6.A(1)
152 CM
ACTION ITEM

WESTERN
PACIFIC
REGIONAL
FISHERY
MANAGEMENT
COUNCIL

Specification of an Acceptable Biological Catch and Annual Catch Limit for the Coral Reef Assemblages of American Samoa, Guam, Northern Mariana Islands and Hawaii for the 2012 Fishing Year

Draft dated
September 21, 2011

Abstract

Coral reef fish stocks are managed under the Archipelagic Fishery Ecosystem Plan (FEP) for the Hawaii, American Samoa, Marianas Archipelago and Pacific Remote Island Areas that was 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. Presently, coral reef fishery are primarily harvested within the 3 nautical mile state/territory/commonwealth jurisdiction using multiple gears and harvested as a multispecies complex. On an archipelagic scale, reef fish contribution to the total marine harvest is very minor compared to the highly commercial scale harvest of pelagic followed by bottomfish. The fishing year for reef fishes begins January 1 and ends on December 31.

To provide for the long-term sustainability of the coral reef fish stocks and prevent overfishing from occurring, the FEPs requires NMFS to specify an annual catch limit (ACL) for the reef fishes harvested in federal waters as recommended by the Council, including accountability measures (AM) to prevent the ACL from being exceeded.

This assessment evaluates the potential environmental impacts of specifying a particular ACL from the values derived from following the ACL specification process described in the Omnibus Amendment 1-4 (76 FR 37285, June 27, 2011) for fishing year 2012-2013. A post-season accountability measure was chosen recognizing that in-season accountability measure is currently not possible for the Pacific Island areas due to limited capacity in conducting near-real time monitoring.

None of the proposed ACLs would change the fishery or have adverse effects on target or no-target species, marine mammals, sea turtles, or seabirds. None of the proposed ACLs are expected to result in adverse impacts to any designated Essential Fish Habitat or other marine protected areas. Since majority of the coral reef fishery occurs within the 3 nm boundary any socio-economic impact brought about by this new management measure will be minimal (applies only to federal waters). The specification of an ACL is expected to provide for sustainable harvest of bottomfish while preventing overfishing from occurring which would have positive long-term impacts on fishery participants and the fishing communities.

Table of Contents

List of Tables

List of Figures

Appendices

Acronyms and Abbreviations

ABC – Acceptable Biological Catch
ACL – Annual Catch Limit
ACT – Annual Catch Target
AM – Accountability Measure
BMUS – Bottomfish Management Unit Species
Council – Western Pacific Regional Fishery Management Council
CPUE – Catch Per Unit of Effort
CREMUS – Coral Reef Management Unit Species
Hawaii DLNR – Hawaii Department of Land and Natural Resources

EA – Environmental Assessment
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
NMFS – National Marine Fisheries Serice
NWHI – Northwestern Hawaiian Islands
OFL – Overfishing Limit
P* – Acceptable Risk or Probability of Overfishing
PIFSC – NMFS Pacific Islands Fisheries Science Center
SDC – Status Determination Criteria
SSC – Scientific and Statistical Committee
TAC – Total Allowable Cat

Background Information

The 2006 Reauthorization of the Magnuson-Stevens Act required that Regional Fishery Management Councils (RFMC) develop annual catch limits for each of its managed fisheries that may not exceed the fishing level recommendations of its scientific and statistical committee (SSC) or peer review process. Moreover, Councils were required to amend their fishery management plans to establish a mechanism for specifying annual catch limits at a level such that overfishing does not occur in the fishery, including measures to ensure accountability.

The process by which annual catch limits will be implemented has been the focus of much attention by the National Marine Fisheries Service (NMFS) and the Councils through the National SSC Workshops which were convened each year in 2008 to 2010.

The MSA further directs that, unless otherwise provided for under an international agreement to which the U.S. participates, this mechanism must be established by 2010 for fisheries subject to overfishing, and by 2011 for all other fisheries. On January 16, 2009, the National Marine Fisheries Service (NMFS) published advisory guidelines under 50 CFR §600.310 (74 FR 3178) to assist RFMCs in implementing ACL and AM requirements.

To comply with the ACL and AM requirements, the Western Pacific Fishery Management Council (Council), in coordination with NMFS, prepared an omnibus amendment to the Fishery Ecosystem Plans (FEP) for American Samoa, Hawaii, the Mariana Archipelago (Guam and the Commonwealth of the Northern Mariana Islands (CNMI)), Pacific Remote Island Areas, and Pacific Pelagic fisheries. The amendment describes the mechanism the Council will use to specify ACLs and AMs for each FEP fishery. This includes:

1) Establishing a mechanism in each FEP that the Council will use to determine ACLs and AMs , including a process for setting acceptable biological catch limits (ABCs);

2) Adopt the ecosystem component (EC) species classification described in the NMFS advisory guidelines for National Standard 1 (NS1) so the Council can develop specific criteria for identifying EC species in subsequent amendments to the FEPs; and

3) Identify pelagic management unit species that have statutory exceptions to the ACL and AM requirements. The ACL and AM mechanism is designed to ensure long term sustainability of the fishery resources under the Council's jurisdiction.

Annual Catch Limits for Coral Reef Fisheries

Among the more difficult stocks of fish to be managed through catch limits are coral reef fish. Coral reef fish landings are highly diverse, with up to 700 species appearing in the Guam and Northern Mariana Islands catch records. While high species diversity is not confined to coral reef fish—West Coast rock fish number in excess of 70 species—reef fisheries are multi-gear fisheries with widely overlapping catch compositions, and with multiple landing sites.

In Guam, Northern Mariana Islands and American Samoa, reef fisheries are sampled by creel intercept surveys of shoreline and boat-based fishing, from which expansions are generated to give annual catches. Samples of catch and effort are small relative to the volume of fishing and expansions thus have wide error distributions. On the other hand, the creel surveys record all fishing so include commercial and non-commercial catches. In Hawaii, all commercial fishermen have to obtain a commercial marine license and submit monthly catch report to the Division of Aquatic Resources, so commercial reef fish catches may be more complete than in other locations. Recreational and subsistence reef fish catches are recorded in the Hawaii Marine Recreational Fisheries Survey (HMRFS) which again is a small sample of the overall effort

In all locations, most reef fish are caught within the coastal zone, either from shore or boats operating along the margins of coastal coral reefs. Fishing does take place, however on offshore banks and reefs but it is currently difficult if not impossible to separate catches between federal and state/territorial waters except for commercial landings in Hawaii. Nonetheless, the requirements for annual catch limits include consideration of all catch and the parsing out of the federal component with respect to setting catch limits. Furthermore, the nature of the coral reef fishery in these island areas is mostly subsistence and recreational with some practicing cultural takes for traditional practices particularly for weddings and funerals. The proportion of commercial from non-commercial harvest is largely unknown. The proportion of the catch landings of each of the primary reef fish families being harvested relative to its respective biomass estimates from underwater visual census surveys (Williams 2010) showed a only a small harvest mortality compared to the large volume of reef fish available for the fishery (Luck and Dalzell 2010). The coral reef fisheries in these island areas are also not highly selective towards a single species. It is characterized by multi-gear harvesting multi-species. Therefore, there is no selective targeted fishery for sharks and other species of concern. If these assemblages became accessible at a given space and time then fishermen rise up to the unique opportunity.

In addition to the operational difficulties in catch recording and monitoring, the vast majority of reef fish have not been studied for life history and demographic parameters. Age and growth rates, longevity and the ages at which reef fish achieve their maximum size and size at maturity provide clues as to their resiliency to fishing. Moreover, estimation of the natural mortality rate, allied to virgin or lightly fished biomass estimates, may provide initial estimates of sustainable yields. Estimation of catch limits for reef fish based on average catches may grossly under or overestimate productivity, and being averages are likely to be exceeded in some years. Further, the federal authority to set limits on reef fish catches may be limited, especially if the majority of catch comes from within the state or territory waters.

The Western Pacific Regional Fishery Management Council had convened a workshop on "Establishing Annual Catch Limits for Coral Reef Fisheries in the Western Pacific Region" from February 1 to 4, 2011 at the Council Office Conference Room. The workshop participants formulated a prioritized set of actions based on the presentations and scientific discussions. Part of the actions was to analyze the fishery dependent data and determine the species that make up 90% of the total catch to determine which species are subject to risk of overfishing. The logic is that targeted or highly harvested species are more at risk than those that are caught in small numbers. However, this assumption does not apply for species that are naturally in low numbers or are rare that even low level of removal can cause a decline in the stock. These species will automatically be separated out and will be dealt with independently.

The process by which the Council will specify ACLs and Accountability Measures on species under the Fishery Ecosystem Plans is described in the Omnibus Amendment document. The Amendment documents also described the process by which ACLs are to be determined if the stock is classified as a Tier 5 stock (a data poor stock with only a time series of catch is available). The coral reef fishery is considered under Tier 5 thus the ABCs will be determined using a certain measure of central tendency and variability over the time series of catch information as guided by (but not limited to) Restrepo et al. 1998. The options presented in this paper are the first among a series of step towards determining actual numbers for ACLs determination for the coral reef fishery in the Western Pacific.

Annual Catch Limit and Accountability Measure Mechanism

In 2006, the MSA was reauthorized and required regional fishery management councils to amend their fishery management plans (FMP) to include a mechanism for specifying ACLs for all fisheries at a level such that overfishing does not occur, and to implement measures to ensure accountability (AM) for adhering to the catch limits. In response to the ACL requirement, the Council amended its five FEPs, (American Samoa, Northern Mariana Islands, Hawaii, Pacific Remote Island Areas and Pelagics) to establish a mechanism for specifying ACLs and AMs in western Pacific fisheries (76 FR 37285, June 27, 2011).

Pursuant to Amendment 1-3 (76 FR 14367, March 16, 2011), there are three required elements in the ACL mechanism. The first requires the Council's SSC to calculate an acceptable biological catch (ABC) that is set at or below the stock's overfishing limit (OFL). For stocks like the Hawaii bottomfish stocks that have estimates of maximum sustainable yield (MSY) and other MSY-based reference points derived from statistically-based stock assessment models (Tier 1-3 quality data), the ABC is calculated by the SSC based on an ABC control rule that accounts for scientific uncertainty in the estimate of the OFL, and the acceptable level of risk (as determined by the Council) that catch equal to the ABC would result in overfishing. However, the coral reef fish stocks for all island areas lack stock assessments thus have no MSY estimates. These are considered Tier 5 stocks where only catch time series are available. In this case, a qualitative approach based on expert opinion and group consensus (such as described in Restrepo et al. 1998) would be used to determine ABCs based on a measure to define recent catch.

The second element requires the Council to determine an ACL that may not exceed the SSC-recommended ABC. Amendment 1-3 includes methods by which the ACL may be reduced from the ABC based on social, economic, ecological, and management uncertainty (SEEM) considerations. An ACL set below the ABC further reduces the probability that actual catch will exceed the OFL and result in overfishing; however, the ACL may be set equal to ABC if an annual catch target (ACT) is used.

The third and final element in the ACL mechanism is the inclusion of AMs. AMs prevent ACLs from being exceeded and correct or mitigate overages of ACLs if they occur. For example, AMs may include, but are not limited to, closing the fishery, closing specific areas, changing bag limits, or other methods to reduce catch. An 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 mechanism of ACLs and AMs 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 mechanism, see Amendment 1-3 to the all FEPs (76 FR 14367, March 16, 2011) and the final implementing regulations (76 FR 37285, June 27, 2011).

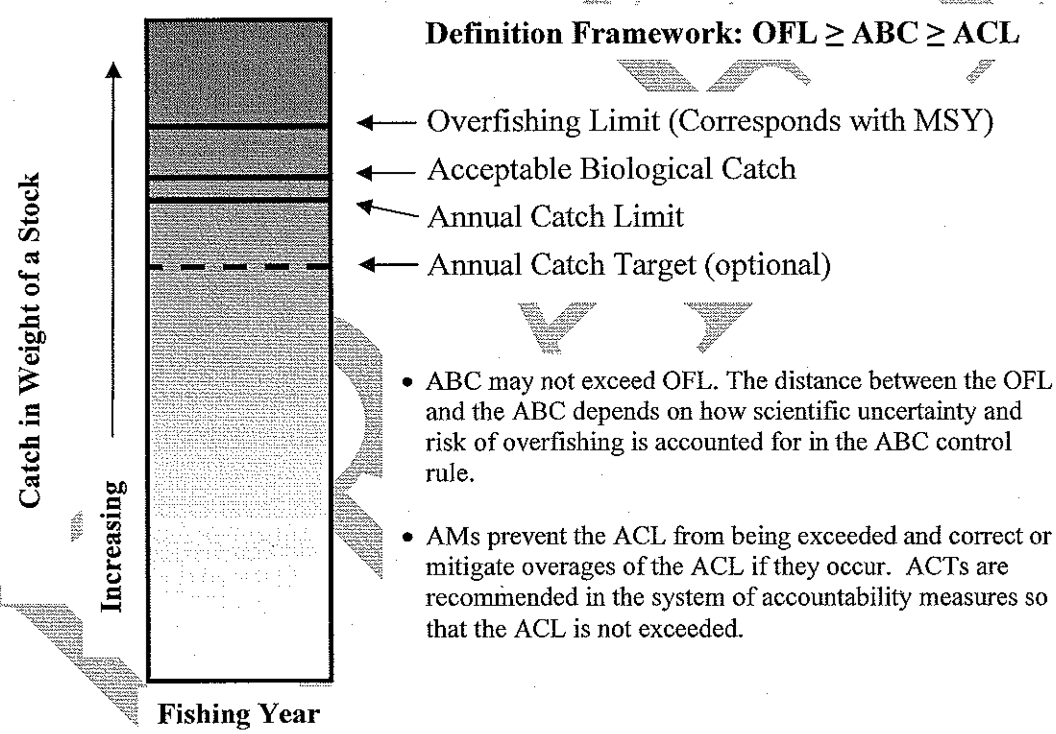

Figure 1. Relationship between OFL, ABC, ACL, and ACT.

Purpose and Need

Provisions of the American Samoa, Guam, Northern Mariana Islands, and Hawaii FEP requires NMFS to specify an ACL for species listed as coral reef management unit species (CREMUS) as recommended by the Council as well as requires AMs to be implemented to ensure the ACL is not exceeded and correct or mitigate overages of ACLs if they occur. The fishery management objective is to specify an ACL and AMs that will prevent overfishing from occurring, and ensure long-term sustainability of coral reef fish stocks.

Proposed Action

The proposed federal action is the specification of ACLs and AMs for the Coral Reef Management Unit Species in the American Samoa, Guam, Northern Marianas and Hawaii for the 2012 fishing year. No ACLs will be specified for the coral reef fish stocks in the Pacific Remote Island Areas (PRIAs) because: 1) the area had been declared as a Monument through Presidential Proclamation 8336 thus there is currently no existing fishery in the area; and 2) there is no fishery data is available to the Council from which the ABCs and ACLs can be derived from. However, the Council would appreciate if NMFS could verify with the US Fish and Wildlife Service if such fishery data exist within their jurisdiction. The fishing year for coral reef fishery starts on January 1, 2012, and ends on December 31, 2012. Catches to be counted towards the ACL would be calculated from the opening of the fishery.

There is no mandatory catch reporting for commercial fisherman in all of the island areas under the WPRFMC jurisdiction except for the State of Hawaii. Creel surveys are used to estimate the amount of commercial and subsistence landing in American Samoa, Guam and CNMI. These creel survey-based sampling provide rough estimates of catch, effort and CPUE which are then expanded to come up with an approximation of the total landing in areas covered by the survey. The various stages by which the data go through is a long process before the expanded catch data is estimated. The scaricity of data on a detailed level limits the ability to create a monthly expansion without sacrificing the credibility of the results thus the expansion of the catch, effort and CPUE data are done on an annual basis. The expansion is only done on an annual basis because monthly expansions are not possible due to scarcity of data. This technicality and due to the limited catch monitoring capacity of the local resource agencies that are in charge of fishery data collection, an in-season AM involving real-time monitoring and catch projection is not possible. As for the State of Hawaii that is currently "fast-tracking" the monthly catch reports (which is being looked at as an in-season monitoring) for the TAC of the bottomfish fishery, they consider that operation already at its maximum and can no longer take in additional fast tracking activities for ACL purposes. A significant factor that they are able to do this for the bottomfish fishery is the support from contractors of the PIFSC. Without them this will not be possible. Current and future budget shortfalls would make this operation more challenging. The most amenable option is a post season accounting of the catch and evaluation if the ACLs had been exceeded. If the catch exceeded the ACL the Council's Plan Team will determine the reason for the overage and recommend to the Council to correct the operational issue that caused the ACL overage, as well as any biological consequences to the stock or complexes resulting from the overage when it is known. The Council can apply an overage adjustment when necessary.

The Council concurred with the SSC to utilize family level aggregations for coral reef fin fish to reduce the number of ACL specifications and limit the specifications to the top 90% of the total coral reef fish catch. The taxa comprising the remaining 10% will be grouped into one complex as minor fishery components with a single ABC. The Council further recommended that species that are particularly rare or vulnerable will have a separate ACL for each. The vulnerable species was identified as Napoleon wrasse (*Cheilinus undulatus*), bumphead parrotfish (*Bolbometopon muricatum*), and reef sharks as determined by the Council. The 75th percentile of the entire catch history for each family was used to define "Recent Catch" when applying the Tier 5 control rule. The Council also concurred with the SSC's rationale for multiplying "Recent Catch" (here defined as the 75th percentile) by the multiplier of 1.0 to calculate the ABC for the coral reef family groupings as provided for in the Tier 5 control rule The Council noted that although coral reef taxa are Tier 5 and most lack estimates of MSY, stock biomass (B) 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). While MSY is unknown, setting ACL equal to ABC is consistent with NMFS approach to setting ABC for Only Reliable Catch Stocks (ORCS) and would prevent excessive increases in catch. Therefore the Council further recommended that ACL for each family be set equal to the ABC based on the above mentioned rationale. For the Hawaii opelu (*Decapterus macarellus*) and akule (*Selar crumenopthalmus*) where MSY has been estimated through a research study by Weng and Sibert (2000), the SSC had set ABC equal to MSY and the Council further recommended ACL equal to ABC.

Decision to be Made

After considering public comments on the proposed ACL alternatives, NMFS, as recommended by the Council, will specify an ACL for the coral reef management unit species complex for fishing year 2012, including a post season AM to minimize exceeding ACLs in longer terms.

Public Involvement

At its 151st meeting, the Council considered and discussed issues relevant to the 2012 Coral Reef Fish ACLs and AMs. The 107th SSC meeting held June 13-15, 2011 and the 151nd Council meeting held June 15-18, 2011, were both open to the public and advertised in Hawaii media as well as the Federal Register (76 FR 37285, June 27, 2011).

Description of the Alternatives

The alternatives considered in this EA are limited to ACL and AMs as they are the management measures to be applied to the fishery for the coral reef management unit species. Although the OFL and ABC are part of the ACL mechanism, the establishment of these reference points is not part of the proposed federal action, but is described for informational purposes.

Development of the Alternatives

Determining level of species aggregations

The level of species aggregation would enable reduction of the number of ACL specifications that needs to be made by grouping species by analogous life history strategy, vulnerability to the fishery, habitat occupancy, ecological and biological characteristics consistent with the FEPs. The levels of aggregation considered here is family level grouping with provisos of limiting the specification to groups that comprise the top 90% of the total catch with the apriori assumption that these are the groups that frequently interact with the fishery and most likely going to be harvested in a higher rate than the other groups which can be considered as incidental or minor portion of the catch.

In its 107th meeting, the SSC chose to apply ***ACLs on a family level aggregation that comprise the top 90% of the coral reef fish catch***. Under this scenario, all coral reef ecosystem MUS that comprise the top 90% of the coral reef fish catch will be grouped to family level while the remaining 10% will be grouped into a single multi-species stock complex for the purpose of setting ACLs. This will be done for each of the FEP area with Guam and CNMI treated separately. To accomplish this, for each year in the available time series, the individual species under the coral reef MUS would be pooled to their respective taxonomic families. This exercise was done by the Coral Reef Ecosystem Plan Team for the purpose of annual monitoring and reporting on the status of the coral reef MUS. This result in the pooling of the corresponding catch landing for all the species into one family level catch upon which the expansion algorithm will be applied (depending on the method used to catch the fish) to come up with an expanded family level catch. Percentage contribution of each family was calculated relative to the total CREMUS landing and sorted to decreasing value. Cumulative percentages were calculated by adding the respective percentage contribution with the succeeding value until the 90% cut-off was reached. The remaining 10% would be grouped into one multi-species stock complex and will be treated as a minor part of the catch. The assumption here is that the top 90% is the component of the CREMUS that is vulnerable to overfishing while the remaining 10% is otherwise. The 10% group is also characterized by species that intermittently appear in the catch based on the percent occurrence in the catch time series. Using these values, the SSC would apply the Tier 5 ABC control rule to recommend an ABC for the coral reef ecosystem stock complex of each FEP area upon which the Council would set an ACL.

In considering the use of stock complex aggregations with respect to data-poor species, the National SSC-ORCS Working Group (Berkson, et al. 2011) pointed out that the setting of ABCs for the complex as a whole should take into account more vulnerable stocks within the complex, noting: "… *An important consideration in the use of stock complexes for management of data poor species is that the catch of individual species within the complex is not monitored or controlled in-season. Consequently there is additional uncertainty associated with management by stock complexes that is not present when stocks are managed independently. If the objective is precautionary management, it may be necessary to build some additional conservatism into the system to account for the additional uncertainty associated with management using stock complexes…* " In order to comply with this recommendation, vulnerable species such as the humphead wrasse, bumphead parrotfish, and reef sharks were separated from their respective families and will have a separate ACL specification. Aside from separting the vulnerable species, grouping the species into taxonomic family minimizes mixing of extremely different species into a single stock comples. Taxonomic family grouping considers similarity in life history strategy, morphological, biological and ecological characteristics although we still recognized that there is still some degree of differences between species within a family. Additional measures were taken in order to reduce the scientific uncertainty by conducting temporal trend analysis of fish length of representative species, size frequency distribution analysis of the catch and underwater census data, comparative regression analysis of the fish length time series data from catch and UVC, catch to biomass ratio, and proxy MSST calculation. Any signal indicating that there is a problem with the species or family groups based on these series of analysis then a more conservative and precautionary approach will be used when specifying ABCs and ACLs.

Under this approach, the family level aggregation of the top 90% and the multispecies stock complex that comprise the remaining 10% would be used to establish limits and reference points for each area, consistent with the overfishing provisions for coral reef fisheries as described in each archipelagic FEP.

Pros

Provides higher resolution than a single aggregated MUS and may provide a better biological and ecological characterization. Does not increase the monitoring burden because the catch reporting is summarized on a family level. Provides an optimum level of estimating catch to biomass ratio as an estimate of mortality by limiting the fished and unfished species on a family level. Catch to biomass information is already available. Expanded catch data from creel survey is also available. The assumption that the top 90% is more vulnerable to overfishing than the remaining 10% is a tolerable assumption. Reduces the number of groups that need specification. Provides fisherman some buffer in terms of selecting which groups to targets once one of the families is approaching it's catch limit.

Cons

This will increase the number of ACLs that needs to be specified:

Am. Samoa = 12
CNMI = 12
Hawaii = 12 (Family); 16 (CREMUS)
Guam = 18

Cannot maximize the use of life history, CPUE, size structure information. Size structure information will be affect mostly by the species composition within the family. The fishing pressure can still increase on a particular species and could cause it to become overfished without any indications in the overall landing trends. Changes in biomass, abundance and size over time (as an indicator if population status) cannot be directly compared with the harvested stock and would depend on what is dominant in the family. The biomass are not estimated on an annual basis, thus it is not feasible to assess the stock status on an annual basis if using biomass as a measure for stock abundance. Annual assessments are needed as part of the accountability measure.

The time series of catches of the CREMUS groupings (in families) generated by the Western Pacific Fishery Information Network was used to calculate the top 90% of the total coral reef fish catch and binning of the remaining 10%. The sum of the catch for the whole time series for each CREMUS family was calculated and was subsequently divided with the total of all CREMUS families. Each ratio was converted to percentage by multiplying with 100 and the percentage landing was sorted to decreasing order. The cumulative percentage was calculated by adding the percentage landing with the landing of subsequent family until 90% was reached. The remaining groups were aggregated into a single species complex comprising the remaining 10% of the total catch and regarded as the minor fishery catches. The CREMUS groupings contained general categories like "other fin fish", "other invertebrates", "miscellaneous reef fish", and "miscellaneous shallow bottomfish" which are regarded as dump bins for fish that are not associated with the major families in the reef fish families and fish that were not identified. If these categories fell on the top 90% of the catch, it was replaced by a number of families of reef fishes that has the same percentage landing as this general category. The rationale behind moving this general category down was the creation of this category was not based on any taxonomic or biological reason and therefore is not a true stock complex.

All of the families under the coral reef MUS is almost entirely associated with coral reef indicating that they occur in similar geographic distribution. Aggregating the coral reef MUS is currently the most optimal level of aggregation to partly ensure consistency in life history strategies, ecological and biological characteristics. The vulnerability of each family will vary depending on the method being used to harvest the individuals. The coral reef fishery as a whole is multi-gear and multi-species in nature. Normally, one reef fish family will interact with two or more types of fishing gear and similarly one fishing gear can harvest fish from multiple families. Therefore, the vulnerability will vary depending on the gear used. Lutjanid snappers and groupers are both harvested in the boat based bottomfishing gear and shore based spearfishing whereas Carangid jacks are harvested in boat based bottomfishing and shore based rod and reel fishery.

National Standard 1 allows for the establishment of stock complexes comprised of several stocks without an indicator stock with SDC and an ACL for the complex as a whole. The remaining 10% of the coral reef MUS has similar vulnerabilities overall since they comprise the minor catches in the fishery. These groups are usually landed in small amounts and this group is comprised of generic categories such as miscellaneous reef fish where individuals counted was not identified with any of the major families being landed.

The table below shows the results of the species aggregation for each of the island areas:

Table 1. Families and stand alone species that comprise the top 90% of the total coral reef catches in American Samoa, Guam, CNMI and Hawaii.

Families	**Am. Samoa**	**Guam**	**CNMI**	**Hawaii**
Acanthuridae – surgeonfish	X	X	X	X
Lutjanidae – snappers	X	X	X	X
S. crumenopthalmus – atule	X	X	X	X
D. macarellus – opelu				X
Carangidae – jacks	X	X	X	X
Lethrinidae – emperors	X	X	X	
Scaridae* – parrotfish	X	X	X	
Serranidae – groupers	X	X	X	
Holocentridae – squirrelfish	X	X		X
Mullidae – goatfish		X	X	
Mugilidae – mullets	X	X	X	X
Siganidae – rabbitfish		X	X	
Kyphosidae – chubs/rudderfish		X		
Labridae** – wrasses		X		
Mollusk*** – turbo snail; octopus; clams	X	X	X	X
Crustacean*** – crabs	X	X		X
Remaining 10%	X	X	X	X

NOTE:

*	Family Scaridae does not include *Bolbometopon muricatum* (bumphead parrotfish)
**	Family Labridae does not include *Cheilinus undulatus* (humphead wrasse)
***	Mollusk is covered by another complimentary ACL specification document
****	Does not cover lobsters and kona crab in this document

Table 2. Total catch landing (from 1990-2008), percentage landings, and cumulative percentage of the CREMUS families in American Samoa

CREMUS Group	Total	% landing	Cumulative %
Acanthuridae – surgeonfish	308,950	15.43	15.43
Lutjanidae – snappers	301,148	15.04	30.46
Selar crumenopthalmus – atule	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	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 – squirrelfish	52,418	2.62	90.27
Mugilidae – mullets	42,864	2.14	92.42
Misc. Bottomfish	38,668	1.93	94.35
Misc. Reef fish	38,084	1.90	96.25
Crustaceans - crabs	37,369	1.87	98.11
Labridae – wrasses	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 wrasse	32	0.00	100.00
Misc. Shallow bottomfish	0	0.00	100.00
Bolbometopon muricatum – bumphead parrotfish	0	0.00	100.00

Table 3. Total catch landing (from 2000-2008), percentage landings, and cumulative percentage of the CREMUS families in the Commonwealth of Northern Mariana Islands

CREMUS Group	Total	% 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 crumenopthalmus – atule	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	29,156	4.38	85.30
Other 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 – squirrelfish	11,761	1.77	97.58
Labridae – wrasses	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 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

Table 4. Total catch landing (from 1985-2008), percentage landings, and cumulative percentage of the CREMUS families in Guam

CREMUS Group	Total	% landing	Cumulative %
Acanthuridae – surgeonfish	1,422,263	15.45	15.45
Carangidae – jacks	930,127	10.11	25.56
Selar crumenopthalmus – atule	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	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 – squirrelfish	146,054	1.59	95.04
Reef Sharks	143,925	1.56	96.61
Algae	118,662	1.29	97.89
Labridae – wrasses	92,529	1.01	98.90
Cheilinus undulatus – humphead 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

Table 5. Total catch landing (from 1985-2008), percentage landings, and cumulative percentage of the CREMUS families in Hawaii

CREMUS Group	Total	% landing	Cumulative %
Selar crumenopthalmus – atule	33,559,719	37.10	37
Decapterus macarellus - opelu	16,302,192	18.02	55
Carangidae – jacks	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	2,094,208	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
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 wrasse	0	0.00	100
Reef Sharks	0	0.00	100

Appendix 1 shows the species included each of the coral reef fish families. Bottomfish MUS will be covered by a separate ACL specification document. Deep and shallow water BMUS was removed from CREMUS estimates (Table 6)

Table 6. List of bottomfish management unit species that was not included in the CREMUS ACL specification even if the shallow water component of these BMUS is technically coral reef fish. These species will be dealt with in a separate ACL specification document

Species name	Common name	Deep or shallow component
Aphareus rutilans	Silvermouth jobfish	Deep
Aprion virescens	Gray jobfish	Shallow
Caranx ignobilis	Giant trevally	Shallow
Caranx lugubris	Black trevally	Deep
Epinephelus fasciatus	Black tip grouper	Shallow
Etelis carbunculus	Ehu	Deep
Etelis coruscans	Onaga	Deep
Lethrinus amboinensis	Ambon emperor	Shallow

Lethrinus rubrioperculatus	Redgill emperor	Shallow
Lutjanus kasmira	Blue line snapper	Shallow
Pristipomoides auricilla	Yellowtail snapper	Deep
Pristipomoides filamentosus	Opakapaka	Deep
Pristipomoides flavipinnis	Yelloweye opakapaka	Deep
Pristipomoides seiboldi	Kalekale	Deep
Pristipomoides zonatus	Gindai	Deep
Seriola dumerili	Amberjack	Shallow
Variola louti	Lunartail grouper	Deep

Estimation of OFL

Being a Tier 5 stock, most of the coral reef fishes do not have estimates of MSY and therefore the OFL cannot be determined. However, there are some numbers in the technical report literature for MSY of parrotfish in American Samoa (Page 1998), akule and opelu for Hawaii (Weng and Sibert 2000). These MSY were not used as proxy OFL value because it is not a formal stock assessment that undergone the proper peer-review process set by the Council. Hence these species still remain as Tier 5 stocks.

Calculation of ABC

Amendment 1-3 of the Pacific Remote Island Areas, American Samoa, Mariana, and Hawaii Archipelagoes described Tier 5 as a data poor stock where most of the coral reef fish stocks belongs in which there are no MSY estimates for any of the stocks and only a time series of catch data are available. The catch time series is characterized by a lack of a stable period since the fishery is inherently variable depending on the local conditions of the fishery and the consistency of data collection. In American Samoa, for example, the boat-based spearfishery prior to 1994 mostly utilizes snorkel to harvest shallow water fishes mostly parrotfish and surgeonfish. With the introduction of SCUBA to the fishery in 1994, it resulted in a dramatic increase in CPUE and catch and reached a peak in 1997 and had declined back to its pre-SCUBA levels by 2002 when the ban on SCUBA-assisted spearfishing was put in place. The decline however was not due to a decline in stock but a local regulation by DMWR that forbids none-American Samoan to engage in this fishery that displaced majority of SCUBA spearfisher who were from Tonga. During this same period, there was no-inshore creel surveys being conducted thus the catch landing information were mostly from boat-based creel surveys rendering the data being an underestimate. The coverage of the inshore data collection also changed expanding from the central region of Tutuila (1980's) to cover the western and eastern region of the island (1990 to 1995 and 2001 onwards) This is probably one of the most well documented fisheries in American Samoa. Therefore selecting a segment of the time series without prior knowledge of the local conditions could infuse bias towards setting any ABCs on a particular stock. This was the rationale for using the entire time series to define "recent catch" in lieu of selecting a "time period where there is no quantitative or qualitative evidence of declining abundance". By using the entire time series, one can therefore incorporate the peaks and troughs brought about by positive and negative changes in the fishery and changes in the data collection.

Once the universe of stocks has been defined, the SSC was presented an array of means of the catch estimates upon which the Tier 5 Control Rule will be applied. There are several metrics to choose from but generally choosing between using: 1) an arithmetic mean; 2) an arithmetic mean with 1 standard deviations above the mean; 3) an arithmetic mean with 2 standard deviations above the mean; 4) a geometric mean (one tailed mean); 5) the 75th percentile; and 6) 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 mean incorporates the variabilities and uncertainties above the mean. The 75th percentile is the value of an array (in this case a catch time series) below which 75% of the observations may be found, and similarly with the 95th percentile with 95% of the data. The 75th percentile was the preferred alternative by the SSC instead of the long-term median (which is the same as 50th percentile).

The series of table below showed the alternatives for possible ABCs for the coral reef fin fish in American Samoa, Guam, CNMI, and Hawaii using the six metrics described above.

Table 7. Alternatives for the acceptable biological catches for the coral reef fin fishes in American Samoa using arithmetic mean, 1 standard deviation above the mean, 2 standard deviation above the mean, geometric mean (one tailed mean), 75th percentile, and 95th percentile.

Family	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	21,607	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	10,868	17,077
Emperor	7,667	4,509	12,175	16,684	6,185	10,255	15,112
Parrotfish*	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	7,632	8,756
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	1,868	1,390	3,259	4,649	1,473	2,136	4,549
Remaining 10%	14,991	7,806	22,797	30,603	12,798	18,910	27,287

NOTE: * excludes Bolbometopon muricatum (bumphead parrotfish)

Table 8. Alternatives for the acceptable biological catches for the coral reef fin fishes in the Commonwealth of Northern Mariana Island using arithmetic mean, 1 standard deviation above the mean, 2 standard deviation above the mean, geometric mean (one tailed mean), 75th percentile and 95th percentile.

Family	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*	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
Remaining 10%	6,120	4,215	10,336	14,551	4,701	9,820	11,778

NOTE: * excludes Bolbometopon muricatum (bumphead parrotfish)

Table 9. Alternatives for the acceptable biological catches for the coral reef fin fishes in Guam using arithmetic mean, 1 standard deviation above the mean, 2 standard deviation above the mean, geometric mean (one tailed mean), 75th percentile, and 95th percentile under the different species aggregation scenarios.

Family	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*	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	4,294	2,623	6,916	9,539	3,642	5,523	8,932
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**	3,855	2,613	6,469	9,082	3,001	5,195	8,184
Other CREMUS***	55,657	30,700	86,357	117,057	47,797	83,214	109,806

NOTE:

* excludes Bolbometopon muricatum (bumphead parrotfish)
** excludes Cheilinus undulatus (humphead wrasse)
*** includes uni'd fish and other sp. and comprise the remaining 15% of the CREMUS catch

Table 10. Alternatives for the acceptable biological catches for the coral reef fin fishes in Hawaii using arithmetic mean, 1 standard deviation above the mean, 2 standard deviation above the mean, geometric mean (one tailed mean), 75th percentile, and 95th percentile under the different species aggregation scenraios.

Family	Arithmetic mean + SD				Geometric mean & percentile		
	Mean	StDev	1SD>mean	2SD>mean	Geomean	75th_%ile	95th_%ile
Atule	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	259,588	314,858	401,522
Jacks	157,826	53,671	211,497	265,168	148,840	190,423	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
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
Snappers	34,903	32,326	67,229	99,555	7,927	65,102	79,783
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

Justification for using 75th percentile in lieu of stock status determination criteria (SDCs): There are currently no official stock status determination criteria for any of the coral reef fish for all of the island areas. Creating SDCs on hundreds of coral reef fish species based on CPUE trends of different fishing method would be overly burdensome and often times the data is too variable that discerning any trends would be subject to limited conclusions. Hawhee (2007) attempted to create SDCs for the coral reef fishery in the Mariana Islands (Guam and CNMI), American Samoa and Hawaii for Inshore and offshore fisheries. In Guam, there were 346 and 149 gear/species combinations for the inshore and offshore fisheries, respectively. ACLs would only apply to the federal portions and will likely affect the offshore fisheries which according to Hawhee showed a general increase in catch, effort and CPUE in which breach to the limit reference points (MSST and B_{flag}) were largely avoided except for the night light fishery for *Selar crumenopthalmus* which is a pulse fishery thus the decline may be open to some interpretation. For CNMI, CPUE were shown to be decreasing with constant catch from 1985 to 2004 but since there were no gear information no reference points were generated. For American Samoa, the CPUE trends were increasing since 1991. There were no reference points generated for the American Samoa CREMUS. Hawaii had shown a slight increase in aggregated CREMUS catch over the whole time series with concurrent decrease in fishing effort resulting in an increase in CPUE. Two hundred twenty two gear/species combination exist of which only 26% is below Bflag and only 19% below MSST.

If individual SDCs would be used for specifying ABCs this would result in 717 species by gear ABC specifications for Guam and Hawaii alone and none for American Samoa and CNMI. Family level SDCs are also not available which can be used to reduce the number of specifications. The Council took a simplistic approach that will be consistent across all island areas which is to use the 75th percentile of the entire catch history as an ABC reference limit. The 75th percentile is a non-parametric approach compared to arithmetic and geometric mean. Utilizing means would be inappropriate since catches (in this case is the only available data) since these tend to assume central tendencies and normality which are mostly violated in cases where there is large variabilities. The Amendment document specified using "long-term median catch history" for Tier 5 stocks which is also the same as 50th percentile (median) of the entire time series. Using the 75th percentile is consistent with the Amendment document and can be regarded as a robust measure when comparing to a know reference limit. In the case of the 2011 MHI deep 7 bottomfish, the MSY was estimated at 383,000 lbs. The ACL specification document described ACL will be set equal to ABC at 346,000 lbs further lowered to an ACT of 325,000 lbs. Using the same data set from which MSY was derived, the 75th percentile of the entire catch time series yield a value of 321,000 lbs which is close to the proposed ACT. Another example is Page (1998) where he estimated the MSY for parrotfish in American Samoa to be at 118,796 lbs (53.9 mt) and the 75th percentile of the entire catch series for parrotfish is 8,145 lbs which is 6.8% of MSY. The 75th percentile is still conservative given that the level of extraction relative to the biomass is low (Luck and Dalzell 2010; Sabater and Tulafono 2011).

Justification for using 1 x recent catch (in this case 75th percentile of the entire catch time series) scenario for setting ABCs: There was no B_{msy} information available for most of the coral reef fish species from which current biomass can be compared to. Pristine biomass can no longer be determined since the reefs had been already fished for several millennia and therefore the current stock is already reduced. This reduced biomass relative to pristine condition is open for further investigation. However, since effort decreased while catch (Sabater and Carroll 2009) and CPUE (Sabater and Tulafono 2011) had been constant over the years, it is not a far fetched assumption that the coral reef fishery is fishing at MSY. If we assume that the current archipelagic biomass for each family as biomass at MSY of the stock and set half of which to be the minimum stock size threshold (MSST: the minimum stock size at which rebuilding to the MSY level would be expected to occur within 10 years if the stock or stock complex were exploited at the maximum fishing mortality threshold), the level of extraction when ABC is set at 1 x 75th percentile will result in a biomass level significantly above MSST even if you double to five times the ABC specification for some reef fish families (Figure 2 to 9: the estimated remaining stock size is estimated by subtracting the ABC value from the standing biomass and ABC was increased linearly to a factor of five to simulate removal at different ABC scenarios). The problematic families where attention should be given are emperors, jacks, and soldierfish. 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.

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.

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.

