Western Pacific Stock Assessment Review (WPSAR) of the 2018 Guam Reef Fish Stock Assessments: Independent Peer Review Report

conducted for

The Center of Independent Experts

by

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Executive Summary

Nineteen stocks of Guam fishery resources were analyzed using data limited length-based equilibrium methodologies coupled with Monte Carlo bootstrap methods. The results were reviewed as to whether the analyses and (more importantly) the data were sufficient to determine overfishing and catch limits at F30% SPR (C30). The analysis was sufficient for overfishing determinations for 12 of the 19 stocks. The analysis was sufficient for only 4 stocks; and for 3 stocks both overfishing and C30 determinations could be made. These results indicate the extreme data limitations, especially in understanding the level of catch that is occurring and the overall catch histories.

It is recommended that most immediate improvements are achieved through in the estimation of catch and catch at size, as well as improvements in the estimation of life history parameters. The former implies alternative reporting and monitoring requirements, and a more rigorous design for Guam surveys such that total catch and catch at size can be better estimated from expanded samples. Statistical survey designs, post stratification and general linear modeling methods might be useful. For the latter, improvements in growth, maturity and length-weight would be the areas of focus. It is unlikely that meaningful improvements in natural mortality rates will be achieved, although alternative growth rates might change expert opinion somewhat. The time frame for doing this is, of course, dependent on funding. Life history studies can rely on more ad hoc sampling which means there is more flexibility in the running of these. Survey/monitoring design and implementation would require 2-3 years to get running given funding was available.

I also recommend that the relaxation of equilibrium assumptions be explored for some stocks where data might allow it. For example, one might still assume constant recruitment, but define blocks of years where catches and size frequencies are constant within a block, but differing between blocks. I expect that there will be convergence problems for some stocks and parameter sets, but I think it is important to begin to evaluate how restrictive equilibrium assumptions might be. Also, this kind of study could begin almost immediately.

The development of generic management strategy evaluations (MSEs) and management procedures (MPs) for Guam resources would require a more extensive time horizon (3-5 years) for testing, demonstration and implementation. It would also require more science/management dialog in the formulation of procedures. These cannot be driven by science alone. Guam resource users need to be drawn into a management process and use their expertise to guide choices. There would also be a need for a long-term commitment to the MSE MP process.

Background

The 2006 re-authorization of the Magnuson-Stevens Fishery Conservation and Management Act calls for annual catch limits (ACLs) to be set for all exploited stocks in the United States and its territories in order to, among other goals, insure sustainable harvesting practices. In the U.S. Pacific, exploited stocks include a multitude of coral reef-associated finfish species inhabiting shallow-water areas around a large number of islands and atolls. The high species diversity, the mixture of commercial and recreational fishing effort and the institutional difficulty in monitoring has resulted in data-poor situations for these stocks. This has led the Western Pacific Regional Fishery Management Council (WPRFMC) to set ACLs using basic analytical methods, such as using the 75th percentile of historical catches, or using catch-based methods applied at the family level (Sabater & Kleiber, 2013). However, efforts in fisheries-independent surveys and life history research have improved this situation so that some limited length-based assessment approaches can now be attempted for some individual coral-reef fish stocks.

The requirement for catch limits and status determinations in the Act has led to a need for benchmark assessments for a selection of Guam's fishery resources. The methods to do so built off recent Hawaii coral reef fish stock assessment methodologies (Nadon 2017). Nineteen of the more commonly exploited coral-reef fish species of Guam were chosen. Analyses use a length-based model to estimate equilibrium mortality rates and stock status metrics: fishing mortality (F) and spawning potential ratio (SPR) over the equilibrium time period, associated F at SPR = 30% ($F30$), catch associated with $F30$ ($C30$). In this Review, I and other members of the Review Panel evaluated these analyses relative to the status statistics that were estimated. This Report provides my conclusions in this regard.

