WESTERN
PACIFIC
REGIONAL
FISHERY
MANAGEMENT
COUNCIL

P* Working Group Meeting

December 11-12, 2013
1:00 pm – 5:00 pm
Council Conference Room
WPRFMC Office

Day 1
Present On Site: Dr. Pierre Kleiber (ret. NMFS PIFSC), Dr. Bob Humphreys (NMFS PIFSC), Mr. Ed Watamura (Advisory Panel Chair), Mr. Roy Morioka (H-FACT), Mr. Ed Ebisui (Council member, Program Planning Chair), Marlowe Sabater (WPRFMC), Dr. Bob Skillman (ret. NMFS PIFSC), Paul Dalzell (WPRFMC)

On the Conference Line: Dr. Erik Franklin (UH HIMB), Dr. Domingo Ochavillo (DMWR, AS), Dr. Todd Miller (DFW, CNMI), Michael Tenorio (DFW, CNMI), Mr. Jarad Makaiau (NMFS – PIRO)

Day 2
Present On Site: Dr. Pierre Kleiber (ret. NMFS PIFSC), Dr. Bob Humphreys (NMFS PIFSC), Mr. Ed Watamura (Advisory Panel Chair), Mr. Roy Morioka (H-FACT), Mr. Ed Ebisui (Council member, Program Planning Chair), Marlowe Sabater (WPRFMC), Paul Dalzell (WPRFMC), Dr. Erik Franklin (UH HIMB), Gerard DiNardo (NMFS PIFSC), Lennon Thomas (NMFS PIFSC)

On the Conference Line: Dr. Domingo Ochavillo (DMWR, AS), Mr. Jarad Makaiau (NMFS – PIRO)

DRAFT REPORT

Introductions

Mr. Edwin Ebisui chaired the third meeting of the P* Working Group. In attendance were Robert Skillman, Pierre Kleiber, Robert Humphreys, Ed Watamura, Roy Morioka, Jarad Makaiau, Erik Franklin, Domingo Ochavillo, Todd Miller and Michael Tenorio. The meeting was co-chaired by Marlowe Sabater and Paul Dalzell as staff support.

Recommendations from the SSC

Council staff presented on the summary of the recommendations by the Scientific and Statistical Committee from its 114th meeting. The recommendation focuses on the endorsement of the Martell, Froese and Kleiber model for management purposes and directed staff to finalize the MSY estimates for P* analysis. In addition, the SSC recommended to reconvene the P* WG and finalize the criteria to determine the appropriate level of risk and associated acceptable biological catch for the fishing year 2015. Council staff reminded the working group members that it is critical to finalize the P* score in this meeting in order to meet the timeline needed to complete the specification package to utilize the new ABCs for fishing year 2015.

Review of the previous P* WG Meeting

Council staff summarized the accomplishments of the P* WG from the 2 previous meetings. Staff also presented on the action items of the WG from the second meeting and how those action items were addressed: 1)Covert the PSA scores from Thomas (2013) to the same scale as what is used in the Productivity-Susceptibility Dimension of the P* Analysis. The converted values were included in the briefing materials (Document 7.0). This would serve as a proxy for the Guam P-S exercise; 2) Finish/refine the P* criteria particularly the scientific information and the stock status. The scientific information was revisited and the approach aspect elements were re-evaluated for changes; 3) Follow-up with SSC members on their P-S scores. All of the P* WG members assigned to provide P-S scores had submitted their scores and was included in the briefing materials; and 4) Finalize the technical paper. The technical paper was included in the briefing materials as the final draft.

Review of the biomass-augmented catch-MSY model

Dr. Pierre Kleiber presented on the results of the comparative analysis using the augmented catch-MSY and the tier 1 stock assessment (Territory and MHI Deep 7 Bottomfish) to determine accuracy of the MSY results from the augmented catch-MSY model. Overall, the results of the augmented catch-MSY model are more conservative than the stock assessment results. For Guam bottomfish, catch-MSY estimated an MSY of 60,000 lbs while the stock assessment estimated 56,000 lbs. The results for American Samoa showed more conservative results than Guam where the catch-MSY estimated 51,000 lbs and the stock assessment estimated 76,000 lbs. The results for CNMI are less than half of the results of the stock assessment (catch-MSY = 100,000 lbs and stock assessment 173,000 lbs). For all comparative analysis, the biomass estimates are incorporated to simulate what was done with the augmented approach. However, there is some circularity in the approach because the biomass estimates used in the augmented approach came from the biomass generated by the stock assessment. It was hoped that the estimates be more close to each other.

