annually. The purpose of the action is to comply with provisions of the fishery ecosystem plans (FEP) for American Samoa, the Mariana Archipelago, and Hawaii which require NMFS to specify an ACL for each stock and stock complex in western Pacific coral reef ecosystem fisheries and implement AMs that prevent ACLs from being exceeded, and correct or mitigate overages of ACLs if they occur.

Given the number of individual coral reef ecosystem stocks and stock complexes in each island area, individual species were aggregated into higher taxonomic groups, generally at the family level. A range of ACL specifications was developed for each taxonomic group based on an

analysis of catch data, estimated biomass data, and in consideration of the ratio of estimated catch-to-estimated biomass for each taxonomic group. In general, the ACL specification for each taxonomic group is proposed to be set equal to the level of catch associated with the 75th percentile of the entire catch history for the taxonomic group in each island area. However, species of special management interest, as determined by the Western Pacific Fishery Management Council (Council), were removed from the taxonomic groupings. Separate ACL specifications are proposed for those stocks and set to five percent of each stock's estimated biomass. Additionally, for two individual stocks for which estimates of maximum sustainable yield (MSY) are available, the proposed ACL specification would be set equal to MSY. The proposed ACL specifications were recommended by the Council and were developed in accordance with the approved ACL mechanism described in each FEP, and in consideration of the best available scientific, commercial, and other information.

Currently, near-real time processing of catch information cannot be achieved in any western Pacific coral reef fishery. Therefore, in-season AMs to prevent an ACL from being exceeded (e.g., fishery closures in federal waters) are not possible at this time. For this reason, the AM being proposed for all coral reef ecosystem fisheries is a post-season accounting of the catch each fishing year and evaluation of whether an ACL has been exceeded. Consistent with regulations implementing western Pacific FEPs, if landings of a stock or stock complex exceed the specified ACL in a fishing year, the Council would take action in accordance with 50 CFR 600.310(g) to correct the operational issue that caused the ACL overage, which may include a recommendation that NMFS implement a downward adjustment to the ACL for that stock complex in the subsequent fishing year, or other measures, as appropriate.

This environmental assessment (EA) evaluates the potential environmental impacts of the proposed ACL specifications in fishing years 2012 and 2013. The EA includes a description of the information and methods used by the Council to develop the proposed ACLs. The analysis in this EA indicates that the proposed ACL specifications and AMs are not expected to change the conduct of any western Pacific coral reef fishery, so there would be no large or adverse environmental effects on target, non-target, or bycatch species, or on protected species that may interact with coral reef ecosystem fisheries. The proposed ACLs and AMs are not expected to conflict with ongoing fishery management activities and programs conducted by other federal agencies, local resource management agencies or communities, or result in any impacts to coastal or marine areas, including designated essential fish habitat, habitat areas of particular concern, critical habitat, marine protected areas, or unique areas. The specification of ACLs and implementation of AMs are part of a suit of management measures in coral reef fisheries of the western Pacific intended to promote the sustainable harvest of coral reef fishery resources while preventing overfishing from occurring which would have positive long-term impacts on fishery participants and fishing communities.

NMFS is seeking public comment on the proposed rule to specify ACLs and implement AMs for the coral reef ecosystem fisheries of the western Pacific. Instructions on how to comment on the proposed rule can be found by searching on RIN 0648-XA674 at www.regulations.gov, or by contacting the responsible official or Council at the above address.

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Acronyms and Abbreviations

ABC – Acceptable Biological Catch
ACL – Annual Catch Limit
ACT – Annual Catch Target
AM – Accountability Measure
CNMI or NMI (Commonwealth of the Northern Mariana Islands)
CREMUS – Coral Reef Ecosystem Management Unit Species
Council – Western Pacific Fishery Management Council
CPUE – Catch Per Unit of Effort
CRED – Coral Reef Ecosystem Division
DAWR – Guam Division of Aquatic and Wildlife Resources
DMWR – American Samoa Department of Marine and Wildlife Resources
DFW – Northern Mariana Islands Division of Fish and Wildlife
EA – Environmental Assessment
EC – Ecosystem Component
EEZ – Exclusive Economic Zone
FEP – Fishery Ecosystem Plan

FMP – Fishery Management Plan
FR – Federal Register
HDAR – Hawaii Division of Aquatic Resources
MHI – Main Hawaiian Islands
Magnuson-Stevens Act – Magnuson-Stevens Fishery Conservation and Management Act
MFMT – Maximum Fishing Mortality Threshold
MSST – Minimum Stock Size Threshold
MSY – Maximum Sustainable Yield
MUS – Management Unit Species
NMFS – National Marine Fisheries Service
NOAA – National Oceanic and Atmospheric Administration
OFL – Overfishing Limit
OY – Optimum Yield
PIFSC – NMFS Pacific Islands Fisheries Science Center
PIRO – Pacific Islands Regional Office
RAMP – Rapid Assessment Monitoring Program
SCREFP – Special Coral Reef Ecosystem Fishing Permit
SD – Standard Deviation
SDC – Status Determination Criteria
SSC – Scientific and Statistical Committee
WPacFIN – Western Pacific Fisheries Information Network

1. Background Information

Fisheries for coral reef ecosystem management unit species (CREMUS) in federal waters of the exclusive economic zone (EEZ; generally 3-200 nmi) around the U.S. Pacific Islands are governed by one of four fishery ecosystem plans (FEP) developed by the Western Pacific Fishery Management Council (Council) and implemented by the National Marine Fisheries Service (NMFS) under the authority of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). Three of the FEPs are archipelagic-based and include the American Samoa Archipelago FEP, the Hawaii Archipelago FEP, and the Mariana Archipelago FEP, which covers federal waters around Guam and the Commonwealth of the Northern Mariana Islands (CNMI). The fourth FEP covers federal waters of the U.S. Pacific remote island areas (PRIA) which include Palmyra Atoll, Kingman Reef, Jarvis Island, Baker Island, Howland Island, Johnston Atoll, and Wake Island. For each FEP, federal regulations at 50 CFR §665 defines CREMUS to include all coral reef associated species, families or subfamilies which spend the majority of their non-pelagic (post settlement) life stages within waters less than or equal to 50 fathoms (300 feet) in total depth. CREMUS do not include species defined in other sections of 50 CFR §665 as bottomfish, crustacean, precious coral or pelagic management unit species (MUS).

Federal requirements for coral reef ecosystem fisheries of the western Pacific include a prohibition on the use of destructive and non-selective gear methods, vessel identification and gear marking requirements. A special coral reef ecosystem fishing permit (SCERFP) and logbook reporting is also required for harvesting certain CREMUS defined in federal regulations as Potentially Harvested Coral Reef Taxa, and for fishing with new gear methods, or fishing in designated low-use MPAs. Federal requirements also direct NMFS to specify an annual catch limit (ACL) and accountability measures (AM) for each coral reef ecosystem stock and stock complex[1], as recommended by the Council, and considering the best available scientific, commercial, and other information about the fishery for that stock or stock complex.

Overview of the ACL Specification Process

In accordance with the Magnuson-Stevens Act and the FEPs, there are three required elements in the development of an ACL specification. The first requires the Council's Scientific and Statistical Committee (SSC) to calculate an acceptable biological catch (ABC) that is set at or below the stock or stock complex's overfishing limit (OFL). The OFL is an estimate of the catch level above which overfishing is occurring. ABC is the level of catch that accounts for the scientific uncertainty in the estimate of OFL and other scientific uncertainty. To determine the appropriate ABC, the ACL mechanism described in the FEPs includes a five-tiered system of acceptable biological catch control rules that account for varying levels of scientific data available for a given fishery.

When calculating an ABC for a stock or stock complex, the SSC must first evaluate the information available for the stock and assign the stock or stock complex into one of the five

[1] The Magnuson-Stevens Act defines the term "stock of fish" to mean a species, subspecies, geographic grouping, or other category of fish capable of management as a unit. Federal regulations at 50 CFR §660.310(c) defines "stock complex" to mean a group of stocks that are sufficiently similar in geographic distribution, life history, and vulnerabilities to the fishery such that the impact of management actions on the stocks is similar.

tiers. The SSC must then apply the control rule assigned to that tier to determine ABC. For data poor stocks like CREMUS where only catch data are available and OFL is unknown, ABC is calculated by the SSC based on the Tier 5 ABC control rule (Tier 5: Data poor, Ad hoc Approach to Setting ABCs) which directs the SSC to multiply the average catch from a time period when there is no quantitative or qualitative evidence of declining abundance ("Recent Catch") by a factor based on a qualitative estimate of relative stock size or biomass (B) in the year of management. When it is not possible to analytically determine B relative to the biomass necessary to produce the maximum sustainable yield (MSY) from the fishery, or B_{MSY}, the process allows for an approach based on informed judgment, including expert opinion and consensus-building methods. Table 1 provides a summary of the Council's default ABC control rule for data poor stocks.

Table 1. Tier 5 ABC Control Rule (Data poor, Ad hoc Approach to Setting ABCs)

If estimate of B is above B_{MSY}	ABC = 1.00 x Recent Catch
If estimate of B is above minimum stock size threshold (MSST), but below B_{MSY}	ABC = 0.67 x Recent Catch
If estimate of B is below MSST (i.e., overfished)	ABC = 0.33 x Recent Catch

The ACL process also allows the SSC to utilize any other information deemed useful to establish ABC and may recommend an ABC that differs from the results of the default ABC control rule calculation based on factors such as data uncertainty, recruitment variability, declining trends in population variables, and other factors determined relevant by the SSC. However, the SSC must explain its rationale.

The second element requires the Council to determine an ACL that may not exceed the SSC recommended ABC. The process includes methods by which the ACL may be reduced from the ABC based on social, economic, and ecological considerations, or management uncertainty (SEEM). An ACL set below the ABC further reduces the probability that actual catch will exceed the OFL and result in overfishing.

The third and final element in the ACL process is the inclusion of AMs. There are two categories of AMs, in-season AMs and AMs that make adjustments to an ACL if it is exceeded. In-season AMs prevent an ACL from being exceeded and may include, but are not limited to, closing the fishery, closing specific areas, changing bag limits, or other methods to reduce catch. An annual catch target (ACT) may also be used in the system of AMs so that an ACL is not exceeded. An ACT is the management target of the fishery and accounts for management uncertainty in controlling the actual catch at or below the ACL.

If the Council determines that an ACL has been exceeded, the Council may recommend as an AM, that NMFS reduce the ACL in the subsequent fishing year by the amount of the overage. In determining whether an overage adjustment is necessary, the Council would consider the magnitude of the overage and its impact on the affected stock's status. Additionally, if an ACL is exceeded more than once in a four-year period, the Council is required to re-evaluate the ACL process, and adjust the system, as necessary, to improve its performance and effectiveness. Figure 1 illustrates the relationship between the terms used in this section.

For more details on the specific elements of the ACL specification mechanism and process, see Amendment 1 to the PRIA FEP, Amendment 2 to the American Samoa Archipelago FEP, Amendment 2 to the Mariana FEP, Amendment 3 to the Hawaii Archipelago FEP, and the final implementing regulations at 50 CFR §665.4 (76 FR 37285, June 27, 2011).

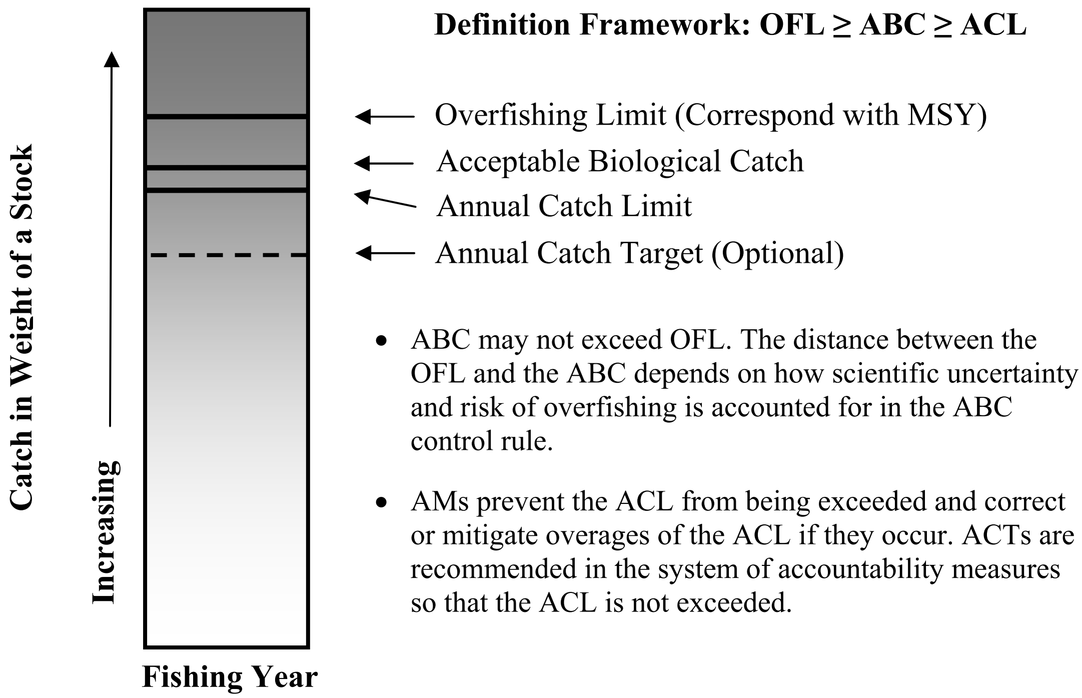

Figure 1. Relationship between OFL, ABC, ACL, and ACT

1.1 Purpose and Need

ACLs are needed in order to comply with the Magnuson-Stevens Act and provisions of the FEPs for American Samoa, the Mariana Archipelago, and Hawaii which require NMFS to specify an ACL for each stock and stock complex in western Pacific coral reef ecosystem fisheries. The fishery management objective of this action is to specify an ACL for all western Pacific coral reef ecosystem stocks and stock complexes that will prevent overfishing from occurring, and ensure long-term sustainability of the resource while allowing fishery participants to continue to benefit from its utilization. AMs also are needed to correct or mitigate overages of the ACL should they occur.

1.2 Proposed Action

NMFS proposes to specify an ACL for each coral reef ecosystem stock and stock complex managed under the FEPs for American Samoa, the Marianas (which includes Guam and the CNMI) and Hawaii. The proposed ACL specifications are based on the recommendations of the Council which were developed in accordance with the approved ACL mechanism described in the FEPs and implementing federal regulations at 50 CFR §665.4, and considering the best available scientific, commercial, and other information.

The ACL for each stock and stock complex would be specified for the 2012 and 2013 fishing years which begin on January 1 and end on December 31, annually. Each year, in each island area, catches would be counted towards the ACL for each coral reef ecosystem stock and stock complex starting on January 1 and continuing through December 31 based on catch data collected by local resource management agencies through their respective fishery monitoring programs[2], and by NMFS through federal logbook reporting.

Pursuant to 50 CFR 665.4, when an ACL for any stock or stock complex is projected to be reached, based on best available information, NMFS will restrict fishing for that stock or stock complex in federal waters around the applicable U.S. EEZ to prevent the ACL from being exceeded. The restriction may include, but is not limited to closure of the fishery, closure of specific areas or restriction in effort (76 FR 37286, June 27, 2011). However, in-season restrictions are not possible for any coral reef ecosystem fishery at this time because catch statistics are generally not available until at least six months after the data has been collected (see Section 2.3.2 for more details on data collection). For this reason, NMFS also proposes to implement the Council's recommended AM which requires the Council to conduct a post-season accounting of the annual catch for each stock and stock complex relative to its ACL immediately after the end of the fishing year. If landings of any stock or stock complex exceed the specified ACL in a fishing year, the Council would take action in accordance with 50 CFR 600.310(g) to correct the operational issue that caused the ACL overage. NMFS would implement the Council's recommended action, which could include a downward adjustment to the ACL for that stock or stock complex in the subsequent fishing year, or other measures, as appropriate. Additionally, as a performance measure specified in each FEP, if any ACL is exceeded more than once in a four-year period, the Council is required to re-evaluate the ACL process, and adjust the system, as necessary, to improve its performance and effectiveness.

1.3 Decision to be Made

After considering public comments on the proposed action and alternatives considered, NMFS will specify ACLs and AMs for coral reef ecosystem stocks and stock complexes in American Samoa, CNMI, Guam and Hawaii for fishing years 2012 and 2013. The Regional Administrator of the NMFS Pacific Islands Regional Office (PIRO) will also use the information in this environmental assessment to make a determination about whether the selected ACL specifications and AMs would be a major federal action with the potential to have a significant environmental impact that would require the preparation of an environmental impact statement.

[2] Catch data for coral reef fisheries in each island area are collected at the lowest taxonomic level possible by state and territorial fisheries agencies in American Samoa, the CNMI, Guam, and Hawaii. The data are then expanded using algorithms developed by NMFS Pacific Islands Fisheries Science Center (PIFSC), Western Pacific Fisheries Information Network (WPacFIN) to generate estimates of total catches from both commercial and non-commercial sectors, except in Hawaii where total catch is based only on catch reported by the commercial fishing sector, as required under State law.

1.4 Public Involvement

At its 151st and 152nd meetings, the Council considered and discussed issues relevant to ACL and AM specifications for western Pacific coral reef ecosystem stocks and stock complexes in American Samoa, Guam, the CNMI, and Hawaii including ABC recommendations of the 107th and 108th SSC, and the range of ACLs considered in this document. The 107th and 108th SSC meetings were held June 13-15, 2011 and October 17-19, 2011, respectively, while the 151st and 152nd Council meetings were held June 15-18, 2011 and October 19-22, 2011, respectively. All meetings were open to the public and advertised through notices in the Federal Register (76 FR 30107, May 24, 2011 and; 76 FR 60004; September 28, 2011) and on the Council's website.

NMFS is seeking public comment on the proposed rule to specify ACLs and implement AMs for the coral reef ecosystem fisheries of the western Pacific. Instructions on how to comment on the proposed rule can be found by searching on RIN 0648-XA674 at www.regulations.gov, or by contacting the responsible official or Council at addresses on the cover page.

2. Description of the Alternatives Considered

The alternatives considered in this document are a range of ACL specifications for coral reef stocks and stock complexes in American Samoa, Guam, CNMI and Hawaii. Although OFL and ABC are part of the ACL process, they are not part of the proposed federal action because OFL is unknown and has not been determined for any coral reef ecosystem stock or stock complex. Additionally, ABCs were previously calculated by the Council's SSC at its 107th and 108th meetings, in accordance with the approved ACL mechanism described in the FEPs and implementing federal regulations at 50 CFR §665.4, and after consideration of the best available scientific, commercial, and other information. However, a detailed discussion of OFL and calculation of ABC is included for informational purposes.

2.1 Development of the Alternatives

The SSC and Council developed the ABC and ACL recommendations in accordance with the Magnuson-Stevens Act and federal regulations at 50 CFR §665.4 that implement the ACL specification mechanism of the FEPs described in Section 1. This section summarizes the data, methods, and procedures considered in SSC and Council deliberations, including the Council's ACL specification document reviewed by the SSC and Council (WPFMC 2011). A full report of the 107th and 108th SSC and the 151st and 152nd Council deliberations can be found on the Council website at: www.wpcouncil.org.

Determining the level of species aggregations

CREMUS in each FEP area are defined to include all coral reef associated species, families or subfamilies which spend the majority of their non-pelagic (post settlement) life stages within waters less than or equal to 50 fathoms in total depth (75 FR 2198, January 14, 2010). However, CREMUS do not include species defined in 50 CFR §665 as a bottomfish MUS, crustacean MUS (i.e., lobsters, kona crab and deepwater shrimps), precious coral MUS (i.e., black, pink and bamboo corals) or pelagic MUS (e.g., tunas and billfish). In the U.S. Pacific Islands, fisheries for CREMUS occur almost exclusively within state and territorial waters. However, the inclusion of all coral reef associated species in the FEPs was intended to be a proactive measure so that data could be collected if coral reef fisheries were to expand into the U.S. EEZ, and so that ecosystem considerations could be integrated into the management regime of the FEPs. Therefore, CREMUS include stocks are currently harvested by fishers as well as hundreds of stocks that are not generally harvested or retained in either state or federal waters.

Recognizing that an annual specification of hundreds of individual ABCs and ACLs would be administratively impossible to implement, monitor and enforce, the Council at its 151st meeting concurred with the 107th SSC's recommendation to aggregate individual CREMUS of each island area into higher taxonomic groups, and specify an ACL for each taxonomic group that comprises the top 90% of the total coral reef fish catch over the available catch time series. To accomplish this, individual CREMUS in each island area were combined into their respective taxonomic group, generally at the family level. The taxonomic groupings also include general categories like, "miscellaneous reef fish," "miscellaneous bottomfish," and "miscellaneous shallow bottomfish" which are categories established in the data collection system for species that are not identified to the species or family level. Species that were identified, but not associated with any of the major harvested taxonomic families and individually comprised a small percentage of the catch were included in the categories "other CRE-finfish" or "other invertebrates."

The catch percentage contribution of each taxonomic group was then calculated relative to the total estimated CREMUS landings throughout the available time series, and the results were sorted in order of decreasing value. Cumulative percentages were calculated by adding the respective cumulative percent contribution with the succeeding value until a 90% cut-off was reached. The taxonomic groups comprising the remaining 10% were then grouped into a single multi-species complex for the purposes of the ACL specification. However, for the purposes of establishing ACLs, bumphead parrotfish *(Bolbometopon muricatum),* humphead or Napoleon wrasse (*Cheilinus undulatus)* and reef sharks were removed from the taxonomic level aggregation so that separate ACLs could be specified for these species. These species are generally regarded as a rare occurrence in catch records and underwater visual surveys and may be vulnerable to overfishing, and are, therefore, of special management interest to the Council.

In addition, two coral reef associated Hawaii bottomfish MUS – kahala (*Seriola dumerili)*, and taape (*Lutjanus kasmira*) – were included in the Hawaii CREMUS groupings Carangidae (jacks) and Lutjanidae (snapper), respectively, because these species are not considered in the NMFS stock assessments used to establish ACLs for Hawaii bottomfish MUS. Therefore, these species are included in the ACL specifications for Carangidae and Lutjanidae as described in this document.

Tables 2-5 summarize the results of the taxonomic grouping analysis for American Samoa, Guam, the Northern Mariana Islands, and Hawaii, including the percentage of catch relative to the total CREMUS catch from the available time series, and the cumulative catch percentage of all taxonomic groups. Tables 1-4 in Appendix A provide a list of the individual species that comprise each CREMUS grouping by island area as identified through the fishery monitoring programs administered by local resource management agencies, with assistance from NMFS PIFSC Western Pacific Fisheries Information Network (WPacFIN).

Table 2. Estimated total catch of CREMUS groupings in American Samoa, including percentage landings, and cumulative percent of landings (1990-2008)

American Samoa CREMUS Grouping	Total (lb)	% landing	Cumulative %
Acanthuridae – surgeonfish	308,950	15.43	15.43
Lutjanidae – snappers	301,148	15.04	30.46
Selar crumenophthalmus – atule or bigeye scad	239,024	11.94	42.40
Mollusks – turbo snail; octopus; giant clams	197,222	9.85	52.25
Carangidae – jacks	156,244	7.80	60.05
Lethrinidae – emperors	145,665	7.27	67.32
Scaridae – parrotfish[1]	119,908	5.99	73.31
Serranidae – groupers	117,029	5.84	79.15
Other Invertebrates	93,831	4.69	83.84
Other CRE-Finfish	76,463	3.82	87.66
Holocentridae – soldierfish/squirrelfish	52,418	2.62	90.27
Mugilidae – mullets	42,864	2.14	92.42
Misc. bottomfish	38,668	1.93	94.35

American Samoa CREMUS Grouping	Total (lb)	% landing	Cumulative %
Misc. reef fish	38,084	1.90	96.25
Crustaceans – crabs	37,369	1.87	98.11
Labridae – wrasses[2]	15,179	0.76	98.87
Kyphosidae – chubs/rudderfish	10,312	0.51	99.39
Mullidae – goatfish	9,349	0.47	99.85
Siganidae – rabbitfish	2,281	0.11	99.97
Reef sharks	354	0.02	99.98
Algae	272	0.01	100.00
Cheilinus undulatus – humphead (Napoleon) wrasse	32	0.00	100.00
Misc. shallow bottomfish	0	0.00	100.00
Bolbometopon muricatum – bumphead parrotfish	0	0.00	100.00

[1] For this analysis, the family Scaridae does not include *Bolbometopon muricatum* (bumphead parrotfish)

[2] For this analysis, the family Labridae does not include *Cheilinus undulatus* (humphead or Napoleon wrasse)

Table 3. Estimated total catch of CREMUS groupings in Guam, including percentage landings, and cumulative percent of landings (1985-2008)

Guam CREMUS Grouping	Total (lb)	% landing	Cumulative %
Acanthuridae – surgeonfish	1,422,263	15.45	15.45
Carangidae – jacks	930,127	10.11	25.56
Selar crumenophthalmus – atulai or bigeye scad	867,442	9.42	34.98
Other CRE-Finfish	763,148	8.29	43.28
Lethrinidae – emperors	757,290	8.23	51.50
Scaridae – parrotfish[1]	531,492	5.77	57.28
Mullidae – goatfish	501,977	5.45	62.73
Mollusks – turbo snail; octopus; giant clams	499,493	5.43	68.16
Siganidae – rabbitfish	487,905	5.30	73.46
Misc. reef fish	351,660	3.82	77.28
Lutjanidae – snappers	341,795	3.71	81.00
Serranidae – groupers	336,949	3.66	84.66
Mugilidae – mullets	254,362	2.76	87.42
Kyphosidae – chubs/rudderfish	237,629	2.58	90.00
Misc. shallow bottomfish	170,537	1.85	91.86
Crustaceans – crabs	147,209	1.60	93.45
Holocentridae – soldierfish/squirrelfish	146,054	1.59	95.04
Reef sharks	143,925	1.56	96.61
Algae	118,662	1.29	97.89
Labridae – wrasses[2]	92,529	1.01	98.90
Cheilinus undulatus – humphead (Napoleon) wrasse	47,880	0.52	99.42
Other Invertebrates	44,962	0.49	99.91
Misc. Bottomfish	5,454	0.06	99.97
Bolbometopon muricatum – bumphead parrotfish	2,917	0.03	100.00

[1] For this analysis, the family Scaridae does not include *Bolbometopon muricatum* (bumphead parrotfish)

[2] For this analysis, family Labridae does not include *Cheilinus undulatus* (humphead or Napoleon wrasse)

Table 4. Estimated total catch of CREMUS groupings in CNMI, including percentage landings, and cumulative percent of landings (2000-2008)

CNMI CREMUS Grouping	Total (lb)	% landing	Cumulative %
Lethrinidae – emperors	210,717	31.67	31.67
Carangidae – jacks	134,710	20.24	51.91
Acanthuridae – surgeonfish	49,649	7.46	59.37
Selar crumenophthalmus – atulai or bigeye scad	45,215	6.79	66.16
Serranidae – groupers	37,978	5.71	71.87
Lutjanidae – snappers	30,304	4.55	76.43
Mullidae – goatfish	29,903	4.49	80.92
Scaridae – parrotfish[1]	29,156	4.38	85.30
Other CRE Finfish	27,216	4.09	89.39
Mollusks – turbo snail; octopus; giant clams	16,158	2.43	91.82
Mugilidae – mullets	13,605	2.04	93.86
Siganidae – rabbitfish	12,969	1.95	95.81
Holocentridae – soldierfish/squirrelfish	11,761	1.77	97.58
Labridae – wrasses[2]	8,121	1.22	98.80
Kyphosidae – chubs/rudderfish	4,198	0.63	99.43
Misc. reef fish	3,663	0.55	99.98
Cheilinus undulatus – humphead (Napoleon) wrasse	66	0.01	99.99
Misc. bottomfish	57	0.01	100.00
Misc. shallow bottomfish	-	0.00	100.00
Bolbometopon muricatum – bumphead parrotfish	-	0.00	100.00
Reef sharks	-	0.00	100.00
Crustaceans - crabs	-	0.00	100.00
Other Invertebrates	-	0.00	100.00
Algae	-	0.00	100.00

[1] For this analysis, the family Scaridae does not include *Bolbometopon muricatum* (bumphead parrotfish)
[2] For this analysis, the family Labridae does not include *Cheilinus undulatus* (humphead or Napoleon wrasse)

Table 5. Total reported catch of CREMUS groupings in Hawaii, including percentage landings, and cumulative percent of landings (1985-2008)

Hawaii CREMUS Grouping	Total (lb)	% landing	Cumulative %
Selar crumenophthalmus – atule or bigeye scad	33,559,719	37.10	37
Decapterus macarellus – opelu or mackerel scad	16,302,192	18.02	55
Carangidae – jacks[1]	11,674,677	12.91	68
Other CRE-Finfish	6,006,068	6.64	75
Mullidae – goatfish	5,632,576	6.23	81
Acanthuridae – surgeonfish	4,082,743	4.51	85
Holocentridae – squirrelfish	2,224,674	2.46	88
Mugilidae – mullets	2,095,284	2.32	90
Lutjanidae – snappers[2]	2,094,208	2.31	92
Mollusks – turbo snails; octopus; giant clams	1,428,864	1.58	94
Scaridae – parrotfish	1,221,909	1.35	95
Algae	1,131,153	1.25	97

Hawaii CREMUS Grouping	**Total (lb)**	**% landing**	**Cumulative %**
Crustaceans – crabs	1,031,345	1.14	98
Other Invertebrates	781,483	0.86	99
Kyphosidae – chubs/rudderfish	625,238	0.69	99
Labridae – wrasses	450,679	0.50	100
Lethrinidae – emperors	103,295	0.11	100
Serranidae – groupers	19,998	0.02	100
Siganidae – rabbitfish	0	0.00	100
Misc. reef fish	0	0.00	100
Misc. shallow bottomfish	0	0.00	100
Misc. bottomfish	0	0.00	100
Bolbometopon muricatum – bumphead parrotfish	0	0.00	100
Cheilinus undulatus – humphead (Napoleon) wrasse	0	0.00	100
Reef sharks	0	0.00	100

Note: *Bolbometopon muricatum* (bumphead parrotfish) and *Cheilinus undulatus* (humphead or Napoleon wrasse) are not known to occur in Hawaii.

[1] Carangidae includes the BMUS, kahala (*Seriola dumerili*) since this species is not included in NMFS bottomfish stock assessments, and is a reef associated species.

[2] Lutjanidae includes BMUS, taape (*Lutjanus kasmira*) since this species is not included in NMFS bottomfish stock assessments, and is a reef associated species.

In establishing the final taxonomic groupings for which ACLs would be established, one caveat was made for the general categories: "other CRE-finfish," "other invertebrates," "miscellaneous reef fish," "miscellaneous bottomfish," and "miscellaneous shallow bottomfish." If any of these "miscellaneous" taxonomic groups were ranked in the top 90% of the catch (as shown in Tables 2-5 above), they were replaced by one or more family level groups from the bottom 10% that were of similar value in terms of percent catch. The rationale behind moving general categories down was because these categories are not based on any taxonomic or biological reasons and true composition of these categories are will continue to be unknown; therefore they cannot be considered true stock complexes for the purposes of ACL specifications.

In the CNMI, the general category "Other CRE-finfish" fell in the top 90% and comprised 4.09 % of the total catch. This category was replaced by three family groups from the bottom 10%, – Mollusks (turbo snails; octopus; giant clams), Mugilidae (mullets) and Siganidae (rabbitfish) – which comprised 2.43% and 2.04%, and 1.95% of the total landings, respectively. In Guam, the general categories "Other CRE-finfish" and "Misc. reef fish" fell in the top 90% and comprised 8.29% and 3.82% of the total catch, respectively. These categories were replaced with all remaining family level groupings (except bumphead parrotfish, humphead wrasse and reef sharks) as the family level groupings cumulatively comprised less than 12% of the total catch. Therefore, in Guam, all taxonomic family groups comprise 85% of the total CREMUS landings while the general categories and the species of special management interest (i.e., bumphead parrotfish, humphead or Napoleon wrasse and reef sharks) make up the remaining 15% of the total catch.

In general, grouping individual CREMUS to their respective taxonomic families is considered by the SSC to be the most optimal level of aggregation to meet the mandate to specify ACLs in fishing year 2012 and is consistent with National Standard 1 guidelines (50 CFR §660.310(c)) as the family groupings consider similarity in life history strategy, morphological, biological and ecological characteristics. While fishermen can and do target individual species within a family group, assessing the vulnerability of individual stocks within a stock complex to fishing activities is difficult because species-level data are not standardized (expanded) for creel survey effort; hence they are inherently more variable than family-level data. Additionally, while it is possible to identify species to the lowest taxonomic level, surveyors differ in their fish identification ability, and presumably, less experienced observers have more difficulty detecting the subtle morphological differences that separate some species. Hence, fish that cannot be identified to the species level are often assigned to a broader taxonomic grouping (Hamm and Tao, 2010), such as a genus or family or even a general category such as "miscellaneous reef fish." In general, the groups that comprise the top 90% of the total catch (or in the case of Guam, the top 85%) frequently interact with the fishery and are most likely to be harvested at a higher rate than the remaining groups which can be considered as incidental or a minor portion of the catch. Therefore, the impacts of management actions on individual stocks would be similar.

While the taxonomic groups comprising the remaining 10% of the catch (or in the case of Guam, the remaining 15%) would be grouped into a single multi-species complex for the purposes of ACL specification, the catch of individual families, and individual species within a family, would continue to be monitored (if identified to the lowest taxonomic level in the original data collection method). If necessary, families and/or species within a family can be removed from any CREMUS grouping in the future for consideration of a separate ACL specification if warranted. Tables 6-9 lists the final taxonomic groupings of CREMUS in American Samoa, Guam, the CNMI and Hawaii for which ACLs will be specified.

Table 6. Final CREMUS grouping for ACL specifications in American Samoa

	American Samoa CREMUS Grouping
Top 90%	Acanthuridae – surgeonfish
	Lutjanidae – snappers
	Selar crumenophthalmus – atule or bigeye scad
	Mollusks – turbo snail; octopus; giant clams
	Carangidae – jacks
	Lethrinidae – emperors
	Scaridae – parrotfish[1]
	Serranidae – groupers
	Holocentridae – squirrelfish
	Mugilidae – mullets
	Crustaceans - crabs
Bottom 10%	Other invertebrates Other CRE-finfish Misc. bottomfish Misc. reef fish Labridae – wrasses[2] Kyphosidae – chubs/rudderfish Mullidae – goatfish Siganidae – rabbitfish Algae

	American Samoa CREMUS Grouping
Bottom 10% (cont).	Misc. shallow bottomfish
Species of Special Management Interest	*Cheilinus undulatus* – humphead (Napoleon) wrasse
	Bolbometopon muricatum – bumphead parrotfish
	Reef sharks

[1] For ACL specifications, family Scaridae does not include *Bolbometopon muricatum* (bumphead parrotfish)
[2] For ACL specifications, family Labridae does not include *Cheilinus undulatus* (humphead or Napoleon wrasse)

Table 7. Final CREMUS grouping for ACL specifications in Guam

	Guam CREMUS Grouping
Top 85%	Acanthuridae – surgeonfish
	Carangidae – jacks
	Selar crumenophthalmus – atule or bigeye scad
	Lethrinidae – emperors
	Scaridae – parrotfish[1]
	Mullidae – goatfish
	Mollusks – turbo snail; octopus; giant clams
	Siganidae – rabbitfish
	Lutjanidae – snappers
	Serranidae – groupers
	Mugilidae – mullets
	Kyphosidae – chubs/rudderfish
	Crustaceans - crabs
	Holocentridae – squirrelfish
	Algae
	Labridae – wrasses[2]
Bottom 15%	Other CRE-finfish Misc. reef fish Misc. shallow bottomfish Other invertebrates Misc. bottomfish
Species of Special Management Interest	*Cheilinus undulatus* – humphead (Napoleon) wrasse
	Bolbometopon muricatum – bumphead parrotfish
	Reef sharks

[1] For ACL specifications, family Scaridae does not include *Bolbometopon muricatum* (bumphead parrotfish)
[2] For ACL specifications, family Labridae does not include *Cheilinus undulatus* (humphead or Napoleon wrasse)

Table 8. Final CREMUS grouping for ACL specifications in CNMI

	CNMI CREMUS Grouping
Top 90%	Lethrinidae – emperors
	Carangidae – jacks
	Acanthuridae – surgeonfish
	Selar crumenophthalmus – atule or bigeye scad
	Serranidae – groupers
	Lutjanidae – snappers

	CNMI CREMUS Grouping
Top 90% (cont.)	Mullidae – goatfish
	Scaridae – parrotfish[1]
	Mollusks – turbo snail; octopus; giant clams
	Mugilidae – mullets
	Siganidae – rabbitfish
Bottom 10%	Other CRE-finfish Holocentridae – squirrelfish Labridae – wrasses[2] Kyphosidae – chubs/rudderfish Misc. reef fish Misc. bottomfish Misc. shallow bottomfish Crustaceans - crabs Other invertebrates Algae
Species of Special Management Interest	*Cheilinus undulatus* – humphead (Napoleon) wrasse
	Bolbometopon muricatum – bumphead parrotfish
	Reef sharks

[1] For ACL specifications, family Scaridae does not include *Bolbometopon muricatum* (bumphead parrotfish)
[2] For ACL specifications, family Labridae does not include *Cheilinus undulatus* (humphead or Napoleon wrasse)

Table 9. Final CREMUS grouping for ACL specifications in Hawaii

	Hawaii CREMUS Grouping
Top 90%	*Selar crumenophthalmus* – akule or bigeye scad
	Decapterus macarellus – opelu or mackerel scad
	Carangidae – jacks[1]
	Mullidae – goatfish
	Acanthuridae – surgeonfish
	Holocentridae – squirrelfish
	Mugilidae – mullets
	Lutjanidae – snappers[2]
	Mollusks – turbo snails; octopus; giant clams
	Scaridae – parrotfish
	Crustaceans – crabs
Bottom 10%	Other invertebrates Other CRE-finfish Algae Kyphosidae – chubs/rudderfish Labridae – wrasses Lethrinidae – emperors Serranidae – groupers
Species of Special Management Interest	Reef sharks

Note: *Bolbometopon muricatum* (bumphead parrotfish) and *Cheilinus undulatus* (humphead or Napoleon wrasse) do not occur in Hawaii.

[1] Carangidae includes the BMUS, kahala (*Seriola dumerili*) since this species is not included in NMFS bottomfish stock assessments, and is a reef associated species.

[2] Lutjanidae includes the BMUS, taape (*Lutjanus kasmira*) since this species is not included in NMFS bottomfish stock assessments, and is a reef associated species.

NMFS/Council Estimation of OFL

While each FEP describes procedures for establishing limits and reference point values based on standardized values of catch per unit effort (CPUE) and effort (E) which serve as proxies for relative biomass (B_{MSY}) and fishing mortality (F_{MSY}), respectively, neither the Council nor NMFS have determined reference point values for any CREMUS. Previous efforts by the Council through Hawhee (2007) demonstrated that there are still significant issues with standardizing CPUE and E for CREMUS, many of which are caught by multiple gear methods. Often times the data were too variable to discern any trends and the conclusions that could be made were questionable. Therefore, OFL has not been estimated for any individual CREMUS in any island area. Estimates of MSY are available for two CREMUS; akule and opelu in Hawaii (Weng and Sibert 2000); however, these estimates were not used as proxy OFL values because they were not conducted through a formal NMFS stock assessment and did not undergo a peer-review process set by the Council and NMFS. Thus, uncertainty in the estimates is unquantified. For this reason, all CREMUS meet the Tier 5 criteria for level of data as described in the Council's ACL process and are considered data poor stocks.

SSC's Calculation of ABC

For data poor stocks like CREMUS where only catch data are available and OFL is currently unknown, the FEPs require ABC to be calculated based on a default ABC control rule (Tier 5: Data poor, Ad hoc Approach to Setting ABCs) which directs the SSC to multiply the average catch from a time period when there is no quantitative or qualitative evidence of declining abundance ("Recent Catch") by a factor based on a qualitative estimate of relative stock size (B) in the year of management where:

- If estimate of B is above B_{MSY}, then ABC can be set at 1.00 x Recent Catch.
- If estimate of B is above minimum stock size threshold (MSST), but below B_{MSY}, ABC should be set at 0.67 x Recent Catch.
- If estimate of B is below MSST (i.e., overfished), ABC should be set at 0.33 x Recent Catch

Determination of "Recent Catch" to Apply in the ABC Control Rule for Data Poor Stocks

In determining the definition of "Recent Catch" to apply in the ABC control rule for each CREMUS groupings in American Samoa, CNMI, Guam and Hawaii, the SSC considered a range of different metrics over the entire time series of catch data available including: (1) the arithmetic mean; (2) one standard deviation (SD) above the mean; (3) two SDs above the mean; (4) the geometric mean (one tailed mean); (5) the 75th percentile; and (6) the 95th percentile. The arithmetic mean takes into consideration extreme values thereby inherently incorporating a larger fluctuation in the data set while geometric means tend to minimize the effect of extreme values and the effects are limited to the true fluctuation of the data. The standard deviation added to the arithmetic mean incorporates the variability and uncertainties above the mean. The 75th

percentile on the other hand is the value of an array (in this case the level of catch in terms of pounds) below which 75% of the observations may be found, and similarly the 95th percentile is the value below which 95% of the observations may be found.

Upon reviewing the different metrics over the entire time series, the SSC determined at its 107th meeting that the catch trends over the available time series were extremely variable and not conducive to allowing the SSC to select a stable portion of the time series. SSC members also expressed concern that the recreational fishery was not captured in the catch history for Hawaii and that fishing methods and participation likely have changed over the history of the fisheries. Furthermore, while most of the fishery data collection programs are long-term, some programs were temporarily suspended and restarted when local resources were available, resulting in temporal and spatial inconsistencies which may contribute to the variability in the time series data. Therefore, the SSC did not express support for an approach based on measures of central tendency (i.e., a statistical distribution that is usually measured by the arithmetic mean, mode or median) because of the high probability (50%) of exceeding this catch in any given year. Instead, the SSC recommended using the 75th percentile of the entire catch history for each taxonomic grouping as the definition of "Recent Catch" because the 75th percentile is a non-parametric approach compared to arithmetic and geometric mean. That is, the percentile approach is a distribution free method and does not rely on assumptions that the data are drawn from a given probability distribution. The SSC further noted that utilizing means would be inappropriate since catches (in this case the only available data) tend to assume central tendencies and normality which are mostly violated in cases where there is large variability.

At its 108th meeting, the SSC revisited the issue, but maintained its recommendation to use the 75th percentile because non-parametric measures are a better way to summarize data with considerable inter-annual variability (Chambers et al., 1983; Cleveland et al., 1993). While the median (50th percentile) would also be a robust measure of the long-term trend in such data, using the median of the catch time series would not be practical because the catch set equal to the 50th percentile would be reached 50% of the time. This is far too sensitive for catch data with significant inter-annual variations and impractical for management. The 75th percentile (the upper bound of the inter-quartile range) would result in fewer false triggering events resulting from inter-annual random fluctuations in the catch data series. The values associated with each of the metrics considered by the SSC for each major taxonomic group are listed in Table 10-13 below and measured in pounds (lb).

Table 10. Metrics of recent catch (in lb) for American Samoa CREMUS groupings

CREMUS Grouping	Arithmetic mean + SD				Geometric mean & percentile		
	Mean	StDev	1SD>mean	2SD>mean	Geomean	75th_%ile	95th_%ile
Surgeonfish	16,261	12,229	28,490	40,719	12,838	19,516	37,175
Snapper	15,850	7,025	22,875	29,900	14,324	18,839	27,391
Atule	14,060	29,337	43,397	72,733	2,330	8,396	63,722
Mollusk	11,601	9,431	21,032	30,462	6,058	16,694	27,001
Jacks	8,223	6,996	15,220	22,216	6,304	9,490	17,077
Emperor	7,667	4,509	12,175	16,684	6,185	7,350	15,112
Parrotfish[1]	6,311	6,654	12,965	19,619	3,959	8,145	18,278
Grouper	6,159	1,801	7,961	9,762	5,904	5,600	8,756

CREMUS Grouping	Arithmetic mean + SD				Geometric mean & percentile		
	Mean	StDev	1SD>mean	2SD>mean	Geomean	75th_%ile	95th_%ile
Squirrelfish	2,759	2,477	5,236	7,713	2,087	2,585	7,304
Mullet	2,679	4,336	7,015	11,351	1,054	2,857	7,727
Crustacean	1,967	1,463	3,430	4,893	1,550	2,136	4,788
Bottom 10%[2]	14,991	7,806	22,797	30,603	12,798	18,910	27,287

[1] For this analysis, family Scaridae does not include *Bolbometopon muricatum* (bumphead parrotfish)
[2] For this analysis, family, bottom 10% does not include *Cheilinus undulatus* (humphead or Napoleon wrasse) or reef sharks

Table 11. Metrics of recent catch (in lb) for Guam CREMUS groupings

CREMUS Grouping	Arithmetic mean + SD				Geometric mean & percentile		
	Mean	StDev	1SD>mean	2SD>mean	Geomean	75th_%ile	95th_%ile
Surgeonfish	59,261	23,308	82,569	105,877	55,015	70,702	101,923
Jacks	38,755	15,313	54,069	69,382	36,360	45,377	60,072
Atule	36,143	38,937	75,081	114,018	18,473	56,514	115,064
Emperor	31,554	12,601	44,155	56,756	29,026	38,720	52,643
Parrotfish[1]	22,146	10,501	32,646	43,147	19,574	28,649	36,477
Goatfish	20,916	9,981	30,897	40,878	18,423	25,367	40,462
Mollusk	20,812	18,126	38,938	57,065	16,788	21,941	43,294
Rabbitfish	20,329	8,321	28,650	36,972	18,560	26,120	29,910
Snappers	14,241	4,854	19,095	23,949	13,413	17,726	19,807
Groupers	14,040	5,754	19,794	25,548	12,894	17,958	21,653
Mullets	10,598	7,533	18,132	25,665	7,840	15,032	23,781
Rudderfish	9,901	5,582	15,483	21,064	8,457	13,247	19,011
Crustacean	6,134	3,747	9,880	13,627	5,203	5,523	12,760
Squirrelfish	6,086	3,771	9,856	13,627	5,135	8,300	12,390
Algae	5,159	8,387	13,546	21,933	1,555	5,329	21,610
Wrasse[2]	3,855	2,613	6,469	9,082	3,001	5,195	8,184
Bottom 15%	55,657	30,700	86,357	117,057	47,797	83,214	109,806

[1] For this analysis, family Scaridae does not include *Bolbometopon muricatum* (bumphead parrotfish)
[2] For this analysis, family Labridae does not include *Cheilinus undulatus* (humphead or Napoleon wrasse)

Table 12. Metrics of recent catch (in lb) for CNMI CREMUS groupings

CREMUS Grouping	Arithmetic mean + SD				Geometric mean & percentile		
	Mean	StDev	1SD>mean	2SD>mean	Geomean	75th_%ile	95th_%ile
Emperor	23,413	11,827	35,240	47,066	19,730	27,466	39,186
Jacks	14,968	8,456	23,424	31,879	12,674	21,512	26,607
Surgeonfish	5,517	2,706	8,223	10,929	4,924	6,884	9,469
Atule	5,024	4,922	9,946	14,868	2,471	7,459	12,419
Grouper	4,220	1,644	5,864	7,507	3,828	5,519	6,179
Snapper	3,367	1,697	5,064	6,760	3,050	3,905	5,968
Goatfish	3,323	2,917	6,239	9,156	2,083	3,670	7,972
Parrotfish[1]	2,672	1,581	4,253	5,833	2,239	3,784	4,832
Mollusk	2,693	3,194	5,887	9,080	853	4,446	7,188
Mullet	2,268	1,427	3,694	5,121	1,536	3,308	3,915
Rabbitfish	1,441	1,427	2,868	4,295	660	2,537	3,633

CREMUS Grouping	Arithmetic mean + SD				Geometric mean & percentile		
	Mean	StDev	1SD>mean	2SD>mean	Geomean	75th_%ile	95th_%ile
Bottom 10%[2]	6,120	4,215	10,336	14,551	4,701	9,820	11,778

[1] For this analysis, family Scaridae does not include *Bolbometopon muricatum* (bumphead parrotfish)

[2] For this analysis, bottom 10% does not include *Cheilinus undulatus* (humphead or Napoleon wrasse) or reef sharks

Table 13. Metrics of recent catch (in lb) for Hawaii CREMUS groupings

CREMUS Grouping	Arithmetic mean + SD				Geometric mean & percentile		
	Mean	StDev	1SD>mean	2SD>mean	Geomean	75th_%ile	95th_%ile
Akule	571,751	279,394	851,145	1,130,539	494,588	734,271	1,021,010
Opelu	270,103	78,268	348,371	426,639	259,558	314,858	401,522
Jacks[1]	157,826	53,671	211,479	265,168	148,840	193,423	233,837
Goatfish	93,876	38,284	132,160	170,444	86,260	125,813	160,747
Surgeonfish	68,046	22,305	90,351	112,656	64,627	80,545	102,614
Snappers[2]	34,903	32,326	67,229	99,555	7,927	65,102	79,783
Squirrelfish	37,078	19,346	56,424	75,769	32,385	44,122	63,317
Mullets	34,921	64,312	99,233	163,544	18,954	41,112	82,153
Mollusk	23,814	9,190	33,005	42,195	21,984	28,765	39,481
Parrotfish	20,365	13,537	33,903	47,440	15,451	33,326	40,127
Crustaceans	17,189	12,675	29,865	42,540	13,866	20,686	44,090
Remaining 10%	134,891	85,845	220,736	306,581	121,297	142,282	215,003

Note: *Bolbometopon muricatum* (bumphead parrotfish) and *Cheilinus undulatus* (humphead or Napoleon wrasse) do not occur in Hawaii.

[1] Carangidae includes the BMUS, kahala (*Seriola dumerili*) since this species is not included in NMFS bottomfish stock assessments, and is a reef associated species.

[2] Lutjanidae includes the BMUS, taape (*Lutjanus kasmira*) since this species is not included in NMFS bottomfish stock assessments, and is a reef associated species.

Estimation of Relative Stock Size

To qualitatively estimate stock status (B) relative to B_{MSY} for each CREMUS group, the SSC relied on an analysis of estimated catch-to-biomass presented in Luck and Dalzell (2010) which synthesized the available catch data time series for each taxonomic group with its corresponding biomass estimates as reported by NMFS Pacific Islands Fisheries Science Center (PIFSC), Coral Reef Ecosystem Division (CRED) through their Reef Assessment and Monitoring Program between 2007 and 2010 (Williams, 2010).[3] Within each island area, catch-to-biomass comparisons were conducted at three scales: (1) major populated islands; (2) lesser populated or unpopulated islands: and (3) both locations combined (i.e., whole archipelago). The analysis found that the percentage of biomass exploited was minor for most reef fish families, ranging from 22.5% (mullets around Guam) to less than 1% (most other reef fish families in all island areas). The report noted, however, that carangids (jacks), kyphosids (rudderfish) and lethrinids (emperors) tend to have the highest exploitation rates (>50% around Guam and populated islands of the CNMI) but acknowledged that this may be caused by an under-representation in visual surveys and included several references to support this position. When catch-to-biomass

[3] For safety reasons, NMFS CRED visual surveys are restricted to depths shallower than 30m which may result in underestimates in biomass particularly for species with significant deep water distributions such as carangids. Additionally, the impacts of survey divers on fish behavior are difficult to quantify and may also result in underestimates of biomass. Problematic species include emperors, jacks and soldier fishes (Jennings and Polunin 1995, Kulbicki 1988, and Watson and Harvey, 2007).

comparisons were viewed throughout the geographic range of a species for each island area (whole archipelago), estimated exploitation rates did not exceed 10% for any taxonomic group, including carangids, kyphosids and lethrinids. While Luck and Dalzell (2010) and Williams (2010) acknowledged issues with their respective data, these reports are likely to be among the best data available for assessing reef population status in the majority of US Pacific coral reef areas. See Appendix B for the detailed report by Luck and Dalzell (2010) and Appendix C for the report by Williams (2010).

The SSC also considered a temporal analysis of size frequency for dozens of representative CREMUS taxa in American Samoa, Guam and CNMI which were obtained from catch data as well as from fishery independent underwater visual census surveys (WPFMC 2011). A regression analysis was done on each size frequency time series to test for significant trends. To make this trend analysis more meaningful, results of the trends from the catch were compared to results from the underwater census surveys to determine fishing impacts on fish size for each species. Any significant increase in size in the catch and increase in the underwater census surveys was assumed to represent sustainable fishing with no impact on the population. On the other extreme end, a significant decrease in size from catch and decrease from those observed underwater was assumed to indicate substantial impact on the population due to fishing. In American Samoa, most of the species showed significant increases in fish sizes for species caught in the fishery. There were no significant trends (although regression lines were mostly constant to slightly decreasing) for those same species observed in the underwater census surveys. In Guam and CNMI, of those species analyzed, only four species showed a significant increase while 30 showed no significant trend (mostly constant over time). Fourteen showed significant decrease in size over time. No significant trends were seen on the same species from the underwater census surveys.

Based on these analyses which are described in WPFMC (2011) and presented at the 107th SSC and discussed again at the 108th meeting, the SSC noted that stock biomass for the coral reef ecosystem taxonomic groups throughout their range (i.e., whole archipelago) is likely to be above $B_{MSY.}$ Therefore, SSC recommended multiplying the level of catch associated with the 75th percentile for each taxonomic group by 1.0 as provided for under the default Tier 5 ABC control rule with the caveat that the ABC for species of special management interest (i.e., bumphead parrotfish, humphead wrasse and reef sharks) be calculated independently. Although crustaceans and mollusks were not included in the analysis conducted by Luck and Dalzell (2010), the ratio of catch-to-biomass throughout the range of these stock complexes is expected to be similar to those of other coral reef taxonomic groups, and B is likely to be above B_{MSY} for these taxa as well. Therefore, multiplying the level of catch associated with the 75th percentile for these taxa by 1.0, as provided for under the Tier 5 ABC control rule, is also appropriate.

<u>Calculation of ABC for Species with MSY and Species of Special Management Interest</u>
For species for which estimates of MSY are available (i.e. Hawaii akule and opelu), and species of special management interest to the Council (i.e., bumphead parrotfish, humphead wrasse and reef sharks), the SSC recommended alternative methods be used to calculate ABC as the level of information available for these taxa do not allow for a straight forward application of the Tier 5 control rule applied to the taxonomic family groupings.

For Hawaii akule and opelu, which have estimates of MSY by Weng and Sibert (2000), the SSC recommended that ABCs be set equal to the MSY for each stock which are 651,292 lb and 393,563 lb, respectively. During the period 2004-2008, the average annual catch of akule was 221,431 lb or 34% of MSY while the average annual catch of opelu over the same period was 184,533 lb or 47% of MSY. Additionally, it is well documented that both akule and opelu are small coastal pelagic species with fast growth rates, short life spans and high natural mortality rates (Dalzell et al., 1996). As such, they are highly resilient to fishing pressure. The SSC believes it is appropriate to set ABC = MSY because these species are relatively short lived (akule 1+ year and opelu 5 years) with high turn-over and because catches of akule have only occasionally exceeded MSY and catches of opelu are well below MSY. Therefore, B is likely to be above B_{MSY}.

For species of special management interest (bumphead parrotfish, humphead or Napoleon wrasse, and reef sharks), the SSC at its 108th meeting noted that these species occur infrequently in NOAA CRED RAMP surveys and have low overall catch. Therefore, data paucity precludes the utility of the Tier 5 control rule. For reef sharks and humphead wrasse, the SSC recommended setting ABC for each taxa at five percent of the biomass estimated by NOAA PIFSC CRED tow-board diver surveys. However, for bumphead parrotfish, only density data is available and limited to Pagan Island, CNMI (1.61 individuals/per km^2), and the American Samoa islands of Tau (1.08 individual/per km^2) and Tutuila (0.41 individuals/per km^2) (NMFS unpublished data). Density estimates for each archipelago were converted to hectares (ha) and expanded based on total area of hard bottom habitat between 0 and 30 m (Mariana Archipelago: 24,289 ha; American Samoa: 7,790 ha) as estimated by Williams (2010). Expanded densities were then converted to biomass in kg using the average length (94 cm) and the CRED allometric conversion factors (a_value: 0.0183; b_value: 3.0421). Biomass was then converted back to pounds and ABC was set to 5% of this estimated biomass. Table 14 lists the estimated stock biomass for reef sharks, humphead or Napoleon wrasse and bumphead parrotfish in American Samoa, Guam, the Northern Mariana Islands and Hawaii.

Table 14. Estimated stock biomass (in lb) of reef sharks, humphead wrasse and bumphead parrotfish in all island areas

<table>
<tr><th rowspan="2">Island Area</th><th colspan="2">Reef sharks</th><th colspan="2">Humphead wrasse[1]</th><th colspan="2">Bumphead parrotfish[1]</th></tr>
<tr><th>Biomass[2]</th><th>5% Biomass</th><th>Biomass[2]</th><th>5% Biomass</th><th>Biomass</th><th>5% Biomass</th></tr>
<tr><td>American Samoa</td><td>26,181</td><td>1,309</td><td>34,860</td><td>1,743</td><td>4,699</td><td>235</td></tr>
<tr><td>CNMI</td><td>111,997</td><td>5,600</td><td>40,184</td><td>2,009</td><td rowspan="2">15,931</td><td rowspan="2">797</td></tr>
<tr><td>Guam</td><td>138,830</td><td>6,942</td><td>39,200</td><td>1,960</td></tr>
<tr><td>Hawaii</td><td>2,231,321</td><td>111,566</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
</table>

[1] *Bolbometopon muricatum* (bumphead parrotfish) and *Cheilinus undulatus* (humphead or Napoleon wrasse) do not naturally occur in Hawaii

[2] Estimated biomass data provided by NMFS, PIFSC, CRED (unpublished data)

Council ACL and AM Recommendations

At its 151st meeting the Council concurred with the approach and ABC recommendations of its SSC and recommended that the ACL for each coral reef family grouping be set equal to the ABC. The Council noted that although CREMUS are Tier 5 and most lack estimates of MSY and

OFL, stock biomass (B) throughout the geographic range of a species for each island area (whole archipelago), is likely to be above B_{MSY} ($B > B_{MSY}$) based on the ratio of catch-to-biomass estimates described in Luck and Dalzell (2010). The Council also noted that for all CREMUS groups, current catch is at or below the SSC recommended ABC values and while MSY for all species except Hawaii akule and opelu are unknown, setting ACL equal to ABC is consistent with NMFS approach for setting ABC for Only Reliable Catch Stocks (ORCS) and would prevent excessive increases in catch.

At its 152nd meeting, the Council maintained its recommendation to set ACL equal to ABC for all CREMUS groups. Regarding species of special management interest (bumphead parrotfish, humphead or Napoleon wrasse and reef sharks), the Council accepted the SSC approach to calculating ABC and recommended setting ACL = ABC. Regarding the ACL of 797 lb for bumphead parrotfish (*Bolbometopon muricatum*) in Guam and CNMI, this ACL would be shared between the two island areas as the ACL was based on the total expanded biomass estimated throughout the Mariana Archipelago which includes both the CNMI and Guam. The Council also expressed concern that the catches from monitoring programs in American Samoa, Guam and CNMI may be under-represented resulting in unrealistically low ABCs and ACLs (See the overview of coral reef fisheries in Section 3.1).

While information on specific patterns of population structure and larval exchange of CREMUS within and across the island archipelagos are limited, several studies on some coral reef species show that there is no significant population structure across the Central Pacific (Craig et al., 2007, Craig et al., 2010, Eble et al., 2011, Gathier et al., 2010, Timmers et al., 2011, and Shultz et al., 2007). These studies suggest that for some species, unpopulated and protected areas such as the NWHI, the northern islands of the CNMI, Rose Atoll and the Pacific Remote Island Areas could serve as areas that replenish coral reef stocks around populated islands. However, other studies suggest that connectivity may occur at much finer scales (Toonen, 2011, Christie, et al., 2010). As such, relying on an archipelagic catch-to-biomass analysis is appropriate as it considers a CREMUS as a stock throughout its range, and does not rely on discrete population segments. The Council recognized that there is room for refining all ABC/ACL specifications; however, it also determined that the approaches described above are reasonable to meet the statutory mandate to establish ACLs for fishing year 2012, given the limited data available. Table 15-18 list the ABCs recommended by the SSC and the ACLs recommended by the Council for CREMUS in American Samoa, Guam, the Northern Mariana Islands and Hawaii. Also included is the average arithmetic mean of the catch over the last five years (2004-2008).

Table 15. SSC and Council Proposed ABC and ACL recommendations and average catch (2004-2008) for American Samoa CREMUS

	American Samoa CREMUS Grouping	Total Estimated Biomass (lb)	SSC Proposed ABC (lb)	Council Proposed ACL (lb)	Mean Catch (lb) 2004-2008
Top 90%	Acanthuridae – surgeonfish	1,779,286	19,516	19,516	9,468
	Lutjanidae – snappers	338,371	18,839	18,839	13,185
	Selar crumenophthalmus – atule or bigeye scad	N/A	8,396	8,396	3,079
	Mollusks – turbo snail; octopus; giant clams	N/A	16,694	16,694	7,886
	Carangidae – jacks	129,955	9,490	9,490	6,273
	Lethrinidae – emperors	142,349	7,350	7,350	6,872
	Scaridae – parrotfish[1]	964,989	8,145	8,145	3,007
	Serranidae – groupers	251,814	5,600	5,600	5,289
	Holocentridae – squirrelfish	45,721	2,585	2,585	1,552
	Mugilidae – mullets	N/A	2,857	2,857	2,608
	Crustaceans - crabs	N/A	2,248	2,248	1,360
Bottom 10%	Remaining 10% combined[2]	>2 million	18,910	18,910	16,556
Species of Special Management Interest	*Bolbometopon muricatum* – bumphead parrotfish	4,699	235	235	0
	Cheilinus undulatus – Humphead (Napoleon) wrasse	34,860	1,743	1,743	32
	Reef Sharks	26,181	1,309	1,309	118

[1] For ACL specifications, family Scaridae does not include *Bolbometopon muricatum* (bumphead parrotfish)
[2] For ACL specifications, family bottom 10% does not include *Cheilinus undulatus* (humphead or Napoleon wrasse) or reef sharks

Table 16. SSC and Council Proposed ABC and ACL recommendations and average catch (2004-2008) for Mariana CREMUS (Guam)

	Mariana CREMUS Grouping (Guam)	Total Estimated Biomass (lb)	SSC Proposed ABC (lb)	Council Proposed ACL (lb)	Mean Catch (lb) 2004-2008
Top 85%	Acanthuridae – surgeonfish	3,535,142	70,702	70,702	41,420
	Carangidae – jacks	472,124	45,377	45,377	42,822
	Selar crumenophthalmus – atulai or bigeye scad	N/A	56,514	56,514	7,312
	Lethrinidae – emperors	290,557	38,720	38,720	17,056
	Scaridae – parrotfish[1]	1,568,760	28,649	28,649	12,870
	Mullidae – goatfish	239,115	25,367	25,367	9,880
	Mollusks – turbo snail; octopus; giant clams	N/A	21,941	21,941	13,083
	Siganidae – rabbitfish	N/A	26,120	26,120	10,132
	Lutjanidae – snappers	1,816,674	17,726	17,726	10,679
	Serranidae – groupers	922,895	17,958	17,958	10,020
	Mugilidae – mullets	N/A	15,032	15,032	2,850
	Kyphosidae – chubs/rudderfish	176,229	13,247	13,247	7,258
	Crustaceans - crabs	N/A	5,523	5,523	2,353

	Mariana CREMUS Grouping (Guam)	Total Estimated Biomass (lb)	SSC Proposed ABC (lb)	Council Proposed ACL (lb)	Mean Catch (lb) 2004-2008
	Holocentridae – squirrelfish	343,170	8,300	8,300	2,699
	Algae	N/A	5,329	5,329	639
	Labridae – wrasses[2]	886,855	5,195	5,195	1,757
Bottom 15%	Other CREMUS (Remaining 15% combined)	>3.4 million	83,214	83,214	22,920
Species of Special Management Interest	*Bolbometopon muricatum* – bumphead parrotfish	15,931 (Marianas)	797 (Marianas)	797 (Marianas)	0
	Cheilinus undulatus – Humphead (Napoleon) wrasse	39,200	1,960	1,960	795
	Reef sharks	138,830	6,942	6,942	1,113

[1] For ACL specifications, family Scaridae does not include *Bolbometopon muricatum* (bumphead parrotfish)

[2] For ACL specifications, family Labridae does not include *Cheilinus undulatus* (humphead or Napoleon wrasse)

Table 17. SSC and Council Proposed ABC and ACL recommendations and average catch (2004-2008) for Mariana CREMUS (CNMI)

	Mariana CREMUS Grouping (CNMI)	Total Estimated Biomass (lb)	SSC Proposed ABC (lb)	Council Proposed ACL (lb)	Mean Catch (lb) 2004-2008
Top 90%	Lethrinidae – emperors	290,557	27,466	27,466	26,970
	Carangidae – jacks	472,124	21,512	21,512	18,530
	Acanthuridae – surgeonfish	3,535,142	6,884	6,884	6,676
	Selar crumenophthalmus – atulai or bigeye scad	N/A	7,459	7,459	5,391
	Serranidae – groupers	922,895	5,519	5,519	4,511
	Lutjanidae – snappers	1,816,674	3,905	3,905	3,712
	Mullidae – goatfish	922,895	3,670	3,670	3,662
	Scaridae – parrotfish[1]	1,568,870	3,784	3,784	3,675
	Mollusks – turbo snail; octopus; giant clams	N/A	4,446	4,446	3,191
	Mugilidae – mullets	N/A	3,308	3,308	2,877
	Siganidae – rabbitfish	N/A	2,537	2,537	2,180
Bottom 10%	Remaining 10% (combined)[2]	>3.4 million	9,820	9,820	8,659
Species of Special Management Interest	*Bolbometopon muricatum* – bumphead parrotfish	15,931 (Marianas)	797 (Marianas)	797 (Marianas)	N/A
	Cheilinus undulatus – Humphead (Napoleon) wrasse	40,184	2,009	2,009	66
	Reef Sharks	111,997	5,600	5,600	0

[1] For ACL specifications, family Scaridae does not include *Bolbometopon muricatum* (bumphead parrotfish)

[2] For ACL specifications, bottom 10% does not include *Cheilinus undulatus* (humphead or Napoleon wrasse) or reef sharks

Table 18. SSC and Council Proposed ABC and ACL recommendations and average catch (2004-2008) for Hawaii CREMUS

	Hawaii CREMUS Grouping	Total Estimated Biomass (lb)	SSC Proposed ABC (lb)	Council Proposed ACL (lb)	Mean Catch (lb) 2004-2008
Top 90%	*Selar crumenophthalmus* – akule or bigeye scad[1]	N/A	651,292	651,292	221,431
	Decapterus macarellus – opelu or mackerel scad[1]	N/A	393,563	393,563	184,533
	Carangidae – jacks[2]	130,521,134	193,423	193,423	139,398
	Mullidae – goatfish	12,017,286	125,813	125,813	48,671
	Acanthuridae – surgeonfish	104,285,468	80,545	80,545	86,109
	Lutjanidae – snappers[3]	33,557,777	65,102	65,102	9,057
	Holocentridae – squirrelfish	7,049,398	44,122	44,122	31,808
	Mugilidae – mullets	N/A	41,112	41,112	8,964
	Mollusks – turbo snails; octopus; giant clams	N/A	28,765	28,765	21,361
	Scaridae – parrotfish	76,936,076	33,326	33,326	34,326
	Crustaceans – crabs	N/A	20,686	20,686	18,713
Bottom 10%	Remaining 10% (combined)	>58 million	142,282	142,282	73,081
Species of Special Management Interest	Reef Sharks	2,231,321	111,566	111,566	0

1 ABC and ACL is based on estimate of MSY by Weng and Sibert (2000)

2 Carangidae includes the BMUS, kahala (*Seriola dumerili*) since this species is not included in NMFS bottomfish stock assessments, and is a reef associated species.

3 Lutjanidae includes the BMUS, taape (*Lutjanus kasmira*) since this species is not included in NMFS bottomfish stock assessments, and is a reef associated species.

Regarding AMs, the Council at its 152nd meeting recommended a post-season evaluation of the catch relative to the recommended ACL for each coral reef ecosystem stock and stock complex. If landings of a stock or stock complex exceed the specified ACL in a fishing year, the Council would take action in accordance with 50 CFR 600.310(g) to correct the operational issue that caused the ACL overage, which may include a recommendation that NMFS implement a downward adjustment to the ACL for that stock complex in the subsequent fishing year, or other measures, as appropriate.

2.2 ACL Alternatives for Coral Reef Ecosystem MUS in 2012 and 2013

Features common to all alternatives

The alternatives considered in this document cover a range of ACL specifications for each coral reef ecosystem stock and stock complex in American Samoa, Guam, the CNMI and Hawaii based on the taxonomic groupings described in Section 2.1, as recommended by the Council. In accordance with the Magnuson-Stevens Act and the ACL mechanism described in all western Pacific FEPs, an ACL specification may not exceed the ABC recommendation made by the Council's SSC. Due to the number of ACL specifications that must be made, the alternatives considered for each taxonomic group in each island area are described in text in Sections 2.2.1-

2.2.4 while the specific ACL values associated with each alternative are listed in Table 19-22, and are measured in terms of pounds (lb).

Pursuant to 50 CFR 665.4, when an ACL for any stock or stock complex is projected to be reached, based on best available information, NMFS will restrict fishing for that stock or stock complex in federal waters around the applicable U.S. EEZ to prevent the ACL from being exceeded. The restriction may include, but is not limited to closure of the fishery, closure of specific areas or restriction in effort (76 FR 37286, June 27, 2011). However, in-season restrictions are not possible for any fishery at this time because, catch statistics are generally not available until at least six months after the data has been collected (See Section 2.3 for more details on data collection). For this reason, under all alternatives considered, as an AM, the Council would determine as soon as possible after the fishing year whether an ACL for any stock or stock complex had been exceeded. If landings of a stock or stock complex exceed the specified ACL in a fishing year, the Council would take action in accordance with 50 CFR 600.310(g) to correct the operational issue that caused the ACL overage. NMFS would implement the Council's recommended action, which could include a downward adjustment to the ACL for that stock complex in the subsequent fishing year, or other measures, as appropriate. Additionally, as a performance measure specified in each FEP, if an ACL is exceeded more than once in a four-year period, the Council is required to re-evaluate the ACL process, and adjust the system, as necessary, to improve its performance and effectiveness. Each alternative also assumes continuation of all existing federal and local resource management laws and regulations.

2.2.1 Alternative 1: No Action (Status Quo)

Under this alternative, NMFS would not specify an ACL for any CREMUS in any island area and AMs, which prevent an ACL from being exceeded and correct and mitigate overages of an ACL if they occur, would not be necessary. However, this alternative would not be in compliance with the Magnuson-Stevens Act or the provisions of the FEPs which require ACLs be specified for all stocks and stock complexes. Alternative 1 serves as the baseline for the environmental impact assessment.

2.2.2 Alternative 2: Specify ACLs based on Arithmetic Mean of the Catch

Under this alternative, the ACL for each CREMUS taxonomic group would be set at the value associated with the arithmetic mean of the total catch based the available time series. For all CREMUS taxonomic groups (except American Samoa atule — *Selar crumenophthalmus*), the ACL would be lower than the ABC recommended by the SSC because the ABC was set to the level of catch at which 75% of the catch observations were found to be lower. The arithmetic mean is based on average catch and a mean is almost always lower than the 75th percentile, except in cases of extreme catch variability as occurs in the American Samoa fishery for atule or *Selar crumenophthalmus*.

Under this alternative, the ACL for species of special management interest (bumphead parrotfish, humphead or Napoleon wrasse, and reef sharks) would be set equal to the total estimated biomass.

2.2.3 Alternative 3: Specify ACLs based on the 75th Percentile of the Catch (Preferred)

Under this alternative, the ACL for each CREMUS taxonomic group (except for Hawaii akule and opelu) would be set at the 75th percentile of the total catch based on the available time series. The ACL would be equal to the ABC recommended by the SSC. For Hawaii akule and opelu, the ACL would be set equal to the MSY values estimated by Weng and Sibert (2000) which are 651,292 lb and 393,563 lb, respectively. The ACL for these species would be equal to the respective ABC recommended by the SSC.

Additionally, under this alternative, the ACL for species of special management interest (bumphead parrotfish, humphead or Napoleon wrasse, and reef sharks) would be set at 5 percent of the total estimated biomass. Under this alternative, the ACL for bumphead parrotfish (*Bolbometopon muricatum*) would be shared by both CNMI and Guam.

2.2.4 Alternative 4: Specify ACLs based on the 95th Percentile of the Catch

Under this alternative, the ACL for each CREMUS taxonomic group would be set at the 95th percentile of the catch based on the available time series. For all CREMUS taxonomic groups, the ACL values would exceed the SSC recommended ABCs under this alternative. Although an ACL set at the 95th percentile of the catch history does not conform to the FEP requirements for ACLs because the ACLs would exceed the SSC recommended ABC, this alternative is included because it allows NMFS to evaluate the potential impact of any ACL being exceeded. Additionally, under this alternative, the ACL for species of special management interest (bumphead parrotfish, humphead [Napoleon] wrasse and reef sharks) would be set at 10 percent of the total estimated biomass. Under this alternative, the ACL for bumphead parrotfish (*Bolbometopon muricatum*) would be shared by both CNMI and Guam.