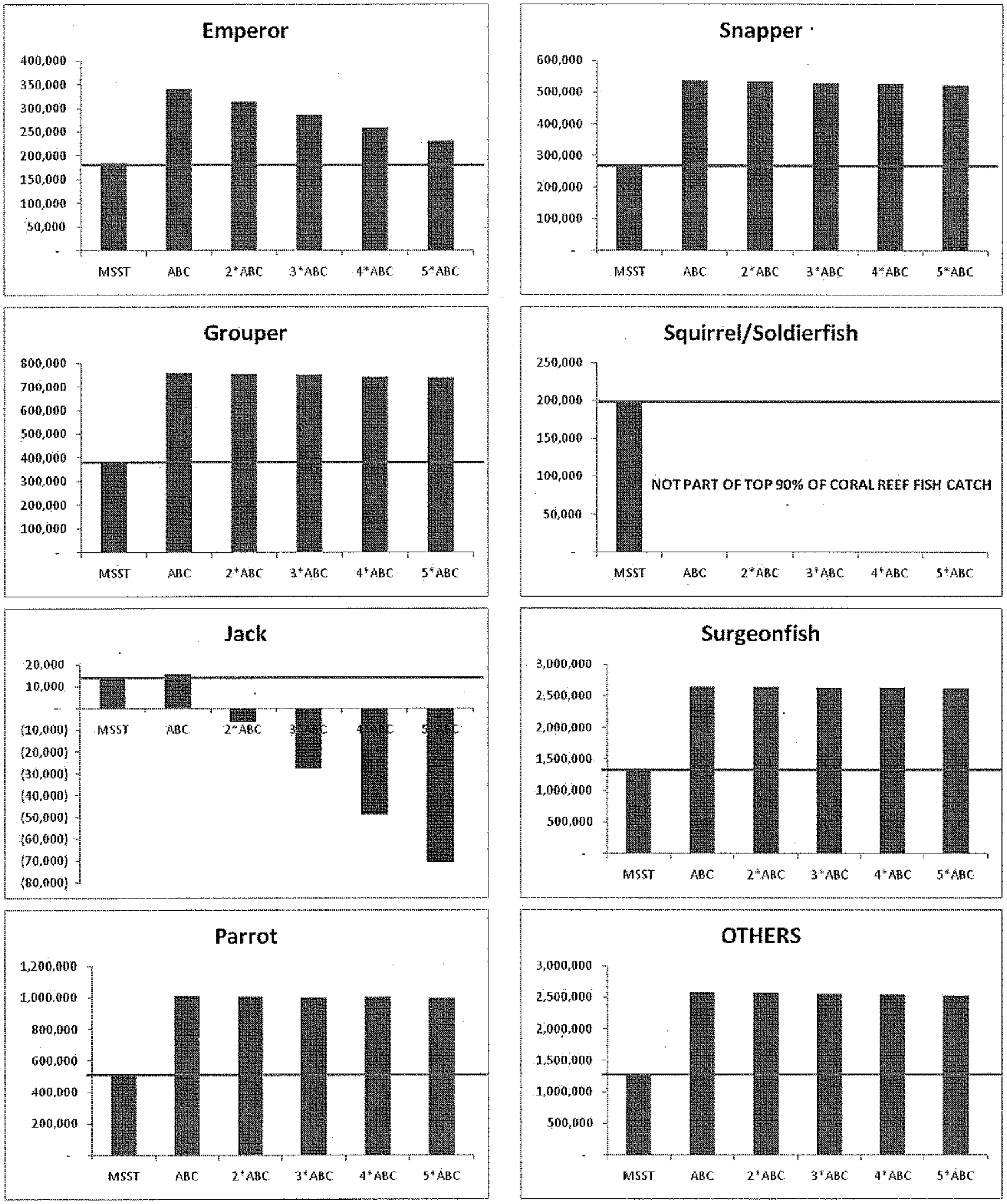

Figure 2. CNMI coral reef fin fish MSST vs and stock size at ABC and linear projections of ABCs for the whole Mariana Islands archipelago. Stock size below the line would indicate overfishing.

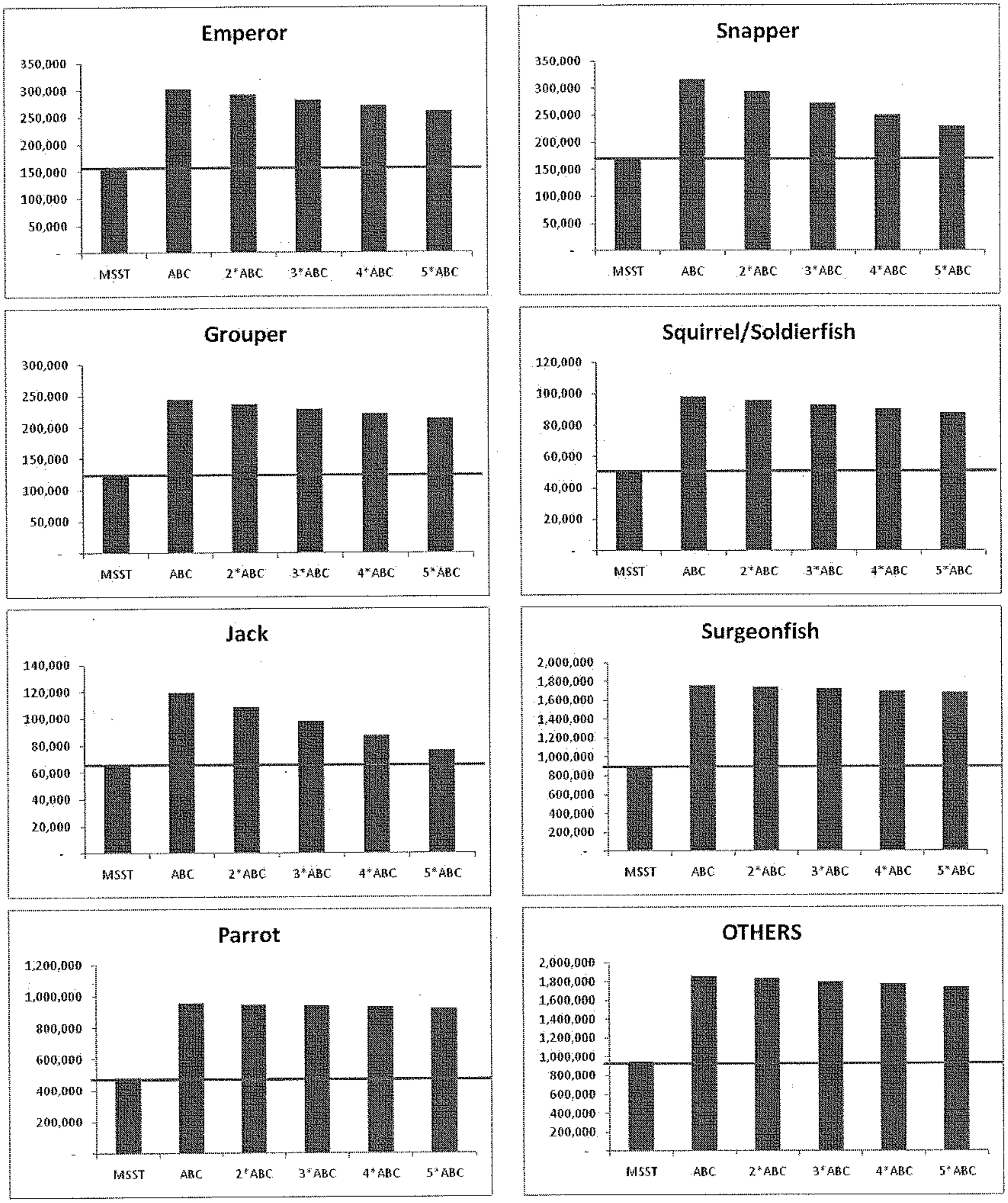

Figure 3. American Samoa coral reef fin fish MSST vs and stock size at ABC and linear projections of ABCs for the whole American Samoa archipelago. Stock size below the line would indicate overfishing.

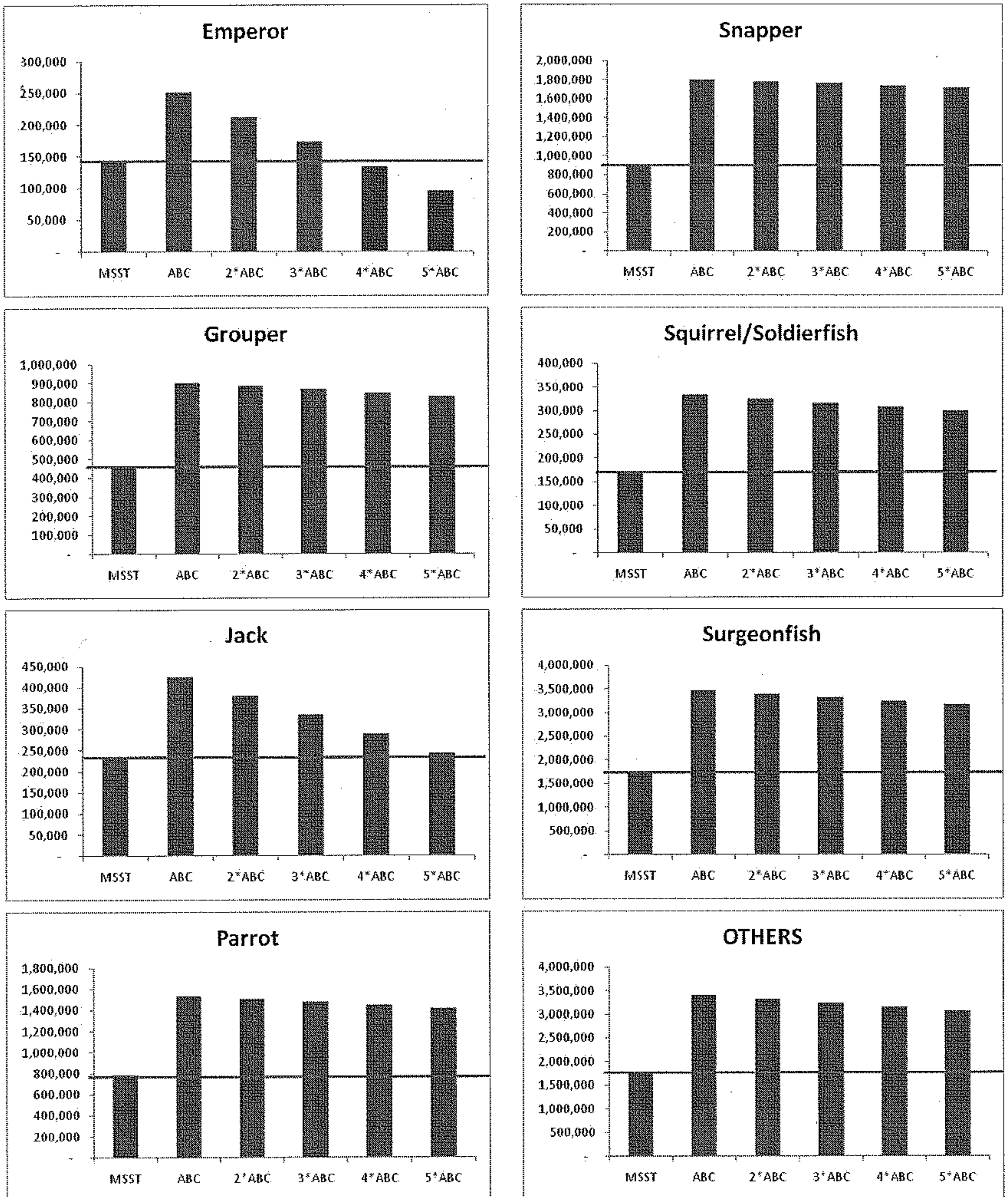

Figure 4. Guam coral reef fin fish MSST vs and stock size at ABC and linear projections of ABCs for the whole Mariana Islands archipelago. Stock size below the line would indicate overfishing.

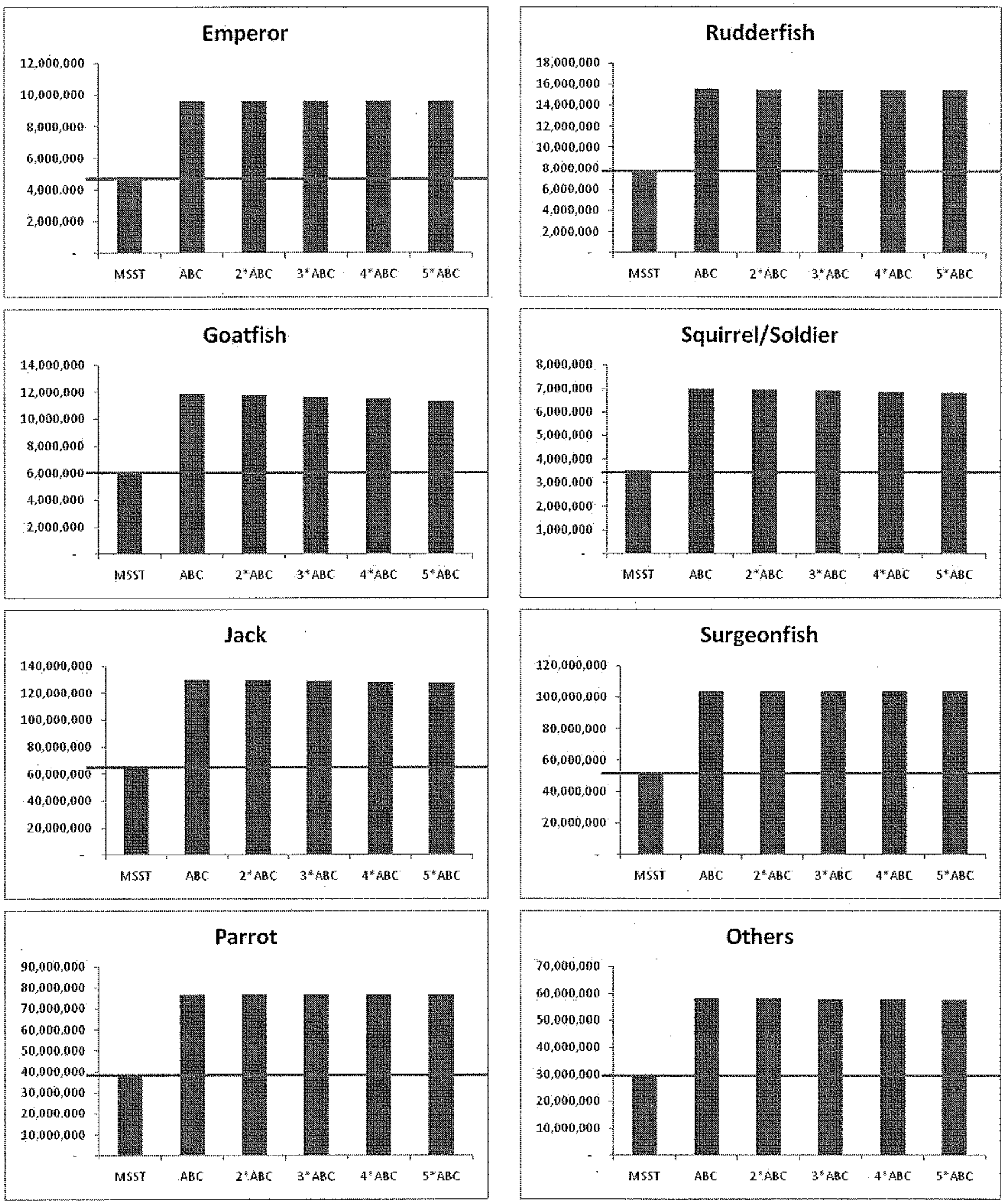

Figure 5. Hawaii coral reef fin fish MSST vs and stock size at ABC and linear projections of ABCs for the whole Hawaiian archipelago including the NWHI. Stock size below the line would indicate overfishing.

Council ACL and AM Recommendations

The Council in it's 151st meeting in June 16-18, 2011 made the following recommendations regarding ACLs and AMs:

1. Concurred with the SSC to utilize family level aggregations for coral reef fin fish to reduce the number of ACL specifications and limit the specifications to the top 90% of the total coral reef fish catch. The taxa comprising the remaining 10% will be grouped into one complex as minor fishery components with a single ABC. The Council further recommended that species that are particularly rare or vulnerable (e.g., *Bolbometopon muricatum* or bumphead parrotfish) be identified and that the ABC be determined by the SSC so that the Council can specify an ACL at the October meeting;

2. Concurred with the SSC's rationale for using the 75th percentile of the entire catch history for each family as the definition of "Recent Catch" when applying the Tier 5 control rule;

3. Concurred with the SSC's rationale for multiplying "Recent Catch" (here defined as the 75th percentile) by the multiplier of 1.0 to calculate the ABC for the coral reef family groupings as provided for in the Tier 5 control rule;

4. Concurred with the ABC recommendations of the SSC and recommends that the ACL for each coral reef family grouping be set equal to the ABC. The Council notes that although coral reef taxa are Tier 5 and most lack estimates of MSY, stock biomass (B) 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);

5. Concurred with the SSC recommendation that ABC be set equal to MSY, and recommended that the ACL be set equal to ABC for species with an estimate of MSY (Hawaii akule and opelu, Hawaii deepwater shrimp, and Hawaii black coral);

6. Concurred with the SSC recommendation that the ABC be set according to the Tier 4 Control Rule whereby ABC = 0.9 MSY for species with an estimate of MSY, but little to no current catch (CNMI deepwater shrimp). For these species, the Council recommends their ACL be set equal to their ABC;

7. Concurred with the SSC recommendation that ABC be set to the 75th percentile of the entire catch history, and recommended ACL be set equal to ABC for all remaining invertebrate species (lobsters in all areas, octopus in all areas, and Hawaii opihi);

8. Noted that for species listed in E to G, current catch is at or below the SSC recommended ABC values. While MSY is 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;

9. Recognized that there is room for refining ABC/ACL specifications. However, the Council believes this approach is reasonable in order to meet the statutory deadline. The approved Council ACL mechanism provides for an overage adjustment as an accountability measure (AM) should an ACL be exceeded;

10. Requested NMFS explore ways to develop in-season monitoring of stocks in order to provide Archipelagic Plan Teams the ability to evaluate annual catches relative to ACLs in a timely manner;

11. Recommended that the SSC determine ABCs for deep water bottomfish stock complexes in American Samoa, Guam, and CNMI so that the Council can specify an ACL at the October meeting;

12. Directed Council staff to assess the species in the CREMUS and evaluate their catch history for possible ecosystem component reclassification or removal from the management units.

Following the Council's recommendation, the following are the ABCs and ACLs for the coral reef ecosystem MUS in American Samoa, Guam, CNMI, and Hawaii.

Table 11. Acceptable Biological Catches and Annual Catch Limits for the coral reef fish families that comprise the top 90% of the total coral reef fish catch and species complex comprising the remaining 10% of the total coral reef fish catch regarded as the minor fishery components in American Samoa.

Family	Total estimated biomass (lbs)	Proposed ABC (lbs)	Proposed ACL (lbs)	$\text{Mean}_{\text{last 5 yrs}}$ (lbs)
Acanthuridae	1,779,286	19,516	19,516	9,468
Lutjanidae	338,371	18,839	18,839	13,185
Selar crumenopthalmus	N/A	8,396	8,396	3,079
Mollusk	N/A	16,694	16,694	7,886
Carangidae	129,955	9,490	9,490	6,273
Lethrinidae	142,349	7,350	7,350	6,872
Scaridae*	964,989	8,145	8,145	3,007
Serranidae	251,814	5,600	5,600	5,289
Holocentridae	45,721	2,585	2,585	1,552
Mugilidae	N/A	2,857	2,857	2,608
Crustacean**	N/A	2,136	2,136	1,360
Remaining 10%	>2 million	18,910	18,910	16,556

NOTE:

* Family Scaridae does not include *Bolbometopon muricatum* (bumphead parrotfish)

** Does not include lobsters

Table 12. Acceptable Biological Catches and Annual Catch Limits for the coral reef fish families that comprise the top 85% of the total coral reef fish catch and species complex comprising the remaining 15% of the total coral reef fish catch regarded as the minor fishery components in Guam. The incremental difference between each group is small that only 85% was reach with family level grouping and the rest are general CREMUS categories analogous to the remaining 10% bin in other island areas.

Family	Total estimated biomass (lbs)[1]	Proposed ABC (lbs)	Proposed ACL (lbs)	Mean$_{last\ 5\ yrs}$ (lbs)
Acanthuridae	3,535,142	70,702	70,702	41,420
Carangidae	472,124	45,377	45,377	42,822
Selar crumenopthalmus	N/A	56,514	56,514	7,312
Lethrinidae	290,557	38,720	38,720	17,056
Scaridae*	1,568,760	28,649	28,649	12,870
Mullidae	239,115	25,367	25,367	9,880
Mollusk	N/A	21,941	21,941	13,083
Siganidae	N/A	26,120	26,120	10,132
Lutjanidae	1,816,674	17,726	17,726	10,679
Serranidae	922,895	17,958	17,958	10,020
Mugilidae	N/A	15,032	15,032	2,850
Kyphosidae	176,229	13,247	13,247	7,258
Crustacean**	N/A	5,523	5,523	2,353
Holocentridae	343,170	8,300	8,300	2,699
Algae	N/A	5,329	5,329	639
Labridae***	886,855	5,195	5,195	1,757
Other CREMUS	>3.4 million	83,214	83,214	22,920

NOTE:

1 Biomass estimates based on entire Mariana Archipelago from Guam to Urucas, including Guam's offshore banks and the Western Mariana Ridge

* Family Scaridae does not include *Bolbometopon muricatum* (bumphead parrotfish)

** Does not cover lobsters

*** Family Labridae does not include *Cheilinus undulatus* (humphead wrasse)

Table 13. Acceptable Biological Catches and Annual Catch Limits for the coral reef fish families that comprise the top 90% of the total coral reef fish catch and species complex comprising the remaining 10% of the total coral reef fish catch regarded as the minor fishery component in CNMI.

Family	Total estimated biomass (lbs)[1]	Proposed ABC (lbs)	Proposed ACL (lbs)	Mean$_{last\ 5\ yrs}$ (lbs)
Lethrinidae	290,557	27,466	27,466	23,413
Carangidae	472,124	21,512	21,512	14,968
Acanthuridae	3,535,142	6,884	6,884	5,517
Selar crumenopthalmus	N/A	7,459	7,459	5,024
Serranidae	922,895	5,519	5,519	4,220
Lutjanidae	1,816,674	3,905	3,905	3,367
Mullidae	922,895	3,670	3,670	3,323
Scaridae*	1,568,870	3,784	3,784	2,672
Mollusk	N/A	4,446	4,446	2,693
Mugilidae	N/A	3,308	3,308	2,268

Siganidae	N/A	2,537	2,537	1,441
Remaining 10%	>3.4 million	9,820	9,820	6,120

NOTE:
1 Biomass estimates based on entire Mariana Archipelago from Guam to Urucas, including Guam's offshore banks and the Western Mariana Ridge
* Family Scaridae does not include *Bolbometopon muricatum* (bumphead parrotfish)

Table 14. Acceptable Biological Catches and Annual Catch Limits for the coral reef fish families that comprise the top 90% of the total coral reef fish catch and species complex comprising the remaining 10% of the total coral reef fish catch regarded as the minor fishery component in Hawaii.

Family	Total estimated biomass (lbs)	Proposed ABC (lbs)	Proposed ACL (lbs)	Mean last 5 yrs (lbs)
Selar crumenopthalmus	N/A	651,292	651,292	221,431
Decapterus macarellus	N/A	393,563	393,563	184,533
Carangidae*	130,521,134	193,423	193,423	139,398
Mullidae	12,017,286	125,813	125,813	48,671
Acanthuridae	104,285,468	80,545	80,545	86,109
Lutjanidae**	33,557,777	65,102	65,102	9,057
Holocentridae	7,049,398	44,122	44,122	31,808
Mugilidae	N/A	41,112	41,112	8,964
Mollusk	N/A	28,765	28,765	21,361
Parrotfish***	76,936,076	33,326	33,326	34,326
Crustaceans****	N/A	20,686	20,686	18,713
Remaining 10%	>58 million	142,282	142,282	73,081

NOTE:
* Carangidae includes kahala since this was not included in the stock assessment analysis
** Lutjanidae includes *Lutjanus kasmira* since this was not included in the stock assessment analysis
*** Mollusk is covered by another complimentary ACL specification document
**** Family Scaridae does not include *Bolbometopon muricatum* (bumphead parrotfish)
***** Crustacean is covered by another complimentary ACL specification document

Justifications for setting ACLs equal to ABCs for coral reef MUS: Despite growing concerns about the coral reef fishery experiencing overfishing and stocks being overfished, the US state and territories in the Pacific island region continue to experience changes in socio-economic conditions that drives the utilization of the marine resources. Pacific island territories had sustainably fished their marine resources for millennia and subsistence fishing had declined over the recent century due to westernization of culture brought about by the US occupancy where paid employment gradually replaced subsistence living resulting in a decrease participation (therefore fishing effort) both on boat and shore-based fisheries (Sabater and Carroll 2009). In Hawaii, subsistence fishing transitioned to recreational fishing due to significant improvements in the economic conditions of local residents.

Table 15 shows the island and archipelagic level exploited biomass for each of the CREMUS families in American Samoa, Guam, CNMI and Hawaii. Preliminary analysis of coral reef fish expanded harvest from creel surveys and commercial fishery catch reports relative to habitat-expanded biomass from underwater census surveys showed a low level extraction which can be used as a proxy of fishing mortality (Luck and Dalzell 2010; Sabater and Carroll 2009).

There is enough buffer in the biomas that further reduction in catch limits is deemed overly restrictive for the fishery.

Table 15. Percentage of exploited biomass for various catch and biomass permutations in American Samoa , Commonwealth of the Northern Mariana Islands (CNMI), Guam, and the Hawaiian Archipelago (MHI = Main Hawaiian Islands; NWHI = Northwestern Hawaiian Islands).

Catch Data	Biomass Data	Acanthuridae	Carangidae	Carcharhinidae	Holocentridae	Kyphosidae	Labridae
Am. Samoa (Tutuila Only)	Am. Samoa (Tutuila Only)	0.86	11.13	0.45	4.74	16.83	2.02
	Am. Samoa (Tutuila, Tau, Ofu, Olosega)	0.56	7.07	0.16	1.89	3.91	1.28
CNMI	Rota to FDM	0.72	67.43	0.44	1.57	6.45	0.75
	Rota to Northern Island	0.30	4.42	0.12	0.63	0.45	0.37
	Whole Mariana Archipelago	0.22	3.99	0.08	0.57	0.41	0.21
Guam	Guam Island	6.12	157.61	0.66	19.73	67.11	0.55
	Guam and Banks	4.24	104.89	0.44	8.57	44.66	0.36
	Whole Archipelago	1.01	7.92	0.11	0.72	3.58	0.16
CNMI and Guam	Southern Banks to FDM	2.25	201.08	1.00	2.89	63.37	0.51
	Whole Archipelago	1.23	11.91	0.19	1.29	3.99	0.36
MHI	MHI	0.21	3.07	0.35	2.06	0.72	0.09
Hawaiian Archipelago	Hawaiian Archipelago	0.07	0.04	0.00	0.59	0.15	0.02

Catch Data	Biomass Data	Lethrinidae	Lutjanidae	Mullidae	Scaridae	Serranidae	Other	Total
Am. Samoa (Tutuila Only)	Am. Samoa (Tutuila Only)	7.35	9.60	1.32	0.50	5.53	1.45	1.90
	Am. Samoa (Tutuila, Tau, Ofu, Olosega)	5.26	4.54	1.03	0.33	2.50	1.08	1.25
CNMI	Rota to FDM	24.52	1.95	6.88	1.30	1.75	1.20	2.49
	Rota to Northern Islands	10.83	0.26	3.71	0.51	0.59	0.47	0.84
	Whole Mariana Archipelago	9.90	0.23	2.36	0.35	0.50	0.32	0.63
Guam	Guam Island	160.34	9.81	22.54	3.29	12.86	8.69	8.84
	Guam and Banks	75.94	6.05	13.13	2.18	7.23	5.18	5.66
	Whole Archipelago	5.36	0.50	4.66	0.66	0.95	1.46	1.30
CNMI and Guam	Southern Banks to FDM	32.17	3.63	10.06	1.77	3.48	3.23	4.19
	Whole Archipelago	15.26	0.73	7.02	1.01	1.45	1.79	1.92
MHI	MHI	0.39	0.43	0.29	0.30	0.07	0.62	0.41
Hawaiian Archipelago	Hawaiian Archipelago	0.02	0.11	0.10	0.05	0.07	0.19	0.08

* = Carangids, kyphoids and carcharinids were not seen in Guam RAMP surveys. Biomass values for these families in were estimated using the corresponding family biomass (kg/ha) density from CNMI.

Dalzell and Adams (1997) had shown an estimated annual reef fish yield per reef area at 0.79 t/km2 (equivalent to 1,769 lbs/km2) and 7.04 t/km2 (equivalent to 15,767 lbs/km2) for Guam and American Samoa, respectively. The annual harvest of coral reef fish per unit reef area estimated at 506 lbs/km2 and 3,744 lbs/km2 for Guam and American Samoa, respectively, calculated from the WPacFIN CREMUS dataset. Comparing the annual harvest from the annual yield showed annual harvest for Guam is merely 29% of the annual reef fish production and 24% for American Samoa. This is just accounting for the production alone and not including the already existing standing biomass.

A series of analysis was conducted to determine whether the fish stock has been impacted by years of fishing. This provides auxiliary information on the performance of the stock. Normally, fish sizes will decrease if overfishing is occurring due to targeted preference for larger individuals (Shin et al.2005). Average fish length for various species in the catch and those observed in the underwater census surveys were plotted over time to determine the long term trend in sizes for species in American Samoa (Figure 10 and 11), Guam (Figure 12 – catch data; Figure 14 – UVC data combined with CNMI) and CNMI (Figure 13 – catch data; Figure 14 – UVC data combined with Guam) Regression analysis was done on time series to test for significant trends (data was pooled for Saipan and Guam to increase the sample size). Most of the species in American Samoa showed significant increases in fish sizes for species caught in the fishery whereas there were no significant trends (although lines were mostly constant to slightly decreasing) for those same species observed in the underwater census surveys. In the Mariana Islands, of those species analyzed, only 4 showed a significant increase while 30 showed no significant trend (mostly constant over time) and 14 showed significant decrease in size over time. No significant trends were seen on the same species from the underwater census surveys. To make this trend analysis more meaningful, we compared the results of the trends from the catch versus those 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 sustainable fishing with no impact on the population whereas on the other extreme end where significan decrease in size from catch and decrease from those observered underwater indicates substantial impact on the population due to fishing. Table 12 and 13 describes the result of the trend analysis where the coral reef fishery did not have any substantial impact on the coral reef fish population.

Biomass estimates of akule and opelu is not available due to it underrepresentation in any underwater census surveys whereas it is prevalent in the catch data. Catch to biomass ratio is therefore not reliable. However, it is well documented that both akule and opelu are small coastal pelagic species with fast growth rates, short lifespans and high natural mortality rates (Dalzell et al 1996). As such they are highly resilient to fishing. Moreover, environmental and oceanographic influences are likely to have a greater influence on both these species, especially akule (Weng & Sibert 2000). Additionally, as opelu mature and increase in size they move from living in the epi-pelagic zone to a demersal life history and beyond the range of the gears (hoop nets, handlines) used to catch this species (Sousa & Gjosaeter 1987). Thus the fishery is primarily focused on juvenile fish while the spawning stock As such, setting the ABC as the MSY is consistent with the life histories af these fishes, and annual catches are likely to reflect natural fluctuations in abundance, rather than responses of the stocks to fishing.

For mollusk and crustaceans, these are small scale subsistence fishery using gleaning methods and pole spear for octopus. This does not include commercially harvested lobsters which are described in another specification document. These stocks are entirely within state waters since these assemblages are found on reef flats. Majority of the inshore gleaning catches are comprised of octopus and turbo snails. These assemblages are highly productive and have a short lifespan of less than one year. Minor part of the subsistence reef flat harvest is the trochus shellfish that has a lifespan on 15 to 20 years. Most of the crustaceans included in this fishery are mangrove crabs and brackish water shrimps. None of these assemblages are found in federal waters and in order to be consistent with the process, the same metrics will be used for mollusk and crustaceans.

Justification for using archipelagic biomass over island scale biomass: Recent changes in the fishery management approach from single species based to ecosystem based management (WPFMC 2009a, 2009b, 2009c, 2009d) has an implicit assumption that each species interacts with the environment and the holistic approach to management would include large scale interactions. Reef fish biomass varies at difference spatial scales (Sabater and Tofaeono 2007) and these scales has to be incorporated in any management strategies. The diversity of the coral reef fish assemblages indicates varying life history strategies part of which is the pelagic larval duration (PLD) which is an index on how far the species disperses. The longer the PLD the father it reaches depending on the intensity and direction of the current system in a given locality. Doherty et al. (1995) showed the genetic connectivity between 7 species of reef fishes in the Great Barrier Reef, Australia. The gene flow depends on the larval duration. Species that has longer PLD tends to have higher genetic homogeneity in the population covering larger area. Aside from PLD, timescales by which genetic and demographic processes operate could dictate the level of spatial connectivity for a particular species. Eble et al. (2011) demonstrated that the brown surgeonfish, *Acanthurus nigrofuscus*, is just one large undifferentiated population ranging from Hawaii to the Eastern Indian Ocean. Conversely, some species are also localized in terms of their range as dictated by their life history strategy. Toonen et al. (2011) showed boundaries of connectivity in the Hawaiian Archipelago based on 27 taxonomically and ecologically diverse species ranging from reef invertebrates to marine mammals. Larval simulation studies in American Samoa had shown varying level of connectivities among the the different Samoan islands and seamounts (Kendall and Poti 2011) which justifies the use of an archipelagic scale approach to ACL specifications. The distance by which each island is separated is not the great in which a larva with a minimum of 30 days PLD released from one island cannot reach the other islands. Larval simulation studies utilizing hydrodynamic models use virtual larvae in the order of tens of thousands which is still few compared to the natural number of larvae released during a single spawning event (Kendall and Poti 2011, Kobayashi 2008). In addition, gene and larval flow studies have shown the importance of proximity to a neighboring island that allows "larval hopping" (Scheltema and Williams 1983). Most of the islands in the archipelagoes of Hawaii, American Samoa and the Marianas are separated from each other at an average of hundreds of kilometers which not beyond the range of a species with a 30 day PLD. The archipelagic catch to biomass ratio fits the goal of an archipelagic ecosystem approach to fishery management as described in the FEPs. Moreover, the Presidential Proclamation on establishing the different monuments with the aim of protecting and preserving the objects (including fish) within its boundary and balancing interest relating to traditional uses of the ocean (including fishing) ultimately creates a pool of larval sources by which open access areas can benefit from. Utter disregard of the benefits from the monument areas deem these areas as closed system with little or no benefits to the stakeholders. Ultimately, it would defy one purpose of establishing marine protected areas. Lastly, in table 15, even if we only consider the single island biomass relative to the catch, most of the reef fish family catch is still below its corresponding biomass. Any overages were explained by under representation in the uncerwater census data and over representation in the catch data.

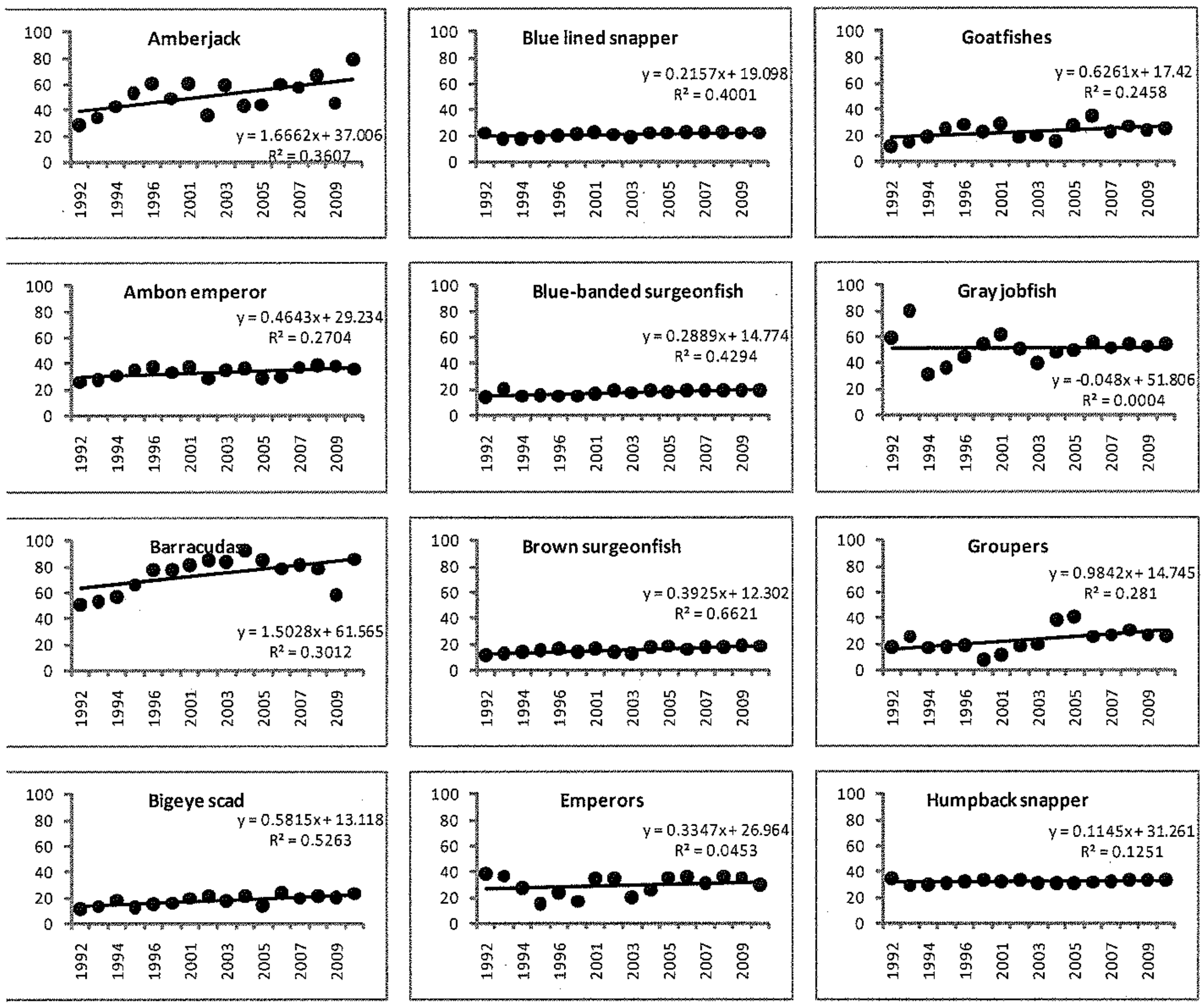

Figure 6. Temporal trend in lengths of species that comprise 90% of the total coral reef catch in American Samoa from boat and shore catches