The Hawaii results (MHI Deep7 bottomfish) got reversed where the catch-MSY results are higher than the stock assessment. The data used for the analysis was catch scenario 2 where the unreported non-commercial landing was assumed to be 1:1 to the reported commercial landing. The MSY estimate for the catch-MSY approach was 1,548,000 lbs whereas the MSY from the stock assessment (using CPUE scenario 1) was 848,000 lbs which is 45% lower that the catch-MSY result.

The discrepancy in the results may be due to the assumption in the biomass and stock status. The territories have high biomass and low fishing mortality in which it is favorable for the Schaefer model (underlying model in the catch-MSY approach). Once the stock approaches high fishing mortality, the Schaefer model becomes erratic. Simulation run was also conducted to test for effect of the long catch time series. The data also for Hawaii goes all the way from 1948. The data was truncated to the most recent since 1970. The results were almost the same. Also checked the r-k density plot to see if there is anything wrong but the plot does not provide any indication that there is something wrong in the *r-k* algorithm.

The Hawaii data seemed to be anomaly in more case than one. The Chair liked the idea that the model is generating conservative results for data poor stocks. However, in the case for stocks that are exploited there must be some ancillary factors affecting the results that need to be accounted for.

Review and changes to the P* Dimensions and Criteria

Council staff presented the different dimensions of the P* analysis and the criteria under each dimension as revised by the P* WG members from the last 2 meetings. The WG members reviewed the preliminary scores of the Model Information and Uncertainty Characterization Dimensions. The WG members retained the preliminary scores and deemed it applicable for the current methods under Tier 3.

For the Model Information Dimension, the WG deemed the MFK model falls somewhere between 2 and 4 since it aspects captured within this range.

Model Information Description	Score
Highly quantitative probabilistic approach that provides estimates of depletion and biomass status; includes MSY benchmarks; model input parameters include fishery dependent and independent information with limited assumptions	0.0
Quantitative probabilistic approach that provides estimates of depletion and biomass status; includes MSY benchmarks; model input parameters include at least fishery dependent or fishery independent information with additional assumptions;	2.0
Quantitative assessment non-probabilistic approach utilizing bulk estimators providing measures of exploitation or B, proxy reference points, includes MSY benchmarks; some sources of mortality accounted for	4.0
Semi quantitative assessment; utilizes estimators that generate relative measures of exploitation or B, proxy reference points, no MSY benchmarks, absolute measures of stock unavailable	6.0
No benchmark values, but reliable catch history	8.0
Bad. No benchmark values, and scarce or unreliable catch records	10.0

In order to determine exactly where, the WG scored the approach aspect. The scores are as follows:

Approach Aspects (AAs)	Score
Reliable catch history	0
Measure of depletion	1
Species-specific data	1
All sources of mortality accounted for (z)	0.5
Fishery independent information	0.5
Probability distribution available (output)	0
Population/biological parameters (r or k etc.)	0.5
SUM	**3.5**

Using the scaling equivalency table, the score of 3.5 has a scaled equivalent of 3.0. Hence for the **Model Information Dimension the score is 3.0.**

The Uncertainty Characterization Dimension had not been revised since this dimension is applicable for a Tier 1 to Tier 3 stock. The WG maintained the **score of 5** for this model-based approach under this Tier. The table for this Dimension is shown below:

Uncertainty Characterization Description	Score
Complete. Key determinant – uncertainty in both assessment inputs and environmental conditions included	0.0
High. Key determinant – reflects more than just uncertainty in future recruitment	2.5
Medium. Uncertainties are addressed via statistical techniques and sensitivities, but full uncertainty is not carried forward in projections	**5.0**
Low. Distributions of Fmsy and MSY are lacking	7.5
None. Only single point estimates; no sensitivities or uncertainty evaluations	10.0

Fishing Level Scoring Session

This model approach provides an estimate of relative sustainable harvest level and has limited information on the stock status. Hence the third dimension had been revised to provide insight of F/F_{MSY} and not B/B_{MSY}. Council staff presented a summary of the Fishing Level Table (Document 4.0) and explained how the values were derived. Each of the families with MSY estimates were scored based on the criteria constructed by the P* Working Group at its second meeting. The summary of the table is shown below. A logical argument in Excel was crafted following the criteria designed by the WG members. In order to determine the final scores for each family, the WG was asked to define and determine 2 parameters:

1) Define catch – would the catch be defined as the point estimate of the most recent year in the time series; or an average of 3 years; or an average of 5 years
2) Determine MSY based on 2 different method in defining the r and k range – here termed as k-revise method A and k-revise method B

Description	Fishing level	Score
Lightly harvested	Catch << 1/3MSY	0.0
Moderately harvested	Catch < MSY	2.5
Fully harvested	Catch ≈ MSY	5.0
Heavily harvested	Catch > MSY	7.5
Over exploited	Catch >> 3xMSY	10.0

Rationale for using 3 year average:

The catch data used in this analysis is the combined creel data (three territories) and the commercial dealer reports with a downward adjustment of 5-8% to account for data overlap. This is the same data set used in the biomass-augmented catch-MSY approach. Using an average of a recent segment of the catch time series addresses short term fluctuation in catches brought about by variability in productivity and fishery dynamics. A three year average allows us to see trends that are occurring recently and is reasonable time frame for management to be reactive to recent changes in the fishery. This also balances random fluctuation in catch as opposed to real stock change which can then be used as point estimate for comparison with MSY reference points.

Rationale for using k-revise method B:

The catch-MSY method utilizes a range of combination of r and k values to determine MSY. It first identifies a broad range of values and narrows down the range in every round of iteration. Once the range is defined it randomly selects 30,000 pairs to comprise the probability distribution. The *k*-revise methods both operate as a mechanism to define the range of values for the *r*-*k* pairs.

Method A has a very narrow range of starting values therefore when selecting the loci of *r*-*k* pairs the cluster of pairing might not be capturing the full range of possible value. This is evident in the Figure 1 where the *r*-*k* plot tends to have less density in potential r and k combination. This results in a narrow and steep probability distribution (Figure 3). The curve showed a degree of skewness and bimodal peaks in some MUS. This distribution will have a significant impact on the risk of overfishing table where a slight reduction in risk level will have a large decrease in potential acceptable biological catches.

Method B allows for a broad range of starting values. Since *k* is the most unknown amongst the parameters being used in the model, there is a benefit to have a broad range of starting values for exploration. The *r*-*k* density plot shows more consistency and uniformity of possible combination (Figure 2). Method B provides a better chance to refine the *r*-k combination. This is more evident in the probability distribution around the MSY where it showed a more normal curve with moderate steepness and wider base. This distribution is more preferred when formulating the risk table where there is a gradual decrease in the probability distribution from the peak.