Table 19. ACL alternatives (in lb) for American Samoa CREMUS in 2012 and 2013

American Samoa CREMUS Grouping	**Alt. 1**	**Alt. 2**	**Alt. 3 (Preferred)**	**Alt. 4**	**Recent Ave. Catch**
	Status Quo	*Arithmetic Mean*	*75th Percentile*	*95th Percentile*	*2004-2008*
Acanthuridae – surgeonfish	No ACL	16,261	19,516	37,175	9,468
Lutjanidae – snappers	No ACL	15,850	18,839	27,391	13,185
Selar crumenophthalmus – atule or bigeye scad	No ACL	14,060	8,396	63,722	3,079
Mollusks – turbo snail; octopus; giant clams	No ACL	11,601	16,694	27,001	7,886
Carangidae – jacks	No ACL	8,223	9,490	17,077	6,273
Lethrinidae – emperors	No ACL	7,667	7,350	15,112	6,872
Scaridae – parrotfish[1]	No ACL	6,311	8,145	18,278	3,007
Serranidae – groupers	No ACL	6,159	5,600	8,756	5,289
Holocentridae – squirrelfish	No ACL	2,759	2,585	7,304	1,552
Mugilidae – mullets	No ACL	2,679	2,857	7,727	2,608
Crustaceans - crabs	No ACL	1,868	2,136	4,788	1,360

American Samoa CREMUS Grouping	Alt. 1	Alt. 2	Alt. 3 (Preferred)	Alt. 4	Recent Ave. Catch
	Status Quo	*Arithmetic Mean*	*75th Percentile*	*95th Percentile*	*2004-2008*
Remaining 10% combined[2]	No ACL	14,991	18,910	27,287	16,556

American Samoa Species of Special Management Interest	Alt. 1	Alt. 2	Alt. 3 (Preferred)	Alt. 4	Recent Ave. Catch
	Status Quo	*Estimated Biomass*	*5% of Estimated Biomass*	*10% of Estimated Biomass*	*2004-2008*
Bolbometopon muricatum – bumphead parrotfish	No ACL	4,699	235	469	0
Cheilinus undulatus – Humphead (Napoleon) wrasse	No ACL	34,860	1,743	3,486	32
Reef Sharks	No ACL	26,181	1,309	2,618	118

[1] For ACL specifications, family Scaridae does not include *Bolbometopon muricatum* (bumphead parrotfish)

[2] For ACL specifications, bottom 10% does not include *Cheilinus undulatus* (humphead or Napoleon wrasse) or reef sharks

Table 20. ACL alternatives (in lb) for Guam CREMUS in 2012 and 2013

Guam CREMUS Grouping	Alt. 1	Alt. 2	Alt. 3 (Preferred)	Alt. 4	Recent Ave. Catch
	Status Quo	*Arithmetic Mean*	*75th Percentile*	*95th Percentile*	*2004-2008*
Acanthuridae – surgeonfish	No ACL	59,261	70,702	101,923	41,420
Carangidae – jacks	No ACL	38,755	45,377	60,072	42,822
Selar crumenophthalmus – atule or bigeye scad	No ACL	36,143	56,514	115,064	7,312
Lethrinidae – emperors	No ACL	31,554	38,720	52,643	17,056
Scaridae – parrotfish1	No ACL	22,146	28,649	36,477	12,870
Mullidae – goatfish	No ACL	20,916	25,367	40,462	9,880
Mollusks – turbo snail; octopus; giant clams	No ACL	20,812	21,941	43,294	13,083
Siganidae – rabbitfish	No ACL	20,329	26,120	29,910	10,132
Lutjanidae – snappers	No ACL	14,241	17,726	19,807	10,679
Serranidae – groupers	No ACL	14,040	17,958	21,653	10,020
Mugilidae – mullets	No ACL	10,598	15,032	23,781	2,850
Kyphosidae – chubs/rudderfish	No ACL	9,901	13,247	19,011	7,258
Crustaceans - crabs	No ACL	4,294	5,523	8,932	2,353
Holocentridae –	No ACL	6,086	8,300	12,390	2,699

Guam CREMUS Grouping	Alt. 1	Alt. 2	Alt. 3 (Preferred)	Alt. 4	Recent Ave. Catch
	Status Quo	*Arithmetic Mean*	*75th Percentile*	*95th Percentile*	*2004-2008*
squirrelfish					
Algae	No ACL	5,159	5,329	21,610	639
Labridae – wrasses2	No ACL	3,855	5,195	8,184	1,757
Other CREMUS (Remaining 15% combined)	No ACL	55,657	83,214	109,806	22,920
Guam Species of Special Management Interest	**Alt. 1**	**Alt. 2**	**Alt. 3 (Preferred)**	**Alt. 4**	**Recent Ave. Catch**
	Status Quo	*Estimated Biomass*	*5% of Estimated Biomass*	*10% of Estimated Biomass*	*2004-2008*
Bolbometopon muricatum – bumphead parrotfish	No ACL	15,931 (Marianas)	797 (Marianas)	1,593 (Marianas)	0
Cheilinus undulatus – Humphead (Napoleon) wrasse	No ACL	39,200	1,960	3,920	795
Reef Sharks	No ACL	138,830	6,942	13,883	1,113

[1] For ACL specifications, family Scaridae does not include *Bolbometopon muricatum* (bumphead parrotfish)
[2] For ACL specifications, family Labridae does not include *Cheilinus undulatus* (humphead or Napoleon wrasse)

Table 21. ACL alternatives (in lb) for CNMI CREMUS in 2012 and 2013

CNMI CREMUS Grouping	Alt. 1	Alt. 2	Alt. 3 (Preferred)	Alt. 4	Recent Ave. Catch
	Status Quo	*Arithmetic Mean*	*75th Percentile*	*95th Percentile*	*2004-2008*
Lethrinidae – emperors	No ACL	23,413	27,466	39,186	26,970
Carangidae – jacks	No ACL	14,968	21,512	26,607	18,530
Acanthuridae – surgeonfish	No ACL	5,517	6,884	9,469	6,676
Selar crumenophthalmus – atulai or bigeye scad	No ACL	5,024	7,459	12,419	5,391
Serranidae – groupers	No ACL	4,220	5,519	6,179	4,511
Lutjanidae – snappers	No ACL	3,367	3,905	5,968	3,712
Mullidae – goatfish	No ACL	3,323	3,670	7,972	3,662
Scaridae – parrotfish[1]	No ACL	2,672	3,784	4,832	3,675
Mollusks – turbo snail; octopus; giant clams	No ACL	2,693	4,446	7,188	3,191
Mugilidae – mullets	No ACL	2,268	3,308	3,915	2,877

CNMI CREMUS Grouping	Alt. 1	Alt. 2	Alt. 3 (Preferred)	Alt. 4	Recent Ave. Catch
	Status Quo	*Arithmetic Mean*	*75th Percentile*	*95th Percentile*	*2004-2008*
Siganidae – rabbitfish	No ACL	1,441	2,537	3,633	2,180
Remaining 10% (combined)[2]	No ACL	6,120	9,820	11,778	8,659
CNMI Species of Special Management Interest	**Alt. 1**	**Alt. 2**	**Alt. 3 (Preferred)**	**Alt. 4**	**Recent Ave. Catch**
	Status Quo	*Estimated Biomass*	*5% of Estimated Biomass*	*10% of Estimated Biomass*	*2004-2008*
Bolbometopon muricatum – bumphead parrotfish	No ACL	15,931 (Marianas)	797 (Marianas)	1,593 (Marianas)	N/A
Cheilinus undulatus – Humphead (Napoleon) wrasse	No ACL	40,184	2,009	4,018	66
Reef Sharks	No ACL	111,997	5,600	11,199	0

[1] For ACL specifications, family Scaridae does not include *Bolbometopon muricatum* (bumphead parrotfish)
[2] For ACL specifications, bottom 10% does not include *Cheilinus undulatus* (humphead or Napoleon wrasse) or reef sharks

Table 22. ACL alternatives (in lb) for Hawaii CREMUS in 2012 and 2013

Hawaii CREMUS Grouping	Alt. 1	Alt. 2	Alt. 3 (Preferred)	Alt. 4	Recent Ave. Catch
	Status Quo	*Arithmetic Mean*	*75th Percentile*	*95th Percentile*	*2004-2008*
Selar crumenophthalmus – akule or bigeye scad*	No ACL	571,751	651,292*	1,021,010	221,431
Decapterus macarellus opelu or mackerel scad*	No ACL	270,103	393,563*	401,522	184,533
Carangidae – jacks[1]	No ACL	157,826	193,423	233,837	139,398
Mullidae – goatfish	No ACL	93,876	125,813	160,747	48,671
Acanthuridae – surgeonfish	No ACL	68,046	80,545	102,614	86,109
Lutjanidae – snappers[2]	No ACL	34,903	65,102	79,783	8,964
Holocentridae – squirrelfish	No ACL	37,078	44,122	63,317	9,057
Mugilidae – mullets	No ACL	34,921	41,112	82,153	31,808
Mollusks – turbo snails; octopus; giant clams	No ACL	23,814	28,765	39,481	21,361
Scaridae – parrotfish	No ACL	20,365	33,326	40,127	34,326
Crustaceans – crabs	No ACL	17,189	20,686	44,090	18,713
Remaining 10% (combined)	No ACL	134,891	142,282	215,003	73,081

Hawaii CREMUS Grouping	Alt. 1	Alt. 2	Alt. 3 (Preferred)	Alt. 4	Recent Ave. Catch
	Status Quo	*Arithmetic Mean*	*75th Percentile*	*95th Percentile*	*2004-2008*
Hawaii Species of Special Management Interest	**Alt. 1**	**Alt. 2**	**Alt. 3 (Preferred)**	**Alt. 4**	**Recent Ave. Catch**
	Status Quo	*Estimated Biomass*	*5% of Estimated Biomass*	*10% of Estimated Biomass*	*2004-2008*
Reef Sharks	No ACL	2,231,321	111,566	223,132	0

* Indicates ACL values based on estimate of MSY by Weng and Sibert (2000)

1 Carangidae includes the BMUS, kahala (*Seriola dumerili*) since this species is not included in NMFS bottomfish stock assessments and is a reef associated species.

2 Lutjanidae includes the BMUS, taape (*Lutjanus kasmira*) since this species is not included in NMFS bottomfish stock assessments and is a reef associated species.

2.3 Alternatives Not Considered in Detail

2.3.1 Specification of ACLs for PRIA CREMUS

Although required by the PRIA FEP, ACLs will not be specified for any CREMUS in the PRIA because commercial fishing is prohibited out to 50 nautical miles by Presidential Proclamation 8336 which established the Pacific Remote Island Marine National Monument (74 FR 1565, January 12, 2009), and there is no coral reef ecosystem habitat beyond the monument boundaries. ACLs for non-commercial coral reef ecosystem fisheries within the boundaries of the PRIA monument may be developed in the future through a separate action in accordance with Proclamation 8336, if the Secretary of Commerce determines non-commercial fishing can be allowed, and managed as a sustainable activity. Therefore, until such determination is made, there is a functional equivalent of an ACL of zero for CREMUS in the PRIA.

2.3.2 Specification of In-season AMs

To prevent ACL from being exceeded, federal regulations implementing western Pacific FEPs in 50 CFR 665.4 state that when any ACL is projected to be reach, the Regional Administrator shall inform permit holders that fishing for that stock will be restricted on a specified date. Restrictions may include but are not limited to, closing the fishery, closing specific areas, changing bag limits, or otherwise restricting effort or catch. However, near-real time processing of catch information cannot be achieved in any western Pacific coral reef fishery. Therefore, in-season AMs to prevent an ACL from being exceeded (e.g., fishery closures in federal waters) are not possible at this time.

In each island area, NMFS relies primarily on the fishery data collection programs administered by the respective local resource management agencies. However, these agencies presently do not have the personnel or resources to process catch data in near-real time, and so fisheries statistics are generally not available until at least six months after the data have been collected. While the

State of Hawaii has the capability to monitor and track the catch of seven bottomfish species towards specified catch limits, additional resources would be required to extend these capabilities to the hundreds of coral reef ecosystem stocks. Significant resources would also be required to support the establishment of near-real time in-season monitoring capabilities in American Samoa, Guam and the Northern Mariana Islands. Therefore, until resources are made available by NMFS or other sources, the only AMs that are available to fishery managers at this time are actions associated with post-season reviews of the fishery to determine whether an ACL has been exceeded, evaluation of the possible reasons for this, and a downward adjustment to the ACL, if warranted.

While a federal special coral reef ecosystem fishing permit (SCREFP) and logbook reporting are required to fish in federal waters for certain CREMUS defined in federal regulations as Potentially Harvested Coral Reef Taxa, NMFS has only issued one such permit since the requirements were established in 2004. That permit, issued in July 2011, authorizes the culture and harvest of hatchery-produced fingerling of the jack, *Seriola rivoliana* (Carangidae) in a mesh cage towed by a vessel in the U.S. EEZ around Hawaii. As noted in Section 1.3, catches of *Seriola rivoliana* that would occur under this SCREFP would not be counted towards the ACL for Hawaii Carangids (jacks) because they are not wild-caught and were produced from fish culture facilities.

NMFS does not anticipate issuing any new SCREFP permits in 2012 or 2013 in any island area and therefore, does not expect to be able to use catch reported through federal logbooks as the basis for implementing in-season closures.

3. Potentially Affected Environment and Potential Impacts of the Proposed ACL Specifications

This section describes the affected fishery and potentially affected fishery resources, other biological and physical resources and potential impacts of the proposed ACL specifications and AMs on these resources. Climate change and environmental justice issues are considered, along with potential impacts to fishing communities, special marine areas, safety, and fishery administration and enforcement.

Resources harvested in coral reef fisheries of the western Pacific are highly diverse, with up to 700 species appearing in catch records in the Mariana Archipelago (Guam and the CNMI) and approximately 300 species in American Samoa and 100 in Hawaii. In each island area, commercial and non-commercial fishermen fish from shore, and from vessels and employ numerous gears to harvest CREMUS, including multiple variations of hook and line methods, nets, traps, spearfishing and hand gathering. The majority of coral reef ecosystem habitat is found shoreward of the U.S. EEZ, which is generally 3-200 nm from shore. In the CNMI, the U.S. EEZ extends from the shore to 200 nm; however, the federal coral reef ecosystem management area applies only to offshore waters from 3-200 nm from shore, consistent with the other island areas. Because coral reef fishing is conducted almost exclusively in nearshore waters from 0-3 nm, these fisheries are managed primarily by local resource management agencies.

Overview of fishery data collection systems in American Samoa, Guam and CNMI
In American Samoa, the CNMI and Guam, coral reef fisheries information is collected by local resource management agencies, with assistance from NMFS PIFSC Western Pacific Fisheries Information Network (WPacFIN) through three fisheries monitoring programs. They include: (1) the boat-based creel survey program; (2) the shore-based creel survey program; and (3) the commercial purchase system or trip ticket invoice program.

Boat-based creel survey program
The boat-based creel survey program collects catch, effort, and participation data on offshore fishing activities conducted by commercial, recreational, subsistence and charter fishing vessels. Surveys are conducted at boat ports or ramps, and data collection consists of two main components - participation counts (trips) and fisher interviews. Survey days are randomly selected and the number of survey days range from 3-8 per month. Surveys are stratified by week-days, weekend-days and day- and night-time. Data expansion algorithms are applied by NMFS WPacFIN to estimate 100% “coverage” and are based on port, type of day, and fishing method (Impact Assessment, 2008).

Shore-based creel survey program
The shore-based creel survey program was established to randomly sample inshore fishing trip information and consists of two components - participation counts and fishers interviews. Participation counts are based on a ‘bus route’ method, with predefined stopping points and time constraints. Survey days are randomly selected, and range from 2-4 times per week. Data expansion algorithms are applied by NMFS WPacFIN to estimate 100% “coverage” and are based on island region, type of day and fishing method (Impact Assessment, 2008). The shore-

based creel surveys cover fishing by persons engaged in commercial, recreational, and subsistence fishing activities.

Commercial purchase system
The commercial purchase system or "trip ticket invoice" monitors fish sold locally and collects information submitted by vendors (fish dealers, hotels and restaurants) who purchase fish directly from fishers. Each invoice usually compiles daily trip landings. Only American Samoa has mandatory requirements for vendors to submit invoice reports; the all other islands have voluntary programs (Impact Assessment, 2008).

Overview of fishery data collection systems in Hawaii
In Hawaii, coral reef fisheries information is collected only from the commercial fishing sector through a mandatory license and monthly reporting system administered by the State of Hawaii. Under state law, anyone who takes marine life for commercial purposes is required to obtain a commercial marine license (CML) and submit a catch report (popularly known as a "C3" form) on a monthly basis. Required information collected includes day fished, area fished, fishing method used, hours fished per method, and species caught (number/pounds caught and released). Recreational catch information for some coral reef fisheries is opportunistically collected through the Hawaii Marine Recreational Fishing Survey (HMRFS) and annual catch amounts are reported through NMFS Marine Fisheries Statistics Survey (MRFSS) at http://www.st.nmfs.noaa.gov/st1/index.html. However, a 2006 review of MRFSS by the National Resource Council (NRC) noted that the catch estimation method was not correctly matched with the catch sampling survey design, leading to potential bias in the estimates. Based on this finding, the Council in 2006 recommended that that MRFSS catch estimates not be used as a basis for management or allocation decisions. In 2008, NMFS established the National Saltwater Angler Registry Program as part of the Marine Recreational Information Program to improve recreational fisheries information (73 FR 79705, December 30, 2008).

Except for HMRFS data, NMFS WPacFIN obtains all coral reef fisheries information in the western Pacific through cooperative agreements with the state and territorial fisheries agencies in American Samoa, CNMI, Guam, and Hawaii and provides access to this data on its website http://www.pifsc.noaa.gov/wpacfin. Generally, complete data for any calendar year is not available until at least 6 months after the year has ended.

Overview of federal permit and reporting requirements
While a federal special coral reef ecosystem fishing permit (SCREFP) and logbook reporting are required to fish in federal waters for certain CREMUS defined in federal regulations as Potentially Harvested Coral Reef Taxa, NMFS has only issued one such permit since the requirements were established in 2004. NMFS does not anticipate issuance of any new SCREFP permits in 2012 or 2013 in any island area, and therefore does not expect to be able to use catch reported through federal logbooks as the basis for implementing in-season closures.

Overview of the proposed ACL management system
If the proposed ACL specifications are implemented, catches of all CREMUS would be counted towards the appropriate CREMUS group's ACL specification regardless of whether catch occurred in federal or local waters. However, as noted in Section 2.3, local resource management

agencies presently do not have the personnel or resources to process catch data in near-real time, and so fisheries statistics are generally not available until at least six months after the data have been collected. Therefore, in season AMs (e.g., fishery closures) are not possible. However, as an AM, post-season accounting of catch towards every ACL specification would occur, and if an ACL is exceeded and affects the sustainability of that stock or stock complex, NMFS would take action to correct the operational issue that caused the ACL overage, as recommended by the Council, which could include a downward adjustment to the ACL for that stock or stock complex in the subsequent fishing year.

3.1 Affected Coral Reef Fisheries and Potential Impacts

3.1.1 American Samoa Coral Reef Fisheries and Potential Impacts

The Samoa Archipelago is located in the South Pacific Ocean and consists of seven major volcanic islands, several small islets, and two coral atolls. The largest islands in this chain are Upolu (approximately 436 square miles) and Savaii (approximately 660 square miles) which belong to the Independent State of Samoa with a population of approximately 178,000 people. The Territory of American Samoa includes Tutuila (approximately 55 square miles), the Manua Island group of Ofu, Olosega and Tau (with a total land area of less than 20 square miles), and two coral atolls (Rose Atoll and Swains Island). More than 90 percent of American Samoa's population (approximately 68,000 people) lives on Tutuila. The U.S. EEZ around American Samoa is approximately 156,246 square miles and extends from 3-200 nm from shore.

Overview of American Samoa Coral Reef Fisheries

In American Samoa, coral reef fishes and invertebrates are harvested in subsistence and small-scale commercial fisheries by various gear types including hook and line, spear gun, and gillnets. The CREMUS catch composition in American Samoa is dominated by six families/groups: Acanthuridae or surgeonfishes (averaging 16,181 lb per year), Lutjanidae or snappers (15,838 lb per year), *Selar crumenophthalmus* or atule or bigeye scad (15,533 lb per year), mollusks including top shells, octopus, clams (11,672 lb per year), Carangidae or jacks (8,200 lb per year), and Scaridae or parrotfishes (7,764 per year) (Sabater and Tulafono 2011). For more information on target, non-target stocks and bycatch in American Samoa's coral reef fisheries, see Section 3.3.1.1.

Although coral reef fisheries surveys in American Samoa cover fishing by persons engaged in commercial, recreational, and subsistence fishing activities, only estimates of total commercial landings of "Reef fishes" are made available on the WPacFIN website. In 2010, these landings totaled 26,453 lb (http://www.pifsc.noaa.gov/wpacfin/as/Data/ECL_Charts/ae3amain.htm. Website accessed on September 12, 2011). However, this figure is likely to be underestimated because WPacFIN reef fish landings do not include catch of all species defined as CREMUS under the American Samoa FEP such as bigeye scad, round scad, mollusks and shallow water snappers, emperors and groupers which together comprise a significant component of the total CREMUS catch. Instead, for public dissemination, WPacFIN may report these taxa under the categories "Other fishes" or "bottomfishes."

Periodic increases and declines in coral reef landings have been observed in the fishery, with a relatively large decline in the early 1990s (Figure 2). The cause of declines in catches is thought to be attributed to a combination of several factors including fishing pressure, natural and anthropogenic habitat degradation (pollution, eutrophication and sedimentation from runoff), sociological changes associated with a shift from subsistence to a market (cash for goods and services) economy and a series of devastating hurricanes.

Average annual commercial reef fish catch in American Samoa was 29,313 pounds from 1982 to 2010. The lowest estimated commercial catches were during 1984, the early 1990s, and 2004 with peak estimated commercial catch occurring in 1997 corresponding with the SCUBA spear fishery (Figure 2). Commercial reef fish catches from 2001 to the present are estimated to have remained below 30,000 pounds annually. Low catch years associated with hurricanes may be the result of fleet damage or fishermen being occupied with other work. The American Samoa Department of Marine and Wildlife Resources (DMWR) reported that the decline in commercial reef fish catches after 1997 may have resulted from increased enforcement of commercial license requirements between 1997 and 2000 (Tulafono 2007). In 2001, DMWR banned the use of SCUBA gear while fishing to help reduce fishing pressure on the reefs.

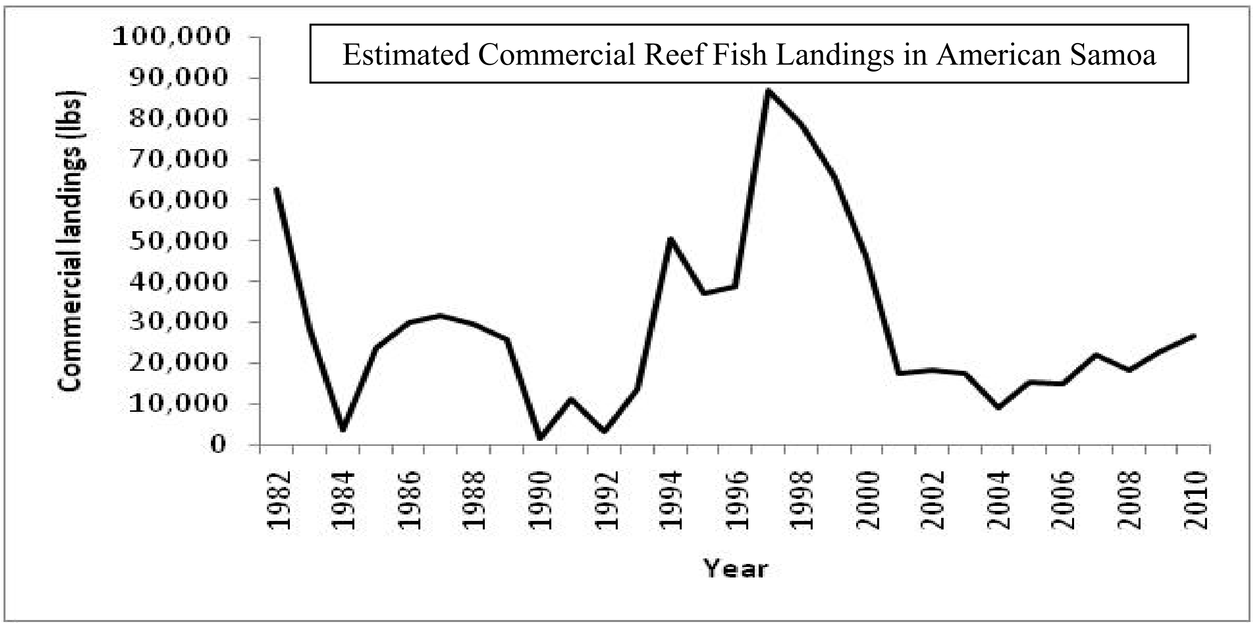

Figure 2. Estimated commercial landings of reef fish in American Samoa from 1982 to 2010
Source: http://www.pifsc.noaa.gov/wpacfin/as/Data/ECL_Charts/ae3amain.htm

The boat-based coral reef fisheries have the potential to harvest coral reef taxa in federal waters, particularly in association with bottomfish fishing. The spear fishery primarily harvests fish from within territorial waters. Coral reef fishery participation has fluctuated over the years due to socio-economic changes, hurricane effects, and changes in fishery management laws such as the ban on SCUBA spearfishing in 2001. The number of boats ranged from a low of 15 in 1992 following a hurricane (Val) that hit the islands in December 1991 to a high of 37 boats in 1986 during the peak of the bottomfish fishery (Figure 3).

Fishery participation has declined over the years (Sabater and Carroll 2009; Sabater and Tulafono 2011). There are currently 22 boats participating in the coral reef fishery and these shift between spearfishing and bottomfishing with occasional trolling activities. The average number of fishermen per boat on a typical bottomfishing trip is three while that of a spearfishing trip ranges from 1 to 7. Overall, regardless of the method used, there are approximately 88 fishermen participating in the boat based coral reef fishery.

The commercial price per pound for CREMUS in American Samoa ranged from $2.22 to $3.71. The annual commercial value of the coral reef fishery in 2010 was $70,894, based on the 2010 catch of 26,453 lb and the average price of reef fish of $2.68 per pound. Assuming participation and fishing effort was equal throughout the fleet in 2010, each vessel would have caught approximately 1,202 lb of CREMUS valued at $3,222.

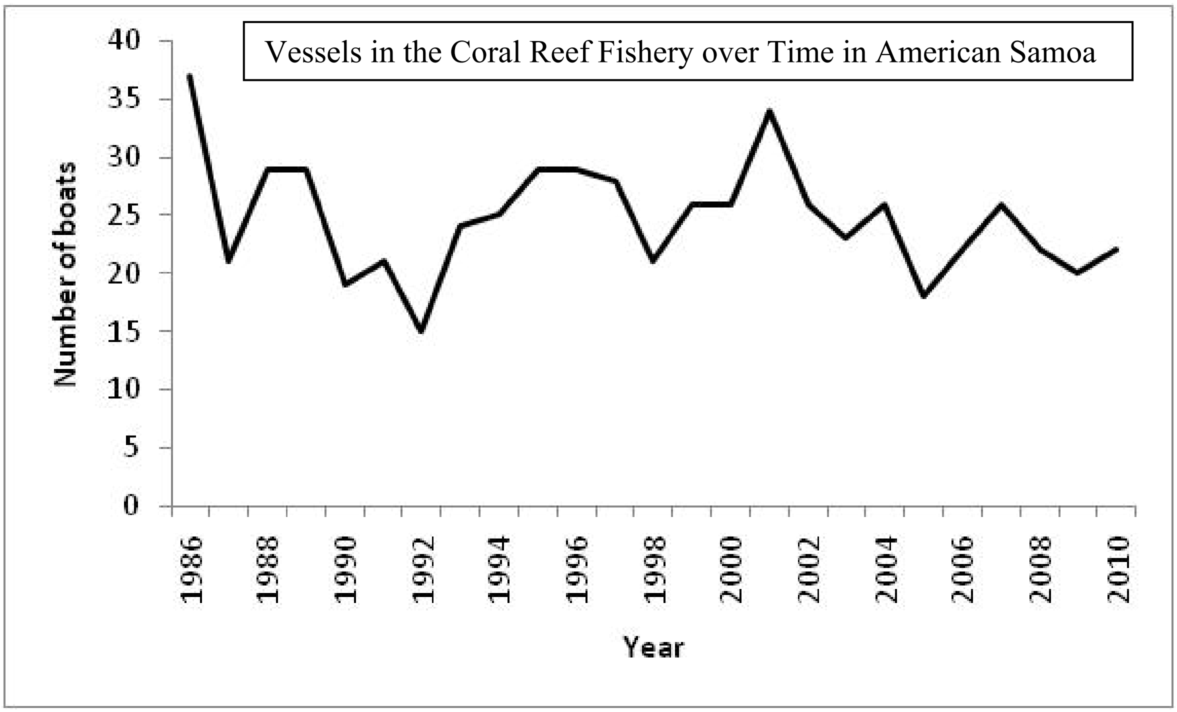

Figure 3. Number of vessels participating in the American Samoa coral reef fishery from 1986 to 2010

Potential Impacts of the Proposed ACL specifications and AM on American Samoa Coral Reef Fisheries

Under the no-action alternative, which is the baseline alternative, American Samoa coral reef fisheries would not be managed using annual catch limits, accountability measures would not be needed, and fishing would continue to be monitored by American Samoa Department of Marine and Wildlife Resources (DMWR), NMFS and the Council with fisheries statistics becoming available approximately six months or longer after the data have been initially collected. The status of CREMUS, including species of special management interest to the Council would continue to be subject to ongoing discussion and review.

Under all of the action alternatives including the proposed action (Alternative 3), fishing for American Samoa CREMUS would be subject to annual catch limits shown in Table 15 and Table 19. As Table 15 and 19 shows, the 2012 and 2013 ACL specifications for each alternative are generally higher than recent harvests so landings are not expected to exceed the respective ACLs, and the ACLs are not expected to result in a race to the fish over each of the next two years. However, Alternative 3 is preferred over Alternative 2 as the latter is based on a mean and the SSC did not express support for an approach based on measures of central tendency (i.e., a statistical distribution that is usually measured by the arithmetic mean, mode or median) because of the high probability (50%) of exceeding this catch in any given year. Alternative 3 is also preferred over Alternative 4 because Alternative 4 would exceed ABC which is inconsistent with the Magnuson-Stevens Act. For species of special management interest to the Council, Alternative 3 is preferred because it is the most conservative.

As there is no in-season closure ability to prevent ACLs from being exceeded, the proposed ACLs are not expected to result in a change to the conduct of the fishery including gear types, areas fished, effort, or participation.

No changes in fisheries monitoring would occur as a result of implementing the ACL specifications and current monitoring of CREMUS catches through shore-based and boat-based creel surveys would continue to be done by American Samoa DMWR. The AM for American Samoa coral reef fisheries would require a post-season review of the catch data to determine whether an ACL for any coral reef stock or stock complex was exceeded. Therefore, while data fisheries monitoring systems would not change as a result of ACL specifications, the annual tracking of catch relative to an ACL is expected to result in improved timeliness of catch processing and availability of fisheries statistics as the Council would need to determine as soon as possible after the fishing year whether an ACL had been exceeded.

If an ACL were exceeded, NMFS, as recommended by the Council would take action to correct the operational issue that caused the ACL overage. This could include a downward adjustment to the ACL for that stock or stock complex in the subsequent fishing year. NMFS cannot speculate on which MUS would be affected or the magnitude of the overage adjustment that might be taken; therefore, the fishery and environmental impacts of future actions such as changes to ACLs or AMs would be evaluated separately, once details are available.

3.1.2 Guam Coral Reef Fisheries and Potential Impacts

The Mariana Archipelago (approximately 396 square miles of land area) is composed of 15 volcanic islands that are part of a submerged mountain chain stretching nearly 1,500 miles from Guam to Japan, and is comprised of two political jurisdictions: the Territory of Guam and the CNMI, both of which are U.S. possessions. The island of Guam has a land area of approximately 212 square miles. The EEZ around Guam is approximately 81,470 square miles and extends from 3-200 nm from shore.

Overview of Guam Coral Reef Fisheries

Shore-based fishing accounts for most of the fish and invertebrate harvest from coral reefs around Guam. Myers (1997) noted that seven families (Acanthuridae, Mullidae, Siganidae, Carangidae, Mugilidae, Lethrinidae, and Scaridae) had species that were consistently among the top ten species in any given year from fiscal year 1991 to fiscal year 1995 and accounted for 45 percent of the annual fish harvest. Approximately 40 taxa of invertebrates are harvested by the nearshore fishery, including 12 crustacean taxa, 24 mollusk taxa, and four echinoderm taxa (Hensley and Sherwood 1993; Myers 1997). For more information on target, non-target stocks and bycatch in Guam's coral reef fisheries, see Section 3.3.2.1.

Virtually no information exists on the condition of the reefs on Guam's offshore banks. On the basis of anecdotal information, most of the offshore banks are in good condition because of their isolation. According to Myers (1997), less than 20 percent of the total coral reef resource harvested in Guam is taken from the EEZ, primarily because the offshore coral reef banks within the EEZ waters are less accessible than nearshore reef fishing areas. Finfish make up most of the catch in the EEZ and are caught in association with bottomfish fishing. Most offshore banks are deep, remote and subject to strong currents. Generally, these banks are only accessible during calm weather in the summer months (May to August/September). Galvez Bank is the closest and most accessible and, consequently, fished most often. In contrast, the other banks (White Tuna, Santa Rose, and Rota) are remote and can only be fished during exceptionally good weather conditions (Green 1997). Local fishermen report that up to ten commercial boats, with two to three people per boat, and some recreational boats, use the banks when the weather is good (Green 1997).

Although coral reef fisheries surveys in Guam cover fishing by persons engaged in commercial, recreational, and subsistence fishing activities, only estimates of total commercial landings of "Reef fishes" are made available on the WPacFIN website. In 2009, these landings totaled 124,401 lb (http://www.pifsc.noaa.gov/wpacfin/guam/dawr/Data/Landings_Charts/ge3b.htm. Website accessed on September 12, 2011). However, like in American Samoa, this figure is likely to be underestimated because WPacFIN reef fish landings do not include catch of all species defined as CREMUS under the Mariana Archipelago FEP such as bigeye scad, round scad, mollusks and shallow water snappers, emperors and groupers which together comprise a significant component of the total CREMUS catch. Instead, for public dissemination WPacFIN may report these taxa under the categories "Other fishes" or "bottomfishes."

The coral reef fishery long term commercial landing trends in Guam showed an increase from 1982 to 1996 and a decline after a short term increase in early 2000. Landings declined thereafter and remained between 80,000 and 100,000 lbs in recent years (Figure 4).

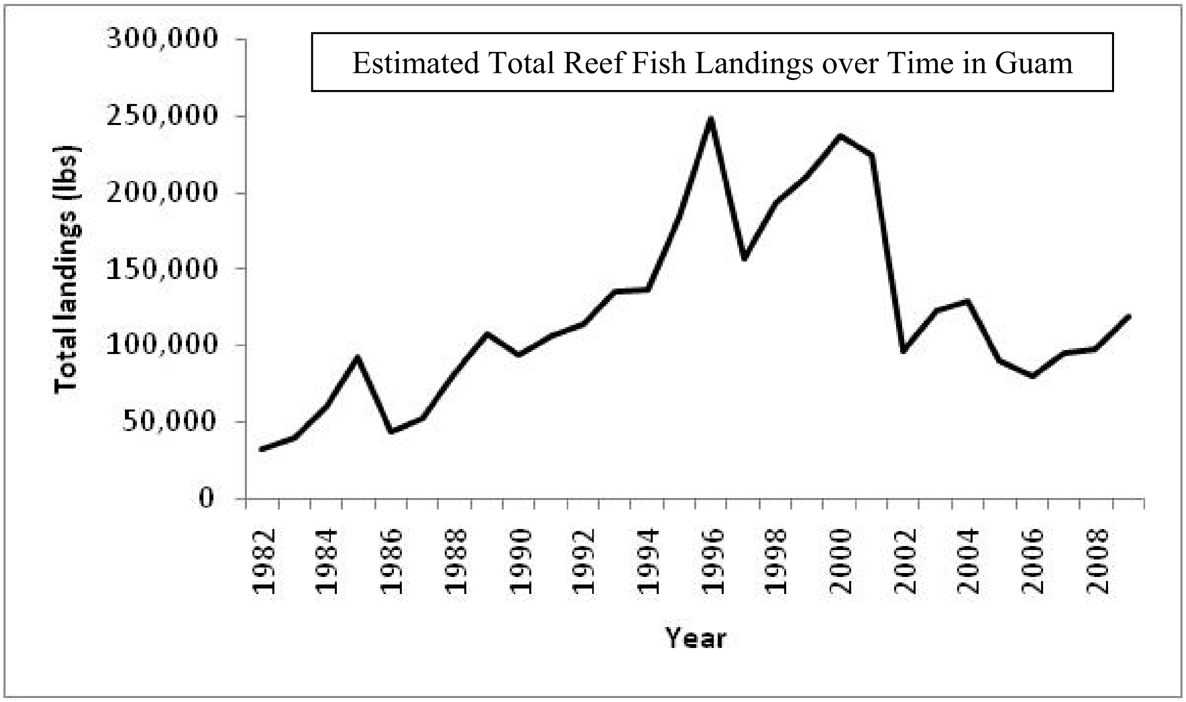

Figure 4. Estimated total landings of reef fish (commercial and non-commercial) in Guam from 1982 to 2009

Source: http://www.pifsc.noaa.gov/wpacfin/guam/dawr/Data/Landings_Charts/ge3b.htm

The number of boats participating in the coral reef fishery ranged from 58 in 1983 to 210 in 1995 (Figure 5). The number of boats participating in 2009 was approximately 116. There were 3 to 4 fishermen per boat, thus, the estimated coral reef boat based fishing population is approximately 348 individuals.

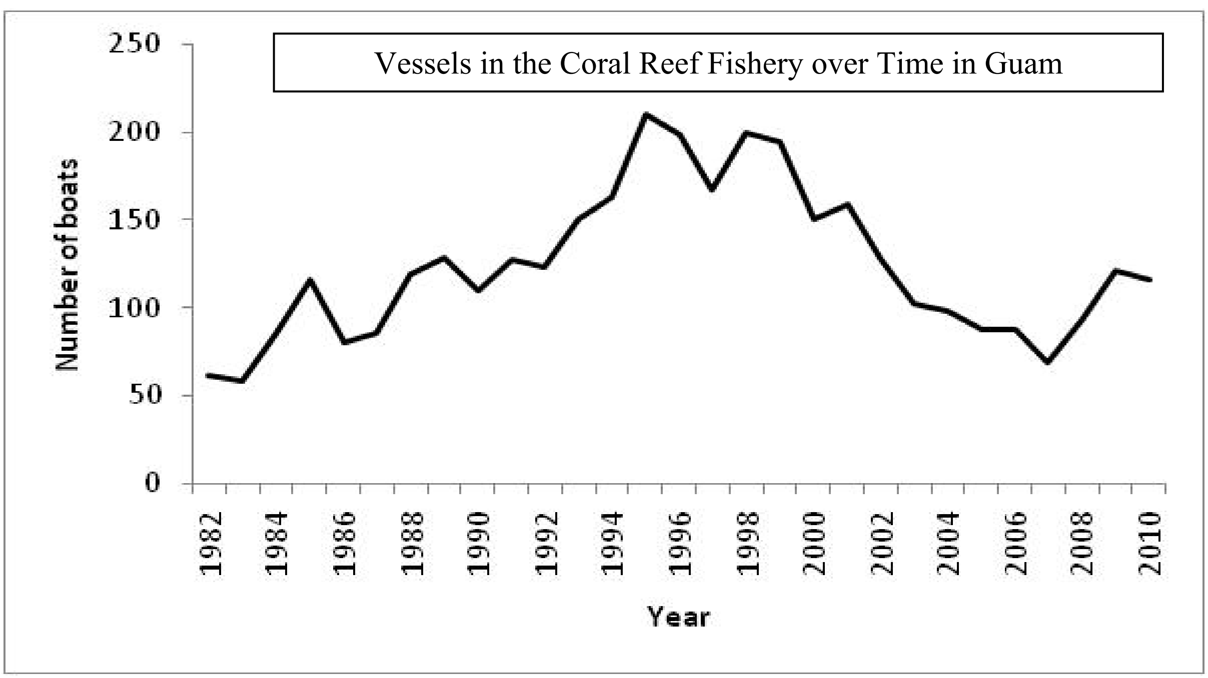

Figure 5. Number of vessels participating in the Guam coral reef fishery from 1982 to 2009

The average price per pound of coral reef fish in 2009 was $2.82 per pound. With a total landing of 124,401 lb, the coral reef fishery in Guam is valued at approximately $350,811. Assuming participation and fishing effort was equal throughout the fleet in 2009, each vessel would have caught approximately 1,072 lb of CREMUS valued at $3,023.

Potential Impacts of the Proposed ACL specifications and AM on Guam Coral Reef Fisheries

Under the no-action alternative, which is the baseline alternative, Guam coral reef fisheries would not be managed using annual catch limits, accountability measures would not be needed, and fishing would continue to be monitored by Guam Division of Aquatic Resources (DAWR), NMFS and the Council with fisheries statistics becoming available approximately six months or longer after the data have been initially collected. The status of CREMUS, including species of special management interest to the Council would continue to be subject to ongoing discussion and review.

Under all of the action alternatives including the proposed action (Alternative 3), fishing for Guam coral reef ecosystem MUS would be subject to annual catch limits shown in Table 16 and Table 20. As Table 16 and 20 shows, the 2012 and 2013 ACL specifications for each alternative are generally higher than recent harvests so the landings are not expected to exceed the respective ACLs, and the ACLs are not expected to result in a race to the fish over the next two years. However, Alternative 3 is preferred over Alternative 2 as the latter is based on a mean and the SSC did not express support for an approach based on measures of central tendency (i.e., a statistical distribution that is usually measured by the arithmetic mean, mode or median) because of the high probability (50%) of exceeding this catch in any given year. Alternative 3 is also preferred over Alternative 4 because the latter would exceed ABC which is inconsistent with the Magnuson-Stevens Act. For species of special management interest to the Council, Alternative 3 is preferred because it is the most conservative.

As there is no in-season closure ability to prevent ACLs from being exceeded, the proposed ACLs are not expected to result in a change to the conduct of the fishery including gear types, areas fished, effort, or participation.

No changes in fisheries monitoring would occur as a result of the ACL specification and current monitoring of CREMUS catches through shore-based and boat-based creel surveys would continue to be done by the Guam DAWR. The AM for Guam coral reef fisheries would require a post-season review of the catch data to determine whether an ACL for any coral reef stock or stock complex was exceeded. Therefore, while data fisheries monitoring systems would not change as a result of ACL specifications, the annual tracking of catch relative to an ACL is expected to result in improved timeliness of catch processing and availability of fisheries statistics as the Council would need to determine as soon as possible after the fishing year whether an ACL had been exceeded.

If an ACL were exceeded, NMFS, as recommended by the Council would take action to correct the operational issue that caused the ACL overage. This could include a downward adjustment to the ACL for that stock or stock complex in the subsequent fishing year. NMFS cannot speculate on which MUS would be affected or the magnitude of the overage adjustment that might be taken; therefore, the fishery and environmental impacts of future actions such as changes to ACLs or AMs would be evaluated separately, once details are available.

3.1.3 CNMI Coral Reef Fisheries and Potential Impacts

The CNMI has a land area of approximately 184 square miles. The EEZ around the CNMI is approximately 292,717 square miles however, the federal coral reef ecosystem management area applies only to offshore waters from 3-200 nm from shore, consistent with the other island areas.

Overview of CNMI Coral Reef Fisheries

Coral reef fisheries in the CNMI are mostly limited to nearshore areas of the three southernmost islands of Saipan, Rota, and Tinian. Limited fishing for CREMUS occurs north of Saipan. Finfish and invertebrates are the primary targets, but small quantities of seaweed are also taken. For more information on target, non-target stocks and bycatch in CNMI's coral reef fisheries, see Section 3.3.3.1.

Although coral reef fisheries surveys in the CNMI cover fishing by persons engaged in commercial, recreational, and subsistence fishing activities, only estimates of total commercial landings of "Reef fishes" are made available on the WPacFIN website. In 2009, these landings totaled 72,211 pounds (http://www.pifsc.noaa.gov/wpacfin/cnmi/Data/Landings_Charts/ce3b.htm. Website accessed on September 12, 2011). However, this figure is likely to be underestimated because WPacFIN reef fish landings do not include catch of all species defined as CREMUS under the Mariana Archipelago FEP such as bigeye scad, round scad, mollusks and shallow water snappers, emperors and groupers which together comprise a significant component of the total CREMUS catch. Instead, for public dissemination, WPacFIN may report these taxa under the categories "Other fishes" or "bottomfishes." The peak of the landings of coral reef fishes occurred in 1989 followed by a drop (Figure 6).

The number of participants in the coral reef fishery of the CNMI has fluctuated over the past decade. CNMI DFW (unpublished data) estimates that the highest number of boats engaged in bottomfishing and spearfishing that also caught shallow water coral reef taxa was 27 boats in 2007 (Figure 7). The most recent data indicate that 16 vessels participated in the coral reef fishery in 2009. The average number of fisherman was estimated to be about 45 fishermen over the past decade with a range of 2 to 5 fishermen per boat depending on the method used.

The average price per pound of reef fish in 2009 was approximately \$2.59. With a total estimated landing of 72,211 lb, the coral reef fishery in the CNMI is valued at approximately \$187,026. Assuming participation and fishing effort was equal throughout the fleet in 2009, each vessel would have landed approximately 18,053 lb of CREMUS valued at \$11,689.

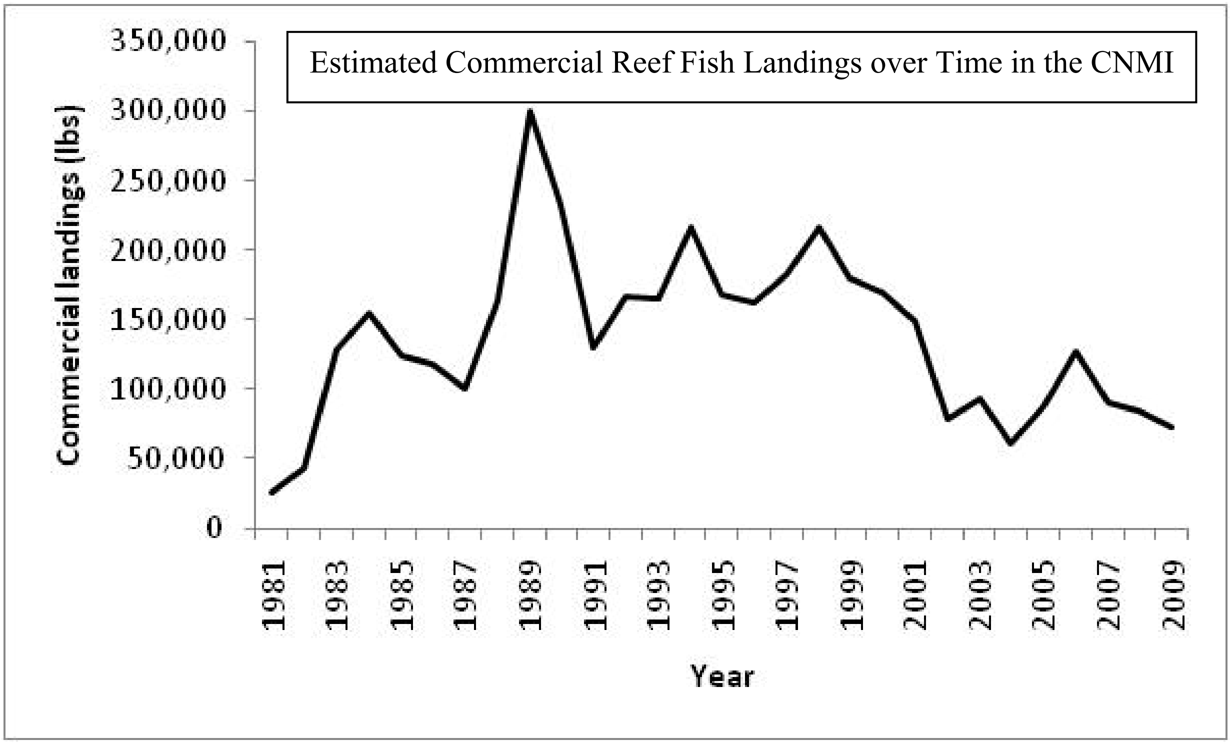

Figure 6. Estimated commercial landings of reef fishes in the CNMI from 1981 to 2009
Source: http://www.pifsc.noaa.gov/wpacfin/cnmi/Data/Landings_Charts/ce3b.htm

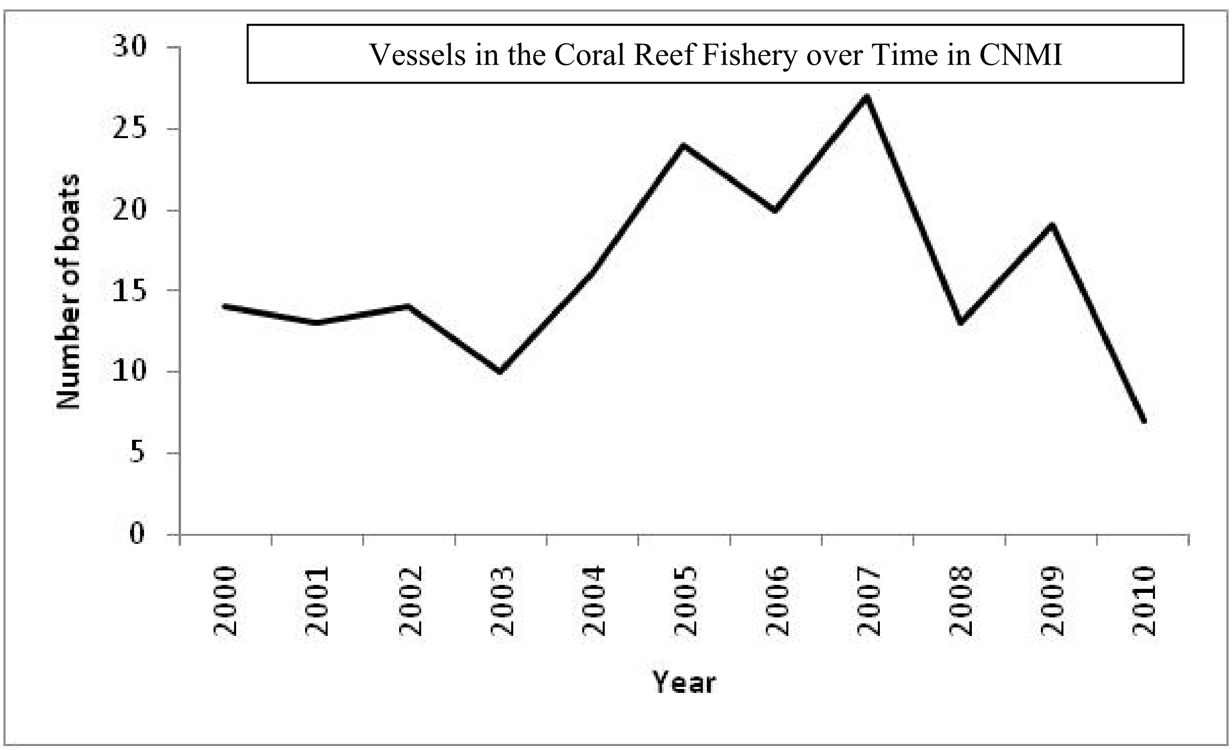

Figure 7. Number of vessels participating in the CNMI coral reef fishery from 2000 to 2010

Potential Impacts of the Proposed ACL specifications and AM on CNMI Coral Reef Fisheries
Under the no-action alternative, which is the baseline alternative, CNMI coral reef fisheries would not be managed using annual catch limits, accountability measures would not be needed, and fishing would continue to be monitored by CNMI Division of Fish and Wildlife, NMFS and the Council with fisheries statistics becoming available approximately six months or longer after the data have been initially collected. The status of CREMUS, including species of special management interest to the Council would continue to be subject to ongoing discussion and review.

Under all of the action alternatives including the proposed action (Alternative 3), fishing for CNMI coral reef ecosystem MUS would be subject to annual catch limits shown in Table 17 and Table 21. As Table 17 and 21 shows, the 2012 and 2013 ACL specifications for alternatives 3 and 4 are generally higher than recent harvests so landings are not expected to exceed the ACL, and the ACLs are not expected to result in a race to the fish over each of the next two years. However, Alternative 3 is preferred over Alternative 2 as the latter is based on a mean and the SSC did not express support for an approach based on measures of central tendency (i.e., a statistical distribution that is usually measured by the arithmetic mean, mode or median) because of the high probability (50%) of exceeding this catch in any given year. Alternative 3 is also preferred over Alternative 4 because Alternative 4 would exceed ABC which is inconsistent with the Magnuson-Stevens Act. For species of special management interest to the Council, Alternative 3 is preferred because it is the most conservative.

As there is no in-season closure ability to prevent ACLs from being exceeded, the proposed ACLs are not expected to result in a change to the conduct of the fishery including gear types, areas fished, effort, or participation.

No changes in fisheries monitoring would occur as a result of the ACL specifications and current monitoring of CREMUS catches through shore-based and boat-based creel surveys would continue to be done by CNMI DFW. The accountability measure (AM) for CNMI coral reef fisheries would require a post-season review of the catch data to determine whether an ACL for any coral reef stock or stock complex was exceeded. Therefore, while data fisheries monitoring systems would not change as a result of ACL specifications, the annual tracking of catch relative to an ACL is expected to result in improved timeliness of catch processing and availability of fisheries statistics as the Council would need to determine as soon as possible after the fishing year whether an ACL had been exceeded.

If an ACL were exceeded, NMFS, as recommended by the Council would take action to correct the operational issue that caused the ACL overage. This could include a downward adjustment to the ACL for that stock or stock complex in the subsequent fishing year. NMFS cannot speculate on which MUS would be affected or the magnitude of the overage adjustment that might be taken; therefore, the fishery and environmental impacts of future actions such as changes to ACLs or AMs would be evaluated separately, once details are available.

3.1.4 Hawaii Coral Reef Fisheries and Potential Impacts

The Hawaiian Islands are made up of 137 islands, islets, and coral atolls that extend for nearly 1,500 miles from Kure Atoll in the northwest to the Island of Hawaii in the southeast. The

Hawaiian Islands are often grouped into the Northwestern Hawaiian Islands (Nihoa to Kure) and the Main Hawaiian Islands (Hawaii to Niihau). The total land area of the 19 primary islands and atolls is approximately 6,423 square miles. The majority (70 percent) of the 1.3-million people residing in Hawaii live on the island of Oahu. The seven other main Hawaiian Islands are Hawaii, Maui, Molokai, Lanai, Kahoolawe (uninhabited), Kauai, and Niihau.

Overview of Hawaii Coral Reef Fisheries

In Hawaii, the coral reef ecosystem management area includes the U.S. EEZ around the main Hawaiian Islands, which generally extends from 3-200 nmi offshore; however, the majority of CREMUS catch are harvested from nearshore waters under the jurisdiction of the State of Hawaii from the shoreline and from vessels by both commercial and non-commercial fishermen. Under state law, anyone who takes marine life for commercial purposes is required to obtain a commercial marine license (CML) and submit a catch report (popularly known as a "C3" form) on a monthly basis. MHI catches of the ten most commonly reported coral reef species include akule, opelu, jacks, goatfish, surgeonfish, squirrelfish, mullets, snappers, octopus, and parrotfish. For more information on target, non-target stocks and bycatch in Hawaii's coral reef fisheries, see Section 3.3.4.1. Commercial fishing in the NWHI was closed with the designation of the Papahanaumokuakea Marine National Monument. Some pelagic fishing for sustenance is allowed under permit within the monument, but there is no fishing allowed for CREMUS in the NWHI at this time.

The commercial landing of CREMUS in Hawaii has fluctuated over the past six decades (Figure 8). The highest commercial landings occurred in 1999 with close to 3.5 million lb. In 2010, estimated commercial landings of CREMUS were just over 1.3 million lb with akule and opelu accounting for nearly one-third of the commercial catch (254,996 lb and 204,643 lb, respectively).

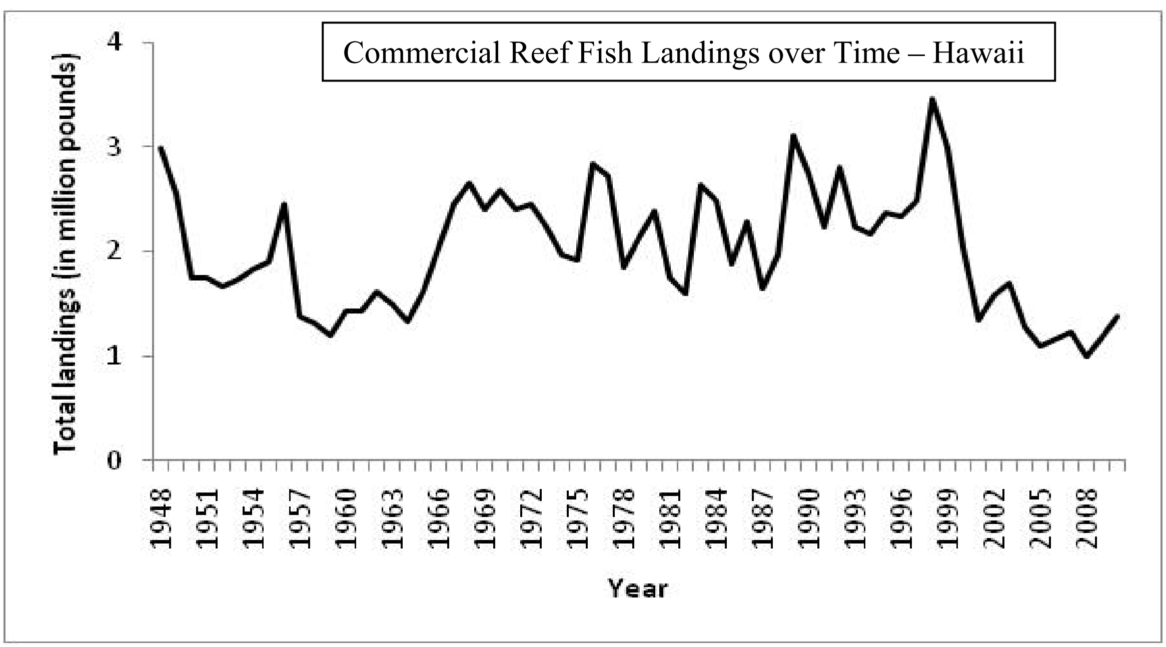

Figure 8. Reported Commercial landings of reef fishes in the Hawaii from 1948 to 2010
Source: WPacFIN unpublished data

In 2010, the average price per pound for coral reef fish in Hawaii was $3.01. With a total estimated commercial landing of 1.3 million lb, the coral reef fishery in Hawaii is valued at approximately $3.9 million.

The total number of individuals that participate in Hawaii's coral reef fisheries is currently unknown and could include hundreds of thousands of individuals that fish from both the shoreline and from vessels commercially and non-commercially. Hamm et al., (2010) provides the most recent estimate of the number of licensed commercial fishermen in Hawaii and reports there were 4,263 licensees in 2008. However, not all licensed fishers harvest CREMUS; therefore, the exact number of individual that may participate in Hawaii's coral reef fisheries is unknown.

By far, the largest coral reef fishery in Hawaii in terms of catch landed is the akule fishery which harvests the coastal pelagic species primarily by surround net and in smaller amounts from shoreline casting. The second largest fishery is the opelu fishery which harvests this coastal pelagic species primarily by hoop netting at night and by hook and line during the day. Although exact numbers are not available, it is estimated that up to 35 vessels may participate in Hawaii's akule and opelu fisheries.

Potential Impacts of the Proposed ACL specifications and AM on Hawaii Coral Reef Fisheries
Under the no-action alternative, which is the baseline alternative, Hawaii's coral reef fisheries would not be managed using annual catch limits, accountability measures would not be needed, and fishing would continue to be monitored by Hawaii Division of Aquatic Resources (HDAR), NMFS and the Council with fisheries statistics becoming available approximately six months or longer after the data have been initially collected. The status of CREMUS, including species of special management interest to the Council would continue to be subject to ongoing discussion and review.

Under each alternative including the proposed action (Alternative 3), fishing for Hawaii coral reef ecosystem MUS would be subject to annual catch limits shown in Table 18 and Table 22. As Table 18 shows, the 2012 and 2013 ACL specifications are generally higher than recent harvests so landings are not expected to exceed the respective ACLs, and the ACLs are not expected to result in a race to the fish over each of the next two years. However, Alternative 3 is preferred over Alternative 2 as the latter is based on a mean and the SSC did not express support for an approach based on measures of central tendency (i.e., a statistical distribution that is usually measured by the arithmetic mean, mode or median) because of the high probability (50%) of exceeding this catch in any given year. Alternative 3 is also preferred over Alternative 4 because Alternative 4 would exceed ABC which is inconsistent with the Magnuson-Stevens Act. For species of special management interest to the Council, Alternative 3 is preferred because it is the most conservative.

As there is no in-season closure ability to prevent ACLs from being exceeded, the proposed ACLs are not expected to result in a change to the conduct of the fishery including gear types, areas fished, effort, or participation.

No changes in fisheries monitoring would occur as a result of the ACL specification and current monitoring of CREMUS catches through shore-based and boat-based creel surveys would continue to be done by HDAR. The AM for Hawaii coral reef fisheries would require a post-season review of the catch data to determine whether an ACL for any coral reef stock or stock complex was exceeded. Therefore, while data fisheries monitoring systems would not change as a result of ACL specifications, the annual tracking of catch relative to an ACL is expected to result in improved timeliness of catch processing and availability of fisheries statistics as the Council would need to determine as soon as possible after the fishing year whether an ACL had been exceeded.

If an ACL were exceeded, NMFS, as recommended by the Council would take action to correct the operational issue that caused the ACL overage. This could include a downward adjustment to the ACL for that stock or stock complex in the subsequent fishing year. NMFS cannot speculate on which MUS would be affected or the magnitude of the overage adjustment that might be taken; therefore, the fishery and environmental impacts of future actions such as changes to ACLs or AMs would be evaluated separately, once details are available.

3.2. Affected Fishing Communities and Potential Impacts

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 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)". National Standard 8 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.

3.2.1American Samoa Fishing Community

Overview

In 1999, the Council identified American Samoa as a fishing community. The Secretary of Commerce approved this definition on April 19, 2009 (64 FR 19067).

Potential Impacts of the Proposed ACL specifications and AM on the American Samoa Fishing Community

Under the no-action alternative, which is the baseline alternative, American Samoa coral reef fisheries would not be managed using annual catch limits, accountability measures would not be needed, and fishing would continue to be monitored by American Samoa DMWR, NMFS and the Council. The affected fishing community would continue to be a part of the Council decision-making process.

Under all alternatives considered, including the proposed action, fishing for coral reef ecosystem MUS would be subject to annual catch limits. The ACL specifications are generally higher than recent harvests so ACLs are not expected to be exceeded in any of the reef fish fisheries, and no change to any fishery is anticipated. The proposed ACLs are intended to provide for community use of fishing resources, while helping to ensure that coral reef fishing is sustainable over the long term. Ongoing monitoring and future ACL adjustments are expected to benefit people who rely on fishing by providing additional review of fishing and catch levels, which, in turn, would enhance sustainability of the coral reef fisheries of American Samoa.

3.2.2 Guam Fishing Community

Overview
In 1999, the Council identified Guam as a fishing community. The Secretary of Commerce approved this definition on April 19, 2009 (64 FR 19067).

Potential Impacts of the Proposed ACL specifications and AM on the Guam Fishing Community
Under the no-action alternative, which is the baseline alternative, Guam coral reef fisheries would not be managed using annual catch limits, accountability measures would not be needed, and fishing would continue to be monitored by Guam DAWR, NMFS and the Council. The affected fishing community would continue to be a part of the Council decision-making process.

Under all alternatives considered, including the proposed action, fishing for coral reef ecosystem MUS would be subject to annual catch limits. The ACL specifications are generally higher than recent harvests so ACLs are not expected to be exceeded in any of the reef fish fisheries, and no change to any fishery is anticipated. The proposed ACLs are intended to provide for community use of fishing resources, while helping to ensure that coral reef fishing is sustainable over the long term. Ongoing monitoring and future ACL adjustments are expected to benefit people who rely on fishing by providing additional review of fishing and catch levels, which, in turn, would enhance sustainability of the coral reef fisheries of Guam.

3.2.3. CNMI Fishing Community

Overview
In 1999, the Council identified CNMI as a fishing community. The Secretary of Commerce approved this definition on April 19, 2009 (64 FR 19067).

Potential Impacts of the Proposed ACL specifications and AM on the CNMI Fishing Community
Under the no-action alternative, which is the baseline alternative, CNMI coral reef fisheries would not be managed using annual catch limits, accountability measures would not be needed, and fishing would continue to be monitored by CNMI DFW, NMFS and the Council. The affected fishing community would continue to be a part of the Council decision-making process.

Under all alternatives considered, including the proposed action, fishing for coral reef ecosystem MUS would be subject to annual catch limits. The ACL specifications are generally higher than recent harvests so ACLs are not expected to be exceeded in any of the reef fish fisheries, and no change to any fishery is anticipated. The proposed ACLs are intended to provide for community use of fishing resources, while helping to ensure that coral reef fishing is sustainable over the long term. Ongoing monitoring and future ACL adjustments are expected to benefit people who rely on fishing by providing additional review of fishing and catch levels, which, in turn, would enhance sustainability of the coral reef fisheries of the CNMI.

3.2.4 Hawaii Fishing Community

Overview

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).

Potential Impacts of the Proposed ACL specifications and AM on Fishing Communities of Hawaii

Under the no-action alternative, which is the baseline alternative, Hawaii coral reef fisheries would not be managed using annual catch limits, accountability measures would not be needed, and fishing would continue to be monitored by Hawaii DAR, NMFS and the Council. The affected fishing community would continue to be a part of the Council decision-making process.

Under all alternatives considered, including the proposed action, fishing for coral reef ecosystem MUS would be subject to annual catch limits. The ACL specifications are generally higher than recent harvests so ACLs are not expected to be exceeded in any of the reef fish fisheries, and no change to any fishery is anticipated. The proposed ACLs are intended to provide for community use of fishing resources, while helping to ensure that coral reef fishing is sustainable over the long term. Ongoing monitoring and future ACL adjustments are expected to benefit people who rely on fishing by providing additional review of fishing and catch levels, which, in turn, would enhance sustainability of the coral reef fisheries of Hawaii.

3.3. Potentially Affected Resources and Potential Impacts

3.3.1 American Samoa Resources and Potential Impacts

3.3.1.1 Potentially Affected Target, Non-target Stocks, and Bycatch in American Samoa Coral Reef Fisheries

As with other Pacific Islands, it is difficult to determine “target” and “non-target” stocks because resources harvested in American Samoa’s coral reef fisheries are highly diverse, with approximately 300 species appearing in catch records (Appendix A). Based on recent average catch reported in (Table 15), 90% of the CREMUS catch in American Samoa is comprised of primarily eight family groups which include Acanthuridae (surgeonfish), Lutjanidae (snappers), Carangidae (jacks), Lethrinidae (emperors), Scaridae (parrotfish), Holocentridae (soldier/squirrelfish), Mugilidae (mullets), the coastal pelagic jack, *Selar crumenophthalmus* (atule). Several species of mollusks (snails, octopus and clams) and crustaceans (crabs) comprise the top 90% of the catch. Additionally, several other coral reef ecosystem taxa are also commonly harvested and retained and comprise the remaining 10% of the catch. However, some species defined in federal regulations as American Samoa CREMUS (50 CFR 665.121) are not harvested at all.

While the boat-based and shore-based creel survey programs administered by DMWR provide for the collection of bycatch information, no such information is currently available, indicating that most of the fish that are caught are retained. However, like other Pacific Islands, discards, if they occur, are usually due to cultural reasons (i.e., taboo) or practical reasons such as toxicity (e.g., ciguatera and poison).

As previously noted, coral reef fishing is conducted predominantly in nearshore waters from 0-3 nm because the majority of coral reef ecosystem habitat is found shoreward of the U.S. EEZ, which is generally 3-200 nm from shore. Consequently, it might be argued that there is no bycatch problem for coral reef fisheries under federal control. Nevertheless, there are federal management regulations currently in place which minimize the potential for bycatch through the prohibition on the use of destructive and non-selective gear methods. Specifically, federal regulations allow only certain gear types to be used while fishing for CREMUS. These include: (1) hand harvest; (2) spear; (3) slurp gun; (4) hand net/dip net; (5) hoop net for crab; (6) throw net; (7) barrier net; (8) surround/purse net that is attended at all times; (9) hook and line; (10) crab and fish traps with vessel ID number affixed; and (11) remotely operated vehicles/submersibles.

While the American Samoa FEP describes procedures for establishing limits and reference point values based on standardized values of catch per unit effort (CPUE) and effort (E) which serve as proxies for relative biomass (B_{MSY}) and fishing mortality (F_{MSY}), respectively, neither the Council or NMFS have data sufficient for determining reference point values for any American Samoa CREMUS. Therefore, stock status of American Samoa CREMUS is unknown. However, based on an analysis of archipelagic-wide estimates of catch-to-biomass presented in Luck and Dalzell (2010) and shown in Appendix B, estimated exploitation rates did not exceed 10% for any CREMUS taxonomic group, suggesting biomass is likely to be above B_{MSY}, although Luck and Dalzell (2010) report much higher exploitation rates when catch-to-biomass comparisons are limited to Tutuila.

Potential Impacts of the Proposed ACL specifications and AM on Target, Non-target and Bycatch in American Samoa Coral Reef Fisheries

The Council and its SSC have grouped individual stocks of American Samoa CREMUS into higher taxonomic groups (stock complexes) generally at the family level and propose to specify ACLs for each CREMUS stock and stock complex as listed in Table 15. Alternatives to the proposed ACL are shown in Table 19. The ACL specification for each stock and stock complex is proposed to be set at a level substantially lower than the estimated biomass, where that information is available. Specifically, no ACL would be higher than 8% of the stock or stock complex's estimated biomass. The proposed ACLs under other alternatives are also higher than recent catches, so it is expected that fishing activity will remain the same, and the ACLs would not be exceeded.

Under all of the alternatives, including the proposed action, no new monitoring would be implemented; however, as an AM, a post-season review of the catch data would be conducted as soon as possible after the fishing year to determine whether an ACL for any stock or stock complex was exceeded. If an ACL were exceeded, NMFS, as recommended by the Council would take action to correct the operational issue that caused the ACL overage. This could include a downward adjustment to the ACL for that stock or stock complex in the subsequent fishing year.

The impacts of an ACL specification for American Samoa CREMUS are expected to be beneficial because it would establish a limit on the amount of fish that are harvested annually where none previously existed. While the lack of in-season catch monitoring ability precludes in-season measures (such as fishery closure) to prevent the ACL from being exceeded, the ACL is set substantially lower than estimated biomass and is intended to prevent overfishing from occurring. Additionally, the post-season review of catch relative to the proposed ACL for each stock and stock complex is part of a management regime designed to prevent coral reef fisheries from becoming overfished. The additional level of post season review of the catch would also provide an enhanced level of management review of the fisheries and would provide an opportunity for the Council to refine ACL and AM specifications, as needed.

The proposed ACLs are generally higher than recent catch levels, so fisheries are not expected to be affected, and, therefore, there is no change to harvest levels expected to occur as a result of implementing the ACL specifications. This, together with the fact that there are no in-season closures, leads to the conclusion that the ACL specifications and AM measures would not have a large or adverse effect on target, non-target or bycatch species caught in American Samoa's coral reef fisheries.

3.3.1.2 Potentially Affected Protected Resources in American Samoa

The coral reef fisheries of the western Pacific region have been evaluated for impacts on protected resources and are 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 relevant laws and policies. Additional detailed descriptions of potentially affected protected resources and their life histories can be found in section 3.3.4 of the FEP for American Samoa (WPFMC 2009a). There is no critical habitat designated for ESA-listed marine species around American Samoa.

Applicable ESA Coordination for American Samoa Coral Reef Fisheries
In an informal consultation letter dated March 7, 2002, NMFS determined that the Coral Reef Ecosystem FMP management approach and fisheries that operate in accordance with regulations implementing the FMP are not likely to adversely affect ESA-listed species known to occur in waters around American Samoa or their designated critical habitat. In 2009, the Council developed and NMFS approved five new archipelagic-based fishery ecosystem plans (FEP), including the American Samoa Archipelago FEP. The FEP incorporated and reorganized elements of the Councils' species-based FMPs, including the Coral Reef Ecosystem FMP into a spatially-oriented management plan (75 FR 2198, January 14, 2010). All applicable regulations were retained through the development and implementation of the FEP for American Samoa, and no substantial changes to the coral reef fisheries around American Samoa that require further consultation have occurred since the FEP was implemented.