Description of the Individual Reviewer's Role in the Review Activities

My role in this CIE Review was to provide my expert opinion on the results of the analyses with regards to the terms of reference for 19 stocks of Guam fishery resources. Key aspects of these analyses included: 1) the determination of life history parameters for each species; 2) survey/monitoring methodologies to estimate biomass, total catch and size frequencies by species for Guam; and 3) estimation models of FSPR and SPR based on the life histories and surveys.

Summary of Findings for each Term of Reference

General Comments
The Terms of Reference for this review require:

> *1. For each individual species/stock of the 19 Guam species, review the application of the general approach for each of the following calculations. For each calculation, consider decisions points, input parameters, assumptions, and primary sources of uncertainty.*
>
> *a. Fishing mortality (F), spawning potential ratio (SPR), and corresponding overfishing limit (F at SPR=30%, aka F30).*
>
> *b. Generation of overfishing limit from C30 (catch levels corresponding to F30)*

distribution calculation.

2. Determine whether the results for individual species from question 1 can be used for management purposes under the Magnuson- Stevens Act and relevant Fishery Ecosystem Plan (FEP) with no or minor further analyses or changes (considering that the data itself and the general approach have been accepted for stock assessment purposes). If results of this analysis should not be applied for management purposes with or without minor further analyses, indicate which alternative set of existing results should be used to inform setting fishery catch limits instead and describe why.

3. As needed, suggest recommendations for future improvements and research priorities. Indicate whether each recommendation should be addressed in the short/immediate term (2 months), mid- term (3- 5 years), and long- term (5- 10 years). Also indicate whether each recommendation is high priority (likely most affecting results and/or interpretation), mid priority, or low priority.

As noted in the Background Section, these TORs are in the context of extreme data limitation of the Guam fisheries. The key points of these are the unequivocal determination of whether the estimates of fishing mortality rate (F) relative to F30%SPR, estimates of SPR and estimates of the catch at F30%SPR (C30) are useful for management purposes. It is important to note that the F values are rates per year and are therefore dimensionless. However, the requirement for determination of C30 means that you must determine the scale of the abundance of the resource. The only way to do this in any stock assessment is to have some knowledge of the catch that is being extracted and/or some knowledge of the biomass of the resource. Usually, in stock assessments, it is the catch that is the *scale-providing* statistic. If the catch or biomass is not known with any confidence, then you will not have confidence in estimates of C30 *by any method.* There is no getting around this. Though we expound on data-limited approaches there is no substitute for data. Many (most?) data limited approaches require that some expert opinion be made on what the catches have been and their magnitude relative to reference points (such as CatchMSY). However, as noted, you cannot create data. Poor understanding of catches will limit the confidence in C30 estimates.

Conversely, with estimates of rates (Fs) there is more hope. There are any number of ways in stock assessment that estimates of mortality rates might be achieved. Of course, those options are limited in the case of Guam. But the assessment under review notes the difference between rate estimation and scale (C30) estimation, and this review's comments are arranged accordingly.

I would also like to comment on the "…useful for management purposes..." clause of the TORs. I am interpreting this to mean whether the science and data allows us to determine a usable estimate of the fishing rate relative to Fmsy proxies (F30%SPR) and usable estimates of C30. I have some doubts whether these will be useful in management in the larger management context. Clearly, that is beyond my remit in this review. Nevertheless, I will address this issue a bit more in the recommendations section.

Comments on methodology

A quick description of the methodology is as follows:

A standard length-based population model was used in which key life history parameters (von Bertalanffy growth parameters, natural mortality rates, maturity/fecundity ogives, length-weight relationships) were used to describe dynamics. Fishing mortality rates were imposed with length-based selectivities. This population dynamics model was fit to length-frequency data in order to get estimates of F. From these, one gets estimates of SPR and F30%SPR. These were applied against either an estimate of current catch or current biomass (or both) to get C30's.

Size frequencies and catches were estimated from irregular observations (creel surveys, landing sites around the island) which were expanded to the entire island. Biomass was estimated from diver surveys expanded to the surrounding waters of the island.