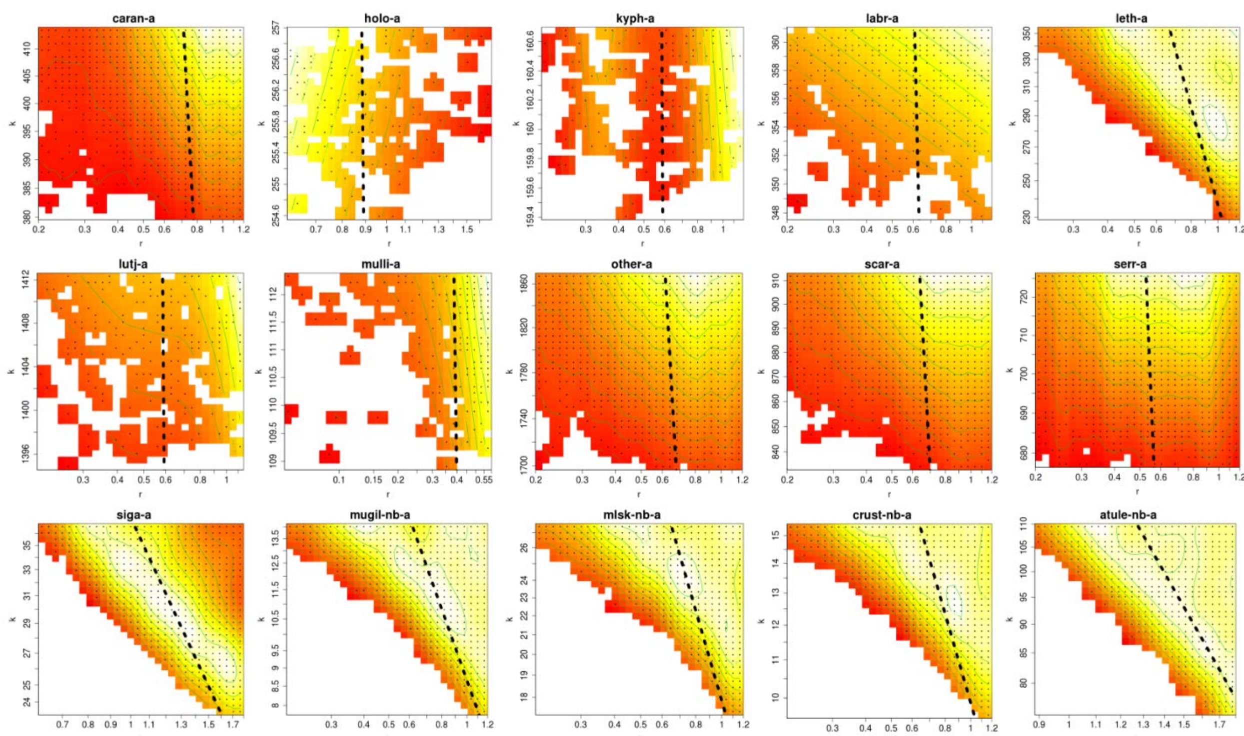

Figure 1. Density plots of possible r-k combinations for the different families of reef fish and reef associated organisms using k-revise method A showing the sparseness of the possible r-k field. Dashed lines are the loci of acceptable r-k pair that determines the MSY.

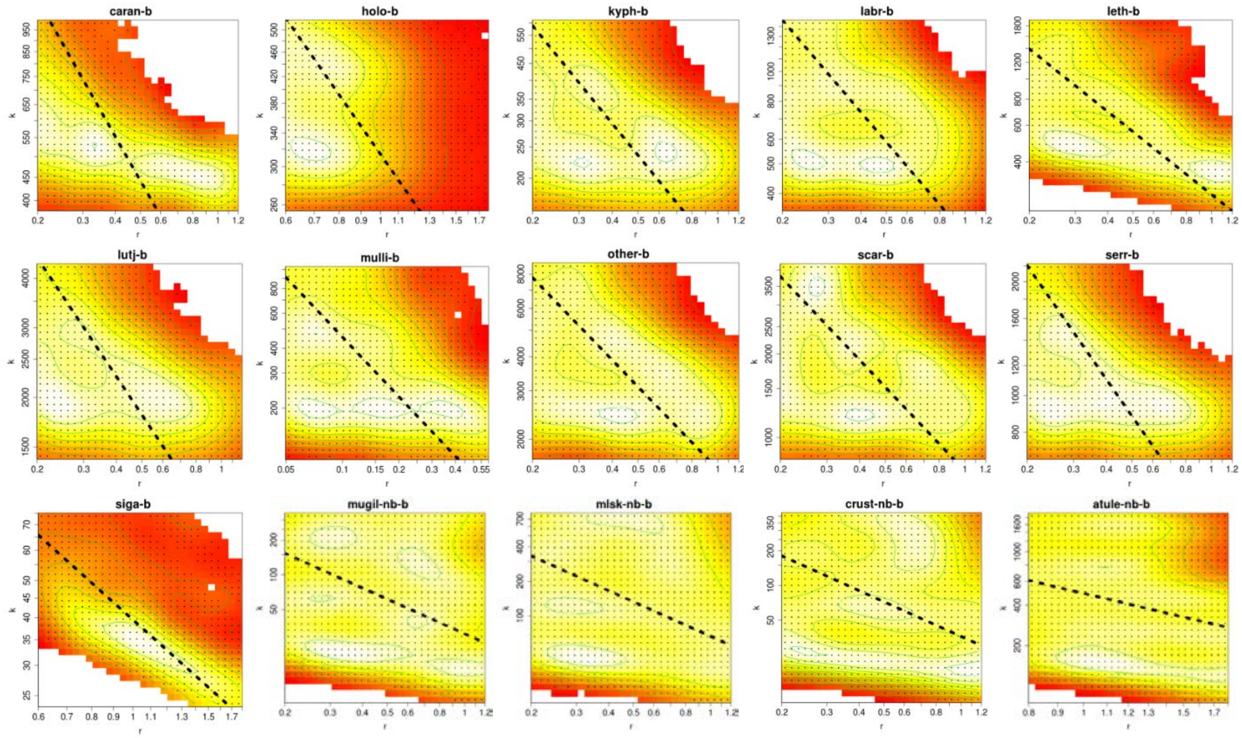

Figure 2. Density plots of possible r-k combinations for the different families of reef fish and reef associated organisms using k-revise method B showing an improved r-k field increasing the robustness of the loci. Dashed lines are the loci of acceptable r-k pair that determines the MSY.