Marine Mammals
The MMPA prohibits, with certain exceptions, taking of marine mammals in the U.S., and by persons aboard U.S. flagged vessels (i.e., persons and vessels subject to U.S. jurisdiction). On

November 29, 2011, NMFS published the final List of Fisheries (LOF) for 2012 which classifies commercial fisheries of the United States into one of three categories based upon the level of serious injury and mortality of marine mammals that occurs incidental to each fishery with Category 1 being the highest and Category 3 being the lowest (76 FR 73912). However, due to the nature of this fishery as primarily a near-shore fishery with relatively small levels of commercial harvest, NMFS has not classified this fishery in its LOF; however, NMFS classifies the similar coral reef fisheries in Hawaii including the Hawaii inshore gillnet, opelu/akule net, inshore purse seine, throw net, cast net, hukilau net, crab net, crab trap, fish trap, inshore handline, handpick and spearfishing fisheries as Category III fishery under Section 118 of the MMPA, as the fishery is one with a low likelihood or no known incidental takings of marine mammals. Therefore, NMFS concludes that coral reef fisheries in the American Samoa would be comparable to the Category III classification in Hawaii and would be one with a low likelihood of incidentally taking marine mammals.

Cetaceans listed as threatened or endangered under the ESA and that have been observed in the waters around American Samoa include the humpback whale (*Megaptera novaeangliae*), sperm whale (*Physeter macrocephalus*), and sei whale (*Balaenoptera borealis*) (WPFMC 2009a). To date, no humpback, sperm, blue, fin or sei whale interactions have been observed or reported in the American Samoa coral reef fishery. Table 23 shows non-ESA listed marine mammals occurring around American Samoa.

Table 23. Non ESA-listed marine mammals occurring around American Samoa

Common Name	Scientific Name	Common Name	Scientific Name
Blainville's beaked whale	*Mesoplodon densirostris*	Minke whale	*Balaenoptera acutorostrata*
Bottlenose dolphin	*Tursiops truncatus*	Pygmy killer whale	*Feresa attenuata*
Bryde's whale	*Balaenoptera edeni*	Pygmy sperm whale	*Kogia breviceps*
Common dolphin	*Delphinus delphis*	Risso's dolphin	*Grampus griseus*
Cuvier's beaked whale	*Ziphius cavirostris*	Rough-toothed dolphin	*Steno bredanensis*
Dwarf sperm whale	*Kogia sima*	Short-finned pilot whale	*Globicephala macrorhynchus*
False killer whale	*Pseudorca crassidens*	Spinner dolphin	*Stenella longirostris*
Fraser's dolphin	*Lagenodelphis hosei*	Spotted dolphin	*Stenella attenuata*
Killer whale	*Orcinus orca*	Striped dolphin	*Stenella coeruleoalba*
Melon-headed whale	*Peponocephala electra*		

Sources: NMFS PIRO and PIFSC unpublished
Note: Marine mammal survey data are limited for this region. This table represents likely occurrences in the action area.

Sea Turtles

There are five Pacific sea turtles designated under the Endangered Species Act (ESA) as either threatened or endangered. Green and hawksbill sea turtles are most likely to frequent nearshore habitat when foraging around American Samoa. The breeding populations of Mexico's olive ridley sea turtles (*Lepidochelys olivacea*) are currently listed as endangered, while all other ridley populations are listed as threatened. Leatherback sea turtles (*Dermochelys coriacea*) and hawksbill turtles (*Eretmochelys imbricata*) are also classified as endangered. Additionally, the loggerhead sea turtle (*Caretta caretta*) population in the South Pacific Ocean was recently identified as a distinct population segment and listed as endangered. Green sea turtles (*Chelonia mydas*) are listed as threatened (the green sea turtle is listed as threatened throughout its Pacific range, except for the endangered population nesting on the Pacific coast of Mexico). These five species of sea turtles are highly migratory, or have a highly migratory phase in their life history (NMFS 2001). For more detailed information on the life history of sea turtles, see section 3.3.1 of the Council's EIS on Amendment 18 to the Fishery Management Plan for Pelagic Fisheries of the Western Pacific Region (WPFMC 2009b). There have been no reported or observed interactions with sea turtles in the American Samoa commercial coral reef fishery.

Seabirds

Newell's shearwater (*Puffinus auricularis newelli*) is listed as threatened under the Endangered Species Act. The Newell's shearwater, generally known with other shearwaters and petrels as ta`i`o in Samoan, breeds only in colonies on the main Hawaiian Islands. Newell's shearwater has been sighted once in American Samoa and is considered a rare visitor to the archipelago.Additionally, there have been no reports of interactions between the American Samoa coral reef ecosystem fisheries and seabirds; therefore, NMFS concludes that the fisheries, as currently conducted under the proposed action, would not affect ESA listed seabirds.

Other seabirds not listed under the ESA found in American Samoa are listed in Table 24.

Table 24. Seabirds occurring in American Samoa

Residents (i.e., breeding)		
Samoan name	**Common name**	***Scientific name***
ta'i'o	Wedge-tailed shearwater	*Puffinus pacificus*
ta'i'o	Audubon's shearwater	*Puffinus lherminieri*
ta'i'o	Christmas shearwater	*Puffinus nativitatis*
ta'i'o	Tahiti petrel	*Pterodroma rostrata*
ta'i'o	Herald petrel	*Pterodroma heraldica*
ta'i'o	Collared petrel	*Pterodroma brevipes*
fua'o	Red-footed booby	*Sula sula*
fua'o	Brown booby	*Sula leucogaster*
fua'o	Masked booby	*Sula dactylatra*
tava'esina	White-tailed tropicbird	*Phaethon lepturus*
tava'e'ula	Red-tailed tropicbird	*Phaethon rubricauda*
atafa	Great frigatebird	*Fregata minor*
atafa	Lesser frigatebird	*Fregata ariel*
gogouli	Sooty tern	*Sterna fuscata*
gogo	Brown noddy	*Anous stolidus*
gogo	Black noddy	*Anous minutus*
laia	Blue-gray noddy	*Procelsterna cerulea*
manu sina	Common fairy-tern (white tern)	*Gygis alba*

Source: WPFMC 2003 (updated in WPFMC 2009a).

Potential Impacts of the Proposed ACL Specifications and AM on Protected Resources in American Samoa

The proposed ACL specification and AM would not affect protected marine resources of American Samoa because the ACLs and AM would not result in substantial changes to the way the coral reef fisheries are conducted. There have been no known or observed interactions between these fisheries and protected species in American Samoa. Managing coral reef fisheries using ACLs and AMs would be an addition to the current fishery management regime that is intended to provide for long-term sustainable catches of fishery stocks. Because these fisheries are currently sustainably managed and subject to conservation measures in accordance with various resource conservation and management laws, the ACLs and AM would not result in a change to distribution, abundance, reproduction, or survival of ESA-listed species or increase interactions with protected resources.

If at any time the fishery, environment, or status of a listed species or marine mammal species were to change substantially, or if a fishery were found to be occurring in or near new critical habitat, NMFS would undertake additional consultation, as required, to comply with requirements of the ESA and the MMPA.

3.3.2 Guam Potentially Affected Resources and Potential Impacts

3.3.2.1 Potentially Affected Target, Non-target Stocks, and Bycatch in Guam Coral Reef Fisheries

As with other Pacific Islands, it is difficult to determine "target" and "non-target" stocks because resources harvested in the Mariana Archipelago, including Guam's coral reef fisheries, are highly diverse, with approximately 700 species appearing in catch records (Appendix A). Based on recent average catch reported in Table 16, 90% of the CREMUS catch in Guam is comprised of 11 family groups which include Acanthuridae (surgeonfish), Carangidae (jacks), Lethrinidae (emperors), Scaridae (parrotfish), Mullidae (goatfishes), Siganidae (rabbitfish), Lutjanidae (snappers), Serranidae (groupers), Mugilidae (mullets), Kyphosidae (rudderfish), Holocentridae (soldier/squirrelfish), as well as the coastal pelagic jack, *Selar crumenophthalmus* (atulai), several species of mollusks (snails, octopus and clams) crustaceans (crabs) and algae. Additionally, several other coral reef ecosystem taxa are also commonly harvested and retained and make up the remaining 15% of the catch. However, some species defined in federal regulations as Mariana CREMUS (50 CFR 665.421) are not harvested at all.

While the boat-based and shore-based creel survey programs administered by DAWR provide for the collect of bycatch information, no such information is currently available, indicating that most of the fish that are caught are retained. However, like other Pacific Islands, discards, if they occur, are usually due to cultural reasons (i.e., taboo) or practical reasons such as toxicity (e.g., ciguatera and poison).

As previously noted, coral reef fishing is conducted predominantly in nearshore waters from 0-3 nm because the majority of coral reef ecosystem habitat is found shoreward of the U.S. EEZ, which is generally 3-200 nm from shore. Consequently, it might be argued that there is no bycatch problem for coral reef fisheries under federal control. Nevertheless, there are federal management regulations currently in place to minimize the potential for bycatch through the prohibition on the use of destructive and non-selective gear methods. Specifically, federal regulations allow only certain gear types to be used while fishing for CREMUS. These include: (1) hand harvest; (2) spear; (3) slurp gun; (4) hand net/dip net; (5) hoop net for crab; (6) throw net; (7) barrier net; (8) surround/purse net that is attended at all times; (9) hook and line; (10) crab and fish traps with vessel ID number affixed; and (11) remotely operated vehicles/submersibles.

While the Mariana Archipelago FEP describes procedures for establishing limits and reference point values based on standardized values of catch per unit effort (CPUE) and effort (E) which serve as proxies for relative biomass (B_{MSY}) and fishing mortality (F_{MSY}), respectively, neither the Council nor NMFS have data that are sufficient for determining reference points values for any Mariana CREMUS in Guam. Therefore, stock status of CREMUS in Guam is unknown. However, based on an analysis of archipelagic-wide estimates of catch-to-biomass presented in Luck and Dalzell (2010) and shown in Appendix B, estimated exploitation rates did not exceed 8% for any CREMUS taxonomic group, suggesting biomass is likely to be above $B_{MSY,}$ although Luck and Dalzell (2010) report much higher exploitation rates when catch-to-biomass comparisons are limited to islands with high populated densities (i.e., Guam and the southern islands of CNMI).

Potential Impacts of the Proposed ACL specifications and AM on Target, Non-target and Bycatch in Guam Coral Reef Fisheries

The Council and its SSC have grouped individual stocks of CREMUS in Guam into higher taxonomic groups (stock complexes) generally at the family level and propose to specify ACLs for each CREMUS stock and stock complex that are listed in Table 16. Alternatives to the proposed ACL are shown in Table 20. The ACL specification for each stock and stock complex is proposed to be set at a level substantially lower than the estimated biomass, where that information is available and specifically, no ACL would be higher than 13% of the stock or stock complex's estimated biomass. The proposed ACLs under the other alternatives are also higher than recent catches, and it is expected that fishing activity would remain the same so the ACLs are not likely to be exceeded. The Guam CRE MUS ACL for Carangidae (jacks) under Alternative 2 is lower than recent catches, but even if the ACL were to be exceeded under Alternative 2, the proposed ACL is set at less than 10% of the biomass estimates for jacks.

Under all of the alternatives, including the proposed action, no new monitoring would be implemented. However, as an AM, a post-season review of the catch data would be conducted as soon as possible after the fishing year to determine whether an ACL for any stock or stock complex was exceeded. If an ACL were exceeded, NMFS, as recommended by the Council would take action to correct the operational issue that caused the ACL overage. This could include a downward adjustment to the ACL for that stock or stock complex in the subsequent fishing year.

The impacts of an ACL specification for Guam CREMUS are expected to be beneficial because it would establish a limit on the amount of fish that are harvested annually where none previously existed. While the lack of in-season catch monitoring ability precludes in-season measures (such as fishery closure) to prevent the ACL from being exceeded, the ACL is set substantially lower than estimated biomass and is intended to prevent overfishing from occurring. Additionally, the post-season review of catch relative to the proposed ACL for each stock and stock complex is part of a management regime designed to prevent coral reef fisheries from becoming overfished. The additional level of post season review of the catch would also provide an enhanced level of management review of the fisheries and would provide an opportunity for the Council to refine ACL and AM specifications, as needed.

The proposed ACLs are generally higher than recent catch levels, so fisheries are not expected to be affected. Therefore, there is no change to harvest levels expected to occur as a result of implementing the ACL specifications. This, together with the fact that there would be no in-season closures, leads to the conclusion that the ACL specifications and AM measures would not have a large or adverse effect on target, non-target or bycatch species caught in Guam's coral reef fisheries.

3.3.2.2 Potentially Affected Protected Resources in Guam

The coral reef fisheries of the western Pacific region have been evaluated for impacts on protected resources and are 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 relevant laws and policies. Additional detailed descriptions of potentially affected protected resources and their life histories can be found in section 3.3.4 of the FEP for the Mariana Archipelago (WPFMC 2009c). There is no critical habitat designated for ESA-listed species in the Mariana Archipelago.

Applicable ESA Coordination for Guam

In an informal consultation letter dated June 3, 2008, NMFS determined that the continued authorization of coral reef fisheries of the Mariana Archipelago as managed under the Coral Reef Ecosystems FMP is not likely to adversely affect ESA-listed marine species or their designated critical habitat. In 2009, the Council developed and NMFS approved five new archipelagic-based fishery ecosystem plans (FEP), including the Mariana Archipelago FEP. The FEP incorporated and reorganized elements of the Councils' species-based FMPs, including the Coral Reef Ecosystem FMP, into a spatially-oriented management plan (75 FR 2198, January 14, 2010). All applicable regulations were retained through the development and implementation of the FEP for the Mariana Archipelago, and no substantial changes to the coral reef fisheries around Guam that require further consultation have occurred since the FEP was implemented.

Marine Mammals

The MMPA prohibits, with certain exceptions, taking of marine mammals in the U.S., and by persons aboard U.S. flagged vessels (i.e., persons and vessels subject to U.S. jurisdiction). On November 29, 2011, NMFS published the final List of Fisheries (LOF) for 2012 which classifies commercial fisheries of the United States into one of three categories based upon the level of serious injury and mortality of marine mammals that occurs incidental to each fishery with Category 1 being the highest and Category 3 being the lowest (76 FR 73912). However, due to the nature of this fishery as primarily a near-shore fishery with relatively small levels of commercial harvest, NMFS has not classified this fishery in its LOF; however, NMFS classifies the similar coral reef fisheries in Hawaii including the Hawaii inshore gillnet, opelu/akule net, inshore purse seine, throw net, cast net, hukilau net, crab net, crab trap, fish trap, inshore handline, handpick and spearfishing fisheries as Category III fishery under Section 118 of the MMPA, as the fishery is one with a low likelihood or no known incidental takings of marine mammals. Therefore, NMFS concludes that coral reef fisheries in Guam would be comparable to the Category III classification in Hawaii and would be one with a low likelihood of incidentally taking marine mammals.

Cetaceans listed as endangered under the ESA that have been observed in waters of the Mariana Islands include the humpback whale (*Megaptera novaeangliae*), sperm whale (*Physeter macrocephalus*), and sei whale (*Balaenoptera borealis*) (WPFMC 2009c). Other ESA listed marine mammals that may occur in the EEZ around the Mariana Islands Archipelago include the blue whale (*Balaenoptera musculus*) and the fin whale (*Balaenoptera physalus*). Table 25 lists known non-ESA listed marine mammals that have been observed in the Mariana Archipelago and are protected by the MMPA.

Table 25. Non-ESA listed marine mammals occurring around the Mariana Archipelago

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

Source: Eldredge 2003

Sea Turtles

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

Based on nearshore surveys conducted jointly between the CNMI–DFW and NMFS around the Southern Mariana Islands (Rota and Tinian 2001; Saipan 1999), an estimated 1,000 to 2,000 green sea turtles forage in these areas (Kolinski et al., 2001). Nesting beaches and seagrass beds on Tinian and Rota are in good condition but beaches and seagrass beds on Saipan have been impacted by hotels, golf courses and general tourist activities. Nesting surveys for green sea turtles have been done on Guam since 1973 with the most consistent data collected between 1990 and 2001 (Cummings 2002). Survey results show nesting in Guam to be generally increasing with 1997 having the most numerous nesting females at 60 (Cummings 2002). From October 1, 2006 through July 31, 2008, 55 green turtle nests were counted at various beaches during opportunistic surveys throughout Guam (DAWR 2009). Aerial surveys done in 1990–2000 also found an increase in green sea turtle sightings around Guam with over 200 turtles counted in 2000 (Cummings 2002). There have been occasional sightings of leatherback turtles around Guam (Eldredge 2003); however, the extent to which leatherback turtles are present around the Mariana Archipelago is unknown. There are no known reports of loggerhead or olive ridley turtles in waters around the Mariana Archipelago (WPFMC 2009c).

Seabirds

The following seabirds are considered residents of the Mariana Archipelago: wedge-tailed shearwater (*Puffinus pacificus*), white-tailed tropicbird (*Phaethon lepturus*), red-tailed tropicbird (*Phaethon rubricauda*), masked booby (*Sula dactylatra*), brown booby (*Sula leucogaster*), red-footed booby (*Sula sula*), white tern (*Gygis alba),* sooty tern (*Sterna fuscata*), brown noddy (*Anous stolidus*), black noddy (*Anous minutus*), and the great frigatebird (*Fregata minor*). There are no known interactions between seabirds and any of the Mariana Archipelago coral reef fisheries (WPFMC 2009c); therefore, NMFS concludes that the fisheries, as currently conducted under the proposed action, would not affect ESA listed seabirds.

The following seabirds have been sighted and are considered visitors (some more common than others) to the Mariana Archipelago; short-tailed shearwater (*Puffinus tenuirostris;* common visitor), Newell's shearwater (*Puffinus auricularis;* rare visitor), Audubon's shearwater (*Puffinus iherminieri*), Leach's storm-petrel (*Oceanodroma leucorhoa*), and the Matsudaira's storm-petral (*Oceanodroma matsudairae*). Of these, only the Newell's shearwater is listed as threatened under the ESA. There have been no sightings of the endangered short-tailed albatross (*Phoebastria albatrus*) in the CNMI although the CNMI is within the range of the only breeding colony at Torishima, Japan (WPFMC 2009c).

Potential Impacts of the Proposed ACL Specifications and AM on Protected Resources in Guam

The proposed ACL specifications and AM would not affect protected resources throughout the Mariana Archipelago because the ACLs and AM would not result in substantial changes to the way the coral reef fisheries are conducted. There have been no known or observed interactions between these fisheries and protected species in Guam. Managing coral reef fisheries using

ACLs and AMs would be an addition to the current fishery management regime that is intended to provide for long-term sustainable catches of fishery stocks. Because these fisheries are currently sustainably managed and subject to conservation measures in accordance with various resource conservation and management laws, the ACLs and AM would not result in a change to distribution, abundance, reproduction, or survival of ESA-listed species or increase interactions with protected resources.

If at any time the fishery, environment, or status of a listed species or marine mammal species were to change substantially, or if a fishery were found to be occurring in or near new critical habitat, NMFS would undertake additional consultation as required to comply with requirements of the ESA and the MMPA.

3.3.3 CNMI Potentially Affected Resources and Potential Impacts

3.3.3.1 Potentially Affected Target, Non-target Stocks, and Bycatch in the CNMI Coral Reef Fisheries

As with other Pacific Islands, it is difficult to determine "target" and "non-target" stocks because resources harvested in the Mariana Archipelago, including CNMI's coral reef fisheries are highly diverse, with over a hundred species appearing in catch records (Appendix A). Based recent on average catch reported in Table 17, 90% of the CREMUS catch in CNMI is comprised of 9 family groups which include Lethrinidae (emperors), Carangidae (jacks), Acanthuridae (surgeonfish), Serranidae (groupers), Lutjanidae (snappers), Mullidae (goatfishes), Scaridae (parrotfish), Mugilidae (mullets), Siganidae (rabbitfish), the coastal pelagic jack, *Selar crumenophthalmus* (atulai), and several species of mollusks (snails, octopus and clams). Additionally, several other coral reef ecosystem taxa are also commonly harvested and retained and make up the remaining 10% of the catch. However, some species defined in federal regulations as Mariana CREMUS (50 CFR 665.421) are not harvested at all.

While the boat-based and shore-based creel survey programs administered by CNMI DFW provide for the collection of bycatch information, no such information is currently available indicating that most of the fish that are caught are retained. However, like other Pacific Islands, discards, if they occur, are usually due to cultural reasons (i.e., taboo) or practical reasons such as toxicity (e.g., ciguatera and poison).

In the CNMI, the U.S. EEZ extends from the shore to 200 nm; however, the federal coral reef ecosystem management area applies only to offshore waters from 3-200 nm from shore, consistent with the other island areas. As previously noted, coral reef fishing is conducted predominantly in nearshore waters from 0-3 nm because the majority of coral reef ecosystem habitat is found within this boundary. Consequently, it might be argued that there is no bycatch problem for coral reef fisheries under federal control. Nevertheless, there are federal management regulations currently in place to minimize the potential for bycatch through the prohibition on the use of destructive and non-selective gear methods. Specifically, federal regulations allow only certain gear types to be used while fishing for CREMUS. These include: (1) hand harvest; (2) spear; (3) slurp gun; (4) hand net/dip net; (5) hoop net for crab; (6) throw net; (7) barrier net; (8) surround/purse net that is attended at all times; (9) hook and line; (10)

crab and fish traps with vessel ID number affixed; and (11) remotely operated vehicles/submersibles.

While the Mariana Archipelago FEP describes procedures for establishing limits and reference point values based on standardized values of catch per unit effort (CPUE) and effort (E) which serve as proxies for relative biomass (B_{MSY}) and fishing mortality (F_{MSY}), respectively, neither the Council nor NMFS have sufficient data to determine reference point values for any Mariana CREMUS in CNMI. Therefore, stock status of CREMUS in CNMI is unknown. However, based on an analysis of archipelagic-wide estimates of catch-to-biomass presented in Luck and Dalzell (2010) and shown in Appendix B, estimated exploitation rates did not exceed 10% for any CREMUS taxonomic group, suggesting biomass is likely to be above $B_{MSY,}$ although Luck and Dalzell (2010) report much higher exploitation rates when catch-to-biomass comparisons are limited to islands with high populated densities (i.e., Guam and southern islands of CNMI).

Potential Impacts of the Proposed ACL specifications and AM on Target, Non-target Stocks, and Bycatch in the CNMI Coral Reef Fisheries

The Council and its SSC have grouped individual stocks of CREMUS in CNMI into higher taxonomic groups (stock complexes) generally at the family level and propose to specify ACLs for each CREMUS stock and stock complex that are listed in Table 17. Alternatives to the proposed ACL are shown in Table 21. The ACL specification for each stock and stock complex is proposed to be set at a level substantially lower that the estimated biomass, where that information is available and specifically, no ACL would be higher than 10% of the stock or stock complex's estimated biomass. The proposed ACLs under other alternatives are also higher than recent catches and since fishing activity is expected to remain the same, the ACLs are not likely to be exceeded.

Under all of the alternatives, including the proposed action, no new monitoring would be implemented; however, as an AM a post-season review of the catch data would be conducted as soon as possible after the fishing year to determine whether an ACL for any stock or stock complex was exceeded. If an ACL were exceeded, NMFS, as recommended by the Council would take action to correct the operational issue that caused the ACL overage. This could include a downward adjustment to the ACL for that stock or stock complex in the subsequent fishing year.

The impacts of an ACL specification for CNMI CREMUS are expected to be beneficial because it would establish a limit on the amount of fish that are harvested annually where none previously existed. While the lack of in-season catch monitoring ability precludes in-season measures (such as fishery closure) to prevent the ACL from being exceeded, the ACL is set substantially lower than estimated biomass and is intended to prevent overfishing from occurring. Additionally, the post-season review of catch relative to the proposed ACL for each stock and stock complex is part of a management regime designed to prevent coral reef fisheries from becoming overfished. The additional level of post season review of the catch would also provide an enhanced level of management review of the fisheries and would provide an opportunity for the Council to refine ACL and AM specifications, as needed.

The proposed ACLs are generally higher than recent catch levels, so fisheries are not expected to be affected, and therefore, there is no change to harvest levels expected to occur as a result of implementing the ACL specifications. This, together with the fact that there are no in-season closures, leads to the conclusion that the ACL specifications and AM measures would not have a large or adverse effect on target, non-target or bycatch species caught in CNMI's coral reef fisheries.

3.3.3.2 Potentially Affected Protected Resources in the CNMI

The coral reef fisheries of the western Pacific region have been evaluated for impacts on protected resources and are 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 laws and policies. Additional detailed descriptions of potentially affected protected resources and their life histories can be found in section 3.3.4 of the FEP for the Mariana Archipelago (WPFMC 2009c). There is no critical habitat designated for ESA-listed species in the Mariana Archipelago.

Applicable ESA Coordination for the CNMI

In an informal consultation letter dated June 3, 2008, NMFS determined that the continued authorization of coral reef fisheries of the Mariana Archipelago as managed under the Coral Reef Ecosystems FMP is not likely to adversely affect ESA-listed marine species or their designated critical habitat. In 2009, the Council developed and NMFS approved five new archipelagic-based fishery ecosystem plans (FEP), including the Mariana Archipelago FEP. The FEP incorporated and reorganized elements of the Councils' species-based FMPs, including the Coral Reef Ecosystem FMP into a spatially-oriented management plan (75 FR 2198, January 14, 2010). All applicable regulations were retained through the development and implementation of the FEP for the Mariana Archipelago, and no substantial changes to the coral reef fisheries around the CNMI that require further consultation have occurred since the FEP was implemented.

Marine Mammals

The MMPA prohibits, with certain exceptions, taking of marine mammals in the U.S., and by persons aboard U.S. flagged vessels (i.e., persons and vessels subject to U.S. jurisdiction). On November 29, 2011, NMFS published the final List of Fisheries (LOF) for 2012 which classifies commercial fisheries of the United States into one of three categories based upon the level of serious injury and mortality of marine mammals that occurs incidental to each fishery with Category 1 being the highest and Category 3 being the lowest (76 FR 73912). However, due to the nature of this fishery as primarily a near-shore fishery with relatively small levels of commercial harvest, NMFS has not classified this fishery in its LOF; however, NMFS classifies the similar coral reef fisheries in Hawaii including the Hawaii inshore gillnet, opelu/akule net, inshore purse seine, throw net, cast net, hukilau net, crab net, crab trap, fish trap, inshore handline, handpick and spearfishing fisheries as Category III fishery under Section 118 of the MMPA, as the fishery is one with a low likelihood or no known incidental takings of marine mammals. Therefore, NMFS concludes that coral reef fisheries in the CNMI would be comparable to the Category III classification in Hawaii and would be one with a low likelihood of incidentally taking marine mammals.

Cetaceans listed as endangered under the ESA that have been observed in waters of the Mariana Islands include the humpback whale (*Megaptera novaeangliae*), sperm whale (*Physeter macrocephalus*), and sei whale (*Balaenoptera borealis*) (WPFMC 2009c). Other ESA listed marine mammals that may occur in the EEZ around the Mariana Islands Archipelago include the blue whale (*Balaenoptera musculus*) and the fin whale (*Balaenoptera physalus*). Table 26 lists known non-ESA listed marine mammals that have been observed in the Mariana Archipelago and are protected by the MMPA.

Table 26. Non-ESA listed marine mammals occurring around the Mariana Archipelago

Common Name	Scientific Name
Blainville's beaked whale	*Mesoplodon densirostris*
Bottlenose dolphin	*Tursiops truncatus*
Bryde's whale	*Balaenoptera edeni*
Common dolphin	*Delphinus delphis*
Cuvier's beaked whale	*Ziphius cavirostris*
Dwarf sperm whale	*Kogia sima*
False killer whale	*Pseudorca crassidens*
Fraser's dolphin	*Lagenodelphis hosei*
Killer whale	*Orcinus orca*
Longman's beaked whale	*Indopacetus pacificus*
Melon-headed whale	*Peponocephala electra*
Minke whale	*Balaenoptera acutorostrata*
Northern Elephant Seal	*Mirounga angustirostris*
Pantropical Spotted Dolphin	*Stenella attenuate*
Pygmy killer whale	*Feresa attenuata*
Pygmy sperm whale	*Kogia breviceps*
Risso's dolphin	*Grampus griseus*
Rough-toothed dolphin	*Steno bredanensis*
Short-finned pilot whale	*Globicephala macrorhynchus*
Spinner dolphin	*Stenella longirostris*
Spotted dolphin	*Stenella attenuata*
Striped dolphin	*Stenella coeruleoalba*

Source: Eldredge 2003

Sea Turtles

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

Based on nearshore surveys conducted jointly between the CNMI–DFW and NMFS around the Southern Mariana Islands (Rota and Tinian 2001; Saipan 1999), an estimated 1,000 to 2,000 green sea turtles forage in these areas (Kolinski et al., 2001). Nesting beaches and seagrass beds on Tinian and Rota are in good condition but beaches and seagrass beds on Saipan have been impacted by hotels, golf courses and general tourist activities. Intensive monitoring in occurred on Saipan at seven beaches from March 4 to August 31, 2009 resulting in 16 green turtle nests documented. Rapid assessments at Rota beaches Okgok and Tatgua on July 12, 2009 yielded 13 nests. On Tinian, from July 22-31, 2009, 36 nests at five beaches were documented (Maison et. al 2010). There have been occasional sightings of leatherback turtles around Guam (Eldredge 2003); however, the extent to which leatherback turtles are present around the Mariana Archipelago is unknown. There are no known reports of loggerhead or olive ridley turtles in waters around the Mariana Archipelago (WPFMC 2009c).

Seabirds

The following seabirds are considered residents of the Mariana Archipelago: wedge-tailed shearwater (*Puffinus pacificus*), white-tailed tropicbird (*Phaethon lepturus*), red-tailed tropicbird (*Phaethon rubricauda*), masked booby (S*ula dactylatra*), brown booby (*Sula leucogaster*), red-footed booby (*Sula sula*), white tern (*Gygis alba),* sooty tern (*Sterna fuscata*), brown noddy (*Anous stolidus*), black noddy (*Anous minutus*), and the great frigatebird (*Fregata minor*). There are no known interactions between seabirds and any of the Mariana Archipelago coral reef fisheries (WPFMC 2009c); therefore, NMFS concludes that the fisheries, as currently conducted under the proposed action, would not affect ESA listed seabirds.

The following seabirds have been sighted and are considered visitors (some more common than others) to the Mariana Archipelago; short-tailed shearwater (*Puffinus tenuirostris;* common visitor), Newell's shearwater (*Puffinus auricularis;* rare visitor), Audubon's shearwater (*Puffinus iherminieri*), Leach's storm-petrel (*Oceanodroma leucorhoa*), and the Matsudaira's storm-petral (*Oceanodroma matsudairae*). Of these, only the Newell's shearwater is listed as endangered. There have been no sightings of the endangered short-tailed albatross (*Phoebastria albatrus*) in the CNMI although the CNMI is within the range of the only breeding colony at Torishima, Japan (WPFMC 2009c).

Potential Impacts of the Proposed ACL Specifications and AM on Protected Resources in the CNMI

The proposed ACL specifications and AM would not affect protected resources throughout the Mariana Archipelago because the ACLs and AM would not result in substantial changes to the way the coral reef fisheries are conducted. There have been no known or observed interactions between these fisheries and protected species in the CNMI. Managing coral reef fisheries using ACLs and AMs would be an addition to the current fishery management regime that is intended to provide for long-term sustainable catches of fishery stocks. Because these fisheries are currently sustainably managed and subject to conservation measures in accordance with various resource conservation and management laws, the ACLs and AM would not result in a change to distribution, abundance, reproduction, or survival of ESA-listed species or increase interactions with protected resources.

If at any time the fishery, environment, or status of a listed species or marine mammal species were to change substantially, or if a fishery were found to be occurring in or near new critical habitat, NMFS would undertake additional consultation as required to comply with requirements of the ESA and the MMPA.

3.3.4 Hawaii Potentially Affected Resources and Potential Impacts

3.3.4.1 Potentially Affected Target, Non-target Stocks, and Bycatch in Hawaii Coral Reef Fisheries

As with other Pacific Islands, it is difficult to determine "target" and "non-target" stocks because resources harvested in Hawaii's coral reef fisheries are highly diverse, with approximately 300 species appearing in catch records (Appendix A). Based on recent average catch reported in Table 18, 90% of the CREMUS catch in Hawaii is comprised of 7 family groups which include Carangidae (jacks), Mullidae (goatfishes), Acanthuridae (surgeonfish), the Lutjanidae (specifically, taape), Holocentridae (soldierfish/squirrelfish) Mugilidae (mullets), and Scaridae (parrotfish). However, two species of coastal pelagic jacks (*Selar crumenophthalmus* or akule and *Decapterus macarellus* or opelu), account for over half of the total recent catch. Several other coral reef ecosystem taxa are also commonly harvested and retained and make up the remaining 10% of the catch. However, some species defined in federal regulations as Mariana CREMUS (50 CFR 665.221) are not harvested at all.

The commercial marine license and catch reporting program administered by HDAR provide for the collection of bycatch information; however, no such information is currently available. Nevertheless, some discards are likely because some reef fish in state waters are subject to minimum size requirements and weight restrictions for sale. These include species of mullet, milkfish, moi (or threadfin), oio (or bonefish), parrotfish, jacks, goatfish, surgeonfish akule (or bigeye scad), and opelu (or round mackerel). However, like other Pacific Islands, discards, if they occur, are also due to cultural reasons (i.e., taboo) or practical reasons such as toxicity (e.g., ciguatera and poison).

Section 4.5 of the Hawaii FEP (WPFMC 2009) includes a complete description of gears employed in Hawaii's coral reef fisheries and a summary of bycatch characteristics of these gears. In general, coral reef fishing generates very little bycatch because almost all reef fish are retained.

As previously noted, coral reef fishing is conducted predominantly in nearshore waters from 0-3 nm because the majority of coral reef ecosystem habitat is found shoreward of the U.S. EEZ, which is generally 3-200 nm from shore. Consequently, it might be argued that there is no bycatch problem for coral reef fisheries under federal control. Nevertheless, there are federal management regulations currently in place to minimize the potential for bycatch through the prohibition on the use of destructive and non-selective gear methods. Specifically, federal regulations allow only certain gear types to be used while fishing for CREMUS. These include: (1) hand harvest; (2) spear; (3) slurp gun; (4) hand net/dip net; (5) hoop net for crab; (6) throw net; (7) barrier net; (8) surround/purse net that is attended at all times; (9) hook and line; (10) crab and fish traps with vessel ID number affixed; and (11) remotely operated vehicles/submersibles.

While the Hawaii FEP describes procedures for establishing limits and reference point values based on standardized values of catch per unit effort (CPUE) and effort (E) which serve as proxies for relative biomass (B_{MSY}) and fishing mortality (F_{MSY}), respectively, neither the Council or NMFS have data that would allow the determination of reference point values for any Hawaii CREMUS. Therefore, stock status of Hawaii CREMUS is unknown. However, based on an analysis of archipelagic-wide estimates of catch-to-biomass presented in Luck and Dalzell (2010) and shown in Appendix B, estimated exploitation rates for Hawaii CREMUS did not exceed 4% for any taxonomic group, suggesting biomass is likely to be above B_{MSY}, although Luck and Dalzell (2010) report much higher exploitation rates when catch-to-biomass comparisons are limited to islands with high populated densities (i.e., main Hawaiian Islands).

Potential Impacts of the Proposed ACL specifications and AM on Target, Non-target Stocks, and Bycatch in Hawaii's Coral Reef Fisheries

The Council and its SSC have grouped individual stocks of Hawaii CREMUS into higher taxonomic groups (stock complexes) generally at the family level and propose to specify ACLs for each CREMUS stock and stock complex that are listed in Table 18. Alternatives to the proposed ACL are shown in Table 22. The ACL specification for each stock and stock complex is proposed to be set at a level substantially lower that the estimated biomass, where that information is available and specifically, no ACL would be higher than 1% of the stock or stock complex's estimated biomass. However, under Alternatives 2 and 3, there is the potential for the ACL to be exceeded for Acanthurids (surgeonfishes) and Scarids (parrotfishes) as recent catch is higher than the ACLs associated with these alternatives. If this occurs, the impacts to these CREMUS groups are not expected to result in a large adverse effect because the ACLs under both alternatives are set less than a fraction of 1% of the estimated biomasses listed in Table 18.

Under all alternatives considered, including the proposed action, no new monitoring would be implemented; however, as an AM a post-season review of the catch data would be conducted as soon as possible after the fishing year to determine whether an ACL for any stock or stock complex was exceeded. If an ACL were exceeded, NMFS, as recommended by the Council would take action to correct the operational issue that caused the ACL overage. This could include a downward adjustment to the ACL for that stock or stock complex in the subsequent fishing year.

The impacts of an ACL specification for Hawaii CREMUS are expected to be beneficial because it would establish a limit on the amount of fish that are harvested annually where none previously existed. While the lack of in-season catch monitoring ability precludes in-season measures (such as fishery closure) to prevent the ACL from being exceeded, the ACL is set substantially lower than estimated biomass and is intended to prevent overfishing from occurring. Additionally, the post-season review of catch relative to the proposed ACL for each stock and stock complex is part of a management regime designed to prevent coral reef fisheries from becoming overfished. The additional level of post season review of the catch would also provide an enhanced level of management review of the fisheries and would provide an opportunity for the Council to refine ACL and AM specifications, as needed.

The proposed Hawaii ACLs are generally higher than recent catch levels, and the fisheries are not expected to change, therefore, there is no change to harvest levels expected to occur as a result of implementing the ACL specifications. This, together with the fact that there are no in-season closures, and there would be enhanced review of fishing on CRE MUS, leads to the conclusion that the ACL specifications and AM measures would not have a large or adverse effect on target, non-target or bycatch species caught in Hawaii's coral reef fisheries.

3.3.4.2 Potentially Affected Protected Resources in Hawaii

The coral reef fisheries of the western Pacific region have been evaluated for impacts on protected resources and are 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 laws and policies. Additional detailed descriptions of potentially affected protected resources and their life histories can be found in section 3.3.4 of the FEP for the Hawaii Archipelago (WPFMC 2009d).

Applicable ESA Coordination for Hawaii Coral Reef Fisheries

In an informal consultation letter dated March 7, 2002, NMFS determined that the Coral Reef Ecosystem FMP management approach and fisheries that operate in accordance with regulations implementing the FMP was not likely to adversely affect ESA-listed species known to occur in waters around Hawaii or their designated critical habitat. In 2009, the Council developed and NMFS approved five new archipelagic-based fishery ecosystem plans (FEP), including the Hawaii Archipelago FEP. The FEP incorporated and reorganized elements of the Councils' species-based FMPs, including the Coral Reef Ecosystem FMP into a spatially-oriented management plan (75 FR 2198, January 14, 2010). All applicable regulations were retained through the development and implementation of the FEP for Hawaii and no substantial changes to the coral reef fisheries around Hawaii have occurred since the FEP was implemented that require further consultation at this time.

Marine Mammals

The MMPA prohibits, with certain exceptions, taking of marine mammals in the U.S., and by persons aboard U.S. flagged vessels (i.e., persons and vessels subject to U.S. jurisdiction). On November 29, 2011, NMFS published the final List of Fisheries (LOF) for 2012 which classifies commercial fisheries of the United States into one of three categories based upon the level of serious injury and mortality of marine mammals that occurs incidental to each fishery with Category 1 being the highest and Category 3 being the lowest (76 FR 73912). All Hawaii coral reef fisheries including the Hawaii inshore gillnet, opelu/akule net, inshore purse seine, throw net, cast net, hukilau net, crab net, crab trap, fish trap, inshore handline, handpick and spearfishing fisheries are classified as Category III fisheries under Section 118 of the MMPA and have a low likelihood or no known incidental takings of marine mammals.

Table 27 lists known non-ESA listed marine mammals that have been observed in the Hawaiian Archipelago and are protected by the MMPA. See section 4.3 for more information on the MMPA determination.

Cetaceans listed as endangered under the ESA and observed in the Hawaiian Archipelago are the humpback whale (*Megaptera novaeangliae*), sperm whale (*Physeter macrocephalus*), blue whale (*Balaenoptera musculus*), fin whale (*B. physalus*), and sei whale (*B. borealis*). The Hawaiian monk seal is the only endemic pinniped in Hawaii and is listed as endangered under the ESA.

On November 17, 2010, NMFS published a proposed rule to list the Hawaiian insular false killer whale as an endangered species under the ESA (75 FR 70169). NMFS is also proposing to designate areas in the main Hawaiian Islands as monk seal critical habitat. Specific areas proposed include terrestrial and marine habitats from 5 m inland from the shoreline extending seaward to the 500 m depth contour around Kaula Island, Niihau, Kauai, Oahu, Maui Nui (including Kahoolawe, Lanai, Maui and Molokai) and Hawaii Island (76 FR 32026, June 2, 1011). If either proposal is finalized, NMFS would re-initiate consultation under Section 7 of the ESA to determine the impact of fishing activities on critical habitat and begin planning and coordination with the Council and the public regarding any necessary management measures.

Table 27. Non-ESA listed marine mammals occurring around Hawaii

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

Sea Turtles

The breeding populations of Mexico's olive ridley sea turtles (*Lepidochelys olivacea*) are currently listed as endangered, while all other ridley populations are listed as threatened. Leatherback sea turtles (*Dermochelys coriacea*) and hawksbill turtles (*Eretmochelys imbricata*) are also classified as endangered. Additionally, the loggerhead sea turtle (*Caretta caretta*) population in the North Pacific Ocean was recently identified as a distinct population segment and listed as endangered. Green sea turtles (*Chelonia mydas*) are listed as threatened (the green sea turtle is listed as threatened throughout its Pacific range, except for the endangered population nesting on the Pacific coast of Mexico). These five species of sea turtles are highly migratory, or have a highly migratory phase in their life history. There is a resident population of green sea turtles in Hawaii and it is the most commonly sighted species of sea turtle in waters around Hawaii.

Seabirds

Seabirds listed as threatened or endangered under the ESA are managed by the USFWS. The short-tailed albatross, which is listed as endangered under the ESA, is a migratory seabird that is known to be occasionally present in the NWHI. No interactions between seabirds and the coral reef fishery have been observed or reported. Other listed seabirds found in the region are the endangered Hawaiian petrel (*Pterodroma phaeopygia)* and the threatened Newell's shearwater (*Puffinus auricularis newelli*). Non-listed seabirds known to be present are the blackfooted albatross (*Phoebastria nigripes*); Laysan albatross (*P. immutabilis*); wedge-tailed (*Puffinus pacificus*), sooty (*P. griseus*) and fleshfooted (*P. carneipes*) shearwaters, as well as the masked booby (*Sula dactylatra*), brown booby (*Sula leucogaster*), and red-footed booby *(Sula sula*). Most of these seabirds forage far from the islands and are unlikely to interact with the coral reef fishery. There are no known interactions between seabirds and any of the Hawaii coral reef fisheries (WPFMC 2009d); therefore, NMFS concludes that the fisheries, as currently conducted under the proposed action, would not affect ESA listed seabirds.

Potential Impacts of the Proposed ACL Specifications and AM on Protected Resources in Hawaii

The proposed ACL specification and AM would not affect protected resources throughout the Hawaii Archipelago because none of the alternatives is expected to result in substantial changes to the way the coral reef fisheries are conducted. Managing coral reef fisheries using ACLs and AMs would be an addition to the current fishery management regime that is intended to provide for long-term sustainable catches of fishery stocks. Because these fisheries are currently sustainably managed and subject to conservation measures in accordance with various resource conservation and management laws, none of the alternatives is expected to change the distribution, abundance, reproduction, or survival of listed species or increase interactions with protected resources.

If at any time the fishery, environment, or status of a listed species or marine mammal species were to change substantially, or if a fishery were found to be occurring in or near new critical habitat, NMFS would undertake additional consultation as required to comply with requirements of the ESA and the MMPA.

3.4 Potential Impacts to Essential Fish Habitat and Habitat Areas of Particular Concern

Essential fish habitat (EFH) is defined as those waters and substrate as necessary for fish spawning, breeding, feeding, and growth to maturity. This includes the marine areas and their chemical and biological properties that are utilized by the organism. Substrate includes sediment, hard bottom, and other structural relief underlying the water column along with their associated biological communities. In 1999, the Council developed and NMFS approved EFH definitions for management unit species (MUS) of the Bottomfish and Seamount Groundfish FMP (Amendment 6), Crustacean FMP (Amendment 10), Pelagic FMP (Amendment 8), and Precious Corals FMP (Amendment 4) (74 FR 19067, April 19, 1999). NMFS approved additional EFH definitions for coral reef ecosystem species in 2004 as part of the implementation of the Coral Reef Ecosystem FMP (69 FR8336, February 24, 2004). EFH definitions were also approved for deepwater shrimp through an amendment to the Crustaceans FMP in 2008 (73 FR 70603, November 21, 2008).

Ten years later, in 2009, the Council developed and NMFS approved five new archipelagic-based fishery ecosystem plans (FEP). The FEPs incorporated and reorganized elements of the Councils' species-based FMPs into a spatially-oriented management plan (75 FR 2198, January 14, 2010). EFH definitions and related provisions for all FMP fishery resources were subsequently carried forward into the respective FEPs. In addition to and as a subset of EFH, the Council described 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, and/or the habitat type is rare. In considering the potential impacts of a proposed fishery management action on EFH, all designated EFH and HAPC must be considered.

The designated areas of EFH and HAPC for all FEP MUS by life stage are summarized in Table 28. The Council is currently reviewing habitat information relevant to Hawaii bottomfish and seamount groundfish and may refine these EFH/HAPC designations if warranted (76 FR 13604, March 14, 2011).

Table 28. EFH and HAPC for Western Pacific FEP MUS

MUS	Species Complex	EFH	HAPC
Bottomfish MUS	**American Samoa, Guam and CNMI bottomfish species:** lehi (*Aphareus rutilans*) uku (*Aprion virescens*), giant trevally (*Caranx ignoblis*), black trevally (*Caranx lugubris*), blacktip grouper *(Epinephalus fasciatus)*, Lunartail grouper *(Variola louti)*, ehu (*Etelis carbunculus*), onaga (*Etelis coruscans*), ambon emperor *(Lethrinus amboinensis)*, redgill emperor *(Lethrinus rubrioperculatus)*, taape (*Lutjanus kasmira*), yellowtail kalekale (*Pristipomoides auricilla*), opakapaka (*P. filamentosus*), yelloweye snapper (*P. flavipinnis*), kalekale (*P. sieboldii*), gindai (*P. zonatus*), and amberjack (*Seriola dumerili*).	**Eggs and larvae:** the water column extending from the shoreline to the outer limit of the EEZ down to a depth of 400 m (200 fm). **Juvenile/adults:** the water column and all bottom habitat extending from the shoreline to a depth of 400 m (200 fm)	All slopes and escarpments between 40–280 m (20 and 140 fm)

MUS	Species Complex	EFH	HAPC
	Hawaii bottomfish species: uku (*Aprion virescens*), thicklip trevally (*Pseudocaranx dentex*), giant trevally (*Caranx ignoblis*), black trevally (*Caranx lugubris*), amberjack (*Seriola dumerili*), taape (*Lutjanus kasmira*), ehu (*Etelis carbunculus*), onaga (*Etelis coruscans*), opakapaka (*Pristipomoides filamentosus*), yellowtail kalekale (*P. auricilla*), kalekale (*P. sieboldii*), gindai (*P. zonatus*), hapuupuu (*Epinephelus quernus*), lehi (*Aphareus rutilans*)	**Eggs and larvae:** the water column extending from the shoreline to the outer limit of the EEZ down to a depth of 400 m (200 fathoms) **Juvenile/adults:** the water column and all bottom habitat extending from the shoreline to a depth of 400 meters (200 fm)	All slopes and escarpments between 40–280 m (20 and 140 fm) Three known areas of juvenile opakapaka habitat: two off Oahu and one off Molokai
Seamount Groundfish MUS	**Hawaii Seamount groundfish species (50–200 fm):** armorhead (*Pseudopentaceros wheeleri*), raftfish/butterfish (*Hyperoglyphe japonica*), alfonsin (*Beryx splendens*)	**Eggs and larvae:** the (epipelagic zone) water column down to a depth of 200 m (100 fm) of all EEZ waters bounded by latitude 29°–35° **Juvenile/adults:** all EEZ waters and bottom habitat bounded by latitude 29°–35° N and longitude 171° E–179° W between 200 and 600 m (100 and 300 fm)	No HAPC designated for seamount groundfish
Crustaceans MUS	**Spiny and slipper lobster complex (all FEP areas):** spiny lobster (*Panulirus marginatus*), spiny lobster (*P. penicillatus, P.* spp.), ridgeback slipper lobster (*Scyllarides haanii*), Chinese slipper lobster (*Parribacus antarcticus*) **Kona crab :** Kona crab (*Ranina ranina*)	**Eggs and larvae:** the water column from the shoreline to the outer limit of the EEZ down to a depth of 150 m (75 fm) **Juvenile/adults:** all of the bottom habitat from the shoreline to a depth of 100 m (50 fm)	All banks in the NWHI with summits less than or equal to 30 m (15 fathoms) from the surface
	Deepwater shrimp (all FEP areas): (*Heterocarpus* spp.)	**Eggs and larvae:** the water column and associated outer reef slopes between 550 and 700 m **Juvenile/adults:** the outer reef slopes at depths between 300-700 m	No HAPC designated for deepwater shrimp.

MUS	Species Complex	EFH	HAPC
Precious Corals MUS	**Shallow-water precious corals (10-50 fm) all FEP areas:** black coral (*Antipathes dichotoma*), black coral (*Antipathis grandis*), black coral (*Antipathes ulex*) **Deep-water precious corals (150–750 fm) all FEP areas:** Pink coral (*Corallium secundum*), red coral (*C. regale*), pink coral (*C. laauense*), midway deepsea coral (*C.* sp nov.), gold coral (*Gerardia* spp.), gold coral (*Callogorgia gilberti*), gold coral (*Narella* spp.), gold coral (*Calyptrophora* spp.), bamboo coral (*Lepidisis olapa*), bamboo coral (*Acanella* spp.)	EFH for Precious Corals is confined to six known precious coral beds located off Keahole Point, Makapuu, Kaena Point, Wespac bed, Brooks Bank, and 180 Fathom Bank EFH has also been designated for three beds known for black corals in the Main Hawaiian Islands between Milolii and South Point on the Big Island, the Auau Channel, and the southern border of Kauai	Includes the Makapuu bed, Wespac bed, Brooks Banks bed For Black Corals, the Auau Channel has been identified as a HAPC
Coral Reef Ecosystem MUS	**Coral Reef Ecosystem MUS (all FEP areas)**	EFH for the Coral Reef Ecosystem MUS includes the water column and all benthic substrate to a depth of 50 fm from the shoreline to the outer limit of the EEZ	Includes all no-take MPAs identified in the CREFMP, all Pacific remote islands, as well as numerous existing MPAs, research sites, and coral reef habitats throughout the western Pacific

The proposed ACL specification and AM would not have a direct effect on EFH or HAPC in any of the subject island areas because coral reef fisheries are not known to have large adverse effects on EFH or HAPC for any MUS and none of the alternatives considered ares expected to result in substantial changes to the way the coral reef fisheries in American Samoa, Guam, CNMI and Hawaii are conducted.

3.5 Potential Impacts on Fishery Administration and Enforcement

3.5.1 Federal Agencies and the Council

Fisheries in federal waters are currently managed by the Council in accordance with the approved fishery ecosystem plans (FEP), and NMFS PIRO is responsible for implementing and enforcing fishery regulations that implement the FEPs. NMFS PIFSC conducts research and reviews fishery data provided through logbooks and fishery monitoring systems administered by state and territorial resource management agencies. The Council, PIRO and PIFSC collaborate with local agencies in the administration of fisheries of the western Pacific through other activities including coordinating meetings, conducting research, developing information, processing fishery management actions, training fishery participants, and conducting educational and outreach activities for the benefit of fishery communities.

NOAA's Office of Law Enforcement (OLE) is responsible for enforcement of the nation's marine resource laws, including those regulating fisheries and protected resources. OLE, Pacific Islands Division oversees enforcement of federal regulations in American Samoa, Guam, the CNMI and Hawaii and enters into Joint Enforcement Agreements (JEA) with each participating state and territory.

The U.S. Coast Guard's (USCG) Fourteenth District (Honolulu) jurisdiction is the U.S. EEZ as well as the high seas in the Western and Central Pacific. At over 10 million square miles, its area of responsibility is the largest of any USCG District. The USCG patrols the region with airplanes, helicopters, and surface vessels, as well as monitors vessels through VMS. The USCG also maintains patrol assets on Guam.

Potential impacts to federal agencies

The proposed ACL and AM specifications would not require a change to monitoring or collecting fishery data. However, monitoring of catch data towards an ACL would be conducted by PIFSC in collaboration with local resource management agencies, and is expected to result in improved timeliness in processing species specific catch reporting on an annual basis. No changes to the role of law enforcement agents or the U.S. Coast Guard would be required in association with implementing these specifications. The ACL and AM specifications would not result in any change to the fishery that would pose an additional risk to human safety at sea.

3.5.2 Local Agencies

Currently, local marine resource management agencies in each of the four areas are responsible for the conservation and management of coral reef habitats and fishery resources. These agencies monitor catches through licenses and fishery data collection programs, conduct surveys of fishermen and scientific surveys of fish stocks, establish and manage marine protected areas, provide outreach and educational services, serve on technical committees, and enforce local and federal resource laws through JEAs, among other responsibilities.

Potential impacts to local agencies

The specification of ACLs and AMs for coral reef ecosystem fisheries of American Samoa, Guam, the CNMI, and Hawaii is not expected to result in changes to fishery monitoring by the local resource management agencies. However, monitoring of catch data for ACL purposes would continue to be conducted by PIFSC in collaboration with local resource management agencies and is expected to result in improved timeliness in processing species specific catch reporting on an annual basis.

No change to enforcement activities would be required in association with implementing these specifications because there is no fishery closure recommended for any of the areas. Additionally, the ACL and AM specifications would not result in any change to the fishery that would pose an additional risk to human safety associated with coral reef fishing in local waters.

Substantial additional administrative resources would be required in the future to support the establishment of in-season monitoring capabilities in American Samoa, Guam and the Northern Mariana Islands. Until additional resources are made available, only AMs that review whether an ACL is exceeded, and other post-season review, are possible at this time.

3.6 Environmental Justice

NMFS considered the effect of the proposed ACL specifications and AMs on Environmental Justice communities that include members of minority and low-income groups. The ACLs would apply to everyone that catches coral reef fishes, and no new monitoring is required for the ACL specification or the AM to be implemented. The environmental review in this EA establishes that the proposed specifications of ACLs and provisions for post-season harvest reviews as the AMs in the western Pacific Coral Reef Ecosystem fisheries are not expected to result in a change to the way the fisheries are conducted. The ACLs and AMs are intended to provide for sustainability of CREMUS which is, in turn, expected to benefit these resources and the human communities that rely on their harvest. The proposed specifications are not likely to result in a large adverse impact to the environment that could have disproportionately large or adverse effects on members of Environmental Justice communities in American Samoa, Guam, the CNMI, or Hawaii.

3.7 Climate Change

Changes in the environment from global climate change have the potential to affect coral reef ecosystem MUS fisheries. Effects of climate change may include: sea level rise; increased intensity or frequency of coastal storms and storm surges; changes in rainfall (more or less) that can affect salinity nearshore or increase storm runoff and pollutant discharges into the marine environment; increased temperatures resulting in coral bleaching, and hypothermic responses in some marine species (IPCC 2007). Increased carbon dioxide uptake can increase ocean acidity, which can disrupt calcium uptake processes in corals, crustaceans, mollusk, reef-building algae, and plankton, among other organisms (Houghton et al. 2001;The Royal Society 2005; Caldeira and Wickett 2005; Doney 2006; Kleypas et al. 2006). Climate change can also lead to changes in ocean circulation patterns which can affect the availability of prey, migration, survival, and dispersal (Buddenmeier et al. 2004). Damage to coastal areas due to storm surge or sea level rises as well as changes to catch rates, migratory patterns, or visible changes to habitats are among the most likely changes that would be noted first. Climate change has the potential to adversely affect some organisms, while others could benefit from changes in the environment.

The impacts from climate change may be difficult to discern from other impacts; however monitoring of physical conditions and biological resources by a number of agencies would continue to occur and would allow fishery managers to continually make adjustments in fishery management regimes in response to changes in the environment.

The efficacy of the proposed ACL and AM specifications in providing for sustainable levels of fishing for CREMUS is not expected to be adversely affected by climate change. Recent catch and biological status of the species informed the development of the ACLs and AMs. Monitoring would continue, and if harvests were reduced, ACLs could be adjusted in the future.

The proposed specifications are not expected to result in a change to the manner in which the fishery is conducted, so no change in greenhouse gas emissions is expected.

3.8 Additional Considerations

3.8.1 Overall Impacts

When compared against recent fishing harvests, ACLs would be higher but are considered an acceptable level of catch that will prevent overfishing and provide for long-term sustainability of the target stocks. The specifications were developed using the best available scientific information, in a manner that accords with the fishery regulations, and after considering catches, participation trends, and estimates of the status of the fishery resources. The AMs are also not likely to cause large adverse impacts to resources that would benefit from post-season data review. For these reasons, the proposed ACLs and AMs are not expected to result in large, irreversible, or irretrievable impacts to the environment.

3.8.2 Cumulative Effects of the Proposed Action

Recent CREMUS-related fishery management actions

In July 2011, NMFS issued a special coral reef ecosystem fishing permit (SCREFP) to a private company which authorized the culture and harvest of *Seriola rivoliana*, (a CREMUS belonging to the family Carangidae or jack) in a mesh cage towed by a vessel in the U.S. EEZ around Hawaii. A SCREFP was required because the company sought to harvest a species that required a federal fishing permit and proposed to use a new gear method in fishing operations. The SCREFP is not related to the proposed specifications or AMs that are described in this document, nor would the recently issued permit influence any decisions that are to be made by NMFS regarding the proposed ACL specifications or AMs for CREMUS. The catches of *Seriola rivoliana* that would occur under the SCREFP are not part of the ACL for the CREMUS group Carangidae that are proposed in the current action because the fish that would be harvested under the SCREFP are not wild-caught and were obtained from fish culture facilities. The proposed ACL specification and AM would not change the conduct of coral reef fisheries in Hawaii, so there would not be a direct or indirect interaction with the towed fish project, nor would the two activities interact to result in an increased environmental effect. For these reasons, this project will not be considered further in this EA.

Recent ACL and AM specifications for other western Pacific fisheries

For all four island areas, the Council is developing ACL and AM recommendations for bottomfish MUS, precious corals MUS, and crustaceans MUS. NMFS recently specified ACLs for the Hawaii bottomfish fishery, which can be obtained at the Council or NMFS' websites. None of the ACLs or AMs would conflict with or reduce the efficacy of existing coral reef ecosystem resource management by local resource management agencies, NMFS, or the Council. The proposed ACL specifications for CREMUS would also not conflict with future ACL and AM specifications in any of the three archipelagic areas because the ACLs apply to specific fishery resources and the ACLs and AMs are not anticipated to result in a large change to coral reef fisheries in any of the areas.

Foreseeable fishery management actions

Fisheries for CREMUS occur almost exclusively within state and territorial waters. Therefore, in the foreseeable future, the Council may re-evaluate the need for conservation and management of CREMUS in federal waters and may recommend NMFS remove certain species from the FEPs and/or re-classify species as "ecosystem component" (EC) species. To be considered for possible classification as an EC species, the species should be: 1) a non-target species; 2) a stock that is not determined to be subject to overfishing, approaching overfished, or overfished; 3) not likely to become subject to overfishing or overfished; and 4) generally not retained for sale or personal use. Various methods for categorizing species and EC components have been preliminarily discussed at Council meetings. These include, but are not limited to, species that are caught exclusively or predominately in state/territorial waters, species that occur infrequently in the available time series, species that are non-native to an FEP area, and species associated with ciguatoxin poisoning and are generally discarded.

In accordance with National Standard 1 guidelines found in 50 CFR §600.310(d), EC species are not considered to be "in the fishery" and thus, do not require specification of an ACL. EC species may, but are not required to, remain in the FEP for data collection purposes, for ecosystem considerations related to the specification of optimum yield for associated CREMUS, as considerations in the development of conservation and management measures for associated CREMUS fisheries, and/or to address other ecosystem issues. However, until such time a particular CREMUS is classified as an EC species, it will remain in the fishery and be subject to the ACL requirements.

Other Foreseeable NOAA Actions

<u>Monk Seals</u>

NMFS currently has two proposals concerning the Hawaiian monk seal population that occur in federal waters of the exclusive economic zone (EEZ; generally 3-200 nmi) around the Hawaiian Islands. The first is a proposal to revise designated critical habitat for endangered Hawaiian monk seals to include areas in the MHI (76 FR 32026, June 2011). The second considers monk seal management, research and enhancement activities including the translocation of up to 60 monk seal pups from the NWHI to the MHI (76 FR 51945, August 19, 2011).

A specification of an annual catch limit is not expected to affect a decision of whether or where to establish critical habitat for monk seals in the main Hawaiian Islands because an ACL without an in-season measure would mostly likely result only in monitoring of harvest limits in relation to the ACL, and potential future revisions to the ACL. At this point in time there is insufficient information in the critical habitat proposal to allow NMFS to evaluate the potential impact of a designation of critical habitat on the MHI coral reef ecosystem fisheries as a whole. However, a designation of critical habitat for monk seals in the MHI is not expected to affect the efficacy of using ACLs and AMs to promote long-term sustainability of coral reef ecosystem fisheries. The proposed ACL specifications and AMs would also not affect the quality of habitat being considered for designation as monk seal critical habitat because no change to the conduct of the fishery is likely to occur with the specification of ACLs and AMs.

While recent quantitative fatty acid signature analysis results indicate that monk seals consume a wide range of species including coral reef ecosystem species (Carretta et al., 2010); under current levels of fishing pressure in the MHI, the monk seal population is growing, pupping is increasing, and the pups appear to be foraging successfully. Considering that monk seal foraging success appears to be higher in the MHI than in the NWHI despite higher fishing pressure in the MHI, competition for forage with the MHI coral reef ecosystem fishery does not appear to be adversely impacting monk seals in the MHI.

The conduct of fishing is not expected to change, and so there is no likely immediate environmental outcome. If critical habitat were to be established in the MHI, NMFS would initiate consultation in accordance with Section 7 of the ESA to ensure that all Hawaii fisheries are not likely to result in the destruction or adverse modification of critical habitat.

The proposed translocation of Hawaiian monk seals from the NWHI to the MHI is also not expected to affect the manner in which coral reef fishes are harvested. There could be an increase in the potential for interactions with monk seals because there may be more monk seals in waters of the MHI where coral reef fisheries operate. The proposed translocation of monk seals would, therefore, represent a change in the conditions in which the fishery is taking place, so if the translocation of seals was approved, NMFS would re-evaluate the effects of the MHI coral reef ecosystem fishery on the Hawaiian monk seal population. The proposed ACL specifications would not have a large and adverse effect on monk seals because the catch limit is intended to ensure that harvests are sustainable over the long term. If conditions change in the environment that would affect target stocks, then NMFS and the Council would need to consider those conditions in developing future ACL specifications.

Hawaiian Insular False Killer Whale

NMFS is also studying the potential of listing the Hawaiian insular false killer whale as an endangered species based on its possible status as an endangered distinct population segment (75 FR 70169, November 17, 2010). Coral reef ecosystem fisheries in Hawaii are not known to interact with insular false killer whales; however, NMFS has identified several species of Hawaii CREMUS that could be prey of the species (Oleson et al., 2010). The proposal to specify ACLs would not result in a change to the way coral reef fisheries are conducted and, therefore, is not expected to affect the agency's decision of whether or not to list the insular false killer whale as endangered. ACL specifications would not change the likelihood of interactions, or affect the survival, distribution or behavior of the species in any way. Due to the potential overlap between the whales and the coral reef fishery, however, if this species is listed, NMFS would initiate consultation in accordance with Section 7 of the ESA to ensure that all Hawaii fisheries are not likely to jeopardize the continued existence of the species or result in the destruction or adverse modification of critical habitat.

Bumphead Parrotfish and Corals

NMFS has initiated a status review of the bumphead parrotfish or *Bolbometopon muricatum* (75 FR 16713, April 4, 2010) and 82 species of coral (75 FR 6616, February 10, 2010) to determine if listing of these species under the Endangered Species Act (ESA) is warranted. The proposal to specify ACLs is not expected to affect the agency's decision to list, change the likelihood of interactions, or affect the survival, distribution or behavior of the species in any way. However, because bumphead parrotfish is a CREMUS and fishing for CREMUS occurs in the coral reef ecosystem near corals, if these species are listed, NMFS would initiate consultation in accordance with Section 7 of the ESA to ensure that coral reef fisheries of the western Pacific region are not likely to jeopardize the continued existence of the bumphead parrotfish or any species of coral or result in the destruction or adverse modification of critical habitat.

National Marine Sanctuaries

NOAA's Office of National Marine Sanctuaries (ONMS) has initiated a review of the Hawaiian Humpback Whale National Marine Sanctuary in the main Hawaiian Islands which may include revisions to its management plan and regulations to fulfill the purposes and policies of the National Marine Sanctuaries Act (75 FR 40579, July 14, 2010). As there is no in-season management measures proposed, the way coral reef fisheries are conducted is not expected to change and, therefore, the proposed ACL specification and AMs would not have an environmental effect that could affect future decisions about possible changes to the sanctuary management plan nor would the proposed action affect sanctuary resources.

Additionally, NOAA's ONMS is proposing to add five additional discrete geographical areas to the Fagatele Bay National Marine Sanctuary and change the name of the sanctuary to the American Samoa National Marine Sanctuary (FR 76 65566, October 21, 2011). The proposed ACL specification and AM would not affect the decision about changes to the sanctuary nor would the proposed action affect sanctuary resources.

Foreseeable actions by others

Many other non-fishing related activities occur in the same areas where coral reef resources may be found or where the fisheries may take place. One activity that has the potential to affect the Guam coral reef fishery is the Guam military buildup. This activity, involves three major components which include: (1) development of facilities and infrastructure to support approximately 8,000 Marines and their 9,000 dependents being relocated from Okinawa, Japan to the island of Guam and additional operations and training activities; (2) construction of a new deep-draft wharf generally within Apra Harbor, Guam to support transient nuclear aircraft carriers; and (3) development of facilities and infrastructure to support and establishment of air missile defense system on Guam. Other activities would include improvements to off-base roads and bridges to support increased traffic as well as utilities (water and power) to support increased demands by the military (Joint Guam Program Office, 2010).

Dredging activities have the potential to result in direct localized impact to coral reef resources within Apra Harbor through loss of habitat, and indirect impacts through increased turbidity and sedimentation during and immediately after dredging occurs. Other support activities, including highway and utilities improvements may also the potential to impact marine resources through run-off and sedimentation if conducted on and around nearshore areas. Measures to minimize and mitigate impacts of these activities on the human environment are being addressed through ongoing consultations between the military, the Governments of Guam and the CNMI and other federal agencies.

Increased numbers of military and support personnel also have the potential to result in an increase in use of nearshore waters, including more vessel activity, as well as add to the number of people participating in coral reef fisheries. All harvests of CREMUS around each island area would be counted toward the attainment of the annual catch limits. The potential increase in fishery participants around Guam is not expected to directly interact with the proposed ACL specifications in a way that would affect either the fishery or environment because the ACLs are based on a function of catch rates to biomass of coral reef ecosystem stocks. Ongoing monitoring of catch would likely show increases in catch if additional people were participating in the fishery. The resource management objective (preventing overfishing using ACLs and AMs) would not be affected by a change in the number of fishery participants, however, because the limits are based on the historic catches considered against biomass estimates. If, in the future, additional catches were detected in fishery surveys, the cause of the increase in catches could be considered in light of increased participation and fishery managers would be able to consider those factors in future ACL specifications. Furthermore, the buildup is likely to be gradual, and since the ACL specification and AM recommendations are reviewed annually, the Council and NMFS could modify the fishery management program in response to changes in the fishery.

4. Consistency with Other Applicable Laws

4.1 National Environmental Policy Act

NOAA Administrative Order (NAO) 216-6, Environmental Review Procedures, in accordance with 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. This EA has been written and organized to satisfy the requirements of NEPA. The NMFS Regional Administrator will use the analysis in this EA to determine whether the proposed action would have a significant environmental impact, which would require the preparation of an EIS.

4.1.1 Preparers and Reviewers

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4.1.2 Coordination with others

The proposed action described in this EA was developed in coordination with various federal and local government agencies that are represented on the Western Pacific Fishery Management Council. Specifically, agencies that participated in the deliberations and development of the proposed management measures include:

- American Samoa Department of Marine and Wildlife Resources
- Guam Department of Agriculture, Division of Aquatic and Wildlife Resources
- Hawaii Department of Land and Natural Resources, Division of Aquatic Resources
- Northern Marina Island Department of Land and Natural Resources, Division of Fish and Wildlife
- U.S. Coast Guard
- U.S. Fish and Wildlife Service
- U.S. Department of State

4.1.3 Public Coordination

The development of the proposed ACL and AM specifications for American Samoa, Guam, the CNMI, and Hawaii has taken place in public meetings of the SSC and the Council. In addition, the Council advertised the need to focus on federal annual catch limits in media releases, newsletter articles, and on the Council's website, http://www.wpcouncil.org.

NMFS is soliciting public comment on the proposed ACL and AM specifications described in this EA. This EA, the proposed specifications, and instructions on how to comment on the proposed specifications can be found by searching RIN 0648-XA674 at www.regulations.gov, or by contacting the responsible official or Council listed in this document.

4.2 Endangered Species Act

The Endangered Species Act (ESA) provides for the protection and conservation of threatened and endangered species. Section 7(a)(2) of the ESA requires federal agencies to ensure that any action authorized, funded, or carried out by such agencies is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of the critical habitat of such species. NMFS completed Section 7 consultations for coral reef fisheries in American Samoa and Hawaii on March 2, 2002 and Mariana coral reef fisheries (Guam and CNMI) on June 3, 2008 and determined that coral reef fisheries that operate in accordance with federal fishery regulations are not likely to adversely affect listed species or critical habitat. Because the proposed action is not expected to modify vessel operations or other aspects of any fishery, NMFS concludes that coral reef ecosystem fisheries in American Samoa, Guam, CNMI, and Hawaii as currently conducted under the proposed action, would not have an effect on ESA listed species or any designated critical habitats that was not considered in prior consultations, and that no further consultation is required at this time.

On September 22, 2011, NMFS and the U.S. Fish and Wildlife Service (USFWS) determined that the loggerhead sea turtle (*Caretta caretta*) population is composed of nine distinct population segments (DPS) that constitute ‘‘species’’ that may be listed as threatened or endangered under the ESA (76 FR 58868). Specifically, NMFS and USFWS determined that the loggerhead sea turtles in the North Pacific Ocean which encompasses waters around Hawaii, CNMI and Guam are a DPS that is endangered and at risk of extinction. Similarly, NMFS and USFWS determined that the loggerhead sea turtles in the South Pacific Ocean which encompasses waters around American Samoa are a DPS that is endangered and at risk of extinction. However, there have been no reported or observed incidental take of a loggerhead sea turtle in the history of any coral reef ecosystem fishery in any island area. Additionally, there have been no confirmed sightings of these species around American Samoa, Guam or the CNMI, while in Hawaii their occurrence within shallow waters where coral reef habitats are found is extremely rare. Therefore, the likelihood that the these fisheries would interact with either the North Pacific or South Pacific loggerhead DPS is extremely rare, and there is no additional information available that would change the conclusions of previous Section 7 consultations for coral reef fisheries in American Samoa, Hawai, Guam or the CNMI. Because none of the alternatives considered would modify operations of any fishery in any way, NMFS concludes that the proposed action would not modify fishery operations in a manner that causes an effect on any ESA-listed species or critical habitat including seabirds, sea turtles, and marine mammals that was not considered in prior consultations, and that no further consultation is required at this time.

On November 17, 2010, NMFS published a proposed rule to list the Hawaiian insular false killer whale as an endangered species under the ESA (75 FR 70169). NMFS is also proposing to designate areas in the MHI as monk seal critical habitat. Specific areas proposed include terrestrial and marine habitats from 5 m inland from the shoreline extending seaward to the 500 m depth contour around Kaula Island, Niihau, Kauai, Oahu, Maui Nui (including Kahoolawe, Lanai, Maui and Molokai) and Hawaii Island (76 FR 32026, June 2, 1011). Additionally, the agency is also evaluating whether to list the bumphead parrotfish and a number of coral species under the ESA although nothing specific has been proposed as of this date. If new species are listed, or if critical habitat is designated in areas that may be affected by federal fisheries, NMFS will re-initiate consultation under Section 7 of the ESA to determine the impact of fishing activities on listed species and their critical habitat as required by law.