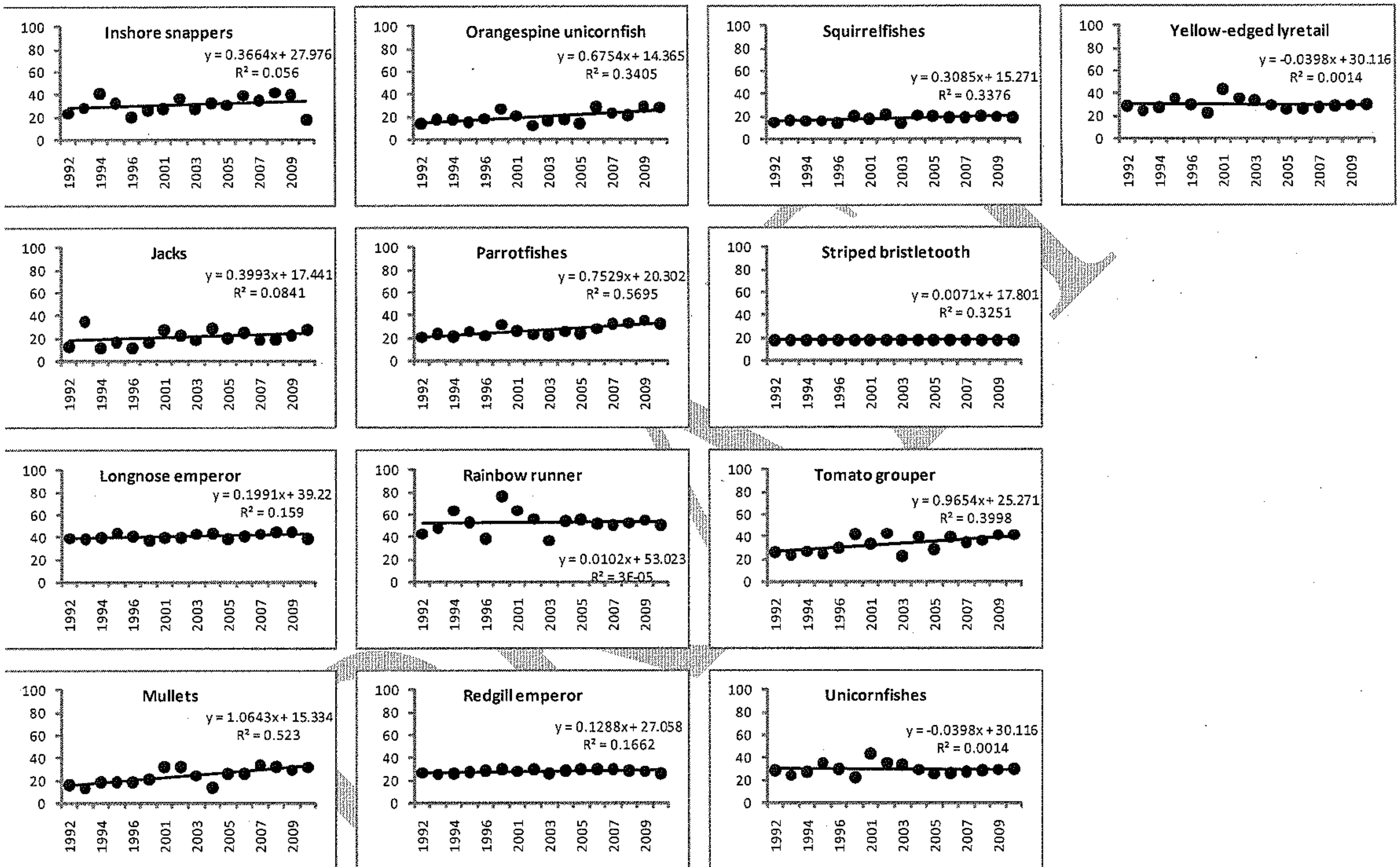

Figure 6. Continued

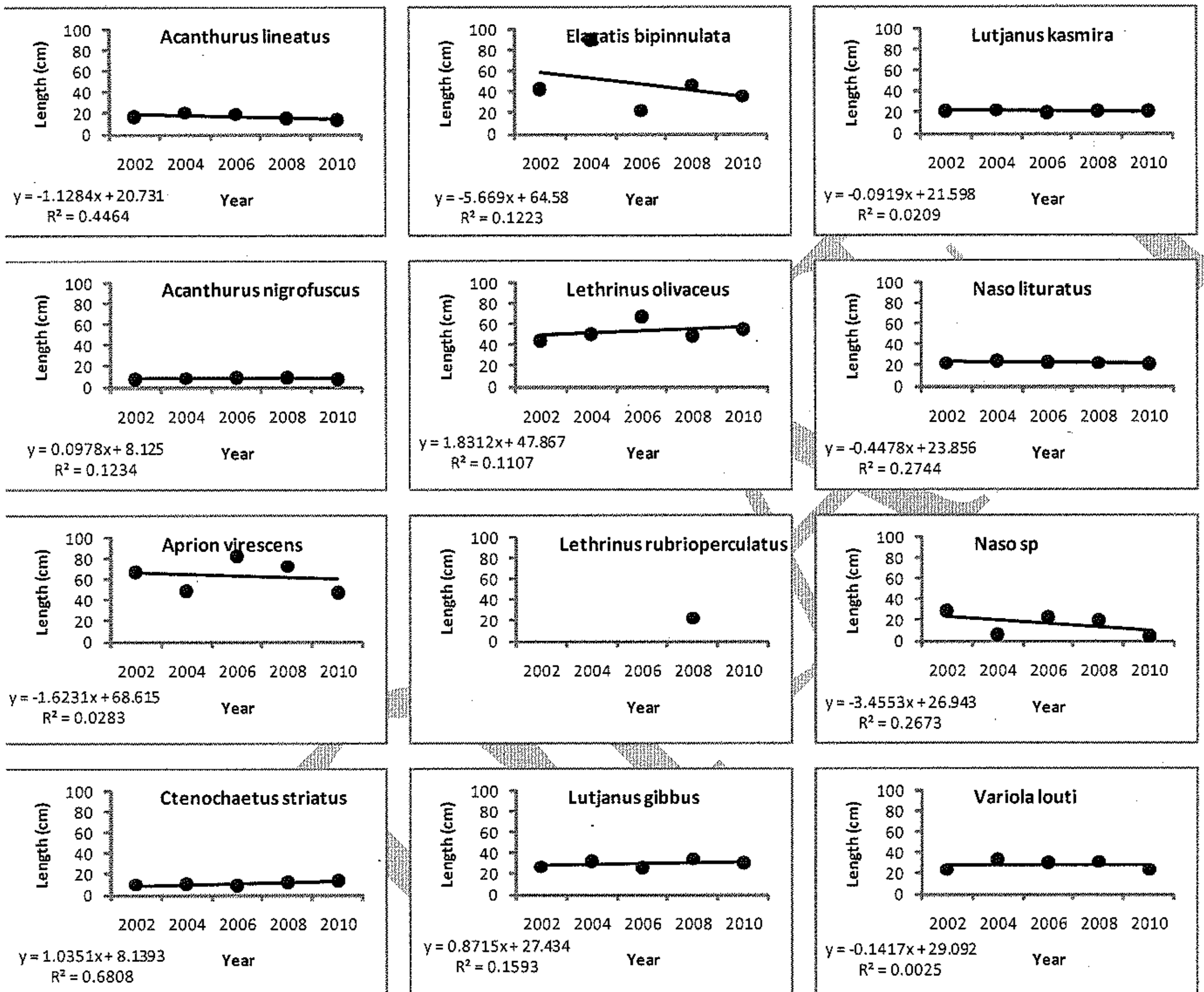

Figure 7. Temporal trend in lengths of species that comprise 90% of the total coral reef catch in American Samoa from underwater census surveys

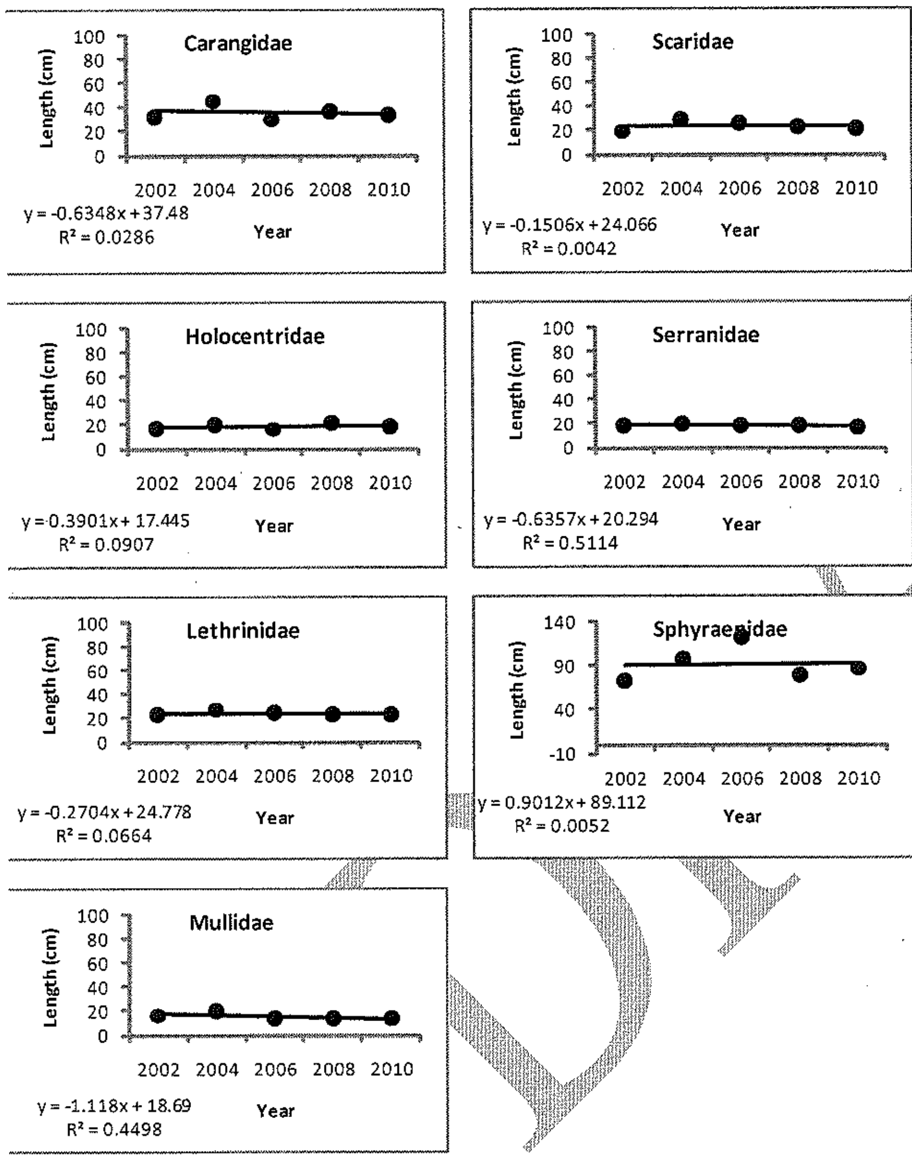

Figure 7. Continued

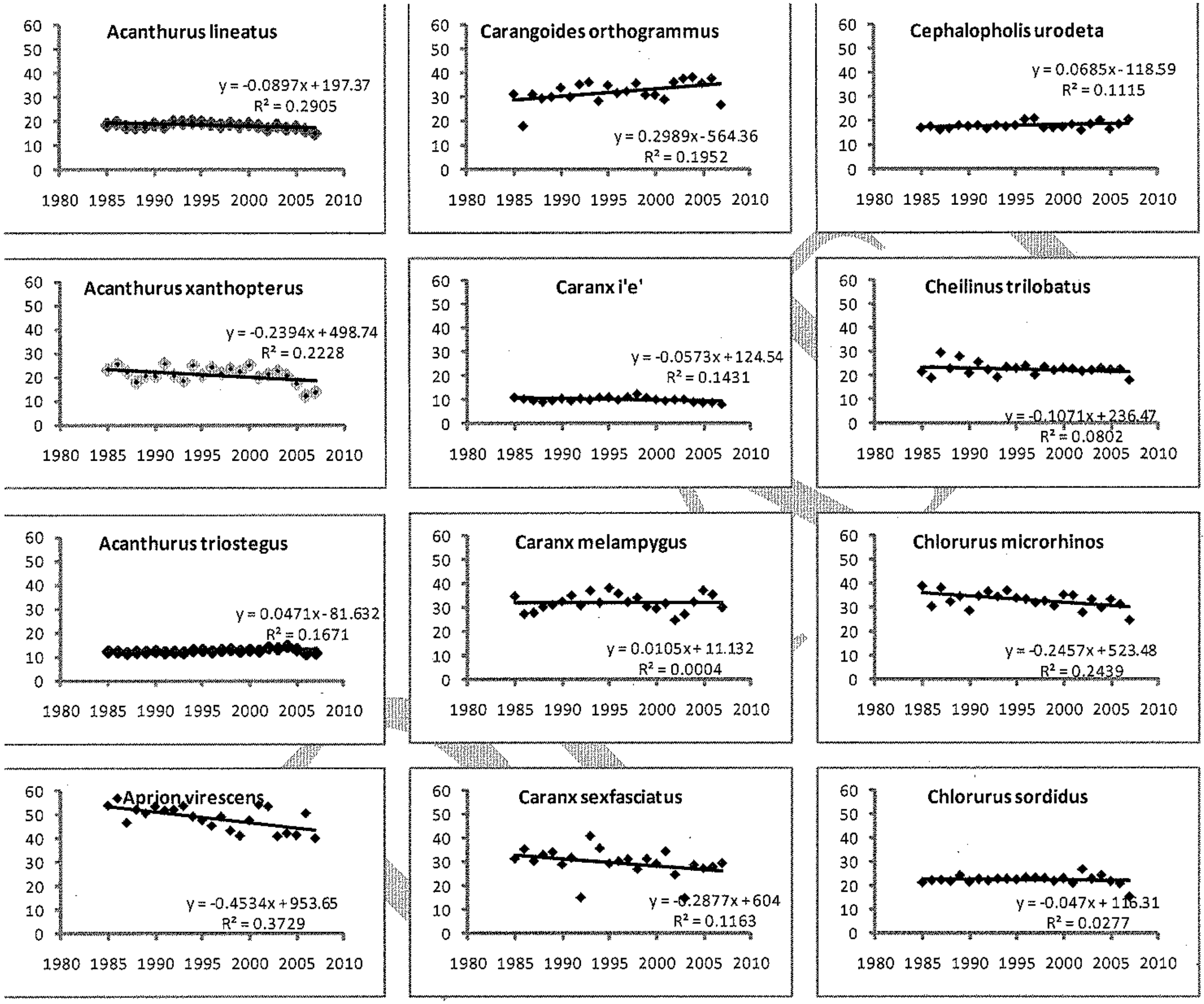

Figure 8. Temporal trend in lengths of species that comprise 90% of the total coral reef catch in Guam from boat and shore catches

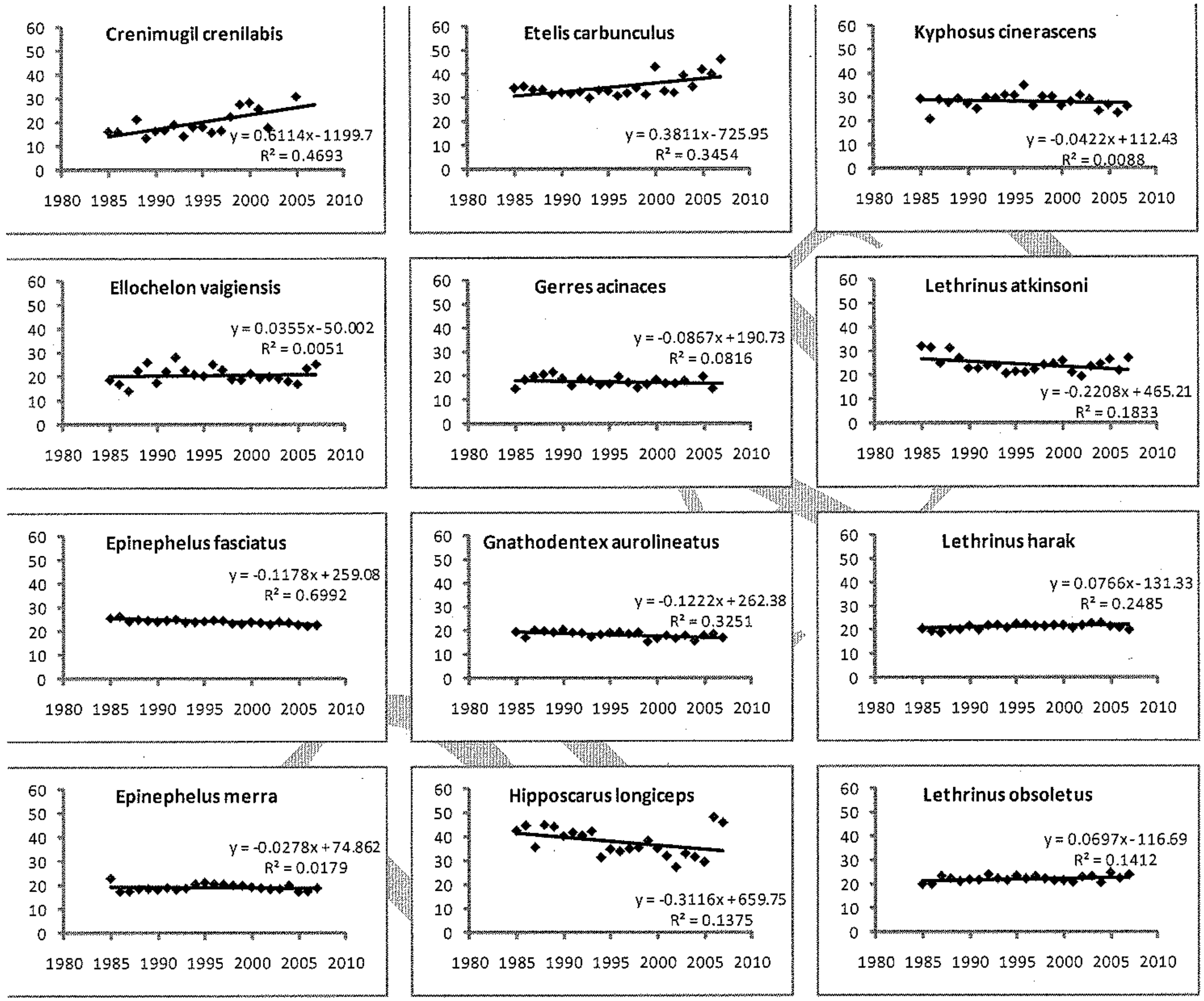

Figure 8. Continued

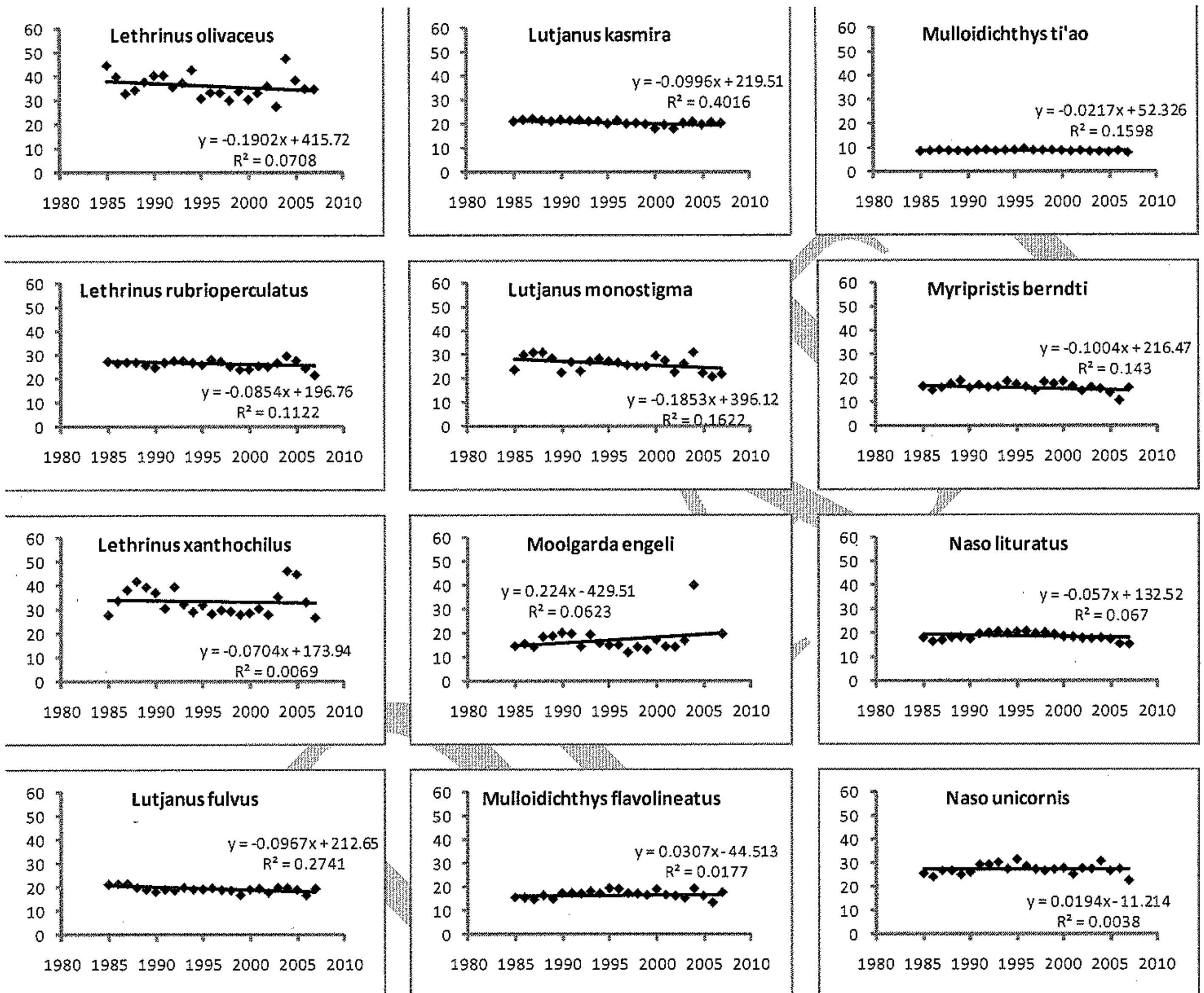

Figure 8. Continued

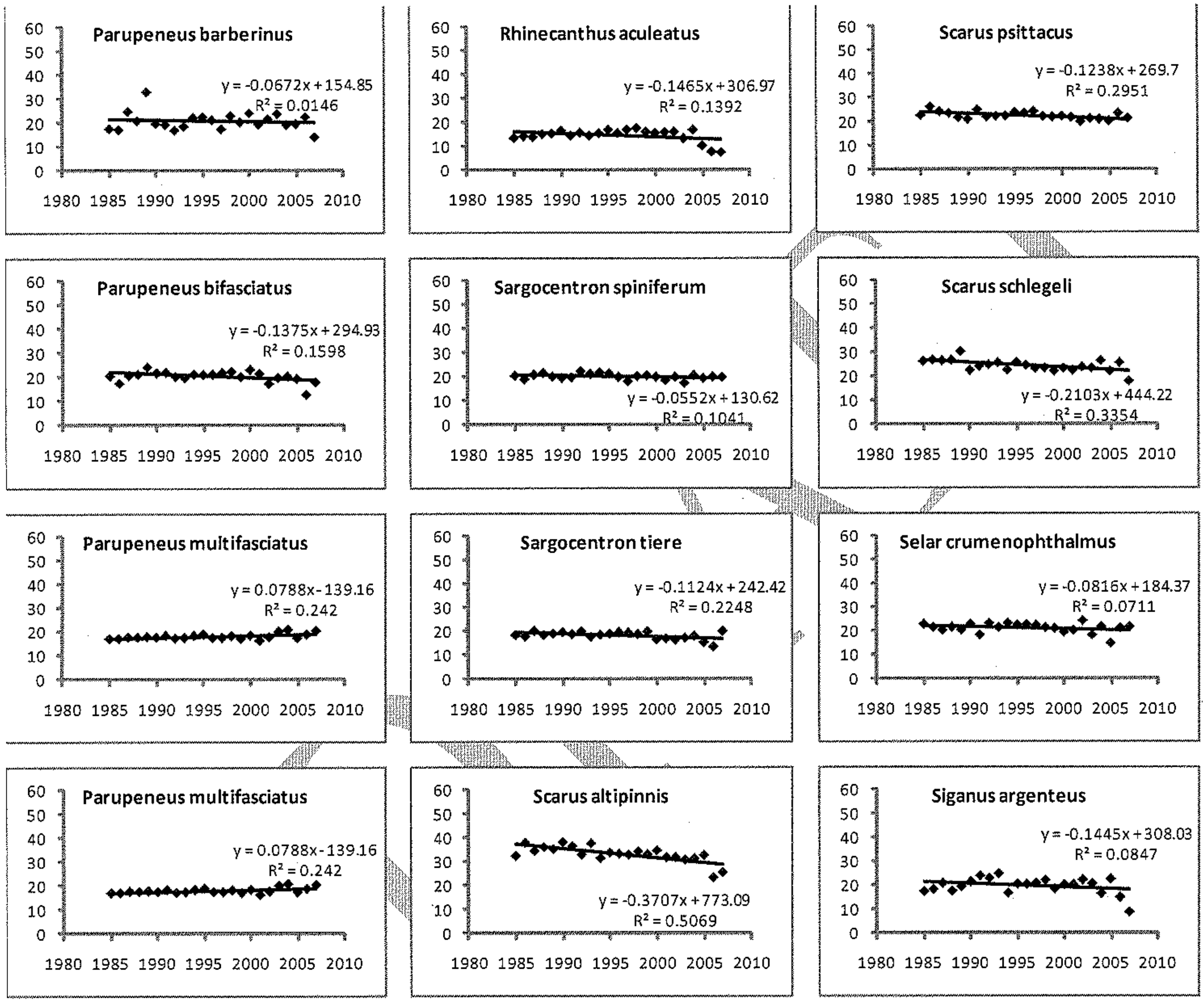

Figure 8. Continued

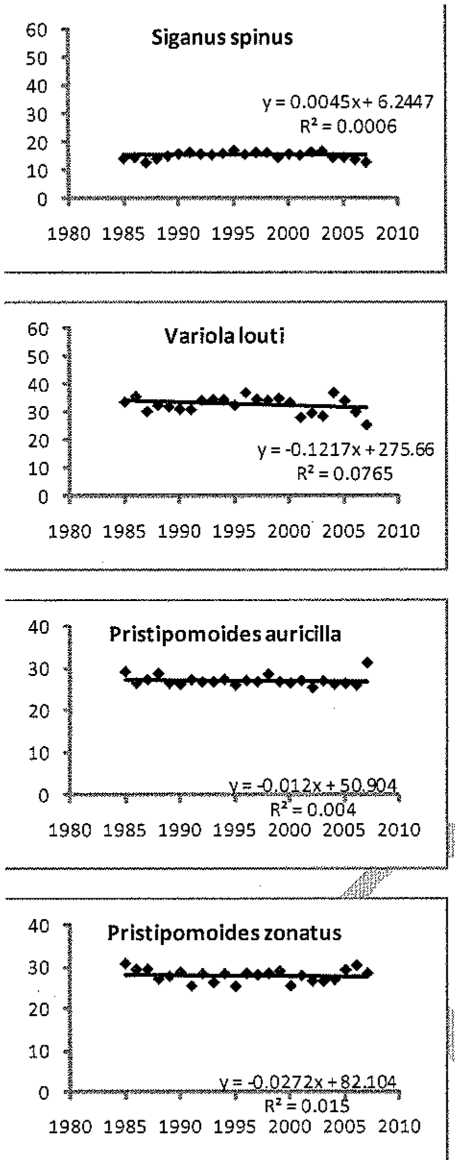

Figure 8. Continued

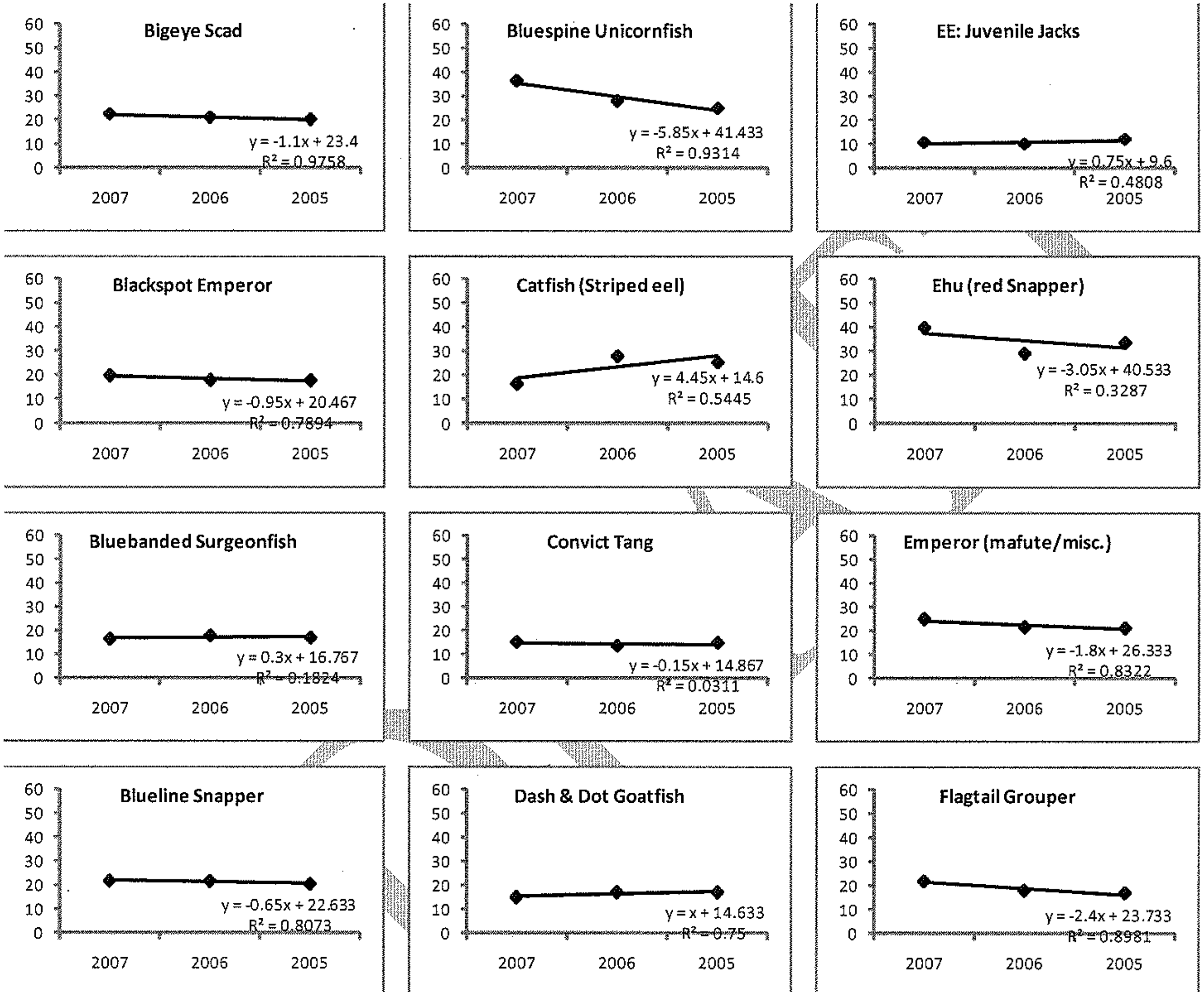

Figure 9. Temporal trend in lengths of species that comprise 90% of the total coral reef catch in CNMI from boat and shore catches

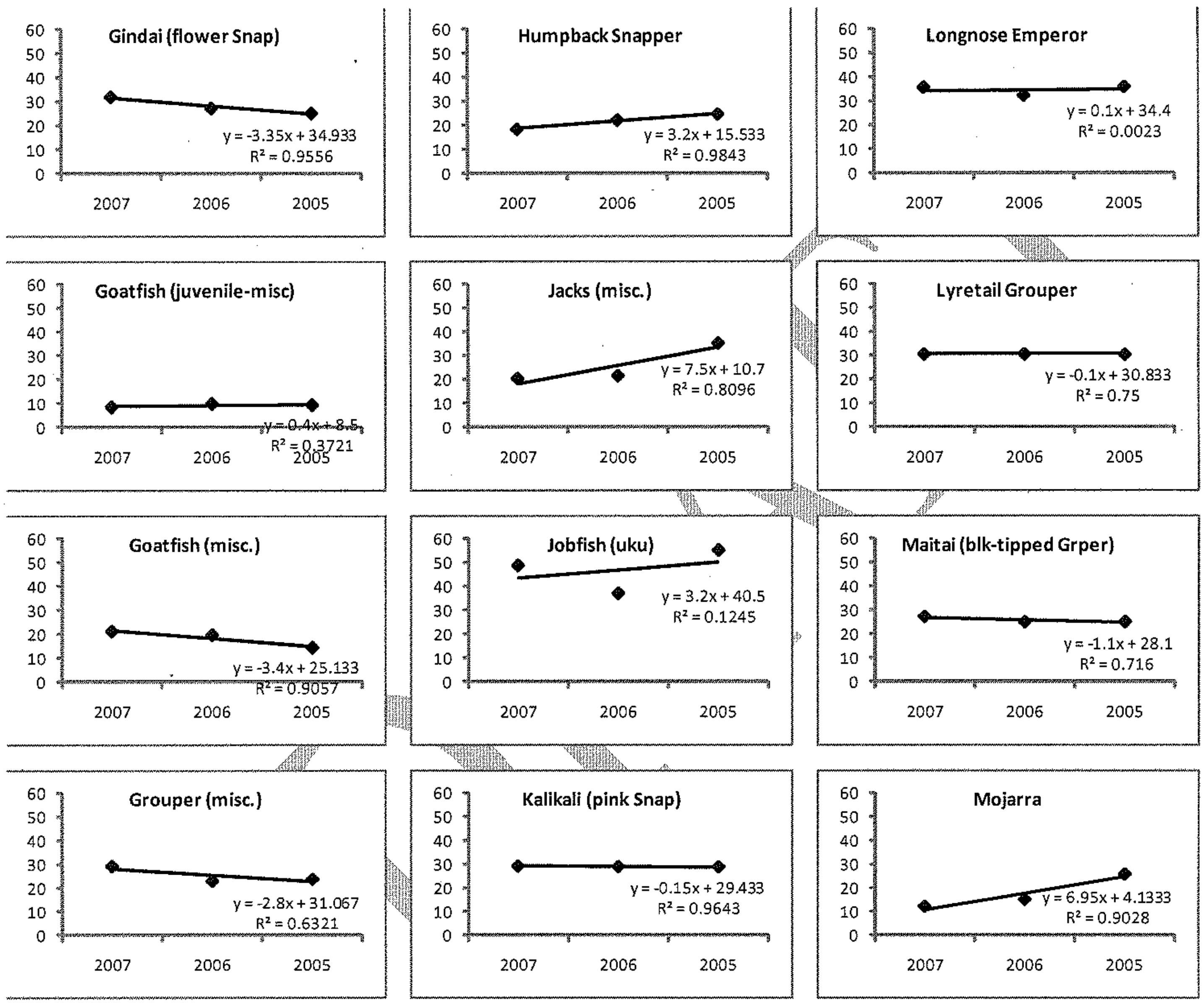

Figure 9. Continued

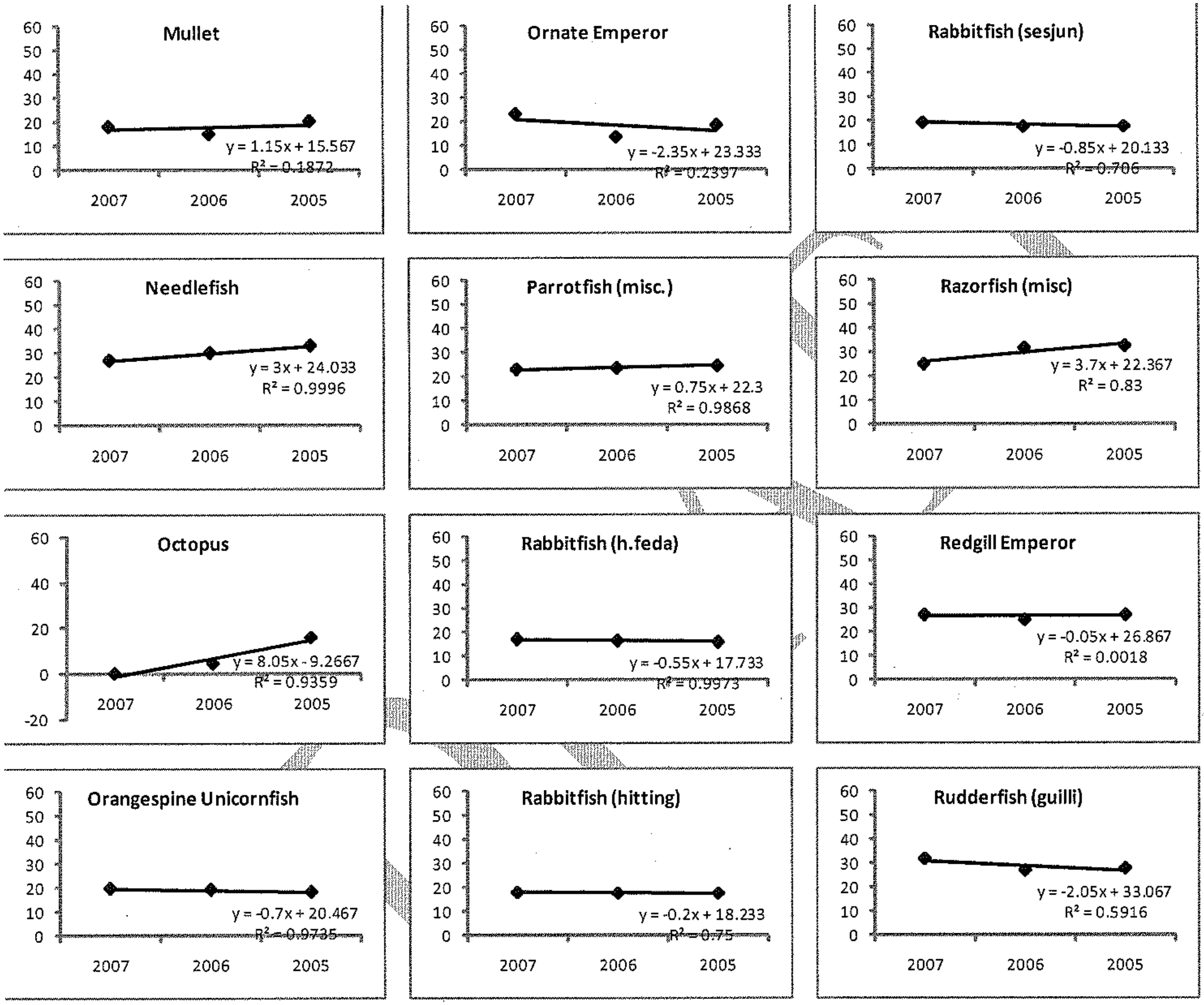

Figure 9. Continued

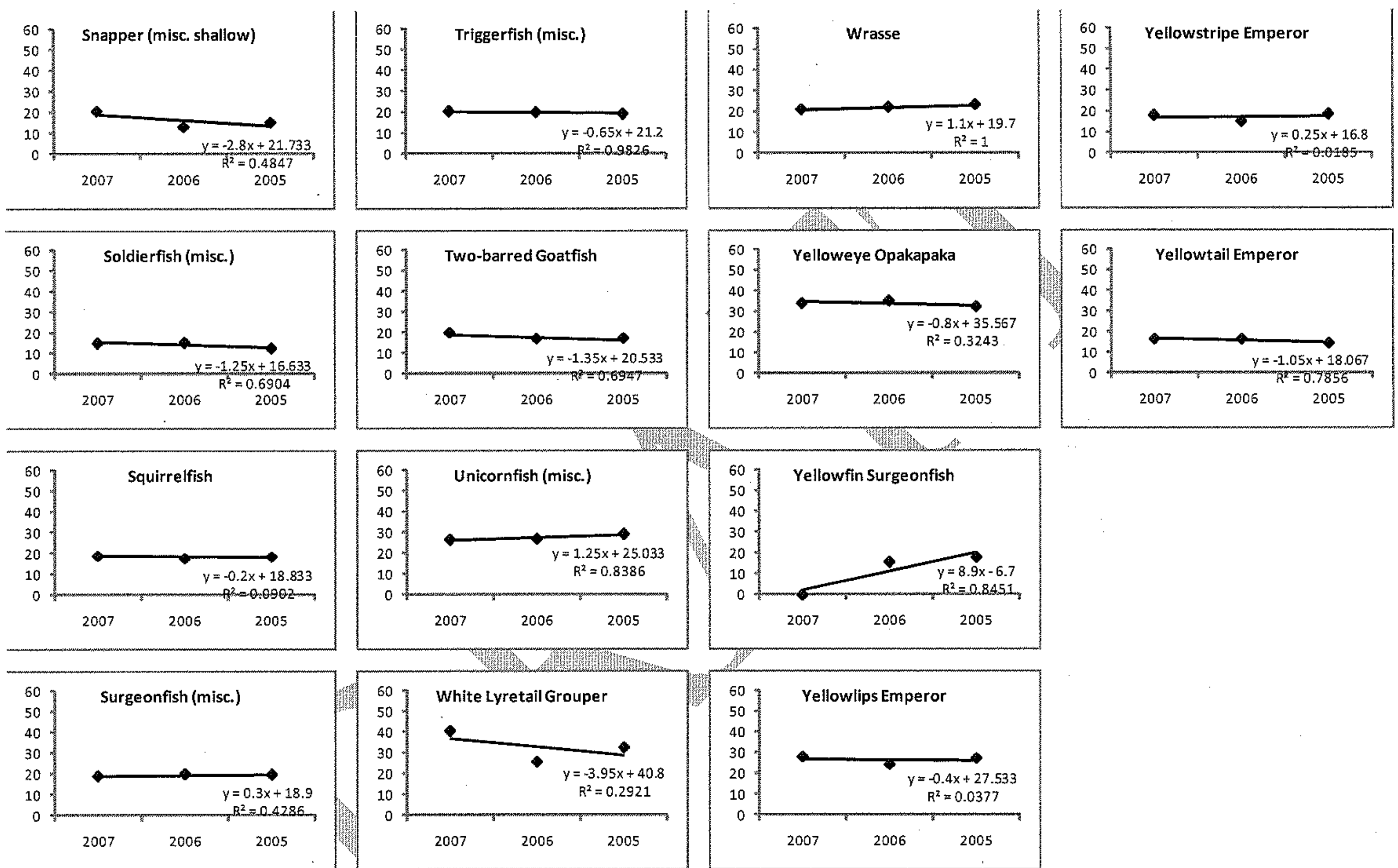

Figure 9. Continued

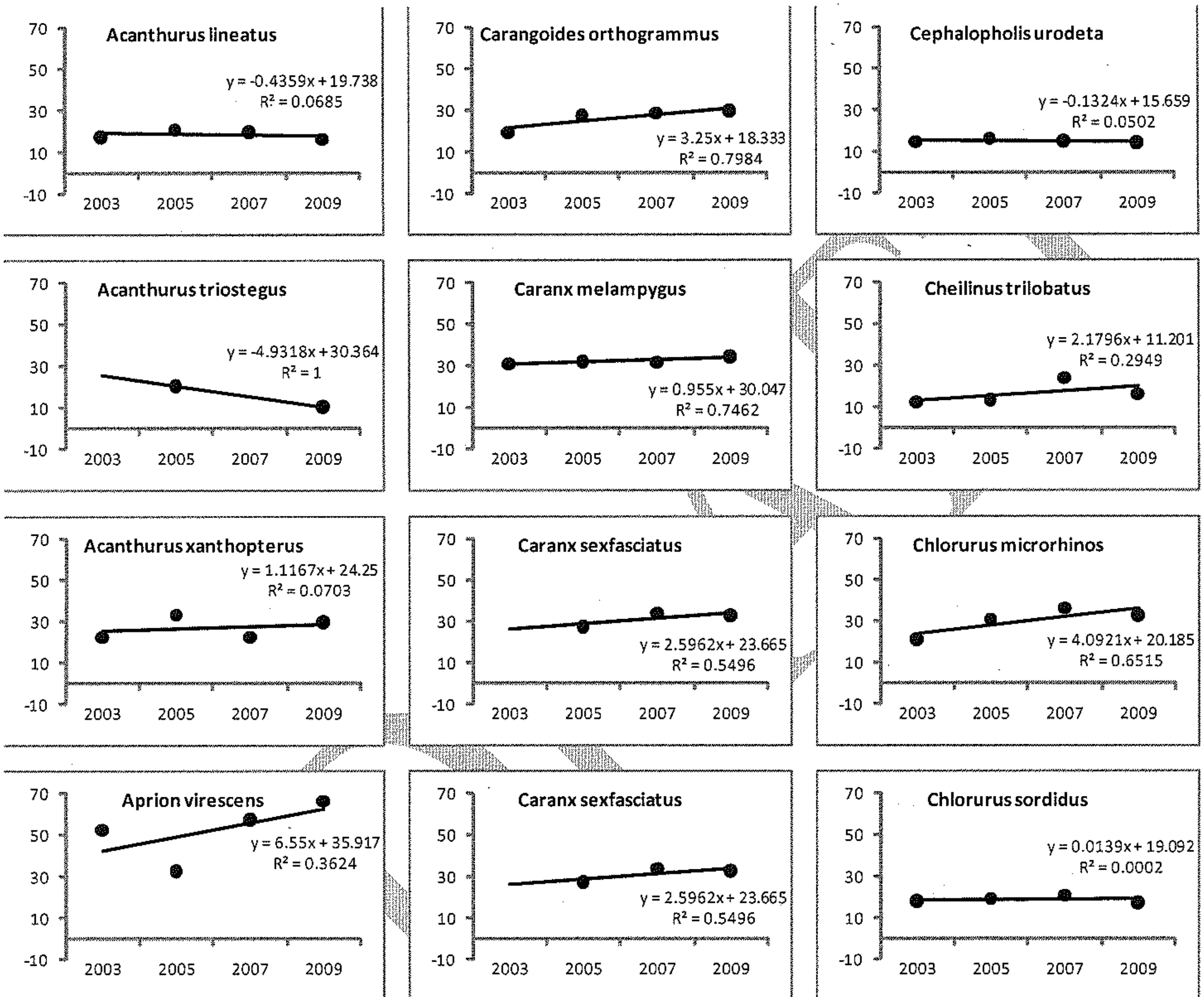

Figure 10. Temporal trend in lengths of species that comprise 90% of the total coral reef catch in the Nortern Mariana Islands from underwater visual census