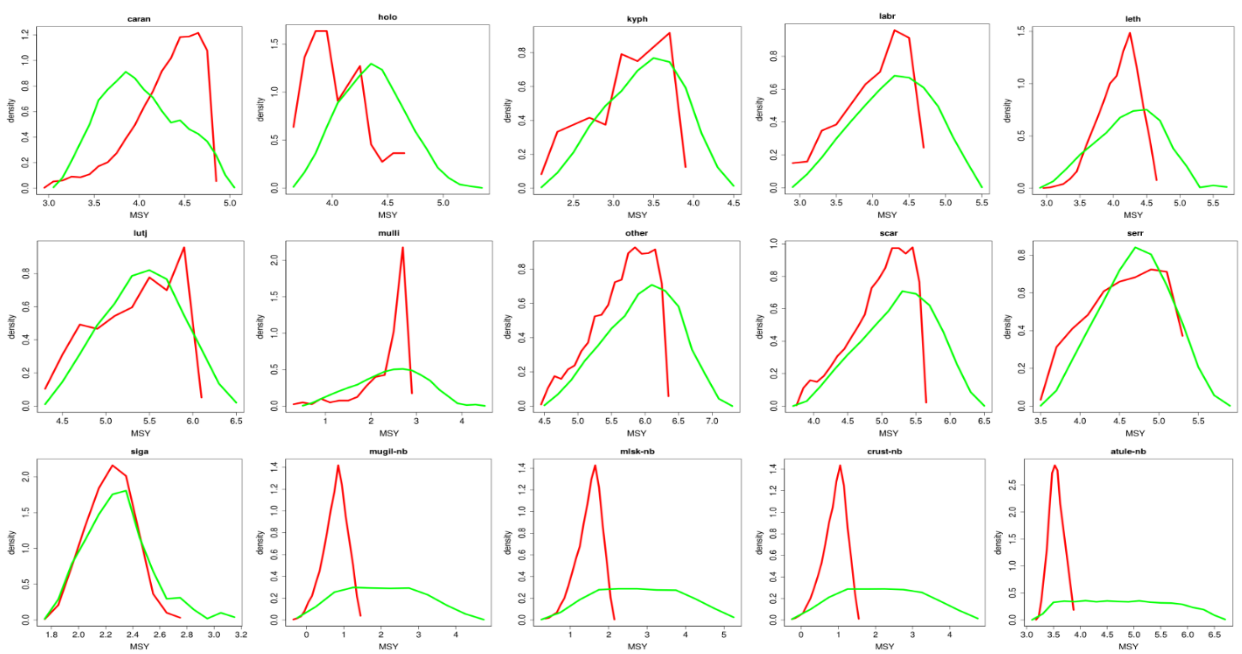

Figure 3. Probability distributions of possible MSY value estimated by k-revise method A (red) and method B (green).

Productivity and Susceptibility Scoring Session

P* Working Group Members were requested to provide a score on the productivity and susceptibility for species that dominates the catch under each of their respective family grouping. When multiple species are scored under each family, the scores were averaged across species to represent the final score.

Hawaii – Bob Humphreys presented a summary of the Productivity Susceptibility scores (in collaboration with Ed DeMartini) for the coral reef MUS for Hawaii. The scores were given for species that make up the 90% of the coral reef catch. The productivity scores were based on the life history characteristics (e.g. age and growth, longevity, L_{inf} etc.) available from local studies or from the literature. Susceptibility scores were based on the type of fishery it was harvested as well as proximity of the habitat to human presence. If there is no information then a default risk score of 5 is assigned. Details of the PS scores are found in appendix xxx.

Guam – Lennon Thomas presented on the Productivity Susceptibility Analysis for the Guam coral reef MUS.