4.3 Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA) prohibits, with certain exceptions, the take of marine mammals in the U.S. and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the United States. The MMPA gives the Secretary of Commerce authority and duties for all cetaceans (whales, dolphins, and porpoises) and pinnipeds (seals and sea lions, except walruses). Under section 118 of the MMPA, NMFS must publish, at least annually, a List of Fisheries that classifies U.S. commercial fisheries into one of three categories. Specifically, the MMPA mandates that each fishery be classified according to whether it has a frequent, occasional, or remote likelihood of, or no known, incidental mortality or serious injury to marine mammals.

The coral reef fisheries in each island area are listed as Category III fisheries under Section 118 of the MMPA (76 FR 73912, November 29, 2011). A Category III fishery is one with a low likelihood or no known incidental takings of marine mammals. Because the proposed action would not modify vessel operations or other aspects of any fishery, NMFS concludes that these fisheries, as currently conducted under the proposed action, would not negatively affect marine mammals in any manner not previously considered or authorized the commercial fishing take exemption under section 118 of the MMPA.

4.4 Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) requires a determination that a recommended management measure has no effect on the land, water uses, or natural resources of the coastal zone or is consistent to the maximum extent practicable with an affected state’s enforceable coastal zone management program. On November 16, 2011, NMFS sent a letter to the appropriate state government agencies in American Samoa, Guam, Hawaii and the CNMI informing them of its determination that the proposed action is consistent, to the maximum extent practicable, with their respective coastal zone management programs.

4.5 Paperwork Reduction Act

The purpose of the Paperwork Reduction Act is to minimize the paperwork burden on the public resulting from the collection of information by or for the Federal government. It is intended to ensure the information collected under the proposed action is needed and is collected in an efficient manner (44 U.S.C. 3501(1)). The proposed action would not establish any new permitting or reporting requirements and therefore it is not subject to the provisions of the Paperwork Reduction Act.

4.6 Regulatory Flexibility Act

The Regulatory Flexibility Act (RFA) (5 U.S.C. 601 *et seq.*) requires government agencies to assess and present the impact of their regulatory actions on small entities including small businesses, small organizations, and small governmental jurisdictions. The assessment is done by preparing an Initial Regulatory Flexibility Analysis when impacts are expected. The purpose and need for action is described in Section 1.2. Section 2.0 describes the management alternatives considered to meet the purpose and need for action. Section 3.0 provides a description of the fisheries that may be affected by this action and analyzes environmental impacts of the alternatives considered.

The proposed action would specify an annual catch limit (ACL) for each coral reef ecosystem stock and stock complex in American Samoa, Guam, the Northern Mariana Islands, and Hawaii for fishing years 2012 and 2013. If the ACL for any stock or stock complex is exceeded, NMFS would take action to correct the operational issue that caused the ACL overage, as recommended by the Council which could include a downward adjustment to the ACL for that stock or stock complex in the subsequent fishing year.

American Samoa

In 2010, approximately 22 vessels engaged in commercial fishing for CREMUS. The 2010 average gross revenue per vessel was $3,222 based on an average price of $2.68 per pound, and harvest of 26,453 lb. In general, the relative importance of CREMUS to commercial participants as a percentage of overall fishing or household income is unknown, as the total suite of fishing and other income-generating activities by individual operations across the year has not been examined.

Guam

In 2009, approximately 116 vessels engaged in fishing for CREMUS. The 2009 average gross revenue per vessel was $3,023 based on an average price of $2.82 per pound, and harvest of 124,401 lb. In general, the relative importance of CREMUS to commercial participants as a percentage of overall fishing or household income is unknown, as the total suite of fishing and other income-generating activities by individual operations across the year has not been examined.

CNMI

In 2009, approximately 16 vessels engaged in fishing for CREMUS. The 2009 average gross revenue per vessel was $11,689 based on an average price of $2.59 per pound, and harvest of 72,211 lb. In general, the relative importance of CREMUS to commercial participants as a percentage of overall fishing or household income is unknown, as the total suite of fishing and other income-generating activities by individual operations across the year has not been examined.

Hawaii
In 2010, estimated commercial landing of CREMUS was just over 1.3 million lb with akule and opelu accounting for nearly one-third of the commercial catch (254,996 lb and 204,643 lb, respectively). Therefore, for the purpose of this analysis, Hawaii akule and opelu fisheries have been analyzed separately from other Hawaii CREMUS as they are discrete fisheries and together, account for nearly half of the total CREMUS landings annually.

Although exact figures are not available, NMFS estimates that up to 35 vessels may engage in fishing for akule and opelu throughout the state. Based on 2010 data from NMFS WPacFIN (http://www.pifsc.noaa.gov/wpacfin/reportlanding.php accessed on September 15, 2011), 254,996 lb of akule were sold at $2.83 per lb while 204,643 lb of opelu were sold at $2.58 per lb. resulting in a combined ex-vessel value of $1,249,635. Assuming all 35 vessels fished for akule and opelu equally, 2010 average gross revenue per vessel is estimated at $35,703. Excluding akule and opelu, total estimated commercial landings of all other Hawaii CREMUS was approximately 840,360 lb. Assuming all 4,263 Hawaii commercial marine license holders fished for CREMUS equally, the 2010 average gross per vessel revenue is estimated to be $197 based on an average price of $3.01 per pound. In general, the relative importance of CREMUS to commercial participants as a percentage of overall fishing or household income is unknown, as the total suite of fishing and other income-generating activities by individual operations across the year has not been examined.

Based on available information, NMFS has determined that all vessels participating in CREMUS fisheries in American Samoa, Guam, CNMI and Hawaii are small entities under the Small Business Administration definition of small entity, i.e., they are engaged in the business of fish harvesting, are independently owned or operated, are not dominant in their field of operation and have annual gross receipts not in excess of $4 million. Therefore, there are no disproportionate economic impacts between large and small entities. Furthermore, there are no disproportionate economic impacts among the universe of vessels based on gear, home port, or vessel length. For these reasons, an initial regulatory flexibility analysis is not required and none has been prepared.

4.7 Administrative Procedures Act

All federal rulemaking is governed under the provisions of the Administrative Procedures Act (APA) (5 U.S.C. Subchapter II) which establishes a “notice and comment” procedure to enable public participation in the rulemaking process. Under the APA, NMFS is required to publish notification of proposed rules in the Federal Register and to solicit, consider and respond to public comment on those rules before they are finalized. The APA also establishes a 30-day waiting period from the time a final rule is published until it becomes effective, with rare exceptions.

The specification of ACLs for CREMUS in American Samoa, Guam, the CNMI and Hawaii complies with the provisions of the APA through the Council’s extensive use of public meetings, requests for comments, and consideration of comments in developing ACL recommendations. Additionally, NMFS will publish a proposed rule announcing the proposed ACL specifications described in this document which will include requests for public comments. After considering public comments, NMFS will publish a final rule which will become effective 30 days after publication.

4.8 Executive Order 12898: Environmental Justice

On February 11, 1994, President William Clinton issued Executive Order 12898 (E.O. 12898), "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations." E.O. 12898 provides that "each Federal agency shall make achieving environmental justice part of its mission 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." E.O. 12898 also provides for agencies to collect, maintain, and analyze information on patterns of subsistence consumption of fish, vegetation, or wildlife. An agency's actions may also affect subsistence patterns of consumption and indicate the potential for disproportionately high and adverse human health or environmental effects on low-income populations, and minority populations. A memorandum by President Clinton, which accompanied E.O. 12898, made it clear that environmental justice should be considered when conducting NEPA analyses by stating the following: "Each Federal agency should analyze the environmental effects, including human health, economic, and social effects of Federal actions, including effects on minority populations, low-income populations, and Indian tribes, when such analysis is required by NEPA."

Each alternative would result in a catch limit for all CREMUS. Participants in coral reef ecosystem fisheries in all of the areas would be advised of the catch limits, but that would be the extent of the impact of the ACL specifications on fishery participants. Under the proposed action, the AM for coral reef fisheries would be a post-season accounting of catch towards each ACL specification. If an ACL for any stock or stock complex is exceeded and affects the sustainability of that stock or stock complex, NMFS would take action to correct the operational issue that caused the ACL overage, as recommended by the Council which could include a downward adjustment to the ACL for that stock or stock complex in the subsequent fishing year.

The ACLs and AMs are expected to result in enhanced monitoring of coral reef fishery catches. The ACLs and AMs are also intended to ensure that fishing for CREMUS remains sustainable. There would be no high or adverse environmental impacts from the proposed ACL specifications or from the AM measures so no disproportionately high and adverse effects to members of minority populations or low-income populations would occur. As there would be no change to the fishery, the proposed action would not affect sustenance fishing by members of minority and low-income groups.

4.9 Executive Order 12866

A "significant regulatory action" means any regulatory action that is likely to result in a rule that may –

1) Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the

environment, public health or safety, or State, local, or tribal government or communities;

2) Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;
3) Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or
4) Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the Executive Order.

The specification of ACLs for coral reef fisheries of the western Pacific has been determined to be not significant under E.O. 12866 because it will not: have an annual effect on the economy of $100M, create a serious inconsistency or otherwise interfere with an action taken or planned by another agency, materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof, or raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the Executive Order. A Regulatory Impact Review has been prepared which 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 (Appendix D).

Based on analysis provided in the RIR, the proposed action is not expected to have an adverse effect of $100 million or more, create a serious inconsistency or otherwise interfere with an action taken by another agency, materially alter the budgetary impact of programs or rights or obligations of recipients, or raise novel legal or policy issues. Therefore, it is not considered to be a significant regulatory action. However, there is expected to be an increased interest on the part of fishermen regarding catch limits, especially where specified ACLs are low because of the limits to the data used in developing ACLs.

4.10 Information Quality Act

The Information Quality Act requires federal agencies to ensure and maximize the quality, objectivity, utility, and integrity of information disseminated by federal agencies. 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 proposed specifications during meetings of the Council over the past several years. The information was also improved based on the guidance and comments from the Council's advisory groups.

Council and NMFS staffs prepared the document based on information provided by NMFS Pacific Islands Fisheries Science Center (PIFSC) and NMFS Pacific Islands Regional Office (PIRO) and after providing opportunities for members of the public to comment at Council meetings and the EA will be made available to the public during the comment period for the proposed specification. The process of public review of this document provides an opportunity for comments on the information contained in this document, as well as for the provision of additional information regarding the proposed specifications and potential environmental effects.

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Appendix A List of CREMUS Comprising Each Taxonomic Group by FEP Area

Table 1. American Samoa CREMUS

American Samoa CREMUS	Common Name	Scientific Name
Surgeonfish	Achilles tang	*Acanthurus achilles*
Surgeonfish	Barred unicornfish	*Naso thynnoides*
Surgeonfish	Bignose unicornfish	*Naso vlamingii*
Surgeonfish	Black tongue unicornfish	*Naso hexacanthius*
Surgeonfish	Blackstreak surgeonfish	*Acanthurus nigricauda*
Surgeonfish	Blue-banded surgeonfish	*Acanthurus lineatus*
Surgeonfish	Bluelined surgeonfish	*Acanthurus nigroris*
Surgeonfish	Bluespine unicornfish	*Naso unicornis*
Surgeonfish	Brown surgeonfish	*Acanthurus nigrofuscus*
Surgeonfish	Convict tang	*Acanthurus triostegus*
Surgeonfish	Elongate surgeonfish	*Acanthurus mata*
Surgeonfish	Eye-striped surgeonfish	*Acanthurus dussumeiri*
Surgeonfish	Gray unicornfish	*Naso caesius*
Surgeonfish	Humpback unicornfish	*Naso brachycentron*
Surgeonfish	Humpnose unicornish	*Naso tuberosus*
Surgeonfish	Mimic surgeonfish	*Acanthurus pyorferus*
Surgeonfish	Naso tang	*Naso spp.*
Surgeonfish	Orangespine unicornfish	*Naso lituratus*
Surgeonfish	Orange-spot surgeonfish	*Acanthurus olivaceus*
Surgeonfish	Pacific sailfin tang	*Zebrasoma veliferum*
Surgeonfish	Ringtail surgeonfish	*Acanthurus blochii*
Surgeonfish	Spotted unicornfish	*Naso brevirostris*
Surgeonfish	Striped bristletooth	*Ctenochaetus striatus*
Surgeonfish	Surgeonfishes/tangs	*Acanthurus sp.*
Surgeonfish	Twospot bristletooth	*Ctenochaetus binotatus*
Surgeonfish	Unicornfishes (misc)	*Naso spp.*
Surgeonfish	Whitebar surgeonfish	*Acanthurus leucopareius*
Surgeonfish	Whitecheek surgeonfish	*Acanthurus nigricans*
Surgeonfish	Whitemargin unicornfish	*Naso annulatus*
Surgeonfish	Whitespotted surgeonfish	*Acanthurus guttatus*
Surgeonfish	Yellow-eyed bristletooth	*Ctenochaetus strigosus*
Surgeonfish	Yellowfin surgeonfish	*Acanthurus xanthopterus*
Snappers	Inshore snappers	Lutjanidae
Snappers	Brown jobfish	*Aphareus furca*
Snappers	Scarlet snapper	*Etelis radiosus*
Snappers	Red snapper	*Lutjanus bohar*

American Samoa CREMUS	Common Name	Scientific Name
Snappers	Twinspot/red snapper	*Lutjanus bohar*
Snappers	Yellow margined snapper	*Lutjanus fulvus*
Snappers	Humpback snapper	*Lutjanus gibbus*
Snappers	Onespot snapper	*Lutjanus monostigma*
Snappers	Rufous snapper	*Lutjanus rufolineatus*
Snappers	Blood snapper	*Lutjanus sanguineus*
Snappers	Timor snapper	*Lutjanus timorensis*
Snappers	Black snapper	*Macolor niger*
Snappers	Kusakar's snapper	*Paracaesio kusakarii*
Snappers	Stone's snapper	*Paracaesio stonei*
Snappers	Multidens snapper	*Pristipomoides multidens*
Atulai	Bigeye scad	*Selar crumenophthalmus*
Mollusks	Mangrove clam	*Anodontia edentula*
Mollusks	Pen shell clam	*Atrina rigida*
Mollusks	Pipi clam	*Donax deltoides*
Mollusks	Squid	Teuthida
Mollusks	Clams (misc)	Bivalvia
Mollusks	Cone snail	*Conus sp.*
Mollusks	Octopus (cyanea)	*Octopus cyanea*
Mollusks	Octopus (ornatus)	*Octopus ornatus*
Mollusks	Octopus	*Octopus sp.*
Mollusks	Giant clam	*Tridacna sp.*
Mollusks	Turban snail	*Trochus sp.*
Mollusks	Green snails	*Turbo sp.*
Jacks	Blue kingfish trevally	*Carangoides caeruleopinnatus*
Jacks	Goldspot trevally	*Carangoides orthogrammus*
Jacks	Trevally (misc)	*Carangoides sp.*
Jacks	Jacks (misc)	*Caranx sp.*
Jacks	Black jack	*Caranx lugubris*
Jacks	Bluefin trevally	*Caranx melampygus*
Jacks	Brassy trevally	*Caranx papuensis*
Jacks	Bigeye trevally	*Caranx sexfasciatus*
Jacks	Rainbow runner	*Elagatis bipinnulatus*
Jacks	Leatherback	*Scomberoides lysan*
Jacks	Snubnose pompano	*Trachinotus blochii*
Jacks	Whitemouth trevally	*Uraspis secunda*
Emperors	Emperors (misc)	Lethrinidae
Emperors	Goldenline bream	*Gnathodentex aureolineatus*
Emperors	Yellowspot emperor	*Gnathodentex aurolineatus*
Emperors	Blueline bream	*Gymnocranius grandoculis*

American Samoa CREMUS	Common Name	Scientific Name
Emperors	Orangespot emperor	*Lethrinus erythracanthus*
Emperors	Longnose emperor	*Lethrinus elongatus*
Emperors	Bigeye emperor	*Monotaxis grandoculis*
Emperors	Sweetlip emperor	*Lethrinus miniatus*
Parrotfish	Stareye parrotfish	*Calotomus carolinus*
Parrotfish	Longnose parrotfish	*Hipposcarus longiceps*
Parrotfish	Yellowband parrotfish	*Scarus schlegeli*
Parrotfish	Parrotfishes (misc)	*Scarus sp.*
Groupers	Eightbar grouper	*Epinephelus octofasciatus*
Groupers	Giant grouper	*Epinephelus lanceolatus*
Groupers	Golden hind	*Cephalopholis aurantia*
Groupers	Greasy grouper	*Epinephelus tauvina*
Groupers	Groupers (misc)	*Epinephelus sp.*
Groupers	Hexagon grouper	*Epinephelus hexagonatus*
Groupers	Honeycomb grouper	*Epinephelus merra*
Groupers	Inshore groupers	Serrandidae
Groupers	Longspine grouper	*Epinephelus longispinnis*
Groupers	Netfin grouper	*Epinephelus miliaris*
Groupers	One-bloch grouper	*Epinephelus melanostigma*
Groupers	Peacock grouper	*Cephalopholis argus*
Groupers	Pygmy grouper	*Cephalopholis spiloparaea*
Groupers	Saddleback grouper	*Plectropomus laevis*
Groupers	Six-banded grouper	*Cephalopholis sexmaculatus*
Groupers	Slender grouper	*Anyperodon leucogrammicus*
Groupers	Smalltooth grouper	*Epinephelus microdon*
Groupers	Spotted grouper	*Epinephelus maculatus*
Groupers	Squaretail grouper	*Plectropomus areolatus*
Groupers	Striped grouper	*Epinephelus morrhua*
Groupers	Tomato grouper	*Cephalopholis sennerati*
Groupers	Ybanded grouper	*Cephalopholis igarashiensis*
Groupers	Yellowspot grouper	*Epinephelus timorensis*
Groupers	Leopard coral trout	*Plectropomus leopardus*
Groupers	Powell's grouper	*Saloptia powelli*
Groupers	White-edged lyretail	*Variola albimarginata*
Squirrelfish	Bigscale soldierfish	*Myripristis berndti*
Squirrelfish	Blackfin squirrelfish	*Neoniphon opercularis*
Squirrelfish	Blackspot squirrelfish	*Sargocentron melanospilos*
Squirrelfish	Blotcheye soldierfish	*Myripristis murdjan*
Squirrelfish	Bluelined squirrelfish	*Sargocentron tiere*
Squirrelfish	Brick soldierfish	*Myripristis amaena*

American Samoa CREMUS	Common Name	Scientific Name
Squirrelfish	Bronze soldierfish	*Myripristis adusta*
Squirrelfish	Crown squirrelfish	*Sargocentron diadema*
Squirrelfish	Double tooth soldierfish	*Myripristis hexagona*
Squirrelfish	Filelined squirrelfish	*Sargocentron microstoma*
Squirrelfish	Hawaiian squirrelfish	*Sargocentron xantherythrum*
Squirrelfish	Pearly soldierfish	*Myripristis kuntee*
Squirrelfish	Peppered squirrelfish	*Sargocentron punctatissimum*
Squirrelfish	Pink squirrelfish	*Sargocentron tieroides*
Squirrelfish	Saber squirrelfish	*Sargocentron spiniferum*
Squirrelfish	Sammara squirrelfish	*Neoniphon sammara*
Squirrelfish	Scarlet soldierfish	*Myripristis pralinius*
Squirrelfish	Squirrelfish	*Sargocentron sp.*
Squirrelfish	Tailspot squirrelfish	*Sargocentron caudimaculatum*
Squirrelfish	Violet soldierfish	*Myripristis violaceus*
Squirrelfish	Violet squirrelfish	*Sargocentron violaceum*
Squirrelfish	Whitetip soldierfish	*Myripristis vittata*
Squirrelfish	Yellowfin soldierfish	*Myripristis chryseres*
Squirrelfish	Yellowstriped squirrelfish	*Neoniphon aurolineatus*
Mullets	Mullets	Mugilidae
Mullets	Fringelip mullet	*Crenimugil crenilabis*
Mullets	Diamond scale mullet	*Ellochelon vaigiensis*
Mullets	False mullet	*Neomyxus leuciscus*
Crustaceans	Crabs	Decapoda
Crustaceans	Grapsid crab	Graspidae
Crustaceans	Pa'a crab	*Ocypode ceratopthalma*
Crustaceans	Seven-11 crab	*Carpilius maculatus*
Crustaceans	Small crab	Decapoda
Crustaceans	Mangrove crab	*Scylla serrate*
Crustaceans	Large red crab	*Sesama erythrodactyla*
Crustaceans	Hermit crab	*Coenobita clypeatus*
Invertebrates	Invertebrates (misc)	n/a
Invertebrates	Sea urchins (misc)	Diadema
Invertebrates	Black sea urchin	Diadema
Invertebrates	White sea urchin	Salmacis spp.
Invertebrates	Cubed loli	*Holothuria atra (cubed)*
Invertebrates	Cubed leapord sea cucumber	*Bahadschia argus (cubed)*
Invertebrates	Surf redfish	*Actinopyga maurtiana*
Invertebrates	Sea cucumber (misc)	Cucumariidae
Invertebrates	Sea cucumber - gau	Cucumariidae
Invertebrates	Sea cucumber gonads	Cucumariidae

American Samoa CREMUS	Common Name	Scientific Name
Invertebrates	Leapord sea cucumber	*Bahadschia argus*
Invertebrates	Loli	*Holothuria atra*
Other CRE-Finfish	Flyingfish	Exocoetidae
Other CRE-Finfish	Cornetfish	*Fistularia commersonii*
Other CRE-Finfish	Mojarras	Gerreidae
Other CRE-Finfish	Gobies	Gobiidae
Other CRE-Finfish	Sweetlips	*Plectorhinchus sp.*
Other CRE-Finfish	Halfbeaks	Hemiramphidae
Other CRE-Finfish	Flagtails	Kuhliidae
Other CRE-Finfish	Barred flagtail	*Kuhlia mugil*
Other CRE-Finfish	Mountain bass	*Kuhlia sp.*
Other CRE-Finfish	Ponyfish	*Leiognathidae*
Other CRE-Finfish	Tilefishes	*Malacanthus sp.*
Other CRE-Finfish	Sunfish	*Masturus lanceolatus*
Other CRE-Finfish	Filefishes	*Monacanthidae*
Other CRE-Finfish	Silver batfish	*Monodactylus argenteus*
Other CRE-Finfish	Moray eels	*Gymnothorax sp.*
Other CRE-Finfish	Dragon eel	*Enchelycore pardalis*
Other CRE-Finfish	Yellowmargin moray eel	*Gymnothorax flavimarginatus*
Other CRE-Finfish	Giant moray eel	*Gymnothorax javanicus*
Other CRE-Finfish	Spotted moray eels	*Gymnothorax sp.*
Other CRE-Finfish	Undulated moray eel	*Gymnothorax undulatus*
Other CRE-Finfish	Rays	Batiodea
Other CRE-Finfish	Eagle ray	*Aetobatis narinari*
Other CRE-Finfish	Monogram monocle bream	*Scolopsis monogramma*
Other CRE-Finfish	Nurse shark	*Pempheris sp.*
Other CRE-Finfish	Sweepers	Pempheridae
Other CRE-Finfish	Prettyfins	Cyprinididae
Other CRE-Finfish	Threadfin	*Polynemus sp.*
Other CRE-Finfish	Angelfishes	*Centropyge flavissimus*
Other CRE-Finfish	Emperor angelfish	*Pomacanthus imperator*
Other CRE-Finfish	Banded sergeant	*Abudefduf septemfasciatus*
Other CRE-Finfish	Sergeant major	*Abudefduf sp.*
Other CRE-Finfish	Damselfish	*Dascyllus trimaculatus*
Other CRE-Finfish	Bigeyes	Priacanthidae
Other CRE-Finfish	Glasseye	*Heteropriacanthus cruentatus*
Other CRE-Finfish	Paeony bulleye	*Priacanthus blochii*
Other CRE-Finfish	Moontail bullseye	*Priacanthus hamrur*
Other CRE-Finfish	Bigeye squirrelfish	*Priacanthus sp.*
Other CRE-Finfish	Dottybacks	*Pseudochromidae*

American Samoa CREMUS	Common Name	Scientific Name
Other CRE-Finfish	Scorpionfishes	Scorpaenidae
Other CRE-Finfish	Lionfish	*Pterois sp.*
Other CRE-Finfish	Stonefish	*Synaceia sp.*
Other CRE-Finfish	Small barracuda	Sphyraenidae
Other CRE-Finfish	Great barracuda	*Sphyraena barracuda*
Other CRE-Finfish	Bigeye barracuda	*Sphyraena forsteri*
Other CRE-Finfish	Heller's barracuda	*Sphyraena helleri*
Other CRE-Finfish	Blackfin barracuda	*Sphyraena qenie*
Other CRE-Finfish	Barracudas (misc)	*Sphyraena sp.*
Other CRE-Finfish	Seahorses	Sygnathidae
Other CRE-Finfish	Lizardfish	Synodontidae
Other CRE-Finfish	Terapon perch	*Terapon jarbua*
Other CRE-Finfish	Moorish Idol	*Zanclus cornutus*
Other CRE-Finfish	Freshwater eel	*Anguilla marmorata*
Other CRE-Finfish	Flashlightfishes	Anomalopidae
Other CRE-Finfish	Frogfishes	Antennariidae
Other CRE-Finfish	Cardinalfish	Apogonidae
Other CRE-Finfish	Silversides	*Hypoathernia temminckii*
Other CRE-Finfish	Trumpetfish	*Aulostomus chinensis*
Other CRE-Finfish	Triggerfish	Balistidae
Other CRE-Finfish	Orangestripe triggerfish	*Balistapus undulatus*
Other CRE-Finfish	Clown triggerfish	*Balistoides conspicillum*
Other CRE-Finfish	Titan triggerfish	*Balistoides viridescens*
Other CRE-Finfish	Needlefish	Belonidae
Other CRE-Finfish	Blennies	Blennidae
Other CRE-Finfish	Angler flatfish	*Asterorhombus fijiensis*
Other CRE-Finfish	Gold banded fusilier	*Caesio caerulaurea*
Other CRE-Finfish	Coral crouchers	*Caracanthus maculatus*
Other CRE-Finfish	Butterflyfishes (misc)	*Chaetodon sp.*
Other CRE-Finfish	Butterflyfish (auriga)	*Chaetodon auriga*
Other CRE-Finfish	Saddleback butterflyfish	*Chaetodon ephippium*
Other CRE-Finfish	Racoon butterflyfish	*Chaetodon lunula*
Other CRE-Finfish	Butterflyfish (melanotic)	*Chaetodon melannotus*
Other CRE-Finfish	Milkfish	*Chanos chanos*
Other CRE-Finfish	Tilapia	*Tilapia zillii*
Other CRE-Finfish	Two spotted hawkfish	*Amplycirrhitus bimacula*
Other CRE-Finfish	Stocky hawkfish	*Cirrhitus pinnalatus*
Other CRE-Finfish	Flame hawkfish	*Neocirrhites armatus*
Other CRE-Finfish	Herrings	Clupeidae
Other CRE-Finfish	White eel	*Conger cinereus*

American Samoa CREMUS	Common Name	Scientific Name
Other CRE-Finfish	Conger eels	*Conger sp.*
Other CRE-Finfish	Porcupinefish	*Diodon (Porcupine) sp.*
Other CRE-Finfish	Remoras	Echeneidae
Other CRE-Finfish	Anchovies	Engraulidae
Other CRE-Finfish	Batfishes	Ephippidae
Misc. Bottomfish	Bottomfish (misc)	n/a
Misc. Reef Fish	Reef fish (misc)	n/a
Wrasse	Arenatus wrasse	*Oxycheilinus arenatus*
Wrasse	Bandcheck wrasse	*Oxycheilinus diagrammus*
Wrasse	Barred thicklip	*Hemigymnus fasciatus*
Wrasse	Bird wrasse	*Hemigymnus fasciatus*
Wrasse	Blackeye thicklip	*Hemigymnus melapterus*
Wrasse	Checkerboard wrasse	*Halichoeres hortulanus*
Wrasse	Cheilinus wrasse (misc)	*Cheilinus sp.*
Wrasse	Christmas wrasse	*Thalassoma trilobata*
Wrasse	Cigar wrasse	*Cheilio inermus*
Wrasse	Red ribbon wrasse	*Thalassoma quinquevittaitum*
Wrasse	Rockmover wrasse	*Novaculichthys taeniorus*
Wrasse	Sunset wrasse	*Thalassoma lutescens*
Wrasse	Surge wrasse	*Thalassoma purpureum*
Wrasse	Triple tail wrasse	*Cheilinus trilobatus*
Wrasse	Weedy surge wrasse	*Halichoeres margaritaceus*
Wrasse	Whitepatch wrasse	*Xyrichtys aneitensis*
Wrasse	Wrasses (misc.)	Labridae
Wrasse	Floral wrasse	*Cheilinus chlorourus*
Wrasse	Harlequin tuskfish	*Cheilinus fasciatus*
Rudderfish	Rudderfish (bigibus)	*Kyphosus bigibus*
Rudderfish	Rudderfish (cinerascens)	*Kyphosus cinerascens*
Rudderfish	Western drummer	*Kyphosus cornelii*
Rudderfish	Rudderfish	*Kyphosus sp.*
Rudderfish	Lowfin drummer	*Kyphosus vaigiensis*
Goatfish	Goatfish (misc)	Mullidae
Goatfish	Yellowstripe goatfish	*Mulloidichthys flavolineatus*
Goatfish	Orange goatfish	*Mulloidichthys pfluegeri*
Goatfish	Yellow goatfishes	*Mulloidichthys sp.*
Goatfish	Yellowfin goatfish	*Mulloidichthys vanicolensis*
Goatfish	Dash-and-dot goatfish	*Parupeneus barberinus*
Goatfish	Doublebar goatfish	*Parupeneus bifasciatus*
Goatfish	White-lined goatfish	*Parupeneus ciliatus*
Goatfish	Yellowsaddle goatfish	*Parupeneus cyclostomus*

American Samoa CREMUS	Common Name	Scientific Name
Goatfish	Redspot goatfish	*Parupeneus heptacanthus*
Goatfish	Indian goatfish	*Parupeneus indicus*
Goatfish	Parupenus insularis	*Parupeneus insularis*
Goatfish	Multi-barred goatfish	*Parupeneus multifasciatus*
Goatfish	Side spot goatfish	*Parupeneus pleurostigma*
Goatfish	Banded goatfish (misc)	*Parupeneus sp.*
Rabbitfish	Rabbitfish	Siganidae
Rabbitfish	Forktail rabbitfish	*Siganus aregenteus*
Rabbitfish	Scribbled rabbitfish	*Siganus spinus*
Algae	Red algae	Red Algae
Algae	Seaweeds	Seaweeds
Misc. Shallow bottomfish	Shallow bottomfish (misc)	n/a
Species of Special Management Interest	Bumphead parrotfish	*Bolbometopon muricatum*
Species of Special Management Interest	Humphead (Napoleon) wrasse	*Cheilinus undulatus*
Species of Special Management Interest	Reef sharks (misc)	Carcharhinidae
Species of Special Management Interest	Silvertip shark	*Carcharhinus albimarginatus*
Species of Special Management Interest	Grey Reef shark	*Carcharhinus amblyrhynchos*
Species of Special Management Interest	Galapagos shark	*Carcharhinus galapagenis*
Species of Special Management Interest	Black tip reef shark	*Carcharhinus melanopterus*
Species of Special Management Interest	White tip reef shark	*Carcharhinus triaenodon*
Species of Special Management Interest	Hammerhead shark	Sphyrnidae

Table 2. Mariana CREMUS (Guam)

Mariana CREMUS (Guam)	Common Name	Scientific Name
Surgeonfish	Surgeon/Unicornfishes	Acanthuridae
Surgeonfish	Achilles Tang	*Acanthurus achilles*
Surgeonfish	Bariene Surgeonfish	*Acanthurus bariene*
Surgeonfish	White-Bar Surgeonfish	*Acanthurus blochii*
Surgeonfish	Chronixis Surgeonfish	*Acanthurus chronixis*
Surgeonfish	Eye-Stripe Surgeonfish	*Acanthurus dussumieri*
Surgeonfish	Whitespotted Surgeonfish	*Acanthurus guttatus*
Surgeonfish	Palelipped Surgeonfish	*Acanthurus leucocheilus*
Surgeonfish	Whitebar Surgeonfish	*Acanthurus leucopareius*

Mariana CREMUS (Guam)	**Common Name**	**Scientific Name**
Surgeonfish	Bluebanded Surgeonfish	*Acanthurus lineatus*
Surgeonfish	White-Freckled Surgeonfish	*Acanthurus maculiceps*
Surgeonfish	Elongate Surgeonfish	*Acanthurus mata*
Surgeonfish	Whitecheek Surgeonfish	*Acanthurus nigricans*
Surgeonfish	Epaulette Surgeonfish	*Acanthurus nigricauda*
Surgeonfish	Brown Surgeonfish	*Acanthurus nigrofuscus*
Surgeonfish	Bluelined Surgeonfish	*Acanthurus nigroris*
Surgeonfish	Surgeonfish	*Acanthurus nubilus*
Surgeonfish	Orangeband Surgeonfish	*Acanthurus olivaceus*
Surgeonfish	Chocolate Surgeonfish	*Acanthurus pyroferus*
Surgeonfish	Thompson'S Surgeonfish	*Acanthurus thompsoni*
Surgeonfish	Convict Tang	*Acanthurus triostegus triostegus*
Surgeonfish	Yellowfin Surgeonfish	*Acanthurus xanthopterus*
Surgeonfish	2-Spot Bristletooth	*Ctenochaetus binotatus*
Surgeonfish	Black Surgeonfish	*Ctenochaetus hawaiiensis*
Surgeonfish	Blue-Spotted Bristletooth	*Ctenochaetus marginatus*
Surgeonfish	Striped Bristletooth	*Ctenochaetus striatus*
Surgeonfish	Goldring Surgeonfish	*Ctenochaetus strigosus*
Surgeonfish	Tomini Surgeonfish	*Ctenochaetus tominiensis*
Surgeonfish	Whmargin Unicornfish	*Naso annulatus*
Surgeonfish	Humpback Unicornfish	*Naso brachycentron*
Surgeonfish	Spotted Unicornfish	*Naso brevirostris*
Surgeonfish	Whtongue Unicornfish	*Naso caesius*
Surgeonfish	Bltongue Unicornfish	*Naso hexacanthus*
Surgeonfish	Orangespine Unicornfish	*Naso lituratus*
Surgeonfish	Lopez' Unicornfish	*Naso lopezi*
Surgeonfish	Whtongue Unicornfish	*Naso thynnoides*
Surgeonfish	Humpnose Unicornfish	*Naso tuberosus*
Surgeonfish	Bluespine Unicornfish	*Naso unicornis*
Surgeonfish	Bignose Unicornfish	*Naso vlamingii*
Surgeonfish	Hepatus Tang	*Paracanthurus hepatus*
Surgeonfish	Yellow Tang	*Zebrasoma flavescens*
Surgeonfish	Brown Tang	*Zebrasoma scopas*
Surgeonfish	Sailfin Tang	*Zebrasoma veliferum*
Jacks	Pennantfish	*Alectis ciliaris*
Jacks	Malabar Trevally	*Alectis indicus*
Jacks	Jacks, Trevallys	Carangidae
Jacks	Trevally	*Carangoides caeruleopinnatus*
Jacks	Shadow Kingfish	*Carangoides dinema*
Jacks	Bar Jack	*Carangoides ferdau*
Jacks	Yell-Dotted Trevally	*Carangoides fulvoguttatus*
Jacks	Headnotch Trevally	*Carangoides hedlandensis*
Jacks	Yellow Spotted Jack	*Carangoides orthogrammus*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Jacks	Barcheek Trevally	*Carangoides plagiotaenia*
Jacks	Trevally	*Carangoides talamparoides*
Jacks	Longfin Trevally	*Carangoides uii*
Jacks	Juvenile Caranx	*Caranx i'e'*
Jacks	Bluefin Trevally	*Caranx melampygus*
Jacks	Brassy Trevally	*Caranx papuensis*
Jacks	Bigeye Trevally	*Caranx sexfasciatus*
Jacks	Mackerel Scad	*Decapterus macarellus*
Jacks	Mackerel Scad	*Decapterus macrosoma*
Jacks	Round Scad	*Decapterus maruadsi*
Jacks	Round Scad	*Decapterus russelli*
Jacks	Rainbow Runner	*Elagatis bipinnulatus*
Jacks	Golden Trevally	*Gnathanodon speciosus*
Jacks		*Megalaspis cordyla*
Jacks	Pilotfish	*Naucrates ductor*
Jacks	Elagatis, Scomberoides, Seriola	*Naucratini*
Jacks	Leatherback	*Scomberoides lysan*
Jacks	Almaco Jack	*Seriola rivoliana*
Jacks	Small Spotted Pompano	*Trachinotus bailloni*
Jacks	Silver Pompano	*Trachinotus blochii*
Jacks	Mandibular Kingfish	*Ulua mandibularis*
Jacks	Kingfish	*Uraspis helvola*
Jacks	Deep Trevally	*Uraspis secunda*
Jacks	Whitemouth Trevally	*Uraspis uraspis*
Atulai	Bigeye Scad	*Selar crumenopthalmus*
Emperors	Yellow-Spot Emperor	*Gnathodentex aurolineatus*
Emperors	Japanese Bream	*Gymnocranius euanus*
Emperors	Blue-Lined Bream	*Gymnocranius grandoculus*
Emperors	Grey Bream	*Gymnocranius griseus*
Emperors	Blue-Spotted Bream	*Gymnocranius microdon*
Emperors	Stout Emperor	*Gymnocranius sp*
Emperors	Emperors	*Lethrinidae*
Emperors	Yellowtail Emperor	*Lethrinus atkinsoni*
Emperors	Orange-Spotted Emperor	*Lethrinus erythracanthus*
Emperors	Longfin Emperor	*Lethrinus erythropterus*
Emperors	Longspine Emperor	*Lethrinus genivittatus*
Emperors	Thumbprint Emperor	*Lethrinus harak*
Emperors	Pinkear Emperor	*Lethrinus lentjan*
Emperors	Smtoothed Emperor	*Lethrinus microdon*
Emperors	Orange-Striped Emperor	*Lethrinus obsoletus*
Emperors	Longface Emperor	*Lethrinus olivaceus*
Emperors	Ornate Emperor	*Lethrinus ornatus*
Emperors	Black-Blotch Emperor	*Lethrinus semicinctus*

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Emperors	Slender Emperor	*Lethrinus variegatus*
Emperors	Yellowlip Emperor	*Lethrinus xanthochilus*
Emperors	Bigeye Emperor	*Monotaxis grandoculus*
Emperors	Large-Eye Bream	*Wattsia mossambica*
Parrotfish	Bucktooth Parrotfish	*Calotomus carolinus*
Parrotfish	Spineytooth Parrotfish	*Calotomus spinidens*
Parrotfish	Bicolor Parrotfish	*Cetoscarus bicolor*
Parrotfish	Parrotfish	*Chlorurus bleekeri*
Parrotfish	Parrotfish	*Chlorurus bowersi*
Parrotfish	Tan-Faced Parrotfish	*Chlorurus frontalis*
Parrotfish	Steephead Parrotfish	*Chlorurus microrhinos*
Parrotfish	Parrotfish	*Chlorurus pyrrhurus*
Parrotfish	Bullethead Parrotfish	*Chlorurus sordidus*
Parrotfish	Parrotfish	*Hipposcarus longiceps*
Parrotfish	Seagrass Parrotfish	*Leptoscarus vaigiensis*
Parrotfish	Parrotfishes	Scaridae
Parrotfish	Fil-Finned Parrotfish	*Scarus altipinnis*
Parrotfish	Parrotfish	*Scarus chameleon*
Parrotfish	Parrotfish	*Scarus dimidiatus*
Parrotfish	Parrotfish	*Scarus festivus*
Parrotfish	Yellowfin Parrotfish	*Scarus flavipectoralis*
Parrotfish	Tricolor Parrotfish	*Scarus forsteni*
Parrotfish	Vermiculate Parrotfish	*Scarus frenatus*
Parrotfish	Blue-Barred Parrotfish	*Scarus ghobban*
Parrotfish	Parrotfish	*Scarus globiceps*
Parrotfish	Java Parrotfish	*Scarus hypselosoma*
Parrotfish	Parrotfish	*Scarus sp.*
Parrotfish	Black Parrotfish	*Scarus niger*
Parrotfish	Parrotfish	*Scarus oviceps*
Parrotfish	Greenthroat Parrotfish	*Scarus prasiognathos*
Parrotfish	Pale Nose Parrotfish	*Scarus psittacus*
Parrotfish	Parrotfish	*Scarus quoyi*
Parrotfish	Parrotfish	*Scarus rivulatus*
Parrotfish	Parrotfish	*Scarus rubroviolaceus*
Parrotfish	Chevron Parrotfish	*Scarus schlegeli*
Parrotfish	Parrotfish	*Scarus spinus*
Parrotfish	Tricolor Parrotfish	*Scarus tricolor*
Parrotfish	Parrotfish	*Scarus xanthopleura*
Goatfish	Goatfishes	Mullidae
Goatfish	Yellowstriped Goatfish	*Mulloidichthys flavolineatus*
Goatfish	Orange Goatfish	*Mulloidichthys pflugeri*
Goatfish	Juvenile Goatfish	*Mulloidichthys ti'ao*
Goatfish	Yellowfin Goatfish	*Mulloidichthys vanicolensis*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Goatfish		*Parupeneus barberinoides*
Goatfish	Dash And Dot Goatfish	*Parupeneus barberinus*
Goatfish		*Parupeneus bifasciatus*
Goatfish	White-Lined Goatfish	*Parupeneus ciliatus*
Goatfish	Yellow Goatfish	*Parupeneus cyclostomus*
Goatfish	Redspot Goatfish	*Parupeneus heptacanthus*
Goatfish	Indian Goatfish	*Parupeneus indicus*
Goatfish	Multibarred Goatfish	*Parupeneus multifasciatus*
Goatfish	Sidespot Goatfish	*Parupeneus pleurostigma*
Goatfish	Goatfish	*Parupeneus sp.*
Goatfish	Goatfish	*Upeneus arge*
Goatfish	Band-Tailed Goatfish	*Upeneus taeniopterus*
Goatfish	Blackstriped Goatfish	*Upeneus tragula*
Goatfish	Yellowbanded Goatfish	*Upeneus vittatus*
Mollusks	Spiney Chiton	*Acanthopleura spinosa*
Mollusks	Bubble Shells,Sea Hares	Acteonidae
Mollusks	Antique Ark	*Anadara antiquata*
Mollusks	Indo-Pacific Ark	*Arca navicularis*
Mollusks	Ventricose Ark	*Arca ventricosa*
Mollusks	Ark Shells	Arcidae
Mollusks	Common Paper Nautilus	*Argonauta argo*
Mollusks	Gruner'S Paper Nautilus	*Argonauta gruneri*
Mollusks	Brown Paper Nautilus	*Argonauta hians*
Mollusks	Nodose Paper Nautilus	*Argonauta nodosa*
Mollusks	Noury'S Paper Nautilus	*Argonauta nouri*
Mollusks	Paper Nautiluses	*Argonautidae*
Mollusks	Pacific Sand Clam	*Asaphis violescens*
Mollusks	Gaudy Sand Clam	*Aspaphis deflorata*
Mollusks	Peron'S Sea Butterfly	*Atlanta peroni*
Mollusks		Atlantidae
Mollusks	Wh Pacific Atys	*Atys naucum*
Mollusks	Almond Ark	*Babatia amygdalumtostum*
Mollusks	Goblets,Dwarf Tritons	*Buccinidae*
Mollusks	Ampule Bubble	*Bulla ampulla*
Mollusks	Bubble Shells	*Bullidae*
Mollusks	Lined Bubble	*Bullina lineata*
Mollusks	Giant Frog Shell	*Bursa bubo*
Mollusks	Warty Frog Shell	*Bursa bufonia*
Mollusks	Blood-Stain Frog Shell	*Bursa cruentata*
Mollusks	Granulate Frog Shell	*Bursa granularis*
Mollusks	Lamarck'S Frog Shell	*Bursa lamarcki*
Mollusks	Red-Mth Frog Shell	*Bursa lissostoma*
Mollusks	Udder Frog Shell	*Bursa mammata*

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Mollusks	Ruddy Frog Shell	*Bursa rebeta*
Mollusks	Wine-Mth Frog Shell	*Bursa rhodostoma*
Mollusks	Frog Shells	Bursidae
Mollusks	Umbilicate Ovula	*Calpurnus verrucosus*
Mollusks	File Miter	*Cancilla filaris*
Mollusks	Smoky Goblet	*Cantharus fumosus*
Mollusks	Waved Goblet	*Cantharus undosus*
Mollusks	Varitated Cardita	*Cardita variegata*
Mollusks	Carditid Clams	Carditidae
Mollusks	Vibex Bonnet	*Casmaria erinaceus*
Mollusks	Heavy Bonnet	*Casmaria ponderosa*
Mollusks	Helmet Shells	Cassidae
Mollusks	Horned Helmet	*Cassius cornuta*
Mollusks	3-Toothed Cavoline	*Cavolina tridentata*
Mollusks	Unicate Cavoline	*Cavolina uncinata*
Mollusks	Sea Butterfly	*Cavolinia cf globulosa*
Mollusks	Sea Butterflies	Cavolinidae
Mollusks	Turret,Worm-Shells	Cerithiidae
Mollusks	Column Certh	*Cerithium columna*
Mollusks	Giant Knobbed Certh	*Cerithium nodulosum*
Mollusks	Lazarus Jewel Box	*Chama lazarus*
Mollusks	Jewel Boxes	Chamidae
Mollusks	Triton Trumpet	*Charonia tritonis*
Mollusks	Ramose Murex	*Chicoreus ramosus*
Mollusks	Chitons	Chitonidae
Mollusks	Cook'S Scallop	*Chlamys cooki*
Mollusks	Squamose Scallop	*Chlamys squamosa*
Mollusks	Bivalves	*Class Bivalvia*
Mollusks	Pyramid Clio	*Clio cuspidata*
Mollusks	Irregular Urchins	*Clio pyramidata*
Mollusks	Morus Certh	*Clypeomorus concisus*
Mollusks	Punctate Lucina	*Codakia punctata*
Mollusks	Maculated Dwarf Triton	*Columbraria muricata*
Mollusks	Shiny Dwarf Triton	*Columbraria nitidula*
Mollusks	Twisted Dwarf Triton	*Columbraria tortuosa*
Mollusks	Cone Shells	Conidae
Mollusks	Sand-Dusted Cone	*Conus arenatus*
Mollusks	Princely Cone	*Conus aulicus*
Mollusks	Aureus Cone	*Conus aureus*
Mollusks	Gold-Leaf Cone	*Conus auricomus*
Mollusks	Banded Marble-Cone	*Conus bandanus*
Mollusks	Bubble Cone	*Conus bullatus*
Mollusks	Captain Cone	*Conus capitaneus*

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Mollusks	Cat Cone	*Conus catus*
Mollusks	Chaldean Cone	*Conus chaldeus*
Mollusks	Comma Cone	*Conus connectens*
Mollusks	Crowned Cone	*Conus coronatus*
Mollusks	Cylindrical Cone	*Conus cylandraceus*
Mollusks	Distantly-Lined Cone	*Conus distans*
Mollusks	Hebrew Cone	*Conus ebraeus*
Mollusks	Ivory Cone	*Conus eburneus*
Mollusks	Episcopus Cone	*Conus episcopus*
Mollusks	Pacific Yellow Cone	*Conus flavidus*
Mollusks	Frigid Cone	*Conus frigidus*
Mollusks	General Cone	*Conus generalis*
Mollusks	Geography Cone	*Conus geographus*
Mollusks	Acorn Cone	*Conus glans*
Mollusks	Imperial Cone	*Conus imperialis*
Mollusks	Ambassador Cone	*Conus legatus*
Mollusks	Leopard Cone	*Conus leopardus*
Mollusks	Lithography Cone	*Conus lithoglyphus*
Mollusks	Lettered Cone	*Conus litteratus*
Mollusks	Livid Cone	*Conus lividus*
Mollusks	Luteus Cone	*Conus luteus*
Mollusks	Dignified Cone	*Conus magnificus*
Mollusks	Soldier Cone	*Conus miles*
Mollusks	1000-Spot Cone	*Conus miliaris*
Mollusks	Morelet'S Cone	*Conus moreleti*
Mollusks	Muricate Cone	*Conus muriculatus*
Mollusks	Music Cone	*Conus musicus*
Mollusks	Weasel Cone	*Conus mustelinus*
Mollusks	Obscure Cone	*Conus obscurus*
Mollusks	Pertusus Cone	*Conus pertusus*
Mollusks	Flea-Bite Cone	*Conus pulicarius*
Mollusks	Rat Cone	*Conus rattus*
Mollusks	Netted Cone	*Conus retifer*
Mollusks	Blood-Stained Cone	*Conus sanguinolentus*
Mollusks	Leaden Cone	*Conus scabriusculus*
Mollusks	Marriage Cone	*Conus sponsalis*
Mollusks	Striatellus Cone	*Conus striatellus*
Mollusks	Striated Cone	*Conus striatus*
Mollusks	Terebra Cone	*Conus terebra*
Mollusks	Checkered Cone	*Conus tesselatus*
Mollusks	Textile Cone	*Conus textile*
Mollusks	Tulip Cone	*Conus tulipa*
Mollusks	Varius Cone	*Conus varius*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Mollusks	Flag Cone	*Conus vexillum*
Mollusks	Calf Cone	*Conus vitulinus*
Mollusks	Eroded Coral Shell	*Coralliophila erosa*
Mollusks	Violet Coral Shell	*Coralliophila neritodidea*
Mollusks	Coral Shells	Coralliophilidae
Mollusks	Giant Oyster	*Crassostrea gigas*
Mollusks	Mangrove Oyster	*Crassostrea mordax*
Mollusks	Bionic Rock Shell	*Cronia biconica*
Mollusks	Speciosus Scallop	*Cryptopecten speciosum*
Mollusks	Cigar Pteropod	*Cuvierina columnella*
Mollusks	Tritons	Cymatiidae
Mollusks	Clandestine Triton	*Cymatium clandestinium*
Mollusks	Jeweled Triton	*Cymatium gemmatum*
Mollusks	Liver Triton	*Cymatium hepaticum*
Mollusks	Wide-Lipped Triton	*Cymatium labiosum*
Mollusks	Black-Spotted Triton	*Cymatium lotorium*
Mollusks	Short-Neck Triton	*Cymatium muricinum*
Mollusks	Nicobar Hairy Triton	*Cymatium nicobaricum*
Mollusks	Common Hairy Triton	*Cymatium pileare*
Mollusks	Aquatile Hairy Triton	*Cymatium pilere aquatile*
Mollusks	Pear Triton	*Cymatium pyrum*
Mollusks	Red Triton	*Cymatium rubeculum*
Mollusks	Dwarf Hairy Triton	*Cymatium vespaceum*
Mollusks	Gold-Ringer Cowry	*Cypraea annulus*
Mollusks	Arabian Cowry	*Cypraea arabica*
Mollusks	Eyed Cowry	*Cypraea argus*
Mollusks	Golden Cowry	*Cypraea aurantium*
Mollusks	Beck'S Cowry	*Cypraea beckii*
Mollusks	Bistro Cowry	*Cypraea bistronatata*
Mollusks	Snake'S Head Cowry	*Cypraea caputserpentis*
Mollusks	Carnelian Cowry	*Cypraea carneola*
Mollusks	Chinese Cowry	*Cypraea chinensis*
Mollusks	Chick-Pea Cowry	*Cypraea cicercula*
Mollusks	Clandestine Cowry	*Cypraea clandestina*
Mollusks	Sieve Cowry	*Cypraea cribaria*
Mollusks	Sowerby'S Cowry	*Cypraea cylindrica*
Mollusks	Depressed Cowry	*Cypraea depressa*
Mollusks	Dillwyn'S Cowry	*Cypraea dillywini*
Mollusks	Eglantine Cowry	*Cypraea eglantina*
Mollusks	Eroded Cowry	*Cypraea erosa*
Mollusks	Globular Cowry	*Cypraea globulus*
Mollusks	Honey Cowry	*Cypraea helvola*
Mollusks	Swallow Cowry	*Cypraea hirundo*

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Mollusks	Humphrey'S Cowry	*Cypraea humphreysi*
Mollusks	Isabelle Cowry	*Cypraea isabella*
Mollusks	Lined-Lip Cowry	*Cypraea labrolineata*
Mollusks	Limacina Cowry	*Cypraea limicina*
Mollusks	Lynx Cowry	*Cypraea lynx*
Mollusks	Reticulated Cowry	*Cypraea maculifera*
Mollusks	Map Cowry	*Cypraea mappa*
Mollusks	Marie'S Cowry	*Cypraea mariae*
Mollusks	Humpback Cowry	*Cypraea mauritiana*
Mollusks	Microdon Cowry	*Cypraea microdon*
Mollusks	Money Cowry	*Cypraea moneta*
Mollusks	Nuclear Cowry	*Cypraea nucleus*
Mollusks	Porus Cowry	*Cypraea poraria*
Mollusks	Punctata Cowry	*Cypraea punctata*
Mollusks	Jester Cowry	*Cypraea scurra*
Mollusks	Grape Cowry	*Cypraea staphlea*
Mollusks	Stolid Cowry	*Cypraea stolida*
Mollusks	Mole Cowry	*Cypraea talpa*
Mollusks	Teres Cowry	*Cypraea teres*
Mollusks	Tiger Cowry	*Cypraea tigris*
Mollusks	Ventral Cowry	*Cypraea ventriculus*
Mollusks	Pacific Deer Cowry	*Cypraea vitellus*
Mollusks	Undulating Cowry	*Cypraea ziczac*
Mollusks	Cowrys	Cypraeidae
Mollusks	3-Spined Cavoline	*Diacria trispinosa*
Mollusks	Anal Triton	*Distorso anus*
Mollusks	Dorid Nudibranchs	Doridae
Mollusks	Clatherate Drupe	*Drupa clathrata*
Mollusks	Elegant Pacific Drupe	*Drupa elegans*
Mollusks	Digitate Pacific Drupe	*Drupa grossularia*
Mollusks	Purple Pacific Drupe	*Drupa morum*
Mollusks	Prickley Pacific Drupe	*Drupa ricinus*
Mollusks	Strawberry Drupe	*Drupa rubusidacaeus*
Mollusks	Spectacular Scallop	*Excellichlamys spectiablis*
Mollusks	Spindles	Fasciolariidae
Mollusks	Pac Strawberry Cockle	*Fragum fragum*
Mollusks	Tumid Venus	*Gafrarium tumidum*
Mollusks	Rosy Gyre Triton	*Gyrineum roseum*
Mollusks	Purple Gyre Triton	*Gyrinium pusillum*
Mollusks	Little Love Harp	*Harpa amouretta*
Mollusks	True Harp	*Harpa harpa*
Mollusks	Major Harp	*Harpa major*
Mollusks	Harp Shells	Harpidae

Mariana CREMUS (Guam)	**Common Name**	**Scientific Name**
Mollusks	Lance Auger	*Hastula lanceata*
Mollusks	Pencil Auger	*Hastula penicillata*
Mollusks	Spanish Dancer	*Hexabranchus sanguineus*
Mollusks	Giant Clam	*Hippopus hippopus*
Mollusks	Anatomical Murex	*Homalocanthia anatomica*
Mollusks	Gr-Lined Paber Bubble	*Hydratina physis*
Mollusks	Cone-Like Miter	*Imbricaria conularis*
Mollusks	Olive-Shaped Miter	*Imbricaria olivaeformis*
Mollusks	Bonelike Miter	*Imbricaria punctata*
Mollusks	Saddle Tree Oyster	*Isognomon ephippium*
Mollusks	Tree Oysters	*Isognomonidae*
Mollusks	Janthina Snail	*Janthina janthina*
Mollusks	Pelagic Snails	Janthinidae
Mollusks	Chiragra Spider Conch	*Lambis chiragra*
Mollusks	Ormouth Spider Conch	*Lambis crocota*
Mollusks	Common Spider Conch	*Lambis lambis*
Mollusks	Scorpio Conch	*Lambis scorpius scorpius*
Mollusks	Spider Conch	*Lambis sp.*
Mollusks	Giant Spider Conch	*Lambis truncata*
Mollusks	Nobby Spindle	*Latirus nodatus*
Mollusks	Spindle	*Latirus rudis*
Mollusks	Fragile Lima	*Lima fragilis*
Mollusks	Indo-Pac Spiny Lima	*Lima vulgaris*
Mollusks	Limas	Limidae
Mollusks	Camp Pitar Venus	*Lioconcha castrensis*
Mollusks	Hieroglyphic Venus	*Lioconcha hieroglyphica*
Mollusks	Ornate Pitar Venus	*Lioconcha ornata*
Mollusks	Scabra Periwinkle	*Littorina scabra*
Mollusks	Undulate Periwinkle	*Littorina undulata*
Mollusks	Periwinkles	*Littorinidae*
Mollusks	Lucinas	*Lucinidae*
Mollusks	Apple Tun	*Malea pomum*
Mollusks	Pinnacle Murex	*Marchia bipinnatus*
Mollusks	Fenestrate Murex	*Marchia martinetana*
Mollusks	Melampus Shells	Melampidae
Mollusks	Yellow Melampus	*Melampus luteus*
Mollusks	Flamboyant Cuttlefish	*Metasepia pfefferi*
Mollusks	Mini Lined-Bubble	*Micromelo undatus*
Mollusks	Ventricose Milda	*Milda ventricosa*
Mollusks	Miraculous Scallop	*Mirapecten mirificus*
Mollusks	Imperial Miter	*Miter imperalis*
Mollusks	Acuminate Miter	*Mitra acuminata*
Mollusks	Cardinal Miter	*Mitra cardinalis*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Mollusks	Chrysalis Miter	*Mitra chrysalis*
Mollusks	Gold-Mth Miter	*Mitra chrysostoma*
Mollusks	Coffee Miter	*Mitra coffea*
Mollusks	Contracted Miter	*Mitra contracta*
Mollusks	Kettle Miter	*Mitra cucumaria*
Mollusks	Rusty Miter	*Mitra ferruginea*
Mollusks	Strawberry Miter	*Mitra fraga*
Mollusks	Tesselate Miter	*Mitra incompta*
Mollusks	Episcopal Miter	*Mitra mitra*
Mollusks	Papal Miter	*Mitra papalis*
Mollusks	Red-Painted Miter	*Mitra rubitincta*
Mollusks	Pontifical Miter	*Mitra stictica*
Mollusks	Miter Shells	Mitridae
Mollusks	Mollusca	MOLLUSCA
Mollusks	Burnt Murex	*Murex burneus*
Mollusks	Murex Shells	Muricidae
Mollusks	Mussels	Mytilidae
Mollusks	Tragonula Murex	*Naquetia trigonulus*
Mollusks	Triquetra Murex	*Naquetia triquetra*
Mollusks	Francolina Jopas	*Nassa francolina*
Mollusks	Nassa Mud Snails	Nassariidae
Mollusks	Granulated Nassa	*Nassarius graniferus*
Mollusks	Margarite Nassa	*Nassarius margaritiferus*
Mollusks	Pimpled Basket	*Nassarius papillosus*
Mollusks	Moon Shells	Naticidae
Mollusks	Nautilus	Nautilidae
Mollusks	Chambered Nautilus	*Nautilus ponpilius*
Mollusks	Clathrus Miter	*Neocancilla clathrus*
Mollusks	Flecked Miter	*Neocancilla granitina*
Mollusks	Butterfly Miter	*Neocancilla papilio*
Mollusks	Ox-Palate Nerite	*Nerita albicilla*
Mollusks	Plicate Nerite	*Nerita plicata*
Mollusks	Polished Nerite	*Nerita polita*
Mollusks	Reticulate Nerite	*Nerita signata*
Mollusks	Nerites	Neritidae
Mollusks	Diotocardia	*O Archaeogastropoda*
Mollusks	Octopus	Octopodidae
Mollusks	Common Octopus	*Octopus cyanea*
Mollusks	Red Octopus	*Octopus luteus*
Mollusks	Ornate Octopus	*Octopus ornatus*
Mollusks	Octopus	*Octopus sp*
Mollusks	Pelagic Octopus	*Octopus sp 1*
Mollusks	Long-Armed Octopus	*Octopus sp 2*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Mollusks	Elongate Octopus	*Octopus teuthoides*
Mollusks	Amethyst Olive	*Oliva annulata*
Mollusks	Carnelian Olive	*Oliva carneola*
Mollusks	Red-Mth Olive	*Oliva miniacea*
Mollusks	Peg Olive	*Oliva paxillus*
Mollusks	Olive Shells	Olividae
Mollusks	Squids	*Order Teuthoidea*
Mollusks	True Oysters	Ostreidae
Mollusks	Cat'S Ear Otopleura	*Otopleura auriscati*
Mollusks	Common Egg Cowry	*Ovula ovum*
Mollusks	Egg Shells	Ovulidae
Mollusks	Scallops	Pectinidae
Mollusks	Crispate Venus	*Periglypta crispata*
Mollusks	Youthful Venus	*Periglypta puerpera*
Mollusks	Reticulate Venus	*Periglypta reticulata*
Mollusks	Pearl Oyster	*Pinctada margaritfera*
Mollusks	Bicolor Pen Shell	*Pinna bicolor*
Mollusks	Pen Shells	Pinnidae
Mollusks	Breast-Shaped Moon	*Polinices mamatus*
Mollusks	Pear-Shaped Moon	*Polinices tumidus*
Mollusks	Strawberry Goblet	*Pollia fragaria*
Mollusks	Beautiful Goblet	*Pollia pulchra*
Mollusks	Fruit Ovula	*Prionovula fruticum*
Mollusks	Pearl Oysters	Pteriidae
Mollusks	Crenulate Miter	*Pterygia crenulata*
Mollusks	Fenestrate Miter	*Pterygia fenestrata*
Mollusks	Nut Miter	*Pterygia nucea*
Mollusks	Rough Miter	*Pterygia scabricula*
Mollusks	Club Murex	*Pterynotus elongatus*
Mollusks	Fluted Murex	*Pterynotus laqueatus*
Mollusks	3-Winged Murex	*Pterynotus tripterus*
Mollusks	Solid Pupa	*Pupa solidula*
Mollusks	Perssian Purpura	*Purpura persica*
Mollusks	Sulcate Pyram	*Pyramidella sulcata*
Mollusks	Pyram Shells	*Pyramidellidae*
Mollusks	Quoy'S Coral Shell	*Quoyula madreporarum*
Mollusks	Rapa Snail	*Rapa rapa*
Mollusks	Rough Vertigus	*Rhinoclavis aspera*
Mollusks	Obelisk Vertigus	*Rhinoclavis sinensis*
Mollusks	Chaste Miter	*Sabricola casta*
Mollusks	Tiger Scallop	*Semipallium tigris*
Mollusks	Broadclub Cuttlefish	*Sepia latimanus*
Mollusks	Cuttlefish	*Sepia sp.*

Mariana CREMUS (Guam)	**Common Name**	**Scientific Name**
Mollusks	Bigfin Reef Squid	*Sepioteuthis lessoniana*
Mollusks	Box Mussel	*Septifer bilocularis*
Mollusks	Lacy Murex	*Siratus laciniatus*
Mollusks	Thorny Oysters	*Spondylidae*
Mollusks	Ducal Thorny Oyster	*Spondyulus squamosus*
Mollusks	Baggy Pen Shell	*Streptopinna saccata*
Mollusks	True Conchs	Strombidae
Mollusks	Samar Conch	*Strombus dentatus*
Mollusks	Fragile Conch	*Strombus fragilis*
Mollusks	Gibbose Conch	*Strombus gibberulus*
Mollusks	Lavender-Mouth Conch	*Strombus haemastoma*
Mollusks	Silver-Lip Conch	*Strombus lentigninosus*
Mollusks	Red-Lip Conch	*Strombus luhuanus*
Mollusks	Micro Conch	*Strombus microurceus*
Mollusks	Mutable Conch	*Strombus mutabilis*
Mollusks	Pretty Conch	*Strombus plicatus*
Mollusks	Laciniate Conch	*Strombus sinuatus*
Mollusks	Bull Conch	*Strombus taurus*
Mollusks	Pyramid Top	*Tectus pyramis*
Mollusks	Box-Like Tellin	*Tellina capsoides*
Mollusks	Cat'S Tongue Tellin	*Tellina linguafelis*
Mollusks	Remie'S Tellin	*Tellina remies*
Mollusks	Rasp Tellin	*Tellina scobinata*
Mollusks	Tellin Clams	Tellinidae
Mollusks	Terebellum Conch	*Terebellum terebellum*
Mollusks	Similar Auger	*Terebra affinis*
Mollusks	Fly-Spotted Auger	*Terebra areolata*
Mollusks	Eyed Auger	*Terebra argus*
Mollusks	Babylonian Auger	*Terebra babylonia*
Mollusks	Certhlike Auger	*Terebra cerithiana*
Mollusks	Short Auger	*Terebra chlorata*
Mollusks	Crenulated Auger	*Terebra crenulata*
Mollusks	Dimidiate Auger	*Terebra dimidiata*
Mollusks	Tiger Auger	*Terebra felina*
Mollusks	Funnel Auger	*Terebra funiculata*
Mollusks	Spotted Auger	*Terebra gutatta*
Mollusks	Marlinspike Auger	*Terebra maculata*
Mollusks	Cloud Auger	*Terebra nubulosa*
Mollusks	Subulate Auger	*Terebra subulata*
Mollusks	Undulate Auger	*Terebra undulata*
Mollusks	Auger Shells	Terebridae
Mollusks	Belligerent Rock Shell	*Thais armigera*
Mollusks	Tuberose Rock Shell	*Thais tuberosa*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Mollusks	Partridge Tun	*Tonna perdix*
Mollusks	Tun Shells	Tonnidae
Mollusks	Angulate Cockle	*Trachycardium angulatum*
Mollusks	Giant Clam	*Tridacna crocea*
Mollusks	Lagoon Giant Clam	*Tridacna derasa*
Mollusks	Giant Clam	*Tridacna gigas*
Mollusks	Common Giant Clam	*Tridacna maxima*
Mollusks	Fluted Giant Clam	*Tridacna squamosa*
Mollusks	Giant Clams	Tridacnidae
Mollusks	Top Shells	Trochidae
Mollusks	Top Shell	*Trochus niloticus*
Mollusks	Radiate Top	*Trochus radiatus*
Mollusks	Vases	Turbinellidae
Mollusks	Turban Shell	Turbinidae
Mollusks	Silver-Mouth Turbin	*Turbo argyrostoma*
Mollusks	Tapestry Turbin	*Turbo petholatus*
Mollusks	Rough Turbin	*Turbo setosus*
Mollusks	Ceramic Vase	*Vasum ceramicum*
Mollusks	Common Pacific Vase	*Vasum turbinellus*
Mollusks	Venus Shells	Veneridae
Mollusks	Bernhard'S Miter	*Vexillum bernhardiana*
Mollusks	Cancellaria Miter	*Vexillum cancellarioides*
Mollusks	Saffron Miter	*Vexillum crocatum*
Mollusks	Roughened Miter	*Vexillum exasperatum*
Mollusks	Patriarchal Miter	*Vexillum patriarchalis*
Mollusks	Half-Banded Miter	*Vexillum semifasciatum*
Mollusks	Specious Miter	*Vexillum speciosum*
Mollusks	Bumpy Miter	*Vexillum tuberosum*
Mollusks	Turbin Miter	*Vexillum turbin*
Mollusks	Decorated Miter	*Vexillum unifasciatum*
Mollusks	Spotted Vitularia	*Vitularia miliaris*
Rabbitfish	Manahak (Forktail Rabbitfish)	*Siganus aregenteus*
Rabbitfish	Manahak	*Siganus sp*
Rabbitfish	Rabbitfish	Siganidae
Rabbitfish	Fork-Tail Rabbitfish	*Siganus argenteus*
Rabbitfish	Seagrass Rabbitfish	*Siganus canaliculatus*
Rabbitfish	Coral Rabbitfish	*Siganus corallinus*
Rabbitfish	Pencil-Streaked Rabbitfish	*Siganus doliatus*
Rabbitfish	Fuscescens Rabbitfish	*Siganus fuscescens*
Rabbitfish	Golden Rabbitfish	*Siganus guttatus*
Rabbitfish	Lined Rabbitfish	*Siganus lineatus*
Rabbitfish	White-Spotted Rabbitfish	*Siganus oramin*
Rabbitfish	Masked Rabbitfish	*Siganus puellus*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Rabbitfish	Peppered Rabbitfish	*Siganus punctatissimus*
Rabbitfish	Gold-Spotted Rabbitfish	*Siganus punctatus*
Rabbitfish	Randal'S Rabbitfish	*Siganus randalli*
Rabbitfish	Scribbled Rabbitfish	*Siganus spinus*
Rabbitfish	Vermiculated Rabbitfish	*Siganus vermiculatus*
Rabbitfish	Rabbitfish	*Siganus vulpinus*
Snappers	Snappers	Lutjanidae
Snappers	River Snapper	*Lutjanus argentimaculatus*
Snappers	Two-Spot Snapper	*Lutjanus biguttatus*
Snappers	Red Snapper	*Lutjanus bohar*
Snappers	Snapper	*Lutjanus boutton*
Snappers	Checkered Snapper	*Lutjanus decussatus*
Snappers	Blackspot Snapper	*Lutjanus ehrenbergi*
Snappers	Snapper	*Lutjanus fulviflamma*
Snappers	Flametail Snapper	*Lutjanus fulvus*
Snappers	Humpback Snapper	*Lutjanus gibbus*
Snappers	Malabar Snapper	*Lutjanus malabaricus*
Snappers	Onespot Snapper	*Lutjanus monostigma*
Snappers	Scribbled Snapper	*Lutjanus rivulatus*
Snappers	Snapper	*Lutjanus sebae*
Snappers	1/2-Barred Snapper	*Lutjanus semicinctus*
Snappers	One-Lined Snapper	*Lutjanus vitta*
Snappers	Bl And Wh Snapper	*Macolor macularis*
Snappers	Black Snapper	*Macolor niger*
Snappers	Fusilier	*Paracaesio sordidus*
Snappers	Yellowtail Fusilier	*Paracaesio xanthurus*
Snappers	Deepwater Snapper	*Randallichthys filamentosus*
Snappers	Shallow Snappers	SHALLOW SNAPPERS
Snappers	Sailfin Snapper	*Symphorichthys spilurus*
Groupers	Red-Flushed Grouper	*Aethaloperca rogaa*
Groupers	Grouper	*Anyperodon leucogrammicus*
Groupers	Orange Grouper	*Cephalopholis analis*
Groupers	Peacock Grouper	*Cephalopholis argus*
Groupers	Brownbarred Grouper	*Cephalopholis boenack*
Groupers	Ybanded Grouper	*Cephalopholis igarashiensis*
Groupers	Leopard Grouper	*Cephalopholis leopardus*
Groupers	Coral Grouper	*Cephalopholis miniata*
Groupers	Harlequin Grouper	*Cephalopholis polleni*
Groupers	6-Banded Grouper	*Cephalopholis sexmaculata*
Groupers	Tomato Grouper	*Cephalopholis sonnerati*
Groupers	Grouper	*Cephalopholis sp*
Groupers	Pygmy Grouper	*Cephalopholis spiloparaea*
Groupers	Flag-Tailed Grouper	*Cephalopholis urodeta*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Groupers	Grouper	*Cromileptes altivelis*
Groupers	Orange Grouper	*Epinephelus caeruleopunctatus*
Groupers	Brown-Spotted Grouper	*Epinephelus chlorostigma*
Groupers	Grouper	*Epinephelus corallicola*
Groupers	Grouper	*Epinephelus cyanopodus*
Groupers	Blotchy Grouper	*Epinephelus fuscoguttatus*
Groupers	Hexagon Grouper	*Epinephelus hexagonatus*
Groupers	Grouper	*Epinephelus howlandi*
Groupers	Giant Grouper	*Epinephelus lanceolatus*
Groupers	Grouper	*Epinephelus macrospilos*
Groupers	Highfin Grouper	*Epinephelus maculatus*
Groupers	Malabar Grouper	*Epinephelus malabaricus*
Groupers	Bl-Spot Honeycomb Grouper	*Epinephelus melanostigma*
Groupers	Honeycomb Grouper	*Epinephelus merra*
Groupers	Grouper	*Epinephelus miliaris*
Groupers	Grouper	*Epinephelus morrhua*
Groupers	Wavy-Lined Grouper	*Epinephelus ongus*
Groupers	Marbled Grouper	*Epinephelus polyphekadion*
Groupers	Grouper	*Epinephelus retouti*
Groupers	7-Banded Grouper	*Epinephelus septemfasciatus*
Groupers	Tidepool Grouper	*Epinephelus socialis*
Groupers	4-Saddle Grouper	*Epinephelus spilotoceps*
Groupers	Greasy Grouper	*Epinephelus tauvina*
Groupers	Truncated Grouper	*Epinephelus truncatus*
Groupers	Wh-Margined Grouper	*Gracila albomarginata*
Groupers	Squaretail Grouper	*Plectropomus areolatus*
Groupers	Saddleback Grouper	*Plectropomus laevis*
Groupers	Leopard Coral Trout	*Plectropomus leopardus*
Groupers	Blue-Lined Coral Trout	*Plectropomus oligacanthus*
Groupers	Powell'S Grouper	*Saloptia powelli*
Groupers	Sea Basses,Groupers	Serranidae
Groupers	Whmargin Lyretail Grouper	*Variola albimarginata*
Mullet	Fringelip Mullet	*Crenimugil crenilabis*
Mullet	Yellowtail Mullet	*Ellochelon vaigiensis*
Mullet	Engel'S Mullet	*Moolgarda engeli*
Mullet	Bluespot Mullet	*Moolgarda seheli*
Mullet	Gray Mullet	*Mugil cephalus*
Mullet	Mullets	Mugilidae
Mullet	Acute-Jawed Mullet	*Neomyxus leuciscus*
Rudderfish	Rudderfish	*Kyphosidae*
Rudderfish	Insular Rudderfish	*Kyphosus bigibbus*
Rudderfish	Highfin Rudderfish	*Kyphosus cinerascens*
Rudderfish	Lowfin Rudderfish	*Kyphosus vaigiensis*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Crustaceans	Spider Crab	*Achaeus japonicus*
Crustaceans	Snapping Shrimp	Alphaeidae
Crustaceans	Snapping Shrimp	*Alpheus bellulus*
Crustaceans	Snapping Shrimp	*Alpheus paracrinitus*
Crustaceans	Anchylomerids	*Anchylomeridae*
Crustaceans	Slipper Lobster	*Arctides regalis*
Crustaceans	Acorn Barnacle	*Balanus sp*
Crustaceans	Mantis Shrimp	*Bathysquillidae*
Crustaceans	Box Crab	*Calappa bicornis*
Crustaceans	Box Crab	*Calappa calappa*
Crustaceans	Box Crab	*Calappa hepatica*
Crustaceans	Box Crabs	Calappidae
Crustaceans	Decorator Crab	*Camposcia retusa*
Crustaceans	Cancrids	Cancridae
Crustaceans	7-11 Crab	*Carpilius convexus*
Crustaceans	7-11 Crab	*Carpilius maculatus*
Crustaceans	Red-Legged Sw Crab	*Charybdis erythrodactyla*
Crustaceans	Red Sw Crab	*Charybdis hawaiiensis*
Crustaceans	Box Crab	*Cycloes granulosa*
Crustaceans	Elbow Crab	*Daldorfia horrida*
Crustaceans	Marine Hermit Crab	*Dardanus gemmatus*
Crustaceans	Marine Hermit Crab	*Dardanus megistos*
Crustaceans	Marine Hermit Crab	*Dardanus pendunculatus*
Crustaceans	Marine Hermit Crab	*Dardanus sp.*
Crustaceans	Commensal Shrimp	*Dasycaris zanzibarica*
Crustaceans	Decapod Crustaceans	*Decapoda*
Crustaceans	Marine Hermit Crabs	Diogenidae
Crustaceans	Dorippid Crab	*Dorippe frascone*
Crustaceans	Sponge Crab	*Dromia dormia*
Crustaceans	Sponge Crabs	Dromiidae
Crustaceans	Mole Crab	*Emerita pacifica*
Crustaceans	Soft Lobster	*Enoplometopus debelius*
Crustaceans	Hairy Lobster	*Enoplometopus occidentalis*
Crustaceans	Redeye Crab	*Eriphia sebana*
Crustaceans	Red-Reef Crab	*Etisus dentatus*
Crustaceans	Red-Reef Crab	*Etisus splendidus*
Crustaceans	Brown-Reef Crab	*Etisus utilis*
Crustaceans	Mantis Shrimp	Eurysquillidae
Crustaceans	Squat Lobsters	Galatheidae
Crustaceans	Gecarcinids	Gecarcinidae
Crustaceans	Bbee And Harlequin Shrimp	Gnathophyllidae
Crustaceans	Bumblebee Shrimp	*Gnathophylloides mineri*
Crustaceans	Bumblebee Shrimp	*Gnathophyllum americanum*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Crustaceans	Mantis Shrimp	*Gonodactylaceus mutatus*
Crustaceans	Mantis Shrimp	*Gonodactylellus affinis*
Crustaceans	Mantis Shrimp	*Gonodactylidae*
Crustaceans	Mantis Shrimp	*Gonodactylus chiragra*
Crustaceans	Mantis Shrimp	*Gonodactylus platysoma*
Crustaceans	Mantis Shrimp	*Gonodactylus smithii*
Crustaceans	Shore Crabs	Grapsidae
Crustaceans	Shore Crab	*Grapsus albolineatus*
Crustaceans	Shore Crab	*Grapsus grapsus tenuicrustat*
Crustaceans	Hapalocarcinids	Hapalocarcinidae
Crustaceans	Mantis Shrimp	Harposquillidae
Crustaceans	Mantis Shrimp	Hemisquillidae
Crustaceans	Deepwater Shrimps	*Heteropenaeus sp*
Crustaceans	Hump-Backed Shrimp	Hippolytidae
Crustaceans	Homolids	Homolidae
Crustaceans	Soft Lobster	*Hoplometopus holthuisi*
Crustaceans	Harlequin Shrimp	*Hymenocera picta*
Crustaceans	Hyperid Amphipods	Hyperiidae
Crustaceans	Slipper Lobster	*Ibacus sp*
Crustaceans	True Crabs	*Io Brachyura*
Crustaceans	Long-Handed Lobster	*Justitia longimanus*
Crustaceans	Hump-Backed Shrimp	*Koror misticius*
Crustaceans	Elbow Crab	*Lambrus longispinis*
Crustaceans	Palaemonid Shrimp	*Leander plumosus*
Crustaceans	Lithodids	Lithodidae
Crustaceans	Swimming Crab	*Lupocyclus grimquedentatus*
Crustaceans	Lycaeids	Lycaeidae
Crustaceans	3-Toothed Frog Crab	*Lyreidus tridentatus*
Crustaceans	Mantis Shrimp	Lysiosquillidae
Crustaceans	Barnacles	Lythoglyptidae
Crustaceans	Telescope-Eye Crab	*Macrophthalmus telescopicus*
Crustaceans	Spider Crabs	Majidae
Crustaceans	Penaeid Prawn	*Metapenaeopsis sp 1*
Crustaceans	Penaeid Prawn	*Metapenaeopsis sp 2*
Crustaceans	Penaeid Prawn	*Metapenaeopsis sp 3*
Crustaceans	Box Crab	*Mursia spinimanus*
Crustaceans	Mantis Shrimp	Nannosquillidae
Crustaceans	Soft Lobsters	Nephropidae
Crustaceans	Large Ghost Crab	*Ocypode ceratopthalma*
Crustaceans	Ghost Crab	*Ocypode cordimana*
Crustaceans	Ghost Crab	*Ocypode saratum*
Crustaceans	Ocypodids	Ocypodidae
Crustaceans	Mantis Shrimp	Odontodactylidae