The probability distributions of the key statistics were generated using a Monte Carlo/bootstrap analysis where the life-history, biomass, catch and length frequency data were specified to have assumed distributions based on estimated means and variance (Monte Carlo) or bootstrapped over a number of iterations in which each iteration fit the population model (for a set of life-history bootstrap/Monte Carlo parameters) to a size frequency Monte Carlo sample to get F, F30%SPR and SPR for each iteration. Then for each iteration these were applied against a Monte Carlo catch (or biomass) estimate to get an estimate of C30 for each estimate. The accumulation of all iterations provided probability distributions of these statistics.

There are important and strong assumptions that are required to use these methods. The analysts are well aware of these assumptions. Indeed, Nadon (Nadon, M. O. 2016. (draft) Stock assessment of the coral reef fishes of Guam, 2017. U.S. Dep. Commer., NOAA Tech. Memo., NOAA- TM- NMFS- PIFSC- XX, ~200 p.) discusses them at length. But they need reiterating, since the degree with which any individual species/stock meets these is the basis of the review.

First, the methods assume that each species represents a single stock surrounding the island. In some species, it is unclear how much close by banks contribute to the Guam resource. To some degree, this can be mitigated if there is no trend in the unknown contribution and the fishery catches are stable. But especially in the biomass method, this becomes more of an issue.

The second major assumption group is that the survey/monitoring procedures represent a random sample of what it being measured (size frequencies of the catch, the estimate of total catch and the estimate of total biomass), and that expansion factors are appropriate. For example, expanding samples of catch at different times and locations to catch as a whole requires an expansion factor. Clearly, the Guam fisheries have not been monitored or sampled in a systematic way. Additionally, the degree with which a Monte Carlo method captures the underlying uncertainty distribution is largely unknown. So, whether these assumptions might possibly be met are evaluated on a case by case basis.

The third set of assumptions are the life history parameters. As always, the key to a population's productivity relies on these parameters. The authors have extensively reviewed the literature to obtain local and regional estimates of these parameters. They also devised a decision tree to determine when to use local/regional or super regional substitutes, and in the latter case when to use a bootstrap method to estimate the underlying probability distributions.

The last set of assumptions relate to the application of the population model. While the dynamics model is a standard depiction of how a population grows, the extreme Guam data limitation requires some strong assumptions. The major assumption is that the population is in a condition of stable equilibrium. This implies that recruitment, catches and fishing have been stable without trend. The evidence for this is scanty at best. Often it is unclear whether large fluctuations in catch estimates are a reflection of the estimation method, changes in fishing practices or changes in population. The analyses addressed this by attempting to pick years where catches/fisheries were more stable, and to examine infrequent size-frequency data to see if there have been recruitment pulses. But the evidence is not very good. In this review, considerable 'judgement' is being used to determine if equilibrium conditions are sufficient to allow an acceptance of F, SPR statistics estimated.

Other assumptions of the application of the model are: flat-topped selectivity, M constant over ages, that size "sub-groups" are based on variation in Linf. The flat-topped assumption is more suspect when there are fish that are outside the range of the fishery (are larger fish inaccessible due to depth (for divers) or more represented in outer areas around the island?). This is largely unexamined and it is unlikely the data exist to do so. Constant M may be unlikely, yet in terms of F and SPR estimation the implications are well-known and the F, SPR advice is often robust to this. The sub-group estimation assumed that sub-groups were based on variation in Linf where Linf was distributed normally (mean and variance from life history) and that there were 20 sub-groups whose Linf ranged over ±1 std dev and that the proportion of recruitment to each sub-group reflected the Linf distribution. The choice of 20 subgroups is adequate; that subgroups are based on Linf is more suspect (why not variations in K or t0?). But in the larger scheme of things this is probably minor.