American Samoa – Domingo Ochavillo presented the summary of the Productivity Susceptibility scores for the coral reef MUS for American Samoa. The scoring was based on the available life history characteristics for the productivity criteria. Scoring for the susceptibility was based on dominance in the coral reef fish catch. Details of the PS scores are found in appendix xxx.

CNMI – Todd Miller presented on the summary of the Productivity Susceptibility scores (in collaboration with Michael Tenorio, Sean MacDuff and John Gourley) for the coral reef MUS for CNMI. The basis for the scoring was from its commonness or predominance in the underwater census surveys, creel survey, market survey and BioSampling program. For the productivity scores this was based on the frequency of sighting in the underwater surveys. For the susceptibility scores

P* for the Western Pacific Coral Reef Management Unit Species

Summing all the dimension scores yields the total uncertainties and when deducted from the 50% risk of overfishing will result in the P*. The associated catch to that P* will be the acceptable biological catch. Since the P* values are in 5% increment. The P* scores were round up or down depending on the scores proximity to the incremental value.

Table 1. Summary of the dimension scores and the resulting P* and associated ABCs for the Hawaii management unit species with ACLs for fishing year 2015.

Hawaii Grouping	**M.I.**	**U.C**	**S.S**	**P.S**	∑	**P***
Acanthuridae – surgeonfish	3	5	0	5.8	13.8	36.2
Atule - *Selar crumenophthalmus*	3	5	2.5	2.5	13.0	37.0
Carangidae – jacks	3	5	0	2.5	10.5	39.5
Crustaceans – crabs	3	5	5	5	18.0	32.0
Holocentridae – squirrelfish	3	5	2.5	6.3	16.8	33.3
Kyphosidae - rudderfish	3	5	0	5	13.0	37.0

Labridae - wrasses	3	5	0	5	13.0	37.0
Lethrinidae - emperors	3	5	0	5	13.0	37.0
Lutjanidae – snappers	3	5	0	1.2	9.2	40.8
Mollusks – turbo snails; octopus	3	5	5	5	18.0	32.0
Mugilidae – mullets	3	5	2.5	6.6	17.1	32.9
Mullidae – goatfish	3	5	2.5	5.6	16.1	33.9
Opelu - *Decapterus macarellus*	3	5	2.5	5	15.5	34.5
Other CREMUS	3	5	0	6	14.0	36.0
Scaridae – parrotfish	3	5	0	7.5	15.5	34.5
Serranidae - groupers	3	5	0	0	8.0	42.0
Spiny lobster	3	5	0	5	13.0	37.0

Table 2. Summary of the dimension scores and the resulting P* and associated ABCs for the Guam management unit species with ACLs for fishing year 2015.

Guam Grouping	**M.I.**	**U.C**	**S.S**	**P.S**	∑	**P***
Acanthuridae – surgeonfish	3	5	2.5	3.9	14.4	35.6
Algae	3	5	0	5	13	37
Selar crumenophthalmus	3	5	7.5	4.3	19.8	30.2
Carangidae – jacks	3	5	5	5.7	18.7	31.3
Crustaceans – crabs	3	5	0	5	13	37
Holocentridae – squirrelfish	3	5	0	4.8	12.8	37.2
Kyphosidae – rudderfish	3	5	2.5	5.6	16.1	33.9
Labridae – wrasses	3	5	0	7.5	15.5	34.5
Lethrinidae – emperors	3	5	0	6.3	14.3	35.7
Lutjanidae – snappers	3	5	0	7.4	15.4	34.6
Mollusks – turbo snail; octopus	3	5	0	5	13	37
Mugilidae – mullets	3	5	0	5.8	13.8	36.2
Mullidae – goatfish	3	5	0	3.8	11.8	38.2
Other CRE	3	5	0	5	13	37
Scaridae – parrotfish	3	5	2.5	5.8	16.3	33.7
Serranidae – groupers	3	5	0	6.7	14.7	35.3
Siganidae – rabbitfish	3	5	0	4.1	12.1	37.9
Spiny lobster	3	5	0	5	13	37

Table 3. Summary of the dimension scores and the resulting P* and associated ABCs for the CNMI management unit species with ACLs for fishing year 2015.