Mariana CREMUS (Guam)	Common Name	Scientific Name
Crustaceans	Mantis Shrimp	*Odontodactylus brevirostris*
Crustaceans	Mantis Shrimp	*Odontodactylus scyallarus*
Crustaceans	Mantis Shrimp	*Oratosquilla oratoria*
Crustaceans	Mantis Shrimp	Oratosquillidae
Crustaceans	Soldier Hermit Crab	Paguridae
Crustaceans	Coral Hermit Crab	*Paguritta gracilipes*
Crustaceans	Coral Hermit Crab	*Paguritta harmsi*
Crustaceans	Palaemonid Shrimp	Palaemonidae
Crustaceans	Mole Lobster	*Palinurellus wieneckii*
Crustaceans	Painted Crayfish	*Panulirus albiflagellum*
Crustaceans	Painted Crayfish	*Panulirus versicolor*
Crustaceans	Elbow Crabs	Parthenopidae
Crustaceans	Panaeid Prawns	Penaeidae
Crustaceans	Penaeid Prawn	*Penaeus latisulcatus*
Crustaceans	Penaeid Prawn	*Penaeus monodon*
Crustaceans	Flat Rock Crab	*Percnon planissimum*
Crustaceans	Commensal Shrimp	*Periclimenes amboinensis*
Crustaceans	Commensal Shrimp	*Periclimenes brevicarpalis*
Crustaceans	Commensal Shrimp	*Periclimenes cf ceratophthalmus*
Crustaceans	Commensal Shrimp	*Periclimenes holthuisi*
Crustaceans	Commensal Shrimp	*Periclimenes imperator*
Crustaceans	Commensal Shrimp	*Periclimenes inornatus*
Crustaceans	Commensal Shrimp	*Periclimenes kororensis*
Crustaceans	Commensal Shrimp	*Periclimenes ornatus*
Crustaceans	Commensal Shrimp	*Periclimenes psamathe*
Crustaceans	Commensal Shrimp	*Periclimenes soror*
Crustaceans	Commensal Shrimp	*Periclimenes tenuipes*
Crustaceans	Commensal Shrimp	*Periclimenes venustus*
Crustaceans	Porcelain Crab	*Petrolisthes lamarkii*
Crustaceans	Phronimids	Phronimidae
Crustaceans	Shore Crab	*Plagusia depressa tuberculata*
Crustaceans	Platyscelids	*Platyscelidae*
Crustaceans	Commensal Shrimp	*Pliopotonia furtiva*
Crustaceans	Long-Eyed Swimming Crab	*Podophthalmus vigil*
Crustaceans	Commensal Shrimp	*Pontonides uncigar*
Crustaceans	Commensal Shrimp	Pontoniidae
Crustaceans	Porcellanid Crabs	Porcellanidae
Crustaceans	Swimming Crabs	Portunidae
Crustaceans	Blue Swimming Crab	*Portunus pelagicus*
Crustaceans	Swimming Crab	*Portunus sanguinolentus*
Crustaceans	Mantis Shrimp	Protosquillidae
Crustaceans	Mantis Shrimp	*Pseudosquilla ciliata*
Crustaceans	Mantis Shrimp	Pseudosquillidae

Mariana CREMUS (Guam)	Common Name	Scientific Name
Crustaceans	Hingebeak Prawn	*Rhinchocinetes hiatti*
Crustaceans	Hinge-Beaked Prawns	*Rhynchocinetidae*
Crustaceans	Mangrove Crab	*Scylla serrata*
Crustaceans	Solenocerids	*Solenoceridae*
Crustaceans	Mantis Shrimp	*Squillidae*
Crustaceans	Commensal Shrimp	*Stegopontonia commensalis*
Crustaceans	Cleaner Shrimp	*Stenopodidae*
Crustaceans	Banded Coral Shrimp	*Stenopus hispidus*
Crustaceans	Mantis Shrimps	*Stomatopoda*
Crustaceans	Snapping Shrimp	*Synalpheus carinatus*
Crustaceans	Acorn Barnacle	*Tetraclitella divisa*
Crustaceans	Swimming Crab	*Thalamita crenata*
Crustaceans	Ambonian Shrimp	*Thor amboinensis*
Crustaceans	Xanthid Crab	*Unid Megalops*
Crustaceans	Portunid Crab	*Unid sp 1*
Crustaceans	Xanthid Crab	*Unid sp 1*
Crustaceans	Portunid Crab	*Unid sp 2*
Crustaceans	Xanthid Crab	*Unid sp 2*
Crustaceans	Palaemonid Shrimp	*Urocaridella antonbruunii*
Crustaceans	Dark-Finger Coral Crabs	*Xanthidae*
Crustaceans	Urchin Crab	*Zebrida adamsii*
Crustaceans	Shallow Reef Crab	*Zosymus aeneus*
Squirrelfish	Squirrel,Soldierfishes	Holocentridae
Squirrelfish	Squirrelfishes	Holocentrinae
Squirrelfish	Soldierfishes	Myripristinae
Squirrelfish	Bronze Soldierfish	*Myripristis adusta*
Squirrelfish	Brick Soilderfish	*Myripristis amaena*
Squirrelfish	Doubletooth Soldierfish	*Myripristis amaena*
Squirrelfish	Bigscale Soldierfish	*Myripristis berndti*
Squirrelfish	Yellowfin Soldierfish	*Myripristis chryseres*
Squirrelfish	Pearly Soldierfish	*Myripristis kuntee*
Squirrelfish	Red Soldierfish	*Myripristis murdjan*
Squirrelfish	Scarlet Soldierfish	*Myripristis pralinia*
Squirrelfish	Violet Soldierfish	*Myripristis violacea*
Squirrelfish	White-Tipped Soldierfish	*Myripristis vittata*
Squirrelfish	White-Spot Soldierfish	*Myripristis woodsi*
Squirrelfish	Clearfin Squirrelfish	*Neoniphon argenteus*
Squirrelfish	Yellowstriped Squirrelfish	*Neoniphon aurolineatus*
Squirrelfish	Blackfin Squirrlefish	*Neoniphon opercularis*
Squirrelfish	Bloodspot Squirrelfish	*Neoniphon sammara*
Squirrelfish	Deepwater Soldierfish	*Ostichthys brachygnathus*
Squirrelfish	Deepwater Soldierfish	*Ostichthys kaianus*
Squirrelfish	Cardinal Squirrelfish	*Plectrypops lima*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Squirrelfish	Tailspot Squirrelfish	*Sargocentron caudimaculatum*
Squirrelfish	3-Spot Squirrelfish	*Sargocentron cornutum*
Squirrelfish	Crown Squirrelfish	*Sargocentron diadema*
Squirrelfish	Spotfin Squirrelfish	*Sargocentron dorsomaculatum*
Squirrelfish	Furcate Squirrelfish	*Sargocentron furcatum*
Squirrelfish	Samurai Squirrelfish	*Sargocentron ittodai*
Squirrelfish	Squirrelfish	*Sargocentron lepros*
Squirrelfish	Blackspot Squirrelfish	*Sargocentron melanospilos*
Squirrelfish	Finelined Squirrelfish	*Sargocentron microstoma*
Squirrelfish	Dark-Striped Squirrelfish	*Sargocentron praslin*
Squirrelfish	Speckled Squirrelfish	*Sargocentron punctatissimum*
Squirrelfish	Long-Jawed Squirrelfish	*Sargocentron spiniferum*
Squirrelfish	Blue-Lined Squirrelfish	*Sargocentron tiere*
Squirrelfish	Pink Squirrelfish	*Sargocentron tieroides*
Squirrelfish	Violet Squirrelfish	*Sargocentron violaceum*
Wrasse	Chiseltooth Wrasse	*Anampses caeruleopunctatus*
Wrasse	Geographic Wrasse	*Anampses geographicus*
Wrasse	Wrasse	*Anampses melanurus*
Wrasse	Yellowtail Wrasse	*Anampses meleagrides*
Wrasse	Yellowbreasted Wrasse	*Anampses twisti*
Wrasse	Lyretail Hogfish	*Bodianus anthioides*
Wrasse	Axilspot Hogfish	*Bodianus axillaris*
Wrasse	2-Spot Slender Hogfish	*Bodianus bimaculatus*
Wrasse	Diana'S Hogfish	*Bodianus diana*
Wrasse	Blackfin Hogfish	*Bodianus loxozonus*
Wrasse	Mesothorax Hogfish	*Bodianus mesothorax*
Wrasse	Hogfish	*Bodianus tanyokidus*
Wrasse	Floral Wrasse	*Cheilinus chlorourus*
Wrasse	Red-Breasted Wrasse	*Cheilinus fasciatus*
Wrasse	Snooty Wrasse	*Cheilinus oxycephalus*
Wrasse	Tripletail Wrasse	*Cheilinus trilobatus*
Wrasse	Cigar Wrasse	*Cheilio inermis*
Wrasse	Yel-Cheeked Tuskfish	*Choerodon anchorago*
Wrasse	Harlequin Tuskfish	*Choerodon fasciatus*
Wrasse	Wrasse	*Cirrhilabrus balteatus*
Wrasse	Wrasse	*Cirrhilabrus cyanopleura*
Wrasse	Exquisite Wrasse	*Cirrhilabrus exquisitus*
Wrasse	Johnson'S Wrasse	*Cirrhilabrus johnsoni*
Wrasse	Wrasse	*Cirrhilabrus katherinae*
Wrasse	Yellowband Wrasse	*Cirrhilabrus luteovittatus*
Wrasse	Rhomboid Wrasse	*Cirrhilabrus rhomboidalis*
Wrasse	Red-Margined Wrasse	*Cirrhilabrus rubrimarginatus*
Wrasse	Clown Coris	*Coris aygula*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Wrasse	Dapple Coris	*Coris batuensis*
Wrasse	Pale-Barred Coris	*Coris dorsomacula*
Wrasse	Yellowtailed Coris	*Coris gaimardi*
Wrasse	Knife Razorfish	*Cymolutes praetextatus*
Wrasse	Finescale Razorfish	*Cymolutes torquatus*
Wrasse	Wandering Cleaner Wrasse	*Diproctacanthus xanthurus*
Wrasse	Sling-Jawed Wrasse	*Epibulus insidiator*
Wrasse	Sling-Jawed Wrasse	*Epibulus n sp*
Wrasse	Bird Wrasse	*Gomphosus varius*
Wrasse	2-Spotted Wrasse	*Halichoeres biocellatus*
Wrasse	Drab Wrasse	*Halichoeres chloropterus*
Wrasse	Canary Wrasse	*Halichoeres chrysus*
Wrasse	Wrasse	*Halichoeres dussumieri*
Wrasse	Checkerboard Wrasse	*Halichoeres hortulanus*
Wrasse	Weedy Surge Wrasse	*Halichoeres margaritaceus*
Wrasse	Dusky Wrasse	*Halichoeres marginatus*
Wrasse	Pinstriped Wrasse	*Halichoeres melanurus*
Wrasse	Black-Ear Wrasse	*Halichoeres melasmapomus*
Wrasse	Ornate Wrasse	*Halichoeres ornatissimus*
Wrasse	Seagrass Wrasse	*Halichoeres papilionaceus*
Wrasse	Wrasse	*Halichoeres prosopeion*
Wrasse	Wrasse	*Halichoeres purpurascens*
Wrasse	Richmond'S Wrasse	*Halichoeres richmondi*
Wrasse	Zigzag Wrasse	*Halichoeres scapularis*
Wrasse	Shwartz Wrasse	*Halichoeres shwartzi*
Wrasse	Wrasse	*Halichoeres sp*
Wrasse	3-Spot Wrasse	*Halichoeres trimaculatus*
Wrasse	Wrasse	*Halichoeres zeylonicus*
Wrasse	Striped Clown Wrasse	*Hemigymnus fasciatus*
Wrasse	1/2 &1/2 Wrasse	*Hemigymnus melapterus*
Wrasse	Wrasse	*Hologymnosus annulatus*
Wrasse	Ring Wrasse	*Hologymnosus doliatus*
Wrasse	Tubelip Wrasse	*Labrichthys unilineatus*
Wrasse	Bicolor Cleaner Wrasse	*Labroides bicolor*
Wrasse	Bluestreak Cleaner Wrasse	*Labroides dimidiatus*
Wrasse	Black-Spot Cleaner Wrasse	*Labroides pectoralis*
Wrasse	Allen'S Wrasse	*Labropsis alleni*
Wrasse	Micronesian Wrasse	*Labropsis micronesica*
Wrasse	Wedge-Tailed Wrasse	*Labropsis xanthonota*
Wrasse	Leopard Wrasse	*Macropharyngodon meleagris*
Wrasse	Negros Wrasse	*Macropharyngodon negrosensis*
Wrasse	Seagrass Razorfish	*Novaculichthys macrolepidotus*
Wrasse	Dragon Wrasse	*Novaculichthys taeniourus*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Wrasse	Arenatus Wrasse	*Oxycheilinus arenatus*
Wrasse	2-Spot Wrasse	*Oxycheilinus bimaculatus*
Wrasse	Celebes Wrasse	*Oxycheilinus celebecus*
Wrasse	Bandcheek Wrasse	*Oxycheilinus digrammus*
Wrasse	Oriental Wrasse	*Oxycheilinus orientalis*
Wrasse	Ringtail Wrasse	*Oxycheilinus unifasciatus*
Wrasse	Wrasse	*Paracheilinus bellae*
Wrasse	Wrasse	*Paracheilinus sp*
Wrasse	Wrasse	*Polylepion russelli*
Wrasse	Wrasse	*Pseudocheilinops ataenia*
Wrasse	Striated Wrasse	*Pseudocheilinus evanidus*
Wrasse	6 Line Wrasse	*Pseudocheilinus hexataenia*
Wrasse	8 Line Wrasse	*Pseudocheilinus octotaenia*
Wrasse	Line Wrasse	*Pseudocheilinus sp*
Wrasse	4 Line Wrasse	*Pseudocheilinus tetrataenia*
Wrasse	Rust-Banded Wrasse	*Pseudocoris aurantiofasciata*
Wrasse	Torpedo Wrasse	*Pseudocoris heteroptera*
Wrasse	Yamashiro'S Wrasse	*Pseudocoris yamashiroi*
Wrasse	Chiseltooth Wrasse	*Pseudodax moluccanus*
Wrasse	Polynesian Wrasse	*Pseudojuloides atavai*
Wrasse	Smalltail Wrasse	*Pseudojuloides cerasinus*
Wrasse	Wrasse	*Pterogogus cryptus*
Wrasse	Wrasse	*Pterogogus guttatus*
Wrasse	Red-Shoulder Wrasse	*Stethojulis bandanensis*
Wrasse	Wrasse	*Stethojulis strigiventor*
Wrasse	Wrasse	*Stethojulis trilineata*
Wrasse	2 Tone Wrasse	*Thalassoma amblycephalum*
Wrasse	6 Bar Wrasse	*Thalassoma hardwickii*
Wrasse	Jansen'S Wrasse	*Thalassoma janseni*
Wrasse	Crescent Wrasse	*Thalassoma lunare*
Wrasse	Sunset Wrasse	*Thalassoma lutescens*
Wrasse	Surge Wrasse	*Thalassoma purpureum*
Wrasse	5-Stripe Surge Wrasse	*Thalassoma quinquevittatum*
Wrasse	Xmas Wrasse	*Thalassoma trilobatum*
Wrasse	Wh-Barred Pygmy Wrasse	*Wetmorella albofasciata*
Wrasse	Bl-Spot Pygmy Wrasse	*Wetmorella nigropinnata*
Wrasse	Wrasse	*Xiphocheilus sp*
Wrasse	Yblotch Razorfish	*Xyrichtys aneitensis*
Wrasse	Celebe'S Razorfish	*Xyrichtys celebecus*
Wrasse	Razorfish	*Xyrichtys geisha*
Wrasse	Yellowpatch Razorfish	*Xyrichtys melanopus*
Wrasse	Blue Razorfish	*Xyrichtys pavo*
Other	Starry Triggerfish	*Abalistes stellatus*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Other	Barred Needlefish	*Ablennes hians*
Other	Blackspot Sergeant	*Abudefduf lorenzi*
Other	Yellowtail Sergeant	*Abudefduf notatus*
Other	Banded Sergeant	*Abudefduf septemfasciatus*
Other	Scis-Tail Sgt Major	*Abudefduf sexfasciatus*
Other	Black Spot Sergeant	*Abudefduf sordidus*
Other	Sergeant-Major	*Abudefduf vaigiensis*
Other	Spiney Basslets	Acanthoclinidae
Other	Hiatt'S Basslet	*Acathoplesiops hiatti*
Other	Goby	*Acentrogobius bonti*
Other	Seagrass Filefish	*Acreichthys tomentosus*
Other	Shrimpfish	*Aeoliscus strigatus*
Other	Spotted Eagle Ray	*Aetobatis narinari*
Other	Eagle Ray	*Aetomyleaus maculatus*
Other	Indo-Pacific Bonefish	*Albula glossodonta*
Other	Bonefish	*Albula neoguinaica*
Other	Bonefish	Albulidae
Other	Lancetfishes	Alepisauidae
Other	Lancetfish	*Alepisaurus ferox*
Other	Dorothea'S Wriggler	*Allomicrodesmis dorotheae*
Other	Blenny	*Alticus arnoldorum*
Other	Unicorn Filefish	*Aluterus monoceros*
Other	Filefish	*Aluterus scriptus*
Other	Filefish	*Amanses scopas*
Other	Glass Perch	Ambassidae
Other	Glassie	*Ambassis buruensis*
Other	Glassie	*Ambassis interrupta*
Other	2-Spot Hawkfish	*Amblycirrhitus bimacula*
Other	Goby	*Amblyeleotris faciata*
Other	Goby	*Amblyeleotris fontaseni*
Other	Goby	*Amblyeleotris guttata*
Other	Goby	*Amblyeleotris randalli*
Other	Brown-Barred Goby	*Amblyeleotris steinitzi*
Other	Bluespotted Goby	*Amblyeleotris wheeleri*
Other	Blue Pilchard	*Amblygaster clupeoides*
Other	Spotted Pilchard	*Amblygaster sirm*
Other	Damselfish	*Amblygliphidodon aureus*
Other	Staghorn Damsel	*Amblygliphidodon curacao*
Other	White-Belly Damsel	*Amblygliphidodon leucogaster*
Other	Ternate Damsel	*Amblygliphidodon ternatensis*
Other	Goby	*Amblygobius decussatus*
Other	Goby	*Amblygobius hectori*
Other		*Amblygobius linki*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Other	Goby	*Amblygobius nocturnus*
Other	Goby	*Amblygobius phalaena*
Other	Goby	*Amblygobius rainfordi*
Other	Goby	*Amblygobius sp*
Other	Evileye Puffer	*Amblyrhinchotus honckenii*
Other	Prawn Goby	*Amlbyeleotris periophthalma*
Other	Org-Fin Anemonefish	*Amphiprion chrysopterus*
Other	Clark'S Anemonefish	*Amphiprion clarkii*
Other	Tomato Anemonefish	*Amphiprion frenatus*
Other	Dusky Anemonefish	*Amphiprion melanopus*
Other	False Clown Anemonefish	*Amphiprion ocellaris*
Other	Pink Anemonfish	*Amphiprion peridaeraion*
Other	3-Banded Anemonefish	*Amphiprion tricinctus*
Other	Dragonet	*Anaora tentaculata*
Other	Allardice'S Moray	*Anarchias allardicei*
Other	Canton Island Moray	*Anarchias cantonensis*
Other	Seychelles Moray	*Anarchias seychellensis*
Other	Freshwater Eel	*Anguilla bicolor*
Other	Freshwater Eel	*Anguilla marmorata*
Other	Freshwater Eel	Anguillidae
Other	Flashlightfish	Anomalopidae
Other	Flashlightfish	*Anomalops katoptron*
Other	Anglerfish	*Antenariidae*
Other	Pigmy Frogfish	*Antennarius analis*
Other	Frogfish	*Antennarius biocellatus*
Other	Freckled Frogfish	*Antennarius coccineus*
Other	Giant Frogfish	*Antennarius commersonii*
Other	Bandtail Frogfish	*Antennarius dorehensis*
Other	Sargassumfish	*Antennarius maculatus*
Other	Spotfin Frogfish	*Antennarius nummifer*
Other	Painted Frogfish	*Antennarius pictus*
Other	Randall'S Frogfish	*Antennarius randalli*
Other	Spiney-Tufted Frogfish	*Antennarius rosaceus*
Other	Bandfin Frogfish	*Antennatus tuberosus*
Other	Boarfish	*Antigonia malayana*
Other	Velvetfishes	*Aploactinidae*
Other	Cardinalfish	*Apogon amboinensis*
Other	Broad-Striped Cardinalfish	*Apogon angustatus*
Other	Bigeye Cardinalfish	*Apogon bandanensis*
Other	Cryptic Cardinalfish	*Apogon coccineus*
Other	Ohcre-Striped Cardinalfish	*Apogon compressus*
Other	Redspot Cardinalfish	*Apogon dispar*
Other	Longspine Cardinalfish	*Apogon doryssa*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Other	Elliot'S Cardinalfish	*Apogon ellioiti*
Other	Cardinalfish	*Apogon eremeia*
Other	Evermann'S Cardinalfish	*Apogon evermanni*
Other	Eyeshadow Cardinalfish	*Apogon exostigma*
Other	Bridled Cardinalfish	*Apogon fraenatus*
Other	Cardinalfish	*Apogon fragilis*
Other	Gilbert'S Cardinalfish	*Apogon gilberti*
Other	Guam Cardinalfish	*Apogon guamensis*
Other		*Apogon hartzfeldii*
Other	Iridescent Cardinalfish	*Apogon kallopterus*
Other	Inshore Cardinalfish	*Apogon lateralis*
Other	Bluestreak Cardinalfish	*Apogon leptacanthus*
Other	Black Cardinalfish	*Apogon melas*
Other	Cardinalfish	*Apogon nigripinnis*
Other	Black-Striped Cardinalfish	*Apogon nigrofasciatus*
Other	Cardinalfish	*Apogon notatus*
Other	7-Lined Cardinalfish	*Apogon novemfasciatus*
Other	Pearly Cardinalfish	*Apogon perlitus*
Other	Cardinalfish	*Apogon rhodopterus*
Other	Sangi Cardinalfish	*Apogon sangiensis*
Other	Gray Cardinalfish	*Apogon savayensis*
Other	Seale'S Cardinalfish	*Apogon sealei*
Other	Cardinalfish	*Apogon sp*
Other	Bandfin Cardinalfish	*Apogon taeniophorus*
Other	Bandfin Cardinalfish	*Apogon taeniopterus*
Other	3-Spot Cardinalfish	*Apogon trimaculatus*
Other	Ocellated Cardinalfish	*Apogonichthys ocellatus*
Other	Perdix Cardinalfish	*Apogonichthys perdix*
Other	Cardinalfishes	Apogonidae
Other	Angelfish	*Apolemichthys griffisi*
Other	Flagfin Anglefish	*Apolemichthys trimaculatus*
Other	Angelfish	*Apolemichthys xanthopunctatus*
Other	2-Lined Soapfish	*Aporops bilinearis*
Other	Snake Eel	*Apterichtus klazingai*
Other	Twinspot Cardinalfish	*Archamia biguttata*
Other	Orange-Lined Cardinalfish	*Archamia fucata*
Other	Blackbelted Cardinalfish	*Archamia zosterophora*
Other	Scheele'S Conger	*Ariosoma scheelei*
Other	Flounder	*Arnoglossus intermedius*
Other	Brown Puffer	*Arothron hispidus*
Other	Puffer	*Arothron manilensis*
Other	Puffer	*Arothron mappa*
Other	White-Spot Puffer	*Arothron meleagris*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Other	Black-Spotted Puffer	*Arothron nigropunctatus*
Other	Star Puffer	*Arothron stellatus*
Other	Black Spotted Sole	*Aseraggodes melanostictus*
Other	Smith'S Sole	*Aseraggodes smithi*
Other	Whitaker'S Sole	*Aseraggodes whitakeri*
Other	Lance Blenny	*Aspidontus dussumieri*
Other	Cleaner Mimic	*Aspidontus taeniatus*
Other		*Asteropteryx semipunctatus*
Other	Intermediate Flounder	*Asterorhombus intermedius*
Other	Goby	*Asterropteryx ensiferus*
Other	Silverside	Atherinidae
Other	Tropical Silverside	*Atherinomorus duodecimalis*
Other	Striped Silverside	*Atherinomorus endrachtensis*
Other	Silverside	*Atherinomorus lacunosus*
Other	Hardyhead Silverside	*Atherinomorus lacunosus*
Other	Bearded Silverside	*Atherion elymus*
Other	Blenny	*Atrosalarius fuscus holomelas*
Other	Trumpetfish	Aulostomidae
Other	Trumpetfish	*Aulostomus chinensis*
Other	Goby	*Austrolethops wardi*
Other	Goby	*Awaous grammepomus*
Other	Goby	*Awaous guamensis*
Other	Undulate Triggerfish	*Balistapus undulatus*
Other	Triggerfishes	Balistidae
Other	Clown Triggerfish	*Balistoides conspicillum*
Other	Titan Triggerfish	*Balistoides viridescens*
Other	Goby	*Bathygobius cocosensis*
Other	Goby	*Bathygobius cotticeps*
Other	Goby	*Bathygobius fuscus*
Other	Needlefish	Belonidae
Other	Soapfish	*Belonoperca chaubanaudi*
Other	Lantern-Eye Fish	Berycidae
Other	Flashlightfish	*Beryx decadactylus*
Other	Pipefish	*Bhanotia nuda*
Other	Conger Eel	*Blachea xenobranchialis*
Other	Blenny	*Blenniella cyanostigma*
Other	Blenny	*Blenniella gibbifrons*
Other		*Blenniella paula*
Other	Blenny	*Blenniella periophthalmus*
Other	Blennies	Blenniidae
Other	Flounders	Bothidae
Other	Peacock Flounder	*Bothus mancus*
Other	Leopard Flounder	*Bothus pantherinus*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Other	Taylor'S Inflator Filefish	*Brachaluteres taylori*
Other	Snake Eel	*Brachysomophis sauropsis*
Other	Codlet	*Bregmaceros nectabanus*
Other	Codlets	*Bregmacerotidae*
Other	Free-Tailed Brotula	*Brosmophyciops pautzkei*
Other	Reef Cusk Eel	*Brotula multibarbata*
Other	Townsend'S Cusk Eel	*Brotula townsendi*
Other	Goby	*Bryaninops amplus*
Other	Goby	*Bryaninops erythrops*
Other	Goby	*Bryaninops natans*
Other	Goby	*Bryaninops ridens*
Other	Goby	*Bryaninops youngei*
Other	Pipefish	*Bulbonaricus brauni*
Other	Gudgeon	*Butis amboinensis*
Other	Livebearing Brotulas	Bythitidae
Other	Goby	*Cabillus tongarevae*
Other	Snake Eel	*Caecula polyophthalma*
Other	Scissor-Tailed Fusilier	*Caesio caerulaurea*
Other	Fusilier	*Caesio cuning*
Other	Lunar Fusilier	*Caesio lunaris*
Other	Yellowback Caesio	*Caesio teres*
Other	Fusilier	*Caesionidae*
Other	Goldies	*Callanthiidae*
Other	Snake Eel	*Callechelys marmorata*
Other	Snake Eel	*Callechelys melanotaenia*
Other	Dragonets	Callionymidae
Other	Delicate Dragonet	*Callionymus delicatulus*
Other	Mangrove Dragonet	*Callionymus enneactis*
Other	Simple-Spined Dragonet	*Callionymus simplicicornis*
Other	Goby	*Callogobious sp*
Other	Goby	*Callogobius bauchotae*
Other	Goby	*Callogobius centrolepis*
Other	Goby	*Callogobius hasselti*
Other	Goby	*Callogobius maculipinnis*
Other	Goby	*Callogobius okinawae*
Other	Goby	*Callogobius plumatus*
Other	Goby	*Callogobius sclateri*
Other	Longfin	*Calloplesiops altivelis*
Other	Sleeper	*Calumia godeffroyi*
Other	Gray Leatherjacket	*Cantherhines dumerilii*
Other	Specktacled Filefish	*Cantherhines fronticinctus*
Other	Honeycomb Filefish	*Cantherhines pardalis*
Other	Rough Triggerfish	*Canthidermis maculatus*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Other	Puffer	*Canthigaster amboinensis*
Other	Puffer	*Canthigaster bennetti*
Other	Puffer	*Canthigaster compressa*
Other	Sharp Back Puffer	*Canthigaster coronata*
Other	Puffer	*Canthigaster epilampra*
Other	Puffer	*Canthigaster janthinoptera*
Other	Puffer	*Canthigaster leoparda*
Other	Circle-Barred Toby	*Canthigaster ocellicincta*
Other	Papuan Toby	*Canthigaster papua*
Other	Sharpnose Puffer	*Canthigaster solandri*
Other	Saddle Shpns Puffer	*Canthigaster valentini*
Other	Boarfishes	Caproidae
Other	Coral Crouchers	*Caracanthidae*
Other	Velvetfish	*Caracanthus maculatus*
Other	Velvetfish	*Caracanthus unipinna*
Other	Pearlfish	*Carapodidae*
Other	Pearlfish	*Carapus mourlani*
Other	Blackfin Shark	*Carcharhinus limbatus*
Other	Great White Shark	*Carcharodon carcharius*
Other	Shrimpfishes	*Centriscidae*
Other	Golden Angelfish	*Centropyge aurantia*
Other	Bicolor Angelfish	*Centropyge bicolor*
Other	Dusky Angelfish	*Centropyge bispinosus*
Other	Colin'S Angelfish	*Centropyge colini*
Other	White-Tail Angelfish	*Centropyge flavicauda*
Other	Lemonpeel Anglefish	*Centropyge flavissimus*
Other	Herald'S Anglefish	*Centropyge heraldi*
Other	Flame Anglefish	*Centropyge loriculus*
Other	Multicolor Angelfish	*Centropyge multicolor*
Other	Multibarred Angelfish	*Centropyge multifasciatus*
Other	Black-Spot Anglefish	*Centropyge nigriocellus*
Other	Midnight Angelfish	*Centropyge nox*
Other	Shepard'S Anglefish	*Centropyge shepardi*
Other	Keyhole Angelfish	*Centropyge tibicen*
Other	Pearlscale Anglefish	*Centropyge vrolicki*
Other	Grouper	*Cephalopholis cyanostigma*
Other	Triplefin	*Ceratobregma helenae*
Other	Threadfin Butterflyfish	*Chaetodon auriga*
Other	E Triangular Butterflyfish	*Chaetodon barronessa*
Other	Bennetts Butterflyfish	*Chaetodon bennetti*
Other	Burgess' Butterflyfish	*Chaetodon burgessi*
Other	Speckled Butterflyfish	*Chaetodon citrinellus*
Other	Saddleback Butterflyfish	*Chaetodon ephippium*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Other	Ylw-Crn Butterflyfish	*Chaetodon flavocoronatus*
Other	Kleins Butterflyfish	*Chaetodon kleinii*
Other	Lined Butterflyfish	*Chaetodon lineolatus*
Other	Racoon Butterflyfish	*Chaetodon lunula*
Other	Redfinned Butterflyfish	*Chaetodon lunulatus*
Other	Black-Back Butterflyfish	*Chaetodon melannotus*
Other	Mertens Butterflyfish	*Chaetodon mertensii*
Other	Meyer'S Butterflyfish	*Chaetodon meyeri*
Other	Butterflyfish	*Chaetodon modestus*
Other	Spot-Tail Butterflyfish	*Chaetodon ocellicaudus*
Other	8-Banded Butterflyfish	*Chaetodon octofasciatus*
Other	Ornate Butterflyfish	*Chaetodon ornatissimus*
Other	Spot-Nape Butterflyfish	*Chaetodon oxycephalus*
Other	Spotbnded Butterflyfish	*Chaetodon punctatofasciatus*
Other	4-Spotted Butterflyfish	*Chaetodon quadrimaculatus*
Other	Latticed Butterflyfish	*Chaetodon rafflesii*
Other	Retculted Butterflyfish	*Chaetodon reticulatus*
Other	Dotted Butterflyfish	*Chaetodon semeion*
Other	Oval-Spot Butterflyfish	*Chaetodon speculum*
Other	Tinker'S Butterflyfish	*Chaetodon tinkeri*
Other	Chevron Butterflyfish	*Chaetodon trifascialis*
Other	Pac Dblsddl Butterflyfish	*Chaetodon ulietensis*
Other	Teardrop Butterflyfish	*Chaetodon unimaculatus*
Other	Vagabond Butterflyfish	*Chaetodon vagabundus*
Other	Butterflyfish	*Chaetodontidae*
Other	Vermiculated Angelfish	*Chaetodontoplus mesoleucus*
Other	Saddled Sandburrower	*Chalixodytes tauensis*
Other	Gaper	*Champsodon vorax*
Other	Gapers	*Champsodontidae*
Other	Milkfish	*Chanidae*
Other	Long-Jawed Moray	*Channomuraena vittata*
Other	Milkfish	*Chanos chanos*
Other	Lined Cardinalfish	*Cheilodipterus artus*
Other	Intermediate Cardinalfish	*Cheilodipterus intermedius*
Other	Cardinalfish	*Cheilodipterus isostigma*
Other	Lg-Toothed Cardinalfish	*Cheilodipterus macrodon*
Other	5-Lined Cardinalfish	*Cheilodipterus quinquelineata*
Other	Truncate Cardinalfish	*Cheilodipterus singapurensis*
Other	Flying Fish	*Cheilopogon spilonopterus*
Other	Flying Fish	*Cheilopogon spilopterus*
Other	Flying Fish	*Cheilopogon unicolor*
Other	Minstrel Fish	*Cheiloprion labiatus*
Other	Ceram Mullet	*Chelon macrolepis*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Other	False Moray Eel	Chlopsidae
Other	Pipefish	*Choeroichthys brachysoma*
Other	Pipefish	*Choeroichthys sculptus*
Other	Duckbill	*Chrionema squamiceps*
Other	Midget Chromis	*Chromis acares*
Other	Bronze Reef Chromis	*Chromis agilis*
Other	Yel-Speckled Chromis	*Chromis alpha*
Other	Ambon Chromis	*Chromis amboinensis*
Other	Yellow Chromis	*Chromis analis*
Other	Black-Axil Chromis	*Chromis atripectoralis*
Other	Dark-Fin Chromis	*Chromis atripes*
Other	Blue-Axil Chromis	*Chromis caudalis*
Other	Deep Reef Chromis	*Chromis delta*
Other	Twin-Spot Chromis	*Chromis elerae*
Other	Scaly Chromis	*Chromis lepidolepis*
Other	Lined Chromis	*Chromis lineata*
Other	Bicolor Chromis	*Chromis margaritifer*
Other	Black-Bar Chromis	*Chromis retrofasciata*
Other	Ternate Chromis	*Chromis ternatensis*
Other	Vanderbilt'S Chromis	*Chromis vanderbilti*
Other	Blue-Green Chromis	*Chromis viridis*
Other	Weber'S Chromis	*Chromis weberi*
Other	Yel-Axil Chromis	*Chromis xanthochir*
Other	Black Chromis	*Chromis xanthura*
Other	2-Spot Demoiselle	*Chrysiptera biocellata*
Other	Surge Demoiselle	*Chrysiptera brownriggii*
Other	Blue-Line Demoiselle	*Chrysiptera caeruleolineata*
Other	Blue Devil	*Chrysiptera cyanea*
Other	Gray Demoiselle	*Chrysiptera glauca*
Other	Blue-Spot Demoiselle	*Chrysiptera oxycephala*
Other	King Demoiselle	*Chrysiptera rex*
Other	Talbot'S Demoiselle	*Chrysiptera talboti*
Other	Tracey'S Demoiselle	*Chrysiptera traceyi*
Other	1-Spot Demoiselle	*Chrysiptera unimaculata*
Other	Peacock Bass	*Cichla ocellaris*
Other	Cichlids	Cichlidae
Other	Threadfin Hawkfish	*Cirrhitichthys aprinus*
Other	Falco'S Hawkfish	*Cirrhitichthys falco*
Other	Pixy Hawkfish	*Cirrhitichthys oxycephalus*
Other	Hawkfish	Cirrhitidae
Other	Stocky Hawkfish	*Cirrhitus pinnulatus*
Other	Fringelip Snake Eel	*Cirricaecula johnsoni*
Other	Chestnut Blenny	*Cirripectes castaneus*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Other	Spotted Blenny	*Cirripectes fuscoguttatus*
Other	Blenny	*Cirripectes perustus*
Other	Barred Blenny	*Cirripectes polyzona*
Other	Squiggly Blenny	*Cirripectes quagga*
Other	Red-Streaked Blenny	*Cirripectes stigmaticus*
Other	Red-Speckled Blenny	*Cirripectes variolosus*
Other	Air-Breath Catfish	*Clarias batrachus*
Other	Air-Breath Catfish	*Clarias macrocephalus*
Other	Air-Breath Catfish	Clariidae
Other	Herring,Sprat,Sardines	Clupeidae
Other	Velvetfish	*Cocotropis larvatus*
Other	White Eel	*Conger cinereus cinereus*
Other	Conger Eel	*Conger oligoporus*
Other	Conger Eel	*Conger sp*
Other	White,Conger,Garden Eel	Congridae
Other	Deepwater Glasseye	*Cookeolus boops*
Other	Bulleye	*Cookeolus japonicus*
Other	Orangebanded Coralfish	*Coradion chrysozonus*
Other	Goby	*Coryphopterus signipinnis*
Other	Network Pipefish	*Corythoichthys flavofasciatus*
Other	Pipefish	*Corythoichthys haematopterus*
Other	Reef Pipefish	*Corythoichthys intestinalis*
Other	Bl-Breasted Pipefish	*Corythoichthys nigripectus*
Other	Ocellated Pipefish	*Corythoichthys ocellatus*
Other	Many-Spotted Pipefish	*Corythoichthys polynotatus*
Other	Guilded Pipefish	*Corythoichthys schultzi*
Other	Roughridge Pipefish	*Cosmocampus banneri*
Other	D'Arros Pipefish	*Cosmocampus darrosanus*
Other	Maxweber'S Pipefish	*Cosmocampus maxweberi*
Other	Sand Burrowers	Creedidae
Other	Mullet	*Crenimugil heterochilos*
Other	Goby	*Cristagobius sp*
Other	Goby	*Cryptocentroides insignis*
Other	Goby	*Cryptocentrus*
Other	Goby	*Cryptocentrus cinctus*
Other	Goby	*Cryptocentrus koumansi*
Other	Goby	*Cryptocentrus leptocephalus*
Other	Goby	*Cryptocentrus sp A*
Other	Goby	*Cryptocentrus strigilliceps*
Other	Goby	*Ctenogobiops aurocingulus*
Other	Goby	*Ctenogobiops feroculus*
Other	Goby	*Ctenogobiops pomastictus*
Other	Long-Finned Prwn Goby	*Ctenogobiops tangarorai*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Other	Flathead	*Cymbacephalus beauforti*
Other	Swallowtail Hawkfish	*Cyprinocirrhites polyactis*
Other	Flying Fish	*Cypselurus angusticeps*
Other	Flying Fish	*Cypselurus poecilopterus*
Other	Flying Fish	*Cypselurus speculiger*
Other	Flying Gurnard	*Dactyloptena orientalis*
Other	Flying Gurnard	*Dactyloptena petersoni*
Other	Flying Gurnard	*Dactylopteridae*
Other	Humbug Dascyllus	*Dascyllus aruanus*
Other	Black-Tail Dascyllus	*Dascyllus melanurus*
Other	Reticulated Dascyllus	*Dascyllus reticulatus*
Other	3-Spot Dascyllus	*Dascyllus trimaculatus*
Other	Stingray	Dasyatididae
Other	Blue-Spotted Sting Ray	*Dasyatis kuhlii*
Other	Scorpionfish	*Dendrochirus biocellatus*
Other	Scorpionfish	*Dendrochirus brachypterus*
Other	Zebra Lionfish	*Dendrochirus zebra*
Other	Slatey Sweetlips	*Diagramma pictum*
Other	Lanternfish	*Diaphus schmidti*
Other	Bythitid	*Dinematichthys iluocoetenoides*
Other	Porcupinefish	*Diodon eydouxi*
Other	Porcupinefish	*Diodon hystrix*
Other	Porcupinefish	*Diodon liturosus*
Other	Porcupinefish	Diodontidae
Other	Dragonet	*Diplogrammus goramensis*
Other	Bristlemouth	*Diplophos sp*
Other	White-Spot Damsel	*Dischistodus chrysopoecilus*
Other	Black-Vent Damsel	*Dischistodus melanotus*
Other	White Damsel	*Dischistodus perspicillatus*
Other	Banded Pipefish	*Doryramphus dactyliophorus*
Other	Bluestripe Pipefish	*Doryramphus excisus*
Other	Janss' Pipefish	*Doryramphus janssi*
Other	Negros Pipefish	*Doryramphus negrosensis*
Other	Sprat	*Dussumieria elopsoides*
Other	Sprats	*Dussumieria sp B*
Other	Diskfishes	Echeneidae
Other	Remora	*Echeneis naucrates*
Other	Whiteface Moray	*Echidna leucotaenia*
Other	Snowflake Moray	*Echidna nebulosa*
Other	Girdled Moray Eel	*Echidna polyzona*
Other	Unicolor Moray	*Echidna unicolor*
Other	Bramble Shark	*Echinorhinidae*
Other	Bramble Shark	*Echinorhinus brucus*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Other	Bramble Shark	*Echinorhinus cookei*
Other	Banda Clown Blenny	*Ecsenius bandanus*
Other	Blenny	*Ecsenius bicolor*
Other	Blenny	*Ecsenius opsifrontalis*
Other	Blenny	*Ecsenius sellifer*
Other	Blenny	*Ecsenius yaeyamaensis*
Other	Snake Eel	*Elapsopsis versicolor*
Other	Sleepers	Eleotrididae
Other	Gudgeon	*Eleotris fusca*
Other	Bonnetmouth	*Emmelichthys karnellai*
Other	Bonnet Mouths	*Emmelichtyidae*
Other	Pearlfish	*Encheliophis boraboraensis*
Other	Pearlfish	*Encheliophis gracilis*
Other	Pearlfish	*Encheliophis homei*
Other	Pearlfish	*Encheliophis vermicularis*
Other	Bayer'S Moray	*Enchelycore bayeri*
Other	Bikini Atoll Moray	*Enchelycore bikiniensis*
Other	Dark-Spotted Moray	*Enchelycore kamara*
Other	White-Margined Moray	*Enchelycore schismatorhynchus*
Other	Viper Moray	*Enchelynassa canina*
Other	Blenny	*Enchelyurus kraussi*
Other	Gold Anchovy	*Enchrasicholina devisi*
Other	Blue Anchovy	*Enchrasicholina heterolobus*
Other	Oceanic Anchovy	*Enchrasicholina punctifer*
Other	Anchovies	Engraulidae
Other	Flounder	*Engyprosopon sp*
Other	Triplefin	*Enneapterygius hemimelas*
Other	Triplefin	*Enneapterygius minutus*
Other	Triplefin	*Enneapterygius nanus*
Other	Blenny	*Entomacrodus caudofasciatus*
Other	Blenny	*Entomacrodus cymatobiotus*
Other	Blenny	*Entomacrodus decussatus*
Other	Blenny	*Entomacrodus niuafooensis*
Other	Blenny	*Entomacrodus sealei*
Other	Blenny	*Entomacrodus stellifer*
Other	Blenny	*Entomacrodus striatus*
Other	Blenny	*Entomacrodus thalassinus*
Other	Batfish	Ephippidae
Other	Orange-Spotted Grouper	*Epinephelus coioides*
Other	Hagfish	*Eptaptretus carlhubbsi*
Other	Bonnetmouth	*Erythrocles scintillans*
Other	Spiny Dogfish	*Etmopterus pusillus*
Other	Ribbon Halfbeak	*Euleptorhamphus viridis*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Other	Dragon Fish	*Eurypegasus draconis*
Other	Mantis Shrimp	*Eutremus teres*
Other	Kawakawa	*Eviota afelei*
Other	Herring	*Eviota albolineata*
Other	Goby	*Eviota bifasciata*
Other	Goby	*Eviota cometa*
Other	Goby	*Eviota distigma*
Other	Goby	*Eviota fasciola*
Other	Goby	*Eviota herrei*
Other	Goby	*Eviota infulata*
Other	Goby	*Eviota lachdebrerei*
Other	Goby	*Eviota latifasciata*
Other	Goby	*Eviota melasma*
Other	Goby	*Eviota nebulosa*
Other	Goby	*Eviota pellucida*
Other	Goby	*Eviota prasina*
Other	Goby	*Eviota prasites*
Other	Goby	*Eviota punctulata*
Other	Goby	*Eviota queenslandica*
Other	Goby	*Eviota saipanensis*
Other	Goby	*Eviota sebreei*
Other	Goby	*Eviota sigillata*
Other	Goby	*Eviota smaragdus*
Other	Goby	*Eviota sp*
Other	Goby	*Eviota sparsa*
Other	Goby	*Eviota storthynx*
Other	Goby	*Eviota zonura*
Other	Snake Eel	*Evipes percinctus*
Other	Blenny	*Exalias brevis*
Other	Flying Fish	*Exocoetidae*
Other	Flying Fish	*Exocoetus volitans*
Other	Goby	*Exyrias belissimus*
Other	Goby	*Exyrias puntang*
Other	Cornetfish	*Fistularia commersoni*
Other	Cornetfish	Fistulariidae
Other	Bay Cardinalfish	*Foa brachygramma*
Other	Cardinalfish	*Foa sp*
Other	Longnosed Butterflyfish	*Forcipiger flavissimus*
Other	Big Longnose Butterflyfish	*Forcipiger longirostris*
Other	Cardinalfish	*Fowleria abocellata*
Other	Marbled Cardinalfish	*Fowleria marmorata*
Other	Spotcheek Cardinalfish	*Fowleria punctulata*
Other	Variegated Cardinalfish	*Fowleria variegatus*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Other	Goby	*Fusigobius longispinus*
Other	Goby	*Fusigobius neophytus*
Other	Tiger Shark	*Galeocerdo cuvier*
Other	Lg-Toothed Ponyfish	*Gazza achlamys*
Other	Toothed Ponyfish	*Gazza minuta*
Other	Ornate Angelfish	*Genicanthus bellus*
Other	Black-Spot Angelfish	*Genicanthus melanospilos*
Other	Watanabe'S Angelfish	*Genicanthus watanabei*
Other	Mojarras	Gerreidae
Other	Deep-Bodied Mojarra	*Gerres abbreviatus*
Other	Common Mojarra	*Gerres acinaces*
Other	Filamentous Mojarra	*Gerres filamentosus*
Other	Oblong Mojarra	*Gerres oblongus*
Other	Oyena Mojarra	*Gerres oyena*
Other	Mojarra	*Gerres punctatus*
Other	Telescopefish	*Giganturidae*
Other	Goby	*Gladigobius ensifera*
Other	Goby	*Glossogobius biocellatus*
Other	Goby	*Glossogobius celebius*
Other	Goby	*Glossogobius guirus*
Other	Blenny	*Glyptoparus delicatulus*
Other	Goby	*Gnatholepis anjerensis*
Other		*Gnatholepis caurensis*
Other	Goby	*Gnatholepis scapulostigma*
Other	Goby	*Gnatholepis sp A*
Other	Clingfish	Gobiesocidae
Other	Goby	Gobiidae
Other	Goby	*Gobiodon albofasciatus*
Other	Goby	*Gobiodon citrinus*
Other	Goby	*Gobiodon okinawae*
Other	Goby	*Gobiodon quinquestrigatus*
Other	Goby	*Gobiodon rivulatus*
Other	Goby	*Gobiopsis bravoi*
Other	Bristlemouth	*Gonostoma atlanticum*
Other	Bristlemouth	*Gonostoma ebelingi*
Other	Bristlemouths	*Gonostomatidae*
Other	Orange-Barred Garden Eel	*Gorgasia preclara*
Other	Conger Eel	*Gorgasia sp*
Other	Goldies	*Grammatonotus sp 1*
Other	Goldies	*Grammatonotus sp 2*
Other	2-Lined Mackerel	*Grammatorcynos bilineatus*
Other	Yellowstripe Soapfish	*Grammistes sexlineatus*
Other	Soapfish	Grammistidae

Mariana CREMUS (Guam)	Common Name	Scientific Name
Other	Ocellate Soapfish	*Grammistops ocellatus*
Other	Wormfish	*Gunnellichthys monostigma*
Other	Onestripe Wormfish	*Gunnellichthys pleurotaenia*
Other	Wormfish	*Gunnellichthys viridescens*
Other	Philippine Cardinalfish	*Gymnapogon philippinus*
Other	Cardinalfish	*Gymnapogon urospilotus*
Other	Fusilier	*Gymnocaesio gymnopterus*
Other	Zebra Moray	*Gymnomuraena zebra*
Other	Moray Eel	*Gymnothorax berndti*
Other	Buro Moray	*Gymnothorax buroensis*
Other	Moray Eel	*Gymnothorax elegans*
Other	Enigmatic Moray	*Gymnothorax enigmaticus*
Other	Fimbriated Moray	*Gymnothorax fimbriatus*
Other	Yellow-Margined Moray	*Gymnothorax flavimarginatus*
Other	Brown Spotted Moray	*Gymnothorax fuscomaculatus*
Other	Graceful-Tailed Moray	*Gymnothorax gracilicaudus*
Other	Moray Eel	*Gymnothorax hepaticus*
Other	Giant Moray	*Gymnothorax javanicus*
Other	Blotch-Necked Moray	*Gymnothorax margaritophorus*
Other	Marshall Isles Moray	*Gymnothorax marshallensis*
Other	Dirty Yellow Moray	*Gymnothorax melatremus*
Other	Whitemouth Moray	*Gymnothorax meleagris*
Other	Monochrome Moray	*Gymnothorax monochrous*
Other	1-Spot Moray	*Gymnothorax monostigmus*
Other	Moray Eel	*Gymnothorax neglectus*
Other	Yellowmouth Moray	*Gymnothorax nudivomer*
Other	Pinda Moray	*Gymnothorax pindae*
Other	Moray Eel	*Gymnothorax polyuranodon*
Other	Richardson'S Moray	*Gymnothorax richardsoni*
Other	Yellow-Headed Moray	*Gymnothorax rueppelliae*
Other	Moray Eel	*Gymnothorax sp cf Melatremus*
Other	Undulated Moray	*Gymnothorax undulatus*
Other	Zonipectis Moray	*Gymnothorax zonipectus*
Other	Sweetlips	*Haemulidae*
Other	Brock'S Pipefish	*Halicampus brocki*
Other	Duncker'S Pipefish	*Halicampus dunckeri*
Other	Samoan Pipefish	*Halicampus mataafae*
Other	Glittering Pipefish	*Halicampus nitidus*
Other	Spikefish	*Halimochirurgus alcocki*
Other	Triplefin	*Helcogramma capidata*
Other	Triplefin	*Helcogramma chica*
Other	Triplefin	*Helcogramma hudsoni*
Other	Damselfish	*Hemiglyphidodon plagiometopon*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Other	Halfbeak	*Hemiramphus archipelagicus*
Other	Halfbeak	*Hemiramphus far*
Other	Halfbeak	*Hemiramphus lutkei*
Other	Halfbeak	*Hemirhamphidae*
Other	Pyrimid Butterflyfish	*Hemitaurichthys polylepis*
Other	Butterflyfish	*Hemitaurichthys thompsoni*
Other	Longfinned Bannerfish	*Heniochus acuminatus*
Other	Pennant Bannerfish	*Heniochus chrysostomus*
Other	Bannerfish	*Heniochus diphreutes*
Other	Masked Bannerfish	*Heniochus monoceros*
Other	Singular Butterflyfish	*Heniochus singularis*
Other	Humphead Bannerfish	*Heniochus varius*
Other	Gold Spot Herring	*Herklotsichthys quadrimaculatus*
Other	Conger Eel	*Heteroconger hassi*
Other	Goby	*Heteroeleotris sp*
Other	Glasseye	*Heteropriacanthus cruentatus*
Other	Whipray	*Himantura fai*
Other	Wh Tail Whipray	*Himantura granulata*
Other	Leopard Ray	*Himantura uarnak*
Other	Pipefish	*Hippichthys cyanospilos*
Other	Pipefish	*Hippichthys spicifer*
Other	Pipefish	*Hippocampus histrix*
Other	Pipefish	*Hippocampus kuda*
Other	Sargassum Fish	*Histrio histrio*
Other	Fairy Basslet	*Holanthias borbonius*
Other	Fairy Basslet	*Holanthias katayamai*
Other	Tilefish	*Hoplolatilus cuniculus*
Other	Tilefish	*Hoplolatilus fronticinctus*
Other	Tilefish	*Hoplolatilus starcki*
Other	Silverside	*Hypoatherina barnesi*
Other	Silverside	*Hypoatherina cylindrica*
Other	Silverside	*Hypoatherina ovalaua*
Other	Halfbeak	*Hyporhamphus acutus acutus*
Other	Halfbeak	*Hyporhamphus affinis*
Other	Halfbeak	*Hyporhamphus dussumieri*
Other	Snake Eel	*Ichthyapus vulturus*
Other	Spiny Devilfish	*Inimicus didactylus*
Other	Keeled Silverside	*Iso hawaiiensis*
Other	6-Band Hawkfish	*Isocirrhitus sexfasciatus*
Other	Keeled Silversides	Isonidae
Other	Beautiful Rockskipper	*Istiblennius bellus*
Other	Blenny	*Istiblennius chrysospilos*
Other	Streaky Rockskipper	*Istiblennius dussumieri*

Mariana CREMUS (Guam)	**Common Name**	**Scientific Name**
Other	Blenny	*Istiblennius edentulus*
Other	Interrupted Rockskipper	*Istiblennius interruptus*
Other	Blenny	*Istiblennius lineatus*
Other	Goby	*Istigobius decoratus*
Other	Goby	*Istigobius ornatus*
Other	Goby	*Istigobius rigilius*
Other	Goby	*Istigobius spence*
Other	Billfishes	Istiophoridae
Other	Mackerel Shark	*Isurus oxyrhinchus*
Other	Bl-Nostril False Moray	*Kaupichthys atronasus*
Other	Shortfin False Moray	*Kaupichthys brachychirus*
Other	Common False Moray	*Kaupichthys hyoproroides*
Other	Goby	*Kellogella quindecimfasciata*
Other	Goby	*Kelloggella cardinalis*
Other	Sand Dart	*Kraemeria bryani*
Other	Sand Dart	*Kraemeria cunicularia*
Other	Sand Dart	*Kraemeria samoensis*
Other	Sand Darts	Kraemeriidae
Other	Dark-Margined Flagtail	*Kuhlia marginata*
Other	Barred Flagtail	*Kuhlia mugil*
Other	River Flagtail	*Kuhlia rupestris*
Other	Flagtails	*Kuhliidae*
Other	Longhorn Cowfish	*Lactoria cornuta*
Other	Spiny Cowfish	*Lactoria diaphana*
Other	Thornback Cowfish	*Lactoria fornasini*
Other	Oceanic Blaasop	*Lagocephalus lagocephalus*
Other	Silverstripe Blaasop	*Lagocephalus sceleratus*
Other	Oriental Snake Eel	*Lamnostoma orientalis*
Other	Ponyfishes	Leiognathidae
Other	Slipmouth	*Leiognathus bindus*
Other	Slipmouth	*Leiognathus elongatus*
Other	Common Slipmouth	*Leiognathus equulus*
Other	Slipmouth	*Leiognathus smithursti*
Other	Oblong Slipmouth	*Leiognathus stercorarius*
Other	Saddled Snake Eel	*Leiuranus semicinctus*
Other	Clingfish	*Lepadichthys caritus*
Other	Clingfish	*Lepadichthys minor*
Other	Fusilier Damsel	*Lepidozygus tapienosoma*
Other	Barracudina	*Lestidium nudun*
Other	Sand Burrower	*Limnichthys donaldsoni*
Other	Clingfish	*Liobranchia stria*
Other	Swissguard Basslet	*Liopropoma lunulatum*
Other	Swissguard Basslet	*Liopropoma maculatum*

Mariana CREMUS (Guam)	**Common Name**	**Scientific Name**
Other	Swissguard Basslet	*Liopropoma mitratum*
Other	Swissguard Basslet	*Liopropoma multilineatum*
Other	Pallid Basslet	*Liopropoma pallidum*
Other	Pinstripe Basslet	*Liopropoma susumi*
Other	Redstripe Basslet	*Liopropoma tonstrinum*
Other	Blenny	*Litobranchus fowleri*
Other	Giantscale Mullet	*Liza melinoptera*
Other	Triplefin	*Lobotes surinamensis*
Other	Tripletails	Lobotidae
Other	Goby	*Lotilia graciliosa*
Other	Magenta Slender Basslet	*Luzonichthys waitei*
Other	Whitley'S Slender Basslet	*Luzonichthys whitleyi*
Other	Goby	*Macrodontogobius wilburi*
Other	Goby	*Mahidolia mystacina*
Other	Tilefishes	Malacanthidae
Other	Quakerfish	*Malacanthus brevirostris*
Other	Striped Blanquillo	*Malacanthus latovittatus*
Other	Manta Ray	*Manta birostris*
Other	Sharptail Sunfish	*Masturus lanceolatus*
Other	Tarpons	*Megalopidae*
Other	Indo-Pacific Tarpon	*Megalops cyprinoides*
Other	Poison-Fang Blenny	*Meiacanthus anema*
Other	Poison-Fang Blenny	*Meiacanthus atrodorsalis*
Other	1-Stripe Poison-Fang Blenny	*Meiacanthus ditrema*
Other	Striped Poison-Fang Blenny	*Meiacanthus grammistes*
Other	Black Triggerfish	*Melichthys niger*
Other	Pinktail Triggerfish	*Melichthys vidua*
Other	Brotula	*Microbrotula sp*
Other	Wormfish	*Microdesmidae*
Other	Anderson'S Shrt-Nosed Pipefish	*Micrognathus andersonii*
Other	Pygmy Short-Nosed Pipefish	*Micrognathus brevirostris*
Other	Pipefish	*Microphis brachyurus*
Other	Pipefish	*Microphis brevidorsalis*
Other	Pipefish	*Microphis leiaspis*
Other	Pipefish	*Microphis manadensis*
Other	Pipefish	*Microphis retzii*
Other	Ventricose Milda	*Minyichthys myersi*
Other	Myer'S Pipefish	*Mobulidae*
Other	Ocean Sunfishes	*Molidae*
Other	Filefishes	*Monacanthidae*
Other	Monos	*Monodactylidae*
Other	Mono	*Monodactylus argenteus*
Other	Codlings	*Moridae*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Other	Rusty Spaghetti Eel	*Moringua ferruginea*
Other	Java Spaghetti Eel	*Moringua javanica*
Other	Spaghetti Eel	*Moringua microchir*
Other	Worm Eel	*Moringuidae*
Other	Goby	*Mugilogobius tagala*
Other	Goby	*Mugilogobius villa*
Other	Pike Eels	*Muraenesocidae*
Other	Pike Conger	*Muraenesox cinereus*
Other	Snake Eel	*Muraenichthys gymnotus*
Other	Snake Eel	*Muraenichthys laticaudata*
Other	Snake Eel	*Muraenichthys macropterus*
Other	Snake Eel	*Muraenichthys schultzi*
Other	Snake Eel	*Muraenichthys sibogae*
Other	Morays	*Muraenidae*
Other	Lanternfishes	*Myctophidae*
Other	Laternfish	*Myctophum brachygnathos*
Other	Eagle Ray	*Myliobatidae*
Other	Snake Eel	*Myrichthys bleekeri*
Other	Banded Snake Eel	*Myrichthys colubrinus*
Other	Spotted Snake Eel	*Myrichthys maculosus*
Other	Snake Eel	*Myrophis uropterus*
Other	Hagfish	*Myxinidae*
Other	Combtooth Blenny	*Nannosalarius nativitatus*
Other	Nurse Shark	*Nebrius ferrugineus*
Other	Lemon Shark	*Negaprion acutidens*
Other	Decorated Dartfish	*Nemateleotris decora*
Other	Helfrichs' Dartfish	*Nemateleotris helfrichi*
Other	Fire Dartfish	*Nemateleotris magnifica*
Other	Threadfin Breams	*Nemipteridae*
Other	Breams	*Nemipteridae*
Other	Forktail Bream	*Nemipterus furcosus*
Other	Butterfly Bream	*Nemipterus hexadon*
Other	Notched Butterfly Bream	*Nemipterus peronii*
Other	Butterfly Bream	*Nemipterus tolu*
Other	Flame Hawkfish	*Neocirrhitus armatus*
Other	Royal Damsel	*Neoglyphidodon melas*
Other	Yellowfin Damsel	*Neoglyphidodon nigroris*
Other	Coral Demoiselle	*Neopomacentrus nemurus*
Other	Freshwater Demoiselle	*Neopomacentrus taeniurus*
Other	Violet Demoiselle	*Neopomacentrus violascens*
Other	Man-Of-War Fish	*Nomeidae*
Other	Triplefin	*Norfolkia brachylepis*
Other	Redtooth Triggerfish	*Odonus niger*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Other	Foldlip Mullet	*Oedalechilus labiosus*
Other	Mangrove Blenny	*Omobranchus obliquus*
Other	Blenny	*Omobranchus rotundiceps*
Other	Blenny	*Omox biporos*
Other	Bivalve Pearlfish	*Onuxodon fowleri*
Other	Snake Eel	*Ophichthidae*
Other	Dark-Shouldered Snake Eel	*Ophichthus cephalozona*
Other	Cusk Eel	*Ophidiidae*
Other	Sleeper	*Ophieleotris aporos*
Other	Sleeper	*Ophiocara porocephala*
Other	Jawfishes	*Opisthognathidae*
Other	Variable Jawfish	*Opisthognathus sp A*
Other	Wass' Jawfish	*Opisthognathus sp B*
Other	Knifejaws	Oplegnathidae
Other	Spotted Knifejaw	*Oplegnathus punctatus*
Other	Goby	*Oplopomops diacanthus*
Other	Goby	*Oplopomus oplopomus*
Other	Goby	*Opua nephodes*
Other	Nurse,Zebra,Carpet Sharks	Orectolobidae
Other	Tilapia	*Oreochromis mossambicus*
Other	Boxfish, Cowfish	Ostraciidae
Other	Cube Trunkfish	*Ostracion cubicus*
Other	Spotted Trunkfish	*Ostracion meleagris meleagris*
Other	Reticulate Boxfish	*Ostracion solorensis*
Other	Longnose Hawkfish	*Oxycirrhitus typus*
Other	Sleeper	*Oxyleotris lineolatus*
Other	Longnose Filefish	*Oxymonacanthus longirostris*
Other	Smallwing Flying Fish	*Oxyporhamphus micropterus*
Other	Goby	*Oxyurichthys guibei*
Other	Goby	*Oxyurichthys microlepis*
Other	Goby	*Oxyurichthys ophthalmonema*
Other	Goby	*Oxyurichthys papuensis*
Other	Goby	*Oxyurichthys tentacularis*
Other	Goby	*Padanka sp*
Other	Goby	*Palutris pruinosa*
Other	Goby	*Palutris reticularis*
Other	Arc-Eyed Hawkfish	*Paracirrhitus arcatus*
Other	Freckeled Hawkfish	*Paracirrhitus forsteri*
Other	Whitespot Hawkfish	*Paracirrhitus hemistictus*
Other	Goby	*Paragobiodon echinocephalus*
Other	Goby	*Paragobiodon lacunicolus*
Other	Goby	*Paragobiodon melanosoma*
Other	Goby	*Paragobiodon modestus*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Other	Goby	*Paragobiodon xanthosoma*
Other	Seychelle'S Wormfish	*Paragunnellichthy seychellensis*
Other	Barracudinas	Paralepididae
Other	Blacksaddle Mimic	*Paraluteres prionurus*
Other	Filefish	*Paramonacanthus cryptodon*
Other	Filefish	*Paramonacanthus japonicus*
Other	Latticed Sandperch	*Parapercis clathrata*
Other	Cylindrical Sandperch	*Parapercis cylindrica*
Other	Blk-Dotted Sandperch	*Parapercis millipunctata*
Other	Red-Barred Sandperch	*Parapercis multiplicata*
Other	Black-Banded Sandperch	*Parapercis tetracantha*
Other	Blotchlip Sandperch	*Parapercis xanthozona*
Other	Sandperch	*Parapriacanthus ransonneti*
Other	Mcadam'S Scorpionfish	*Parascorpaena mcadamsi*
Other	Mozambique Scorpionfish	*Parascorpaena mossambica*
Other	Peacock Sole	*Pardachirus pavoninus*
Other	Blenny	*Parenchelyurus hepburni*
Other	Flying Fish	*Parexocoetus brachypterus*
Other	Flying Fish	*Parexocoetus mento*
Other	Beautiful Hover Goby	*Parioglossus formosus*
Other	Lined Hover Goby	*Parioglossus lineatus*
Other	Naked Hover Goby	*Parioglossus nudus*
Other	Palustris Hover Goby	*Parioglossus palustris*
Other	Rainford'S Hover Goby	*Parioglossus rainfordi*
Other	Rao'S Hover Goby	*Parioglossus raoi*
Other	Taeniatus Hover Goby	*Parioglossus taeniatus*
Other	Vertical Hover Goby	*Parioglossus verticalis*
Other	Shortsnouted Ray	*Pasinachus sephen*
Other	Dragonfish	Pegasidae
Other	Sweepers	*Pempherididae*
Other	Bronze Sweeper	*Pempheris oualensis*
Other	Armourheads	*Pentacerotidae*
Other	Smalltooth Whiptail	*Pentapodus caninus*
Other	3-Striped Whiptail	*Pentapodus trivittatus*
Other	Duckbills	Percophidae
Other	Goby	*Periophthalmus argentilineatus*
Other	Goby	*Periophthalmus kalolo*
Other	Yelloweye Filefish	*Pervagor alternans*
Other	Orangetail Filefish	*Pervagor aspricaudatus*
Other	Blackbar Filefish	*Pervagor janthinosoma*
Other	Blackheaded Filefish	*Pervagor melanocephalus*
Other	Blacklined Filefish	*Pervagor nigrolineatus*
Other	Blenny	*Petroscirtes breviceps*