A Comment on the Implications of the Equilibrium Assumption

By assuming equilibrium, we are implicitly assuming that the Fs and SPRs represent a long term stable period reflected in the size frequencies and that C30's generated represent stable catches and/or biomass over a specified period, *and* that in the case of C30 that these conditions will continue over the management time-horizon. That is a lot to buy. It is notable that the TORs did *NOT* ask for us to determine whether a stock is overfished or not. However, if one accepts that a stock is in equilibrium, then the SPR/SPR30 ratio is also the measure of whether the stock is overfished or not. One might comment that this is a technicality of the analysis. Others may not agree that the F/F30 estimate is acceptable but the SPR/SPR30 is not, but this remains to be determined.

A Comment on the Presentation of Results

One criticism of the presentation of results is that the analysis results were mostly combined from the overall Monte Carlo simulations. For example, plots of size frequencies and predictions are labeled as model fits. But what they are (I believe) are the median estimates of the binned length frequencies versus the median predictions of the Monte Carlo fits from the simulations. I would have preferred that there was some more in-depth examination of the fitting results. For example, observed and predicted size frequencies for a species' "base case" or mean/median size frequencies, especially for cases where the size frequencies were fairly well-known would have been useful. Then, one could have to explore likelihood profiles for key parameters. The reason I

am focusing on size frequencies is that as we go forward, I have more hope for the F and SPR estimation than the catch/biomass side of the analysis.

Final Comment on Methods

Despite the caveats mentioned above, I find the methodology to be innovative and useful. The methods are sound and the assumptions are well noted. The limitations are, of course, the limitations of data and how far the assumptions can be stretched. Therefore, the species by species determinations are not a criticism of the methods, but rather the degree to which I believe the assumptions are being met.

With that, I address the individual stocks:

Stock by Stock Determinations

Family **Species**

Acanthuridae ***Naso unicornis***

Can analysis be used for determining overfishing status?	Yes
If not, what alternative might be used?	Not Applicable
Can analysis be used for determining C30 limits?	No
If not, what alternative might be used?	CatchMSY, Catch%tile

Comments:

Data for this species included a fairly large number of length frequencies and accepted growth-life history parameters. A new base case was generated at the meeting using a new longevity estimate (reduced from 50 to 23 years). This led to a large increase in M from 0.06 to 0.14. While I agree with the change, this also demonstrates the sensitivity of results to new (better?) basic life history parameter estimates. The mean catch estimate over recent years was about 5,000 kg annually with a CV of about 1.0. However, estimated catch in recent years is about ½ to ⅓ of what was estimated in prior decades. The estimated F, F30 and SPR/SPR30 were 0.18, 0.19 and 0.31/0.3, respectively. Because of the stable life history estimates and large size frequency samples, the estimated values of the status statistics are usably precise. And the estimated probability distributions are usable. Effectively, the results indicate that the fishing mortality rate is about equal to F30; thus, the catch at C30 should be about what the catch is now. However, it is much less certain what that catch is in actual kilograms. The diver-based estimate of biomass is likely to be biased low, perhaps by an order of magnitude. Looking at the distribution of total catch estimates, there is a fairly high probability that C30 catches could be lower than 2,500 or higher than 10,000 kg (examining distribution plots). Coupled with somewhat tenuous equilibrium assumptions, it is deemed that the C30 estimates are not useful based on this analysis.

Note in the above and in subsequent species, one might say that it is inconsistent to argue that catch estimates are too variable to use in C30 estimates, but that the same catch data will have to be used in CatchMSY or Catch%tile methods. And one making that argument has a point. To some extent, that is the result of the TORs: we are asked to comment on the bias and precision of the C30 estimates emanating from these analyses, which I have. I believe that other local experts

may do better than these analyses in defining catches. However, I also believe that other indirect approaches to management such as MSE management procedures would help to reduce this inconsistency (see recommendations section).

Note that in what follows, biomass generated from the catch estimates are usually larger (often much larger) than the diver generated estimates. However, if the diver estimate is larger, it should probably be used.