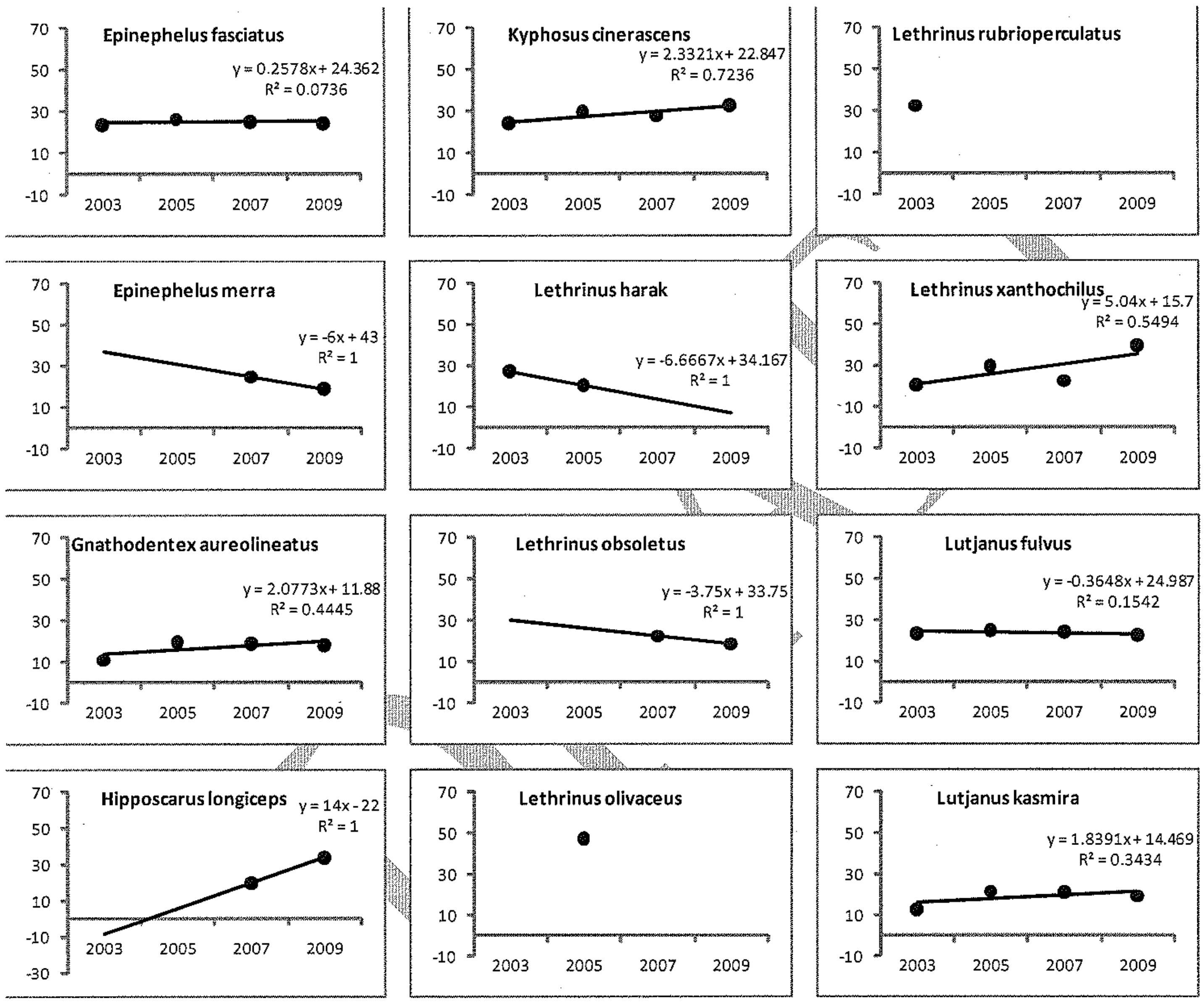

Figure 10. Continued

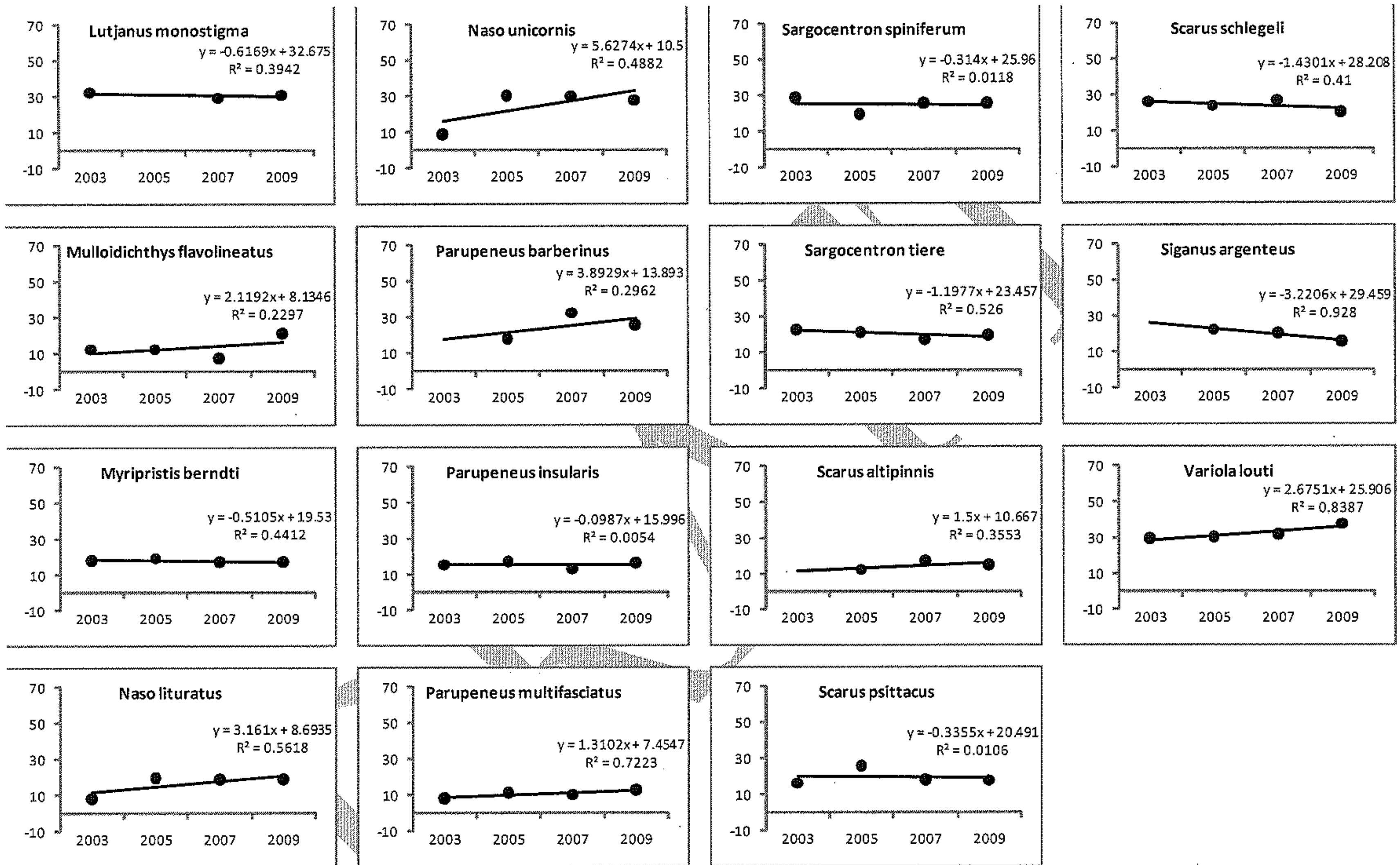

Figure 10. Continued

Table 16. Regression trends and significance of fish sizes over time of the species comprising the coral reef catches in American Samoa

Species	Catch data					UVC data					Pattern interpretation
	R	R^2	SE	F_{stat}	P	R	R^2	SE	F_{stat}	P	
Amberjack	0.60	0.36	10.93	7.90	0.01						
Ambon emperor	0.52	0.27	3.76	5.19	0.04						
Barracudas	0.55	0.30	11.28	6.03	0.03	0.07	0.01	22.70	0.02	0.91	Enhanced harvest with no impact to population
Bigeye scad	0.73	0.53	2.72	15.55	0.00						
Blue lined snapper	0.63	0.40	1.30	9.34	0.01	0.14	0.02	1.15	0.06	0.82	Enhanced harvest with no impact to population
Blue-banded surgeonfish	0.66	0.43	1.64	10.54	0.01	0.67	0.45	2.29	2.42	0.22	Enhanced harvest with no impact to population
Brown surgeonfish	0.81	0.66	1.38	27.43	0.00	0.35	0.12	0.48	0.42	0.56	Enhanced harvest with no impact to population
Emperors	0.21	0.05	7.57	0.66	0.43	0.26	0.07	1.85	0.21	0.68	No change in population
Goatfishes	0.50	0.25	5.41	4.56	0.05	0.67	0.45	2.26	2.45	0.22	Enhanced harvest with no impact to population
Gray jobfish	0.02	0.00	11.66	0.01	0.94	0.17	0.03	17.37	0.09	0.79	
Groupers	0.53	0.28	7.76	5.47	0.03	0.72	0.51	1.13	3.14	0.17	Enhanced harvest with no impact to population
Humpback snapper	0.35	0.13	1.49	2.00	0.18	0.40	0.16	3.65	0.57	0.51	No change in population
Inshore snappers	0.24	0.06	7.41	0.83	0.38						
Jacks	0.29	0.08	6.49	1.29	0.28	0.17	0.03	6.75	0.09	0.79	No change in population
Longnose emperor	0.40	0.16	2.26	2.65	0.13	0.33	0.11	9.48	0.37	0.58	No change in population
Mullets	0.72	0.52	5.01	15.35	0.00						
Orangespine unicornfish	0.58	0.34	4.63	7.23	0.02	0.52	0.27	1.33	1.13	0.36	Enhanced harvest with no impact to population
Parrotfishes	0.75	0.57	3.23	18.52	0.00	0.07	0.00	4.22	0.01	0.92	Enhanced harvest with no impact to population
Rainbow runner	0.01	0.00	9.97	0.00	0.99	0.35	0.12	27.73	0.42	0.56	No change in population
Redgill emperor	0.41	0.17	1.42	2.79	0.12						
Squirrelfishes	0.58	0.34	2.13	7.14	0.02	0.30	0.09	2.26	0.30	0.62	Enhanced harvest with no impact to population
Striped bristletooth	0.57	0.33	0.05	6.74	0.02	0.83	0.68	1.29	6.40	0.09	Enhanced harvest with no impact to population
Tomato grouper	0.34	0.12	0.98	1.82	0.20						
Unicornfishes	0.63	0.40	5.83	9.33	0.01	0.52	0.27	10.44	1.09	0.37	
Yellow-edged lyretail	0.04	0.00	5.19	0.02	0.89	0.05	0.00	5.20	0.01	0.94	

Table 17. Regression trends and significance of fish sizes over time of the species comprising the coral reef catches in the Northern Mariana Islands

Species	Catch data					UVC data					Pattern interpretation
	R	R^2	SE	F_{stat}	P	R	R^2	SE	F_{stat}	P	
Acanthurus lineatus	0.55	0.30	0.02	8.89	0.007	0.27	0.07	0.06	0.16	0.727	Smaller individuals harvested & no change in population
Acanthurus triostegus	0.40	0.16	0.03	3.94	0.060						
Acanthurus xanthopterus	0.49	0.24	0.07	6.58	0.018	0.29	0.09	0.10	0.19	0.708	Smaller individuals harvested & no change in population
Aprion virescens	0.62	0.38	0.04	12.79	0.002	0.54	0.29	0.14	0.80	0.465	Smaller individuals harvested & no change in population
Carangoides orthogrammus	0.42	0.18	0.07	4.60	0.044	0.88	0.77	0.05	6.65	0.123	Smaller individuals harvested & no change in population
Caranx i'e'	0.41	0.16	0.04	4.13	0.055						
Caranx melampygus	0.01	0.00	0.05	0.00	0.958	0.87	0.75	0.01	5.99	0.134	No change in population
Caranx sexfasciatus	0.29	0.09	0.10	1.97	0.175	0.48	0.23	0.04	0.59	0.523	No change in population
Cephalopholis urodeta	0.33	0.11	0.03	2.52	0.127	0.22	0.05	0.03	0.10	0.777	No change in population
Cheilinus trilobatus	0.26	0.07	0.05	1.54	0.228	0.61	0.37	0.12	1.16	0.394	No change in population
Chlorurus microrhinos	0.49	0.24	0.04	6.55	0.018	0.81	0.66	0.07	3.86	0.188	Smaller individuals harvested & no change in population
Chlorurus sordidus	0.21	0.04	0.04	0.94	0.343	0.00	0.00	0.04	0.00	0.999	No change in population
Crenimugil crenilabis											
Ellochelon vaigiensis	0.10	0.01	0.07	0.23	0.638						
Epinephelus fasciatus	0.84	0.70	0.01	49.55	0.000	0.29	0.08	0.03	0.18	0.713	Smaller individuals harvested & no change in population
Epinephelus merra	0.12	0.01	0.03	0.30	0.588						
Etelis carbunculus	0.58	0.34	0.04	10.66	0.004						
Gerres acinaces											
Gnathodentex aurolineatus	0.56	0.31	0.03	9.51	0.006	0.69	0.48	0.10	1.84	0.308	Smaller individuals harvested & no change in population
Hipposcarus longiceps	0.40	0.16	0.06	3.97	0.060						
Kyphosus cinerascens	0.08	0.01	0.05	0.14	0.715	0.85	0.72	0.04	5.20	0.150	No change in population
Lethrinus atkinsoni	0.41	0.17	0.06	4.20	0.053						
Lethrinus harak	0.50	0.25	0.02	7.02	0.015						
Lethrinus obsoletus	0.38	0.14	0.02	3.48	0.076						
Lethrinus olivaceus	0.28	0.08	0.06	1.81	0.193						
Lethrinus rubrioperculatus	0.35	0.13	0.03	3.01	0.097						
Lethrinus xanthochilus	0.11	0.01	0.07	0.28	0.602	0.73	0.53	0.11	2.26	0.272	No change in population
Lutjanus fulvus	0.51	0.26	0.02	7.54	0.012	0.40	0.16	0.02	0.38	0.600	Smaller individuals harvested & no change in population
Lutjanus kasmira	0.62	0.38	0.02	13.14	0.002	0.62	0.39	0.10	1.27	0.377	Smaller individuals harvested & no change in population
Lutjanus monostigma	0.41	0.17	0.05	4.24	0.052	0.58	0.34	0.02	1.04	0.415	Smaller individuals harvested & no change in population

Moolgarda engeli										
Mulloidichthys flavolineatus	0.12	0.01	0.04	0.29	0.594	0.33	0.11	0.21	0.24	0.672	No change in population
Mulloidichthys ti'ao	0.41	0.17	0.02	4.24	0.052						
Myripristis berndti	0.39	0.15	0.05	3.79	0.065	0.67	0.45	0.02	1.65	0.328	No change in population
Naso lituratus	0.27	0.07	0.03	1.65	0.213	0.76	0.57	0.14	2.70	0.242	No change in population
Naso unicornis	0.05	0.00	0.03	0.06	0.809	0.73	0.53	0.22	2.29	0.269	No change in population
Parupeneus barberinus	0.11	0.01	0.08	0.25	0.623	0.39	0.15	0.12	0.35	0.615	No change in population
Parupeneus bifasciatus	0.40	0.16	0.05	4.05	0.057	0.08	0.01	0.06	0.01	0.917	No change in population
Parupeneus multifasciatus	0.48	0.23	0.02	6.38	0.020	0.85	0.72	0.05	5.06	0.153	Enhanced harvest with no impact to population
Pristipomoides auricilla	0.08	0.01	0.02	0.14	0.717						
Pristipomoides zonatus	0.12	0.01	0.02	0.30	0.592						
Rhinecanthus aculeatus	0.43	0.18	0.09	4.68	0.042						
Sargocentron spiniferum	0.32	0.10	0.02	2.41	0.136	0.06	0.00	0.08	0.01	0.941	No change in population
Sargocentron tiere	0.49	0.24	0.04	6.46	0.019	0.70	0.49	0.04	1.95	0.297	Smaller individuals harvested & no change in population
Scarus altipinnis	0.70	0.49	0.04	20.07	0.000	0.40	0.16	0.07	0.38	0.601	Smaller individuals harvested & no change in population
Scarus psittacus	0.55	0.30	0.03	8.90	0.007	0.07	0.00	0.11	0.01	0.934	Smaller individuals harvested & no change in population
Scarus schlegeli	0.58	0.34	0.04	10.66	0.014	0.66	0.43	0.05	1.53	0.342	Smaller individuals harvested & no change in population
Selar crumenophthalmus	0.28	0.08	0.05	1.78	0.197						
Siganus argenteus	0.33	0.11	0.09	2.58	0.123	0.60	0.36	0.06	1.15	0.397	No change in population
Siganus spinus	0.02	0.00	0.04	0.01	0.933						
Variola louti	0.30	0.09	0.04	2.09	0.163	0.93	0.86	0.02	12.01	0.074	No change in population

Trend interpretation		
Catch	UVC	Enhanced harvest & population recovery/improving
Catch	UVC	Larger individuals harvested & population recruiting
Catch	UVC	Smaller individuals harvested & increasing adult population
Catch	UVC	No change in fished population w/ recruitment ongoing
Catch	UVC	Smaller individuals harvested & no change in population
Catch	UVC	No change in population
Catch	UVC	Enhanced harvest with no impact to population
Catch	UVC	Sustainable harvest & population recovering/improving
Catch	UVC	Population/stock is being impacted by fishing

Calculating ABCs for vulnerable species with limited catch data: Difference coral reef fishes have varying level of vulnerability depending on their life history strategy, abundance, and susceptibility to fishing. Species such as *Cheilinus undulatus* (humphead wrasse), *Bolbometopon muricatum* (bumphead parrotfish), and reef sharks were considered as rare and/or vulnerable. They appear infrequently in the catch time series since there is no fishery that targets these species. Encounters with these species are especially rare events even in underwater observations and therefore the probability of an interaction with a certain coral reef fishing method is highly unlikely unless there is a fishery that tracks and targets these group. The lack of catch information limits the utility of Tier 5 control rule and therefore would require an alternate procedure to specify an ABC. These species are highly mobile and are best represented in the tow-board data for NOAA PIFSC-CRED. The tow-board data from the two most recent cruises was used for American Samoa (2008 and 2010), Hawaii, PRIAs and the Mariana Islands (2009 and 2011) because this is the most comparable data sets within the database. Biomass from individual sightings was standardized to the area of each tow expressed in kg/ha (data summarized by Williams, NOAA-PIFSC-CRED). This density information was multiplied with the estimated area of hard bottom habitats on reef fronts from 0-30m (from Williams 2009) to extrapolate an estimated biomass of each species per island. Assuming that this is the standing stock per region and 50% of which is the MSST (includes areas with virgin biomass with a strong assumption that these remote areas are connected to the open areas), the ABC will be set lower than 50% to exercise the precautionary principle. The following tables are the estimated biomass and alternatives for ABCs for each island areas:

Table 18. Estimated standing biomass from tow board surveys in American Samoa with alternative ABC values for vulnerable reef fish species.

Alternatives	Reef sharks		Humphead wrasse		Bumphead parrotfish	
	Biomass	Catch[1]	Biomass	Catch[2]	Biomass	Catch
Estimated biomass (lbs)	26,181	118	34,860	32	-	-
ABC at 50% of biomass	13,091	118	17,430	32	-	-
ABC at 25% of biomass	6,545	118	8,715	32	-	-
ABC at 10% of biomass	2,618	118	3,486	32	-	-
ABC at 5% of biomass	1,309	118	1,743	32	-	-

NOTE:

1 Only 1 data point in the period considered (2004-2008)

2 Only 3 data points in the period considered (2004-2008)

Table 19. Estimated standing biomass from tow board surveys in CNMI with alternative ABC values for vulnerable reef fish species.

Alternatives	Reef sharks		Humphead wrasse		Bumphead parrotfish	
	Biomass	Catch	Biomass	Catch[1]	Biomass	Catch
Estimated biomass (lbs)	111,997	-	40,184	66	-	-
ABC at 50% of biomass	55,999	-	20,092	66	-	-
ABC at 25% of biomass	27,999	-	10,046	66	-	-
ABC at 10% of biomass	11,200	-	4,018	66	-	-
ABC at 5% of biomass	5,600	-	2,009	66	-	-

NOTE:

1 Only 1 data point in the period considered (2004-2008)

Table 20. Estimated standing biomass from tow board surveys in Guam with alternative ABC values for vulnerable reef fish species.

Alternatives	Reef sharks		Humphead wrasse		Bumphead parrotfish	
	Biomass	Catch	Biomass	Catch	Biomass	Catch
Estimated biomass (lbs)	138,830	1,113	39,200	795	-	-
ABC at 50% of biomass	69,415	1,113	19,600	795	-	-
ABC at 25% of biomass	34,708	1,113	9,800	795	-	-
ABC at 10% of biomass	13,983	1,113	3,920	795	-	-
ABC at 5% of biomass	6,942	1,113	1,960	795	-	-

Table 21. Estimated standing biomass from tow board surveys in Hawaii with alternative ABC values for vulnerable reef fish species.

Alternatives	Reef sharks		Humphead wrasse		Bumphead parrotfish	
	Biomass	Catch	Biomass	Catch	Biomass	Catch
Estimated biomass (lbs)	2,231,321	-	N/A	N/A	N/A	N/A
ABC at 50% of biomass	1,115,661	-	N/A	N/A	N/A	N/A
ABC at 25% of biomass	557,830	-	N/A	N/A	N/A	N/A
ABC at 10% of biomass	223,132	-	N/A	N/A	N/A	N/A
ABC at 5% of biomass	111,566	-	N/A	N/A	N/A	N/A

Bumphead parrotfishes are the rarest amongst the entire species/species group analyzed. There were no recorded sightings in American Samoa and the Mariana Islands even it is within the range of the species. The only sightings of bumphead parrotfish was in Wake Island in the Pacific Remote Island Areas. Humphead wrasse and bumphead parrotfishes are known to be naturally absent in the Hawaii archipelago.

Justification for using percent reduction and exemption from SEEM analysis: The social, economic, ecological and management uncertainty (SEEM) analysis was not done due to a lack of large fishery. In setting the ACL, a SEEM analysis could not be performed on this set of stocks primarily because of the nature of the fishery being multispecies and multigear. The strength of the SEEM analysis lies on good representation of participants that has knowledge of the species and the gear it is being caught. In a fishery that has hundreds of species and several ways of catching the species, getting a good representation to conduct a reliable SEEM analysis highly impractical. In addition, the management uncertainty, although we know is high, quantifying it will be a futile task because not a lot of data exist even for a qualitative analysis. Even if management uncertainty is high because of the absence of in-season monitoring, the landings are also low enough relative to the standing archipelagic biomass. The coral reef fishery is different from the Main Hawaiian Island deep 7 bottomfish fishery where there are only 7 species involved with an in-season monitoring and the fishery participation is limited to a couple of specialized hi-liners. A percent reduction is more appropriate based on expert opinion.

Justification for utilizing post season accountability measure overage adjustment: In-season monitoring is currently beyond the capability of the local resource management agencies in all island commonwealth, territories and the State of Hawaii. None of the island commonwealth and territories has mandatory catch reporting. Total catches covering only areas within the survey boundaries are estimated using expansions of the creel survey catch estimates. The expansions are done on an annual basis in order to ensure that there is enough data to pool to come up with a reasonable catch estimate. Realistic monthly expansions are not possible without sacrificing the credibility of the results. Although the State of Hawaii are able to monitor and project catches for the deep 7 bottomfish fishery, attaining a complete catch report in a timely manner from a diverse and high number of participants in the coral reef fishery proved to be a big challenge. In addition, the only sector that is being monitored in Hawaii is the commercial sector. Majority of the coral reef fish catch are known to come from the recreational sector which is poorly monitored. The current personnel and logistics can only accommodate a limited number of species for near real-time monitoring. Expanding the number of species to be monitored is beyond the current capabilities and unless a significant funding resource is provided for the expansion, in-season accountability measures is not possible.

A post season ovarge adjustment is an option specified in NMFS NS1 where on an annual basis, the Council must determine as soon as possible after the fishing year if an ACL was exceeded. If an ACL was exceeded, AMs must be triggered as soon as possible to correct the operational issue that caused the ACL overage, as well as remedy any biological consequences resulting from the overage. These AMs could include, among other things, modifications of in-season AMs or overage adjustments. If catch exceeds the ACL for a given stock or stock complex more than once over a 4-year period, the system of ACLs and AMs should be re-evaluated and modified, if necessary, to improve its performance and effectiveness. Table 10 showed the average catch over the past 5 years in Hawaii parrotfish and surgeonfish harvest exceeded the ACL. This can be explained by an increase in parrotfish and surgeonfish biomass in all island areas making more individuals available in the fishery based on data from underwater visual census surveys by NOAA CRED (Figure 15 and 16). This may have resulted in an increase in CPUE over the last 5 years. Therefore, the exceedance was due to an increase in the harvestable population which obviously did not result in a decrease in the stock.

In addition, the Council considers establishing a multi-year ACL specification for the coral reef MUS. At minimum, the specification should be applied to the 2012 and the 2013 fishing year. Since final 2012 catch data is not likely to be available before the start of the 2013 fishing year, there would be no new information available to specify a different ACL value for the 2013 fishing year. At best, the data can be made available and discussed during the June meeting of the SSC and Council. If the decisions can be made in the same meeting, then any adjustment will only cover half of the year which would be impractical to enforce. Additionally, any overages in fishing year 2012 (if they occur) cannot be accounted for until the 2014 fishing year

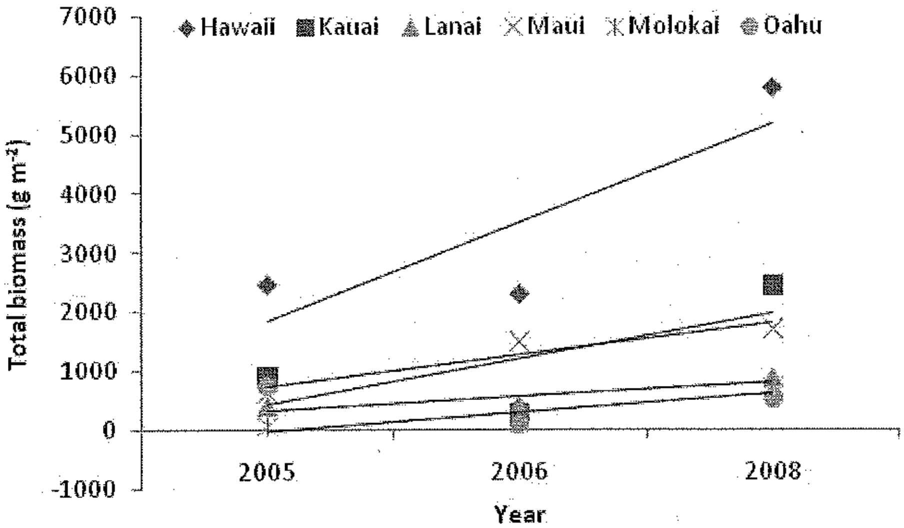

Figure 11. Temporal trend in surgeonfish biomass in 2005, 2006 and 2008 showing increasing trends in the major islands of Hawaii. This coincides with the increase in catches thereby exceeding the ACLs. The exceedance is not due to a decline in stock therefore should not result in overage adjustment.

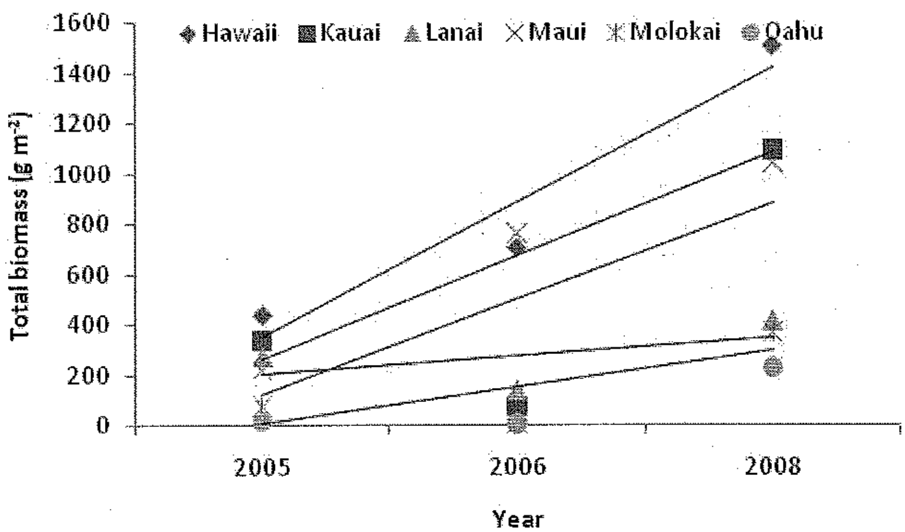

Figure 12. Temporal trend in parrotfish biomass in 2005, 2006 and 2008 showing increasing trends in the major islands of Hawaii. This coincides with the increase in catches thereby exceeding the ACLs. The exceedance is not due to a decline in stock therefore should not result in overage adjustment.

Alternative Not Considered in Detail

Specification based on trophic level aggregation

Under this alternative, NMFS would specify an ACL on trophic groups rather than taxonomic designations. This can be considered as a functional scheme of managing stocks. Changes in trophic ratio may be indicative of impacts on the food chain brought about by multiple stressors such as fishing, climate change, trophic balance, and predator-prey relationships. Although this will minimize the number of ACLs specifications, the monitoring is being done on taxonomic groupings and will also entail additional layer in the relational database to establish trophic assignments. In addition, some species changes diet as it progress through its life history.

Specification of separate State and Federal ACLs

Under this alternative, NMFS would specify a proportion of the overall ACL to be applied in federal waters, and when the federal-ACL was attained, NMFS would close the commercial and non-commercial fisheries for coral reef fish in federal waters only. However, to meet the fishery management objective of preventing overfishing, the local fishery resource management agencies of American Samoa, Guam, CNMI and Hawaii would need to specify an ACL that would apply in state waters. NMFS cannot compel the state and territories to enact rules and regulations to specify a state-ACL. Therefore, if only a federal-ACL was specified, and NMFS closed federal waters upon attainment of the federal-ACL, vessels could continue fishing unabated within state waters and NMFS would have no ability to prevent the overall ACL from being exceeded. For this reason, this alternative was not considered in detail.

Specification of ACLs for Pacific Remote Island Area reef fish stocks

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 are no coral reef ecosystem habitats 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.

Affected Environment and Potential Impacts of the Proposed ACL Specifications

Resources harvested in coral reef fisheries of the western Pacific are highly diverse, with up to 700 species appearing in catch records in the Marianas (Guam and CNMI) and approximately 300 species in American Samoa and Hawaii. In each island area, commercial and non-commercial fishermen fish from shore, in the water, and from vessels and employ numerous gears to harvest CREMUS, including multiple variations of hook and line methods, nets, spearfishing and hand gathering. Additionally, 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. 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. For these reasons, coral reef fisheries of the western Pacific are monitored and managed primarily by local resource management agencies.

In American Samoa, 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 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 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 expansions algorithoms 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, subsistence fishing activities.

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

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 should not be used as a basis for management or allocation decisions. As of 2011, the issues raised by the NRC have not been resolved by MRFSS in Hawaii.

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 their 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.

If the proposed ACL specifications were 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, 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 has been collected. Therefore, in season AMs (e.g., fishery closure) 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 results in biological consequences to 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 2014 fishing year.

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

Affected Coral Reef Fisheries and Potential Impacts

American Samoa Coral Reef Fisheries and Potential Impacts

The Samoa Archipelago is located northeast of Tonga and consists of seven major volcanic islands, several small islets, and two coral atolls. The largest islands in this chain are Upolu (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 crumenopthalmus* 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).

Although coral reef fisheries surveys in American Samoa cover fishing by persons engaged in commercial, recreational, subsistence fishing activities, only estimates of total commercial landings of "Reef fishes" are made available on the WPacFIN website which in 2010, 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 declines in coral reef catches have been observed since the 1990s. 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 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 13). Since 2001 commercial reef fish catches are estimated to be 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 prohibited the use of SCUBA gear while fishing to help reduce fishing pressure on the reefs.

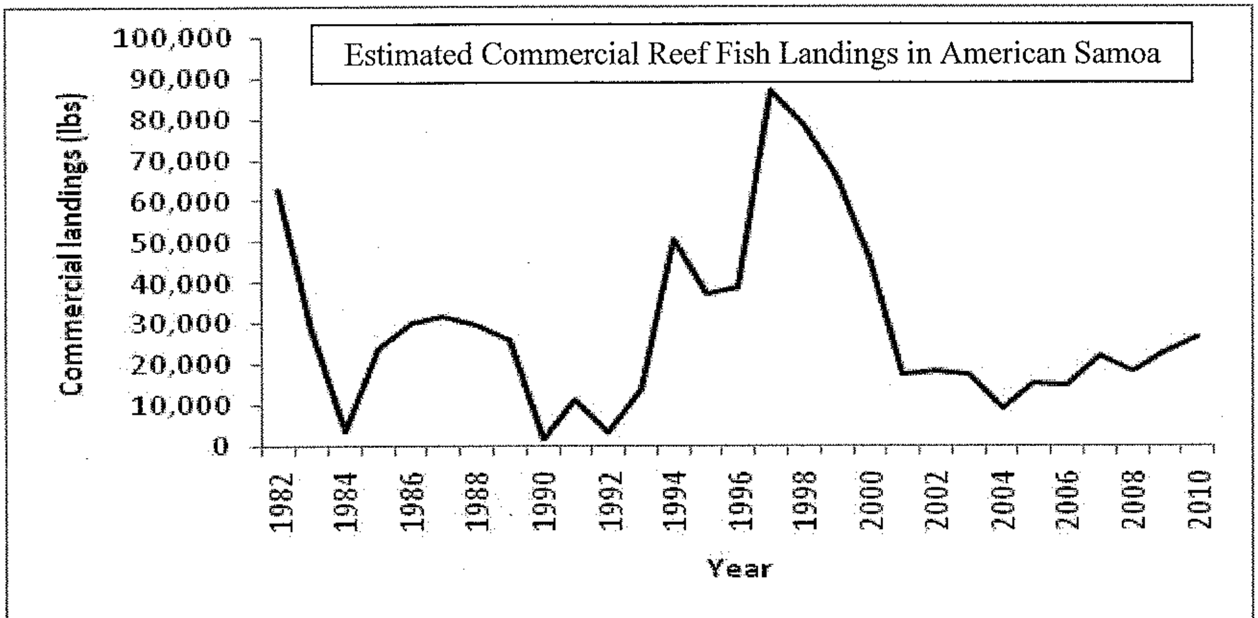

Figure 13. Estimated commercial landings of reef fish in American Samoa from 1982 to 2010

The boat-based coral reef fisheris 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 spear in 2001. The number of boats ranges from a low of 15 in 1992 following a hurricane (Val) that hit the island in December 1991 to a high of 37 boats in 1986 during the peak of the bottomfish fishery (**Error! Reference source not found.**4).

Fishery participation has had a trend of declining 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 3 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 coral reef fishery in 2010 was \$70,894, based on the 2010 catch of 26,453 lb and the average price of reef fish at \$2.68 per pound. Assuming participation and fishing effort was equal throughout the fleet in 2009, each vessel would have caught approximately 1,202 lb or CREMUS valued at \$3,222.

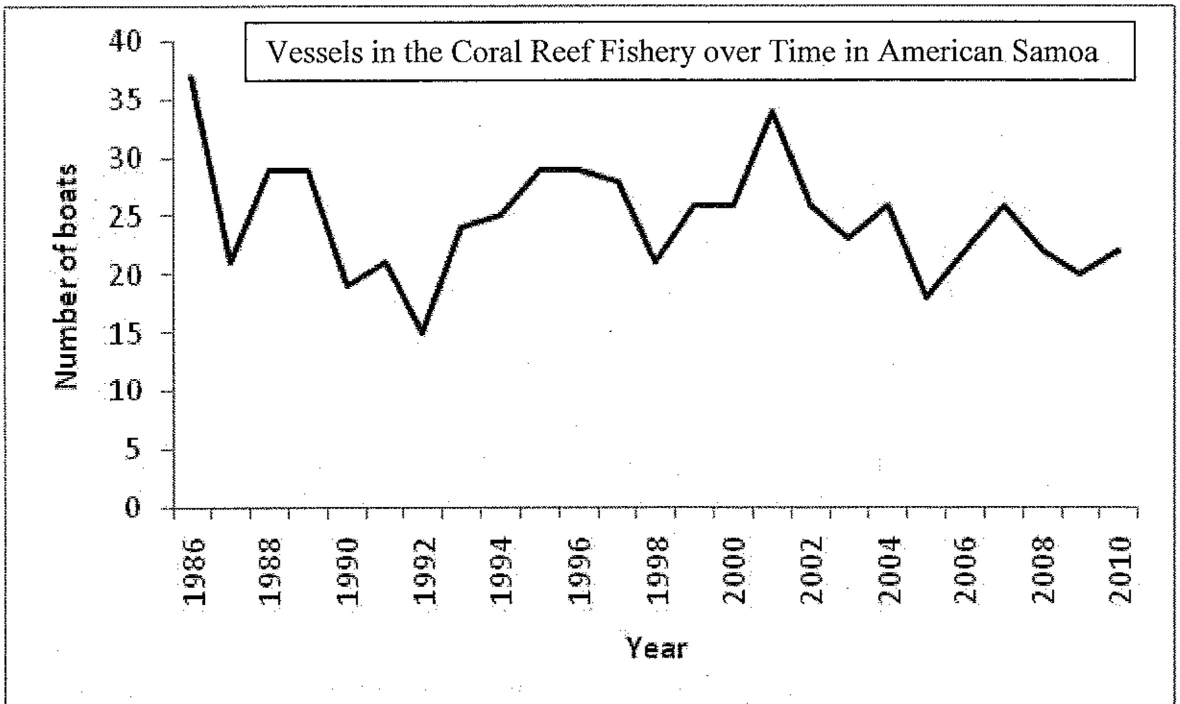

Figure 14. Number of vessels participating in the American Samoa coral reef fishery from 1986 to 2010

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

Under the proposed action fishing for American Samoa CREMUS would be subject to annual catch limits shown in Table 11. Tthe ACL specifications are generally higher than recent harvests so the fishery is not expected to exceed the ACL, and the ACLs are not expected to result in a race to the fish. The proposed ACLs are not expected to result in a change to the conduct of the fishery including a change in 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 will continue to be done by American Samoa Department of Marine and Wildlife Resources (DMWR). The accountability measure (AM) for American Samoa coral reef fisheries would require a post-season review of the catch data to determine whether an ACL for for any coral reef stock or stock complex was exceeded. If an ACL is exceeded and results in biological consequences to 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 2014 fishing year. Therefore, the tracking of catch relative to an ACL is expected to result in improved accuracy and timeliness in species specific catch reporting on an annual basis.