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Other	Blenny	*Petroscirtes mitratus*
Other	Blenny	*Petroscirtes thepassi*
Other	Blenny	*Petroscirtes variabilis*
Other	Blenny	*Petroscirtes xestus*
Other	Snake Eel	*Phenamonas cooperi*
Other	Flashlightfish	*Photoblepheron palpebratus*
Other	Pipefish	*Phoxocampus diacanthus*
Other	Snake Eel	*Phyllophichthus xenodontus*
Other	Codling	*Physiculus sp*
Other	Sand Perch	Pinguipedidae
Other	Blenny	*Plagiotremus laudandus*
Other	Red Sabbertooth Blenny	*Plagiotremus rhynorhynchus*
Other	Blenny	*Plagiotremus tapienosoma*
Other	Batfish	*Platax orbicularis*
Other	Pinnate Spadefish	*Platax pinnatus*
Other	Longfin Spadefish	*Platax teira*
Other	Keeled Needlefish	*Platybelone argalus platyura*
Other	Flathead	Platycephalidae
Other	2-Lined Sweetlips	*Plectorhinchus albovittatus*
Other	Celebes Sweetlips	*Plectorhinchus celebecus*
Other	Harlequin Sweetlips	*Plectorhinchus chaetodonoides*
Other	Sweetlip	*Plectorhinchus flavomaculatus*
Other	Gibbus Sweetlips	*Plectorhinchus gibbosus*
Other	Lined Sweetlips	*Plectorhinchus lessonii*
Other	Goldman'S Sweetlips	*Plectorhinchus lineatus*
Other	Giant Sweetlips	*Plectorhinchus obscurus*
Other	Spotted Sweetlips	*Plectorhinchus picus*
Other	Sweetlip	*Plectorhinchus sp*
Other	Oriental Sweetlips	*Plectorhinchus vittatus*
Other	Fourmanoir'S Basslet	*Plectranthias fourmanoiri*
Other	Basslet	*Plectranthias kamii*
Other	Long-Finned Basslet	*Plectranthias longimanus*
Other	Pygmy Basslet	*Plectranthias nanus*
Other	Basslet	*Plectranthias rubrifasciatus*
Other	Basslet	*Plectranthias winniensis*
Other	Dick'S Damsel	*Plectroglyphidodo dickii*
Other	Bright-Eye Damsel	*Plectroglyphidodo imparipennis*
Other	Johnston Isle Damsel	*Plectroglyphidodo johnstonianus*
Other	Jewel Damsel	*Plectroglyphidodo lacrymatus*
Other	White-Band Damsel	*Plectroglyphidodo leucozonus*
Other	Phoenix Isle Damsel	*Plectroglyphidodo phoenixensis*
Other	Longfins	Plesiopidae
Other	Red-Tipped Longfin	*Plesiops caeruleolineatus*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Other	Bluegill Longfin	*Plesiops corallicola*
Other	Sharp-Nosed Longfin	*Plesiops oxycephalus*
Other	Goby	*Pleurosicya bilobatus*
Other	Caroline Ghost Goby	*Pleurosicya carolinensis*
Other	Blue Coral Ghost Goby	*Pleurosicya coerulea*
Other	Fringed Ghost Goby	*Pleurosicya fringella*
Other	Michael'S Ghost Goby	*Pleurosicya micheli*
Other	Common Ghost Goby	*Pleurosicya mossambica*
Other	Goby	*Pleurosicya muscarum*
Other	Plicata Ghost Goby	*Pleurosicya plicata*
Other	Eel Catfishes	Plotosidae
Other	Striped Eel Catfish	*Plotosus lineatus*
Other	Barred Sand Conger	*Poeciloconger fasciatus*
Other	Spotted Soapfish	*Pogonoperca punctata*
Other	6 Feeler Threadfin	*Polydactylus sexfilis*
Other	Beardfish	*Polymixia japonica*
Other	Beardfish	Polymixiidae
Other	Threadfins	Polynemidae
Other	Angelfishes	Pomacanthidae
Other	Emperor Anglefish	*Pomacanthus imperator*
Other	Blue-Girdled Angelfish	*Pomacanthus navarchus*
Other	Semicircle Angelfish	*Pomacanthus semicirculatus*
Other	6-Banded Angelfish	*Pomacanthus sexstriatus*
Other	Blue-Faced Angelfish	*Pomacanthus xanthometopon*
Other	Damselfishes	Pomacentridae
Other	Damselfish	*Pomacentrus adelus*
Other	Ambon Damsel	*Pomacentrus amboinensis*
Other	Goldbelly Damsel	*Pomacentrus auriventris*
Other	Speckled Damsel	*Pomacentrus bankanensis*
Other	Charcoal Damsel	*Pomacentrus brachialis*
Other	Burrough'S Damsel	*Pomacentrus burroughi*
Other	White-Tail Damsel	*Pomacentrus chrysurus*
Other	Neon Damsel	*Pomacentrus coelestis*
Other	Outer Reef Damsel	*Pomacentrus emarginatus*
Other	Blue-Spot Damsel	*Pomacentrus grammorhynchus*
Other	Lemon Damsel	*Pomacentrus moluccensis*
Other	Nagasaki Damsel	*Pomacentrus nagasakiensis*
Other	Black-Axil Damsel	*Pomacentrus nigromanus*
Other	Sapphire Damsel	*Pomacentrus pavo*
Other	Philappine Damsel	*Pomacentrus philippinus*
Other	Reid'S Damsel	*Pomacentrus reidi*
Other	Blueback Damsel	*Pomacentrus simsiang*
Other	Princess Damsel	*Pomacentrus vaiuli*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Other	Slender Reef-Damsel	*Pomachromis exilis*
Other	Guam Damsel	*Pomachromis guamensis*
Other	Common Javelinefish	*Pomadasyus kaakan*
Other	Lg-Headed Scorpionfish	*Pontinus macrocephalus*
Other	Scorpionfish	*Pontinus sp*
Other	Scopionfish	*Pontinus tentacularis*
Other	Blenny	*Prealticus amboinensis*
Other	Blenny	*Prealticus natalis*
Other	Bigeyes	Priacanthidae
Other	Bigeye	*Priacanthus alalaua*
Other	Goggle-Eye	*Priacanthus hamrur*
Other	Goby	*Priolepis cincta*
Other	Goby	*Priolepis farcimen*
Other	Goby	*Priolepis inhaca*
Other	Goby	*Priolepis semidoliatus*
Other	Bigeye	*Pristigenys meyeri*
Other	Flying Fish	*Prognichthys albimaculatus*
Other	Flying Fish	*Prognichthys sealei*
Other	Freckeled Driftfish	*Psenes cyanophrys*
Other	Rhino Leatherjacket	*Pseudalutarias nasicornis*
Other	Cardinalfish	*Pseudamia amblyuroptera*
Other	Cardinalfish	*Pseudamia gelatinosa*
Other	Cardinalfish	*Pseudamia hayashii*
Other	Cardinalfish	*Pseudamia zonata*
Other	Cardinalfish	*Pseudamiops gracilicauda*
Other	Bartlet'S Fairy Basslet	*Pseudanthias bartlettorum*
Other	Bicolor Fairy Basslet	*Pseudanthias bicolor*
Other	Red-Bar Fairy Basslet	*Pseudanthias cooperi*
Other	Peach Fairy Basslet	*Pseudanthias dispar*
Other	Fairy Basslet	*Pseudanthias huchtii*
Other	Lori'S Anthias	*Pseudanthias lori*
Other	Purple Queen	*Pseudanthias pascalus*
Other	Sq-Spot Fairy Basslet	*Pseudanthias pleurotaenia*
Other	Randall'S Fairy Basslet	*Pseudanthias randalli*
Other	Smithvaniz' Fairy Basslet	*Pseudanthias smithvanizi*
Other	Fairy Basslet	*Pseudanthias sp*
Other	Fairy Basslet	*Pseudanthias squammipinnis*
Other	Y Striped Fairy Basslet	*Pseudanthias tuka*
Other	L-Finned Fairy Basslet	*Pseudanthias ventralis*
Other	White Ribbon Eel	*Pseudechidna brummeri*
Other	Ymargin Triggerfish	*Pseudobalistes flavimarginatus*
Other	Blue Triggerfish	*Pseudobalistes fuscus*
Other	Dottybacks	*Pseudochromidae*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Other	Surge Dottyback	*Pseudochromis cyanotaenia*
Other	Dusky Dottyback	*Pseudochromis fuscus*
Other	Marshall Is Dottyback	*Pseudochromis marshallensis*
Other	Dottyback	*Pseudochromis melanotaenia*
Other	Long-Finned Dottyback	*Pseudochromis polynemus*
Other	Magenta Dottyback	*Pseudochromis porphyreus*
Other	Goby	*Pseudogobius javanicus*
Other	Soapfish	*Pseudogramma polyacantha*
Other	Soapfish	*Pseudogramma sp*
Other	Soapfishes	*Pseudogrammidae*
Other	Amourhead	*Pseudopentaceros pectoralis*
Other	Robust Dottyback	*Pseudoplesiops multisquamatus*
Other	Revelle'S Basslet	*Pseudoplesiops revellei*
Other	Rose Island Basslet	*Pseudoplesiops rosae*
Other	Basslet	*Pseudoplesiops sp*
Other	Hidden Basslet	*Pseudoplesiops typus*
Other	Blackfin Dartfish	*Ptereleotris evides*
Other	Filament Dartfish	*Ptereleotris hanae*
Other	Spot-Tail Dartfish	*Ptereleotris heteroptera*
Other	Dartfish	*Ptereleotris lineopinnis*
Other	Pearly Dartfish	*Ptereleotris microlepis*
Other	Zebra Dartfish	*Ptereleotris zebra*
Other	Yellowstreak Fusilier	*Pterocaesio lativittata*
Other	Twinstripe Fusilier	*Pterocaesio marri*
Other	Ruddy Fusilier	*Pterocaesio pisang*
Other	Mosaic Fusilier	*Pterocaesio tesselatata*
Other	Bluestreak Fusilier	*Pterocaesio tile*
Other	3-Striped Fusilier	*Pterocaesio trilineata*
Other	Spotfin Lionfish	*Pterois antennata*
Other	Clearfin Lionfish	*Pterois radiata*
Other	Turkeyfish	*Pterois volitans*
Other	Ocellated Gurnard	*Pterygiotrigla multiocellata*
Other	Gurnard	*Pterygiotrigla sp*
Other	Slender Suckerfish	*Ptheirichthys lineatus*
Other	Regal Anglefish	*Pygoplites diacanthus*
Other	Fairy Basslet	*Rabaulichthys sp*
Other	Trunkfish	*Ranzania laevis*
Other	Mackerel	*Rastrelliger brachysoma*
Other	Striped Mackerel	*Rastrelliger kanagurta*
Other	Goby	*Redigobius bikolanus*
Other	Goby	*Redigobius horiae*
Other	Goby	*Redigobius sapangus*
Other	Remora	*Remora remora*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Other	Cardinalfish	*Rhabdamia cypselurus*
Other	Cardinalfish	*Rhabdamia gracilis*
Other	Blenny	*Rhabdoblenius rhabdotrachelus*
Other		*Rhabdoblennius ellipes*
Other	Blenny	*Rhabdoblennius snowi*
Other	Guitarfish	*Rhinchobatus djiddensis*
Other	Picassofish	*Rhinecanthus aculeatus*
Other	Wedge Picassofish	*Rhinecanthus rectangulus*
Other	Blackbelly Picassofish	*Rhinecanthus verrucosa*
Other	Guitarfish	Rhinobatidae
Other	Ribbon Eel	*Rhinomuraena quaesita*
Other	Weedy Scorpionfish	*Rhinopias frondosa*
Other	Remora	*Rhombochirus osteochir*
Other	Smallnose Boxfish	*Rhynchostracion nasus*
Other	Largenose Boxfish	*Rhynchostracion rhynorhynchus*
Other	Telescopefish	*Rosaura indica*
Other	Minute Filefish	*Rudarius minutus*
Other		*Salarius alboguttatus*
Other	Spotted Rock Blenny	*Salarius fasciatus*
Other	Blenny	*Salarius luctuosus*
Other	Blenny	*Salarius segmentatus*
Other	Righteye Flounders	Samaridae
Other	3 Spot Flounder	*Samariscus triocellatus*
Other	Graceful Lizardfish	*Saurida gracilis*
Other	Nebulous Lizardfish	*Saurida nebulosa*
Other	Scats	*Scatophagidae*
Other	Scat	*Scatophagus argus*
Other	Schindleriid	*Schindleria praematurus*
Other	Shindleriid	*Schindleriidae*
Other	Snake Eel	*Schismorhinchus labialis*
Other	Snake Eel	*Schultzidia johnstonensis*
Other	Snake Eel	*Schultzidia retropinnis*
Other	Spinecheek	*Scolopsis affinis*
Other	2 Line Spinecheek	*Scolopsis bilineatus*
Other	Ciliate Spinecheek	*Scolopsis ciliatus*
Other	Bl And Wh Spinecheek	*Scolopsis lineatus*
Other	Margarite'S Spinecheek	*Scolopsis margaritifer*
Other	Spinecheek	*Scolopsis taeniopterus*
Other	3 Line Spinecheek	*Scolopsis trilineatus*
Other	Spinecheek	*Scolopsis xenochrous*
Other	Narrow-Barred King Mackerel	*Scomberomorus commerson*
Other	Scorpionfish	Scorpaenidae
Other	Guam Scorpionfish	*Scorpaenodes guamensis*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Other	Hairy Scorpionfish	*Scorpaenodes hirsutus*
Other	Kellogg'S Scorpionfish	*Scorpaenodes kelloggi*
Other	Minor Scorpionfish	*Scorpaenodes minor*
Other	Coral Scorpionfish	*Scorpaenodes parvipinnis*
Other	Blotchfin Scorpionfish	*Scorpaenodes varipinis*
Other	Devil Scorpionfish	*Scorpaenopsis diabolus*
Other	Pygmy Scorpionfish	*Scorpaenopsis fowleri*
Other	Flasher Scorpionfish	*Scorpaenopsis macrochir*
Other	Tassled Scorpionfish	*Scorpaenopsis oxycephala*
Other	Papuan Scorpionfish	*Scorpaenopsis papuensis*
Other	Scorpionfish	*Scorpaenopsis sp*
Other	Tiger Snake Moray	*Scuticaria tigrinis*
Other	Yellowspotted Scorpionfish	*Sebastapistes cyanostigma*
Other	Galactacma Scorpionfish	*Sebastapistes galactacma*
Other	Mauritius Scorpionfish	*Sebastapistes mauritiana*
Other	Barchin Scorpionfish	*Sebastapistes strongia*
Other	Pugnose Soapy	*Secutor ruconius*
Other	Basslet	*Selenanthias myersi*
Other	Hawkfish Anthias	*Serranocirrhitus latus*
Other	Goby	*Sicyopterus macrostetholepis*
Other	Goby	*Sicyopterus micrurus*
Other	Goby	*Sicyopterus sp*
Other	Goby	*Sicyopus leprurus*
Other	Goby	*Sicyopus sp*
Other	Goby	*Sicyopus zosterophorum*
Other	Peppered Moray	*Sideria picta*
Other	White-Eyed Moray	*Sideria prosopeion*
Other	Goby	*Signigobius biocellatus*
Other	Goby	*Silhouettea sp*
Other	Sillagos	*Sillaginidae*
Other	Cardinalfish	*Sillago sihama*
Other	Cardinalfish	*Siphamia fistulosa*
Other	Cardinalfish	*Siphamia fuscolineata*
Other	Cardinalfish	*Siphamia versicolor*
Other	Banded Sole	*Soleichthys heterohinos*
Other	Soles	Soleidae
Other	Ghost Pipefish	*Solenostomidae*
Other	Ghost Pipefish	*Solenostomus cyanopterus*
Other	Ornate Ghost Pipefish	*Solenostomus paradoxus*
Other	Flathead	*Sorsogona welanderi*
Other	Cardinalfish	*Sphaeramia nematoptera*
Other	Cardinalfish	*Sphaeramia orbicularis*
Other	Sharpfin Barracuda	*Sphyraena acutipinnis*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Other	Great Barracuda	*Sphyraena barracuda*
Other	Yellowtail Barracuda	*Sphyraena flavicauda*
Other	Blackspot Barracuda	*Sphyraena forsteri*
Other	Arrow Barracuda	*Sphyraena novaehollandiae*
Other	Pygmy Barracuda	*Sphyraena obtusata*
Other	Slender Barracuda	*Sphyraena putnamiae*
Other	Blackfin Barracuda	*Sphyraena qenie*
Other	Barracudas	Sphyraenidae
Other	Blue Sprat	*Spratelloides delicatulus*
Other	Silver Sprat	*Spratelloides gracilis*
Other	Blenny	*Stanulus seychellensis*
Other	White-Bar Gregory	*Stegastes albifasciatus*
Other	Pacific Gregory	*Stegastes fasciolatus*
Other	Farmerfish	*Stegastes lividus*
Other	Dusky Farmerfish	*Stegastes nigricans*
Other	Leopard Shark	*Stegastoma varium*
Other	Panatella Silverside	*Stenatherina panatella*
Other	Goby	*Stenogobius genivittatus*
Other	Goby	*Stenogobius sp*
Other	Hatchetfishes	*Sternoptichidae*
Other	Goby	*Stiphodon elegans*
Other	Goby	*Stiphodon sp*
Other	Samoan Anchovy	*Stolephorus apiensis*
Other	Indian Anchovy	*Stolephorus indicus*
Other	Gold Esurine Anchovy	*Stolephorus insularis*
Other	Caroline Islands Anchovy	*Stolephorus multibranchus*
Other	West Pacific Anchovy	*Stolephorus pacificus*
Other	Anchovy	*Stolephorus sp*
Other	Reef Needlefish	*Strongylura incisa*
Other	Littoral Needlefish	*Strongylura leiura leiura*
Other	Giant Esturine Moray	*Strophidon sathete*
Other	Scythe Triggerfish	*Sufflamen bursa*
Other	Halfmoon Triggerfish	*Sufflamen chrysoptera*
Other	Bridle Triggerfish	*Sufflamen freanatus*
Other	Symphysanid	*Symphysanodon typus*
Other	Sympysanodon	*Symphysanodontidae*
Other	Stonefish	*Synanceia verrucosa*
Other	Cutthroat Eel	*Synaphobranchidae*
Other	Cutthroat Eel	*Synaphobranchus sp*
Other	Cirlcled Dragonet	*Synchiropus circularis*
Other	Ladd'S Dragonet	*Synchiropus laddi*
Other	Morrison'S Dragonet	*Synchiropus morrisoni*
Other	Ocellated Dragonet	*Synchiropus ocellatus*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Other	Dragonet	*Synchiropus sp*
Other	Mandarin Fish	*Synchiropus splendidus*
Other	Pipefish, Seahorse	*Syngnathidae*
Other	Alligator Pipefish	*Syngnathoides biaculeatus*
Other	Lizardfish	Synodontidae
Other	2-Spot Lizardfish	*Synodus binotatus*
Other	Clearfin Lizardfish	*Synodus dermatogenys*
Other	Reef Lizardfish	*Synodus englemanni*
Other	Blackblotch Lizardfish	*Synodus jaculum*
Other	Variegatus Lizardfish	*Synodus variegatus*
Other	Leaf Fish	*Taenianotus triacanthus*
Other	Goby	*Taenioides limicola*
Other	Giant Reef Ray	*Taeniura meyeni*
Other	Crescent-Banded Grunter	*Terapon jarbua*
Other	Thornfishes	*Teraponidae*
Other	Smooth Puffers	*Tetraodontidae*
Other	Mangrove Waspfish	*Tetraroge barbata*
Other	Waspfishes	*Tetrarogidae*
Other	Little Priest	*Thryssa baelama*
Other	Broadhead Flathead	*Thysanophrys arenicola*
Other	Longsnout Flathead	*Thysanophrys chiltonae*
Other	Fringlip Flathead	*Thysanophrys otaitensis*
Other	Tilapia	*Tilapia zillii*
Other	Banded Archerfish	*Toxotes jaculator*
Other	Archerfishes	Toxotidae
Other	Double-Ended Pipefish	*Trachyramphus bicoarctata*
Other	Spikefishes	*Triacanthodidae*
Other	Reef Whitetip Shark	*Triaenodon obesus*
Other	Sand Divers	Trichonotidae
Other	Micronesian Sand-Diver	*Trichonotus sp*
Other	Gurnards	Triglidae
Other	Goby	*Trimma caesiura*
Other	Goby	*Trimma naudei*
Other	Goby	*Trimma okinawae*
Other	Goby	*Trimma sp A*
Other	Goby	*Trimma sp B*
Other	Goby	*Trimma taylori*
Other	Goby	*Trimma tevegae*
Other	Goby	*Trimmatom eviotops*
Other	3 Tooth Puffer	*Triodon bursarius*
Other	3 Tooth Puffer	*Triodon macropterus*
Other	Tripletooth Puffers	*Triodontidae*
Other	Triplefins	*Tripterygiidae*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Other	Keeled Houndfish	*Tylosurus acus melanotus*
Other	Houndfish	*Tylosurus crocodilis crocodilis*
Other	Longjaw Triplefin	*Ucla xenogrammus*
Other	Stargazers	*Uranoscopidae*
Other	Stargazer	*Uranoscopus sp*
Other	Porcupine Ray	*Urogymnus africanus*
Other	Unicolor Snake Moray	*Uropterygius concolor*
Other	Fiji Moray Eel	*Uropterygius fijiensis*
Other	Brown-Spotted Snake Eel	*Uropterygius fuscoguttatus*
Other	Gosline'S Snake Moray	*Uropterygius goslinei*
Other	Moon Moray	*Uropterygius kamar*
Other	Lg-Headed Snake Moray	*Uropterygius macrocephalus*
Other	Marbled Snake Moray	*Uropterygius marmoratus*
Other	Tidepool Snake Moray	*Uropterygius micropterus*
Other	Lg-Spotted Snake Moray	*Uropterygius polyspilus*
Other	Moray Eel	*Uropterygius supraforatus*
Other	Moray Eel	*Uropterygius xanthopterus*
Other	Roundray	*Urotrygon daviesi*
Other	Glass Goby	*Valenciennea muralis*
Other	Parva Goby	*Valenciennea parva*
Other	Goby	*Valenciennea puellaris*
Other	Goby	*Valenciennea sexguttatus*
Other	Goby	*Valenciennea sp*
Other	Goby	*Valenciennea strigatus*
Other	Goby	*Vanderhorstia ambanoro*
Other	Goby	*Vanderhorstia lanceolata*
Other	Goby	*Vanderhorstia ornatissima*
Other	Guilded Triggerfish	*Xanthichthys auromarginatus*
Other	Bluelined Triggerfish	*Xanthichthys careuleolineatus*
Other	Crosshatch Triggerfish	*Xanthichthys mento*
Other	Wriggler	*Xenishthmus sp*
Other	Flathead Wriggler	Xenisthmidae
Other	Barred Wriggler	*Xenisthmus polyzonatus*
Other	Triggerfish	*Xenobalistes tumidipectoris*
Other	Blenny	*Xiphasia matsubarai*
Other	Moorish Idols	*Zanclidae*
Other	Moorish Idol	*Zanclus cornutus*
Other	Esturine Halfbeak	*Zenarchopterus dispar*
Misc. Reef fish	Reef Fish	Reef Fish
Misc. Shallow bottomfish	Shallow Bottomfish	Shallow Bottomfish
Other Invertebrates	Crown-Of-Thorns	*Acanthaster planci*
Other Invertebrates	Stonefish	*Actinopyga lecanora*
Other Invertebrates	Blackfish	*Actinopyga miliaris*

Mariana CREMUS (Guam)	**Common Name**	**Scientific Name**
Other Invertebrates	Sea Cucumber	*Actinopyga obesa*
Other Invertebrates	Sea Cucumber	*Actinopyga sp*
Other Invertebrates	Starfish	Asterinidae
Other Invertebrates	Starfish	Asteropidae
Other Invertebrates	Starfish	Astropectinidae
Other Invertebrates	Sea Cucumber	*Bohadschia argus*
Other Invertebrates	Sea Cucumber	*Bohadschia graeffei*
Other Invertebrates	Brown Sandfish	*Bohadschia marmorata*
Other Invertebrates	Sea Cucumber	*Bohadschia paradoxa*
Other Invertebrates	Sea Cucumber	*Bohadschia sp*
Other Invertebrates	Irregular Urchins	Brissidae
Other Invertebrates	Jellyfish	*Cephea sp*
Other Invertebrates	Cidarians	*Cidaridae*
Other Invertebrates	Crinoids	*Class Crinoidea*
Other Invertebrates	Sea Urchins	Class Echinoidea
Other Invertebrates		Clypeasteridae
Other Invertebrates	Sea Cucumbers	Cucumariidae
Other Invertebrates	Longspine Urchin	*Diadema savignyi*
Other Invertebrates	Longspine Urchin	*Diadema setosum*
Other Invertebrates	Sea Urchins	Diadematidae
Other Invertebrates	Sea Urchins	Echinoidea
Other Invertebrates	Sea Urchins	Echinometridae
Other Invertebrates	Reef Starfish	Echinosteridae
Other Invertebrates	Longspine Urchin	*Echinothrix calamaris*
Other Invertebrates	Longspine Urchin	*Echinothrix diadema*
Other Invertebrates	Sea Urchins	Echinothuriidae
Other Invertebrates	Slate Pencil Urchin	*Heterocentrotus mammillatus*
Other Invertebrates	Lollyfish	*Holothuria atra*
Other Invertebrates	Pinkfish	*Holothuria edulis*
Other Invertebrates	White Teatfish	*Holothuria fuscogilva*
Other Invertebrates	Elephant'S Trunkfish	*Holothuria fuscopunctata*
Other Invertebrates	Sea Cucumber	*Holothuria hilla*
Other Invertebrates	Sea Cucumber	*Holothuria impatiens*
Other Invertebrates	Sea Cucumber	*Holothuria leucospilota*
Other Invertebrates	Sea Cucumber	*Holothuria sp*
Other Invertebrates	Sea Cucumber	*Holothuriidae*
Other Invertebrates	Sea Cucumbers	*Holothuroidea*
Other Invertebrates	Spiney-Armed Starfish	*Mithrodia bradleyi*
Other Invertebrates	Orange Starfish	*Ophidiaster confertus*
Other Invertebrates	Starfish	Oreasteridae
Other Invertebrates	Sea Cucumbers	*Phyllophoridae*
Other Invertebrates	Common Urchin	*Pseudoboletia maculata*
Other Invertebrates	Starfish	*Sc Asteroidea*

Mariana CREMUS (Guam)	Common Name	Scientific Name
Other Invertebrates	Basket,Brittle, Serpentstars	*Sc Ophiuroidea*
Other Invertebrates	Starfish	*Sphaerasteridae*
Other Invertebrates	Sea Cucumbers	*Stichopodidae*
Other Invertebrates	Greenfish	*Stichopus chloronotus*
Other Invertebrates	Sea Cucumber	*Stichopus horrens*
Other Invertebrates	Sea Cucumber	*Stichopus noctivatus*
Other Invertebrates	Sea Cucumber	*Stichopus sp*
Other Invertebrates	Curryfish	*Stichopus variegatus*
Other Invertebrates	Sea Cucumber	*Synapta maculata*
Other Invertebrates	Sea Cucumber	*Synapta media*
Other Invertebrates	Sea Cucumber	*Synapta sp*
Other Invertebrates	Sea Cucumbers	Synaptidae
Other Invertebrates	Sea Urchins	Temnopleuridae
Other Invertebrates	Prickly Redfish	*Thelenota ananas*
Other Invertebrates	Amberfish	*Thelenota anax*
Other Invertebrates	Sea Cucumber	*Thelenota sp*
Other Invertebrates	Flower Urchin	*Toxopneustes pileolus*
Other Invertebrates	Shortspine Urchins	Toxopneustidae
Other Invertebrates	Shortspine Urchin	*Tri pneustes gratilla*
Species of Special Management Interest	Bumphead parrotfish	*Bolbometopon muricatum*
Species of Special Management Interest	Humphead (Napoleon) wrasse	*Cheilinus undulatus*
Species of Special Management Interest	Reef sharks	*Carcharhinidae*
Species of Special Management Interest	Blackfin shark	*Carcharhinus limbatus*
Species of Special Management Interest	White tip reef shark	*Triaenodon obesus*
Species of Special Management Interest	Hammerhead shark	*Sphyrnidae*
Species of Special Management Interest	Scalloped hammerhead shark	*Sphyrna lewini*
Species of Special Management Interest	Great hammerhead shark	*Sphyrna mokorran*

Table 3. Mariana CREMUS (CNMI)

Mariana CREMUS (CNMI)	Common Name	Scientific Name
Emperors	Bigeye Emperor	*Monotaxis grandoculus*
Emperors	Blackspot Emperor	*Lethrinus harak*
Emperors	Emperor (mafute/misc.)	*Lethrinus sp.*
Emperors	Flametail Emperor	*Lutjanus fulvus*
Emperors	Longnose Emperor	*Lethrinus olivaceus*

Mariana CREMUS (CNMI)	Common Name	Scientific Name
Emperors	Orangefin Emperor	*Lethrinus erythracanthus*
Emperors	Ornate Emperor	*Lethrinus ornatus*
Emperors	Stout Emperor	*Gymnocranius sp.*
Emperors	Yellowlips Emperor	*Lethrinus xanthochilis*
Emperors	Yellowspot emperor	*Gnathodentex aurolineatus*
Emperors	Yellowstripe Emperor	*Lethrinus obsoletus*
Emperors	Yellowtail Emperor	*Lethrinus atkinsoni*
Jacks	Bigeye Trevally	*Caranx sexfasciatus*
Jacks	Bluefin Trevally	*Caranx melampygus*
Jacks	Brassy Trevally	*Caranx papuesis*
Jacks	EE: Juvenile Jacks	*Canranx sp.*
Jacks	Jacks (misc.)	*Caranx sp.*
Jacks	Leatherback	*Scomberoides lysan*
Jacks	Mackerel Scad	*Decapterus macarellus*
Jacks	Rainbow Runner	*Elagatis bipinnulatus*
Jacks	Small-spotted pompano	*Trachinotus bailloni*
Jacks	Snubnose pompano	*Trachinotus blochii*
Jacks	Yellow Spotted Trevally	*Carangoides orthogrammus*
Surgeonfish	Bluebanded Surgeonfish	*Acanthurus lineatus*
Surgeonfish	Bluelined Surgeon	*Acanthurus nigroris*
Surgeonfish	Bluespine Unicornfish	*Naso unicornis*
Surgeonfish	Convict Tang	*Acanthurus triostegus*
Surgeonfish	Orangespine Unicornfish	*Naso lituratus*
Surgeonfish	Surgeonfish (misc.)	*Acanthurus sp.*
Surgeonfish	Unicornfish (misc.)	*Naso sp.*
Surgeonfish	Yellowfin Surgeonfish	*Acanthurus xanthopterus*
Atulai	Bigeye Scad	*Selar crumenopthalmus*
Groupers	Coral Grouper	*Epinephelus corallicola*
Groupers	Flagtail Grouper	*Cephalopholis urodeta*
Groupers	Grouper (misc.)	Serannidae
Groupers	Highfin Grouper	*Epinephelus maculatus*
Groupers	Honeycomb Grouper	*Epinephelus merra*
Groupers	Lyretail Grouper	*Variola louti*
Groupers	Marbled Grouper	*Epinephelus polyphekadion*
Groupers	Peacock Grouper	*Cephalopholis argus*
Groupers	Pink Grouper	*Saloptia powelli*
Groupers	Saddleback Grouper	*Plectropomus laevis*
Groupers	Tomato Grouper	*Cephanopholis sonnerati*
Groupers	White Lyretail Grouper	*Variola albimarginata*
Groupers	Yellow Banded Grouper	*Cephalopholis igarashiensis*
Snappers	Snapper (misc. shallow)	Lutjanidae
Snappers	Humpback Snapper	*Lutjanus gibbus*
Snappers	Onespot Snapper	*Lutjanus monostigmus*
Snappers	Red Snapper	*Lutjanus bohar*

Mariana CREMUS (CNMI)	Common Name	Scientific Name
Snappers	Smalltooth Jobfish	*Aphareus furca*
Goatfish	Dash & Dot Goatfish	*Parupeneus barberrinus*
Goatfish	Goatfish (juvenile-misc)	*Mullidae*
Goatfish	Goatfish (misc.)	*Mullidae*
Goatfish	Sidespot Goatfish	*Parupeneus pleurostigma*
Goatfish	Two-barred Goatfish	*Parupeneus bifasciatus*
Goatfish	Yellowstripe Goatfish	*Mulloidichthys flavolineatus*
Parrotfish	Parrotfish (misc.)	*Scarus sp.*
Parrotfish	Seagrass Parrotfish	*Leptoscarus vaigiensis*
Mollusks	Octopus	*Octopus sp.*
Mollusks	Squid	Teuthida
Mollusks	Trochus	*Trochus sp.*
Mollusks	Clam/bivalve	Bivalvia
Mullet	Mullet	Mugilidae
Rabbitfish	Rabbitfish (hitting)	*Siganus sp.*
Rabbitfish	Rabbitfish (h.feda)	*Siganus puntatus*
Rabbitfish	Rabbitfish (sesjun)	*Siganus spinus*
Other CRE-Finfish	Angelfish	Pomacanthidae
Other CRE-Finfish	Butterflyfish	Chaetodontidae
Other CRE-Finfish	Bigeye/glasseye	*Heteropriacanthus cruentatus*
Other CRE-Finfish	Blue Razorfish	*Xyrichtys pavo*
Other CRE-Finfish	Bronzespot Razorfish	*Xyrichtys celebicus*
Other CRE-Finfish	Cardinal Misc.	Apogonidae
Other CRE-Finfish	Cornetfish	*Fistularia commersonii*
Other CRE-Finfish	Damselfish	Pomacentridae
Other CRE-Finfish	Filefish (misc)	Monacanthidae
Other CRE-Finfish	Flounder (misc)	*Bothus sp.*
Other CRE-Finfish	Fusilier (misc.)	Caesionidae
Other CRE-Finfish	Goggle-eye	*Priacanthus hamrur*
Other CRE-Finfish	Lizardfish misc.	Synodontidae
Other CRE-Finfish	Milkfish	*Chanos chanos*
Other CRE-Finfish	Mojarra	*Gerres sp.*
Other CRE-Finfish	Moray eel	Muraenidae
Other CRE-Finfish	Needlefish	Belonidae
Other CRE-Finfish	Picasso Trigger	*Rhinecanthus aculeatus*
Other CRE-Finfish	Pufferfish	Tetraodontidae
Other CRE-Finfish	Razorfish (misc)	*Tribe Novaculini*
Other CRE-Finfish	Scorpionfishes	Scorpaenidae
Other CRE-Finfish	Sweetlips	*Plectorhinchus picus*
Other CRE-Finfish	Triggerfish (misc.)	Balistidae
Other CRE-Finfish	Trumpetfish	*Aulostomus chinensis*
Other CRE-Finfish	Wedge Trigger	*Rhinecanthus rectangulus*
Squirrelfish	Squirrelfish	Holocentridae
Squirrelfish	Soldierfish (misc.)	Holocentridae

Mariana CREMUS (CNMI)	Common Name	Scientific Name
Wrasse	Wrasse (misc.)	Labridae
Wrasse	Tripletail Wrasse	*Cheilinus trilobatus*
Rudderfish	Rudderfish (guilli)	*Kyphosus sp.*
Rudderfish	Highfin Rudderfish Silver	*Kyphosus cinerascens*
Misc. Reeffish	Reef Fish	n/a
Misc. Bottomfish	Bottom Fish	n/a
Misc. Shallow bottomfish	Shallow Bottomfish	n/a
Crustaceans	Crabs (misc)	n/a
Crustaceans	Coconut Crab	*Birgus latro*
Other Invertebrates	Invertebrates	n/a
Other Invertebrates	Sea Cucumber	Cucumariidae
Algae	Seaweeds	n/a
Algae	Lemu	n/a
Species of Special Management Interest	Bumphead parrotfish	*Bolbometopon muricatum*
Species of Special Management Interest	Humphead (Napoleon) wrasse	*Cheilinus undulatus*
Species of Special Management Interest	Reef sharks (misc)	Carcharhinidae
Species of Special Management Interest	Hammerhead shark	Sphyrnidae

Table 4. Hawaii CREMUS

Hawaii CREMUS	Common Name	Scientific Name
Akule	Bigeye scad	*Selar crumenopthalmus*
Opelu	Round scad	*Decapterus macarellus*
Jacks	DOBE	*Caranx (Urapsis) helvolus*
Jacks	KAGAMI	*Alectis ciliaris*
Jacks	KAHALA	*Seriola rivoliana*
Jacks	KAMANU	*Elagatis bipinnulata*
Jacks	LAE	*Scomberoides lysan,* *S. sancti-petri*
Jacks	NO-BITE	*C. equula*
Jacks	OMAKA	*Atule mata*
Jacks	OMILU	*Caranx melampygus*
Jacks	PAOPAO	*Gnathanodon speciosus*
Jacks	PAPA	*Carangoides orthogrammus*
Jacks	PAPIO, ULUA (MISC.)	*Carangidae*
Goatfish	KUMU	*Parupeneus porphyeus*
Goatfish	MALU	*Parupeneus pleurostigma*
Goatfish	MOANA	*Parupeneus spp.*
Goatfish	MOANO KALE	*Parupeneus cyclostomus*
Goatfish	MOELUA; GOAT FISH	*Mulloidichthys sp.*

Hawaii CREMUS	**Common Name**	**Scientific Name**
	(RED)	
Goatfish	MUNU	*Parupeneus bifasciatus*
Goatfish	WEKE (MISC.)	*Mullidae*
Goatfish	WEKE A'A	*Mulloidichthys flavolineatus*
Goatfish	WEKE NONO	*Mulloidichthys pflugeri*
Goatfish	WEKE PUEO	*Upeneus arge*
Goatfish	WEKE-ULA	*Mulloidichthys vanicolensis*
Groupers	ROI	*Cephalopholis argus*
Surgeonfish	API	*Acanthurus guttatus*
Surgeonfish	BLACK KOLE	*Ctenochaetus hawaiiensis*
Surgeonfish	KALA	*Naso annulatus,* *N. brevirostris,* *N. unicornis*
Surgeonfish	KALALEI	*Naso lituratus*
Surgeonfish	KOLE	*Ctenochaetus strigosus*
Surgeonfish	MAIII	*Acanthurus nigrofuscus*
Surgeonfish	MAIKO	*Acanthurus nigroris*
Surgeonfish	MAIKOIKO	*Acanthurus leucopareius*
Surgeonfish	MANINI	*Acanthurus triostegus*
Surgeonfish	NAENAE	*Acanthurus olivaceus*
Surgeonfish	OPELU KALA	*Naso hexacanthus*
Surgeonfish	PAKUIKUI	*Acnthurus achilles*
Surgeonfish	PALANI	*Acanthurus dussumieri*
Surgeonfish	PUALU	*Acanthurus blochii,* *A. xanthopterus*
Surgeonfish	YELLOW TANG	*Zebrasoma flavescens*
Squirrelfish	ALAIHI	*Holocentridae*
Squirrelfish	ALAIHI MAMA	*Adioryx spinifer*
Squirrelfish	MENPACHI	*Myripristis spp.*
Squirrelfish	PAUU	*Holocentridae*
Mullet	AMAAMA	*Mugil cephalus*
Mullet	SUMMER MULLET	*Mugil sp.*
Snappers	GOLDEN KALI	*Erythrocles schegelii*
Snappers	GURUTSU, GOROTSUKI	*Aphareus furca*
Snappers	RANDALL'S SNAPPER	*Randallichthys filamentosus*
Snappers	TAAPE	*Lutjanus kasmira*
Snappers	TOAU	*Lutjanus fulvus*
Snappers	WAHANUI	*Aphareus furcatus*
Mollusks	HE'E (DAY TAKO)	*Octopus cyanea*
Mollusks	HE'E PU LOA	*Octopus ornatus*
Mollusks	OLEPE	*Albula glossodonta*
Parrotfish	PANUHUNUHU	*Scarus spp.*
Parrotfish	PANUNU	*Scarus spp.*
Parrotfish	UHU (MISC.)	*Catalomus spp.*

Hawaii CREMUS	Common Name	Scientific Name
Crustaceans	A'AMA	*Graspus tenuicrustatus*
Crustaceans	BLUE PINCHER CRAB	*Callinectes sapidus*
Crustaceans	CRAB (MISC.)	n/a
Crustaceans	HAWAIIAN CRAB	*Podophthalmus vigil*
Crustaceans	KUAHONU CRAB	*Portunus sanguinolentus*
Crustaceans	METABETAEUS LOHENA	*METABETAEUS LOHENA*
Crustaceans	MISC. SHRIMP/PRAWN	n/a
Crustaceans	OPAE ULA	*HALOCARIDINA RUBRA*
Crustaceans	A'AMA	*Graspus tenuicrustatus*
Other Invertebrates	HA'UKE'UKE	*Colobocentrotus atratus*
Other Invertebrates	HAWAE	*Tripneustes gratilla*
Other Invertebrates	WANA (urchin)	*Dia dema sp., Echinothrix sp.*
Other Invertebrates	NAMAKO (sea cucumber)	Holothuroidea
Other Invertebrates	SLATE PENCIL URCHINS	*Heterocentrotus mammillatus*
Other Invertebrates	HA'UKE'UKE	*Colobocentrotus atratus*
Other CRE Finfish	AHOLEHOLE	*Kuhlia sandvicensis*
Other CRE Finfish	AWA	*Chanos chanos*
Other CRE Finfish	AWAAWA	*Elops hawaiensis*
Other CRE Finfish	AWEOWEO	*Heteropriacanthus cruentatus*
Other CRE Finfish	GOLD SPOT HERRING	*Herklotsichthys quadrimaculatus*
Other CRE Finfish	HAULIULI	*Gempylus serpens*
Other CRE Finfish	HOGO	*Pontinus macrocephalus*
Other CRE Finfish	HUMUHUMU	*Balistidae*
Other CRE Finfish	IAO	*Pranesus insularum*
Other CRE Finfish	IHEIHE	*Hemiramphidae*
Other CRE Finfish	KAKU	*Sphyraena barracuda*
Other CRE Finfish	KAWALEA	*Sphyraena helleri*
Other CRE Finfish	KUPIPI	*Abudefduf sordidus*
Other CRE Finfish	LAUWILIWILI	*Chaetodon auriga*
Other CRE Finfish	LOULU	*Monacanthidae*
Other CRE Finfish	MAKAIWA	*Etrumeus micropus*
Other CRE Finfish	MALOLO	*Exocoetidae*
Other CRE Finfish	MA'O MA'O	*Abudefduf abdominalis*
Other CRE Finfish	MOI	*Polydactylus sexfilis*
Other CRE Finfish	MOLA MOLA	*Mola mola*
Other CRE Finfish	NEHU	*Stolephorus purpureus*
Other CRE Finfish	NOHU	*Scorpaenopsis spp.*
Other CRE Finfish	NUNU	*Aulostomus chinensis*
Other CRE Finfish	OIO	*Gracilaria parvispora*
Other CRE Finfish	OOPU HUE	*Diodon spp.*
Other CRE Finfish	PAKII	*Bothus spp.*
Other CRE Finfish	PIHA	*Spratelloides delicatulus*
Other CRE Finfish	POO PAA	*Cirrhitus spp.*

Hawaii CREMUS	**Common Name**	**Scientific Name**
Other CRE Finfish	PUHI (MISC.)	*Gymnothorax spp.*
Other CRE Finfish	PUHI (WHITE)	*Muraenidae*
Other CRE Finfish	PUPU	*Congridae spp.*
Other CRE Finfish	SABA	*Scomber japonicus*
Other CRE Finfish	TILAPIA	*Tilapia sp.*
Other CRE Finfish	UPAPALU	*Apogon kallopterus*
Algae	LIMU (MISC.)	*Gracilaria spp.*
Algae	LIMU KOHU	*Asparagopsis taxiformis*
Algae	MANAUEA	*Gracilaria coronopifolia*
Algae	OGO	*Aulostromus chinensis*
Algae	WAWAEIOLE	*Ulva fasciata*
Rudderfish	NENUE	*Kyphosus bigibbus,* *K. cinerescens*
Wrasse	A'AWA	*Bodianus bilunulatus*
Wrasse	HILU	*Coris flavovittata*
Wrasse	HINALEA	*Thalassoma spp.*
Wrasse	KUPOUPOU	*Cheilio inermis*
Wrasse	LAENIHI	*Xyichthys pavo*
Wrasse	MALLATEA	Labridae
Wrasse	OPULE	*Decapterus macarellus*
Wrasse	POOU	*Cheilinus unifasciatus*
Wrasse	WRASSE (MISC.)	Labridae
Emperor	MU	*Monotaxis grandoculis*
Groupers	ROI	*Cephalopholis argus*
Species of Special Management Interest	Reef Sharks	Carcharhinidae
Species of Special Management Interest	Reef Sharks	Sphyrnidae

Western Pacific Region Reef Fish Trends

A Compendium of Ecological and Fishery Statistics for Reef Fishes in American Samoa, Hawai'i and the Mariana Archipelago, in Support of Annual Catch Limit (ACL) Implementation

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Introduction

The Magnuson-Stevens Reauthorization Act (MSRA) of 2006 requires fishery management councils to submit fishery management plans for all fisheries under their authority that require conservation and management. These plans must "establish a mechanism for specifying annual catch limits (ACL)… at a level such that overfishing does not occur in the fishery, including measures to ensure accountability." Ultimately these ACLs are policy decisions on the part of fishery management councils, but they should be "informed by risk analysis and cannot exceed the Acceptable Biological Catch (ABC)", as set by the Scientific and Statistical Committee of each council (Witherell and Dalzell, 2008). For fisheries not currently experiencing overfishing, MSRA requires that ACLs are to be established by 2011.

The Western Pacific Region Fisheries Management Council (WPRFMC) is one of the eight fishery management councils reauthorized by the MSRA. WPRFMC creates policy recommendations for Exclusive Economic Zone (EEZ) waters in Hawai'i and the U.S. territories of the Commonwealth of the Northern Mariana Islands (CNMI), Guam, and American Samoa. All four of these areas support significant coral reef fisheries for which ACLs must be developed by 2011. The purpose of this technical report is to provide data and preliminary analysis of trends in these reef fisheries to facilitate the implementation of ACLs within the Western Pacific Region.

Methods

Study Regions

The region of study includes three archipelagos, namely American Samoa, the Hawaiian Archipelago and the Mariana Islands. The Hawaiian Archipelago is subdivided into the Main Hawaiian Islands (MHI) and the Northwestern Hawaiian Islands (NWHI). Stringent fishing restrictions have been implemented in NWHI (WPRFMC 2009a), with capture for scientific purposes. All fish caught for sustenance must be consumed in the NWHI.

The Mariana Archipelago, a continuous ecological unit, is politically divided into two separate entities: The Territory of Guam; and the Commonwealth of the Northern Mariana Islands (CNMI). Given this political reality, many of the analyses we applied at archipelagic scales were also applied separately to CNMI and Guam.

American Samoa consists of a southern archipelago, Tutuila, Manua Islands and Rose Atoll; and in the north of the US EEZ of Swains Island.

This document aims to analyze reef fish fisheries on both archipelagic and local scales with the term 'local' or 'location' used in reference to any scale smaller than archipelagic. For example, we treat Tutuila Island as a location in the American Samoa Archipelago and Guam Island as a location in the Mariana Archipelago. The term 'area' may refer to an archipelago or location, depending on the context.

Biomass Data

Biomass estimates for reef fish populations were provided by the National Marine Fisheries Service Pacific Islands Fisheries Science Center's (NMFS PIFSC) Coral Reef Ecosystem Division (CRED). As part of their Reef Assessment and Monitoring Program (RAMP), CRED conducts biological surveys on a biennial basis at 55 U.S. Pacific Islands, including the islands analyzed in this document (Williams, 2010). Since June 2007, the surveys have employed a stratified random sampling design within 0-30m hard-bottom habitats. The surveys aim to estimate a reef-fish density by species in three different hard-bottom habitat strata and then extrapolate archipelagic family biomass based on estimates of habitat area.

We requested RAMP biomass estimates for the following eleven coral reef fish families which typically account for the majority of reef fish catches: acanthuridae, carangidae, carcharhinidae, holocentridae, kyphosidae, labridae, lethrinidae, lutjanidae, mullidae, scaridae, and serranidae. The remaining families were combined under the category 'other biomass' such that there were a total of twelve categories (eleven families plus 'other'). (Note: In this document the term 'fish' will be used for all marine organisms that might be targeted in a fishery, i.e. 'fish' may include invertebrates such as crab, lobster, etc.)

In Guam, carangids, carcharhinids and kyphosids were not observed in the most recent RAMP surveys. All three families are known to exist in Guam and may even compose significant portions of the catch record, so we approximated their biomass using the corresponding estimated biomass density for nearest and most ecologically similar region, CNMI. We believe that using these proxies was justified because Guam and CNMI, while politically distinct, are contiguous parts of the same archipelago.

Catch Data

Hawai'i requires commercial fishermen to obtain a Commercial Marine License (CML) and requires all CML holders to submit a monthly logbook of catch data to the Hawai'i Division of Aquatic Resources (HDAR, 2010). The CML catch database extends from 1948 onwards but rigorous quality control procedures for logbook data were not applied until 1966 onwards so we have excluded data prior to that year. The Hawai'i data is reported by statistical grids, with which we were able to separate reef fish catches into those from federal and state waters

The NMFS PIFSC Western Pacific Fisheries Information Network (WPacFIN) boat-based and shore-based creel survey data were analyzed for American Samoa, Guam, and CNMI (Table 1). Creel surveys consist of detailed interviews with fishermen, and they aim to document the number and weight of the catch. The following section is taken from Hamm and Tao (2010), which details the creel survey methodology:

> To be considered a 'complete and useable' interview [i.e. creel survey], the entire catch must be accounted for, either by direct measurements and counts or by estimation procedures. Generally speaking and when possible, all fish are identified to the lowest taxonomic level within the capability of the surveyor collecting the interview and the number of

individuals counted or estimated, individuals weighed and/or measured, and total weights collected or calculated based on samples collected.

Since this document aims to support the creation of ACLs for obligate reef-associated species, certain groups of fish included in the catch records were omitted from analysis. These included pelagic species, including all species in the families istiophoridae, scombridae, and xiiphidae; the schooling carangids *Selar crumenopthalmus* and *Decapterus* spp.; deep-water bottomfish, notably the genera *Aprion*, *Etelis*, and *Pristipomoides*. Additionally, we decided to omit taxa that appeared in less than half of the catch record for a given archipelago on the basis that infrequently caught taxa were unlikely to have ACLs but rather would be incorporated into the ecosystem species category. The Hawaiian Archipelago catch record, for example, consisted of 44 years of data but only taxa that were caught in at least 22 years were included.

For the analyses presented here, the term 'taxa' (or 'taxon') refers to a designation used in the catch record for a given area. Sometimes catch records identified fish to the species level, but quite often fish were only identified to the genus or family level, creating the opportunity for overlapping designations. Thus, *Naso lituratus* and 'miscellaneous *Naso* spp.' are considered two separate taxa here, even though *N. lituratus* is subsumed by the *Naso* spp. label. Table 2 summarizes the number of species and families whose catch records were ultimately analyzed.

Catch data for all reef-associated species are organized by family and presented by archipelago in the attached appendices. With the exception of the Hawaiian logbook data, catch data for individual species are derived from raw samples of creel surveys; they may not represent a wholly unbiased sample of the population of reef-fish caught (Hamm and Tao, 2010). However, these data likely represent the best available information on catch, particularly on the species level, and may help illuminate general trends in reef-based fisheries.

Species Variability in Catch

To ascertain the level of variability in year-to-year species catch, coefficients of variation (or CV, equivalent to the standard deviation of catch divided by the mean catch) were calculated for the ten species with the highest aggregate catch in each archipelago. (In the Mariana Archipelago, catches from CNMI and Guam were evaluated separately.)

Exploited Biomass Estimates

NMFS PIFSC provided annual reef-fish catch by family for American Samoa, CNMI, Guam and Hawai'i in order to estimate the percentage of harvested biomass. These are essential expansions of the aforementioned creel survey data (Hamm, D., personal communication). Recent mean annual catch values were expressed as the percentage of biomass harvested per location/archipelago per family. Current RAMP surveys date from 2007 and only the mean catches for the most recent five years on record were used; namely American Samoa 2004-2008, Hawaiian Archipelago 2005-2009, and for the Mariana Archipelago 2005-2008. (The Marina Archipelago mean catch was four years only because shore-based creel surveys in CNMI did not begin until 2005. Data from 2009 were not yet available.)

Regression analyses also were conducted with biomass as an independent variable and catch as its dependent variable to test for a relationship between catch and biomass on both local and archipelagic scales.

Family Variability in Catch

Variability in reef fish catch by family was analyzed in a manner similar to that used for species-level catch, except that we used expanded catch data, which were standardized for survey effort, rather than raw sample data.

Estimated Trophic Level Calculations

For each archipelago (and the Mariana states CNMI and Guam), the mean trophic score of the aforementioned eleven coral reef families was estimated using sample catch data. Catch data was used for this purpose because calculating family scores required the scores of their constituent species and we did not have species-level biomass data at the time of this analysis. Thus, fishes that were clearly identified to the species level in creel or logbook data were assigned trophic scores using values published from the WorldFish online database Fishbase.org (2000). Weighted family trophic scores were then calculated based on the relative abundance of each species in the family catch record for a given area. Where species information was not available for a given family, the trophic values for all species known to occur in that area were averaged.

Once family trophic scores had been derived, a single ‘reef fish’ trophic score for the population of all reef fishes (i.e. all families) in a given area was estimated by calculating the weighted average of the respective family trophic scores. ‘Reef fish’ scores were weighted using two separate measure of relative abundance: biomass data; and expanded catch data. (It was possible to use biomass data here because family-level data were available.) Overall, catch data was available for more families than was biomass data; however, only those eleven coral reef families common to both the catch and the biomass data were used to estimate ‘reef fish’ scores to enable comparisons between the two methodologies.

Catch in Local versus Federal Waters

We also conducted analyses of catch in local (state or territory) versus Federal waters. For American Samoa and CNMI the closest available proxies were shore- and boat-based catch data, respectively (i.e. shore-based catch was used as a proxy for catch in local waters and boat-based catch was used as a proxy for catch in federal waters). Guam also uses the ‘boat’ and ‘shore’ designations in its creel surveys, but in that case boat catch is further divided into local boat-based and federal boat-based catch. Hence, local catch in Guam is the sum of local boat-based and shore-based catch, whereas federal catch uses only federal-boat data. Hawai’i logbook data include the location of the catch, so federal and local catch are reported directly for that archipelago.

Results:

In two of three archipelagos (American Samoa and Mariana), the taxa were broadly distributed in terms of yearly catch frequency (Figs. 1 A-C). Only in the Hawaiian Archipelago (Fig. 1 D) were a clear majority of taxa found in every single year of the catch record (57 of 100 taxa), although American Samoa and Guam also had modes equivalent to their full records. In CNMI, there were more taxa that were caught in just five years (half the record) than there were taxa caught every single year. As previously mentioned, taxa found in less than half of the catch record for a given area were excluded from analysis therein.

In terms of catch record diversity, Guam had the most taxa analyzed and many more fish identified to the species level than any other region (Table 2). The Hawaiian Archipelago had the highest family richness. American Samoa and CNMI had similar numbers of families and taxa in their catch records. (Many fish in those areas were vaguely identified, usually only to the family level.)

CV values show significant variability in catch for the ten most abundant species (ranked by total catch weight) in each region (Table 3). In American Samoa and CNMI, CV over the past five years was > 0.5 (indicating that standard deviation was more than half of the mean) for eight of ten species, and in Guam seven of ten species were > 0.5. American Samoa also had four species with CV > 1 in the past five years and seven species with CV > 1 over the total record. The Hawaiian Archipelago had lower species catch variability; only one species there had CV > 0.5 over the past five years (although a majority had CV > 0.5 over the whole record).

Catch variability was less pronounced when examining whole families, although values in American Samoa were still significant (Table 4). In that area, CV was > 0.5 for a majority of families for both the past five years and the whole record, and multiple families had CV > 1. The two other archipelagos typically had CV values < 0.5.

Estimates of the percentage of biomass exploited were minor for most reef fish families at most locations (Table 5). Carangids, kyphosids and lethrinids tended to have the highest exploitation rates; they were the only families to have exploitation > 50% at some locations. Most other families had low to moderate exploitation rates, ranging from 22.5 % (mullids around Guam Island) to less than 1% (numerous other families in multiple locations).

By location, the percentage of exploited biomass for most families was highest in Guam, particularly when total Guam catches were compared with biomass estimates from Guam Island only. Eleven of the twelve fish categories—nine families and the ‘other’ category for miscellaneous reef fish—had their highest estimated exploitation rates around Guam. However, when Guam catch was compared with whole archipelagic biomass, the percentage exploited was significantly lower. Total carangid catch in Guam, for example, was nearly 160.3% of estimated biomass; however, it was only 7.9% of archipelagic biomass. In CNMI, exploitation rates for lethrinids (22.5%) and carangids (67.4%) were high in the area encompassing Rota to Farallon de Medinilla (FDM).

Exploitation in American Samoa was low for most families but at the island of Tutuila was moderate (> 10%) for carangids and kyphosids.

The Hawaiian Archipelago had uniformly low values, even when the NWHI were excluded. Only two families in MHI, Carangidae and Holocentridae, had harvest rates greater than 1%.

When total reef fish catch (all families) was compared against total biomass, the percentage exploited was typically less than 5% for most locations. Two locations in the Mariana Archipelago—Guam Island; and Guam Island and Banks—exceeded 5%. Guam Island had the highest total exploitation at 8.8%. Reef fish catch from Guam, however, was only 1.3% of archipelagic biomass.

When all twelve reef fish categories were used, regression analyses showed significant relationships between catch and biomass for Guam Island and Banks; and all locations in the American Samoa and Hawaiian Archipelagos (Table 6). The relationship was particularly strong in MHI (P-value < 0.01). When carangid, kyphosid and lethrinid biomasses were removed—on account of the difficulty of visually estimating the biomass of those families—all locations in all three archipelagos showed a significant relationship between these two parameters. The proportions of total catch and total biomass represented by each family are represented graphically in Figs. 3 A-I.

Estimates of family trophic score were fairly consistent between archipelagos (Table 7). Carcharhinids had the highest single family trophic score (4.23 in Hawai'i) and also the highest mean archipelagic score. Scarids had a score of 2.00 in all regions, the lowest individual and mean values for all families.

Overall 'reef fish' trophic scores were typically larger when calculated with expanded catch data than with biomass estimates (Table 8). The one exception was the Hawaiian Archipelago, but the difference between the two values there was small (0.09). American Samoa had the largest difference between the two methodologies (catch-based score was 0.8 greater than biomass-based score).

Expanded catch data appear to indicate a declining reef fish fishery in American Samoa, Guam and the NWHI (Figs. 2A, C, and E); and a mostly flat trend in CNMI, MHI and the Mariana Archipelago (Figs. 2B, D, and F). For the former three areas, recent mean catches are lower than mean catch over the whole record, whereas they mostly comparable for the latter three areas. Information on local versus federal catch for species and families are provided in the attached appendices.

Discussion

Of particular significance to the task of creating ACLs are three general results: (1) highly variable catch in species with the highest overall catches; (2) low variability in catch for the most frequently caught families; and (3) moderate to low exploitation for most coral reef fish families in most areas.

Regarding the variability of species catch, it must first be reiterated that at the time of this analysis we were only able to acquire 'raw' species-level data, i.e. they were not standardized for survey effort; hence, they are inherently more variable than family-level data. Nonetheless, the high CV values in the predominantly caught reef fish species suggest that implementing species-level ACLs for coral reef fishes could prove exceedingly difficult. For instance, in CNMI the species with the highest total catch, *Lethrinus rubrioperuclatus*, had a CV of 0.9—the standard deviation of its catch is nearly equivalent to its mean catch—over the past five years. In American Samoa, *Lutjanus kasmira* had the highest overall catch. The standard deviation of its catch over the past five years actually exceeds the mean catch (CV > 1) over the same period. WPRFMC and NFMS are currently working to expand (standardize) species-level data by next year, which may reveal lower species CV values than presented here.

Lower variability in family catches may reflect the difficulty of identifying fish to the species level in creel surveys. During the surveys, fish that cannot be identified to the species level are assigned to a broader taxonomic grouping (Hamm and Tao, 2010), such as a genus or family. Observers differ in their fish identification ability, and presumably a less experienced observer will have more difficulty detecting the subtle morphological differences that separate some species. Thus, greater precision in family catch estimates should be expected. Since ACL monitoring will presumably rely heavily on fishery dependent data, family-level ACLs should be easier to implement than species-level ACLs.

However, given the low exploitation values for most reef fish families, even setting ACLs at the family level may prove excessive. Our analysis found that only four families in had > 20% of their biomass harvested in any area. One of these families, mullidae, had exploitation > 20% in only one area (Guam Island: 22.54%); the other three families—carangidae, kyphosidae, and lethrinidae—are either known or suspected to be underrepresented in visual surveys.

Jennings and Polunin (1995) concluded that underwater visual surveys grossly underestimated the amount of exploitable lethrinid biomass in Fiji, and Kulbicki (1988) suggested the same for *Lethrinus* spp. based on a poor relationship between observed density and catch per unit effort (CPUE). Watson et al. (2007a) found that *Kyphosus sydneyanus* kept greater distances from stereo-video cameras when SCUBA divers were present, implying that SCUBA visual surveys would produce inaccurate population estimates for that species; similarly, Denny and Babcock (2004) observed *Pseudocaranx dentex* when using baited underwater cameras but did not observe the species in more than 16 SCUBA visual censuses in same areas. Kulbicki (1988), working in New Caledonia, did not record any carangids in more than 45 visual surveys, despite the presence of several tons worth in the catch record. If the RAMP surveys analyzed here underestimated biomass for these families, the corresponding estimates of percentage exploited would appear artificially high.

Underestimates in coral reef visual survey are also likely to occur when a given taxon has significant deep-water distributions, as is the case for carangids (Williams, 2010), because surveys are typically limited to safe diving depths. RAMP surveys are limited to 30 m, but Randall (2007) notes that *Caranx lugubris* is usually seen in more than 30 m of water, and that many other carangids occur well below depths of 100 m. *C. sexfasciatus* occurs in deep channels up to 96 m and *C. lugubris* is known up to 354 m (Honebrink, 2000). For several other species, there are ontological shifts in depth distribution, with adults preferring deeper waters (Meyers, 1991). Adult *Alectis ciliaris*, for example, usually occur at depths of 60 m or more, well beyond SCUBA survey depths. To further complicate matters, the vertical distribution of a given species may depend on the season, with some species schooling in deep waters during spawning seasons (Watson et al., 2007b). NMFS CRED continues to develop methodologies to account for deep water distributions below current survey depths (Williams, 2010), and the authors of this study advises additional exploitation rate analyses should recalibrated biomass estimates become available.

One final note regarding survey methodology as it relates to our exploitation estimates: It should be reiterated that NOAA CRED did not actually record carangids or kyphosids for the Guam region—apparently they were not seen there. Given that these families were both regularly caught in Guam from 2005-2008, we decided to crudely estimate their biomass there by using the average biomass density of those families over hard-bottom habitats in CNMI. A more refined methodology might produce significantly different biomass estimates, with the commensurate effect on estimates of the percentage exploited. It is somewhat telling that not a single kyphosid was seen in Guam visual surveys, yet the estimated annual kyphosid catch there was > 3,100 kg from 2005-2008.

Despite the aforementioned difficulties associated with estimating biomass for at least three of the twelve reef fish categories used, this analysis showed significant relationships between mean annual catch and estimated biomass for most areas. Furthermore, if carangids, kyphosids, and lethrnids are excluded from regression analyses, strong relationships between catch and estimated biomass emerge in areas where there previously were none. In CNMI, for example, removing these families caused P-values for Rota to FDM to drop from 0.85 to 0.003, and from 0.91 to 0.01 for Rota to the Northern Islands. On an archipelagic scale, P-values for the Marianas fell from 0.13 to 0.003. (P-values < 0.05 indicate statistical significance.) The apparent dependence of catch on biomass is intuitive and corroborates work by Kublicki et al. (1994) where catch (in this case, CPUE) had the highest correlation with biomass of all parameters analyzed in an experimental fishery in Oueva, New Caledonia.

With respect to overall 'reef fish' trophic scores, the fact that catch-based scores were consistently higher than biomass-based scores supports the premise that fishermen are targeting larger fish higher in the food chain. The only exception to this pattern was for the entire Hawaiian Archipelago, but that score may be skewed downward by limited catches in the NWHI, where high-trophic level fishes are present in great numbers. If significant fishing were still occurring in NWHI, the catch-based trophic score for the archipelago as a whole would likely be higher. After the Hawaiian Archipelago, the next highest biomass-based trophic scores were for the Mariana Archipelago and CNMI, respectively. Both of those regions include extensive island networks where fishing pressure is relatively light (WPRFMC, 2009b), resulting in larger biomasses of apex predators and thus higher trophic scores. In summary, estimated 'reef fish' trophic scores are in accord with the known ecological status of the areas in question, suggesting this metric may have some utility in monitoring the impact of ACLs —although clearly more work is needed to refine the methodology.

Fishery resources in the Western Pacific Region have frequently been reported as overexploited, often on the basis that apex predator abundance, size, or biomass are low in underwater surveys (Friedlander and Demartini, 2002; Craig et al., 2005). Taken as whole, this study suggests that coral reef fishery resources in the Western Pacific Region may not be overexploited, but rather, that localized depletion may be occurring in areas where fishing pressure is heavy. Fishing pressure can vary significantly between islands in the same archipelago. In MHI, for example, more than 63% of all reef fish landings from 2005-2009 occurred around the island O'ahu (Fig. 4), easily the most populated and urbanized island in the Hawaiian Archipelago.

There have been previous studies that documented low to moderate exploitation (Craig et al., 2008; see also Table 9) or declines in fishing mortality (Sabater and Caroll, 2009). Table 9 presents several other studies that found low to moderate fishing exploitation in the region, although most of these are not peer reviewed. Interestingly, it is not uncommon to record higher total mortality in un-fished areas than in paired fished areas (Langston et al., 2009; Longnecker et al., 2008c). Such results imply negative fishing mortality and are thus logically invalid; however, it is not illogical that total mortality for certain prey species would be higher in un-fished areas because fishing can remove top-predators that have the capacity to significantly structure reef communities (Babcock et al. 1999).

There are, however, several important caveats to the exploitation results presented here. Firstly, several areas in the Western Pacific Region have shown notable declines in their reef fisheries since monitoring began (Figs. 2 A and C). These declines could indicate reduced productivity (CPUE) in those areas; alternatively, they may simply be the result of reduced fishing effort over time, which has been documented in some parts of the region. In American Samoa, Sabater and Caroll (2009) noted generally low participation in reef fisheries, a non-significant decline in boat-based effort and a significant decrease over the past three decades in shore-based fishing effort. Likewise, Saucerman (1995) noted a downward trend in reef fishing effort there in the early 1990s. These changes were attributed to shifting socioeconomic conditions—many American Samoans now have wage work—and natural disturbances, including several severe hurricanes, crown-of-thorns starfish outbreaks, and coral bleaching events. Nonetheless, the perception of most village elders, at least in the outer islands of Ofu and Olosega, is that fishing is good and similar to what it was in previous decades (Craig et al., 2008).

In Guam, effort has become restricted by reduced shoreline accessibility: Although there are 108 km2 of coral reef area found within three miles of the island of Guam (Burdick et al., 2008), a personal communication from WPRFMC Guam Island Coordinator suggests that 50% of that coastal reef area is now inaccessible by land due to military and other restrictions and a further 25% of coral reef area has only very limited shoreline access. (Note that these reef areas may, however, be accessible by boat.) The impact on reef fishing is twofold: firstly, it creates large de-facto marine protected areas (MPAs) which may provide some replenishment for some coral reef species; secondly, it concentrates fishing into smaller areas potentially leading to localized depletion.

In Hawai’i, the number of recreational saltwater fishing days and anglers have declined significantly from 1991-2006 (Table 10); there are also fewer Hawai’i residents fishing. This may indicate less fishing pressure on MHI coral reefs, although more information on CPUE would be needed to confirm this. Meanwhile, fishing in the NWHI has halted following the area’s declaration as a marine national monument.

In the Hawaiian Archipelago, another caveat to low exploitation is that this analysis only used commercial data when in fact recreational and subsistence catch is likely equal to or greater than inshore commercial fisheries (Friedlander et al., 2008). (For other archipelagos studied here, recreational and subsistence catch data are captured by creel surveys.) Subsequent to our initial analysis, we were able to obtain recreational catch data (NOAA NMFS Office of Science and Technology, 2010) for Hawai’i for eight of the eleven families that we analyzed. The inclusion of these data only significantly affected exploitation for carangids. In MHI, carangid exploitation increased from 3.07 % to 61.31%. However, in the greater Hawaiian Archipelago, exploitation for carangids was still very low (< 1%), probably on account of the large biomass of apex predators in NWHI (Friedlander and Demartini, 2002).

Additionally, our analysis did not include catch from the Hawaiian aquarium fishery, which is on the order of hundreds of thousands of fish per year in MHI (Friedlander et al., 2008).

One final shortcoming of this study is that patterns in fish size were not analyzed. Fish size can have a major influence on the reproductive potential of a given stock and thus its long-term ecological health (Berkeley et al. 2004; Scott et al. 2006). Thus, it is possible that while the percentage of biomass exploited for most families remains relatively low, mean fish size for some populations may have declined significantly due to fishing pressure. Friedlander and DeMartini (2002) found significant differences in size, age structure and trophic guild between carangids, carcharhinids and other apex predators in the largely un-fished NWHI versus the heavily fished MHI. Had fish lengths been included in the catch data analyzed here, it might have been possible to estimate the size or age structures for some reef fish populations. Such an analysis could greatly augment the explanatory power of this study.

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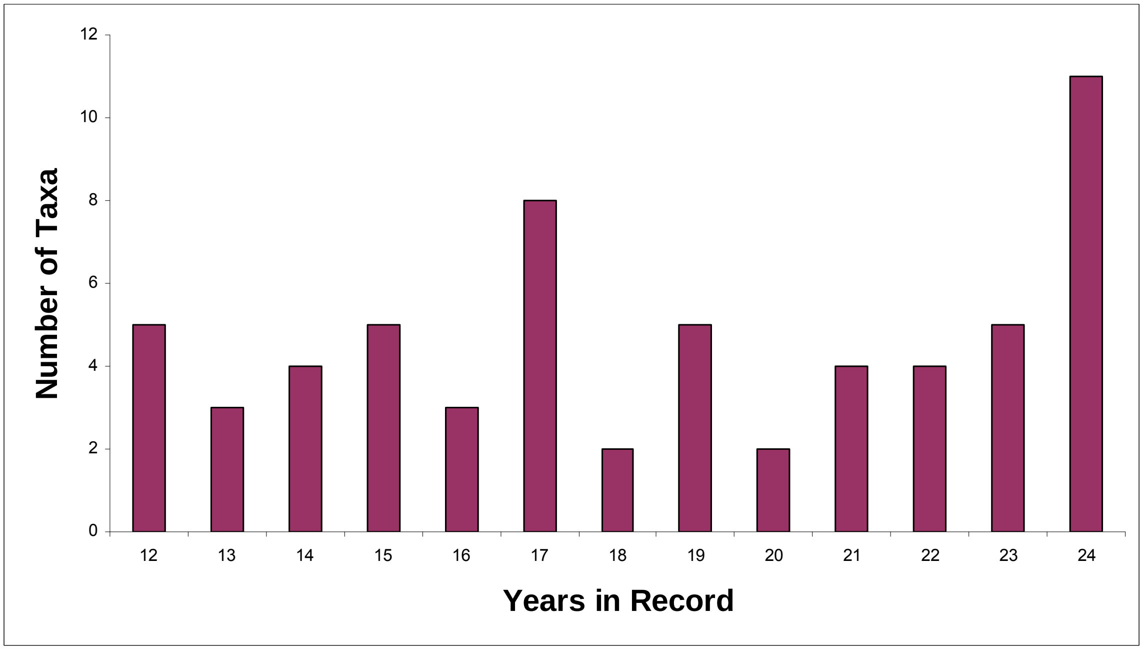
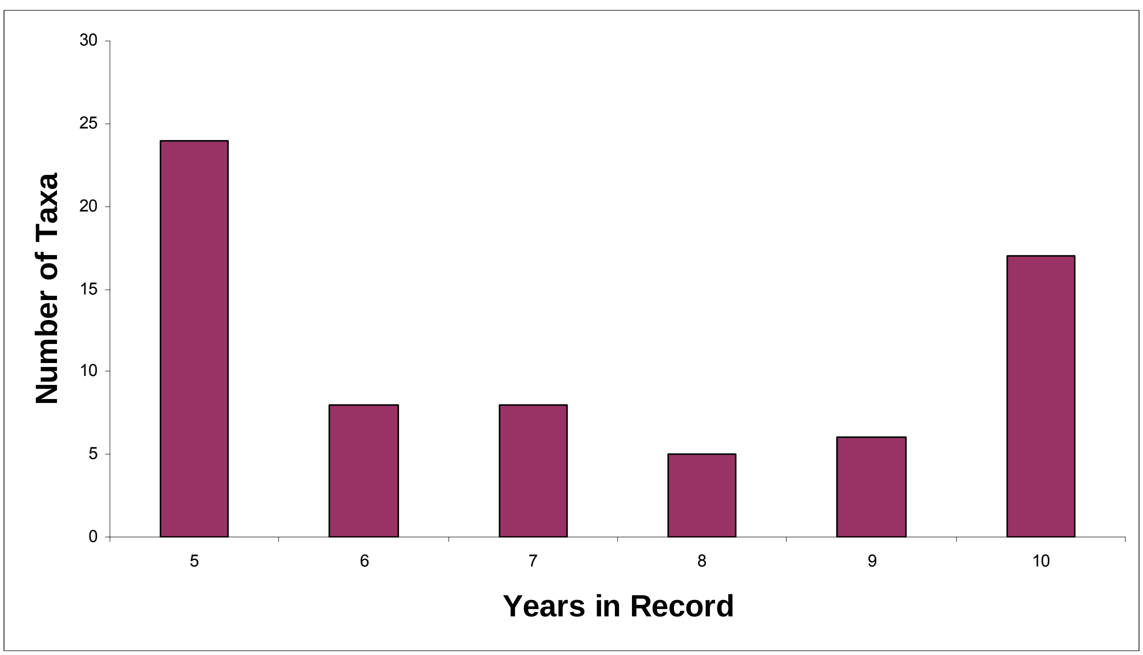
Fig. 1. Frequency of taxa in catch records.