CNMI Grouping	**M.I.**	**U.C**	**S.S**	**P.S**	∑	**P***
Acanthuridae – surgeonfish	3	5	0	4.3	12.3	37.7

Selar crumenophthalmus	3	5	0	2.5	10.5	39.5
Carangidae – jacks	3	5	0	4.2	12.2	37.8
CRE-crustaceans	3	5	0	5	13	37
Holocentridae - squirrelfish	3	5	0	4.8	12.8	37
Kyphosidae – rudderfish	3	5	0	5.6	13.6	36
Labridae – wrasses	3	5	0	7.5	15.5	35
Lethrinidae – emperors	3	5	2.5	4.9	15.4	34.6
Lutjanidae – snappers	3	5	0	3.2	11.2	38.8
Mollusks – turbo snail; octopus	3	5	0	3.2	11.2	38.8
Mugilidae – mullets	3	5	0	4	12	38
Mullidae – goatfish	3	5	0	4	12	38
Other CRE	3	5	0	4.8	12.8	37.2
Scaridae – parrotfish	3	5	0	6	14	36
Serranidae – groupers	3	5	0	5.3	13.3	36.7
Siganidae – rabbitfish	3	5	2.5	4	14.5	35.5
Spiny lobster	3	5	0	5	13	37

Table 4. Summary of the dimension scores and the resulting P* and associated ABCs for the American Samoa management unit species with ACLs for fishing year 2015.

American Samoa Grouping	**M.I.**	**U.C**	**S.S**	**P.S**	∑	**P***
Acanthuridae – surgeonfish	3	5	0	3.3	11.3	38.7
Selar crumenophthalmus	3	5	0	2.5	10.5	39.5
Carangidae – jacks	3	5	0	5	13	37
Crustaceans – crabs	3	5	5	6.3	19.3	30.8
Holocentridae – squirrelfish	3	5	0	6.3	14.3	35.8
Lethrinidae – emperors	3	5	0	5	13	37
Lutjanidae – snappers	3	5	0	7.5	15.5	34.5
Mollusks – turbo snail; octopus	3	5	0	7.5	15.5	34.5
Mugilidae – mullets	3	5	0	5	13	37
Other CRE	3	5	0	5	13	37
Scaridae – parrotfish	3	5	0	5	13	37
Serranidae – groupers	3	5	0	3.8	11.8	38.3
Spiny lobster	3	5	0	5	13	37

Rationale for the species grouping

In the initial ACL specification, the different management unit species are grouped into family levels and ACLs were specified only to the families that comprise 90% of the total catch. This was done to reduce the number of groups that would require ACLs as well as these groups are the ones harvested in large amounts in the fishery. The rest of the families were grouped as the bottom 10% of the catch and was assumed not to be significant in terms of total landings.

The data used in the initial ACL specification was up to 2008 for the territories and 2009. In the re-analysis of the data to be used in the model based approach, the data was updated to 2012 and the catch data for the Territories was from the creel surveys (proxy for total catch to include shore-based and boat-based catch with varying levels of non-commercial catches from multiple gear) and dealer reports (commercial catch). The data was corrected for potential data overlap. The Hawaii data was only for commercial based on the catch reports filed by fishermen with CMLs. No non-commercial catch were accounted for. In the process of identifying the top 90%, the results yield a different grouping compared to the initial specification. This has legal ramifications because the National Standard 1 required stocks subject to ACL specification be identified. This has to be a static list that will be easy to monitor over time. Process-wise this will result in the re-calculation of the top 90% every time new data is available otherwise it is not utilizing best scientific information available. Shifting species groups that require ACLs is hard to monitor and will result inconsistencies in the specification that ultimately will confuse the stakeholders. The current specie groupings are the groups being monitored by the Archipelagic Plan Team and described in the Council annual reports. By using these fixed groupings, it will enable consistent monitoring of catches and groups that would require ACLs should new data become available.

Rationale for the P* values

The assumption behind the tiered system approach is that the scientific uncertainties increase from a data-rich tier to a catch-only tier. This inverse relationship is rationalized by stock having less information regarding the stock status as well as the fishery that harvest the stock, a larger buffer is needed to ensure that the stock is not going to be subject to overfishing or stocks to be overfished. This follows the precautionary principle in data poor situation. In the case for most of the Western Pacific stocks (e.g. coral reefs) where the current ACLs are based on catch-only information, the uncertainties were reduced when the augmented catch-MSY approach was used to estimate MSY. Incorporating biomass from underwater census surveys into the model and some information regarding resilience and assumptions on carrying capacity enabled the Council to enhance the ACL specification from the catch-only approach. The critical factor is the biomass because this parameter is commonly unknown for most surplus production models that use CPUE as a proxy and yet these approaches are treated as a Tier 1 approach.