Guam Coral Reef Fisheries and Potential Impacts

The Mariana Archipelago (approximately 396 square miles) 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 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) 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 mollusc taxa, and four echinoderm taxa (Hensley and Sherwood; Myers 1997).

Virtually no information exists on the condition of the reefs on 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 resources harvested in Guam are taken from the EEZ, primarily because they are associated with less accessible offshore banks. 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, 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, subsistence fishing activities, only estimates of total commercial landings of "Reef fishes" are made available on the WPacFIN website which in 2009 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 landing trend in Guam showed an increase from 1982 to 1996 then started to decline after a short term increase in early 2000. Catches declined thereafter and remained between 80,000 to 100,000 lbs in the recent years (15).

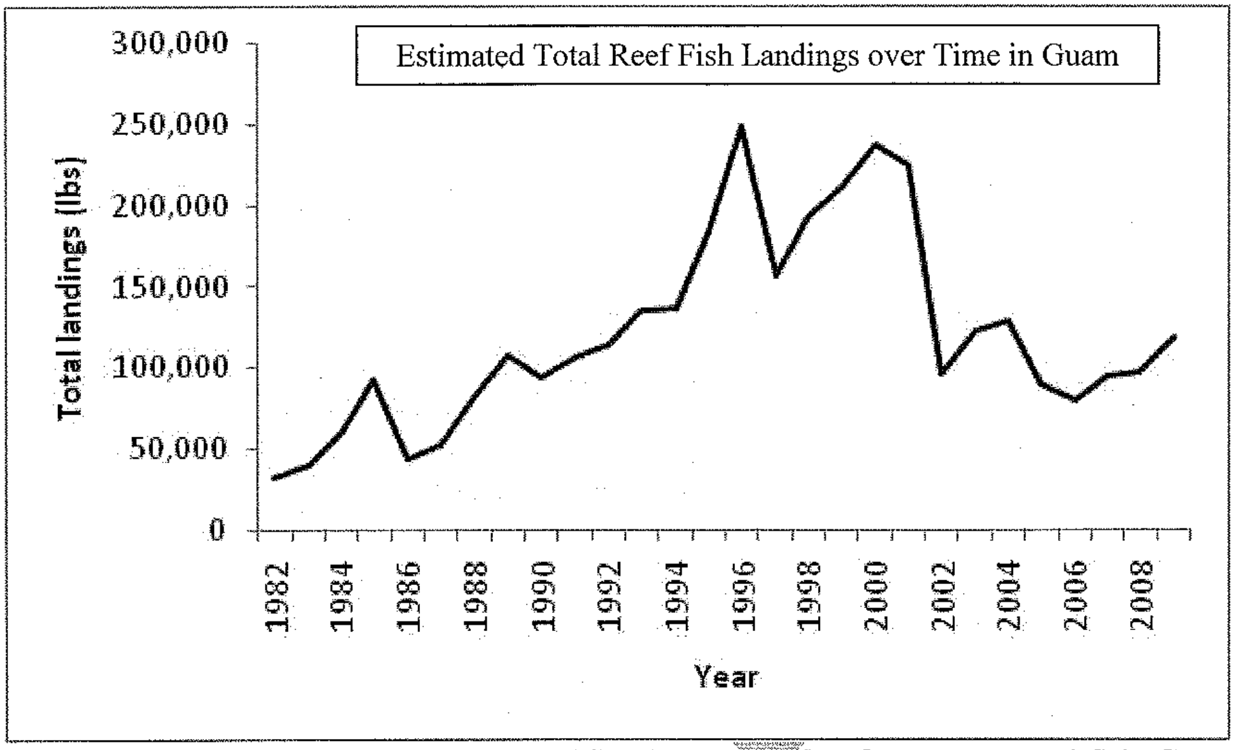

Figure 15. Estimated total landings of reef fish (commercial and non-commercial) in Guam from 1982 to 2009

The number of boats participating in the coral reef fishery ranged from 58 in 1983 to 210 in 1995 (**Error! Reference source not found.**16). The number of boats participating in 2009 was approximately 116 boats. There were 3 to 4 fishermen per boat, thus, the estimated coral reef boat based fishing population is approximately 348 individuals.

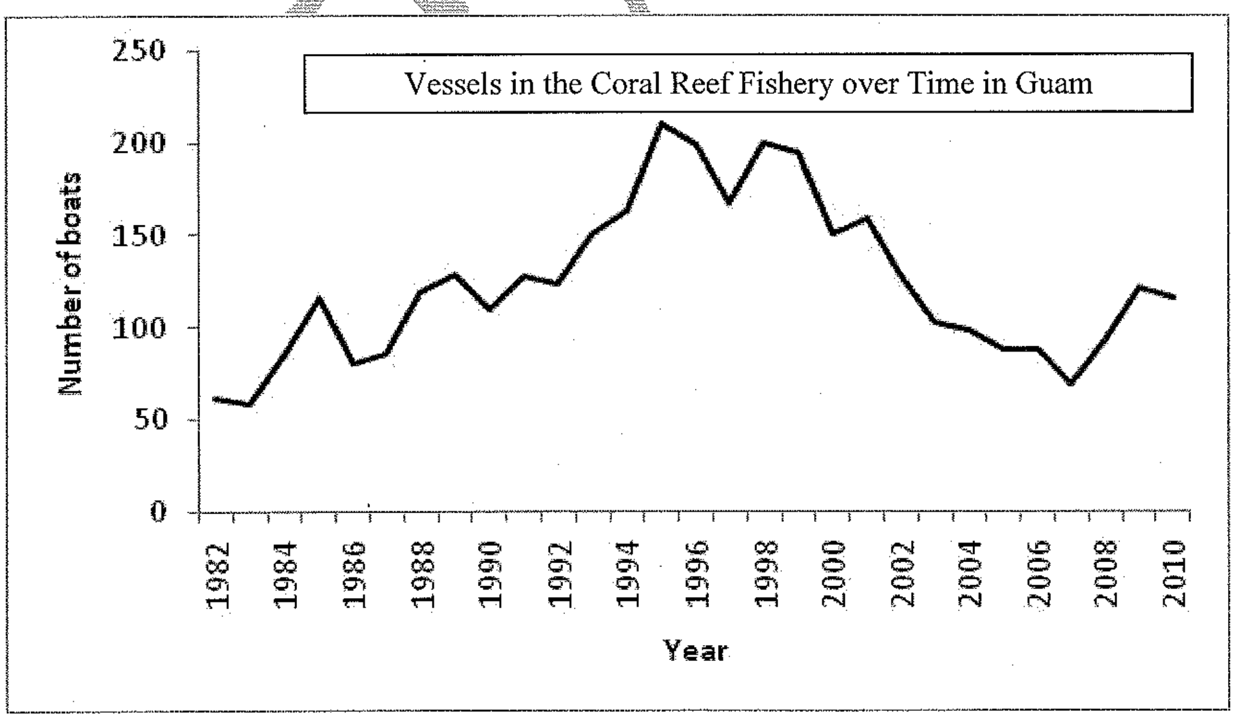

Figure 16. Number of vessels participating in the Guam coral reef fishery from 1982 to 2009

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 proposed action, fishing for Guam coral reef ecosystem MUS would be subject to annual catch limits shown in Table 12. The ACL specifications are generally higher than recent harvests so the fishery is not expected to exceed the ACL, and the ACLs are not expected to result in a race to the fish. The proposed ACLs are not expected to result in a change to the conduct of the fishery including a change in 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 will continue to be done by Guam Division of Aquatic and Wildlife Resources (DAWR). The accountability measure (AM) for Guam coral reef fisheries would require a post-season review of the catch data to determine whether an ACL for for any coral reef stock or stock complex was exceeded. If an ACL is exceeded and results in biological consequences to 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 2014 fishing year. Therefore, the tracking of catch relative to an ACL is expected to result in improved accuracy and timeliness in species specific catch reporting on an annual basis.

CNMI Coral Reef Fisheries and Potential Impacts
The Mariana Archipelago (approximately 396 square miles) 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 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 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 CNMI cover fishing by persons engaged in commercial, recreational, subsistence fishing activities, only estimates of total commercial landings of "Reef fishes" are made available on the WPacFIN website which in 2009 totaled 72,211 pounds in 2009 (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 (**Error! Reference source not found.**17).

The number of participants in the coral reef fishery of CNMI has fluctuated over the past decade. The highest number of boats engaged in bottomfishing that also caught shallow water coral reef taxa and spearfishing was in 2007 with 27 boats (**Error! Reference source not found.**18). The most recent data indicate that only 4 boats are participating 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 fish of reef fish in 2009 was approximately $2.59. With a total estimated landing of 72,211 lb, the coral reef fishery in CNMI is valued at approximately $187,026. Assuming participation and fishing effort was equal throughout the fleet in 2009, each vessel would have caught approximately 18,053 lb of CREMUS valued at $46,457.

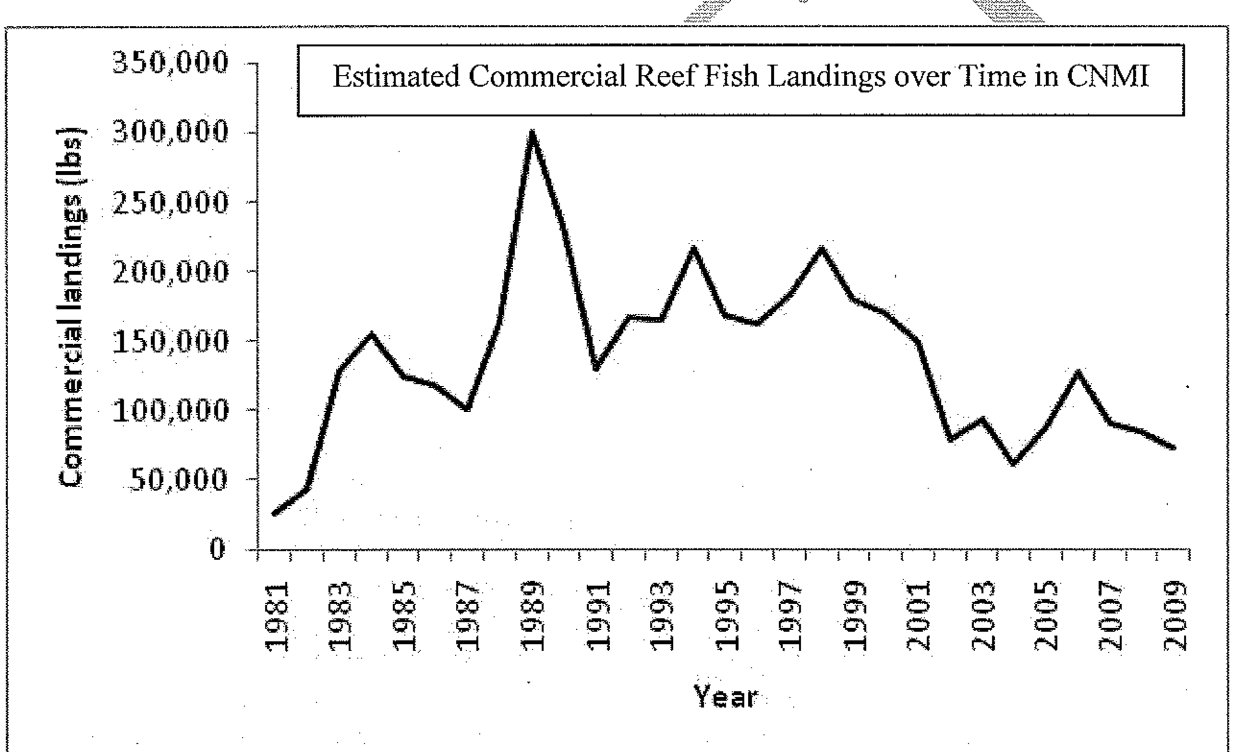

Figure 17. Estimated commercial landings of reef fishes in the CNMI from 1981 to 2009

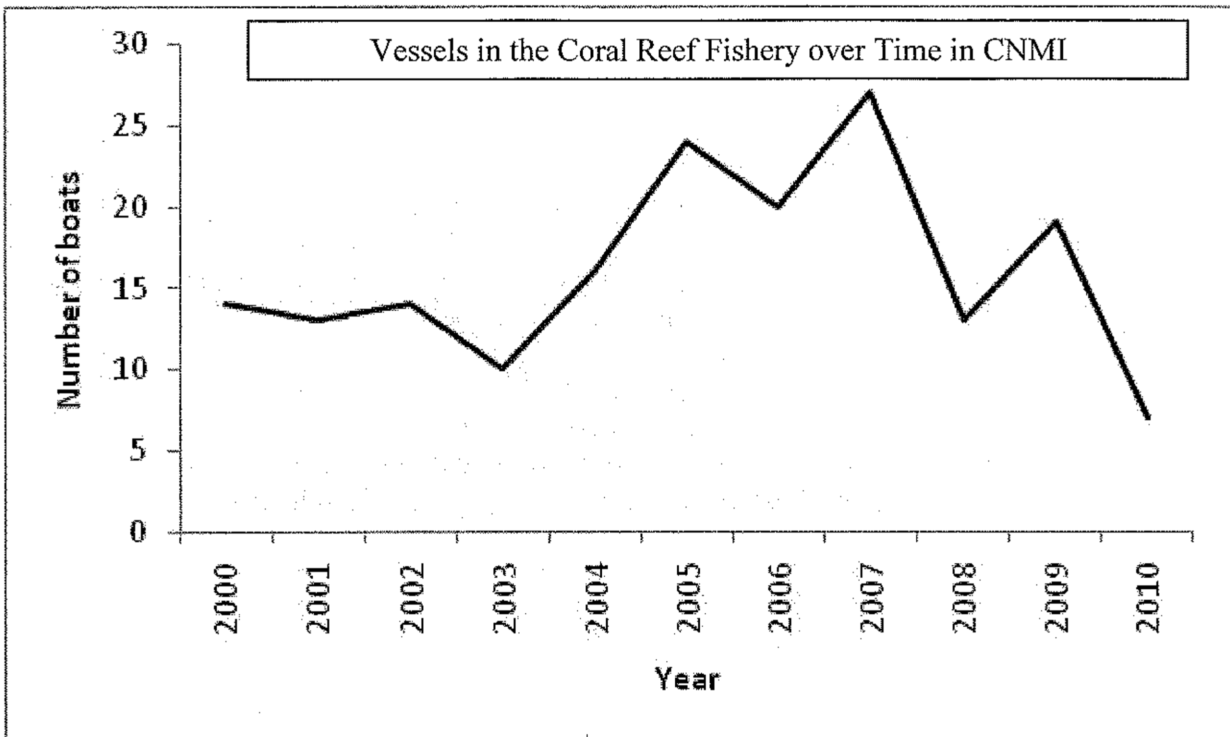

Figure 18. Number of vessels participating in the CNMI coral reef fishery from 2000 to 2010

Potential Impacts of the Proposed ACL specifications and AM on CNMI Coral Reef Fisheries
Under the proposed action, fishing for CNMI coral reef ecosystem MUS would be subject to annual catch limits shown in Table 13. The ACL specifications are generally higher than recent harvests so the fishery is not expected to exceed the ACL, and the ACLs are not expected to result in a race to the fish. The proposed ACLs are not expected to result in a change to the conduct of the fishery including a change in 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 will 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 for any coral reef stock or stock complex was exceeded. If an ACL is exceeded and results in biological consequences to 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 2014 fishing year. Therefore, the tracking of catch relative to an ACL is expected to result in improved accuracy and timeliness in species specific catch reporting on an annual basis.

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 (75 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, Kaho`olawe (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 extend from 3-200 nmi offshore however, the majority of CREMUS catch are harvested from nearshore waters under jurisdiction of the State of Hawaii from vessels or from the shoreline by both commercial and non-commerical 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.

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 19). The highest commercial landing occurred in 1999 with close to 3.5 million lb. 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).

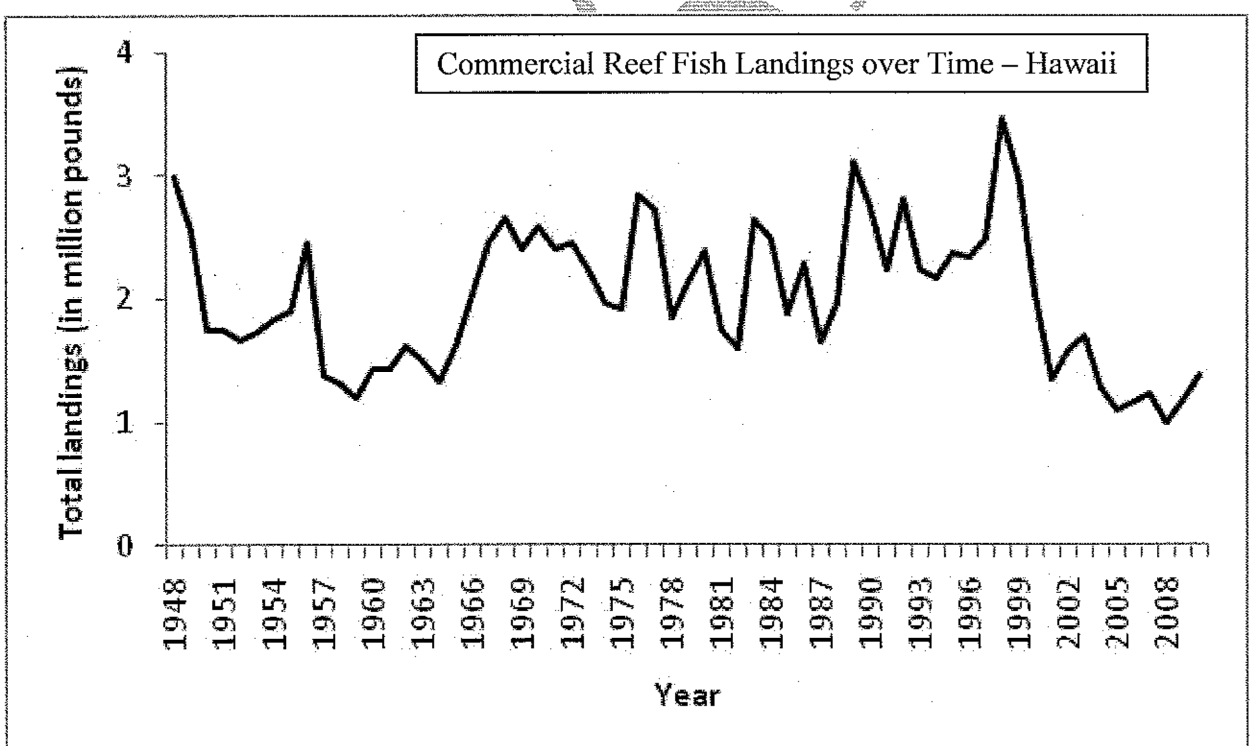

Figure 19. Reported Commercial landings of reef fishes in the Hawaii from 1948 to 2010

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 number of individuals that participate in Hawaii's coral reef fisheries is unknown and could include hundereds of thousands of individuals that fish from both the shoreline and from vessels. 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 license holders fish for CREMUS, therefore the exact number of vessels 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 by primarily by surround net and in smaller amount 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 proposed action, fishing for Hawaii coral reef ecosystem MUS would be subject to annual catch limits shown in Table 14. The ACL specifications are generally higher than recent harvests so the fishery is not expected to exceed the ACL, and the ACLs are not expected to result in a race to the fish. The proposed ACLs are not expected to result in a change to the conduct of the fishery including a change in 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 commercial marine licensese will continue to be done by HDAR. The accountability measure (AM) for Hawaii coral reef fisheries would require a post-season review of the catch data to determine whether an ACL for for any coral reef stock or stock complex was exceeded. If an ACL is exceeded and results in biological consequences to 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 2014 fishing year. T Therefore, the tracking of catch relative to an ACL is expected to result in improved accuracy and timeliness in species specific catch reporting on an annual basis.

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.

American 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 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 none of the reef fish fisheries is expected to exceed the ACL, and so no change to the 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.

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 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 none of the reef fish fisheries is expected to exceed the ACL, and so no change to the 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.

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 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 none of the reef fish fisheries is expected to exceed the ACL, and so no change to the 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.

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 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 none of the reef fish fisheries is expected to exceed the ACL, and so no change to the 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.

Affected Resources and Potential Impacts

American Samoa Affected Resources and Potential Impacts

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 1). Based on recent catch landings reported in (Table 11), 90% of the CREMUS catch in American Samoa is comprised of 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 crumenopthalmus* (atule) and several species of mollusks (snails, octopus and clams) and crustaceans (crabs). 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 collect of Bycatch information, no such information is currently available indicating that most of the fish that are caught are kept and 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/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 minimizes 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 in 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 points 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 determined reference points 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), estimated exploitation rates for CREMUS in American Samoa did not exceed 8% for any taxanomic 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., Tutuila, main Hawaiian Islands, Guam and southern islands of CNMI).

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

The Council and its SSC have grouped individual stocks of American Samoa CREMUS into higher taxanomic groups (stock complex) generally at the family level and propose to specify ACLs for each CREMUS stock and stock complex and are listed in Table 11. The ACL specification for each stock and stock complex is proposed to be set at a level significantly lower that the estimated biomass, where available. Under the proposed action, no new monitoring would be implemented however, as an AM a post-season review of the catch data will be conducted as soon as possible after the fishing year to determine whether an ACL for for any stock or stock complex was exceeded. If an ACL is exceeded and results in biological consequences to 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 2014 fishing year.

The impacts of an ACL specification for American Samoa CREMUS are expected to be beneficial because the ACLs would limit the harvest of all CREMUS in order to help ensure that coral reef fisheries do not become overfished. The additional level of post season review of the catch would also provide a new level of management review of the fisheries and is an opportunity for refinement of ACL 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.

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 MSA, 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 American Samoa (WPFMC 2009a). There is no critical habitat designated for ESA-listed marine species around American Samoa.

Applicable ESA Coordination – 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 was 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 have occurred since the FEP was implemented that require further consultation.

Marine Mammals

The MMPA prohibits, with certain exceptions, the take of marine mammals in the U.S. and by U.S. citizens on the high seas. The coral reef fisheries in American Samoa are listed as Category III fisheries under Section 118 of the MMPA (75 FR 68468, November 8, 2010). A Category III fishery is one with a low likelihood or no known incidental takings of marine mammals. NMFS has also concluded that these fisheries, as currently conducted, will not affect marine mammals in any manner not considered or authorized under the MMPA. Table 22 shows non-ESA listed marine mmals occurring around American Samoa.

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 22. Non ESA-listed marine mammals occuring 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 simus*	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. Loggerhead (*Caretta caretta*) and green sea turtles (*Chelonia mydas*) are listed as threatened (the green sea turtle is listed as threatened throughout its Pacific range, except for the endangered population nesting on the Pacific coast of Mexico). These five species of sea turtles are highly migratory, or have a highly migratory phase in their life history (NMFS 2001). 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 2009g).

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 should be considered an accidental visitor to the archipelago. Other seabirds not listed under the ESA found in American Samoa are listed in **Error! Reference source not found.**3.

Table 23. Seabirds occuring 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*

Residents (i.e., breeding)		
Samoan name	**Common name**	***Scientific name***
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 2009).

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

The proposed ACL specification and AM would not have a direct effect on the 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 would further ensure biologically-sustainable catches for fishery stocks. Because these fisheries are currently sustainably managed and subject to conservation measures in accordance with various resource conservation and management laws, the ACL 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.

Guam Affected Resources and Potential Impacts

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 1). Based recent catch landings reported in **Error! Reference source not found.** 12, 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), the coastal pelagic jack, *Selar crumenopthalmus* (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 kept and 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/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 in 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 points 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 determined 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) , estimated exploitation rates for CREMUS in Guam did not exceed 8% for any taxanomic 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., Tutuila, main Hawaiian Islands, Guam and 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 taxanomic groups (stock complex) generally at the family level and propose to specify ACLs for each CREMUS stock and stock complex and are listed inTable 12. The ACL specification for each stock and stock complex is proposed to be set at a level significantly lower that the estimated biomass, where available. Under the proposed action, no new monitoring would be implemented however, as an AM a post-season review of the catch data will be conducted as soon as possible after the fishing year to determine whether an ACL for for any stock or stock complex was exceeded. If an ACL is exceeded and results in biological consequences to 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 2014 fishing year.

The impacts of an ACL specification for CREMUS in Guam are expected to be beneficial because the ACLs would limit the harvest of all CREMUS in order to help ensure that coral reef fisheries do not become overfished. The additional level of post season review of the catch would also provide a new level of management review of the fisheries, and is an opportunity for refinement of ACL 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 Guam's coral reef fisheries.

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 MSA, 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 – 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 have occurred since the FEP was implemented that require further consultation.

Marine Mammals

The MMPA prohibits, with certain exceptions, the take of marine mammals in the U.S. and by U.S. citizens on the high seas. The coral reef fisheries in the Mariana Archipelago are listed as Category III fisheries under Section 118 of the MMPA (75 FR 68468, November 8, 2010). A Category III fishery is one with a low likelihood or no known incidental takings of marine mammals. NMFS has also concluded that these fisheries, as currently conducted, will not affect marine mammals in any manner not considered or authorized under the MMPA. **Error!**

Reference source not found.4 lists known non-ESA listed marine mammals that have been observed in the Mariana Archipelago and are protected by the MMPA.

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 24. Non-ESA listed marine mammals occuring 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 simus*
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. Loggerhead (*Caretta caretta*) and green sea turtles (*Chelonia mydas*) are listed as threatened (the green sea turtle is listed as threatened throughout its Pacific range, except for the endangered population nesting on the Pacific coast of Mexico). These five species of sea turtles are highly migratory, or have a highly migratory phase in their life history (NMFS 2001).

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 since 1990. There have been up to 60 nesting females observed annually, with a generally increasing trend over the past 12 years aerial surveys done in 1999–2000 also found an increase in green sea turtle sightings around Guam (Cummings 2002). There have been occasional sightings of leatherback turtles around Guam (Eldredge 2003); however, the extent to which (i.e. preferred location, abundance, seasonality) 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 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).

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 CNMI is within the range of the only breeding colony at Tora Shima, Japan (WPFMC 2009c).

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

The proposed ACL specification and AM would not have a direct effect on 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 would further ensure biologically-sustainable catches for fishery stocks. Because these fisheries are currently sustainably managed and subject to conservation measures in accordance with various resource conservation and management laws, the ACL 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.

CNMI Affected Resources and Potential Impacts

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 1). Based recent catch landings reported in Table 13, 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 crumenopthalmus* (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 collect of bycatch information, no such information is currently available indicating that most of the fish that are caught are kept and 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/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 in 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 points 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 determined reference points 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), estimated exploitation rates for CREMUS in CNMI did not exceed 10% for any taxanomic 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., Tutuila, main Hawaiian Islands, 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 taxanomic groups (stock complex) generally at the family level and propose to specify ACLs for each CREMUS stock and stock complex and are listed in Table 13. The ACL specification for each stock and stock complex is proposed to be set at a level significantly lower that the estimated biomass, where available. Under the proposed action, no new monitoring would be implemented however, as an AM a post-season review of the catch data will be conducted as soon as possible after the fishing year to determine whether an ACL for for any stock or stock complex was exceeded. If an ACL is exceeded and results in biological consequences to 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 2014 fishing year.

The impacts of an ACL specification for CREMUS in CNM I are expected to be beneficial because the ACLs would limit the harvest of all CREMUS in order to help ensure that coral reef fisheries do not become overfished. The additional level of post season review of the catch would also provide a new level of management review of the fisheries, and is an opportunity for refinement of ACL 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.

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 MSA, 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 – 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 Guam have occurred since the FEP was implemented that require further consultation.

Marine Mammals

The MMPA prohibits, with certain exceptions, the take of marine mammals in the U.S. and by U.S. citizens on the high seas. The coral reef fisheries in the Mariana Archipelago are listed as Category III fisheries under Section 118 of the MMPA (75 FR 68468, November 8, 2010). A Category III fishery is one with a low likelihood or no known incidental takings of marine mammals. NMFS has also concluded that these fisheries, as currently conducted, will not affect marine mammals in any manner not considered or authorized under the MMPA. Table 25 lists known non-ESA listed marine mammals that have been observed in the Mariana Archipelago and are protected by the MMPA.

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. Non-ESA listed marine mammals occuring 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 simus*
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*

Common Name	Scientific Name
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. Loggerhead (*Caretta caretta*) and green sea turtles (*Chelonia mydas*) are listed as threatened (the green sea turtle is listed as threatened throughout its Pacific range, except for the endangered population nesting on the Pacific coast of Mexico). These five species of sea turtles are highly migratory, or have a highly migratory phase in their life history (NMFS 2001).

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 since 1990. There have been up to 60 nesting females observed annually, with a generally increasing trend over the past 12 years aerial surveys done in 1999–2000 also found an increase in green sea turtle sightings around Guam (Cummings 2002). There have been occasional sightings of leatherback turtles around Guam (Eldredge 2003); however, the extent to which (i.e. preferred location, abundance, seasonality) 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 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).

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 CNMI is within the range of the only breeding colony at Tora Shima, Japan (WPFMC 2009c).

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

The proposed ACL specification and AM would not have a direct effect on 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 would further ensure biologically-sustainable catches for fishery stocks. Because these fisheries are currently sustainably managed and subject to conservation measures in accordance with various resource conservation and management laws, the ACL 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.

Hawaii Affected Resources and Potential Impacts

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 1). Based recent catch landings reported in Table 14, 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 crumenopthalmus* 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 665.421) are not harvested at all.

While the boat-based and shore-based creel survey programs administered by CNMI DFW provide for the collect of bycatch information, no such information is currently available indicating that most of the fish that are caught are kept and 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/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 in 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 points 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 determined reference points 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), estimated exploitation rates for Hawaii CREMUS did not exceed 4% for any taxanomic 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., Tutuila, main Hawaiian Islands, Guam and southern islands of CNMI).

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 taxanomic groups (stock complex) generally at the family level and propose to specify ACLs for each CREMUS stock and stock complex and are listed in Table 14 The ACL specification for each stock and stock complex is proposed to be set at a level significantly lower that the estimated biomass, where available. Under the proposed action, no new monitoring would be implemented however, as an AM a post-season review of the catch data will be conducted as soon as possible after the fishing year to determine whether an ACL for for any stock or stock complex was exceeded. If an ACL is exceeded and results in biological consequences to 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 2014 fishing year.

The impacts of an ACL specification for Hawaii CREMUS are expected to be beneficial because the ACLs would limit the harvest of all CREMUS in order to help ensure that coral reef fisheries do not become overfished. The additional level of post season review of the catch would also provide a new level of management review of the fisheries, and is an opportunity for refinement of ACL 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 Hawaii's coral reef fisheries.

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 MSA, 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 2009b).

Applicable ESA Coordination – Hawaii

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, the take of marine mammals in the U.S. and by U.S. citizens on the high seas. The coral reef fisheries in Hawaii are listed as Category III fisheries under Section 118 of the MMPA (75 FR 68468, November 8, 2010). A Category III fishery is one with a low likelihood or no known incidental takings of marine mammals. NMFS has also concluded that these fisheries, as currently conducted, will not affect marine mammals in any manner not considered or authorized under the MMPA. Table 26 lists known non-ESA listed marine mammals that have been observed in the Hawaiian Archipelago and are protected by the MMPA.

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 any necessary management measures.

Table 26. Non-ESA listed marine mammals occuring in 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 simus*
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. Loggerhead (*Caretta caretta*) and green sea turtles (*Chelonia mydas*) are listed as threatened (the green sea turtle is listed as threatened throughout its Pacific range, except for the endangered population nesting on the Pacific coast of Mexico). These five species of sea turtles are highly migratory, or have a highly migratory phase in their life history. 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 albatrosses (*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.

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

The proposed ACL specification and AM would not have a direct effect on 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 will be an addition to the current fishery management regime that will further ensure biologically-sustainable catches for 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.

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 2004 (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), including the Hawaii Archipelago FEP. The FEP incorporated and reorganized elements of the Councils' species-based FMPs into a spatially-oriented management plan (75 FR 2198, January 14, 2010). As a result, EFH definitions and related provisions for all FMP fishery resources are 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 must be considered. The designated areas of EFH and HAPC for all Hawaii FEP MUS by life stage are summarized in **Error! Reference source not found.**27. 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 27. 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)
	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

MUS	Species Complex	EFH	HAPC
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 none of the alternatives is expected to result in substantial changes to the way the coral reef fisheries are conducted. These fisheries are not known to effect or harm EFH for any MUS.

Potential Impacts on Fishery Administration and Enforcement

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. These the Council, PIRO and PIFSC collaborate with local agencies in the administration of fisheries of the western Pacific through other activities including conducting coordinating meetings, research, developing information, processing fishery management actions, training fishery participants, and conducting educational and outreach activities for the benefit of fishery communities.

NOAA Office of Law Enforcement (OLE) is responsible for enforcement of the nation's marine resource laws, including fisheries and protected resources. OLE, Pacific Islands Division oversees enforcement of federal regulations in American Samoa, Guam, the CNMI and Hawaii and enter 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 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 accuracy and timeliness in species specific catch reporting on an annual basis. No changes to the role of law enforcement agents or the US Coast Guard would be required in association with implementing these specifications. The ACL and AM specifications would not result in any change or risk to human safety at sea.

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 towards an ACL would continue to be conducted by PIFSC in collaboration with local resource management agencies and, is expected to result in improved accuracy and timeliness in species specific catch reporting on an annual basis.

No change to enforcement activities is 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 or risk to human safety associated with coral reef fishing in local waters.

Significant resources will be required in the future to support the establishment of in-season monitoring capabilities in American Samoa, Guam and the Northern Mariana Islands. Until resources are made available by NMFS, only AMs for when the ACL is exceeded are possible at this time.

Environmental Justice

The Council 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 showed 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 is 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.

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. Increased carbon dioxide uptake can increase ocean acidity which can disrupt calcium uptake processes in corals, crustaceans, molluscs, reef-building algae, and plankton, among other organisms. Climate change can also lead to changes in ocean circulation patterns which can affect the availability of prey, migration, survival, and dispersal. 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 will continue to occur and will 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.

Additional considerations

Overall impacts

When compared against recent fishing harvests, most ACLs would not be lower than the most recent harvests. The ACLs 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.

Cumulative Effects of the Proposed Action

Fishery management actions by others in the same area and cumulative effects

In all four areas, the Council is developing ACL and AM recommendations for bottomfish and groundfish MUS, precious corals MUS, and crustaceans. 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.

Consistency with Other Applicable Laws

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 meet 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.

Preparers and Reviewers

Council staff

Marlowe Sabater, Fishery Analyst

NMFS staff

Ethan Brown, Natural Resources Management Specialist, PIRO, SFD
Phyllis Ha, NEPA Specialist, PIRO, SFD
Jarad Makaiau, Fishery Policy Analyst, PIRO, SFD
Lewis Van Fossen, Resource Management Specialist, PIRO, SFD

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

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 imits in media releases, newsletter articles, and on the Council website.

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.

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, it is not likely to affect endangered and threatened species or critical habitat for such species in any manner not considered in the prior consultation.

ESA regulations require reinitiating ESA Section 7 consultation if any of the following criteria are met:

- The amount or extent of taking specified in the incidental take statement is exceeded;
- New information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered;
- The identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion; or
- A new species is listed or critical habitat designated that may be affected by the identified action.

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). Addtionally, the agency is also evaluating whether to revise the ESA listing status of the loggerhead sea turtle from threatened to endanged and 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.

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 of marine mammals.

The coral reef fisheries in each island area are listed as Category III fisheries under Section 118 of the MMPA (75 FR 68468, November 8, 2010). A Category III fishery is one with a low likelihood or no known incidental takings of marine mammals. NMFS has also concluded that these coral reef fisheries, as currently conducted, will not affect marine mammals in any manner not considered or authorized under the MMPA. Because the proposed action would not modify vessel operations or other aspects of any fishery, it is not expected to affect any marine mammal populations or habitats in a manner that has not been previously assessed and analyzed by NMFS.

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 [INSERT DATE], NMFS submitted a copy of this document to the appropriate state government agencies in American Samoa, Guam, Hawaii and the CNMI for review and concurrence, with the preliminary determination that the preferred alternative is consistent, to the maximum extent practicable, with their respective coastal zone management programs.

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.

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 and results in biological consequences to 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 2014 fishing year.

American Samoa
In 2010, approximately 22 vessels engaged in fishing for CREMUS. The 2010 average gross revenue per vessel was $3,222 based on an aveage price of $2.68 per pound, and harvest of 26,453 lb. In general, the relative impornace 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 $3,222 based on an aveage price of $2.59 per pound, and harvest of 124,401 lb. In general, the relative impornace 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 4 vessels engaged in fishing for CREMUS. The 2009 average gross revenue per vessel was $47,747 based on an average price of $2.59 per pound, and harvest of 72,211 lb. In general, the relative impornace 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 enagage 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 aveage price of $3.01 per pound. In general, the relative impornace 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 econonomic impacts among the universe of vessels based on hear, home port, or vessel length. For these reasons, an initial regulatory flexibility analysis is not required and none has been prepared.

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 wait 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, 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 recommednations. 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.

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. That agency action 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 results in biological consequences to 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 2014 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 were 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, 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.

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 ACL 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.

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 staff 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. Additional comments on the document may be received 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 provisions of additional information.

References Cited

AECOS, Inc. 1983. *Central and Western Pacific Regional Fisheries Development Plan*, Vol. 2, Guam Component. Prepared for the Pacific Basin Development Council, Honolulu, Hawaii

Amesbury, J. and R. Hunter-Anderson. 1989. *Native fishing rights and limited entry in Guam.* Western Pacific Regional Fishery Management Council, Honolulu.

Amesbury, J. and R. Hunter-Anderson. 2003. *Review of archaeological and historical data concerning reef fishing in the U.S. flag islands of Micronesia: Guam and the Northern Mariana Islands.* Final Report for the Western Pacific Regional Fishery Management Council, Honolulu, Hawaii.

Amesbury, J., R. Hunter-Anderson, and E. Wells. 1989. *Native fishing rights and limited entry in the CNMI.* Western Pacific Regional Fishery Management Council, Honolulu.

Beckwith, M.W. 1951. The Kumulipo: a Hawaiian creation chant. University of Chicago Press. Chicago, IL.

Berkson, J., L. Barbieri, S. Cadrin, S. L. Cass-Calay, P. Crone, M. Dorn, C. Friess, D. Kobayashi, T. J. Miller, W. S. Patrick, S. Pautzke, S. Ralston, M. Trianni. 2011. Calculating Acceptable Biological Catch for Stocks That Have Reliable Catch Data Only (Only Reliable Catch Stocks – ORCS). NOAA Technical Memorandum NMFS-SEFSC-616, 56 P.

Birkeland, C. (Ed.). 1997a. *Life and death of coral reefs.* New York: Chapman and Hall

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

Cummings, V. 2002. Guam sea turtle recovery report three. Division of Aquatic & Wildlife Resources Draft Report, Guam Department of Agriculture, Mangilao, Guam.

Dalzell, P., Adams, T., Polunin, N. 1996. Coastal fisheries in the Pacific Islands. Oceanography and Marine Biology Annual Review 33, 395-531.

Denny, C.M. and Babcock, R.C. 2004. Do partial marine reserves protect reef fish assemblages? Biological Conservation. 116: 119-129.

Doherty, P.J., Planes, S., Mather, P. 1995. Gene flow and larval duration in seven species of fish from the Great Barrier Reef. Ecology 76(8): 2373-2391

Eldredge, L.G. 2003. The marine reptiles and mammals of Guam. *Micronesica* 35-36: 653-60.

Friedlander, A.M. 1996. *Assessment of the Coral Reef Resources of Hawaii With Emphasis on Waters of Federal Jurisdiction.* Report to Western Pacific Regional Fishery Management Council, Honolulu, Hawaii

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

Green, A. 1997. An Assessment of the Status of the Coral Reef Resources, and Their Patterns of Use in the U.S. Pacific Islands. Final report prepared for the Western Pacific Regional Fishery Management Council, Honolulu, Hawaii

Grigg, R.W. 2002. Precious Corals in Hawaii: Discovery of a New Bed and Revised Management Measures for Existing Beds. Mar. Fish. Rev. 64(1):13-20.

Hamm, D.C., M.M.C. Quach, K.R. Brousseau, and C.J. Graham. 2010. Fishery statistics of the western Pacific, Volume 25. Pacific Islands Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822-2396. Pacific Islands Fish. Sci. Cent. Admin. Rep. H-10-03, Section D: State of Hawaii 2008 Fishery Statistics.

Harman, R.F. and A.Z. Katekaru. 1988. Hawaii commercial fishing survey: Summary of results. Division of Aquatic Resources, Department of Land and Natural Resources, Honolulu, Hawaii

Hensley, R.A. and T.S. Sherwood. 1993. An overview of Guam's Inshore Fisheries. *Marine Fisheries Review*. 55(2): 129-138.