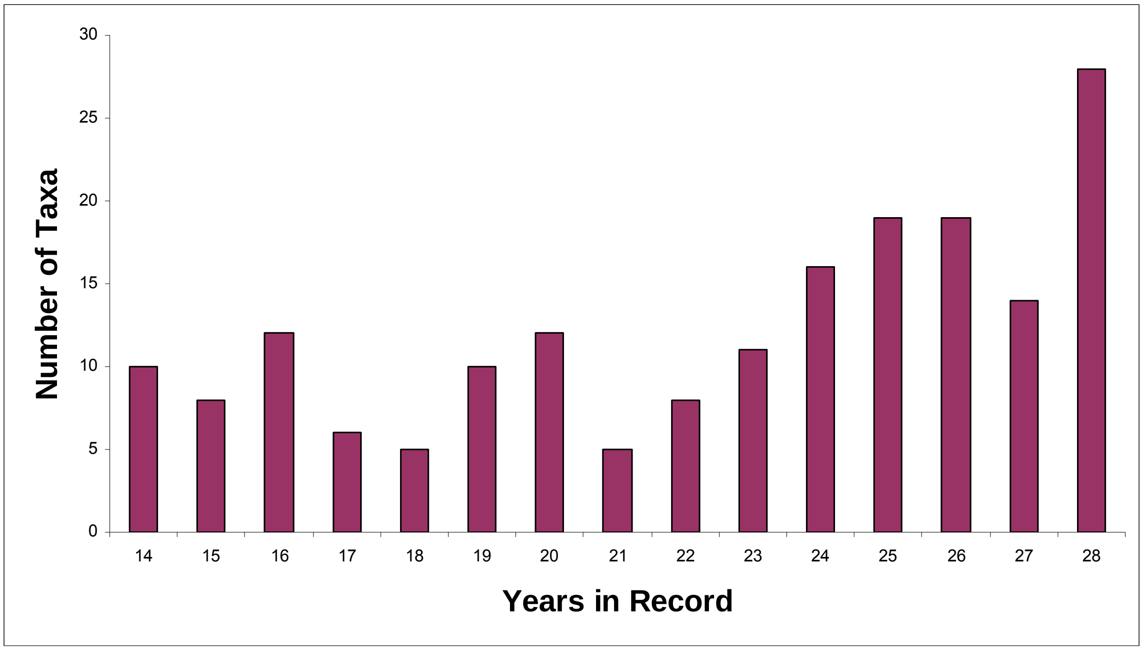
A. American Samoa, Sample Creel Survey Data.



B. CNMI, Sample Creel Survey Data.



C. Guam, Sample Creel Survey Data.



D. Hawaiian Archipelago, Logbook Data.

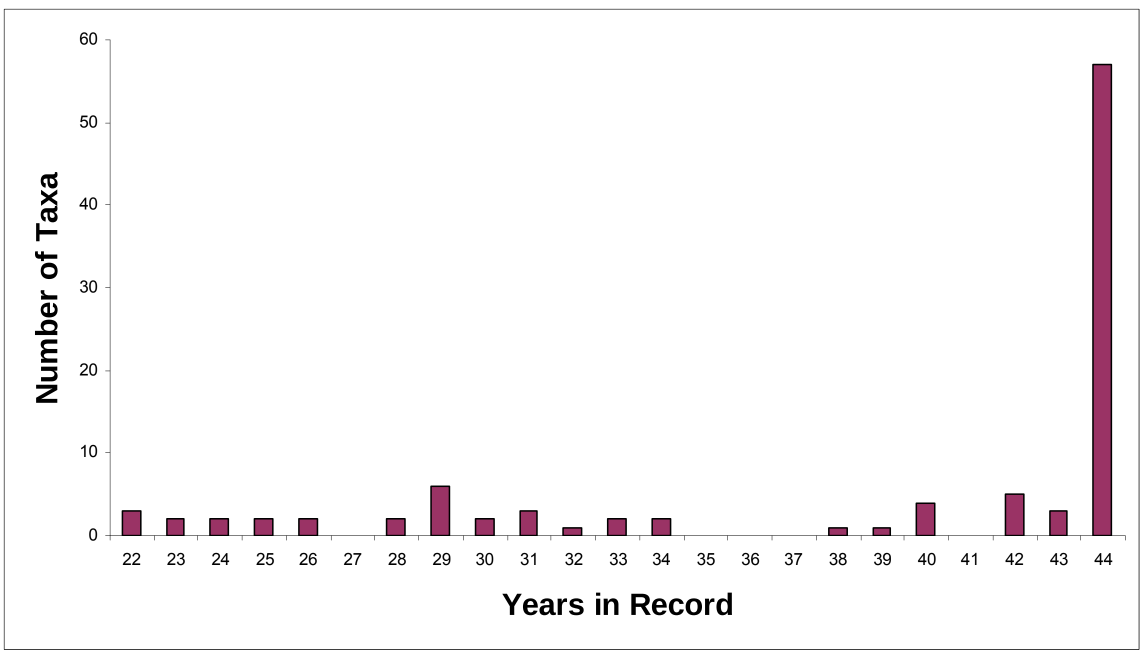
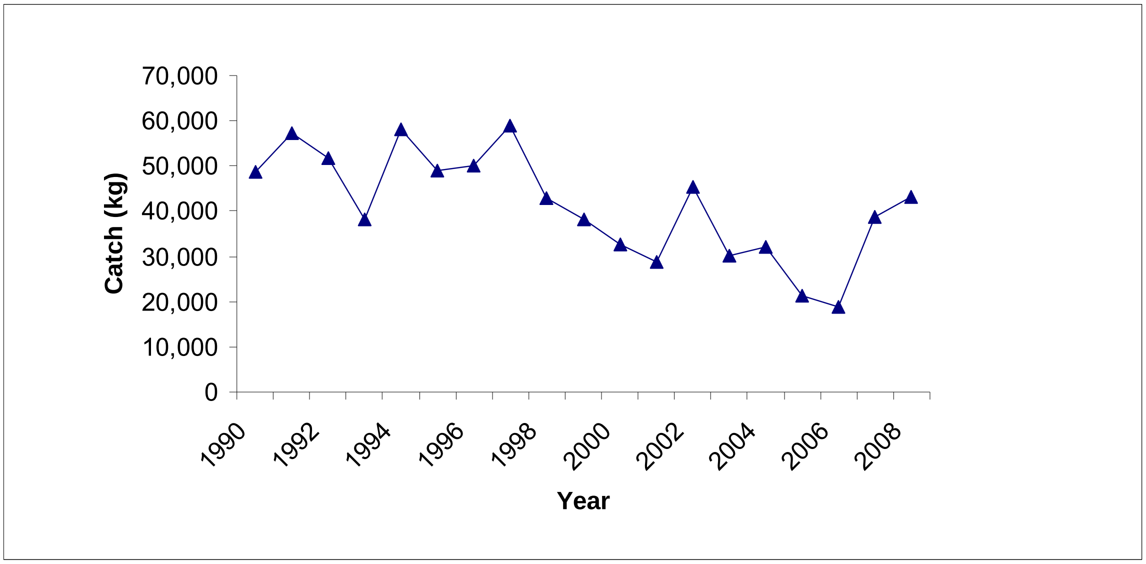


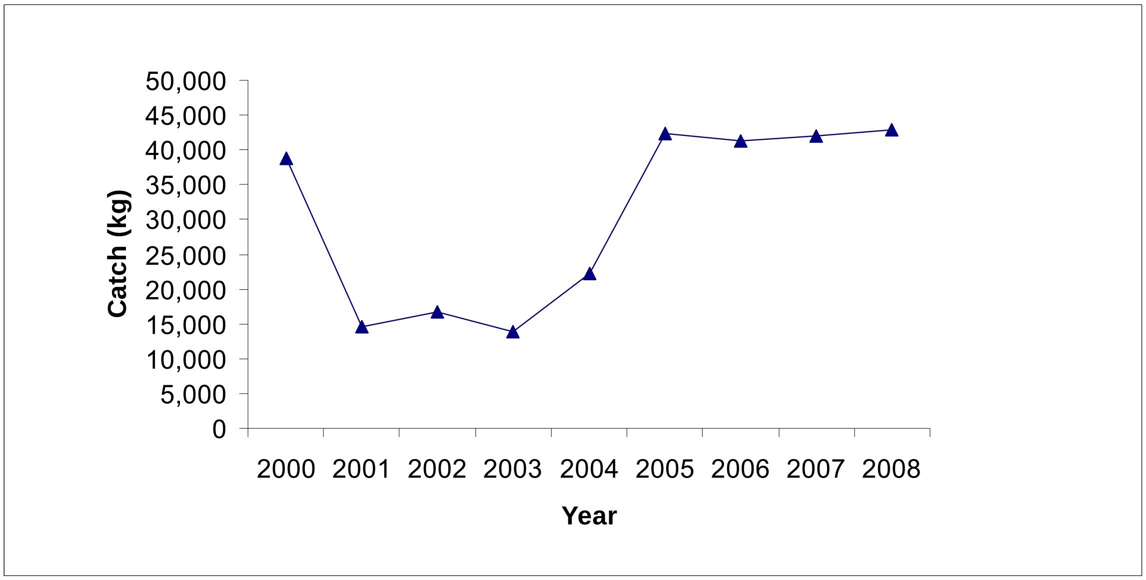
Fig. 2. Total reef fish catch (kg) by archipelago/location.

A. American Samoa. (Source: Expanded creel survey data.)



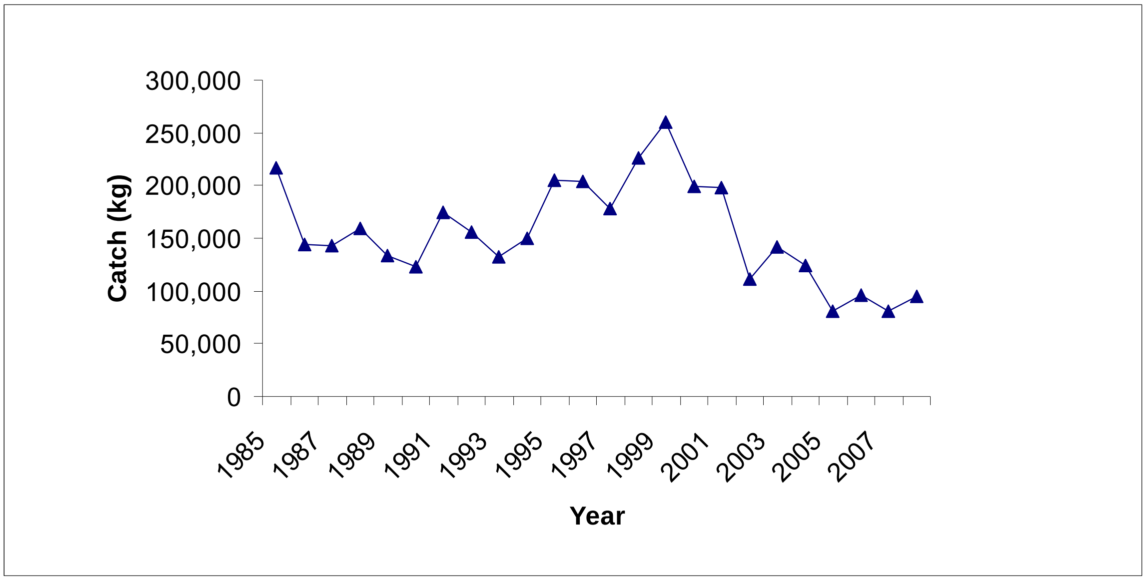
	2004-2008	1990-2008
Mean Catch (kg)	30,823.7	41,260.8
Standard Deviation	10,693.1	11,927.2
Confidence Value	9,372.8	5,363.0
Upper Bound CI	40,196.5	46,623.8
Lower Bound CI	21,451.0	35,897.8

B. CNMI. (Source: Expanded creel survey data.)



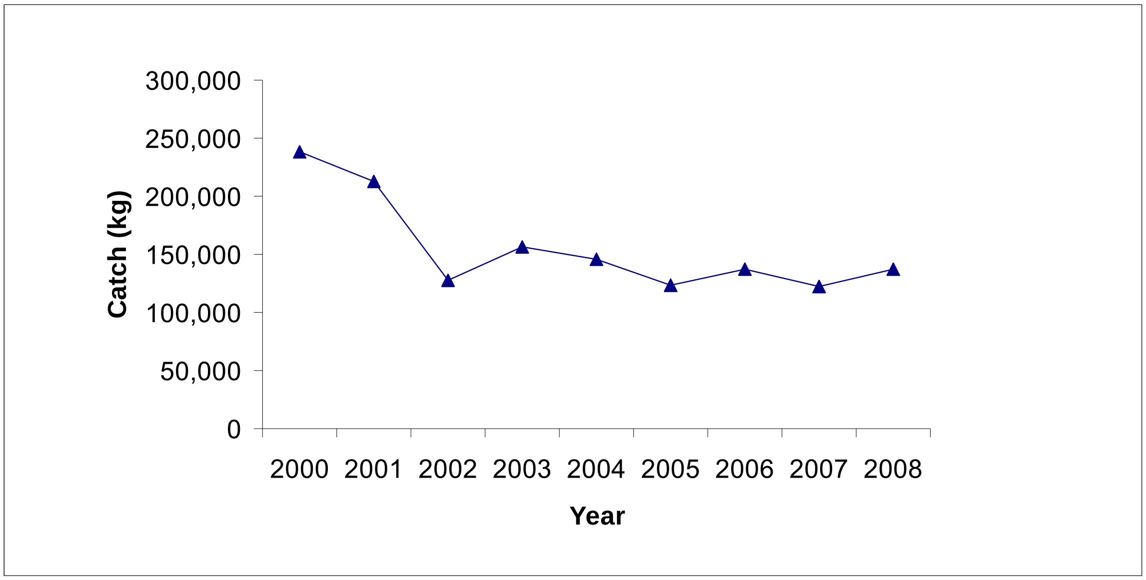
	2005-2008	2000-2008
Mean Catch (kg)	42,108.4	30,502.5
Standard Deviation	664.2	13,243.9
Confidence Value	650.9	8,652.5
Upper Bound CI	42,759.3	39,155.0
Lower Bound CI	41,457.5	21,850.0

C. Guam. (Source: Expanded creel survey data.)



	2005-2008	1985-2008
Mean Catch (kg)	88,017.3	155,532.3
Standard Deviation	8,361.8	48,114.9
Confidence Value	8,194.4	19,249.6
Upper Bound CI	96,211.7	174,781.9
Lower Bound CI	79,822.9	136,282.6

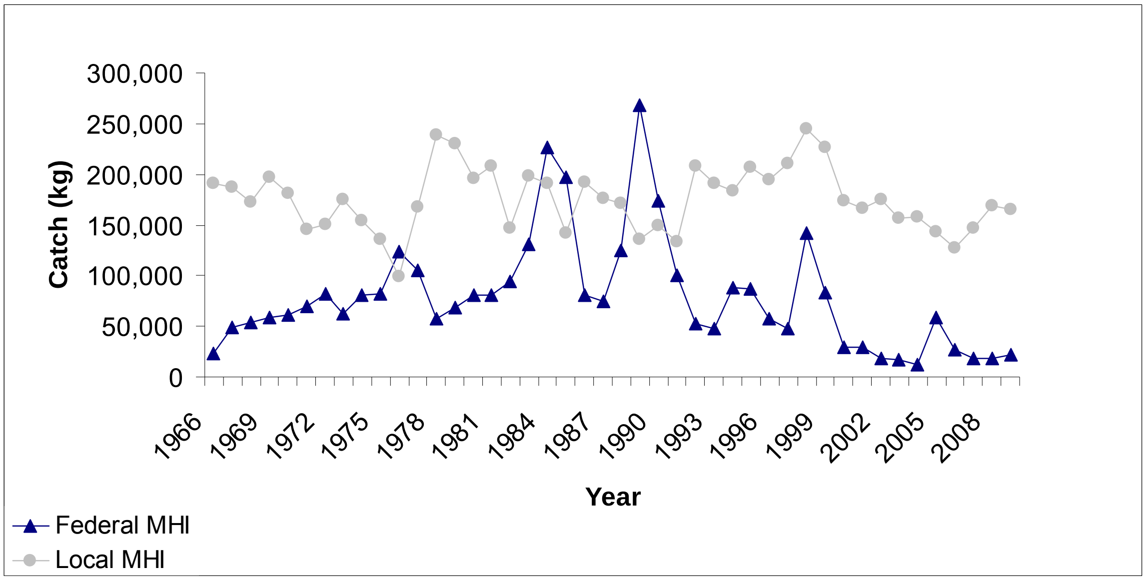
D. Combined Mariana Archipelago. (Source: Expanded creel survey data.)



	2005-2008	2000-2008
Mean Catch (kg)	130,125.7	155,726.2
Standard Deviation	8,308.5	41,555.3
Confidence Value	8,142.2	27,149.0
Upper Bound CI	138,267.9	182,875.1
Lower Bound CI	121,983.5	128,577.2

Note: CNMI shore-based surveys date from 2005 only.

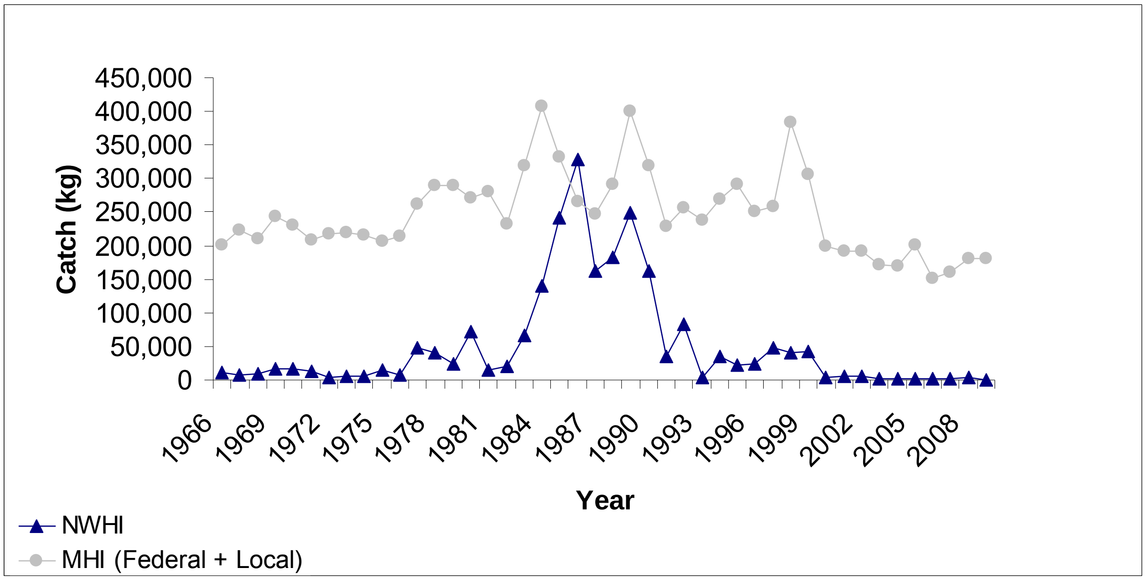
E. Main Hawaiian Islands (MHI). (Source: Commercial marine license logbook data.)



2005-2009	Federal MHI	Local MHI
Mean Catch (kg)	28,808	150,594
Standard Deviation	17,043	17,046
Confidence Value	14,939	14,941
Upper Bound CI	43,746	165,535
Lower Bound CI	13,869	135,653

Total Record (1966-2009)	Federal MHI	Local MHI
Mean Catch (kg)	78,836	175,469
Standard Deviation	55,565	31,317
Confidence Value	16,418	9,253
Upper Bound CI	95,254	184,723
Lower Bound CI	62,418	166,216

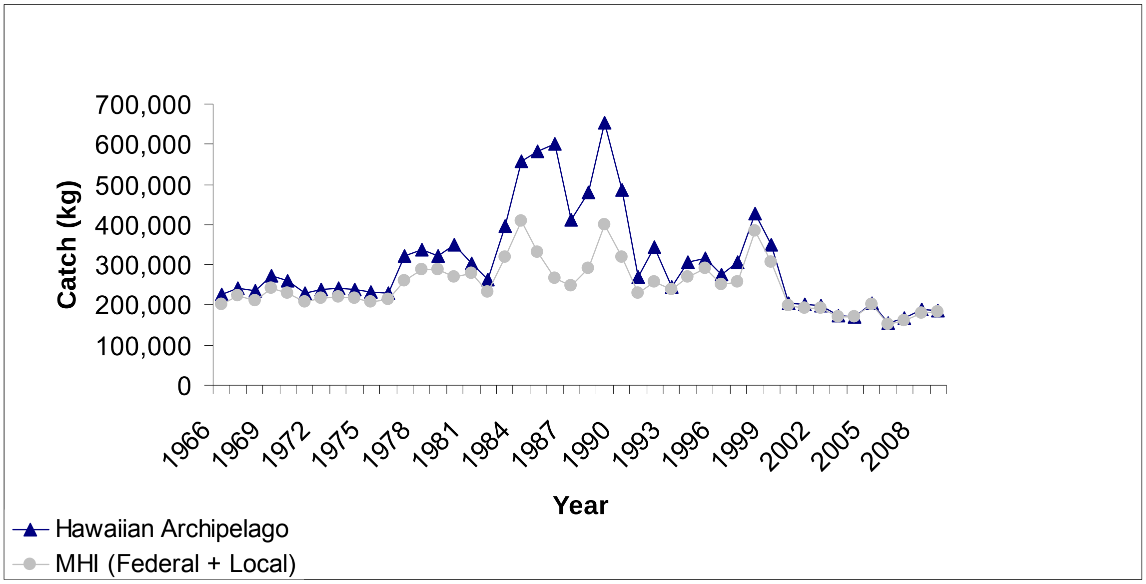
F. MHI versus NWHI. (Source: Commercial marine license logbook data.)



2005-2009	NWHI	MHI (Federal + Local)
Mean Catch (kg)	1,727	175,218
Standard Deviation	1,099	19,247
Confidence Value	963	16,870
Upper Bound CI	2,690	192,088
Lower Bound CI	763	158,348

Total Record (1966-2009)	NWHI	MHI (Federal + Local)
Mean Catch (kg)	50,502	247,155
Standard Deviation	77,028	60,634
Confidence Value	22,760	17,916
Upper Bound CI	73,262	265,071
Lower Bound CI	27,742	229,239

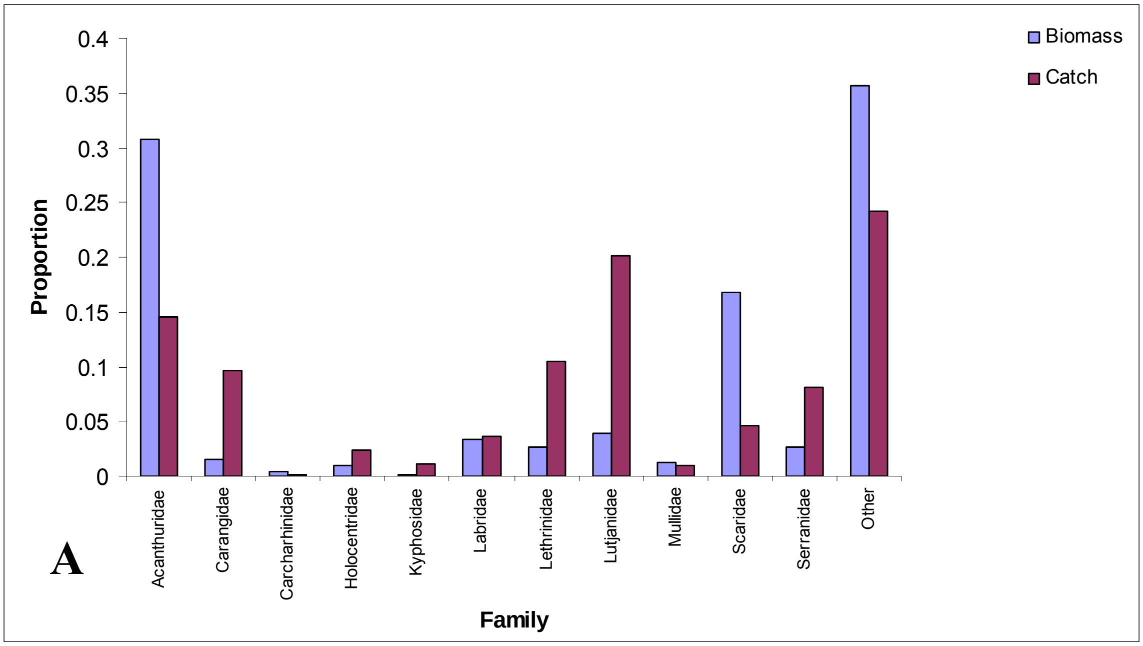
F. MHI versus Hawaiian Archipelago catches. (Source: Commercial marine license logbook data.)



Last Five Years	Hawaiian Archipelago	MHI (Federal + Local)
Mean Catch (kg)	180,404	175,218
Standard Deviation	18,943	19,247
Confidence Value	16,604	16,870
Upper Bound CI	197,008	192,088
Lower Bound CI	163,800	158,348

Total Record	Hawaiian Archipelago	MHI (Federal + Local)
Mean Catch (kg)	304,539	247,155
Standard Deviation	123,567	60,634
Confidence Value	36,511	17,916
Upper Bound CI	341,050	265,071
Lower Bound CI	268,028	229,239

Figure 3. Proportion of archipelagic/local biomass and catch for reef fish families using biomass from: (A) Tutuila; (B) Tutuila, Tau, Ofu, Olosega; (C) Rota to Farallon de Medinilla; (D) Rota to the Northern Islands; (E) Guam Island; (F) Guam Island and Banks; (G)Mariana Archipelago; (H) Main Hawaiian Islands (MHI); and (I) Hawaiian Archipelago.



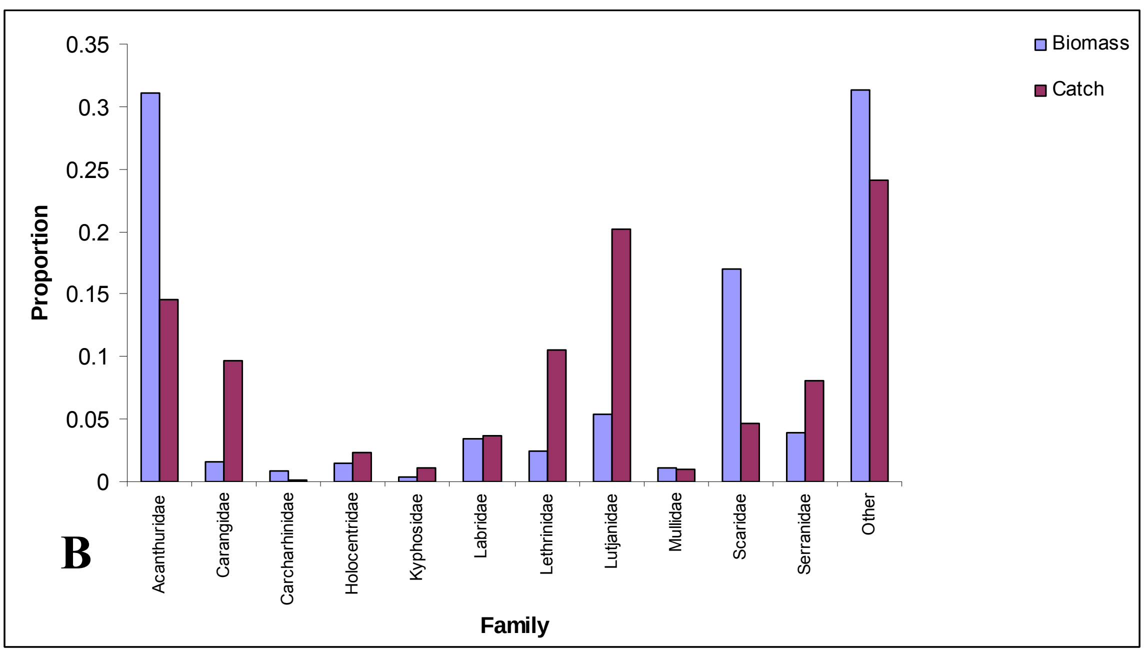
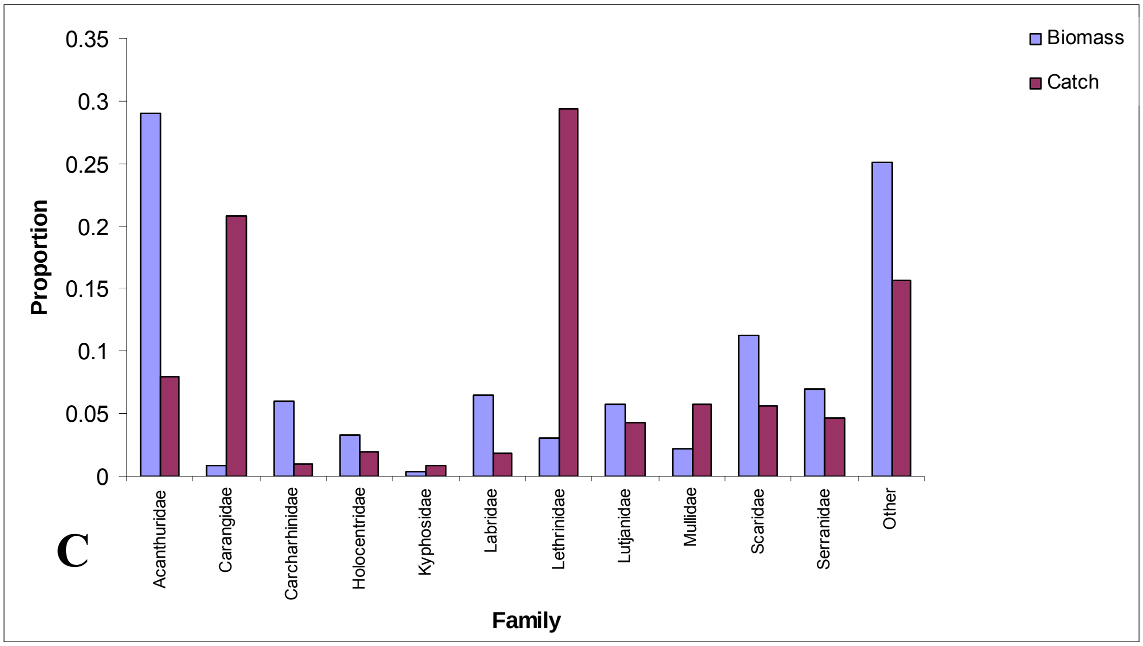


Figure 3. Proportion of archipelagic/local biomass or catch for reef fish families.



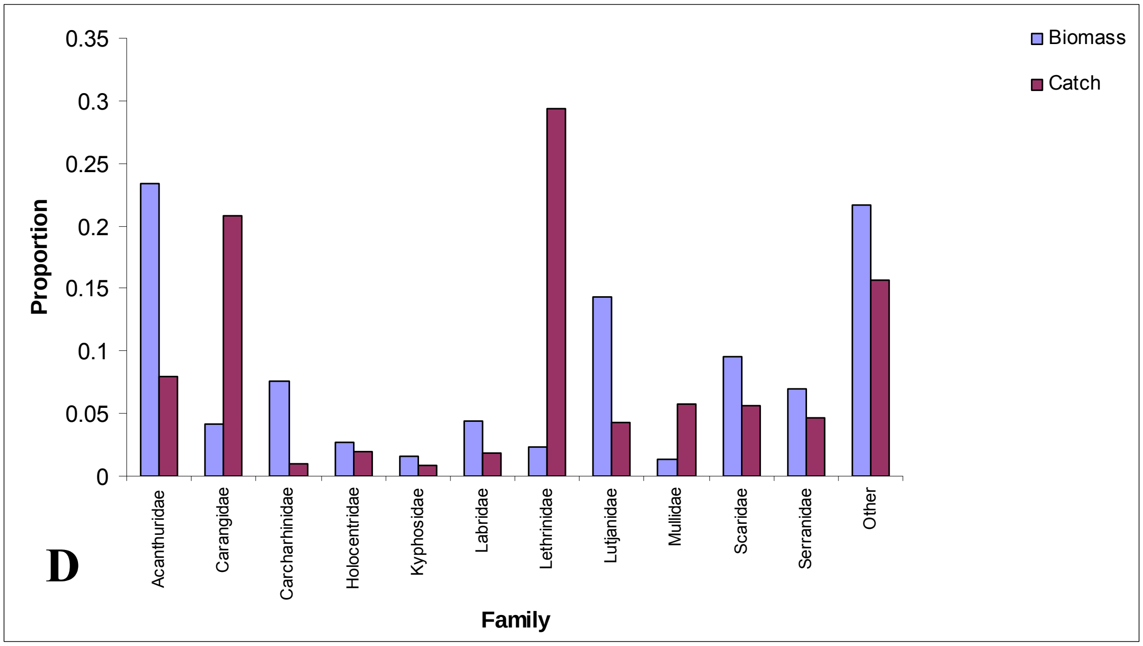
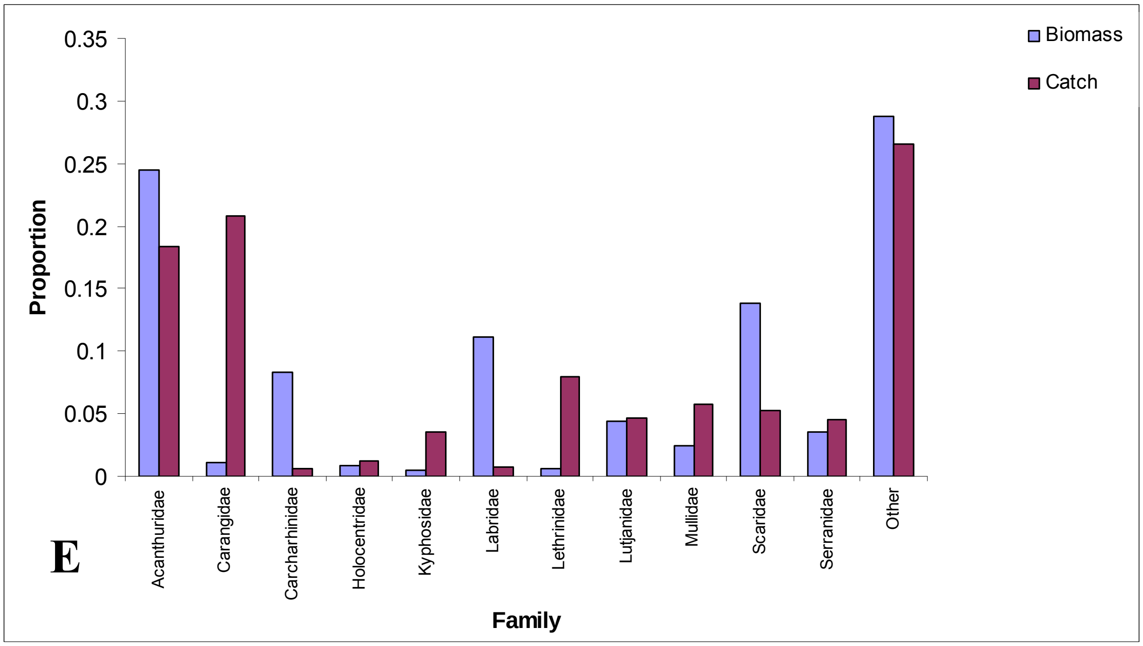


Figure 3. Proportion of regional biomass or catch for reef fish families.



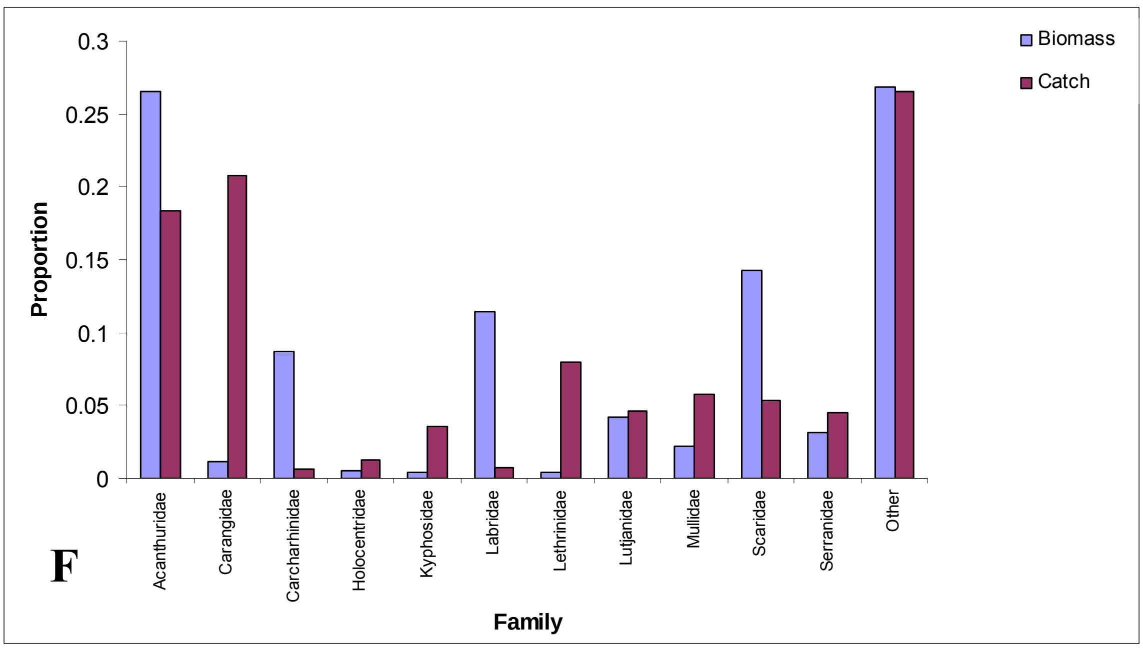
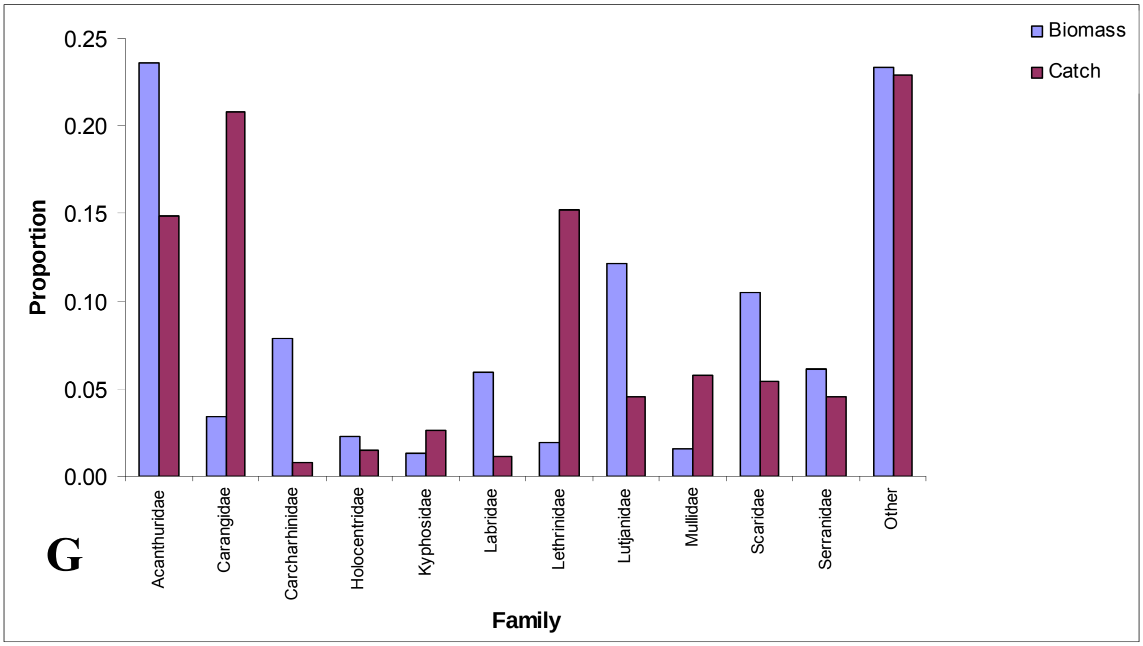
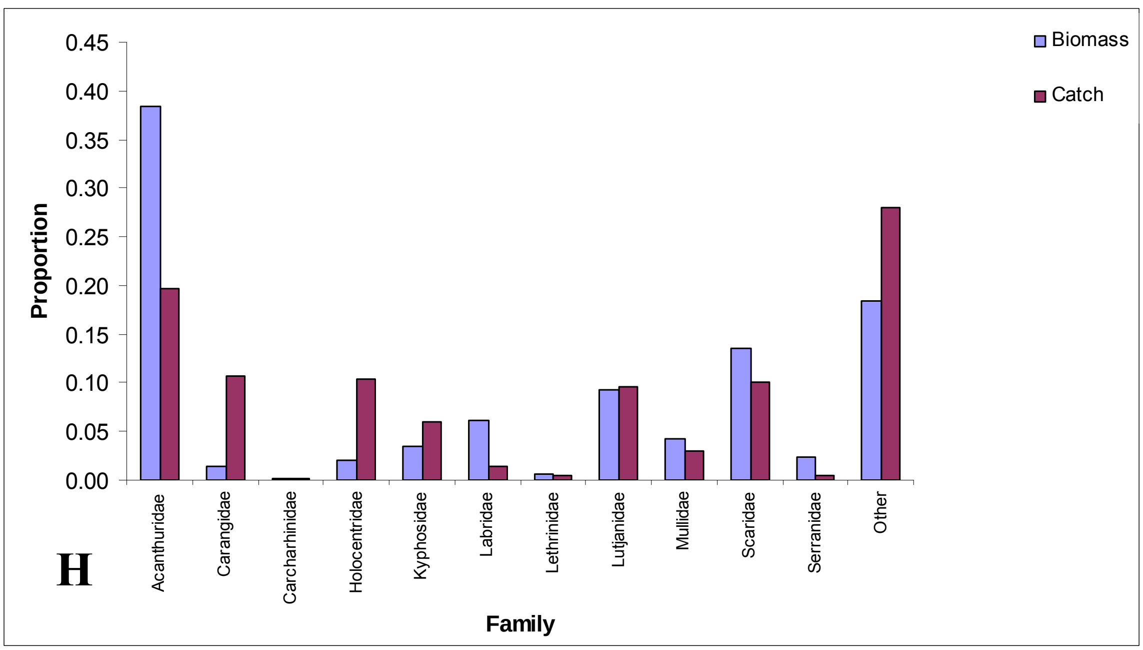


Figure 3. Proportion of regional biomass or catch for reef fish families.





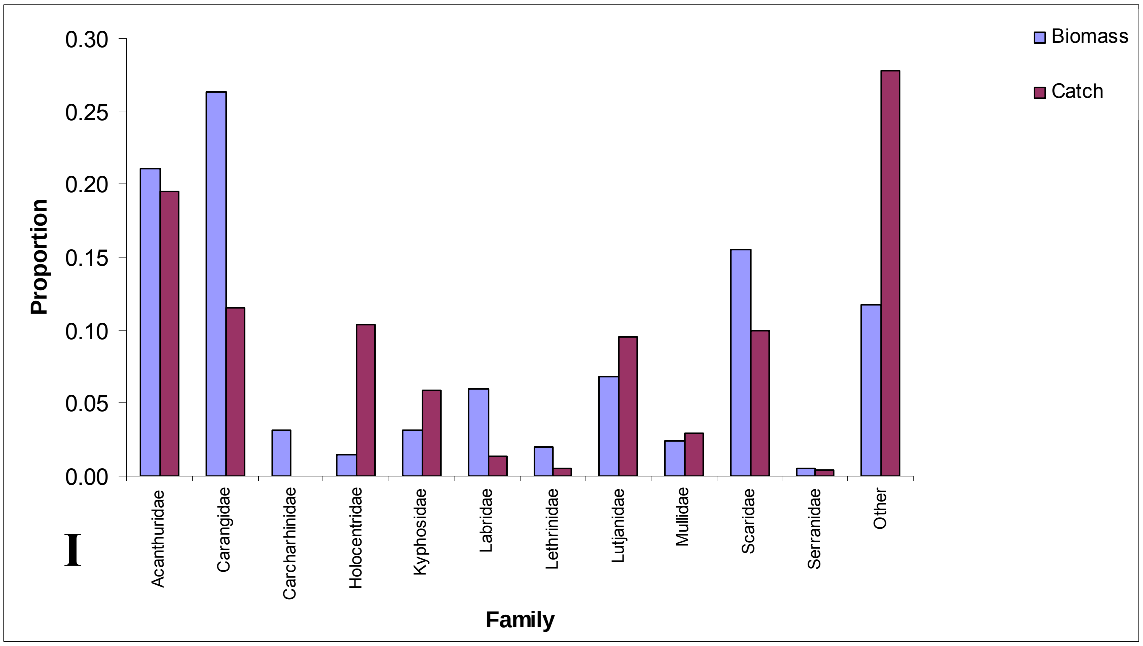
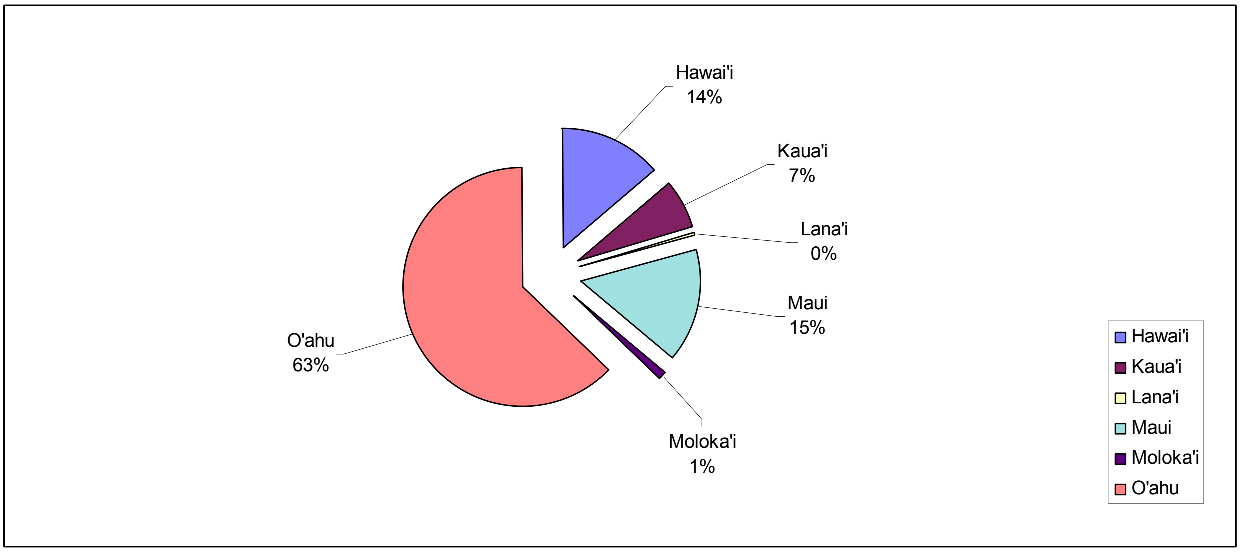

Biomass
Catch
Proportion
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Acanthuridae
Carangidae
Carcharhinidae
Holocentridae
Kyphosidae
Labridae
Lethrinidae
Lutjanidae
Mullidae
Scaridae
Serranidae
Other
I
Family

Figure 4. Graphical representation of the percentage of total reef fish caught in MHI (2005-2009) by island landed.



Appendix C U.S. Pacific Reef Fish Biomass Estimates Based on Visual Survey Data

Ivor Williams
Pacific Islands Fisheries Science Center

The Pacific Islands Fisheries Science Center's Coral Reef Ecosystem Division (CRED) has been working with staff of the NOAA Fisheries Pacific Islands Regional Office (PIRO) and the Western Pacific Regional Fisheries Management Council to assess the applicability of visual survey data collected during CRED's Pacific RAMP expeditions to the establishment of acceptable catch limits (ACLs) for Pacific coral reef fishes. This report describes how survey data were used to estimate reef fish biomass for U.S. Pacific islands. Estimates of biomass are a key component of fishery-independent methods of ACL determination.

Reef Assessment and Monitoring Program (RAMP) biological surveys, and associated habitat and bathymetric mapping operations, are conducted on a biennial basis at 55 US Pacific Islands and cover the majority of US coral reef areas in the Pacific. Survey methods are consistent across all locations visited, and include both small-scale (belt or stationary point count) and large-scale (towed-diver) fish and benthic surveys. Since mid-2007, survey design for small-s ale surveys has been based on a stratified random sampling design within 0-30 m hard-bottom habitats. That data set (i.e., all RAMP cruises since July 2007) is the one used for all biomass density estimates given in this document.

As requested by staff of PIRO and the Council, this document provides estimates of population sizes (biomass) for coral reef fishes in 0-30 m hardbottom habitats. At each island or atoll, population estimates for each habitat stratum were generated by multiplying biomass density from RAMP surveys conducted in the previous three years (i.e., between July 2007 and June 2010) by the estimated area of the habitat stratum. Fishes were grouped by the Coral Reed Ecosystem Management Units (CREMUS) used in federal coral reef fishery management plans for the US Pacific (Table 1).

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Issued 10 August 2010

Table 1. Notes on potential for application of CRED RAMP data to coral reef species complexes

CREMUS Grouping	Comments
Acanthuridae (Surgeonfish)	Highly diverse group. Commonly represented in CRED RAMP data.
Atulai /Akule (scad)	Visual survey data likely to be very poor - Heavily clumped, highly seasonal, surface/midwater/pelagic
Jacks (Carangidae) excl. scad	Significant deep water populations of most jack species.
Squirrelfish/soldierfish (Holocentridae)	Nocturnally and diurnally cryptic, hence daytime visual surveys likely to underestimate population size.
Rudderfish/Drummers (Kyphoside)	Heavily clumped distributions.
Wrasse (Labridae) excluding napolean wrasse	Highly diverse group, including many small species (max size < 10 cm) that are lightly-targeted.
Emperors(Lethrinidae)	Previous studies indicate that lethrinids can be under-represented in visual surveys (Jennings andPolunin 1995)
Snappers (Lutjanidae)	Several lutjanid species have wide depth ranges (including important target species such as *L.kasmira, A. virescens*). It may therefore be difficult to meaningfully estimate population status from visual surveys in 0-30 m depths.
Mullet (Mugilidae)	CRED surveys of hardbottom reef areas do not cover habitats preferred by mullet.
Goatfish (Mullidae)	Commonly encountered, but heavily clumped daytime distributions.
Parrotfish (Scaridae) excluding Bumphead parrotfish	Commonly recorded during visual surveys.
Groupers (Serranidae)	Potential for substantial deeper water populations of some species, behavioral issues affecting visual survey data.
Rabbitfish (Siganidae)	Major component of catch at some locations, but are rarely encountered during CRED visual surveys
Misc. Reef-fish	Not clear which species are within this group.
Misc. Shallow Bottomfish	Which species? *Aprion virescens*? We have some (but limited) data on that species
Misc. Bottomfish	Beyond REA range
Other Finfish	Not clear which species these are, or what scope for management of such a loosely defined group. Unlikely that CRED data would be relevant for non-reef species.
Bumphead Parrotfish	Limited data (v rare, somewhat clumped distributions). Towed diver survey data likely to be preferable to REA data.
Napoleon Wrasse	Limited data – rare enough. Towed diver survey data likely to be preferable to REA data
Reef Sharks	Potential for significant behavioral issues (mobbing in some locations, avoidance in others). Deeper populations also an issue. Towed diver data likely to be far preferable.
Crustaceans, Molluscs, Other invertebrates	Little relevant CRED data
Algae	CRED data may not be that useful – as is lacking information from shallow – presumably targeted –habitats)

Note: Species complexes highlighted in green are those where CRED visual survey data are likely to have most utility. Complexes in orange are those where CRED data is most likely to be useful as relative measures of density rather than absolute values.

General Approach to Biomass Estimation

As describe above, our initial approach has been to derive estimates of population size by extrapolating from visual survey density estimates to total area of suitable habitat. Details and a worked example are given below, but, in brief, calculations are performed per taxon of interest per island and summed per archipelago. CRED survey design is based on stratified random sampling of hardbottom habitat within three depth ranges (0-6 m; 6-18 m; 18- 30 m) and three habitat types (forereef, backreef, lagoon), giving nine potential strata per location. Population totals per island are the sum of estimated populations per habitat-depth strata.

Fish Survey Sampling Design and Data Quality – Example for Rose Atoll, Samoa

Figure 1 shows the habitat-depth survey strata and locations of the twenty seven sites surveyed at Rose Atoll by CRED during the 2008 RAMP cruise. Surveys were allocated among five survey strata found at Rose Atoll: lagoon (6-18 m); backreef (0-6 m); and 3 forereef strata (0-6 m, 6-18 m; and 18-30 m). Other strata at Rose, "reefcrest" and "channel", were not surveyed by CRED in 2008. Note that biomass density estimates given in this document use data from all RAMP surveys conducted by CRED since 2008, i.e. since CRED surveys moved to use of the stationary point count (SPC) method in a stratified random sampling design; for Samoa, data from 2 cruises – 2008 and 2010 – were used. The example below is restricted to 2008 data for simplicity.

Figure 1. Location of fish survey sites at Rose Atoll in 2008 (n=27). Colors correspond to survey strata: dark blue=lagoon 6-18 m; light blue=backreef 0-6 m; green= 0-6 m forereef; yellow=6-18 m forereef; red=18-30 m forereef. Habitat and bathymetric data used to create Figure 1 were generated by the Pacific Islands Benthic Habitat Mapping Center. Since this figure was generated, habitat and depth layers have been improved by integration of data from new additional sources. Areas in white are "softbottom", "unknown", "reef crest", or "channel"

Areas of each habitat stratum and depth zone are shown in Table 2 below. The Rapid Ecological Assessment (REA) fish surveys conducted at each site, including SPC operations, are made over hardbottom. Therefore, extrapolated population estimates are based on the area of hardbottom in each stratum. At some locations, hard/soft GIS layers are lacking or are incomplete. In those cases, total hardbottom habitat for each stratum is derived using an estimate of the proportion of unknown bottom likely to be hardbottom. For example, at Rose Atoll, the 0-6 m backreef stratum consists of 320.4 ha of hardbottom, 7.9 ha of softbottom, and 46.8 ha of unknown bottom type. Hardbottom is therefore 98% of known bottom type in that stratum, and estimated hardbottom is calculated as 320.4 ha (known hardbottom) plus 45.7 ha (=98% of the unknown bottom type in 0-6 m backreef), giving a total of 366.1 ha (Table 2).

The estimated biomass density is then multiplied by habitat area in each stratum to come up with estimated population size (biomass). CRED has not surveyed crest or channel sites, and therefore biomass densities from the most similar habitats are used for those cases (backreef data are used for crest habitat, forereef data for channel habitat). Populations for each stratum are summed to generate an island total biomass for hardbottom in the 0-30 m range (the CRED survey domain). See example for surgeonfish below (Table 3).

Table 2. Rose Atoll habitat area per survey stratum. Total hardbottom per stratum is the sum of measured hardbottom and estimated hardbottom (area of 'unknown' bottom type multiplied by the % of the known area that is hardbottom).

Habitat	Depth	Hardbottom (Ha)	Softbottom (Ha)	Unknown Bottom (Ha)	Hardbottom as % of Known	Tot Hardbottom (Ha)
Lagoon	0-6 m	5.4	<0.1	-	99%	5.4
	6-18 m	10.1	66.3	-	13%	10.1
	18-30 m	-	140.9	-	0%	-
Backreef	0-6 m	320.4	7.9	46.8	98 %	366.1
	6-18 m	23.2	-	0.8	100%	24.1
	18-30 m	1.1	-	-	100%	1.1
Forereef	0-6 m	6.1		-	100%	6.1
	6-18 m	81.2		1.5	100%	82.7
	18-30 m	15.1		6.3	100%	21.4
Crest	0-6 m	41.9	-	-	100 %	41.9
Channel	0-6 m	0.9	-	-	100 %	0.9
	6-18 m	3.1	-	-	100 %	3.1
	18-30 m	0.7	-	-	100 %	0.7

Worked Example – Estimated Population of Surgeonfish at Rose Atoll (0-30 m hardbottom only)

CRED visual survey data used for population estimates come from stationary point counts, which record all species observed within visually-estimated 7.5 m radius cylinders centered on the diver. SPC counts consist of two components: (i) a five minute species enumeration period in which the diver records codes for all species present within the visual estimated cylinder; and (ii) a series of instantaneous counts in which the survey diver works systematically through their species list, recording the number and size of all individuals of that species, each species being counted as close to instantaneously as possible, i.e., the count for each species is made as much as possible by means of a single quick visual sweep of the entire SPC cylinder. Lengths of fish are also visually estimated. The number and size of individuals per species are converted to biomass estimates using published length-length and length-weight conversion factors (Sudekum, Parrish et al. 1991; Choat and Axe 1996; FishBase 2000; Kulbicki, Guillemot et al. 2005) that are maintained on CRED's survey database. Biomass per survey is converted to biomass per unit area by dividing by the area of the SPC (= $\pi * 7.5^2$ m^2). Site surveys are always conducted by pairs of divers, generally conducting two SPCs each per survey, therefore each site's average density estimate represents the mean of at least 2, and generally 4, SPCs. Densities from all sites within a depth and habitat stratum are then averaged to derive a mean stratum density that can be extrapolated to estimate population size. The worked example below shows the calculations used to determine an estimate of surgeonfish biomass at Rose Atoll (Table 3) from component strata densities and strata areas. It is important to note that the total population estimate for Rose Atoll — 24,203 kg — is for 0-30 m hardbottom habitats only.

Table 3. Surgeonfish biomass at Rose Atoll habitat and depth strata. Biomass density derived from CRED RAMP visual survey data. Area per habitat/depth strata derived from CRED GIS information. Note. Biomass densities derived from surveys in 2008-2010.

Habitat	(# survey sites)	Depth	Area (m^2)	Mean Biomass density (gm^{-2})	Estimated Biomass (kg)
Lagoon	(2)	0-6 m	53,841	5.35	288
	(4)	6-18 m	100,615	1.79	180
		18-30 m	-	-	-
Backreef	(9)	0-6 m	3,660,856	2.42	8,853
		6-18 m	240,712	2.42[1]	582
		18-30 m	10,678	2.42[1]	26
Forereef	(13)	0-6 m	60,808	13.00	791
	(19)	6-18 m	827,200	11.79	9,755
	(14)	18-30 m	214,169	10.05	2,153
Crest		0-6 m	419,000	2.42[1]	1,013
Channel		0-6 m	9,294	13.00[2]	121
		6-18 m	31,286	11.79[2]	369
		18-30 m	7,248	10.05[2]	73
				ROSE TOTAL (kg)	**24,203**

Notes: (1) Backreef shallow density estimate used for all backreef crest strata; (2) Forereef density estimates used for channel areas.

American Samoa Archipelagic Population Estimates by CREMUS Grouping (0-30 m hardbottom)

Applying the same process to all Coral Reef Ecosystem Management Unit species for all islands in American Samoa yields the 0-30 m hardbottom reef fish population estimates given in Table 4.

Table 4. Reef fish population estimates for American Samoa. Fish species are pooled by CREMUS groupings. Estimated population biomass is for 0-30 m hardbottom habitat only. (n) is number of sites surveyed per island. Each site is surveyed by means of 2-4 7.5 m diameter SPCs – therefore the number of survey replicates is approximately 4 times the number of sites.

Island	(n)	Area 0-30 m hardbottom (Ha)	ESTIMATED POPULATION BIOMASS (kg) Emperor	Goatfish	Grouper	Jack	Parrot[1]	Reef Shark
Tutuila	(171)	4,888	42,513	20,678	43,491	25,614	271,926	7,111
Tau	(36)	1,003	8,575	3,191	27,534	5,399	60,795	2,929
Ofu & Olosega	(43)	1,055	8,339	2,674	25,310	9,304	86,402	10,354
Rose	(61)	558	4,087	2,411	10,307	8,597	13,142	14,682
Swains	(41)	281	1,055	293	7,580	10,033	5,450	4,154
TOTAL	**(352)**	**7,785**	**64,569**	**29,246**	**114,222**	**58,947**	**437,716**	**39,231**

Island	Rudderfish	Snapper	Squirrel/ Soldierfish	Wrasse[1]	Surgeonfish	Others	Total Fish Bio
Tutuila	2,011	62,463	14,870	53,262	497,952	577,177	1,619,068
Tau	4,705	29,547	11,921	17,378	111,952	90,894	374,821
Ofu & Olosega	1,945	39,932	10,451	13,375	154,103	103,852	466,038
Rose	29	12,534	6,262	10,167	24,203	21,669	128,091
Swains	26	9,008	2,218	3,843	18,870	65,524	128,056
TOTAL	**8,716**	**153,484**	**45,721**	**98,025**	**807,079**	**859,116**	**2,716,074**

Note (1): Here and elsewhere in this document, 'Parrot' mean parrotfishes excluding the Bumphead Parrot, and 'Wrasse' means wrasses excluding the Humphead Wrasse. Catch data for those two species are pooled into their own CREMUS groupings. Estimated biomass of those is included in 'others'.

Uncertainties Associated with Unsurveyed Habitats

As noted elsewhere, CRED surveys are conducted during daytime and are restricted to hardbottom habitats shallower than 30 m. There are therefore limits to what can be concluded from CRED RAMP survey data about populations of taxa that are predominantly found in soft-bottom habitats (e.g. mullet), or in water deeper than 30 m. However, for the majority of reef fish species, daytime densities appear to be generally rather low in softbottom habitats (Friedlander, Brown et al. 2007), and given that habitats classified as soft-bottom make up only around 1/8 of all 0-30 m habitat in American Samoa (Table 5), the lack of data from softbottom habitats may be relatively insignificant for the majority of CREMUS groupings. Of more concern is the general lack of information on reef fish densities in waters deeper than can be readily surveyed by SCUBA divers. It is clear that some groups of fishes, including jacks and sharks can have substantial portions of their populations in waters much deeper than the 30 m limit surveyed by CRED (Thresher and Colin 1986; Chave and Mundy 1994; Parrish and Boland 2004). CRED is currently collaborating on a project to assess reef fish distributions in waters down to 100 m in parts of the Mariana Archipelago. However, given the extensive area of such habitats (e.g., the area of 30-100 m habitat around Tutuila is nearly 4 times the total area of 0-30 m hardbottom from the entire American Samoa group, Table 5), further work to improve density estimates or calibration factors from shallow water population densities seems critical.

Table 5. Area of hardbottom 0-30m; softbottom 0-30m; and deeper reef (all bottom types 30-100m) per island in American Samoa.

Island	Area 0-30m Hardbottom (Ha)	Area 0-30m Softbottom (Ha)	Area 30-100 m All bottom types (Ha)
Tutuila	4,888	200	29,821
Tau	1,003	23	674
Ofu & Olosega	1,055	148	2.074
Rose	564	216	111
Swains	281	1	48
TOTAL	7,790	589	32,729

Mariana Reef Fish Population Estimates by CREMUS grouping (0-30 m hardbottom)

Following the same approach used above for American Samoa, estimates of population biomass for CREMUS in 0-30m hardbottom waters of reefs and islands in the Mariana Archipelago are shown in Table 6.

Table 6. Reef fish population estimates for Mariana Archipelago. Biomass densities come from surveys in 2009. (n) is the number of sites surveyed per island. Each site is surveyed by means of 2-4 7.5 m diameter SPCs.

Island / Reef	# Fish Surveys	Area 0-30 m hardbottom (Ha)	ESTIMATED POPULATION BIOMASS (kg)					
			Emperor	Goatfish	Grouper	Jack	Parrot	Reef Shark
W. Mariana Ridge[1]								
Stingray Shoals	-	19	256	122	1,291	614	1,185	2,623
Parhfinder Reef	-	81	1,119	543	5,403	2,656	5,199	10,402
Arakane Reef	-	48	650	308	3,309	1,564	3,015	6,781
CNMI-Mariana Arc								
FDP	7	138	1,519	484	4,205	3,289	1,607	46,262
Maug	21	314	2,083	1,327	9,664	4,121	14,215	3,678
Supply Reef[1]	-	10	123	52	763	313	566	1,877
Asunscion	13	249	2,194	2,502	15,229	6,652	13,302	47,335
Agrihan	14	851	11,813	3,651	59,741	41,449	60,056	28,581
Pagan	21	1,513	28,709	10,492	61,103	97,733	106,767	68,857
Alamagan	6	346	7,866	6,181	36,179	33,263	27,343	45,964
Guguan	6	200	6,091	1,246	19,634	358	18,630	-
Sarigan	7	198	105	333	7,302	2,558	19,501	2,164
Zealandia[1,2]	-	99	1,346	641	6,800	3,233	6,245	13,817
Anatahan[3]	-	1,182	5,391	4,889	13,374	2,634	26,676	23,529
FDM[4]	-	152	1,968	959	9,880	4,901	9,169	20,115
Saipan	23	4,847	34,598	20,607	71,872	3,477	95,401	-
Aguijan	6	406	-	1,102	5,814	3,202	10,156	22,571
Tinian	14	1,414	4,719	4,969	20,624	-	28,475	-
Tatsumi[5]	-	224	1,176	1,063	3,599	-	5,709	-
Rota	14	1,331	10,769	8,529	7,517	2,139	43,635	59,329
Guam								
Guam	25	7,101	4,404	22,405	31,095	-	142,423	-
11-mile Bank[6]	-	3	4	13	21	-	46	-
Galvez Bank[6]	-	15	24	78	119	-	269	-
Santa Rosa[6]	-	3,551	4,868	15,966	24,085	-	71,993	-
TOTAL (177)	**177**	**24,289**	**131,796**	**108,462**	**418,622**	**214,154**	**711,585**	**403,884**

NOTES (1) No SPC visual surveys have been conducted at Stingray, Pathfinder, Arakane, Supply Reefs, or Zealandia. Based on limited data from 2003-2007 cruises, in which reef fishes were surveyed using different methods and largely in mid-depth habitats only, biomass density estimates for those locations are assumed to be similar to average biomass densities in the unpopulated northern Mariana Islands (Sarigan through FDP).
(2) No bathymetry or habitat data available for Zealandia. Area of 0-30 m hardbottom assumed to be half of that at Sarigan.
(3) No SPC surveys were conducted at Anatahan. Based on 2003-2007 data, biomass densities assumed to be comparable to average of populated Mariana Islands (Guam through Saipan). Anatahan also lacked bathymetry or habitat data. Hardbottom in 0-30 m range was assumed to be the average of Pagan, and Agrihan, those being the two CNMI islands with most similar landmass.
(4) No SPC surveys at FDM. Based on relative remoteness from human populations, biomass densities set to average of unpopulated northern Mariana Islands.
(5) No SPC survey data from Tatsumi. Biomass densities assumed to be same as for Tinian.
(6) No SPC survey data available from Guam banks. Based on 2003-2007 surveys using different methods, Guam banks fish biomass densities assumed to be similar to those in populated southern Mariana Islands (Guam through Saipan). Table cont. next page.

Table 6 continued — Reef fish population estimates for Mariana Archipelago.

Island	Rudderfish	Snapper	Squirrel/ Soldierfish	Surgeonfish	Wrasse	Others	Total Fish Bio
W. Mariana Ridge							
Stingray Shoals	214	3,846	472	3,859	462	4,278	19,221
Parhfinder Reef	911	15,816	2,035	16,110	2,013	17,692	79,901
Arakane Reef	547	9,888	1,205	9,895	1,177	10,988	49,327
CNMI-Mariana Arc							
FDP	1,321	21,930	2,269	20,005	1,493	24,228	128,612
Maug	10,239	24,385	10,079	33,533	3,884	22,179	139,387
Supply Reef	118	2,435	246	2,305	228	2,651	11,677
Asunscion	11,802	49,903	6,038	56,036	4,126	22,740	237,860
Agrihan	31,201	89,482	22,542	136,172	30,187	105,101	619,976
Pagan	5,480	199,499	8,813	168,806	33,341	180,999	970,600
Alamagan	4,288	173,724	14,727	90,578	9,994	152,877	602,983
Guguan	4,726	28,808	10,729	74,614	8,333	69,497	242,666
Sarigan	1,507	9,530	663	18,676	2,391	14,789	79,520
Zealandia	1,128	20,263	2,489	20,328	2,435	22,537	101,262
Anatahan	985	9,081	4,138	75,915	18,425	58,177	243,214
FDM	2,498	29,621	3,781	30,648	3,503	32,196	149,240
Saipan	-	50,803	37,634	249,323	56,967	242,812	863,493
Aguijan	341	2,261	1,237	25,957	7,033	21,589	101,262
Tinian	-	1,181	4,135	102,796	20,885	57,903	245,688
Tatsumi	-	301	1,054	9,412	3,734	9,320	35,367
Rota	2,632	13,281	8,272	77,359	18,113	64,560	316,133
Guam							
Guam	-	41,949	5,693	263,849	113,732	266,915	892,464
11-mile Bank	-	21	8	87	44	160	405
Galvez Bank	-	123	47	504	257	924	2,344
Santa Rosa	-	25,907	7,355	116,763	59,516	179,902	506,354
TOTAL	**79,937**	**824,038**	**155,661**	**1,603,530**	**402,275**	**1,585,012**	**6,638,956**

As elsewhere in this summary, these population estimates are for 0-30 m hardbottom habitats only, and are based on the assumption that biomass density derived from SPCs represents real biomass density in the surveyed habitats. Note also that, as in American Samoa, there are substantial areas of unsurveyed habitats potentially important to some groups of reef fishes, i.e., softbottom habitats in 0-30 m and areas in 30-100 m range (Table 7).

While the total number of survey sites in the Mariana archipelago (177) is fairly substantial, the level of replication is of course much lower at the scale of single islands. Total population estimates will certainly be more robust at larger – particularly at whole archipelago – scales, and data per individual island should not be over interpreted.

Table 7. Area of hardbottom 0-30m; softbottom 0-30m; and deeper reef (all bottom types 30-100m) per island/reef area in Mariana Archipelago. Areas derived from CRED GIS maps except where indicated otherwise.

Island	Area 0-30m Hardbottom (Ha)	Area 0-30m Softbottom (Ha)	Area 30-100 m All bottom types (Ha)
W. Mariana Ridge			
Stingray Shoals[1]	19	6	*
Parhfinder Reef	81	4	52
Arakane Reef	48	5	52
CNMI-Mariana Arc			
FDP	138	-	25,973
Maug	314	4	204
Supply Reef	10	1	20
Asunscion	249	5	262
Agrihan	851	100	871
Pagan	1,513	117	1,564
Alamagan	346	82	479
Guguan	200	-	418
Sarigan	198	2	292
Zealandia[2]	99	1	*
Anatahan[3]	1,182	108	1,217
FDM	152	17	25,973
Saipan	4,847	2,444	6,463
Aguijan	406	21	305
Tinian	1,414	206	2,631
Tatsumi	224	2	420
Rota	1,331	271	2,254
Guam			
Guam	7,101	2,384	6,347
11-mile Bank	3	1	78
Galvez Bank	15	15	2,828
Santa Rosa	3,551	888	*
TOTAL	**24,289**	**6,684**	**> 78,703**

NOTES: (1) No bathymetric or habitat data from Zealandia. Areas of hard and soft bottom < 30 m are estimated from extent of towed diver surveys by CRED staff, and associated site descriptions; (2) Zealandia assumed to be half the size of Sarigan; (3) No habitat or bathymetric data for Anatahan, areas per strata are averages of those from Pagan, and Agrihan (islands with closest land mass to Anatahan);. (*) Insufficient bathymetric or other information from Stingray, Zealandia, or Santa Rosa to estimate areas in deeper strata.

Pacific Remote Island Areas Reef Fish Population Estimates by CREMUS Grouping (0-30 m hardbottom)

The Pacific Remote Island Areas (PRIAs) include seven islands and atolls located in the Central Pacific that are under the jurisdiction of the United States: Baker, Howland, and Jarvis Islands, Johnston Atoll, Kingman Reef, Palmyra Atoll, and Wake Island. Following the approach used above, population estimates of CREMUS groups in 0-30 m hardbottom waters of reefs and islands in the PRIAs are shown in Table 8.