Carangidae *Carangoides orthogrammus*

Can analysis be used for determining overfishing status?	Yes
If not, what alternative might be used?	Not applicable
Can analysis be used for determining C30 limits?	No
If not, what alternative might be used?	CatchMSY, Catch%tile

Comments:

Length frequencies are relatively weak and life histories formed stepwise because of no Guam-based parameters. Catch is very infrequent: annually several hundred kg. Because of the limited size frequencies and the stepwise methods for life history specification, the variation in F/F30 estimates are large. Nevertheless, it appears that the overfishing statistics are marginally useful. Median estimates are: F=0.24; F30=0.27; SPR=0.35. As with the previous stock the fishing rate is close to F30, which implies that C30 should be at about the level of current catch. But again, the scale of that catch is quite uncertain. It is estimated to be about 373kg annually, but the distribution is very wide. Therefore, it is not recommended that the C30 estimate is useful based on these analyses.

Carangidae *Caranx melampygus*

Can analysis be used for determining overfishing status?	Yes
If not, what alternative might be used?	Not Applicable
Can analysis be used for determining C30 limits?	No
If not, what alternative might be used?	CatchMSY, Catch%tile

Comments:

Length frequencies sample sizes appeared to be adequate. Annual catches estimates were quite variable but there did not appear to be much trend in catch or average length or biomass surveys which supports the equilibrium assumption. Therefore, the analysis can be used for overfishing determinations. Median estimates of overfishing statistics are: F=0.75; F30=0.26; SPR=0.06. Thus, it is concluded that the stock is undergoing overfishing. Sensitivities were examined using the stepwise life history parameter procedure. Results were slightly more optimistic, but the overfishing conclusion remained. Annual catches are relatively large (by Guam standards anyway) averaging about 10,580 kg. However, the standard deviation of the estimates was very large at CV>1.0. This carries over into the C30 estimate with that having a CV>1.0, as well. So, the scale of that catch is quite uncertain with a wide distribution. Therefore, it is not recommended that the C30 estimate is useful based on these analyses.

Carangidae *Elagatis bipinnulata*

Can analysis be used for determining overfishing status? No
If not, what alternative might be used? Other Fmsy proxy such as M
Can analysis be used for determining C30 limits? No
If not, what alternative might be used? CatchMSY, Catch%tile
Comments:

Length frequencies sample sizes are small. Annual catches estimates were quite variable with an increasing trend recently. Average sizes appear to be decreasing somewhat. These trends suggest that equilibrium conditions may not be extant. The estimates of F/F30 has a CV of about 2. Therefore, this analysis is not useful in making that determination. Conversely, the total catch estimate seems to be of enough precision as to be useful. However, when this is combined with the F and F30 estimates, the variance becomes large. So, the C30 estimate is not useful either. But because the total catch estimate is reasonable, this might be a good candidate for Catch%tile methods for C30 estimation. As far as overfishing determinations, it is more problematic. One option would be to look for simple Fmsy proxies such as assigning Fmsy=M. Thus, this would provide an OFL fishing rate. Then, the selection of catch%tiles would determine whether F was exceeding M or not.

Holocentridae ***Myripristis berndti***

Can analysis be used for determining overfishing status? No
If not, what alternative might be used? Proxy Fmsy Catch%tile
Can analysis be used for determining C30 limits? No
If not, what alternative might be used? CatchMSY, Catch%tile
Comments:

Length frequencies samples are very concentrated around a small range of sizes which raises questions about the representativeness of these data. Life history parameters do not come from Guam. Additionally, the stepwise procedure cannot be used. Total catch is larger than the biomass estimate from the catch method. Thus, the analyses do not allow useful determinations of overfishing and C30. CatchMSY and Catch%tile methods might be used as alternatives.

Emperor ***Lethrinus erythacanthus***

Can analysis be used for determining overfishing status? No
If not, what alternative might be used? Proxy catch%tile
Can analysis be used for determining C30 limits? No
If not, what alternative might be used? CatchMSY, Catch%tile
Comments:

Length frequencies samples are inadequate. Catch history is extremely variable. Catches are small, but the CV on total catch is > 2.0. It is unlikely that equilibrium conditions are being approximated. The results do not support their use for overfishing C30 determinations. CatchMSY and Catch%tile methods might be used as alternatives.