Honebrink, R. 200. A review of the biology of the family Carangidae, with emphasis on species found in Hawaiian waters. Division of Aquatic Resources (DAR) Technical Report 20-01.

Hunter-Anderson, R.L. and Y. Zan. 1996. Demystifying the *sawei*, a traditional interisland exchange system. *ISLA: A Journal of Micronesian Studies* 41:1-45.

Impact Assessment. 2008. Ecosystem-based fisheries management in the western Pacific. Proceedings from a comprehensive series of workshops convened by the Western Pacific Fishery Management Council. Honolulu, Hawaii. May 2008.

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

Jeff A. Eble, Luiz A. Rocha, Matthew T. Craig, and Brian W. Bowen, "Not All Larvae Stay Close to Home: Insights into Marine Population Connectivity with a Focus on the Brown Surgeonfish (Acanthurus nigrofuscus)," Journal of Marine Biology, vol. 2011, Article ID 518516, 12 pages, 2011. doi:10.1155/2011/518516

Jennings, S. and N.V.C. Polunin. 1995. Biased underwater visual census biomass estimates for target-species in tropical fisheries. Journal of Fish Biology. 47: 733-736.

Jennison-Nolan, J. 1979. *Guam: Changing Patterns of Coastal and Marine Exploitation.* University of Guam Marine Laboratory Technical Report No. 59.

Joseph, A. and V. Murray. 1951. *Chamorros and Carolinians of Saipan.* Harvard University Press, Cambridge, Massachusetts

Kendall, M.S. and M. Poti (eds.), 2011. A Biogeographic Assessment of the Samoan Archipelago. NOAA Technical Memorandum NOS NCCOS 132. Silver Spring, MD. 229 pp

Kolinski, S. P., D. M. Parker, L. I. Ilo & J. K. Ruak. 2001. An assessment of the sea turtles and their marine and terrestrial habitats at Saipan, Commonwealth of the Northern Mariana Islands. Micronesica 34: 55–72.

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

Kulbicki, M. 1988. Correlation between catch data from bottom longlines and fish censures in the SW lagoon of New Caledonia. Proceeding of the 6th International Coral Reef Symposium, Australia, 1988, Vol. 2.

Luck, D. and Dalzell, P. 2010. Western Pacific Region Reef Fish Trends. Western Pacific Regional Fishery Management Council. http://www.wpcouncil.org/documents/Reports/annualreports/Western%20Pacific%20Region%20Reef%20Fish%20Trends%2010-4.pdf

Moore, D.R., J.R. Amesbury, R.L. Hunter-Anderson, and E.F.Wells. 2002. *Results of Monitoring and Data Recovery at Villa Kanton Tasi, Tumon Bay, Guam.* Prepared for Beachfront Development LLC, Tamuning, Guam. Micronesian Archaeological Research Services, Guam

Myers, R.F. 1991. *Micronesian reef fishes: a Practical Guide to the Identification of the Coral Reef Fishes of the Tropical Central and Western pacific*. Coral Graphics. Barrigada, Territory of Guam, United States of America.

Myers, R.F. 1993. Guam's Small-Boat-based Fisheries. *Marine Fisheries Review* 55(2).12 pp.

Myers, R.F. 1997. Assessment of coral reef resources of Guam with emphasis on waters of federal jurisdiction. Report prepared for the Western Pacific Regional Fishery Management Council.

NMFS (National Marine Fisheries Service). 2001. Final Environmental Impact Statement for the Fishery Management Plan for Pelagic Fisheries of the Western Pacific Region.

Orbach, M. 1980. Report on the social, cultural, and economic aspects of fishery development in the Commonwealth of the Northern Mariana Islands. Center for Coastal Marine Studies, University of California, Santa Cruz

Randall, J.E. 2007. Reef and Shore Fishes of the Hawaiian Islands. Sea Grant College Program. University of Hawai'i, Honolulu.

Restrepo, V. R., Thompson, G. G., Mace, P.M., Gabriel, W. L., Low, L. L., MacCall, A. D., Methot, R. D., Powers, J. E., Taylor, B. L., Wade, P. R., and Witzig, J. F. 1998. Technical guidance on the use of precautionary approaches to implementing National Standard 1 of the Magnuson–Stevens Fishery Conservation and Management Act. National Oceanic and Atmospheric Administration (US) Technical Memorandum NMFS-F/SPO-31. 54 pp.

Robert J. Toonen, Kimberly R. Andrews, Iliana B. Baums, et al., "Defining Boundaries for Ecosystem-Based Management: A Multispecies Case Study of Marine Connectivity across the Hawaiian Archipelago," Journal of Marine Biology, vol. 2011, Article ID 460173, 13 pages, 2011. doi:10.1155/2011/460173

Sabater, M.G. Tulafono, R. 2011. American Samoa Archipelagic Fishery Ecosystem Report. Western Pacific Regional Fishery Management Council. ISBN: 1-934061-49-2

Sabater, M.G., Carroll, B.P. 2009. Trends in Reef Fish Population and Associated Fishery after Three Millennia of Resource Utilization and a Century of Socio-Economic Changes in American Samoa. Reviews in Fisheries Science 17 (3): 318-335.

Sabater, M.G., Tofaeono, S. 2007. Scale and benthic composition effects on biomass and trophic group distribution of reef fishes in American Samoa. Pacific Science 61(4): 503-520.

Scheltema R.S., Williams I.P. 1983. Long-Distance Dispersal of Planktonic Larvae and the Biogeography and Evolution of Some Polynesian and Western Pacific Mollusks. Bulletin of Marine Science 33(3):545-565

Shomura, R. 1987. "Hawaii's marine fishery: yesterday and today." NMFS Southwest Fisheries Center Honolulu Laboratory Administrative Report H-87-21.

Sousa, M.I. & Gjosaeter, J. 1987. A revision of growth parameters of some commercially exploited fishes from Mosambique. Revista de Investigacao Pesqueira 16, 19-40.

Starmer, J., C. Bearden, R. Brainard., T. de Cruz, R. Hoeke, P. Houk, S. Holzwarth, S. Kolinksi, J. Miller, R. Schroeder, M. Timmers, M. Trianni, and P. Vroom. 2005. The State of Coral Reefs Ecosystems of the Commonwealth of the Northern Mariana Islands. In: J. Waddell (Ed.) *The State of Coral Reef Ecosystems of the United States and Pacific Freely Associated States: 2005.* NOAA Techinical Memorandum NOS NCC11.

Trianni, M. 1998a. *Qualitative Assessment of World War II Ordinance Sites in Coral Reef Habitats at the Island of Rota: A Historical Record.* CNMI Division of Fish and Wildlife Technical Assistance Report 98a. 18 pp.

Trianni, M.S. 1998b. Summary and further analysis of the nearshore reef fishery of the Northern Mariana Islands. CNMI Division of Fish and Wildlife. Technical Report 98-02 64 pp.

Tulafono, R. 2007. Statement made during the Regional Ecosystem Advisory Group meeting by the Director of the American Samoan Department of Marine and Wildlife Resources, April 2007, Uteli Convention Center, American Samoa. Western Pacific Regional Fishery Management Council, Honolulu Hawaii

Watson, D.L. and Harvey, E.S. 2007a. Behaviour of temperate and sub-tropical reef fishes towards a stationary SCUBA diver. Marine and Freshwater Behaviour and Physiology 40(2): 85-103

Watson, D.L., Harvey, E.S., Kendrick, G.A., Nardi, K., and Anderson, M.J. 2007b. Protection from fishing alters the species composition of fish assemblages in a temperate-tropical transition zone

Weng, K. C. M., and J. R. Sibert. 2000. Analysis of the fisheries for two pelagic Carangids in Hawai'i. Pelagic Fisheries Research Program SOEST 00-04, JIMAR Contribution 00-332. 78 p.

Williams, I. 2010. US Pacific reef fish biomass estimates based on visual survey data. NOAA, National Marine Fishery Service, Pacific Island Fishery Science Center (PIFSC). PIFSC Internal Report: IR-10-024. pp. 1-18.

WPFMC. 2009a. Fishery Ecosystem Plan for the American Samoa Archipelago. Western Pacific Fishery Management Council, Honolulu, Hawaii.

WPFMC. 2009b. Fishery Ecosystem Plan for the Hawaii Archipelago. Western Pacific Fishery Management Council, Honolulu, Hawaii.

WPFMC. 2009c. Fishery Ecosystem Plan for the Marianas Archipelago. Western Pacific Fishery Management Council, Honolulu, Hawai`i.

WPFMC. 2009d. Fishery Ecosystem Plan for the Pacific Remote Island Areas. Western Pacific Fishery Management Council, Honolulu, Hawaii.

WPFMC. 2009e. Fishery Ecosystem Plan for Pacific Pelagic Fisheries of the Western Pacific Region. Western Pacific Fishery Management Council, Honolulu, Hawaii.

WPFMC. 2009f. Final Programatic Environmental Impact Statement. Toward an Ecosystem Approach for the Western Pacific Region: From Species-Based Fishery Management Plans to Place-Based Fishery Ecosystem Plans. Western Pacific Fishery Management Council, Honolulu, Hawaii.

WPFMC. 2009g. Amendment 18 to the Fishery Management Plan for Pelagic Fisheries of the Western Pacific Region, including a final supplemental environmental impact statement, regulatory impact review and initial regulatory flexibiliy act analysis. Honolulu, Hawaii. March 9, 2009.

Appendix 1: Species that comprise the CREMUS grouping in American Samoa, Guam, CNMI and Hawaii

1.A. American Samoa

CREMUS Group	Common name	CREMUS Group	Common name
Atulai	Bigeye scad	Surgeonfish	Naso tang
Emperors	Emperors (misc)	Surgeonfish	Achilles tang
Emperors	Goldenline bream	Surgeonfish	Ringtail surgeonfish
Emperors	Yellowspot emperor	Surgeonfish	Eye-striped surgeonfish
Emperors	Blueline bream	Surgeonfish	Whitespotted surgeonfish
		Surgeonfish	Whitebar surgeonfish
Emperors	Orangespot emperor	Surgeonfish	Blue-banded surgeonfish
Emperors	Longnose emperor	Surgeonfish	Elongate surgeonfish
Emperors	Bigeye emperor	Surgeonfish	Whitecheek surgeonfish
Emperors	Sweetlip emperor	Surgeonfish	Blackstreak surgeonfish
Goatfish	Goatfish (misc)	Surgeonfish	Brown surgeonfish
Goatfish	Yellowstripe goatfish	Surgeonfish	Bluelined surgeonfish
Goatfish	Orange goatfish	Surgeonfish	Orange-spot surgeonfish
Goatfish	Yellow goatfishes	Surgeonfish	Mimic surgeonfish
Goatfish	Yellowfin goatfish	Surgeonfish	Surgeonfishes/tangs
Goatfish	Dash-and-dot goatfish	Surgeonfish	Convict tang
Goatfish	Doublebar goatfish	Surgeonfish	Yellowfin surgeonfish
Goatfish	White-lined goatfish	Surgeonfish	Twospot bristletooth
Goatfish	Yellowsaddle goatfish	Surgeonfish	Striped bristletooth
Goatfish	Redspot goatfish	Surgeonfish	Yellow-eyed bristletooth
Goatfish	Indian goatfish	Surgeonfish	Whitemargin unicornfish
Goatfish	Parupenus insularis	Surgeonfish	Humpback unicornfish
Goatfish	Multi-barred goatfish	Surgeonfish	Spotted unicornfish
Goatfish	Side spot goatfish	Surgeonfish	Gray unicornfish
Goatfish	Banded goatfish (misc)	Surgeonfish	Black tongue unicornfish
Groupers	Inshore groupers	Surgeonfish	Orangespine unicornfish
Groupers	Slender grouper	Surgeonfish	Unicornfishes (misc)
Groupers	Peacock grouper	Surgeonfish	Barred unicornfish
Groupers	Golden hind	Surgeonfish	Humpnose unicornish
Groupers	Ybanded grouper	Surgeonfish	Bluespine unicornfish
Groupers	Six-banded grouper	Surgeonfish	Bignose unicornfish
Groupers	Tomato grouper	Surgeonfish	Pacific sailfin tang
Groupers	Pygmy grouper	Squirrelfish	Bronze soldierfish
Groupers	Flagtail grouper	Squirrelfish	Brick soldierfish
Groupers	Hexagon grouper	Squirrelfish	Bigscale soldierfish
Groupers	Giant grouper	Squirrelfish	Yellowfin soldierfish
Groupers	Longspine grouper	Squirrelfish	Double tooth soldierfish
Groupers	Spotted grouper	Squirrelfish	Pearly soldierfish
Groupers	One-bloch grouper	Squirrelfish	Blotcheye soldierfish
Groupers	Honeycomb grouper	Squirrelfish	Scarlet soldierfish
Groupers	Smalltooth grouper	Squirrelfish	Violet soldierfish
Groupers	Netfin grouper	Squirrelfish	Whitetip soldierfish
Groupers	Striped grouper	Squirrelfish	Yellowstriped squirrelfish
Groupers	Eightbar grouper	Squirrelfish	Blackfin squirrelfish

Groupers	Groupers (misc)
Groupers	Greasy grouper
Groupers	Yellowspot grouper
Groupers	Squaretail grouper
Groupers	Saddleback grouper
Groupers	Leopard coral trout
Groupers	Powell's grouper
Groupers	White-edged lyretail
Jacks	Mackerel scad (opelu)
Jacks	Blue kingfish trevally
Jacks	Goldspot trevally
Jacks	Trevally (misc)
Jacks	Jacks (misc)
Jacks	Black jack
Jacks	Bluefin trevally
Jacks	Brassy trevally
Jacks	Bigeye trevally
Jacks	Rainbow runner
Jacks	Leatherback
Jacks	Snubnose pompano
Jacks	Whitemouth trevally
Mullets	Mullets
Mullets	Fringelip mullet
Mullets	Diamond scale mullet
Mullets	False mullet
Parrotfish	Stareye parrotfish
Parrotfish	Longnose parrotfish
Parrotfish	Yellowband parrotfish
Parrotfish	Parrotfishes (misc)
Rabbitfish	Rabbitfish
Rabbitfish	Forktail rabbitfish
Rabbitfish	Scribbled rabbitfish
Rudderfish	Rudderfish (biggibus)
Rudderfish	Rudderfish (cinerascens)
Rudderfish	Western drummer
Rudderfish	Rudderfish
Rudderfish	Lowfin drummer
Snappers	Inshore snappers
Snappers	Brown jobfish
Snappers	Scarlet snapper
Snappers	Red snapper
Snappers	Twinspot/red snapper
Snappers	Yellow margined snapper
Snappers	Humpback snapper
Snappers	Onespot snapper
Snappers	Rufous snapper
Snappers	Blood snapper
Snappers	Timor snapper

Squirrelfish	Sammara squirrelfish
Squirrelfish	Tailspot squirrelfish
Squirrelfish	Crown squirrelfish
Squirrelfish	Blackspot squirrelfish
Squirrelfish	Filelined squirrelfish
Squirrelfish	Peppered squirrelfish
Squirrelfish	Saber squirrelfish
Squirrelfish	Squirrelfish
Squirrelfish	Bluelined squirrelfish
Squirrelfish	Violet squirrelfish
Squirrelfish	Hawaiian squirrelfish
Squirrelfish	Pink squirrelfish
Wrasse	Wrasses (misc)
Wrasse	Floral wrasse
Wrasse	Harlequin tuskfish
Wrasse	Triple tail wrasse
Wrasse	Cheilinus wrasse (misc)
Wrasse	Cigar wrasse
Wrasse	Bird wrasse
Wrasse	Checkerboard wrasse
Wrasse	Weedy surge wrasse
Wrasse	Barred thicklip
Wrasse	Blackeye thicklip
Wrasse	Rockmover wrasse
Wrasse	Arenatus wrasse
Wrasse	Bandcheck wrasse
Wrasse	Sunset wrasse
Wrasse	Surge wrasse
Wrasse	Red ribbon wrasse
Wrasse	Christmas wrasse
Wrasse	Whitepatch wrasse
Misc. Reef Fish	Reef fish (misc)
Misc. Bottomfish	Bottomfish (misc)
Other Finfish	Freshwater eel
Other Finfish	Flashlightfishes
Other Finfish	Frogfishes
Other Finfish	Cardinalfish
Other Finfish	Silversides
Other Finfish	Trumpetfish
Other Finfish	Triggerfish
Other Finfish	Orangestripe triggerfish
Other Finfish	Clown triggerfish
Other Finfish	Titan triggerfish
Other Finfish	Needlefish
Other Finfish	Blennies
Other Finfish	Angler flatfish
Other Finfish	Gold banded fusilier
Other Finfish	Coral crouchers
Other Finfish	Butterflyfishes (misc)
Other Finfish	Butterflyfish (auriga)

Snappers	Black snapper
Snappers	Kusakar's snapper
Snappers	Stone's snapper
Snappers	Multidens snapper
Other Finfish	Flyingfish
Other Finfish	Cornetfish
Other Finfish	Mojarras
Other Finfish	Gobies
Other Finfish	Sweetlips
Other Finfish	Halfbeaks
Other Finfish	Flagtails
Other Finfish	Barred flagtail
Other Finfish	Mountain bass
Other Finfish	Ponyfish
Other Finfish	Tilefishes
Other Finfish	Sunfish
Other Finfish	Filefishes
Other Finfish	Silver batfish
Other Finfish	Moray eels
Other Finfish	Dragon eel
Other Finfish	Yellowmargin moray eel
Other Finfish	Giant moray eel
Other Finfish	Spotted moray eels
Other Finfish	Undulated moray eel
Other Finfish	Rays
Other Finfish	Eagle ray
Other Finfish	Monogram monocle bream
Other Finfish	Nurse shark
Other Finfish	Sweepers
Other Finfish	Prettyfins
Other Finfish	Threadfin
Other Finfish	Angelfishes
Other Finfish	Emperor angelfish
Other Finfish	Banded sergeant
Other Finfish	Sergeant major
Other Finfish	Damselfish
Other Finfish	Bigeyes
Other Finfish	Glasseye
Other Finfish	Paeony bulleye
Other Finfish	Moontail bullseye
Other Finfish	Bigeye squirrelfish
Other Finfish	Dottybacks
Other Finfish	Scorpionfishes
Other Finfish	Lionfish
Other Finfish	Stonefish
Other Finfish	Small barracuda
Other Finfish	Great barracuda
Other Finfish	Bigeye barracuda
Other Finfish	Saddleback butterflyfish
Other Finfish	Racoon butterflyfish
Other Finfish	Butterflyfish (melanotic)
Other Finfish	Milkfish
Other Finfish	Tilapia
Other Finfish	Two spotted hawkfish
Other Finfish	Stocky hawkfish
Other Finfish	Flame hawkfish
Other Finfish	Herrings
Other Finfish	White eel
Other Finfish	Conger eels
Other Finfish	Porcupinefish
Other Finfish	Remoras
Other Finfish	Anchovies
Other Finfish	Batfishes
Crustaceans	Crabs
Crustaceans	Shrimp
Crustaceans	Kona crab
Crustaceans	Grapsid crab
Crustaceans	Pa'a crab
Crustaceans	Seven-11 crab
Crustaceans	Small crab
Crustaceans	Mangrove crab
Crustaceans	Large red crab
Crustaceans	Spiny lobster
Crustaceans	Hermit crab
Crustaceans	Slipper lobster
Mollusks	Mangrove clam
Mollusks	Pen shell clam
Mollusks	Pipi clam
Mollusks	Squid
Mollusks	Clams (misc)
Mollusks	Cone snail
Mollusks	Octopus (cyanea)
Mollusks	Octopus (ornatus)
Mollusks	Octopus
Mollusks	Giant clam
Mollusks	Turban snail
Mollusks	Green snails
Invertebrates	Invertebrates (misc)
Invertebrates	Sea urchins (misc)
Invertebrates	Black sea urchin
Invertebrates	White sea urchin
Invertebrates	Cubed loli
Invertebrates	Cubed leapord sea cucumber
Invertebrates	Surf redfish
Invertebrates	Sea cucumber (misc)
Invertebrates	Sea cucumber - gau
Invertebrates	Sea cucumber gonads
Invertebrates	Leapord sea cucumber

Other Finfish	Heller's barracuda	Invertebrates	Loli
Other Finfish	Blackfin barracuda	Algae	Red algae
Other Finfish	Barracudas (misc)	Algae	Seaweeds
Other Finfish	Hammerhead shark		
Other Finfish	Seahorses		
Other Finfish	Lizardfish		
Other Finfish	Terapon perch		
Other Finfish	Moorish Idol		

1.B. Guam CREMUS species list

CREMUS Group	Species names	CREMUS Group	Species names
Atulai	*Selar crumenophthalmus*	Other	*Stegastes fasciolatus*
Atulai	*Atule mate*	Other	*Stegastes lividus*
Atulai	*Selar boops*	Other	*Stegastes nigricans*
Emperors	*Lethrinidae*	Other	*Neopomacentrus violascens*
Emperors	*Gnathodentex aurolineatus*	Other	*Lepidozygus tapienosoma*
Emperors	*Gymnocranius griseus*	Other	*Chromis ternatensis*
Emperors	*Lethrinus harak*	Other	*Abudefduf lorenzi*
Emperors	*Lethrinus atkinsoni*	Other	*Abudefduf notatus*
Emperors	*Lethrinus olivaceus*	Other	*Amblygliphidodon leucogaster*
Emperors	*Lethrinus ornatus*	Other	*Amblygliphidodon ternatensis*
Emperors	*Lethrinus obsoletus*	Other	*Chromis atripes*
Emperors	*Lethrinus semicinctus*	Other	*Chromis lineata*
Emperors	*Lethrinus xanthochilus*	Other	*Chromis retrofasciata*
Emperors	*Monotaxis grandoculus*	Other	*Chromis weberi*
Emperors	*Gymnocranius euanus*	Other	*Chromis xanthochir*
Emperors	*Lethrinus erythracanthus*	Other	*Chromis caudalis*
Emperors	*Wattsia mossambica*	Other	*Chromis delta*
Emperors	*Gymnocranius sp*	Other	*Chrysiptera cyanea*
Emperors	*Lethrinus microdon*	Other	*Chrysiptera rex*
		Other	*Chrysiptera talboti*
Emperors	*Lethrinus genivittatus*	Other	*Dascyllus melanurus*
Emperors	*Lethrinus lentjan*	Other	*Dischistodus chrysopoecilus*
Emperors	*Gymnocranius microdon*	Other	*Dischistodus melanotus*
Emperors	*Lethrinus erythropterus*	Other	*Hemiglyphidodon plagiometopon*
Emperors	*Gymnocranius grandoculus*	Other	*Neopomacentrus nemurus*
Emperors	*Lethrinus variegatus*	Other	*Neopomacentrus taeniurus*
Goatfish	*Mullidae*	Other	*Neoglyphidodon melas*
Goatfish	*Mulloidichthys flavolineatus*	Other	*Neoglyphidodon nigroris*
Goatfish	*Mulloidichthys pflugeri*	Other	*Pomacentrus bankanensis*
Goatfish	*Mulloidichthys vanicolensis*	Other	*Pomacentrus burroughi*
Goatfish	*Parupeneus barberinus*	Other	*Pomacentrus coelestis*
Goatfish	*Parupeneus bifasciatus*	Other	*Pomacentrus emarginatus*
Goatfish	*Parupeneus cyclostomus*	Other	*Pomacentrus grammorhynchus*
Goatfish	*Parupeneus heptacanthus*	Other	*Pomacentrus brachialis*
Goatfish	*Parupeneus pleurostigma*	Other	*Pomacentrus philippinus*
Goatfish	*Parupeneus ciliatus*	Other	*Pomacentrus reidi*
Goatfish	*Parupeneus multifasciatus*	Other	*Pomacentrus chrysurus*
Goatfish	*Upeneus taeniopterus*	Other	*Pomacentrus simsiang*
Goatfish	*Upeneus vittatus*	Other	*Pomacentrus nagasakiensis*

Goatfish	*Parupeneus indicus*	Other	*Pomacentrus adelus*
Goatfish	*Upeneus tragula*	Other	*Pomachromis exilis*
Goatfish	*Parupeneus barberinoides*	Other	*Cheiloprion labiatus*
Goatfish	*Parupeneus sp*	Other	*Chrysiptera oxycephala*
Goatfish	*Upeneus arge*	Other	*Chrysiptera unimaculata*
Goatfish	*Mulloidichthys ti'ao*	Other	*Pomacentrus moluccensis*
Groupers	*Serranidae*	Other	*Pomacentrus nigromanus*
Groupers	*Aethaloperca rogaa*	Other	*Pomacentrus auriventris*
Groupers	*Epinephelus truncatus*	Other	*Amphiprion frenatus*
Groupers	*Cephalopholis sp*	Other	*Amphiprion ocellaris*
Groupers	*Cephalopholis spiloparaea*	Other	*Amphiprion tricinctus*
Groupers	*Cephalopholis argus*	Other	*Cirrhitidae*
Groupers	*Cephalopholis analis*	Other	*Amblycirrhitus bimacula*
Groupers	*Cephalopholis igarashiensis*	Other	*Cirrhitichthys falco*
Groupers	*Cephalopholis leopardus*	Other	*Cirrhitichthys oxycephalus*
Groupers	*Cephalopholis boenack*	Other	*Cirrhitus pinnulatus*
Groupers	*Cephalopholis sonnerati*	Other	*Neocirrhitus armatus*
Groupers	*Cephalopholis sexmaculata*	Other	*Oxycirrhitus typus*
Groupers	*Cephalopholis urodeta*	Other	*Paracirrhitus arcatus*
Groupers	*Cromileptes altivelis*	Other	*Paracirrhitus forsteri*
Groupers	*Epinephelus morrhua*	Other	*Paracirrhitus hemistictus*
Groupers	*Epinephelus howlandi*	Other	*Isocirrhitus sexfasciatus*
Groupers	*Epinephelus fuscoguttatus*	Other	*Cirrhitichthys aprinus*
Groupers	*Epinephelus hexagonatus*	Other	*Cyprinocirrhites polyactis*
Groupers	*Epinephelus lanceolatus*	Other	*Chelon macrolepis*
Groupers	*Epinephelus maculatus*	Other	*Liza melinoptera*
Groupers	*Epinephelus socialis*	Other	*Oedalechilus labiosus*
Groupers	*Epinephelus merra*	Other	*Crenimugil heterochilos*
Groupers	*Epinephelus polyphekadion*	Other	*Sphyraenidae*
Groupers	*Epinephelus tauvina*	Other	*Sphyraena barracuda*
Groupers	*Cephalopholis polleni*	Other	*Sphyraena obtusata*
Groupers	*Epinephelus septemfasciatus*	Other	*Sphyraena forsteri*
Groupers	*Plectropomus laevis*	Other	*Sphyraena acutipinnis*
Groupers	*Plectropomus areolatus*	Other	*Sphyraena qenie*
Groupers	*Saloptia powelli*	Other	*Sphyraena putnamiae*
Groupers	*Epinephelus miliaris*	Other	*Sphyraena novaehollandiae*
Groupers	*Gracila albomarginata*	Other	*Sphyraena flavicauda*
Groupers	*Variola albimarginata*	Other	*Polynemidae*
Groupers	*Cephalopholis miniata*	Other	*Polydactylus sexfilis*
Groupers	*Epinephelus cyanopodus*	Other	*Opisthognathidae*
Groupers	*Epinephelus caeruleopunctatus*	Other	*Opisthognathus sp A*
Groupers	*Epinephelus chlorostigma*	Other	*Opisthognathus sp B*
Groupers	*Epinephelus melanostigma*	Other	*Champsodontidae*
Groupers	*Epinephelus malabaricus*	Other	*Champsodon vorax*
Groupers	*Epinephelus ongus*	Other	*Percophidae*
Groupers	*Epinephelus spilotoceps*	Other	*Chrionema squamiceps*
Groupers	*Epinephelus retouti*	Other	*Pinguipedidae*
Groupers	*Plectropomus leopardus*	Other	*Parapercis millipunctata*
Groupers	*Plectropomus oligacanthus*	Other	*Parapercis clathrata*
Groupers	*Anyperodon leucogrammicus*	Other	*Parapercis cylindrica*

Groupers	*Epinephelus corallicola*	Other	*Parapercis xanthozona*
Groupers	*Epinephelus macrospilos*	Other	*Parapercis multiplicata*
Jacks	*Carangidae*	Other	*Parapercis tetracantha*
Jacks	*Alectis ciliaris*	Other	*Trichonotidae*
Jacks	*Alectis indicus*	Other	*Trichonotus sp*
Jacks	*Carangoides orthogrammus*	Other	*Creedidae*
Jacks	*Caranx melampygus*	Other	*Chalixodytes tauensis*
Jacks	*Caranx sexfasciatus*	Other	*Limnichthys donaldsoni*
Jacks	*Decapterus macarellus*	Other	*Uranoscopidae*
Jacks	*Elagatis bipinnulatus*	Other	*Uranoscopus sp*
Jacks	*Gnathanodon speciosus*	Other	*Tripterygiidae*
Jacks	*Scomberoides lysan*	Other	*Enneapterygius hemimelas*
Jacks	*Seriola rivoliana*	Other	*Enneapterygius minutus*
Jacks	*Trachinotus bailloni*	Other	*Enneapterygius nanus*
Jacks	*Trachinotus blochii*	Other	*Helcogramma capidata*
Jacks	*Uraspis helvola*	Other	*Helcogramma chica*
Jacks	*Carangoides caeruleopinnatus*	Other	*Helcogramma hudsoni*
Jacks	*Carangini*	Other	*Norfolkia brachylepis*
Jacks	*Decapterus maruadsi*	Other	*Ceratobregma helenae*
Jacks	*Carangoides ferdau*	Other	*Ucla xenogrammus*
Jacks	*Decapterus macrosoma*	Other	*Blenniidae*
Jacks	*Carangoides plagiotaenia*	Other	*Alticus arnoldorum*
Jacks	*Carangoides talamparoides*	Other	*Aspidontus taeniatus*
Jacks	*Caranx papuensis*	Other	*Cirripectes fuscoguttatus*
Jacks	*Caranx i'e'*	Other	*Cirripectes quagga*
Jacks	*Decapterus russelli*	Other	*Cirripectes polyzona*
Jacks	*Carangoides dinema*	Other	*Cirripectes variolosus*
Jacks	*Ulua mandibularis*	Other	*Ecsenius bicolor*
Jacks	*Carangoides fulvoguttatus*	Other	*Ecsenius opsifrontalis*
Jacks	*Uraspis uraspis*	Other	*Enchelyurus kraussi*
Jacks	*Naucrates ductor*	Other	*Entomacrodus decussatus*
Jacks	*Uraspis secunda*	Other	*Entomacrodus niuafooensis*
Jacks	*Carangoides uii*	Other	*Entomacrodus sealei*
Jacks	*Carangoides hedlandensis*	Other	*Entomacrodus striatus*
Jacks	*Megalaspis cordyla*	Other	*Entomacrodus thalassinus thalassin*
Jacks	*Naucratini*	Other	*Exalias brevis*
Mullet	*Mugilidae*	Other	*Istiblennius chrysospilos*
Mullet	*Moolgarda engeli*	Other	*Blenniella cyanostigma*
Mullet	*Crenimugil crenilabis*	Other	*Istiblennius edentulus*
Mullet	*Ellochelon vaigiensis*	Other	*Istiblennius lineatus*
Mullet	*Mugil cephalus*	Other	*Blenniella periophthalmus*
Mullet	*Neomyxus leuciscus*	Other	*Blenniella gibbifrons*
Mullet	*Moolgarda seheli*	Other	*Meiacanthus atrodorsalis*
Parrotfish	*Scaridae*	Other	*Omobranchus rotundiceps*
Parrotfish	*Calotomus carolinus*	Other	*Parenchelyurus hepburni*
Parrotfish	*Cetoscarus bicolor*	Other	*Petroscirtes mitratus*
Parrotfish	*Hipposcarus longiceps*	Other	*Petroscirtes xestus*
Parrotfish	*Leptoscarus vaigiensis*	Other	*Plagiotremus laudandus*
Parrotfish	*Scarus altipinnis*	Other	*Plagiotremus rhynorhynchus*
Parrotfish	*Scarus frenatus*	Other	*Plagiotremus tapienosoma*

Parrotfish	*Chlorurus frontalis*
Parrotfish	*Scarus ghobban*
Parrotfish	*Chlorurus microrhinos*
Parrotfish	*Scarus globiceps*
Parrotfish	*Scarus oviceps*
Parrotfish	*Scarus psittacus*
Parrotfish	*Scarus rubroviolaceus*
Parrotfish	*Scarus schlegeli*
Parrotfish	*Chlorurus sordidus*
Parrotfish	*Scarus forsteni*
Parrotfish	*Scarus n sp*
Parrotfish	*Scarus festivus*
Parrotfish	*Calotomus spinidens*
Parrotfish	*Scarus xanthopleura*
Parrotfish	*Chlorurus bleekeri*
Parrotfish	*Scarus dimidiatus*
Parrotfish	*Scarus hypselosoma*
Parrotfish	*Scarus prasiognathos*
Parrotfish	*Scarus quoyi*
Parrotfish	*Scarus rivulatus*
Parrotfish	*Scarus spinus*
Parrotfish	*Scarus chameleon*
Parrotfish	*Chlorurus bowersi*
Parrotfish	*Scarus niger*
Parrotfish	*Chlorurus pyrrhurus*
Parrotfish	*Scarus flavipectoralis*
Parrotfish	*Scarus tricolor*
Rabbitfish	*Siganidae*
Rabbitfish	*Siganus argenteus*
Rabbitfish	*Siganus doliatus*
Rabbitfish	*Siganus fuscescens*
Rabbitfish	*Siganus punctatus*
Rabbitfish	*Siganus spinus*
Rabbitfish	*Siganus vermiculatus*
Rabbitfish	*Siganus canaliculatus*
Rabbitfish	*Siganus corallinus*
Rabbitfish	*Siganus guttatus*
Rabbitfish	*Siganus puellus*
Rabbitfish	*Siganus lineatus*
Rabbitfish	*Siganus vulpinus*
Rabbitfish	*Siganus oramin*
Rabbitfish	*Siganus punctatissimus*
Rabbitfish	*Siganus randalli*
Rabbitfish	*Manahak lesso'*
Rabbitfish	*Manahak ha'tang*
Rabbitfish	*Manahak sp*
Rudderfish	*Kyphosidae*
Rudderfish	*Kyphosus cinerascens*
Rudderfish	*Kyphosus vaigiensis*
Rudderfish	*Kyphosus bigibbus*

Other	*Prealticus amboinensis*
Other	*Prealticus natalis*
Other	*Meiacanthus anema*
Other	*Rhabdoblenius rhabdotrachelus*
Other	*Rhabdoblennius snowi*
Other	*Salarius fasciatus*
Other	*Stanulus seychellensis*
Other	*Xiphasia matsubarai*
Other	*Blenniella paula*
Other	*Atrosalarius fuscus holomelas*
Other	*Entomacrodus stellifer*
Other	*Cirripectes castaneus*
Other	*Cirripectes perustus*
Other	*Cirripectes stigmaticus*
Other	*Ecsenius sellifer*
Other	*Ecsenius yaeyamaensis*
Other	*Entomacrodus caudofasciatus*
Other	*Entomacrodus cymatobiotus*
Other	*Glyptoparus delicatulus*
Other	*Rhabdoblennius ellipes*
Other	*Litobranchus fowleri*
Other	*Nannosalarius nativitatus*
Other	*Salarius alboguttatus*
Other	*Salarius segmentatus*
Other	*Salarius luctuosus*
Other	*Omox biporos*
Other	*Aspidontus dussumieri*
Other	*Meiacanthus ditrema*
Other	*Meiacanthus grammistes*
Other	*Petroscirtes breviceps*
Other	*Petroscirtes thepassi*
Other	*Petroscirtes variabilis*
Other	*Omobranchus obliquus*
Other	*Ecsenius bandanus*
Other	*Istiblennius bellus*
Other	*Istiblennius dussumieri*
Other	*Istiblennius interruptus*
Other	*Schindleriidae*
Other	*Schindleria praematurus*
Other	*Eleotrididae*
Other	*Eleotris fusca*
Other	*Butis amboinensis*
Other	*Calumia godeffroyi*
Other	*Ophieleotris aporos*
Other	*Ophiocara porocephala*
Other	*Oxyleotris lineolatus*
Other	*Gobiidae*
Other	*Amblyeleotris faciata*
Other	*Amblyeleotris fontaseni*
Other	*Amblyeleotris guttata*

Snappers	*Lutjanidae*	Other	*Amlbyeleotris periophthalma*
Snappers	*Lutjanus argentimaculatus*	Other	*Amblyeleotris steinitzi*
Snappers	*Lutjanus bohar*	Other	*Amblyeleotris randalli*
Snappers	*Lutjanus fulvus*	Other	*Amblyeleotris wheeleri*
Snappers	*Lutjanus gibbus*	Other	*Cryptocentroides insignis*
Snappers	*Lutjanus rivulatus*	Other	*Cryptocentrus cinctus*
Snappers	*Lutjanus monostigma*	Other	*Cryptocentrus koumansi*
Snappers	*Macolor niger*	Other	*Cryptocentrus cauruleomaculatus*
Snappers	*Paracaesio sordidus*	Other	*Cryptocentrus leptocephalus*
Snappers	*Paracaesio xanthurus*	Other	*Cryptocentrus strigilliceps*
Snappers	*Randallichthys filamentosus*	Other	*Cryptocentrus sp A*
Snappers	*Lutjanus biguttatus*	Other	*Ctenogobiops aurocingulus*
Snappers	*Lutjanus decussatus*	Other	*Ctenogobiops feroculus*
Snappers	*Lutjanus ehrenbergi*	Other	*Ctenogobiops pomastictus*
Snappers	*Lutjanus malabaricus*	Other	*Ctenogobiops tangarorai*
Snappers	*Lutjanus semicinctus*	Other	*Lotilia graciliosa*
Snappers	*Lutjanus vitta*	Other	*Mahidolia mystacina*
Snappers	*Symphorichthys spilurus*	Other	*Vanderhorstia ambanoro*
Snappers	*Macolor macularis*	Other	*Vanderhorstia ornatissima*
Snappers	*Lutjanus sebae*	Other	*Amblygobius decussatus*
Snappers	*Lutjanus boutton*	Other	*Amblygobius hectori*
Snappers	*Lutjanus fulviflamma*	Other	*Amblygobius nocturnus*
Snappers	*SHALLOW SNAPPERS*	Other	*Amblygobius phalaena*
Surgeonfish	*Acanthuridae*	Other	*Amblygobius rainfordi*
Surgeonfish	*Acanthurus achilles*	Other	*Oplopomops diacanthus*
Surgeonfish	*Acanthurus dussumieri*	Other	*Oplopomus oplopomus*
Surgeonfish	*Acanthurus nigricans*	Other	*Signigobius biocellatus*
Surgeonfish	*Acanthurus guttatus*	Other	*Silhouettea sp*
Surgeonfish	*Acanthurus leucopareius*	Other	*Valenciennea muralis*
Surgeonfish	*Acanthurus lineatus*	Other	*Valenciennea puellaris*
Surgeonfish	*Acanthurus blochii*	Other	*Valenciennea sexguttatus*
Surgeonfish	*Acanthurus nigricauda*	Other	*Valenciennea strigatus*
Surgeonfish	*Acanthurus nigrofuscus*	Other	*Valenciennea sp*
Surgeonfish	*Acanthurus nigroris*	Other	*Acentrogobius bonti*
Surgeonfish	*Acanthurus olivaceus*	Other	*Asterropteryx ensiferus*
Surgeonfish	*Acanthurus pyroferus*	Other	*Asteropteryx semipunctatus*
Surgeonfish	*Acanthurus thompsoni*	Other	*Austrolethops wardi*
Surgeonfish	*Acanthurus triostegus triostegus*	Other	*Awaous grammepomus*
Surgeonfish	*Acanthurus xanthopterus*	Other	*Awaous guamensis*
Surgeonfish	*Ctenochaetus binotatus*	Other	*Bathygobius cocosensis*
Surgeonfish	*Ctenochaetus hawaiiensis*	Other	*Bathygobius cotticeps*
Surgeonfish	*Ctenochaetus striatus*	Other	*Bathygobius fuscus*
Surgeonfish	*Naso annulatus*	Other	*Bryaninops amplus*
Surgeonfish	*Naso brachycentron*	Other	*Bryaninops erythrops*
Surgeonfish	*Naso brevirostris*	Other	*Bryaninops natans*
Surgeonfish	*Naso hexacanthus*	Other	*Bryaninops ridens*
Surgeonfish	*Naso lituratus*	Other	*Bryaninops youngei*
Surgeonfish	*Naso tuberosus*	Other	*Cabillus tongarevae*
Surgeonfish	*Naso unicornis*	Other	*Callogobius bauchotae*
Surgeonfish	*Naso vlamingii*	Other	*Callogobius centrolepis*