Relative to other regions surveyed by CRED, habitat and bathymetric information for the PRIAs is more limited. For example, to date, there are no hard/soft layers for the PRIAs available on the Pacific Islands Benthic Habitat Mapping Center (http://www.soest.hawaii.edu/pibhmc/index.htm). Similarly, shallow water bathymetric surveys have not been completed at Baker, Howland, and Jarvis, and for those locations, creation of the depth layers used in this analysis necessitated some use of interpolated chart data. In addition, unlike other regions, for which there are extensive NOAA NCCOS habitat maps (http://ccma.nos.noaa.gov/about/biogeography/prod_table.html), coral reefs in the PRIAs have not yet been so comprehensively mapped. Therefore, for the PRIAs, habitat maps used for this analysis were based on data and habitat classes available from the Millennium Reef Mapping Project (http://www.imars.usf.edu/MC/index.html). Finally, estimated % of hard and soft per depth strata at PRIA locations were not based on hard/soft maps as elsewhere, but were instead estimated by CRED staff familiar with the PRIAs.

Table 8. Reef fish population estimates for Pacific Remote Island Areas. Fish biomass densities come from RAMP surveys in 2007-2010.

Island / Atoll	# Sample Sites	Area 0-30 m hardbottom (Ha)	ESTIMATED POPULATION BIOMASS (kg) Emperor	Goatfish	Grouper	Jack	Parrot	Reef Shark
Baker	25	390	903	746	18,582	23,416	16,911	39,840
Howland	26	173	715	3,412	14,468	16,690	10,125	30,258
Jarvis	49	366	2,055	9,064	30,368	36,283	43,481	225,135
Johnston	51	9,410	-	59,122	-	865,576	453,056	237,390
Kingman	56	3,721	48,860	16,132	125,151	22,723	488,613	1,462,885
Palmyra[1]	68	4,213	112,552	19,401	199,405	113,281	363,747	1,380,995
Wake[2]	29	1,282	13,463	7,258	38,044	20,237	92,975	173,133
TOTAL	**304**	**19,555**	**178,547**	**115,135**	**426,019**	**1,098,207**	**1,468,908**	**3,549,635**

Island	Rudderfish	Snapper	Squirrel/Soldier	Surgeonfish	Wrasse	Other Fish	Total Fish Bio
Baker	2,457	48,507	25,431	65,040	5,706	85,218	332,756
Howland	529	17,051	12,921	34,878	3,659	33,556	178,261
Jarvis	1,414	89,337	14,809	67,862	18,381	104,784	642,975
Johnston	20,284	200,238	82,474	775,999	128,146	411,089	3,233,374
Kingman	2,912	606,216	36,529	438,368	93,490	598,499	3,940,379
Palmyra	16,457	655,443	56,611	618,825	129,291	1,510,014	5,176,021
Wake	11,015	82,403	8,570	97,544	38,216	244,140	826,996
TOTAL	**55,068**	**1,699,194**	**237,345**	**2,098,517**	**416,888**	**2,987,300**	**14,330,763**

Notes: (1) No existing CRED SPC data from Palmyra channel or backreef habitat. Biomass densities from Palmyra forereef used for channel ahbitats; Kingman backreef values used for Palmyra backreef habitats; (2) No existing CRED SPC data from Wake backreef. Biomass densities from those strata at Kingman were used for population estimates.

As with other regions, estimated soft-bottom habitat was considerable at several of the islands, particularly Johnston, and Kingman and Palmyra Atolls (Table 9).

Table 9. Area of hardbottom 0-30 m; softbottom 0-30 m; and deeper reef (all bottom types 30-100 m) per island/reef area at Pacific Remote Island Areas. The 0-30 m and 30-100 m areas were derived from CRED bathymetric maps. The proportion of hard/soft-bottom by habitat and island was estimated by CRED staff familiar with PRIA reefs.

Island	Area 0-30 m Hardbottom (Ha)	Area 0-30 m Softbottom (Ha)	Area 30-100 m All bottom types (Ha)
Baker	390	8	137
Howland	173	5	94
Jarvis	366	4	131
Johnston	8,932	9,991	1,712
Kingman	3,721	1,042	3,483
Palmyra	4,213	1,037	578
Wake	1,282	636	158
TOTAL	**19,555**	**12,723**	**6,294**

Hawaiian Archipelago Reef Fish Population Estimates by CREMUS Grouping (0-30 m hardbottom)

The Hawaiian Archipelago stretches approximately 2,400 km from Hawaii Island in the south to Kure Atoll at the north of the chain. Following the approach used elsewhere in the document, the estimated areas of hardbottom habitat in the 0-30 m range and estimated population biomass of CREMUS groups in that habitat are given in Table 10, which distinguishes between the main Hawaiian Islands (MHI: Hawaii Island to Kauai, all of which are populated or close to human population centers) and the Northwestern Hawaiian Islands (NWHI: French Frigate Shoals to Kure, all of which are unpopulated or very lightly populated by some combination of management, scientific and contract staff). For the MHI other than Kahoolawe, sufficient bathymetric and habitat information is generally available to make reliable estimates of hardbottom habitat in the target range (0-30 m) and deeper categories. We also present information for other depths (30-100 m). However, comparable information is much patchier for several of the NWHI reef areas, particularly for the submerged banks – where there tends to be very little widespread information on bottom type (hard/soft) in shallower depth ranges. In some cases, missing bathymetry (e.g., 30 m contour at Gardener and St Rogatien) further complicates estimation of habitat areas used for reef fish population estimates. Gaps in available bathymetry and/or bottom composition are also a concern for some of the emergent islands and atolls. For example at Lisianski, CRED estimates that there are 954 km2 of habitat in < 30 m of water. However, hard/soft information is only available for 32% of that area, and similarly, for more than half of the total area shallower than 30 m there is insufficient bathymetric information to be able to determine depth strata (i.e., whether it is in 0-6; 6-18; or 18-30 m depth ranges; we know it is shallower than 30 m, but can't further subdivide it). Those gaps reduce our ability to generate robust reef fish population estimates for Lisianski, as further estimations have to be introduced (in this case (i) it was assumed that 36% of habitat of unknown bottom type was hardbottom – based on the weighted average of known bottom type in 0-30 m habitats; and (ii) reef fish biomass densities were generated for the entire 0-30 m range rather than subdividing that into depth strata as we have done elsewhere, and total 0-30 m hardbottom area was multiplied by that overall density to estimate population biomass. Habitat and bathymetric gaps are particularly important for Lisianski because of its large size (total estimated 0-30 m hardbottom area there makes up ~10% of the total 0-30 m area for the archipelago), but information gaps were also concerns for Laysan and Nihoa, and forereef areas at Maro had very limited hard/soft information. In addition, CRED did not survey any submerged banks in the 2007-2008 period, and in fact has only conducted rather few surveys on those areas since the inception of RAMP. Therefore, reef fish biomass densities for submerged banks are guesses based on density values estimated in other strata where conditions are assumed to be similar. Published reports of fish assemblages on submerged NWHI banks – at slightly deeper levels than targeted here - have indicated that habitat quality is often fairly poor on submerged banks, which are mostly low relief with limited coral cover, and that, relative to shallower reef areas in the NWHI, fish biomass tends to be considerably lower on submerged banks (Parrish and Boland 2004; Parrish 2009). In the absence of solid quantitative information, biomass densities on submerged banks of the NWHI were assumed to be 1/3 of the average density in NWHI forereef areas for population estimates given in Table 10.

Another caveat is that RAMP surveys to date have not covered the west coast of the island of Hawaii or south part of Oahu, and therefore biomass densities for those islands are based on surveys of other parts of those islands.

Table 10. Reef fish population estimates for Hawaiian Archipelago. Fish biomass densities come from RAMP surveys in 2007-2008.

Island / Atoll/ Reef	# Srvy Sites	Area 0-30 m hardbottom (Ha)	ESTIMATED POPULATION BIOMASS (kg) Emperor	Goatfish	Grouper	Jack	Parrot	Reef Shark
NWHI								
Kure[1]	22	3,699	-	124,745	-	3,186,804	862,161	79,730
Midway[1]	16	4,996	-	697,989	-	92,315	1,222,131	698,281
Pearl & Hermes	53	11,440	13,619	284,157	-	9,976,321	3,035,306	550,593
Lisianski[2]	16	30,955	52,601	187,448	-	30,915,650	4,736,039	963,859
Pioneer[3]	-	5	47	44	-	803	406	104
Laysan[2]	11	3,400	212,862	105,743	-	761,833	775,690	-
Maro[2]	14	34,193	2,767,710	1,251,927	-	3,957,171	10,653,738	612,341
Raita Bank[3]	-	1,007	30,393	28,477	-	521,205	263,702	67,224
Gardner[3]	-	31,733	279,239	261,643	-	4,788,681	2,422,816	617,635
St Rogatien Bank[3]	-	168	15,196	14,239	-	260,602	131,851	33,612
Brooks Bank[3]	-	66	583	546	-	9,992	5,055	1,289
Fr. Frigate Shoals	49	27,797	724,552	620,893	-	3,628,746	4,643,263	3,283,193
Mokumanamana[4]	-	637	16,806	15,747	-	288,207	145,817	37,172
Nihoa[4]	-	410	10,820	10,138	-	185,552	93,879	23,932
MHI								
Kaula Rock[5]	-	346	4,416	6,572	6,400	4,811	28,956	1,429
Niihau-Lehua	20	9,402	64,519	214,642	116,693	74,777	581,389	90,817
Kauai	24	18,421	31,736	192,670	276,770	392,243	1,681,621	-
Oahu[6]	14	30,640	69,839	575,202	113,278	5,492	1,042,696	-
Lanai	16	3,603	-	41,818	30,913	8,617	217,357	-
Kahoolawe[7]	-	1,801	-	57,444	38,581	9,076	204,174	-
Molokai	16	14,495	47,343	271,977	67,725	27,058	674,962	-
Maui	34	11,772	-	171,694	117,498	26,668	677,420	-
Molokini[7]	-	25	-	797	535	126	2,834	-
Hawaii[8]	62	16,196	29,587	314,453	294,599	81,247	794,711	-
TOTAL	**367**	**267,584**	**4,371,867**	**5,451,005**	**1,062,992**	**59,203,998**	**34,897,975**	**7,061,210**

Notes: (1) Kure and Midway deep forereefs were not surveyed by CRED in 2007-2008, hence deep forereef population estimates for those strata use mid-depth forereef biomass densities from those locations. (2) Substantial gaps in bathymetric and/or bottom type information for Lisianski, Laysan and Maro introduced additional error in estimation of hardbottom areas and extrapolated population sizes based on those habitat areas. (3) For a majority of NWHI banks, habitat and bathymetric information is missing or patchy. In addition, CRED did not conduct visual surveys on NWHI banks during the period used. Published quantitative and semi-quantitative information on fish assemblages on banks in NWHI indicates that reef fish biomass on banks tends to be much lower than on shallower reef areas in the NWHI (Parrish and Boland 2004; Parrish 2009). Therefore, in the absence of other information, NWHI bank biomass densities are assumed to be one-third of average for NWHI forereefs. (4) CRED did not survey reef fishes at Mokumanana or Nihoa in the period 2007-2008. Biomass densities assumed to be average of NWHI forereef. (5) Kaula biomass densities assumed to be same as for Niihau-Lehua. (6) CRED RAMP surveys around Oahu in 2007-2008 did not encompass south Oahu reef areas. As south-shore Oahu reefs have some of the lowest reef fish biomass values in the state of Hawaii(Friedlander, Brown et al. 2006), Oahu biomass densities may be slightly overestimated. (7) Molokini and Kahoolawe were not visited during CRED RAMP cruises in 2007-2008. Biomass densities there are assumed to be double the mean densities for Maui Island. In addition, estimated areas of hardbottom for those locations was not available, hence Molokini hardbottom area was estimated to be 500 m*500 m, and Kahoolawe hardbottom assumed to be 1/2 of that for Lanai, based on published area of habitat in < 10 fathoms (Rohmann, Hayes et al. 2005). (8) Few surveys were conducted in West Hawaii, hence biomass densities used for Hawaii Island, which-are largely based on surveys around the rest of the island, may underestimate island-wide density. Table cont.next page.

Table 10 continued.

Island/Atoll/Reef	ESTIMATED POPULATION BIOMASS (kg) Rudderfish	Snapper	Squirrel/Soldier	Surgeonfish	Wrasse	Other Fish	Total Fish Bio
NWHI							
Kure	1,147,241	71,041	112,921	725,792	535,206	640,835	7,486,476
Midway	1,532,521	295,072	146,418	1,582,091	666,555	1,504,045	8,437,418
Pearl & Hermes	135,856	411,452	259,923	1,371,020	1,326,962	1,697,038	19,062,248
Lisianski	121,314	2,728,747	368,013	3,508,697	2,594,699	5,343,049	51,520,115
Pioneer	174	100	43	578	161	316	2,775
Laysan	387,236	289,310	-	1,551,178	298,100	810,089	5,192,040
Maro	508,429	1,251,979	127,765	8,768,269	2,386,689	2,594,523	34,880,541
Raita Bank	113,205	64,714	27,755	374,995	104,705	205,306	1,801,678
Gardner	1,040,091	594,570	255,002	3,445,343	961,997	1,886,294	16,553,311
St Rogatien Bank	56,602	32,357	13,877	187,497	52,352	102,653	900,839
Brooks Bank	2,170	1,241	532	7,189	2,007	3,936	34,539
Fr. Frigate Shoals	430,216	5,373,305	949,815	8,633,369	1,882,372	3,484,055	33,653,780
Mokumanamana	62,598	35,784	15,347	207,358	57,898	113,527	996,263
Nihoa	40,301	23,038	9,881	133,500	37,275	73,090	641,408
MHI							
Kaula Rock	3,490	40,024	27,502	81,380	10,340	27,087	242,406
Niihau-Lehua	175,855	815,124	318,737	2,067,681	265,429	712,368	5,498,031
Kauai	166,549	1,243,601	57,785	5,884,420	500,024	1,489,266	11,916,685
Oahu	-	224,679	111,329	2,155,676	645,269	2,459,835	7,403,295
Lanai	16,214	5,524	21,580	378,354	74,543	156,486	951,407
Kahoolawe	6,250	63,012	4,500	375,143	102,965	249,086	1,110,230
Molokai	700,429	1,026,894	60,272	1,460,826	273,548	876,864	5,487,899
Maui	21,798	181,250	16,342	1,213,991	326,641	824,589	3,577,891
Molokini	87	875	62	5,206	1,429	3,457	15,408
Hawaii	398,096	448,016	292,184	3,184,023	454,369	1,228,717	7,520,001
TOTAL	**7,066,721**	**15,221,708**	**3,197,586**	**47,303,578**	**13,561,536**	**26,486,511**	**224,886,685**

As with other regions, estimated soft-bottom habitat was considerable at several reef areas, particularly Lisianski, Maro, Gardner, French Frigate Shoals, and Peal and Hermes (Table 11). Incomplete bathymetric information meant that is was not possible to estimate 30-100 m habitat areas for several of the NWHI (Table 11), but some of those areas are likely extensive. Compared to other regions, NWHI habitat area estimates, and reef fish population estimates which are based on those, have relatively large uncertainty.

Table 11. Estimated Area of hardbottom 0-30 m; softbottom 0-30 m; and deeper reef (all bottom types 30-100 m) per island/reef/bank in Hawaiian Archipelago. The 0-30 m and 30-100 m areas were derived from CRED bathymetric maps. The proportion of hard/soft bottom were derived from bottom type maps where available.

Island/Atoll/Reef	Area 0-30 m Hardbottom (Ha)	Area 0-30 m Softbottom (Ha)	Area 30-100 m All bottom types (Ha)
NWHI			
Kure	3,699	4,615	13,484
Midway	4,996	5,156	16,366
Pearl & Hermes	17,812	28,915	20,141
Lisianski[1]	30,955	64,450	23,038
Pioneer [1]	5	UNKNOWN	UNKNOWN
Laysan [1,2]	3,400	1,831	41,925
Maro[1]	34,193	73,352	74,372
Raita Bank[1]	3,454	10,362	23,541
Gardner[1,2]	31,733	95,200	UNKNOWN
St Rogatien Bank[1,2]	1,727	5,181	UNKNOWN
Brooks Bank[1]	66	199	26,598
French Frigate Shoals	27,797	39,999	17,859
Necker/Mokumanamana	637	165	25,087
Nihoa[1,2]	410	37	UNKNOWN
MHI			
Kaula Rock	346	-	5,651
Niihau-Lehua	9,402	1,404	16,251
Kauai	18,421	5,749	20,633
Oahu	30,640	11,633	36,925
Lanai	3,603	1,946	29,670
Kahoolawe[1,2]	1,201	649	UNKNOWN
Molokai	14,495	5,357	109,320
Maui	11,772	7,911	63,335
Molokini[1,2]	25	-	UNKNOWN
Hawaii	16,196	3,971	38,909
TOTAL	**266,984**	**> 368,079**	**UNKNOWN**

Notes: (1) Incomplete or completely lacking information on hard/soft proportions of bottom. Where some information exists, the proportion of hard/soft-bottom per habitat per island was calculated using weighted averages of known bottom type per strata extrapolate to areas with unknown bottom type. For all submerged banks, bottom type information was almost completely lacking, and there % hard was assumed to be 25%. (2) Missing bathymetric information required the area in 0-30 m range to be estimated rather than measured, using following approach: Laysan area in 0-30 m range estimated as double the area in < 10 fathoms derived from NOAA nautical charts (Rohmann, Hayes et al. 2005), as that was close fit for values from known areas in the NWHI; an available 36.6 m contour used for Gardner 36.6 m was used unadjusted as best available estimate for 30 m contour; St Rogatien was assumed to be half the size of Raita Bank based on data given in a published report on NWHI banks (Parrish and Boland 2004); for Nihoa, 14,700 Ha of water estimated to be in < 100 fathoms on the basis of NOAA nautical charts, but for which no more depth information is available, are assumed to all be > 100m deep, as published 10 fathom habitat estimates for Nihoa are similar to CRED GIS estimates for same depth range (Rohmann, Hayes et al. 2005); Kahoolawe is assumed to have 1/3 the reef area of Lanai on basis of relative island size; Molokini assumed to have 500 m*500m of 0-30 m habitat based on NOAA habitat maps.

Utility of CRED Visual Survey Data in Support of Reef Fish ACLs
Strong points of the CRED survey data for ACL development include:

- Consistent methods and survey design across the areas surveyed, hence the data provide excellent *relative* measures of reef fish stocks in surveyed habitats among locations.
- Fish sizes are estimated to nearest cm for all fishes encountered during surveys, making it possible to generate species' size distributions which can be converted into age distributions where appropriate sizeage data is available. Where age-distribution and sufficient life-history information are available, it is possible to derive a range of fishing and stock metrics including F, MSY, SPR, as demonstrated by Ault and colleagues in a number of recent papers (Ault, Smith et al. 2005; Ault, Smith et al. 2008).
- Estimated fish biomass/abundance densities from surveys can be combined with habitat and bathymetric information to derive total *absolute* population sizes within the survey domain.

Potential problems with applying visual survey data in ACL development include:

- Surveys are conducted in hard-bottom habitats only, therefore taxa such as mullet and razorfishes which are predominantly found in non hard-bottom habitats are not well covered by RAMP.
- Visual surveys are restricted to safe-diving depths of < 30 m, hence other methods will have to be used to quantify deeper reef fish stocks and/or appropriate correction factors to account for the portion of stocks present in deeper habitats. Determining appropriate adjustment factors will be difficult for most species given the limited amount of quantitative information available on reef fish distributions in deeper water.
- Taxa with very heavily clumped distributions, or which are very spatially-restricted, such as species which are found predominantly in the shallow surge zone or in shallow coves (e.g. rabbitfishes), are unlikely to be well surveyed by a method which randomizes site locations within the full 0-30 m range;
- Diurnally-cryptic and/or nocturnal taxa, such as soldierfishes, cannot be readily censused by means of daytime visual surveys.
- Impacts of divers on fish behavior (and therefore on counts in visual surveys) are difficult to quantify.
- Habitat and bathymetric data necessary to extrapolate survey density estimates to total population estimates are incomplete and/or of uncertain quality at some US Pacific coral reef locations.

While the problems identified above are non-trivial, current gaps in coral reef fishery dependent data, and the difficulty of gathering reliable high resolution data on the highly diverse and largely non-commercial coral reef fishery, suggest that CRED visual survey data are likely to be among the best data available for assessing reef population status at the majority of US Pacific coral reef areas.

CRED staff will continue to work with PIRO, the Western Pacific Regional Fisheries Management Council and local partners to derive best available relative and absolute biomass estimates for reef fish stocks at appropriate spatial and taxonomic scales.

In the longer term, PIFSC is committed to improving the utility of visual survey data for fisheries assessments. To best accomplish that, attention and resources will need to be devoted to:

- Improving the quality and availability of life-history information for target species in the Pacific;
- Increasing CRED survey replication around important population centers, such as Guam, Saipan, Oahu;
- Improving the quality and availability of nearshore habitat and bathymetric maps for US Pacific territories;
- Improving the scope for calibrations to account for reef fishes in waters below the 100 ft safe-diving limit;
- Using remote vehicles or other assessment tools to determine the extent of fish-behavioral impacts on population estimates from visual survey data; and
- Improving understanding of scales of demographic connectivity of reef fishes, so that population and stock assessments can be made at appropriate spatial scales.

In addition, staff of CRED are exploring the use of visual survey data for stock and population level analyses of Pacific coral reef fish species using the approach of Ault and colleagues (Ault, Smith et al. 2005; Ault, Smith et al. 2008) – i.e. using visual survey data together with life history parameters to generate metrics such as SPR, F/Fmsy, and B/Bmsy for exploited coral reef fishes. That approach offers scope for deriving acceptable extraction limits for reef fish species, and or cross-validating such estimates derived from other data sets (e.g. from fishery dependent data). Further work in these and other areas will greatly improve the utility of the visual survey data.

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Appendix D Regulatory Impact Review

Regulatory Impact Review
for Proposed Annual Catch Limit Specifications and Accountability Measures for Pacific Island Coral Reef Ecosystem Fisheries in 2012 and 2013

1. Introduction

This document is a regulatory impact review (RIR) prepared under Executive Order (E.O.) 12866, “Regulatory Impact Review.” The regulatory philosophy of E.O. 12866 stresses that in deciding whether and how to regulate, agencies should assess all costs and benefits of all regulatory alternatives and choose those approaches that maximize the net benefits of all regulatory alternatives and choose those approaches that maximize the net benefits to the society. To comply with E.O. 12866, NMFS prepares an RIR for all regulatory actions that are of public interest. The RIR provides a review of the problems, policy objectives, and anticipated impacts of regulatory actions.

This RIR is for the proposed annual catch limit (ACL) specifications and accountability measures (AM) for Coral Reef Ecosystem Fisheries of American Samoa, Guam, the Northern Mariana Islands, and Hawaii in 2012 and 2013.

2. Problems and Management Objectives

The purpose of this action is to implement the statutory requirements of the Magnuson-Stevens Act, in conformance with the procedural methods for implementing ACLs and AMs for stocks managed by the Western Pacific Fishery Management Council that are defined in the five fishery ecosystem plans by specifying an ACL and AM for each stock or stock complex managed in the coral reef ecosystem fishery.

The management objective is to specify an ACL for all western Pacific coral reef ecosystem stocks and stock complexes in order to prevent overfishing from occurring, and ensure long-term sustainability of the resource while allowing fishery participants to continue to benefit from its utilization. AMs are needed to account for, address and mitigate overages of the ACL, should overages occur.

3. Description of the Fishery

Descriptions of the Coral Reef Ecosystem (CRE) fisheries operating in American Samoa, CNMI, Guam, and Hawaii are provided in Section 3.1 of the Environmental Assessment (EA). A brief summary of the affected fisheries will be provided here.

3.1 American Samoa Coral Reef Fisheries

Overview of American Samoa Coral Reef Fisheries
In American Samoa, coral reef fishes and invertebrates are harvested in subsistence, recreational, and small-scale commercial fisheries by various gear types including hook and line, spear,

speargun, and gillnets. According to a recent report, the average annual CREMUS catch composition in American Samoa is dominated by the following six families/groups: surgeonfishes (16,181 lb), snappers (15,838 lb), atule or bigeye scad (15,533 lb), mollusks including top shells, octopus, clams (11,672 lb per year), jacks (8,200 lb), and Scaridae or parrotfishes (7,764 lb) (Sabater and Tulafono 2011).

Although coral reef fisheries surveys in American Samoa collect information on fishing by persons engaged in commercial, recreational, and subsistence fishing activities, only estimates of total commercial landings of "Reef fishes" are made available on the WPacFIN website. These fishery surveys sample the fishery and are not comprehensive. WPacFIN estimates 2010 commercial landings to be 26,453 lb[4]. However, WPacFIN reef fish landings do not include catch of all species defined as CREMUS under the American Samoa FEP, so actual commercial reef fish landings are expected to be higher.

Coral reef fisheries landings in commercial, recreational, and subsistence fisheries have generally declined since the 1990's. Annual commercial reef fish catches are believed to have remained below 30,000 lb since 2001.

The boat-based coral reef fisheries have the potential to harvest coral reef taxa in federal waters, particularly in association with bottomfish fishing. The spear fishery primarily harvests fish and invertebrates from within territorial waters. Coral reef fishery participation has fluctuated over the years due to socio-economic changes, hurricane effects, and changes in fishery management laws such as the ban on SCUBA spearfishing in 2001. The number of boats ranged from a low of 15 in 1992 following a hurricane (Val) that hit the islands in December 1991 to a high of 37 boats in 1986 during the peak of the bottomfish fishery. Most recent estimates indicate that 22 boats are participating in the commercial coral reef fishery in American Samoa. These shift between spearfishing and bottomfishing with occasional trolling activities. The average number of fishermen per boat on a typical bottomfishing trip is three, while that of a spearfishing trip ranges from 1 to 7. Overall, regardless of the method used, there are approximately 88 fishermen participating in the boat based coral reef fishery.

Based on information provided through WPacFIN, the commercial price per pound for CREMUS in American Samoa ranged from $2.22 to $3.71 in 2010. The commercial value of the coral reef fishery was an estimated $70,894, based on the 2010 catch of 26,453 lb and the average price of reef fish of $2.68 per pound. Assuming participation and fishing effort were equal throughout the fleet in 2010 each vessel would have caught approximately 1,202 lb of CREMUS valued at $3,222.

3.2 Guam Coral Reef Fisheries

Overview of Guam Coral Reef Fisheries

Shore-based or inwater fishing accounts for most of the fish and invertebrate harvest from coral reefs around Guam. Less than 20% of coral reef resources are harvested from the offshore banks

[4] (http://www.pifsc.noaa.gov/wpacfin/as/Data/ECL_Charts/ae3amain.htm. Website accessed on September 12, 2011).

located in the EEZ. Most offshore banks are deep, remote, and subject to strong currents; these banks are generally accessible only during the summer months.

Although coral reef fisheries surveys in Guam collect information on fishing by persons engaged in commercial, recreational, and subsistence fishing activities, only estimates of total commercial landings of "Reef fishes" are made available on the WPacFIN website. The fishery surveys are not comprehensive and are designed to monitor the fishery over time. In 2009, Guam commercial CRE landings totaled 124,401 lb (http://www.pifsc.noaa.gov/wpacfin/guam/dawr/Data/Landings_Charts/ge3b.htm. Website accessed on September 12, 2011). However, as occurs in the American Samoa CRE fishery, this figure is likely to be underestimated because WPacFIN reef fish landings do not include catch of all species defined as CREMUS under the Mariana Archipelago FEP such as bigeye scad, round scad, mollusks and shallow water snappers, emperors and groupers which together comprise a significant component of the total CREMUS catch. Instead, for public dissemination WPacFIN may report these taxa under the categories "Other fishes" or "bottomfishes."

The coral reef fishery long term commercial landing trends in Guam showed a general upward trend from 1982 to 2000, then exhibited a drop in landings after 2000. Recent landings ranged between 80,000 and 100,000 lb[5]. Figure 4 of the EA depicts Guam coral reef landings from 1982 to 2009. Low catch years associated with hurricanes may be the result of fleet damage or fishermen being occupied with other work. In 2001, the American Samoa Department of Marine and Water Resources prohibited the use of scuba gear while fishing to help reduce fishing pressure on the reefs, which led to the general decline in coral reef landings over the past decade relative to earlier years.

The number of boats participating in the coral reef fishery ranged from 58 in 1983 to 210 in 1995. Approximately 116 boats actively fished in the Guam coral reef fishery in 2009. There were 3 to 4 fishermen per boat, thus, the estimated coral reef boat based fishing population is approximately 348 individuals.

The average price per pound of coral reef fish in 2009 was $2.82 per pound. With a total landing of 124,401 lb, the commercial coral reef fishery in Guam is valued at approximately $350,811. Assuming participation and fishing effort was equal throughout the fleet in 2009, each vessel would have caught approximately 1,072 lb of CREMUS valued at $3,023.

3.3 CNMI Coral Reef Fisheries

Overview of CNMI Coral Reef Fisheries

Coral reef fisheries in the CNMI are mostly limited to nearshore areas of the three southern most islands of Saipan, Rota, and Tinian. Limited fishing for CREMUS occurs north of Saipan. Finfish and invertebrates are the primary targets, but small quantities of seaweed are also taken.

Although coral reef fisheries surveys in the CNMI collect information on fishing by persons engaged in commercial, recreational, and subsistence fishing activities, only estimates of total

[5] http://www.pifsc.noaa.gov/wpacfin/guam/dawr/Data/Landings_Charts/ge3b.htm. Website accessed on September 12, 2011).

commercial landings of "Reef fishes" are made available on the WPacFIN website. The fishery surveys are samples and are not comprehensive.

WPacFIN provides estimates for 2009 commercial landings to be 72,211 lb[6]. However, WPacFIN reef fish landings do not include catch of all species defined as CREMUS under the Mariana Archipelago FEP, so actual commercial reef fish landings are expected to be higher. Commercial landings peaked in 1989 at an estimated 300,000 lb, but have generally ranged between 50,000 to 150,000 lb over the past decade.

The number of participants in the coral reef fishery of the CNMI has fluctuated over the past decade. CNMI DMWR (unpublished data) estimates that the highest number of boats engaged in bottomfishing and spearfishing that also caught shallow water coral reef taxa was 27 boats in 2007 (see Figure 7 of the EA). The most recent data indicate that 16 vessels participated in the coral reef fishery in 2009. The average number of fisherman was estimated to be about 45 fishermen over the past decade with a range of 2 to 5 fishermen per boat depending on the method used.

The average price per pound of reef fish in 2009 was approximately $2.59. With a total estimated landing of 72,211 lb, the coral reef fishery in the CNMI is valued at approximately $187,026. Assuming participation and fishing effort was equal throughout the fleet in 2009, each vessel would have landed approximately 18,053 lb of CREMUS valued at $11,689.

3.4 Hawaii Coral Reef Fisheries

Overview of Hawaii Coral Reef Fisheries

In Hawaii, the coral reef ecosystem management area includes the U.S. EEZ around the main Hawaiian Islands which generally extends from 3-200 nmi offshore; however, the majority of CREMUS catch are harvested from nearshore waters under the jurisdiction of the State of Hawaii from the shoreline, inwater fishing methods, and from vessels by both commercial and non-commercial fishermen. Under state law, anyone who takes marine life for commercial purposes is required to obtain a commercial marine license (CML) and submit a catch report (popularly known as a "C3" form) on a monthly basis. MHI catches of the ten most commonly reported coral reef species include akule, opelu, jacks, goatfish, surgeonfish, squirrelfish, mullets, snappers, octopus, and parrotfish.

The commercial landing of CREMUS in Hawaii has fluctuated over the past six decades peaking in 1999 with close to 3.5 million lb. In 2010, estimated commercial landings of CREMUS were just over 1.3 million lb with akule and opelu accounting for nearly one-third of the commercial catch (254,996 lb and 204,643 lb, respectively).

In 2010, the average price per pound for coral reef fish in Hawaii was $3.01. With a total estimated commercial landing of 1.3 million lb, the total value of the 2010 coral reef fishery landings in Hawaii is estimated to be approximately $3.9 million.

[6] http://www.pifsc.noaa.gov/wpacfin/as/Data/ECL_Charts/ae3amain.htm. Website accessed on September 12, 2011.

The total number of individuals that participate in Hawaii's coral reef fisheries is currently unknown and could include hundreds of thousands of individuals that fish from both the shoreline, in water, and from vessels commercially and non-commercially. Hamm et al., (2010) provides the most recent estimate of the number of licensed commercial fishermen in Hawaii and reports there were 4,263 licensees in 2008. However, not all licensed fishers harvest CREMUS, therefore the exact number of individual participating in Hawaii's coral reef fisheries is unknown.

By far, the largest coral reef fishery in Hawaii in terms of catch landed is the akule fishery which harvests the coastal pelagic species primarily by surround net and in smaller amounts from shoreline casting. The second largest fishery is the opelu fishery which harvests this coastal pelagic species primarily by hoop netting at night and by hook and line during the day. Although exact numbers are not available, it is estimated that up to 35 vessels may participate in Hawaii's akule and opelu fisheries.

4. Description of the ACL Alternatives for the Coral Reef Ecosystem MUS in 2012 and 2013

Proposed ACLs:

The proposed ACLs for each CREMUS grouping under each of the preferred and non-preferred alternatives for American Samoa, CNMI, Guam, and Hawaii are summarized in Tables 19-22 of the EA.

Accountability Measures:

Under all action alternatives considered, the Council would determine as soon as possible after the fishing year, whether or not an ACL for any stock or stock complex had been exceeded. If landings of a stock or stock complex exceed the specified ACL in a fishing year, the Council would take action in accordance with 50 CFR 600.310(g) to correct the operational issue that caused the ACL overage. NMFS would implement the Council's recommended action, which could include a downward adjustment to the ACL for that stock complex in the subsequent fishing year, or other measures, as appropriate. Additionally, as a performance measure specified in each FEP, if an ACL is exceeded more than once in a four-year period, the Council is required to re-evaluate the ACL process, and adjust the system, as necessary, to improve its performance and effectiveness. Each alternative also assumes continuation of all existing federal and local resource management laws and regulations.

4.1 Alternative 1: No Action, Status Quo

Under the No Action Alternative, NMFS would not specify an ACL for any CREMUS in any island area and AMs would not be necessary. However, this alternative would not be in compliance with the Magnuson-Stevens Act or the provisions of the FEPs which require ACLs be specified for all stocks and stock complexes in the fishery.

4.2 Alternative 2: Specify ACLs based on Arithmetic Mean of the Catch

Under Alternative 2, the ACL for each CREMUS taxonomic group would be set at the value associated with the arithmetic mean of the total catch based on the time series for which data were available. For all CREMUS taxonomic groups (except American Samoa atule and squirrelfish), the ACL under Alternative 2 would be lower than the ABC recommended by the SSC because the SSC set the ABC to that level of catch at which 75% of the catch observations were found to be lower.

Under this alternative, the ACL for species of special management interest, as determined by the Council (bumphead parrotfish, humphead or Napoleon wrasse and reef sharks), would be set equal to the total estimated biomass.

4.3 Alternative 3: Specify ACLs based on the 75th Percentile of the Catch (Preferred)

Under this alternative, the ACL for each CREMUS taxonomic group (except for Hawaii akule and opelu) would be set at the 75th percentile of the total catch based on the time series for which data were available. The ACL would be equal to the ABC recommended by the SSC. For Hawaii akule and opelu, the ACL would be set equal to the MSY values estimated by Weng and Sibert (2000), which are 651,292 lb and 393,563 lb, respectively.

The ACL for species of special management interest, as determined by the Council (bumphead parrotfish, humphead (Napoleon) wrasse and reef sharks), would be set at 5 percent of the total estimated biomass. Under this alternative, the ACL for bumphead parrotfish would be specified on an archipelagic-wide basis (i.e., computation of catch in relation to the ACL would be based on fishing in both CNMI and Guam.)

4.4 Alternative 4: Specify ACLs based on the 95th Percentile of the Catch

Under this alternative, the ACL for each CREMUS taxonomic group would be set at the 95th percentile of the catch based on the time series for which data were available. For all CREMUS taxonomic groups, the ACL values would exceed the SSC recommended ABCs under this alternative.

Additionally, under this alternative, the ACL for species of special management interest, as determined by the Council (bumphead parrotfish, humphead [Napoleon] wrasse and reef sharks), would be set at 10 percent of the total estimated biomass. Under this alternative, the ACL for bumphead parrotfish (*Bolbometopon muricatum*) would be specified on an archipelagic-wide basis (i.e., computation of catch in relation to the ACL would be based on fishing in both CNMI and Guam).

5. Analysis of Alternatives

This section describes the potential economic effects of all alternatives that were considered and evaluates the impacts of each action alternative relative to the no-action alternative.

5.1. Alternative 1: No Action

Under Alternative 1, the no-action alternative, coral reef fisheries in American Samoa, Guam, CNMI, and Hawaii would not be managed using annual catch limits and accountability measures would not used. Fishing would continue to be monitored by each of four local resource management agencies (American Samoa Department of Marine and Wildlife Resources, Guam Division of Aquatic and Wildlife Resources, CNMI Division of Fish and Wildlife, and Hawaii Division of Aquatic Resources), NMFS and the Council. Fisheries statistics would continue to be made available approximately six months or longer after the data have been initially collected. The status of CREMUS, including species of special management interest to the Council would continue to be subject to ongoing discussion and fisheries scientific and management review.

5.2 Alternative 2: Specify ACLs based on Arithmetic Mean of the Catch

Under Alternative 2, fishing for CREMUS in American Samoa, Guam, CNMI, and Hawaii would be subject to annual catch limits generally specified based on the arithmetic mean of historical annual catch. The ACLs specified for Alternative 2 (and all other action alternatives) are provided in Tables 19-22 of the EA.

For the most part, the ACLs proposed for Alternative 2 are higher than recent average annual catches. In cases where an ACL is lower than or even just above the recent average catch, it is possible that an ACL could be exceeded in 2012 and/or 2013. Two family groupings appear to be cases where the proposed ACL under Alternative 2 would be lower than recent average catch. In American Samoa, the ACL for the category of remaining 10% of fish would be 14,991, while recent average catch for fish in this category was 16,556. In Guam, the ACL for jacks would be 38,755, while recent average catch of jacks was 42,822. In CNMI, the ACL proposed under Alternative 2 for all family groupings would be lower than average recent catch. As for the species of special management interest for each island area, the ACL would be equal to the total estimated biomass. As with the other alternatives, the Council and NMFS have not established an in-season fishery management measure (such as a closure), so there would be no restrictions for catching those species.

Under Alternative 2, as with the other action alternatives, the inability of fishery management entities to conduct in-season tracking of catch in relation to the ACLs, resulted in the Council and NMFS not considering in-season closures. This means that participants in western Pacific coral reef ecosystem fisheries would be able to fish throughout the entire season. The ACLs as specified under Alternative 2, (as is true for ACLs specified under other alternatives) would not change the conduct of the fishery each year, including gear types, areas fished, effort, or participation. Even if the post-season assessment determines that ACL overages had occurred and that downward adjustments to that ACL are needed for the following fishing year, the lack of ability in assessing catch levels during the ongoing fishing season would not result in any impact to coral reef fisheries which could still continue. Therefore, due to the lack of an in-season fishery closure, coral reef fishery participants should not face any adverse economic impacts in 2012 and 2013 as a result of the proposed ACL and AMs.

No changes in fisheries monitoring would occur as a result of implementing the ACL specifications and current monitoring of CREMUS catches through shore-based and boat-based creel surveys would continue under this alternative. American Samoa, Guam, and CNMI, and commercial catch reporting in Hawaii would continue to be compiled by the local resource agencies. However, under Alternative 2, as with the other action alternatives, the AMs for coral reef fisheries in American Samoa, Guam, CNMI, and Hawaii would require a post-season review of the annual catch data to determine whether an ACL for any coral reef stock or stock complex was exceeded. If so, the Council would take action to correct the operational issue that caused the ACL overage, which could include a downward adjustment of the ACL. NMFS would implement operational adjustments or downward adjustment to the ACL for that stock or stock complex during the following fishing year as recommended by the Council. Indirect adverse economic effects cold result should catch restrictions occur as a result of the specified ACLs. NMFS cannot predict which MUS would be affected or the magnitude of the overage adjustment that might be taken; therefore, the fishery and economic impacts of future actions such as changes to ACLs or AMs would be evaluated separately, once those future actions are available for consideration.

As the choice of the ACL under Alternative 2 would have little, if any, impact on coral reef fishing activities, this suggests that there should be no change in the amount of reef fish supplied to local markets or available for subsistence and cultural sharing practices in 2012 and 2013 as a result of this action..

Incremental costs associated with this alternative are expected to be incurred by the requirement for the Federal agency to conduct post-season fishery review in order to determine whether one or more ACLs had been exceeded and then would incur costs related to corresponding activities to address the overage. These costs may include, but are not limited to Council costs of documentation preparation, meetings, public hearings, and information dissemination. NMFS administrative costs of document preparation, meetings and reviews supporting rulemaking or otherwise respond to Council proposal. Although each alternative would have the same costs involved with post-season fishery performance review, the other incremental costs are expected to be higher when the potential to exceed one or more ACLs is higher, so Alternative 2 is more likely to incur higher public and private administrative costs than Alternative 3 or Alternative 4. It should be noted that none of the administrative activities under any of the alternatives would be substantially higher than the ongoing costs that the Council and its organizational bodies would bear in response to continuing to comply with national requirements under the MSA that call for the Council to develop and recommend appropriate ACLs and AMs, and for NMFS to implement the specifications.

5.3 Alternative 3: Specify ACLs based on the 75th Percentile of the Catch (Preferred)

Under Alternative 3, fishing for CREMUS in American Samoa, Guam, CNMI, and Hawaii would be subject to annual catch limits based on the 75th percentile of historical catch. Under this alternative, the ACLs would be set equal to the ABC recommended by the SSC. The ACLs specified for Alternative 3 (and all other action alternatives) are provided in Tables 19-22 of the EA and would be applicable to fishing years 2012 and 2013. As for the species of special management interest for each island area, the ACL would be equal to 5 percent of the estimated biomass. As with the other alternatives, the Council and NMFS have not established an in-season fishery management measure (such as a closure), so there would be no restrictions for catching those species.

The ACLs proposed for Alternative 3 are higher than recent average annual catches. It is possible that an ACL could be exceeded in 2012 and/or 2013, especially in cases where the proposed ACL is not much more than recent average catch.

Under Alternative 3, as with the other action alternatives, the inability of fishery management entities to conduct in-season tracking of catch in relation to the ACLs resulted in the Council and NMFS not considering in-season closures. This means that participants in western Pacific coral reef ecosystem fisheries would be able to fish throughout the entire season. The ACLs as specified under Alternative 3, (as is true for the ACLs specified under other alternatives) would not change the conduct of the fishery each year, including gear types, areas fished, effort, or participation. Even if the post-season assessment determines that ACL overages had occurred and that downward adjustments to that ACL is needed for the following fishing year, the lack of ability in assessing catch levels during the ongoing fishing season suggests that fishing in coral reef fisheries could still continue. Therefore, due to the lack of an in-season fishery closure, coral reef fishery participants should not face any adverse economic impacts in 2012 and 2013 as a result of the proposed ACL and AMs.

No changes in fisheries monitoring would occur as a result of implementing the ACL specifications, and current monitoring of CREMUS catches through shore-based and boat-based creel surveys would continue under this alternative. American Samoa, Guam, and CNMI, and commercial catch reporting in Hawaii would continue and be compiled by the local resource agencies. However, under Alternative 3, as with the other action alternatives, the AMs for coral reef fisheries in American Samoa, Guam, CNMI, and Hawaii would require a post-season review of the annual catch data to determine whether an ACL for any coral reef stock or stock complex was exceeded. If so, the Council would take action to correct the operational issue that caused the ACL overage, which could include a downward adjustment of the ACL. NMFS would implement operational adjustments or downward adjustment to the ACL for that stock or stock complex during the following fishing year as recommended by the Council. Indirect adverse economic effects cold result should catch restrictions occur as a result of the specified ACLs. NMFS cannot predict which MUS would be affected or the magnitude of the overage adjustment that might be taken; therefore, the fishery and economic impacts of future actions such as changes to ACLs or AMs would be evaluated separately, once those future actions are available for consideration.

As the choice of the ACL under Alternative 3 is not likely to affect coral reef fishing activities, there should not be any change in the amount of reef fish that would be supplied to local markets or for subsistence and cultural sharing practices in 2012 and 2013 as a result of this action..

Incremental costs associated with this alternative are expected to be incurred by the requirement for the Federal agency to conduct post-season fishery review in order to determine whether one or more ACLs had been exceeded. If an ACL was exceeded, there would be costs related to corresponding activities to address the overage. Some of these potential incremental costs were described in Alternative 2. Alternative 3 is expected to incur higher incremental costs in implementing AMs relative to the no action alternative. These incremental costs are likely to be lower relative to Alternative 2. This is because the vast majority of the ACLs proposed under Alternative 3 are higher than those proposed under Alternative 2, and so it is expected that ACL overages would occur less often under Alternative 3 as compared to Alternative 2.

5.4 Alternative 4: Specify ACLs based on the 95th Percentile of the Catch

Under Alternative 4, fishing for CREMUS in American Samoa, Guam, CNMI, and Hawaii would be subject to annual catch limits that were based on the 95th percentile of historical catch. Under this alternative, the ACLs would be higher than the ABC recommended by the SSC, and therefore would not conform to the FEP requirements of establishing ACLs. The ACLs specified for Alternative 4 (and all other action alternatives) are provided in Tables 19-22 of the EA. As for the species of special management interest for each island area, the ACL would be equal to 10 percent of the estimated biomass. As with the other alternatives, the Council and NMFS have not established an in-season fishery management measure (such as a closure), so there would be no restrictions for catching those species

The ACLs proposed for Alternative 4 are higher than recent average annual catch. It is possible that an ACL could be exceeded in 2012 and/or 2013, especially in cases where the proposed ACL is not much more than recent average catch.

Under Alternative 4, as with the other action alternatives, the inability of fishery management entities to conduct in-season tracking of catch in relation to the ACLs resulted in the Council and NMFS not considering in season closures. This means that participants in western Pacific coral reef ecosystem fisheries would be able to fish throughout the entire season. The ACLs as specified under Alternative 4, (as is true for the ACLs specified under other alternatives) would not change the conduct of the fishery each year, including gear types, areas fished, effort, or participation. Even if the post-season assessment determines that ACL overages had occurred and that downward adjustments to that ACL is needed for the following fishing year, the lack of ability in assessing catch levels during the ongoing fishing season suggests that fishing in coral reef fisheries could still continue. Therefore, due to the lack of an in-season fishery closure, coral reef fishery participants should not face any adverse economic impacts in 2012 and 2013 as a result of the proposed ACL and AMs

No changes in fisheries monitoring would occur as a result of implementing the ACL specifications and current monitoring of CREMUS catches through shore-based and boat-based creel surveys would continue. American Samoa, Guam, and CNMI, and commercial catch reporting in Hawaii would continue to be compiled by the local resource agencies. However, under Alternative 4, as with the other action alternatives, the AMs for coral reef fisheries in American Samoa, Guam, CNMI, and Hawaii would require a post-season review of the annual catch data to determine whether an ACL for any coral reef stock or stock complex was exceeded. If so, the Council would take action to correct the operational issue that caused the ACL overage, which could include a downward adjustment of the ACL. NMFS would implement operational adjustments or downward adjustment to the ACL for that stock or stock complex during the following fishing year as recommended by the Council. Indirect adverse economic effects cold

result should catch restrictions occur as a result of the specified ACLs. NMFS cannot predict which MUS would be affected or the magnitude of the overage adjustment that might be taken; therefore, the fishery and economic impacts of future actions such as changes to ACLs or AMs would be evaluated separately, once those future actions are available for consideration.
As the choice of the ACL under Alternative 4 should not have any impact on coral reef fishing activities, there should be no change to the amount of reef fish supplied to local markets or for subsistence and cultural sharing practices in 2012 and 2013 as a result of this action.

Incremental costs associated with this Alternative are expected to be incurred by the requirement for the Federal agency to conduct post-season fishery review in order to determine whether one or more ACLs had been exceeded and then would incur costs related to corresponding activities to address the overage. Some of these potential incremental costs were described in Alternative 2. Alternative 4 is expected to incur higher incremental costs in implementing AMs relative to the no action alternative; however, these incremental costs are expected to be lower relative to Alternative 2 and 3. This is because all ACLs proposed under Alternative 4 are higher than those proposed under Alternative 2 and 3, and so it is expected that ACL overages would occur less often under Alternative 4 as compared to the other action alternatives.

Among the action alternatives, it is not possible to provide a quantitative assessment of which would provide a greater net benefit. While Alternative 3 may incur higher incremental costs in implementing AMs, because of the higher likelihood of triggering AMs, the additional level of post season review of the catch would also provide an enhanced level of management review of the fishery and further help the fishery from becoming overfished.

6. Distributional Changes in Net Benefit

The action alternatives are expected to have no distributional effects among large and small vessels or by geographic region, because the proposed measures should not cause an adverse economic impact to fishermen in 2012 and 2013, as described earlier.

7. Changes in Income and Employment

The action alternatives are not expected to cause adverse economic impacts to fishermen in 2012 and 2013, therefore, changes in income and regional employment are unlikely to occur as a direct consequence of the proposed measures.

8. Determination of a Significant Regulatory Action

A “significant regulatory action” means any regulatory action that is likely to result in a rule that may –

1) Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal government or communities;

2) Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;
3) Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or
4) Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the Executive Order.

The proposed action is not expected to have an adverse effect of $100 million or more, create a serious inconsistency or otherwise interfere with an action taken by another agency, materially alter the budgetary impact of programs or rights or obligations of recipients, or raise novel legal or policy issues. Therefore, it is not considered to be a significant regulatory action. However, there is expected to be an increased interest on the part of fishermen regarding catch limits, especially where specified ACLs are low because of the limits to the data used in developing ACLs.

9. Impacts on Small Entities

This section provides a description of the economic impacts of the proposed alternative on small entities as well as that of the alternatives that were considered in the amendment but not selected.

The reasons why the action is being considered, the objectives of, and the legal basis for the proposed action are addressed in Sections 1.0 and 2.0 of the EA. NMFS does not believe that the proposed regulations would conflict with or duplicate other Federal regulations. Section 3.0 provides a description of the fisheries that may be affected by this action.

The proposed action would specify an annual catch limit (ACL) for each coral reef ecosystem stock and stock complex in American Samoa, Guam, the Northern Mariana Islands, and Hawaii for fishing years 2012 and 2013. The proposed specification would be set at the 75^{th} percentile of historical catch. If the ACL for any stock or stock complex is exceeded and affects the sustainability of that stock or stock complex, NMFS would take action to correct the operational issue that caused the ACL overage, as recommended by the Council which could include a downward adjustment to the ACL for that stock or stock complex in the subsequent fishing year.

NMFS does not have annual revenue information on a per-vessel basis, but assumes that all commercial coral reef fishery participants to be small entities based on the SBA size standard for defining a small business entity in this industry with average annual receipts less than $4.0 million. Average value of 2010 landings per vessel for CREMUS in American Samoa was estimated to be $3,222 and in Guam, average revenue per vessel for CREMUS in 2009 was an estimated $3,023. CNMI vessels averaged $11,689 in CREMUS landings and in Hawaii, vessels that landed akule or opelu, the two most commonly caught species of CREMUS earned an average $35,703 from those landings. The number of vessels participating in CREMUS fishery was estimated to be as follows: 22 in American Samoa (2010), 116 in Guam (2009), 16 in CNMI (2009), and up to 35 vessels that fish for akule or opelu in 2010 (it cannot be determined how many vessels fished for other CREMUS).

Based on available information, NMFS has determined that all vessels participating in CREMUS fisheries in American Samoa, Guam, CNMI and Hawaii are small entities under the Small Business Administration definition of small entity, i.e., they are engaged in the business of fish harvesting, are independently owned or operated, are not dominant in their field of operation and have annual gross receipts not in excess of $4 million. The proposed action of specifying ACL and AMs is expected to have little, if any, adverse economic impact, as described in the RIR. There are no disproportionate economic impacts between large and small entities. Furthermore, there are no disproportionate economic impacts among the universe of vessels based on gear, home port, or vessel length.

NMFS is recommending that the Office of General Counsel for Department of Commerce certify to the Chief Counsel for Advocacy of the Small Business Administration that the proposed action would not have any significant economic impacts on a substantial number of small entities.

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FINDING OF NO SIGNIFICANT IMPACT

Annual Catch Limit Specifications and Accountability Measures for Pacific Islands Coral Reef Ecosystem Fisheries in 2012 and 2013

(RIN 0648-XA674)

December 2011

Introduction

NMFS prepared this Finding of No Significant Impact (FONSI) according to the guidelines established in National Marine Fisheries Service (NMFS) Instruction 30-124-1 (July 22, 2005) and the requirements set forth in National Oceanic and Atmospheric Administration (NOAA) Administrative Order 216-6 (NAO 216-6, May 20, 1999), concerning compliance with the National Environmental Policy Act (NEPA). The environmental impact analysis prepared in accordance with the requirements of NEPA and documented in the attached environmental assessment (EA) supports this FONSI.

Background

Fisheries for coral reef ecosystem management unit species (CREMUS) in federal waters of the western Pacific are governed by four fishery ecosystem plans (FEP) developed by the Western Pacific Fishery Management Council (Council) and implemented by the National Marine Fisheries Service (NMFS) under the authority of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). For each FEP, federal regulations at 50 CFR §665 define CREMUS to include all coral reef associated species, families or subfamilies which spend the majority of their non-pelagic (post settlement) life stages within waters less than or equal to 50 fathoms (300 feet) in total depth. CREMUS do not include species defined in 50 CFR §665 as a bottomfish, crustacean, precious coral or pelagic management unit species (MUS)[1].

Federal requirements direct NMFS to specify an annual catch limit (ACL) and accountability measure (AM) for each coral reef ecosystem stock and stock complex[2], as recommended by the Council, and considering the best available scientific, commercial, and other information about the fishery for that stock or stock complex. The process and mechanism that is to be used in developing ACLs and AMs for western Pacific regional fisheries was implemented in 2011 (76

[1] For the purpose of specifying ACLs and AMs, two bottomfish MUS were included in the current action. Amberjacks (family: Carangidae) and taape, an introduced snapper (family: Lutjanidae), are generally caught in the coral reef fisheries. Since neither of the species that were considered in this action were part of recent bottomfish stock assessments, they were considered with the CREMUS.

[2] The Magnuson-Stevens Act defines the term "stock of fish" to mean a species, subspecies, geographic grouping, or other category of fish capable of management as a unit. Federal regulations at 50 CFR §660.310(c) define "stock complex" to mean a group of stocks that are sufficiently similar in geographic distribution, life history, and vulnerabilities to the fishery such that the impact of management actions on the stocks is similar.

FR 37285; June 27, 2011), and was followed by the Council in developing the proposed ACL specifications and AMs.

NMFS is not specifying ACLs for any CREMUS in the Pacific Remote Island Areas (PRIA) at this time because commercial fishing is prohibited out to 50 nautical miles by Presidential Proclamation 8336 which established the Pacific Remote Island Marine National Monument (74 FR 1565; January 12, 2009), and there is no coral reef habitat beyond the monument boundaries. Therefore, the existing fishing prohibition is the functional equivalent of an ACL of zero.

Proposed Action

After considering a range of alternatives developed in coordination with its plan team members, the Scientific and Statistical Committee and members of the public, the Council recommended Alternative 3 of this EA (see section 2.2.3). If approved, NMFS will specify an annual catch limit (ACL) based on the 75th percentile of the catch for the top family groupings, based on MSY for opelu and akule in Hawaii, and based on 5 percent of estimated stock biomass for reef sharks, humphead wrasse, and bumphead parrotfish. Accountability measures (AMs) for each coral reef ecosystem stock and stock complex managed under the FEPs for American Samoa, the Mariana Islands (including Guam and the Commonwealth of the Northern Mariana Islands or the CNMI), and Hawaii call for a post-season review of the fishery to evaluate whether an ACL was exceeded, and if so, adjust the ACL if warranted. The ACLs and AMs apply to harvests of CRE management unit species (MUS) in fishing years 2012 and 2013 which begin on January 1 and end on December 31 of each year. The purpose of the action is to comply with provisions of the fishery ecosystem plans (FEPs) for American Samoa, the Mariana Archipelago, and Hawaii which require NMFS to specify an ACL for each stock and stock complex in western Pacific coral reef ecosystem fisheries and implement accountability measures (AM). Section 1.2 of the EA describes the proposed action in more detail.

Affected Fisheries

The ACLs and AMs apply to species harvested in coral reef ecosystem fisheries of American Samoa, the CNMI, Guam, and Hawaii. Current fishery requirements will continue unchanged. ACL specifications and AMs are not being considered for the PRIA. Resources harvested in coral reef fisheries of the western Pacific are highly diverse, with up to 700 species appearing in catch records in the Mariana Archipelago (Guam and the CNMI) and approximately 300 species in American Samoa and 100 in Hawaii. In each island area, commercial and non-commercial fishermen fish from shore, and from vessels and employ numerous gears to harvest CREMUS, including multiple variations of hook and line methods, nets, traps, spearfishing and hand gathering. The majority of coral reef ecosystem habitat is found shoreward of the U.S. EEZ, which is generally 3-200 nm from shore. In the CNMI, the U.S. EEZ extends from the shore to 200 nm; however, the federal coral reef ecosystem management area applies only to offshore waters from 3-200 nm from shore, consistent with the other island areas. Because coral reef fishing is conducted almost exclusively in nearshore waters from 0-3 nm, these fisheries are managed primarily by local resource management agencies.

Coordination and Public Involvement

The Council considered and discussed the ACL and AM specifications and alternatives at public meetings held in June and October 2011. The attached EA includes a discussion of public involvement in sections 1.4 and 4.1.3. NMFS will publish the proposed 2012-13 ACL and AM specifications for public review and comment in December 2011 and expects to publish final ACL specifications for the fisheries in early 2012.

Significance Analysis
NAO 216-6 contains criteria for determining the significance of the environmental impacts of a proposed action. In addition, the Council on Environmental Quality's (CEQ) regulations at 40 CFR 1508.27 state that the significance of an action should be analyzed both in terms of "context" and "intensity." Each criterion listed below is relevant in making a finding of no significant impact and has been considered individually, as well as in combination with the others. The significance of this action is analyzed based on the NAO 216-6 criteria and CEQ's context and intensity criteria for the selected alternative. These include:

1) Can the proposed action reasonably be expected to jeopardize the sustainability of any target species that may be affected by the action?

No. The ACL specifications and AMs were developed by fishery scientists and managers to prevent overfishing from occurring and, together with other fishery management under the FEPs, are intended to provide for long-term sustainability of each western Pacific coral reef ecosystem stock and stock complex, while allowing fishery participants to continue to benefit from its utilization.

The ACL specifications were developed in accordance with the approved fishery mechanism and process using the best available data and fishery information. The results of the SSCs and Council's thorough review show that none of the CRE MUS are being subject to overfishing and exploitation rates of all CRE species, considered on an archipelagic level, are low. Establishing the ACLs as the 75th percentile of historic catch for family groupings in the fishery is considered sustainable given the fact that the ACL specification for each stock and stock complex would be set at a level substantially lower than the estimated biomass.

The ACLs for reef sharks, humphead wrasse, and bumphead parrotfish are not likely to jeopardize these species of management concern to the Council because they are set at 5% of estimated stock biomass which is a conservative limit. This limit was considered appropriate by the SSC because these species occur infrequently in NOAA biomass surveys and have low overall catch.

The ACLs for Hawaii akule and opelu were based on MSY and the SSC believes these species are highly resilient to fishing pressure because these species are relatively short lived with high turnover, and because catches of opelu are well below MSY and catches of akule have only occasionally exceeded MSY and, therefore, for both species, neither species is subject to overfishing.

Without an in-season accountability measure (such as a fishery closure), the AMs will not result in a change to the conduct of the fishery; however, there will be a new post-season review of the fishery performance in relation to the ACLs. This new requirement is expected to result in improved timeliness of catch data processing and provides additional evaluation of the CRE fisheries. Additional Council review and evaluation of the reason for overages, if they occur, will take place and this is expected to have a beneficial effect by providing the opportunity for the Council to correct any operational issues that cause ACLs to be exceeded. (EA sections 3.1, 3.3)

For all these reasons, it is not reasonable to expect the ACL specifications and AMs will jeopardize the sustainability of any target species.

2) Can the proposed action reasonably be expected to jeopardize the sustainability of any non-target species?

No. The proposed action is not expected to jeopardize any non-target species. Although in the Pacific Islands it is difficult to differentiate between "target" and "non-target" stocks because harvested coral reef resources are highly diverse and are, for the most part, all are retained, there are federal management regulations currently in place to minimize the potential for bycatch. These regulations prohibit the use of destructive and non-selective gear methods. Discards, if they occur, are usually due to cultural reasons (i.e., taboo) or practical reasons such as toxicity (e.g., potential ciguatera toxin). No non-target species are currently in a state of overfishing or have been found to be overfished.

3) Can the proposed action reasonably be expected to cause substantial damage to the ocean and coastal habitats and/or essential fish habitat as defined under the Magnuson-Stevens Act and identified in Fishery Management Plans?

No. The specification of ACLs and AMs for CREMUS under the preferred alternative will not have a direct effect on essential fish habitat (EFH), habitat areas of particular concern (HAPC) or other ocean or coastal habitats in any of the CRE fisheries because the specifications will not result in substantial changes to the way the coral reef fisheries are conducted. These fisheries are not known to affect or harm EFH, HAPC, or other habitat for any MUS. (EA, section 3.4)

4) Can the proposed action reasonably be expected to have a substantial adverse impact on public health or safety?

No. The ACL specifications and AMs for CREMUS under the preferred alternative are not expected to adversely impact public health or safety because none of the CRE fisheries is expected to change as a result of the specifications. The ACLs are set at levels higher than historic landings in all areas, there are no in-season closures, and monitoring and reporting are not required to change so there is no likelihood for the ACLs to result in a race for the fish or to otherwise change the manner in which CRE fisheries are conducted in the western Pacific region. (EA, section 3.1)

5) Can the proposed action reasonably be expected to adversely affect endangered or threatened species, marine mammals, or critical habitat of these species?

No. The ACL specifications and AMs will not have a direct effect on the protected marine resources because the ACLs and AMs will not result in substantial changes to the way the coral reef fisheries are conducted. There have been no known or observed interactions between these fisheries and protected species and the specification of ACLs and post-season review will not change this. Managing coral reef fisheries using ACLs and AMs will be in addition to the current fishery management regime and it is expected to promote long-term sustainability of the CRE fishery resources. Because these fisheries are currently sustainably managed and subject to conservation measures in accordance with various resource conservation and management laws, the ACLs and AMs would not result in a change to distribution, abundance, reproduction, or survival of ESA-listed species or increase interactions with protected resources.

The coral reef fisheries of the western Pacific region have been evaluated for impacts on protected resources and are managed in compliance with the requirements of the MSA, the Marine Mammal Protection Act (MMPA), the Endangered Species Act (ESA), the Migratory Bird Treaty Act, and other relevant laws and policies. Pursuant to Section 7 of the ESA, NMFS has evaluated coral reef ecosystem fisheries managed under the western Pacific Fishery Ecosystem Plans and determined that these fisheries are not likely to jeopardize the continued existence of any listed species or adversely affect any of their critical habitats. The proposed action is not expected to modify vessel operations or any other aspects of any these fisheries, and therefore, the existing consultation results remain valid.

Recently, NMFS changed the status of the loggerhead sea turtle and listed the North Pacific Ocean stock and the South Pacific Ocean stock as endangered distinct population segments (DPS). These status changes require NMFS to reinitiate a review of the western Pacific fisheries to evaluate the effects of the fishery on loggerhead sea turtles given their new population status. The EA considered whether the ACL specifications and AMs would have an adverse effect on loggerhead sea turtles. Because the ACL specifications and AMs are not associated with in-season closures and changes to fishery operations, the specifications will not affect the conclusions of the consultations or have the potential to result in jeopardizing the survival and recovery of these listed species. The current coral reef ecosystem fisheries have no documented interactions with loggerhead sea turtles, and this is not likely to change.

If, at any time, the fishery, environment, or status of a listed species or marine mammal species changes substantially, or if a fishery is found to be occurring in or near new critical habitat, NMFS will undertake additional consultation, as required, to comply with requirements of the ESA and the MMPA. (EA, sections 3.3, 4.2 and 4.3)

6) Can the proposed action be expected to have a substantial impact on biodiversity and/or ecosystem function within the affected area (e.g., benthic productivity, predator-prey relationships, etc.)?

No. The Council's fishery management plans and fishery resource reviews, including the development of the ACLs and AMs, have not revealed any large adverse impacts on biodiversity and/or ecosystem function occurring because of the coral reef fisheries in the subject areas. The proposed action is not expected to change the conduct of any of these fisheries or the level of fishing effort. The proposed action was developed to prevent overfishing and promote the long-term sustainability of the CRE fishery resources. Because there are no changes expected to occur and the CRE fisheries are managed sustainably and monitored by fishery resource managers, there are no expected large or adverse effects of the proposed action on biodiversity and/or ecosystem function.

7) Are significant social or economic impacts interrelated with natural or physical environmental effects?

No. The specification of ACLs and AMs for CREMUS will not have a large adverse environmental impact that is interrelated with significant social or economic impacts. The ACL specifications are intended to provide for long-term sustainability of CREMUS while allowing fishermen to continue to utilize the resources. The ACLs are being specified without a requirement for in-season management measures. Therefore, the fishery is not expected to change. For this reason, as well, no Environmental Justice concerns arose in the course of preparing the EA. (EA, section 4.8)

8) Are the effects on the quality of the human environment likely to be highly controversial?

No. The Council developed the recommended ACLs and AMs in a public process in accordance with the required process and in coordination with fishery scientists, managers, other resource managers, and other interested parties. None of the effects on the quality of the human environment were found to be highly controversial as neither the conduct of the fisheries nor the levels of effort in any of the fisheries are expected to change as a result of the proposed action. By providing for additional post-season fishery performance review, the specifications will help ensure long-term sustainability of the coral reef resources, while allowing for optimal yield.

9) Can the proposed action reasonably be expected to result in substantial impacts to unique areas, such as historic or cultural resources, park land, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas?

No. The current CREMUS fisheries do not currently have large adverse impacts to such unique resources or areas and the proposed action will not result in large changes to the fishery. Specifying ACLs and conducting post-fishery reviews of fishery performance in comparison to ACLs and adjusting ACLs would not have an environmental outcome in the short term because there are no in-season fishery management measures. Therefore, the fishery is expected to continue in the same manner it currently is being conducted. For this reason, the proposed action is not expected to have any effect on sensitive areas including marine national monuments, national parks, marine sanctuaries and other marine protected areas, or on areas being considered for critical habitat for the endangered Hawaiian monk seal.

10) Are the effects on the human environment likely to be highly uncertain or involve unique or unknown risks?

No. The effects on the human environment are not highly uncertain or unknown because the ACLs and AMs will establish catch limits that are intended, in the long term, to provide for the sustainability of the target fish stocks. The proposed ACLs are greater than current catch levels, which are considered to be sustainable. The ACLs were developed using the best available scientific information, and the process included consideration of scientific uncertainty. The AMs do not require in-season closures so there is no large change to the fishery that will result from implementing the proposed action. For these reasons, the potential environmental effects of the proposed action are not uncertain and do not involve unique or unknown risks.

11) Is the proposed action related to other actions with individually insignificant, but cumulatively significant impacts?

No. For all four island areas, the Council is developing ACL and AM recommendations for bottomfish and groundfish, precious corals, and crustaceans MUS. NMFS recently specified ACLs for the main Hawaiian Islands Deep 7 bottomfish fishery. In the agency's preliminary findings, none of the ongoing proposals to specify ACLs and implement AMs is likely to result in large adverse effects to the environment. Also, the EA includes the agency's consideration of the potential for interaction among these initiatives and none was found that would result in a significant cumulative effect. First, none of the ACLs or AMs would conflict with or reduce the efficacy of existing coral reef ecosystem resource management by local resource management agencies, NMFS, or the Council. The proposed ACL specifications for CREMUS would also not conflict with future ACL and AM specifications in any of the three archipelagic areas because the ACLs apply to fishery-specific MUS resources and do not overlap. Further, the ACLs and AMs are not anticipated to result in a large change to coral reef fisheries in any of the areas. (EA, section 3.8.2)

12) Is the proposed action likely to adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources?

No. Such areas do not exist where these fisheries operate, so there would be no such adverse effects. Additionally, the CREMUS fisheries do not have a destructive impact on the environment and the amount of fish that may be caught under the specifications is not expected to adversely affect any such cultural, scientific, or historical resources that may occur in the areas adjacent to areas where these fisheries occur.

13) Can the proposed action reasonably be expected to result in the introduction or spread of a nonindigenous species?

No. The proposed action will not change the way or locations in which the fisheries are conducted, so it is not expected to result in the spread of any nonindigenous species.

14) Is the proposed action likely to establish a precedent for future actions with significant effects or represent a decision in principle about a future consideration?

No. Although the ACL specifications for CREMUS is a novel regulatory regime for the western Pacific coral reef ecosystem fisheries, the specifications comply with the regulations in the individual archipelagic FEPs and national requirements for all MUS to be managed under ACLs. The ACLs were developed in accordance with an approved method and process found in each FEP, so NMFS' specification of ACLs and AMs for the 2012-13 fishing years will not result in automatic approval for future actions or affect future decisions about appropriate ACLs or AMs.

Catch data will continue to be collected by local resource management agencies through their respective fishery monitoring programs and by NMFS through federal logbook reporting. If an ACL for any stock or stock complex is exceeded and results in biological consequences to that stock or stock complex, NMFS will take action to correct the operational issue that caused the ACL overage, as recommended by the Council, which could include a downward adjustment to the ACL for that stock or stock complex. If there were to be an environmental impact resulting from future management actions by NMFS or the Council that have not been considered here, additional environmental impact review would be done at the time that new management requirements were proposed. Other fishery management actions could be initiated if necessary based on the conditions of CREMUS stocks or stock complexes, as such data become available. No such actions are currently being considered.

15) Can the proposed action reasonably be expected to threaten a violation of Federal, State, or local law or requirements imposed for the protection of the environment?

No. The proposed action complies with requirements of Federal law. The proposed specifications and a preliminary environmental analysis were developed with input from a number of other agencies and members of the public. The proposed specifications do not violate any Federal, State, or local law or requirements for environmental protection. (EA, section 4)

16) Can the proposed action reasonably be expected to result in cumulative adverse effects that could have a substantial effect on the target or non-target species?

No. The ACLs are considered an acceptable level of catch that are part of an overall management scheme intended to prevent overfishing and provide for long-term sustainability of the target and non-target stocks. The specifications were developed using the best available scientific information, in a manner that accords with the fishery regulations, and after considering catches, participation trends, and estimates of the status of the fishery resources. The AMs are also not likely to cause large adverse impacts to resources, which are likely to benefit from the post-season data review. The long-term conservation of fishery resources and the lack of change in the fishery allow NMFS to conclude that the ACL specifications and AMs will not result in cumulative adverse impacts to target or non-target stocks. (EA, section 3.8)

Other Findings

NMFS considered the effect of the proposed ACL specifications and AMs on Environmental Justice communities. The ACLs would apply to everyone who catches coral reef fishes. The proposed specifications of ACLs and provisions for post-season harvest reviews as the AMs are not expected to result in a change to the way the fisheries are conducted, but are intended to provide for sustainability of CREMUS. The proposed ACLs and AMs are expected to benefit these resources and the human communities that rely on their harvest. For these reasons, the proposed specifications are not likely to result in disproportionately large or adverse effects on members of Environmental Justice communities in American Samoa, Guam, the CNMI, or Hawaii. (EA, section 3.6)

NMFS also considered the effects of the project on climate change and climate change impacts on the feasibility of the project. The efficacy of the proposed ACL and AM specifications in providing for sustainable levels of fishing for CREMUS is not expected to be adversely affected by climate change. Recent catch and biological status of the species informed the development of the ACLs and AMs. Monitoring would continue, and if harvests were reduced, ACLs could be adjusted in the future. The proposed specifications are not expected to result in a change to the manner in which the fisheries are conducted, so no change in greenhouse gas emissions is expected. (EA, section 3.7)

Determination
In view of the information presented in this document and the analysis contained in the supporting Environmental Assessment prepared for the Proposed Annual Catch Limit Specifications and Accountability Measures for Pacific Islands Coral Reef Ecosystem Fisheries in 2012 and 2013, and dated December 13, 2011, I have determined that the proposed action will not significantly impact the quality of the human environment as described above and in the supporting EA. In addition, all beneficial and adverse impacts of the proposed action have been addressed to reach the conclusion of no significant impacts. Accordingly, preparation of an Environmental Impact Statement for this action is not necessary.

Michael D. Tosatto
Regional Administrator

DEC 13 2011
Date