Determining the appropriate level of scientific risk varies between regions. Other Regional Fishery Management Council had specified either a default P* values for each tier and a range of P* with a P*max. Currently, the omnibus amendment does not prescribe a range of P* values for each tier. Each tier is comprised of varying level of scientific information and reliability of models. Tier 3 utilizes model based approaches where the uncertainty of OFL (in this case probability distribution around MSY as a proxy for OFL) can be estimated using the Monte-Carlo simulation. The criteria for Tier 3 P* analysis was tweaked from the Tier 1 P* analysis of the MHI Deep 7 bottomfish complex recognizing that the Tier 3 approach is not a real model based stock assessment. The model and scientific information are based on the merits and demerits of parameters and information that fits the Tier 3 methods. Hence a direct comparison between a Tier 1 P* score and a Tier 3 P* score is not feasible. Although intuitively, based on the Tiered approach principle, the P* scores in Tier 3 should not exceed or be equal to the Tier 1 P* score. The closest P* scores from the Tier 3 analysis to the Tier 1 MHI Deep 7 Bottomfish (P*=40.8) were from Family Lutjanidae and Serranidae from Hawaii at 40.8 and 42, respectively. These families are comprised of taape (*Lutjanus kasmira*) and roi (*Cephalopholis argus*) which are invasive species in Hawaii. There are some eradication efforts being conducted by local fishing clubs to maintain ecological balance hence limiting catches for these species is not a priority for the Council. The rest of the MUS from all jurisdiction falls within the range of P* values for the Territory Bottomfish (American Samoa 30-41%; Guam 28-40%; CNMI 28-39%). The stocks we analyzed and the Territory bottomfish stocks (majority of which are considered reef fish as well) both showed similar characteristics in which biomass levels are high relative to what is currently being harvested.

A more detail comparison between the dimensions in the Tier 1 and the Tier 3 accounted for the scientific uncertainties by using a Tier 3 approach. Table 5 shows the comparative scores between assessments versus the augmented catch-MSY approach

Table 5. Comparative analysis of the dimension scores between Tier 1 and Tier 3.

Model	**Tier level**	**Dimension 1 score**	**Dimension 2 score**
MHI Deep 7 Bottomfish[1]	1	1.3	0
Am. Samoa shallow/deep BF[2]	1	1.6	5.0
Guam shallow/deep BF	1	1.6	5.0
CNMI shallow/deep BF	1	1.6	5.0
Biomass augmented catch_MSY	3	3.0	5.0

The tier 3 had higher reduction scores for dimension 1 (assessment information) accounting for the lower quality and less quantity of scientific information utilized in the augmented catch-MSY approach. Dimension 2 (uncertainty characterization), the augmented catch-MSY score is similar to the Territory Bottomfish. The territory bottomfish assessment and the augmented catch-MSY approach had uncertainties around the OFL estimates via the probability distribution around the MSY estimate. These uncertainties were not carried forward to future projections for the augmented catch-MSY approach but were accounted for in the Territory bottomfish assessment. On hindsight the Territory bottomfish assessment should have been scored with a 2.5 instead of 5.

Model-based approach for the Hawaii non-deep 7 bottomfish species

Next Step

1. SSC review of the P* score

[1] Brodziak, J., D. Courtney, L. Wagatsuma, J. O'Malley, H. Lee, W. Walsh, A. Andrews, R. Humphreys, and G. DiNardo. (2011). Stock assessment of the main Hawaiian Islands deep 7 bottomfish complex through 2010. Pacific Islands Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822-2396. Pacific Islands Fish. Sci. Center

[2] Brodziak, J. J. O'Malley, B. Richards, and G. DiNardo. (2012). Stock Assessment Update of the Status of Bottomfish Resources of American Samoa, the Commonwealth of the Northern Mariana Islands and Guam, 2010. National Marine Fisheries Service Pacific Islands Fisheries Science Center, Internal Report IR-12-022. Honolulu, 126 pp.

2. SSC decide which ABC to take given that the risk table is in 5% increment (round up or down)