Surgeonfish	*Paracanthurus hepatus*	Other	*Callogobius hasselti*
Surgeonfish	*Zebrasoma flavescens*	Other	*Callogobius maculipinnis*
Surgeonfish	*Zebrasoma scopas*	Other	*Callogobius okinawae*
Surgeonfish	*Zebrasoma veliferum*	Other	*Callogobius plumatus*
Surgeonfish	*Ctenochaetus strigosus*	Other	*Callogobius sclateri*
Surgeonfish	*Acanthurus bariene*	Other	*Callogobious sp*
Surgeonfish	*Acanthurus mata*	Other	*Cristagobius sp*
Surgeonfish	*Acanthurus chronixis*	Other	*Eviota afelei*
Surgeonfish	*Acanthurus maculiceps*	Other	*Eviota albolineata*
Surgeonfish	*Ctenochaetus marginatus*	Other	*Eviota bifasciata*
Surgeonfish	*Ctenochaetus tominiensis*	Other	*Eviota cometa*
Surgeonfish	*Naso lopezi*	Other	*Eviota distigma*
Surgeonfish	*Acanthurus leucocheilus*	Other	*Eviota fasciola*
Surgeonfish	*Acanthurus nubilus*	Other	*Eviota herrei*
Surgeonfish	*Naso caesius*	Other	*Eviota infulata*
Surgeonfish	*Naso thynnoides*	Other	*Eviota lachdebrerei*
Surgeonfish	*Acanthuridae*	Other	*Eviota latifasciata*
Squirrelfish	*Holocentridae*	Other	*Eviota melasma*
Squirrelfish	*Sargocentron caudimaculatum*	Other	*Eviota nebulosa*
Squirrelfish	*Sargocentron diadema*	Other	*Eviota pellucida*
Squirrelfish	*Sargocentron punctatissimum*	Other	*Eviota prasina*
Squirrelfish	*Sargocentron microstoma*	Other	*Eviota prasites*
Squirrelfish	*Sargocentron praslin*	Other	*Eviota punctulata*
Squirrelfish	*Sargocentron spiniferum*	Other	*Eviota queenslandica*
Squirrelfish	*Sargocentron tiere*	Other	*Eviota sebreei*
Squirrelfish	*Sargocentron tieroides*	Other	*Eviota saipanensis*
Squirrelfish	*Neoniphon argenteus*	Other	*Eviota sigillata*
Squirrelfish	*Neoniphon opercularis*	Other	*Eviota smaragdus*
Squirrelfish	*Neoniphon sammara*	Other	*Eviota sparsa*
Squirrelfish	*Neoniphon aurolineatus*	Other	*Eviota storthynx*
Squirrelfish	*Myripristis adusta*	Other	*Eviota zonura*
Squirrelfish	*Myripristis amaena*	Other	*Eviota sp*
Squirrelfish	*Myripristis berndti*	Other	*Exyrias belissimus*
Squirrelfish	*Myripristis kuntee*	Other	*Exyrias puntang*
Squirrelfish	*Myripristis murdjan*	Other	*Fusigobius longispinus*
Squirrelfish	*Myripristis violacea*	Other	*Fusigobius neophytus*
Squirrelfish	*Myripristis vittata*	Other	*Coryphopterus signipinnis*
Squirrelfish	*Plectrypops lima*	Other	*Gladigobius ensifera*
Squirrelfish	*Myripristis pralinia*	Other	*Glossogobius biocellatus*
Squirrelfish	*Ostichthys kaianus*	Other	*Glossogobius celebius*
Squirrelfish	*Myripristis chryseres*	Other	*Glossogobius guirus*
Squirrelfish	*Myripristis woodsi*	Other	*Gnatholepis anjerensis*
Squirrelfish	*Sargocentron ittodai*	Other	*Gnatholepis scapulostigma*
Squirrelfish	*Sargocentron melanospilos*	Other	*Gnatholepis sp A*
Squirrelfish	*Sargocentron violaceum*	Other	*Gobiodon albofasciatus*
Squirrelfish	*Sargocentron dorsomaculatum*	Other	*Gobiodon citrinus*
Squirrelfish	*Myripristis amaena*	Other	*Gnatholepis caurensis*
Squirrelfish	*Sargocentron cornutum*	Other	*Gobiodon okinawae*
Squirrelfish	*Sargocentron lepros*	Other	*Gobiodon quinquestrigatus*
Squirrelfish	*Sargocentron furcatum*	Other	*Gobiodon rivulatus*

Squirrelfish	*Ostichthys brachygnathus*	Other	*Gobiopsis bravoi*
Squirrelfish	*Holocentrinae*	Other	*Heteroeleotris sp*
Squirrelfish	*Myripristinae*	Other	*Istigobius decoratus*
Wrasse	*Labridae*	Other	*Istigobius ornatus*
Wrasse	*Anampses caeruleopunctatus*	Other	*Istigobius rigilius*
Wrasse	*Anampses meleagrides*	Other	*Istigobius spence*
Wrasse	*Anampses twisti*	Other	*Kelloggella cardinalis*
Wrasse	*Bodianus anthioides*	Other	*Kellogella quindecimfasciata*
Wrasse	*Bodianus axillaris*	Other	*Macrodontogobius wilburi*
Wrasse	*Oxycheilinus arenatus*	Other	*Mugilogobius tagala*
Wrasse	*Oxycheilinus celebecus*	Other	*Mugilogobius villa*
Wrasse	*Cheilinus chlorourus*	Other	*Opua nephodes*
Wrasse	*Cheilinus fasciatus*	Other	*Oxyurichthys guibei*
Wrasse	*Cheilinus oxycephalus*	Other	*Oxyurichthys microlepis*
Wrasse	*Oxycheilinus unifasciatus*	Other	*Oxyurichthys ophthalmonema*
Wrasse	*Cheilinus trilobatus*	Other	*Oxyurichthys papuensis*
Wrasse	*Oxycheilinus orientalis*	Other	*Oxyurichthys tentacularis*
Wrasse	*Cheilio inermis*	Other	*Padanka sp*
Wrasse	*Choerodon anchorago*	Other	*Palutris pruinosa*
Wrasse	*Cirrhilabrus katherinae*	Other	*Palutris reticularis*
Wrasse	*Coris aygula*	Other	*Paragobiodon echinocephalus*
Wrasse	*Coris gaimardi*	Other	*Paragobiodon lacunicolus*
Wrasse	*Cymolutes praetextatus*	Other	*Paragobiodon melanosoma*
Wrasse	*Epibulus insidiator*	Other	*Paragobiodon modestus*
Wrasse	*Gomphosus varius*	Other	*Paragobiodon xanthosoma*
Wrasse	*Halichoeres biocellatus*	Other	*Periophthalmus argentilineatus*
Wrasse	*Halichoeres zeylonicus*	Other	*Periophthalmus kalolo*
Wrasse	*Halichoeres hortulanus*	Other	*Pleurosicya bilobatus*
Wrasse	*Halichoeres margaritaceus*	Other	*Pleurosicya muscarum*
Wrasse	*Halichoeres marginatus*	Other	*Priolepis cincta*
Wrasse	*Halichoeres melasmapomus*	Other	*Priolepis farcimen*
Wrasse	*Halichoeres trimaculatus*	Other	*Priolepis inhaca*
Wrasse	*Hemigymnus fasciatus*	Other	*Priolepis semidoliatus*
Wrasse	*Hemigymnus melapterus*	Other	*Pseudogobius javanicus*
Wrasse	*Hologymnosus doliatus*	Other	*Redigobius bikolanus*
Wrasse	*Labrichthys unilineatus*	Other	*Redigobius horiae*
Wrasse	*Labroides bicolor*	Other	*Redigobius sapangus*
Wrasse	*Labroides pectoralis*	Other	*Sicyopus leprurus*
Wrasse	*Labropsis micronesica*	Other	*Sicyopus zosterophorum*
Wrasse	*Labropsis xanthonota*	Other	*Sicyopus sp*
Wrasse	*Macropharyngodon meleagris*	Other	*Sicyopterus macrostetholepis*
Wrasse	*Novaculichthys macrolepidotus*	Other	*Sicyopterus micrurus*
Wrasse	*Novaculichthys taeniourus*	Other	*Sicyopterus sp*
Wrasse	*Bodianus tanyokidus*	Other	*Stenogobius genivittatus*
Wrasse	*Pseudocheilinus evanidus*	Other	*Stenogobius sp*
Wrasse	*Pseudocheilinus hexataenia*	Other	*Stiphodon elegans*
Wrasse	*Pseudocheilinus octotaenia*	Other	*Stiphodon sp*
Wrasse	*Pseudocheilinus tetrataenia*	Other	*Taenioides limicola*
Wrasse	*Pseudojuloides atavai*	Other	*Trimma caesiura*
Wrasse	*Pseudojuloides cerasinus*	Other	*Trimma naudei*

Wrasse	*Pterogogus cryptus*	Other	*Trimma okinawae*
Wrasse	*Stethojulis bandanensis*	Other	*Trimma taylori*
Wrasse	*Stethojulis strigiventor*	Other	*Trimma tevegae*
Wrasse	*Thalassoma amblycephalum*	Other	*Trimma sp A*
Wrasse	*Thalassoma trilobatum*	Other	*Trimma sp B*
Wrasse	*Thalassoma hardwickii*	Other	*Trimmatom eviotops*
Wrasse	*Thalassoma lutescens*	Other	*Vanderhorstia lanceolata*
Wrasse	*Thalassoma purpureum*	Other	*Amblygobius sp*
Wrasse	*Thalassoma quinquevittatum*	Other	*Valenciennea parva*
Wrasse	*Wetmorella nigropinnata*	Other	*Pleurosicya carolinensis*
Wrasse	*Xyrichtys pavo*	Other	*Pleurosicya coerulea*
Wrasse	*Xyrichtys aneitensis*	Other	*Pleurosicya fringella*
Wrasse	*Thalassoma janseni*	Other	*Pleurosicya micheli*
Wrasse	*Oxycheilinus digrammus*	Other	*Pleurosicya mossambica*
Wrasse	*Oxycheilinus bimaculatus*	Other	*Pleurosicya plicata*
Wrasse	*Polylepion russelli*	Other	*Amblygobius linki*
Wrasse	*Labroides dimidiatus*	Other	*Kraemeriidae*
Wrasse	*Pseudodax moluccanus*	Other	*Kraemeria bryani*
Wrasse	*Anampses melanurus*	Other	*Kraemeria cunicularia*
Wrasse	*Bodianus diana*	Other	*Kraemeria samoensis*
Wrasse	*Bodianus loxozonus*	Other	*Xenisthmidae*
Wrasse	*Bodianus mesothorax*	Other	*Allomicrodesmis dorotheae*
Wrasse	*Cirrhilabrus cyanopleura*	Other	*Xenisthmus polyzonatus*
Wrasse	*Cirrhilabrus exquisitus*	Other	*Xenishthmus sp*
Wrasse	*Cirrhilabrus luteovittatus*	Other	*Microdesmidae*
Wrasse	*Coris batuensis*	Other	*Gunnellichthys monostigma*
Wrasse	*Epibulus n sp*	Other	*Gunnellichthys pleurotaenia*
Wrasse	*Halichoeres chloropterus*	Other	*Nemateleotris helfrichi*
Wrasse	*Halichoeres chrysus*	Other	*Nemateleotris magnifica*
Wrasse	*Halichoeres melanurus*	Other	*Ptereleotris evides*
Wrasse	*Halichoeres richmondi*	Other	*Ptereleotris heteroptera*
Wrasse	*Halichoeres scapularis*	Other	*Ptereleotris microlepis*
Wrasse	*Halichoeres sp*	Other	*Ptereleotris zebra*
Wrasse	*Labropsis alleni*	Other	*Ptereleotris lineopinnis*
Wrasse	*Macropharyngodon negrosensis*	Other	*Nemateleotris decora*
Wrasse	*Pseudocheilinus sp*	Other	*Gunnellichthys viridescens*
Wrasse	*Pseudocoris yamashiroi*	Other	*Paragunnellichthy seychellensis*
Wrasse	*Thalassoma lunare*	Other	*Parioglossus formosus*
Wrasse	*Bodianus bimaculatus*	Other	*Parioglossus lineatus*
Wrasse	*Wetmorella albofasciata*	Other	*Parioglossus nudus*
Wrasse	*Xiphocheilus sp*	Other	*Parioglossus palustris*
Wrasse	*Cymolutes torquatus*	Other	*Parioglossus rainfordi*
Wrasse	*Paracheilinus bellae*	Other	*Parioglossus raoi*
Wrasse	*Paracheilinus sp*	Other	*Parioglossus taeniatus*
Wrasse	*Pseudocheilinops ataenia*	Other	*Parioglossus verticalis*
Wrasse	*Pterogogus guttatus*	Other	*Ptereleotris hanae*
Wrasse	*Anampses geographicus*	Other	*Zanclidae*
Wrasse	*Halichoeres prosopeion*	Other	*Zanclus cornutus*
Wrasse	*Stethojulis trilineata*	Other	*Grammatorcynos bilineatus*
Wrasse	*Diproctacanthus xanthurus*	Other	*Rastrelliger kanagurta*

Wrasse	*Xyrichtys celebecus*
Wrasse	*Xyrichtys geisha*
Wrasse	*Hologymnosus annulatus*
Wrasse	*Halichoeres purpurascens*
Wrasse	*Cirrhilabrus balteatus*
Wrasse	*Cirrhilabrus johnsoni*
Wrasse	*Cirrhilabrus rhomboidalis*
Wrasse	*Xyrichtys melanopus*
Wrasse	*Cirrhilabrus rubrimarginatus*
Wrasse	*Halichoeres ornatissimus*
Wrasse	*Halichoeres shwartzi*
Wrasse	*Choerodon fasciatus*
Wrasse	*Coris dorsomacula*
Wrasse	*Halichoeres papilionaceus*
Wrasse	*Pseudocoris aurantiofasciata*
Wrasse	*Pseudocoris heteroptera*
Wrasse	*Halichoeres dussumieri*
Misc. Reeffish	*ASSORTED REEF FISH*
Misc. S.BF	*SHALLOW BOTTOMFISH*
Misc. BF	*ASSORTED BOTTOMFISH*
Other	*Myxinidae*
Other	*Eptaptretus carlhubbsi*
Other	*Hexanchidae*
Other	*Hexanchus griseus*
Other	*Orectolobidae*
Other	*Nebrius ferrugineus*
Other	*Stegastoma varium*
Other	*Lamnidae*
Other	*Isurus oxyrhinchus*
Other	*Carcharodon carcharius*
Other	*Hemigaliedae*
Other	*Galeocerdo cuvier*
Other	*Triaenodon obesus*
Other	*Carcharhinus limbatus*
Other	*Negaprion acutidens*
Other	*Sphyrnidae*
Other	*Sphyrna lewini*
Other	*Sphyrna mokorran*
Other	*Squalidae*
Other	*Etmopterus pusillus*
Other	*Squalus mitsukurii*
Other	*Echinorhinidae*
Other	*Echinorhinus brucus*
Other	*Echinorhinus cookei*
Other	*Rhinobatidae*
Other	*Rhinchobatus djiddensis*
Other	*Dasyatididae*
Other	*Dasyatis kuhlii*
Other	*Taeniura meyeni*
Other	*Himantura uarnak*
Other	*Scomberomorus commerson*
Other	*Rastrelliger brachysoma*
Other	*Istiophoridae*
Other	*Nomeidae*
Other	*Psenes cyanophrys*
Other	*Gobiesocidae*
Other	*Lepadichthys caritus*
Other	*Lepadichthys minor*
Other	*Liobranchia stria*
Other	*Callionymidae*
Other	*Callionymus enneactis*
Other	*Callionymus simplicicornis*
Other	*Diplogrammus goramensis*
Other	*Synchiropus circularis*
Other	*Synchiropus morrisoni*
Other	*Synchiropus sp*
Other	*Anaora tentaculata*
Other	*Callionymus delicatulus*
Other	*Synchiropus splendidus*
Other	*Synchiropus ocellatus*
Other	*Synchiropus laddi*
Other	*Bothidae*
Other	*Bothus mancus*
Other	*Bothus pantherinus*
Other	*Arnoglossus intermedius*
Other	*Engyprosopon sp*
Other	*Asterorhombus intermedius*
Other	*Samaridae*
Other	*Samariscus triocellatus*
Other	*Soleidae*
Other	*Soleichthys heterohinos*
Other	*Aseraggodes melanostictus*
Other	*Aseraggodes smithi*
Other	*Aseraggodes whitakeri*
Other	*Pardachirus pavoninus*
Other	*Triacanthodidae*
Other	*Halimochirurgus alcocki*
Other	*Balistidae*
Other	*Balistapus undulatus*
Other	*Balistoides conspicillum*
Other	*Balistoides viridescens*
Other	*Canthidermis maculatus*
Other	*Melichthys niger*
Other	*Melichthys vidua*
Other	*Odonus niger*
Other	*Pseudobalistes flavimarginatus*
Other	*Pseudobalistes fuscus*
Other	*Rhinecanthus aculeatus*
Other	*Rhinecanthus rectangulus*
Other	*Sufflamen bursa*

Other	*Urogymnus africanus*	Other	*Sufflamen chrysoptera*
Other	*Himantura granulata*	Other	*Sufflamen freanatus*
Other	*Himantura fai*	Other	*Xanthichthys auromarginatus*
Other	*Pasinachus sephen*	Other	*Xanthichthys careuleolineatus*
Other	*Urotrygon daviesi*	Other	*Xenobalistes tumidipectoris*
Other	*Myliobatidae*	Other	*Abalistes stellatus*
Other	*Aetobatis narinari*	Other	*Rhinecanthus verrucosa*
Other	*Aetomyleaus maculatus*	Other	*Xanthichthys mento*
Other	*Mobulidae*	Other	*Monacanthidae*
Other	*Manta birostris*	Other	*Aluterus scriptus*
Other	*Clupeidae*	Other	*Amanses scopas*
Other	*Spratelloides delicatulus*	Other	*Cantherhines dumerilii*
Other	*Dussumieria sp B*	Other	*Cantherhines pardalis*
Other	*Dussumieria elopsoides*	Other	*Oxymonacanthus longirostris*
Other	*Eutremus teres*	Other	*Paraluteres prionurus*
Other	*Spratelloides gracilis*	Other	*Pervagor janthinosoma*
Other	*Amblygaster clupeoides*	Other	*Aluterus monoceros*
Other	*Amblygaster sirm*	Other	*Brachaluteres taylori*
Other	*Herklotsichthys quadrimaculatus*	Other	*Paramonacanthus cryptodon*
Other	*Engraulidae*	Other	*Paramonacanthus japonicus*
Other	*Enchrasicholina punctifer*	Other	*Pervagor aspricaudatus*
Other	*Thryssa baelama*	Other	*Pervagor melanocephalus*
Other	*Stolephorus pacificus*	Other	*Pervagor nigrolineatus*
Other	*Stolephorus indicus*	Other	*Cantherhines fronticinctus*
Other	*Enchrasicholina heterolobus*	Other	*Acreichthys tomentosus*
Other	*Enchrasicholina devisi*	Other	*Pervagor alternans*
Other	*Stolephorus insularis*	Other	*Pseudalutarias nasicornis*
Other	*Stolephorus apiensis*	Other	*Rudarius minutus*
Other	*Stolephorus multibranchus*	Other	*Ostraciidae*
Other	*Stolephorus sp*	Other	*Lactoria cornuta*
Other	*Megalopidae*	Other	*Lactoria diaphana*
Other	*Megalops cyprinoides*	Other	*Ostracion cubicus*
Other	*Albulidae*	Other	*Ostracion meleagris meleagris*
Other	*Albula glossodonta*	Other	*Lactoria fornasini*
Other	*Albula neoguinaica*	Other	*Ostracion solorensis*
Other	*Anguillidae*	Other	*Rhynchostracion nasus*
Other	*Anguilla bicolor*	Other	*Rhynchostracion rhynorhynchus*
Other	*Anguilla marmorata*	Other	*Triodontidae*
Other	*Moringuidae*	Other	*Triodon macropterus*
Other	*Moringua microchir*	Other	*Triodon bursarius*
Other	*Moringua javanica*	Other	*Tetraodontidae*
Other	*Moringua ferruginea*	Other	*Arothron hispidus*
Other	*Chlopsidae*	Other	*Arothron manilensis*
Other	*Kaupichthys hyoproroides*	Other	*Arothron mappa*
Other	*Kaupichthys atronasus*	Other	*Arothron meleagris*
Other	*Kaupichthys brachychirus*	Other	*Arothron nigropunctatus*
Other	*Muraenidae*	Other	*Arothron stellatus*
Other	*Anarchias allardicei*	Other	*Canthigaster amboinensis*
Other	*Anarchias seychellensis*	Other	*Canthigaster bennetti*
Other	*Echidna leucotaenia*	Other	*Canthigaster coronata*

Other	*Echidna nebulosa*	Other	*Canthigaster epilampra*
Other	*Echidna polyzona*	Other	*Canthigaster janthinoptera*
Other	*Echidna unicolor*	Other	*Canthigaster leoparda*
Other	*Enchelycore bayeri*	Other	*Canthigaster solandri*
Other	*Enchelycore bikiniensis*	Other	*Canthigaster valentini*
Other	*Enchelycore schismatorhynchus*	Other	*Canthigaster compressa*
Other	*Enchelynassa canina*	Other	*Amblyrhinchotus honckenii*
Other	*Gymnomuraena zebra*	Other	*Lagocephalus lagocephalus*
Other	*Gymnothorax fuscomaculatus*	Other	*Lagocephalus sceleratus*
Other	*Gymnothorax marshallensis*	Other	*Canthigaster ocellicincta*
Other	*Gymnothorax melatremus*	Other	*Canthigaster papua*
Other	*Sideria picta*	Other	*Diodontidae*
Other	*Gymnothorax pindae*	Other	*Diodon hystrix*
Other	*Sideria prosopeion*	Other	*Diodon liturosus*
Other	*Gymnothorax sp cf Melatremus*	Other	*Diodon eydouxi*
Other	*Gymnothorax berndti*	Other	*Molidae*
Other	*Gymnothorax buroensis*	Other	*Masturus lanceolatus*
Other	*Gymnothorax fimbriatus*	Other	*Ranzania laevis*
Other	*Gymnothorax flavimarginatus*	Other	*Synchiropus laddi*
Other	*Gymnothorax gracilicaudus*	Crustaceans	*Lythoglyptidae*
Other	*Gymnothorax elegans*	Crustaceans	*Balanus sp*
Other	*Gymnothorax hepaticus*	Crustaceans	*Tetraclitella divisa*
Other	*Gymnothorax javanicus*	Crustaceans	*Stomatopoda*
Other	*Gymnothorax margaritophorus*	Crustaceans	*Bathysquillidae*
Other	*Gymnothorax meleagris*	Crustaceans	*Eurysquillidae*
Other	*Gymnothorax monostigmus*	Crustaceans	*Gonodactylidae*
Other	*Gymnothorax neglectus*	Crustaceans	*Gonodactylellus affinis*
Other	*Gymnothorax richardsoni*	Crustaceans	*Gonodactylus chiragra*
Other	*Gymnothorax rueppelliae*	Crustaceans	*Gonodactylaceus mutatus*
Other	*Gymnothorax undulatus*	Crustaceans	*Gonodactylus platysoma*
Other	*Gymnothorax zonipectus*	Crustaceans	*Gonodactylus smithii*
Other	*Gymnothorax enigmaticus*	Crustaceans	*Hemisquillidae*
Other	*Rhinomuraena quaesita*	Crustaceans	*Odontodactylidae*
Other	*Pseudechidna brummeri*	Crustaceans	*Odontodactylus brevirostris*
Other	*Strophidon sathete*	Crustaceans	*Odontodactylus scyallarus*
Other	*Uropterygius concolor*	Crustaceans	*Protosquillidae*
Other	*Uropterygius marmoratus*	Crustaceans	*Pseudosquillidae*
Other	*Uropterygius micropterus*	Crustaceans	*Pseudosquilla ciliata*
Other	*Uropterygius macrocephalus*	Crustaceans	*Harposquillidae*
Other	*Uropterygius supraforatus*	Crustaceans	*Squillidae*
Other	*Uropterygius xanthopterus*	Crustaceans	*Oratosquillidae*
Other	*Gymnothorax nudivomer*	Crustaceans	*Oratosquilla oratoria*
Other	*Anarchias cantonensis*	Crustaceans	*Lysiosquillidae*
Other	*Channomuraena vittata*	Crustaceans	*Nannosquillidae*
Other	*Gymnothorax monochrous*	Crustaceans	*Hyperiidae*
Other	*Gymnothorax polyuranodon*	Crustaceans	*Phronimidae*
Other	*Uropterygius fuscoguttatus*	Crustaceans	*Lycaeidae*
Other	*Uropterygius goslinei*	Crustaceans	*Platyscelidae*
Other	*Uropterygius kamar*	Crustaceans	*Anchylomeridae*
Other	*Uropterygius polyspilus*	Crustaceans	*Decapoda*

Other	*Scuticaria tigrinis*	Crustaceans	*Penaeidae*
Other	*Enchelycore kamara*	Crustaceans	*Metapenaeopsis sp 1*
Other	*Uropterygius fijiensis*	Crustaceans	*Metapenaeopsis sp 2*
Other	*Synaphobranchidae*	Crustaceans	*Metapenaeopsis sp 3*
Other	*Synaphobranchus sp*	Crustaceans	*Heteropenaeus sp*
Other	*Congridae*	Crustaceans	*Penaeus monodon*
Other	*Conger cinereus cinereus*	Crustaceans	*Penaeus latisulcatus*
Other	*Conger oligoporus*	Crustaceans	*Palaemonidae*
Other	*Gorgasia sp*	Crustaceans	*Leander plumosus*
Other	*Heteroconger hassi*	Crustaceans	*Urocaridella antonbruunii*
Other	*Blachea xenobranchialis*	Crustaceans	*Pontoniidae*
Other	*Ariosoma scheelei*	Crustaceans	*Dasycaris zanzibarica*
Other	*Poeciloconger fasciatus*	Crustaceans	*Periclimenes amboinensis*
Other	*Conger sp*	Crustaceans	*Periclimenes brevicarpalis*
Other	*Gorgasia preclara*	Crustaceans	*Periclimenes cf ceratophthalmus*
Other	*Muraenesocidae*	Crustaceans	*Periclimenes holthuisi*
Other	*Muraenesox cinereus*	Crustaceans	*Periclimenes imperator*
Other	*Ophichthidae*	Crustaceans	*Periclimenes inornatus*
Other	*Brachysomophis sauropsis*	Crustaceans	*Periclimenes kororensis*
Other	*Caecula polyophthalma*	Crustaceans	*Periclimenes ornatus*
Other	*Callechelys marmorata*	Crustaceans	*Periclimenes psamathe*
Other	*Callechelys melanotaenia*	Crustaceans	*Periclimenes soror*
Other	*Leiuranus semicinctus*	Crustaceans	*Periclimenes tenuipes*
Other	*Muraenichthys laticaudata*	Crustaceans	*Periclimenes venustus*
Other	*Muraenichthys macropterus*	Crustaceans	*Pliopotonia furtiva*
Other	*Myrichthys colubrinus*	Crustaceans	*Pontonides uncigar*
Other	*Myrichthys maculosus*	Crustaceans	*Stegopontonia commensalis*
Other	*Ophichthus cephalozona*	Crustaceans	*Stenopodidae*
Other	*Muraenichthys gymnotus*	Crustaceans	*Stenopus hispidus*
Other	*Muraenichthys schultzi*	Crustaceans	*Hippolytidae*
Other	*Muraenichthys sibogae*	Crustaceans	*Koror misticius*
Other	*Myrophis uropterus*	Crustaceans	*Thor amboinensis*
Other	*Schismorhinchus labialis*	Crustaceans	*Gnathophyllidae*
Other	*Schultzidia johnstonensis*	Crustaceans	*Gnathophylloides mineri*
Other	*Schultzidia retropinnis*	Crustaceans	*Gnathophyllum americanum*
Other	*Apterichtus klazingai*	Crustaceans	*Hymenocera picta*
Other	*Cirricaecula johnsoni*	Crustaceans	*Rhynchocinetidae*
Other	*Elapsopsis versicolor*	Crustaceans	*Rhinchocinetes hiatti*
Other	*Evipes percinctus*	Crustaceans	*Alphaeidae*
Other	*Ichthyapus vulturus*	Crustaceans	*Alpheus bellulus*
Other	*Myrichthys bleekeri*	Crustaceans	*Alpheus paracrinitus*
Other	*Phenamonas cooperi*	Crustaceans	*Synalpheus carinatus*
Other	*Phyllophichthus xenodontus*	Crustaceans	*Pandalidae*
Other	*Lamnostoma orientalis*	Crustaceans	*Pandalus Unid sp 1*
Other	*Gonostomatidae*	Crustaceans	*Pandalidae*
Other	*Diplophos sp*	Crustaceans	*Pandalidae*
Other	*Gonostoma atlanticum*	Crustaceans	*Solenoceridae*
Other	*Gonostoma ebelingi*	Crustaceans	*Heterocarpus sp*
Other	*Sternoptichidae*	Crustaceans	*Nephropidae*
Other	*Giganturidae*	Crustaceans	*Enoplometopus debelius*

Other	*Rosaura indica*	Crustaceans	*Enoplometopus occidentalis*
Other	*Chanidae*	Crustaceans	*Hoplometopus holthuisi*
Other	*Chanos chanos*	Crustaceans	*Palinuridae*
Other	*Clariidae*	Crustaceans	*Panulirus sp*
Other	*Clarias macrocephalus*	Crustaceans	*Panulirus homarus*
Other	*Clarias batrachus*	Crustaceans	*Panulirus longipes*
Other	*Plotosidae*	Crustaceans	*Panulirus marginatus*
Other	*Plotosus lineatus*	Crustaceans	*Panulirus ornatus*
Other	*Synodontidae*	Crustaceans	*Panulirus penicillatus*
Other	*Saurida gracilis*	Crustaceans	*Panulirus versicolor*
Other	*Saurida nebulosa*	Crustaceans	*Palinurellus wieneckii*
Other	*Synodus binotatus*	Crustaceans	*Panulirus albiflagellum*
Other	*Synodus englemanni*	Crustaceans	*Ibacus sp*
Other	*Synodus jaculum*	Crustaceans	*Justitia longimanus*
Other	*Synodus variegatus*	Crustaceans	*Scyllaridae*
Other	*Synodus dermatogenys*	Crustaceans	*Arctides regalis*
Other	*Myctophidae*	Crustaceans	*Parribacus antarcticus*
Other	*Diaphus schmidti*	Crustaceans	*Parribacus caledonicus*
Other	*Myctophum brachygnathos*	Crustaceans	*Scyllarides squammosus*
Other	*Paralepididae*	Crustaceans	*Scyllarius timidus*
Other	*Lestidium nudun*	Crustaceans	*Diogenidae*
Other	*Alepisauidae*	Crustaceans	*Dardanus sp*
Other	*Alepisaurus ferox*	Crustaceans	*Dardanus gemmatus*
Other	*Polymixiidae*	Crustaceans	*Dardanus pendunculatus*
Other	*Polymixia japonica*	Crustaceans	*Dardanus megistos*
Other	*Moridae*	Crustaceans	*Lithodidae*
Other	*Physiculus sp*	Crustaceans	*Paguridae*
Other	*Bregmacerotidae*	Crustaceans	*Paguritta gracilipes*
Other	*Bregmaceros nectabanus*	Crustaceans	*Paguritta harmsi*
Other	*Ophidiidae*	Crustaceans	*Galatheidae*
Other	*Brotula multibarbata*	Crustaceans	*Porcellanidae*
Other	*Brotula townsendi*	Crustaceans	*Petrolisthes lamarkii*
Other	*Bythitidae*	Crustaceans	*Emerita pacifica*
Other	*Brosmophyciops pautzkei*	Crustaceans	*Io Brachyura*
Other	*Dinematichthys iluocoetenoides*	Crustaceans	*Homolidae*
Other	*Microbrotula sp*	Crustaceans	*Raninidae*
Other	*Carapodidae*	Crustaceans	*Lyreidus tridentatus*
Other	*Encheliophis homei*	Crustaceans	*Ranina ranina*
Other	*Carapus mourlani*	Crustaceans	*Dorippe frascone*
Other	*Encheliophis boraboraensis*	Crustaceans	*Dromiidae*
Other	*Encheliophis vermicularis*	Crustaceans	*Dromia dormia*
Other	*Encheliophis gracilis*	Crustaceans	*Calappidae*
Other	*Onuxodon fowleri*	Crustaceans	*Calappa bicornis*
Other	*Antenariidae*	Crustaceans	*Calappa calappa*
Other	*Antennarius analis*	Crustaceans	*Calappa hepatica*
Other	*Antennarius biocellatus*	Crustaceans	*Cycloes granulosa*
Other	*Antennarius coccineus*	Crustaceans	*Mursia spinimanus*
Other	*Antennarius commersonii*	Crustaceans	*Majidae*
Other	*Antennarius dorehensis*	Crustaceans	*Achaeus japonicus*
Other	*Antennarius maculatus*	Crustaceans	*Camposcia retusa*

Other	*Antennarius nummifer*	Crustaceans	*Parthenopidae*
Other	*Antennarius pictus*	Crustaceans	*Daldorfia horrida*
Other	*Antennarius randalli*	Crustaceans	*Lambrus longispinis*
Other	*Antennarius rosaceus*	Crustaceans	*Cancridae*
Other	*Antennatus tuberosus*	Crustaceans	*Portunidae*
Other	*Histrio histrio*	Crustaceans	*Charybdis erythrodactyla*
Other	*Exocoetidae*	Crustaceans	*Charybdis hawaiiensis*
Other	*Cheilopogon spilonopterus*	Crustaceans	*Lupocyclus grimquedentatus*
Other	*Cheilopogon spilopterus*	Crustaceans	*Portunus sanguinolentus*
Other	*Cheilopogon unicolor*	Crustaceans	*Portunus pelagicus*
Other	*Cypselurus angusticeps*	Crustaceans	*Podophthalmus vigil*
Other	*Cypselurus poecilopterus*	Crustaceans	*Scylla serrata*
Other	*Cypselurus speculiger*	Crustaceans	*Thalamita crenata*
Other	*Parexocoetus brachypterus*	Crustaceans	*Unid sp 2*
Other	*Parexocoetus mento*	Crustaceans	*Unid sp 1*
Other	*Prognichthys albimaculatus*	Crustaceans	*Xanthidae*
Other	*Prognichthys sealei*	Crustaceans	*Carpilius convexus*
Other	*Exocoetus volitans*	Crustaceans	*Carpilius maculatus*
Other	*Belonidae*	Crustaceans	*Etisus splendidus*
Other	*Ablennes hians*	Crustaceans	*Zosymus aeneus*
Other	*Platybelone argalus platyura*	Crustaceans	*Eriphia sebana*
Other	*Strongylura incisa*	Crustaceans	*Etisus dentatus*
Other	*Tylosurus crocodilis crocodilis*	Crustaceans	*Etisus utilis*
Other	*Strongylura leiura leiura*	Crustaceans	*Unid sp 2*
Other	*Tylosurus acus melanotus*	Crustaceans	*Unid Megalops*
Other	*Hemirhamphidae*	Crustaceans	*Unid sp 1*
Other	*Hemiramphus archipelagicus*	Crustaceans	*Gecarcinidae*
Other	*Hyporhamphus acutus acutus*	Crustaceans	*Grapsidae*
Other	*Hyporhamphus affinis*	Crustaceans	*Grapsus albolineatus*
Other	*Hyporhamphus dussumieri*	Crustaceans	*Grapsus grapsus tenuicrustat*
Other	*Zenarchopterus dispar*	Crustaceans	*Plagusia depressa tuberculata*
Other	*Euleptorhamphus viridis*	Crustaceans	*Percnon planissimum*
Other	*Hemiramphus far*	Crustaceans	*Zebrida adamsii*
Other	*Oxyporhamphus micropterus micropter*	Crustaceans	*Ocypodidae*
Other	*Hemiramphus lutkei*	Crustaceans	*Macrophthalmus telescopicus*
Other	*Atherinidae*	Crustaceans	*Ocypode ceratopthalma*
Other	*Atherion elymus*	Crustaceans	*Ocypode cordimana*
Other	*Hypoatherina ovalaua*	Crustaceans	*Ocypode saratum*
Other	*Atherinomorus lacunosus*	Crustaceans	*Hapalocarcinidae*
Other	*Atherinomorus lacunosus*	Mollusks	*MOLLUSCA*
Other	*Atherinomorus duodecimalis*	Mollusks	*So Heteropoda*
Other	*Atherinomorus endrachtensis*	Mollusks	*O Archaeogastropoda*
Other	*Hypoatherina barnesi*	Mollusks	*Trochidae*
Other	*Hypoatherina cylindrica*	Mollusks	*Trochus niloticus*
Other	*Stenatherina panatella*	Mollusks	*Tectus pyramis*
Other	*Isonidae*	Mollusks	*Trochus radiatus*
Other	*Iso hawaiiensis*	Mollusks	*Turbinidae*
Other	*Berycidae*	Mollusks	*Turbo setosus*
Other	*Beryx decadactylus*	Mollusks	*Turbo argyrostoma*
Other	*Photoblepheron palpebratus*	Mollusks	*Turbo petholatus*

Other	*Anomalopidae*	Mollusks	*Neritidae*
Other	*Anomalops katoptron*	Mollusks	*Nerita plicata*
Other	*Caproidae*	Mollusks	*Nerita polita*
Other	*Antigonia malayana*	Mollusks	*Nerita albicilla*
Other	*Aulostomidae*	Mollusks	*Nerita signata*
Other	*Aulostomus chinensis*	Mollusks	*Littorinidae*
Other	*Fistulariidae*	Mollusks	*Littorina undulata*
Other	*Fistularia commersoni*	Mollusks	*Littorina scabra*
Other	*Centriscidae*	Mollusks	*Cerithiidae*
Other	*Aeoliscus strigatus*	Mollusks	*Cerithium nodulosum*
Other	*Solenostomidae*	Mollusks	*Clypeomorus concisus*
Other	*Solenostomus cyanopterus*	Mollusks	*Rhinoclavis aspera*
Other	*Solenostomus paradoxus*	Mollusks	*Cerithium columna*
Other	*Syngnathidae*	Mollusks	*Rhinoclavis sinensis*
Other	*Choeroichthys sculptus*	Mollusks	*Strombidae*
Other	*Choeroichthys brachysoma*	Mollusks	*Strombus mutabilis*
Other	*Corythoichthys flavofasciatus*	Mollusks	*Strombus luhuanus*
Other	*Corythoichthys intestinalis*	Mollusks	*Strombus gibberulus*
Other	*Corythoichthys nigripectus*	Mollusks	*Strombus microurceus*
Other	*Cosmocampus darrosanus*	Mollusks	*Strombus dentatus*
Other	*Doryramphus excisus*	Mollusks	*Strombus fragilis*
Other	*Doryramphus dactyliophorus*	Mollusks	*Strombus lentigninosus*
Other	*Hippocampus histrix*	Mollusks	*Terebellum terebellum*
Other	*Micrognathus brevirostris pygmaeus*	Mollusks	*Strombus haemastoma*
Other	*Halicampus brocki*	Mollusks	*Strombus sinuatus*
Other	*Halicampus mataafae*	Mollusks	*Strombus taurus*
Other	*Minyichthys myersi*	Mollusks	*Strombus plicatus*
Other	*Phoxocampus diacanthus*	Mollusks	*Lambis sp*
Other	*Syngnathoides biaculeatus*	Mollusks	*Lambis lambis*
Other	*Trachyramphus bicoarctata*	Mollusks	*Lambis chiragra*
Other	*Micrognathus andersonii*	Mollusks	*Lambis truncata*
Other	*Bhanotia nuda*	Mollusks	*Lambis scorpius scorpius*
Other	*Bulbonaricus brauni*	Mollusks	*Lambis crocota*
Other	*Corythoichthys haematopterus*	Mollusks	*Cypraeidae*
Other	*Corythoichthys ocellatus*	Mollusks	*Cypraea moneta*
Other	*Corythoichthys polynotatus*	Mollusks	*Cypraea caputserpentis*
Other	*Corythoichthys schultzi*	Mollusks	*Cypraea annulus*
Other	*Cosmocampus banneri*	Mollusks	*Cypraea lynx*
Other	*Cosmocampus maxweberi*	Mollusks	*Cypraea mappa*
Other	*Doryramphus janssi*	Mollusks	*Cypraea eglantina*
Other	*Doryramphus negrosensis negrsensi*	Mollusks	*Cypraea isabella*
Other	*Halicampus dunckeri*	Mollusks	*Cypraea erosa*
Other	*Halicampus nitidus*	Mollusks	*Cypraea poraria*
Other	*Hippichthys cyanospilos*	Mollusks	*Cypraea carneola*
Other	*Hippichthys spicifer*	Mollusks	*Cypraea helvola*
Other	*Hippocampus kuda*	Mollusks	*Cypraea staphlea*
Other	*Microphis brachyurus brachyurus*	Mollusks	*Cypraea cylindrica*
Other	*Microphis brevidorsalis*	Mollusks	*Cypraea punctata*
Other	*Microphis leiaspis*	Mollusks	*Cypraea cribaria*
Other	*Microphis manadensis*	Mollusks	*Cypraea maculifera*

Other	Microphis retzii	Mollusks	Cypraea depressa
Other	Scorpaenidae	Mollusks	Cypraea tigris
Other	Dendrochirus biocellatus	Mollusks	Cypraea vitellus
Other	Dendrochirus brachypterus	Mollusks	Cypraea talpa
Other	Pontinus macrocephalus	Mollusks	Cypraea clandestina
Other	Pterois antennata	Mollusks	Cypraea nucleus
Other	Pterois radiata	Mollusks	Cypraea microdon
Other	Pterois volitans	Mollusks	Cypraea stolida
Other	Sebastapistes cyanostigma	Mollusks	Cypraea mauritiana
Other	Sebastapistes galactacma	Mollusks	Cypraea arabica
Other	Sebastapistes mauritiana	Mollusks	Cypraea ventriculus
Other	Scorpaenodes minor	Mollusks	Cypraea teres
Other	Scorpaenodes guamensis	Mollusks	Cypraea scurra
Other	Scorpaenodes kelloggi	Mollusks	Cypraea hirundo
Other	Scorpaenodes parvipinnis	Mollusks	Cypraea labrolineata
Other	Scorpaenopsis oxycephala	Mollusks	Cypraea cicercula
Other	Scorpaenopsis diabolus	Mollusks	Cypraea bistronatata
Other	Synanceia verrucosa	Mollusks	Cypraea argus
Other	Taenianotus triacanthus	Mollusks	Cypraea ziczac
Other	Scorpaenodes varipinis	Mollusks	Cypraea globulus
Other	Scorpaenopsis fowleri	Mollusks	Cypraea mariae
Other	Scorpaenopsis macrochir	Mollusks	Cypraea beckii
Other	Sebastapistes strongia	Mollusks	Cypraea aurantium
Other	Parascorpaena mossambica	Mollusks	Cypraea chinensis
Other	Dendrochirus zebra	Mollusks	Cypraea limicina
Other	Rhinopias frondosa	Mollusks	Cypraea humphreysi
Other	Scorpaenodes hirsutus	Mollusks	Cypraea dillywini
Other	Inimicus didactylus	Mollusks	Ovulidae
Other	Pontinus sp	Mollusks	Calpurnus verrucosus
Other	Scorpaenopsis sp	Mollusks	Prionovula fruticum
Other	Parascorpaena mcadamsi	Mollusks	Ovula ovum
Other	Scorpaenopsis papuensis	Mollusks	Naticidae
Other	Tetrarogidae	Mollusks	Polinices mamatus
Other	Tetraroge barbata	Mollusks	Polinices tumidus
Other	Pontinus tentacularis	Mollusks	Tonnidae
Other	Aploactinidae	Mollusks	Tonna perdix
Other	Cocotropis larvatus	Mollusks	Malea pomum
Other	Triglidae	Mollusks	Cassidae
Other	Pterygiotrigla sp	Mollusks	Cassius cornuta
Other	Pterygiotrigla multiocellata	Mollusks	Casmaria erinaceus
Other	Caracanthidae	Mollusks	Casmaria ponderosa
Other	Caracanthus maculatus	Mollusks	Cymatiidae
Other	Caracanthus unipinna	Mollusks	Cymatium pilere aquatile
Other	Platycephalidae	Mollusks	Cymatium nicobaricum
Other	Thysanophrys otaitensis	Mollusks	Cymatium gemmatum
Other	Thysanophrys arenicola	Mollusks	Cymatium muricinum
Other	Thysanophrys chiltonae	Mollusks	Cymatium rubeculum
Other	Cymbacephalus beauforti	Mollusks	Cymatium hepaticum
Other	Sorsogona welanderi	Mollusks	Gyrineum roseum
Other	Dactylopteridae	Mollusks	Distorso anus

Other	*Dactyloptena orientalis*	Mollusks	*Cymatium pileare*
Other	*Dactyloptena petersoni*	Mollusks	*Gyrinium pusillum*
Other	*Pegasidae*	Mollusks	*Charonia tritonis*
Other	*Eurypegasus draconis*	Mollusks	*Cymatium lotorium*
Other	*Ambassidae*	Mollusks	*Cymatium pyrum*
Other	*Ambassis buruensis*	Mollusks	*Cymatium clandestinium*
Other	*Ambassis interrupta*	Mollusks	*Cymatium vespaceum*
Other	*Cephalopholis cyanostigma*	Mollusks	*Cymatium labiosum*
Other	*Epinephelus coioides*	Mollusks	*Bursidae*
Other	*Pseudanthias cooperi*	Mollusks	*Bursa bufonia*
Other	*Pseudanthias pascalus*	Mollusks	*Bursa cruentata*
Other	*Pseudanthias pleurotaenia*	Mollusks	*Bursa granularis*
Other	*Pseudanthias sp*	Mollusks	*Bursa mammata*
Other	*Holanthias borbonius*	Mollusks	*Bursa rhodostoma*
Other	*Holanthias katayamai*	Mollusks	*Bursa bubo*
Other	*Plectranthias kamii*	Mollusks	*Bursa rebeta*
Other	*Plectranthias nanus*	Mollusks	*Bursa lissostoma*
Other	*Selenanthias myersi*	Mollusks	*Bursa lamarcki*
Other	*Pseudanthias bartlettorum*	Mollusks	*Muricidae*
Other	*Pseudanthias bicolor*	Mollusks	*Murex burneus*
Other	*Pseudanthias dispar*	Mollusks	*Vitularia miliaris*
Other	*Pseudanthias lori*	Mollusks	*Naquetia triquetra*
Other	*Pseudanthias randalli*	Mollusks	*Naquetia trigonulus*
Other	*Pseudanthias tuka*	Mollusks	*Siratus laciniatus*
Other	*Pseudanthias smithvanizi*	Mollusks	*Homalocanthia anatomica*
Other	*Pseudanthias ventralis*	Mollusks	*Pterynotus laqueatus*
Other	*Pseudanthias huchtii*	Mollusks	*Pterynotus tripterus*
Other	*Pseudanthias squamipinnis*	Mollusks	*Marchia martinetana*
Other	*Luzonichthys waitei*	Mollusks	*Pterynotus elongatus*
Other	*Luzonichthys whitleyi*	Mollusks	*Marchia bipinnatus*
Other	*Plectranthias longimanus*	Mollusks	*Chicoreus ramosus*
Other	*Plectranthias winniensis*	Mollusks	*Cronia biconica*
Other	*Plectranthias fourmanoiri*	Mollusks	*Thais tuberosa*
Other	*Serranocirrhitus latus*	Mollusks	*Thais armigera*
Other	*Rabaulichthys sp*	Mollusks	*Purpura persica*
Other	*Plectranthias rubrifasciatus*	Mollusks	*Nassa francolina*
Other	*Liopropoma lunulatum*	Mollusks	*Drupa ricinus*
Other	*Liopropoma mitratum*	Mollusks	*Drupa morum*
Other	*Liopropoma multilineatum*	Mollusks	*Drupa grossularia*
Other	*Liopropoma pallidum*	Mollusks	*Drupa elegans*
Other	*Liopropoma susumi*	Mollusks	*Drupa rubusidacaeus*
Other	*Liopropoma tonstrinum*	Mollusks	*Drupa clathrata*
Other	*Liopropoma maculatum*	Mollusks	*Coralliophilidae*
Other	*Grammistidae*	Mollusks	*Coralliophila neritodidea*
Other	*Belonoperca chaubanaudi*	Mollusks	*Coralliophila erosa*
Other	*Grammistes sexlineatus*	Mollusks	*Quoyula madreporarum*
Other	*Grammistops ocellatus*	Mollusks	*Rapa rapa*
Other	*Pogonoperca punctata*	Mollusks	*Buccinidae*
Other	*Callanthiidae*	Mollusks	*Cantharus undosus*
Other	*Grammatonotus sp 1*	Mollusks	*Cantharus fumosus*

Other	*Grammatonotus sp 2*	Mollusks	*Pollia pulchra*
Other	*Pseudochromidae*	Mollusks	*Pollia fragaria*
Other	*Pseudochromis cyanotaenia*	Mollusks	*Columbraria nitidula*
Other	*Pseudochromis fuscus*	Mollusks	*Columbraria tortuosa*
Other	*Pseudochromis marshallensis*	Mollusks	*Columbraria muricata*
Other	*Pseudochromis polynemus*	Mollusks	*Fasciolariidae*
Other	*Pseudochromis porphyreus*	Mollusks	*Latirus nodatus*
Other	*Pseudoplesiops revellei*	Mollusks	*Latirus rudis*
Other	*Pseudoplesiops rosae*	Mollusks	*Nassariidae*
Other	*Pseudoplesiops typus*	Mollusks	*Nassarius papillosus*
Other	*Pseudoplesiops sp*	Mollusks	*Nassarius margaritiferus*
Other	*Pseudoplesiops multisquamatus*	Mollusks	*Nassarius graniferus*
Other	*Acanthoclinidae*	Mollusks	*Olividae*
Other	*Acathoplesiops hiatti*	Mollusks	*Oliva annulata*
Other	*Pseudogrammidae*	Mollusks	*Oliva miniacea*
Other	*Aporops bilinearis*	Mollusks	*Oliva carneola*
Other	*Pseudogramma polyacantha*	Mollusks	*Oliva paxillus*
Other	*Pseudogramma sp*	Mollusks	*Turbinellidae*
Other	*Plesiopidae*	Mollusks	*Vasum turbinellus*
Other	*Calloplesiops altivelis*	Mollusks	*Vasum ceramicum*
Other	*Plesiops caeruleolineatus*	Mollusks	*Mitridae*
Other	*Plesiops corallicola*	Mollusks	*Mitra stictica*
Other	*Pseudochromis melanotaenia*	Mollusks	*Mitra mitra*
Other	*Plesiops oxycephalus*	Mollusks	*Imbricaria olivaeformis*
Other	*Teraponidae*	Mollusks	*Imbricaria punctata*
Other	*Terapon jarbua*	Mollusks	*Imbricaria conularis*
Other	*Kuhliidae*	Mollusks	*Mitra ferruginea*
Other	*Kuhlia mugil*	Mollusks	*Vexillum unifasciatum*
Other	*Kuhlia rupestris*	Mollusks	*Cancilla filaris*
Other	*Kuhlia marginata*	Mollusks	*Vexillum exasperatum*
Other	*Priacanthidae*	Mollusks	*Vexillum crocatum*
Other	*Heteropriacanthus cruentatus*	Mollusks	*Vexillum semifasciatum*
Other	*Priacanthus hamrur*	Mollusks	*Vexillum cancellarioides*
Other	*Pristigenys meyeri*	Mollusks	*Mitra papalis*
Other	*Cookeolus japonicus*	Mollusks	*Neocancilla clathrus*
Other	*Priacanthus alalaua*	Mollusks	*Vexillum patriarchalis*
Other	*Cookeolus boops*	Mollusks	*Vexillum tuberosum*
Other	*Apogonidae*	Mollusks	*Vexillum bernhardiana*
Other	*Apogon angustatus*	Mollusks	*Mitra incompta*
Other	*Apogon bandanensis*	Mollusks	*Mitra coffea*
Other	*Apogon coccineus*	Mollusks	*Mitra cardinalis*
Other	*Apogon exostigma*	Mollusks	*Mitra fraga*
Other	*Apogon fraenatus*	Mollusks	*Mitra cucumaria*
Other	*Apogon guamensis*	Mollusks	*Mitra chrysalis*
Other	*Apogon kallopterus*	Mollusks	*Mitra rubitincta*
Other	*Apogon lateralis*	Mollusks	*Mitra chrysostoma*
Other	*Apogon leptacanthus*	Mollusks	*Neocancilla granitina*
Other	*Apogon taeniopterus*	Mollusks	*Miter imperalis*
Other	*Apogon nigrofasciatus*	Mollusks	*Mitra contracta*
Other	*Apogon novemfasciatus*	Mollusks	*Mitra acuminata*

Other	*Apogon taeniophorus*	Mollusks	*Sabricola casta*
Other	*Apogon savayensis*	Mollusks	*Neocancilla papilio*
Other	*Apogon trimaculatus*	Mollusks	*Pterygia scabricula*
Other	*Apogon sp*	Mollusks	*Vexillum speciosum*
Other	*Apogonichthys ocellatus*	Mollusks	*Pterygia crenulata*
Other	*Archamia biguttata*	Mollusks	*Pterygia nucea*
Other	*Archamia fucata*	Mollusks	*Vexillum turbin*
Other	*Cheilodipterus singapurensis*	Mollusks	*Pterygia fenestrata*
Other	*Cheilodipterus macrodon*	Mollusks	*Harpidae*
Other	*Cheilodipterus quinquelineata*	Mollusks	*Harpa amouretta*
Other	*Fowleria punctulata*	Mollusks	*Harpa major*
Other	*Fowleria marmorata*	Mollusks	*Harpa harpa*
Other	*Fowleria variegatus*	Mollusks	*Conidae*
Other	*Pseudamiops gracilicauda*	Mollusks	*Conus pulicarius*
Other	*Siphamia versicolor*	Mollusks	*Conus coronatus*
Other	*Siphamia fistulosa*	Mollusks	*Conus ebraeus*
Other	*Sphaeramia orbicularis*	Mollusks	*Conus chaldeus*
Other	*Sphaeramia nematoptera*	Mollusks	*Conus sponsalis*
Other	*Apogon amboinensis*	Mollusks	*Conus distans*
Other	*Apogon compressus*	Mollusks	*Conus flavidus*
Other	*Apogon dispar*	Mollusks	*Conus frigidus*
Other	*Apogon doryssa*	Mollusks	*Conus lividus*
Other	*Apogon evermanni*	Mollusks	*Conus miles*
Other	*Apogon gilberti*	Mollusks	*Conus rattus*
Other	*Apogon fragilis*	Mollusks	*Conus catus*
Other	*Apogon perlitus*	Mollusks	*Conus sanguinolentus*
Other	*Apogon sangiensis*	Mollusks	*Conus muriculatus*
Other	*Apogonichthys perdix*	Mollusks	*Conus moreleti*
Other	*Archamia zosterophora*	Mollusks	*Conus eburneus*
Other	*Cheilodipterus isostigma*	Mollusks	*Conus litteratus*
Other	*Gymnapogon urospilotus*	Mollusks	*Conus leopardus*
Other	*Pseudamia amblyuroptera*	Mollusks	*Conus miliaris*
Other	*Pseudamia gelatinosa*	Mollusks	*Conus musicus*
Other	*Pseudamia hayashii*	Mollusks	*Conus vexillum*
Other	*Rhabdamia cypselurus*	Mollusks	*Conus capitaneus*
Other	*Rhabdamia gracilis*	Mollusks	*Conus mustelinus*
Other	*Foa brachygramma*	Mollusks	*Conus tesselatus*
Other	*Foa sp*	Mollusks	*Conus generalis*
Other	*Apogon ellioiti*	Mollusks	*Conus imperialis*
Other	*Apogon sealei*	Mollusks	*Conus bandanus*
Other	*Apogon melas*	Mollusks	*Conus striatus*
Other	*Cheilodipterus artus*	Mollusks	*Conus vitulinus*
Other	*Siphamia fuscolineata*	Mollusks	*Conus striatellus*
Other	*Gymnapogon philippinus*	Mollusks	*Conus lithoglyphus*
Other	*Pseudamia zonata*	Mollusks	*Conus arenatus*
Other	*Apogon eremeia*	Mollusks	*Conus textile*
Other	*Apogon nigripinnis*	Mollusks	*Conus obscurus*
Other	*Apogon notatus*	Mollusks	*Conus glans*
Other	*Apogon rhodopterus*	Mollusks	*Conus terebra*
Other	*Cheilodipterus intermedius*	Mollusks	*Conus scabriusculus*

Other	*Fowleria abocellata*	Mollusks	*Conus luteus*
Other	*Apogon hartzfeldii*	Mollusks	*Conus pertusus*
Other	*Sillaginidae*	Mollusks	*Conus varius*
Other	*Sillago sihama*	Mollusks	*Conus geographus*
Other	*Malacanthidae*	Mollusks	*Conus tulipa*
Other	*Hoplolatilus cuniculus*	Mollusks	*Conus aulicus*
Other	*Hoplolatilus fronticinctus*	Mollusks	*Conus legatus*
Other	*Hoplolatilus starcki*	Mollusks	*Conus episcopus*
Other	*Malacanthus brevirostris*	Mollusks	*Conus magnificus*
Other	*Malacanthus latovittatus*	Mollusks	*Conus retifer*
Other	*Echeneidae*	Mollusks	*Conus aureus*
Other	*Ptheirichthys lineatus*	Mollusks	*Conus auricomus*
Other	*Remora remora*	Mollusks	*Conus cylandraceus*
Other	*Rhombochirus osteochir*	Mollusks	*Conus bullatus*
Other	*Echeneis naucrates*	Mollusks	*Conus connectens*
Other	*Leiognathidae*	Mollusks	*Terebridae*
Other	*Leiognathus equulus*	Mollusks	*Terebra maculata*
Other	*Gazza achlamys*	Mollusks	*Terebra dimidiata*
Other	*Leiognathus stercorarius*	Mollusks	*Terebra subulata*
Other	*Leiognathus elongatus*	Mollusks	*Terebra crenulata*
Other	*Leiognathus smithursti*	Mollusks	*Terebra affinis*
Other	*Leiognathus bindus*	Mollusks	*Terebra nubulosa*
Other	*Secutor ruconius*	Mollusks	*Terebra babylonia*
Other	*Gazza minuta*	Mollusks	*Hastula penicillata*
Other	*Emmelichtyidae*	Mollusks	*Hastula lanceata*
Other	*Emmelichthys karnellai*	Mollusks	*Terebra cerithiana*
Other	*Erythrocles scintillans*	Mollusks	*Terebra funiculata*
Other	*Caesionidae*	Mollusks	*Terebra undulata*
Other	*Caesio caerulaurea*	Mollusks	*Terebra gutatta*
Other	*Caesio teres*	Mollusks	*Terebra felina*
Other	*Pterocaesio marri*	Mollusks	*Terebra chlorata*
Other	*Pterocaesio tile*	Mollusks	*Terebra argus*
Other	*Caesio cuning*	Mollusks	*Terebra areolata*
Other	*Caesio lunaris*	Mollusks	*Atlantidae*
Other	*Pterocaesio lativittata*	Mollusks	*Atlanta peroni*
Other	*Pterocaesio trilineata*	Mollusks	*Janthinidae*
Other	*Pterocaesio pisang*	Mollusks	*Janthina janthina*
Other	*Gymnocaesio gymnopterus*	Mollusks	*Pyramidellidae*
Other	*Pterocaesio tesselatata*	Mollusks	*Pyramidella sulcata*
Other	*Symphysanodontidae*	Mollusks	*Acteonidae*
Other	*Symphysanodon typus*	Mollusks	*Milda ventricosa*
Other	*Nemipteridae*	Mollusks	*Otopleura auriscati*
Other	*Scolopsis lineatus*	Mollusks	*Pupa solidula*
Other	*Scolopsis bilineatus*	Mollusks	*Bullidae*
Other	*Scolopsis margaritifer*	Mollusks	*Bulla ampulla*
Other	*Scolopsis affinis*	Mollusks	*Bullina lineata*
Other	*Scolopsis trilineatus*	Mollusks	*Hydratina physis*
Other	*Scolopsis ciliatus*	Mollusks	*Atys naucum*
Other	*Scolopsis taeniopterus*	Mollusks	*Micromelo undatus*
Other	*Scolopsis xenochrous*	Mollusks	*Melampidae*

Other	*Nemipterus hexadon*	Mollusks	*Melampus luteus*
Other	*Nemipterus peronii*	Mollusks	*Chitonidae*
Other	*Nemipterus tolu*	Mollusks	*Acanthopleura spinosa*
Other	*Nemipterus furcosus*	Mollusks	*Acanthopleura gemmata*
Other	*Lobotidae*	Mollusks	*Arcidae*
Other	*Lobotes surinamensis*	Mollusks	*Arca ventricosa*
Other	*Gerreidae*	Mollusks	*Arca navicularis*
Other	*Gerres acinaces*	Mollusks	*Anadara antiquata*
Other	*Gerres abbreviatus*	Mollusks	*Babatia amygdalumtostum*
Other	*Gerres oblongus*	Mollusks	*Cavolinidae*
Other	*Gerres filamentosus*	Mollusks	*Cavolinia cf globulosa*
Other	*Gerres oyena*	Mollusks	*Cavolina tridentata*
Other	*Gerres punctatus*	Mollusks	*Cavolina uncinata*
Other	*Haemulidae*	Mollusks	*Diacria trispinosa*
Other	*Diagramma pictum*	Mollusks	*Cuvierina columnella*
Other	*Plectorhinchus vittatus*	Mollusks	*Clio pyramidata*
Other	*Plectorhinchus gibbosus*	Mollusks	*Clio cuspidata*
Other	*Plectorhinchus picus*	Mollusks	*Doridae*
Other	*Plectorhinchus obscurus*	Mollusks	*Hexabranchus sanguineus*
Other	*Plectorhinchus celebecus*	Mollusks	*Class Bivalvia*
Other	*Plectorhinchus chaetodonoides*	Mollusks	*Mytilidae*
Other	*Plectorhinchus lessonii*	Mollusks	*Septifer bilocularis*
Other	*Plectorhinchus lineatus*	Mollusks	*Pinnidae*
Other	*Plectorhinchus albovittatus*	Mollusks	*Pinna bicolor*
Other	*Pomadasyus kaakan*	Mollusks	*Streptopinna saccata*
Other	*Plectorhinchus flavomaculatus*	Mollusks	*Pteriidae*
Other	*Plectorhinchus sp*	Mollusks	*Pinctada margaritfera*
Other	*Nemipteridae*	Mollusks	*Isognomonidae*
Other	*Pentapodus caninus*	Mollusks	*Isognomon ephippium*
Other	*Pentapodus trivittatus*	Mollusks	*Pectinidae*
Other	*Monodactylidae*	Mollusks	*Chlamys squamosa*
Other	*Monodactylus argenteus*	Mollusks	*Excellichlamys spectiablis*
Other	*Pempherididae*	Mollusks	*Chlamys cooki*
Other	*Pempheris oualensis*	Mollusks	*Cryptopecten speciosum*
Other	*Parapriacanthus ransonneti*	Mollusks	*Semipallium tigris*
Other	*Toxotidae*	Mollusks	*Mirapecten mirificus*
Other	*Toxotes jaculator*	Mollusks	*Ostreidae*
Other	*Ephippidae*	Mollusks	*Crassostrea mordax*
Other	*Platax orbicularis*	Mollusks	*Crassostrea gigas*
Other	*Platax pinnatus*	Mollusks	*Spondylidae*
Other	*Platax teira*	Mollusks	*Spondyulus squamosus*
Other	*Scatophagidae*	Mollusks	*Limidae*
Other	*Scatophagus argus*	Mollusks	*Lima fragilis*
Other	*Chaetodontidae*	Mollusks	*Lima vulgaris*
Other	*Chaetodon auriga*	Mollusks	*Lucinidae*
Other	*Chaetodon bennetti*	Mollusks	*Codakia punctata*
Other	*Chaetodon citrinellus*	Mollusks	*Chamidae*
Other	*Chaetodon ephippium*	Mollusks	*Chama lazarus*
Other	*Chaetodon flavocoronatus*	Mollusks	*Carditidae*
Other	*Chaetodon kleinii*	Mollusks	*Cardita variegata*

Other	*Chaetodon lineolatus*	Mollusks	*Fragum fragum*
Other	*Chaetodon lunula*	Mollusks	*Trachycardium angulatum*
Other	*Chaetodon melannotus*	Mollusks	*Tridacnidae*
Other	*Chaetodon mertensii*	Mollusks	*Hippopus hippopus*
Other	*Chaetodon modestus*	Mollusks	*Tridacna crocea*
Other	*Chaetodon ornatissimus*	Mollusks	*Tridacna derasa*
Other	*Chaetodon punctatofasciatus*	Mollusks	*Tridacna gigas*
Other	*Chaetodon quadrimaculatus*	Mollusks	*Tridacna maxima*
Other	*Chaetodon reticulatus*	Mollusks	*Tridacna squamosa*
Other	*Chaetodon lunulatus*	Mollusks	*Tellinidae*
Other	*Chaetodon ulietensis*	Mollusks	*Asaphis deflorata*
Other	*Chaetodon unimaculatus*	Mollusks	*Tellina linguafelis*
Other	*Chaetodon vagabundus*	Mollusks	*Tellina scobinata*
Other	*Forcipiger flavissimus*	Mollusks	*Tellina capsoides*
Other	*Forcipiger longirostris*	Mollusks	*Tellina remies*
Other	*Hemitaurichthys polylepis*	Mollusks	*Asaphis violescens*
Other	*Hemitaurichthys thompsoni*	Mollusks	*Veneridae*
Other	*Heniochus acuminatus*	Mollusks	*Periglypta reticulata*
Other	*Heniochus chrysostomus*	Mollusks	*Periglypta crispata*
Other	*Heniochus monoceros*	Mollusks	*Periglypta puerpera*
Other	*Heniochus singularis*	Mollusks	*Lioconcha castrensis*
Other	*Heniochus varius*	Mollusks	*Lioconcha ornata*
Other	*Chaetodon trifascialis*	Mollusks	*Lioconcha hieroglyphica*
Other	*Chaetodon barronessa*	Mollusks	*Gafrarium tumidum*
Other	*Chaetodon burgessi*	Mollusks	*Nautilidae*
Other	*Chaetodon meyeri*	Mollusks	*Nautilus ponpilius*
Other	*Chaetodon ocellicaudus*	Mollusks	*Metasepia pfefferi*
Other	*Chaetodon octofasciatus*	Mollusks	*Sepia sp*
Other	*Chaetodon oxycephalus*	Mollusks	*Sepia latimanus*
Other	*Chaetodon rafflesii*	Mollusks	*Order Teuthoidea*
Other	*Chaetodon semeion*	Mollusks	*Sepioteuthis lessoniana*
Other	*Chaetodon speculum*	Mollusks	*Octopodidae*
Other	*Coradion chrysozonus*	Mollusks	*Octopus sp*
Other	*Chaetodon tinkeri*	Mollusks	*Octopus teuthoides*
Other	*Heniochus diphreutes*	Mollusks	*Octopus sp 1*
Other	*Pomacanthidae*	Mollusks	*Octopus sp 2*
Other	*Apolemichthys trimaculatus*	Mollusks	*Octopus luteus*
Other	*Centropyge bicolor*	Mollusks	*Octopus cyanea*
Other	*Centropyge bispinosus*	Mollusks	*Octopus ornatus*
Other	*Centropyge colini*	Mollusks	*Argonautidae*
Other	*Centropyge flavissimus*	Mollusks	*Argonauta hians*
Other	*Centropyge heraldi*	Mollusks	*Argonauta argo*
Other	*Centropyge loriculus*	Mollusks	*Argonauta nodosa*
Other	*Centropyge multifasciatus*	Mollusks	*Argonauta nouri*
Other	*Centropyge nigriocellus*	Mollusks	*Argonauta gruneri*
Other	*Centropyge shepardi*	Other Invertebrates	*Class Crinoidea*
Other	*Centropyge vrolicki*	Other Invertebrates	*Sc Asteroidea*
Other	*Genicanthus bellus*	Other Invertebrates	*Astropectinidae*
Other	*Genicanthus watanabei*	Other Invertebrates	*Oreasteridae*
Other	*Pomacanthus imperator*	Other Invertebrates	*Ophidiaster confertus*

Other	*Pygoplites diacanthus*	Other Invertebrates	*Asteropidae*
Other	*Centropyge flavicauda*	Other Invertebrates	*Asterinidae*
Other	*Centropyge multicolor*	Other Invertebrates	*Acanthaster planci*
Other	*Centropyge tibicen*	Other Invertebrates	*Mithrodia bradleyi*
Other	*Chaetodontoplus mesoleucus*	Other Invertebrates	*Echinosteridae*
Other	*Genicanthus melanospilos*	Other Invertebrates	*Sphaerasteridae*
Other	*Pomacanthus navarchus*	Other Invertebrates	*Sc Ophiuroidea*
Other	*Pomacanthus sexstriatus*	Other Invertebrates	*Class Echinoidea*
Other	*Pomacanthus xanthometopon*	Other Invertebrates	*Cidaridae*
Other	*Pomacanthus semicirculatus*	Other Invertebrates	*Echinothuriidae*
Other	*Apolemichthys xanthopunctatus*	Other Invertebrates	*Diadematidae*
Other	*Apolemichthys griffisi*	Other Invertebrates	*Diadema savignyi*
Other	*Centropyge nox*	Other Invertebrates	*Diadema setosum*
Other	*Centropyge aurantia*	Other Invertebrates	*Echinothrix diadema*
Other	*Pentacerotidae*	Other Invertebrates	*Echinothrix calamaris*
Other	*Pseudopentaceros pectoralis*	Other Invertebrates	*Temnopleuridae*
Other	*Cichlidae*	Other Invertebrates	*Toxopneustidae*
Other	*Oreochromis mossambicus*	Other Invertebrates	*Tripneustes gratilla*
Other	*Tilapia zillii*	Other Invertebrates	*Toxopneustes pileolus*
Other	*Cichla ocellaris*	Other Invertebrates	*Pseudoboletia maculata*
Other	*Oplegnathidae*	Other Invertebrates	*Echinometridae*
Other	*Oplegnathus punctatus*	Other Invertebrates	*Heterocentrotus mammillatus*
Other	*Pomacentridae*	Other Invertebrates	*Echinoidea*
Other	*Abudefduf septemfasciatus*	Other Invertebrates	*Clypeasteridae*
Other	*Abudefduf sexfasciatus*	Other Invertebrates	*Brissidae*
Other	*Abudefduf sordidus*	Other Invertebrates	*Holothuroidea*
Other	*Abudefduf vaigiensis*	Other Invertebrates	*Stichopodidae*
Other	*Amblygliphidodon aureus*	Other Invertebrates	*Stichopus chloronotus*
Other	*Amblygliphidodon curacao*	Other Invertebrates	*Stichopus horrens*
Other	*Amphiprion chrysopterus*	Other Invertebrates	*Stichopus noctivatus*
Other	*Amphiprion clarkii*	Other Invertebrates	*Stichopus variegatus*
Other	*Amphiprion melanopus*	Other Invertebrates	*Stichopus sp*
Other	*Amphiprion peridaeraion*	Other Invertebrates	*Holothuriidae*
Other	*Chromis acares*	Other Invertebrates	*Holothuria atra*
Other	*Chromis agilis*	Other Invertebrates	*Holothuria edulis*
Other	*Chromis amboinensis*	Other Invertebrates	*Holothuria fuscogilva*
Other	*Chromis analis*	Other Invertebrates	*Holothuria fuscopunctata*
Other	*Chromis atripectoralis*	Other Invertebrates	*Holothuria hilla*
Other	*Chromis viridis*	Other Invertebrates	*Holothuria impatiens*
Other	*Chromis elerae*	Other Invertebrates	*Holothuria leucospilota*
Other	*Chromis lepidolepis*	Other Invertebrates	*Holothuria sp*
Other	*Chromis margaritifer*	Other Invertebrates	*Actinopyga lecanora*
Other	*Chromis vanderbilti*	Other Invertebrates	*Actinopyga miliaris*
Other	*Chromis xanthura*	Other Invertebrates	*Actinopyga obesa*
Other	*Chromis alpha*	Other Invertebrates	*Actinopyga sp*
Other	*Chrysiptera biocellata*	Other Invertebrates	*Cucumariidae*
Other	*Chrysiptera caeruleolineata*	Other Invertebrates	*Phyllophoridae*
Other	*Chrysiptera glauca*	Other Invertebrates	*Synaptidae*
Other	*Chrysiptera brownriggii*	Other Invertebrates	*Synapta maculata*
Other	*Chrysiptera traceyi*	Other Invertebrates	*Synapta media*

Other	*Dascyllus aruanus*	Other Invertebrates	*Synapta sp*
Other	*Dascyllus reticulatus*	Other Invertebrates	*Bohadschia argus*
Other	*Dascyllus trimaculatus*	Other Invertebrates	*Bohadschia graeffei*
Other	*Dischistodus perspicillatus*	Other Invertebrates	*Bohadschia marmorata*
Other	*Plectroglyphidodo dickii*	Other Invertebrates	*Bohadschia paradoxa*
Other	*Plectroglyphidodo imparipennis*	Other Invertebrates	*Bohadschia sp*
Other	*Plectroglyphidodo johnstonianus*	Other Invertebrates	*Thelenota ananas*
Other	*Plectroglyphidodo lacrymatus*	Other Invertebrates	*Thelenota anax*
Other	*Plectroglyphidodo leucozonus*	Other Invertebrates	*Thelenota sp*
Other	*Plectroglyphidodo phoenixensis*	Other Invertebrates	*Cephea sp*
Other	*Pomacentrus amboinensis*	Algae	*Enteromorpha clathrata*
Other	*Pomacentrus pavo*	Algae	*Caulerpaceae*
Other	*Pomacentrus vaiuli*	Algae	*Caulerpa racemosa*
Other	*Pomachromis guamensis*	Algae	*Sargassum polycystum*
Other	*Stegastes albifasciatus*	Algae	*Turbinaria ornata*

1C. Commonwealth of Northern Mariana Islands CREMUS species list

CREMUS Group	Common name	CREMUS Group	Common name
Atulai	Bigeye Scad	Rudderfish	Highfin Rudderfish Brown
Emperors	Emperor (mafute/misc.)	Snappers	Smalltooth Jobfish
Emperors	Longnose Emperor	Snappers	Humpback Snapper
Emperors	Orangefin Emperor	Snappers	Onespot Snapper
Emperors	Blackspot Emperor	Snappers	Red Snapper
Emperors	Yellowstripe Emperor	Snappers	Snapper (misc. shallow)
Emperors	Yellowlips Emperor	Surgeonfish	Surgeonfish (misc.)
Emperors	Flametail Emperor	Surgeonfish	Orangespine Unicornfish
Emperors	Bigeye Emperor	Surgeonfish	Unicornfish (misc.)
Emperors	Stout Emperor	Surgeonfish	Bluebanded Surgeonfish
Emperors	Yellowspot emperor	Surgeonfish	Convict Tang
Emperors	Ornate Emperor	Surgeonfish	Yellowfin Surgeonfish
Emperors	Yellowtail Emperor	Surgeonfish	Bluelined Surgeon
Goatfish	Goatfish (juvenile-misc)	Surgeonfish	Bluespine Unicornfish
Goatfish	Goatfish (misc.)	Surgeonfish	Orangeband Surgeon
Goatfish	Sidespot Goatfish	Squirrelfish	Squirrelfish
Goatfish	Yellowstripe Goatfish	Squirrelfish	Soldierfish (misc.)
Goatfish	Dash & Dot Goatfish	Wrasse	Wrasse
Goatfish	Two-barred Goatfish	Wrasse	Tripletail Wrasse
Groupers	Grouper (misc.)	Misc. Reeffish	Reef Fish
		Misc. Bottomfish	Bottom Fish
Groupers	Highfin Grouper	Other	Scorpionfishes
Groupers	Honeycomb Grouper	Other	Moray eel
Groupers	Marbled Grouper	Other	Cornetfish
Groupers	Peacock Grouper	Other	Trumpetfish
Groupers	Flagtail Grouper	Other	Needlefish
Groupers	Saddleback Grouper	Other	Milkfish
Groupers	Coral Grouper	Other	Lizardfish misc.
Groupers	White Lyretail Grouper	Other	Cardinal Misc.
Groupers	Lyretail Grouper	Other	Bigeye/glasseye
Groupers	Tomato Grouper	Other	Goggle-eye
Groupers	Yellow Banded Grouper	Other	Fusilier (misc.)

Groupers	Pink Grouper	Other	Mojarra
Jacks	Leatherback	Other	Sweetlips
Jacks	Mackerel Scad	Other	Damselfish
Jacks	Jacks (misc.)	Other	Angel/butterfly
Jacks	EE: Juvenile Jacks	Other	Flounder (misc)
Jacks	Yellow Spotted Trevally	Other	Filefish (misc)
		Other	Triggerfish (misc.)
Jacks	Bluefin Trevally	Other	Picasso Trigger
Jacks	Brassy Trevally	Other	Wedge Trigger
Jacks	Bigeye Trevally	Other	Pufferfish
Jacks	Snubnose pompano	Other	Razorfish (misc)
Jacks	Small-spotted pompano	Other	Blue Razorfish
Jacks	Rainbow Runner	Other	Bronzespot Razorfish
Mullet	Mullet	Napoleon Wrasse	Humphead Wrasse
Parrotfish	Parrotfish (misc.)	Crustaceans	Crabs (misc)
Parrotfish	Seagrass Parrotfish	Crustaceans	Kona Crab
Rabbitfish	Rabbitfish (hitting)	Crustaceans	Coconut Crab
Rabbitfish	Rabbitfish (h.feda)	Crustaceans	Spiny Lobster
Rabbitfish	Rabbitfish (menahac)	Crustaceans	Slipper Lobster
Rabbitfish	Rabbitfish (sesjun)	Crustaceans	Shrimp (saltwater)
Rudderfish	Rudderfish (guilli)	Mollusks	Octopus
Rudderfish	Highfin Rudderfish Silver	Mollusks	Squid
		Mollusks	Trochus
		Mollusks	Clam/bivalve
		Other Invertebrates	Invertebrates
		Other Invertebrates	Sea Cucumber
		Algae	Seaweeds
		Algae	Lemu

1.D. Hawaii CREMUS species list

CREMUS Group	Common name	CREMUS Group	Common name
Atulai	HALALU	Wrasse	A'AWA
Emperors	MU	Wrasse	WRASSE (MISC.)
Goatfish	WEKE NONO	Wrasse	HILU
Goatfish	KUMU	Wrasse	HINALEA
Goatfish	MOANA	Wrasse	KUPOUPOU
Goatfish	MOELUA; GOAT FISH (RED)	Wrasse	LAENIHI
Goatfish	WEKE (MISC.)	Wrasse	OPULE
Goatfish	MALU	Wrasse	MALLATEA
Goatfish	MUNU	Wrasse	POOU
Goatfish	WEKE PUEO	Other	AHA
Goatfish	WEKE-ULA	Other	AHOLEHOLE
Goatfish	WEKE A'A	Other	AWA
Goatfish	MOANO KALE	Other	AWAAWA
Groupers	ROI	Other	AWEOWEO
Jacks	KAHALA	Other	HAULIULI
Jacks	OMILU	Other	HUMUHUMU
Jacks	PAPIO, ULUA (MISC.)	Other	IAO
Jacks	KAMANU	Other	IHEIHE
Jacks	LAE	Other	KAKU

Jacks	OMAKA	Other	KAWALEA
Jacks	PAOPAO	Other	KUPIPI
Jacks	KAGAMI	Other	LAUWILIWILI
Jacks	DOBE	Other	MALOLO
Jacks	SASA	Other	MA'O MA'O
Jacks	PAPA	Other	MAKAIWA
Jacks	NO-BITE	Other	MOI
Jacks	BARRED JACK	Other	NEHU
Mullet	AMAAMA	Other	NOHU
Mullet	SUMMER MULLET	Other	NUNU
Mullet	UOUOA	Other	LOULU
Parrotfish	PANUHUNUHU	Other	OIO
Parrotfish	PANUNU	Other	OOPU HUE
Parrotfish	UHU (MISC.)	Other	PAKII
Rudderfish	NENUE	Other	PIHA
Snappers	TAAPE	Other	PUHI (MISC.)
Snappers	WAHANUI	Other	PUHI (WHITE)
Snappers	TOAU	Other	UPAPALU
Snappers	GURUTSU, GOROTSUKI (SEE C	Other	MOLA MOLA
Snappers	RANDALL'S SNAPPER	Other	SABA
Snappers	GOLDEN KALI	Other	TILAPIA
Surgeonfish	KALA	Other	POO PAA
Surgeonfish	KOLE	Other	GOLD SPOT HERRING
Surgeonfish	MAIII	Other	ALFONSIN
Surgeonfish	MAIKO	Other	HOGO
Surgeonfish	MAIKOIKO	Other	PUPU
Surgeonfish	MANINI	Crustaceans	CRAB (MISC.)
Surgeonfish	NAENAE	Crustaceans	KUAHONU CRAB
Surgeonfish	YELLOW TANG	Crustaceans	HAWAIIAN CRAB
Surgeonfish	PAKUIKUI	Crustaceans	SAMOAN CRAB
Surgeonfish	PALANI	Crustaceans	MISC. SHRIMP/PRAWN
Surgeonfish	PUALU	Crustaceans	A'AMA
Surgeonfish	OPELU KALA	Crustaceans	BLUE PINCHER CRAB
Surgeonfish	KALALEI	Crustaceans	OPAE ULA METABETAEUS
Surgeonfish	API	Crustaceans	LOHENA
Surgeonfish	BLACK KOLE	Mollusks	OLEPE
Squirrelfish	ALAIHI	Mollusks	HE'E (DAY TAKO)
Squirrelfish	PAUU	Mollusks	HE'E PU LOA
Squirrelfish	MENPACHI	Other Invertebrates	INA
Squirrelfish	ALAIHI MAMA	Other Invertebrates	WANA
Algae	LIMU (MISC.)	Other Invertebrates	NAMAKO
Algae	LIMU KOHU	Other Invertebrates	HA'UKE'UKE
Algae	MANAUEA	Other Invertebrates	HAWAE
Algae	OGO	Other Invertebrates	SLATE PENCIL URCHINS
Algae	WAWAEIOLE		