Emperor ***Lethrinus olivaceus***

Can analysis be used for determining overfishing status? Yes
If not, what alternative might be used? Not Applicable

Can analysis be used for determining C30 limits? No
If not, what alternative might be used? CatchMSY, Catch%tile
Comments:
Estimates from the life history and size frequency data provide estimates of key statistics with adequate precision. The estimates were: F=0.50, F30=0.14, SPR=0.04. These results indicate a large probability that the stock is undergoing overfishing. Total catch estimates are small, but highly variable such that they are not useful for C30 determinations. CatchMSY and Catch%tile methods might be used as alternatives. Given the extreme overfishing estimates, catch%tiles should reflect the nature of the F/F30 distribution.

Emperor ***Lethrinus xanthochilus***

Can analysis be used for determining overfishing status? Yes
If not, what alternative might be used? Not Applicable
Can analysis be used for determining C30 limits? No
If not, what alternative might be used? CatchMSY, Catch%tile
Comments:
Estimates from the life history and size frequency data provide estimates of key statistics with adequate precision. It was noted that the size frequencies used were limited in the Nadon report, and thus an extended period was used to rerun the analysis. This was accepted as a better base case. The estimates from this were: F=0.15, F30=0.15, SPR=0.29. These results indicate the stock is being fished at the rate close to F30. Thus, C30 catches should be close to the current catch. Total catch estimates are small, but highly variable such that they are not useful for C30 determinations. C30 estimates have a CV>4. CatchMSY and Catch%tile methods might be used as alternatives

Emperor ***Monotaxis grandoculis***

Can analysis be used for determining overfishing status? Yes
If not, what alternative might be used? Not Applicable
Can analysis be used for determining C30 limits? Yes
If not, what alternative might be used? Not Applicable
Comments:
Estimates from the life history and size frequency data provide estimates of key statistics with adequate precision. The estimates from this were: F=0.25, F30=0.21, SPR=0.25. These results indicate the stock is being fished at the rate close to F30. Thus, C30 catches should be close to the current catch. Total catch estimates are small, but highly variable. Interestingly, the median biomass and C30 estimates from the catch method and from the diver survey are very similar. However, the C30 estimate from the diver survey has a much lower standard deviation. It is suggested that this method be used for the C30 estimation.

Lutjanidae ***Aphareus furca***

Can analysis be used for determining overfishing status? No
If not, what alternative might be used? Proxy Fmsy Catch%tile
Can analysis be used for determining C30 limits? No
If not, what alternative might be used? CatchMSY, Catch%tile

Comments:

Variation in the estimates of F/F30 preclude their usefulness for overfishing determinations (CV=2). Additionally, total catches are small with a CV close to 2, as well. The resulting CV of C30 using the catch method is >10. However, the biomass estimate from the diver survey may be usable for formulating a C30 based on an Fmsy proxy such as M. This could be compared with CatchMSY and Catch%tile methods in determining overfishing and C30.

Lutjanidae ***Lutjanus fulvus***

Can analysis be used for determining overfishing status?	Yes
If not, what alternative might be used?	Not Applicable
Can analysis be used for determining C30 limits?	Yes
If not, what alternative might be used?	Not Applicable

Comments:

Estimates from the life history and size frequency data provide estimates of key statistics with adequate precision. The estimates from this were: F=0.86, F30=0.23, SPR=0.05. These results indicate the stock is being fished greatly in excess of F30.The diver survey provides an estimate much greater than that derived from the catch method, and thus is the preferred method here. As such, the estimated C30 is 405 kg with the probability distribution in the Nadon report providing risk estimates.

Lutjanidae ***Lutjanus gibbus***

Can analysis be used for determining overfishing status?	Yes
If not, what alternative might be used?	Not Applicable
Can analysis be used for determining C30 limits?	No
If not, what alternative might be used?	CatchMSY, Catch%tile

Comments:

Estimates from the life history and size frequency data provide estimates of key statistics with adequate precision. The estimates from this were: F=0.12, F30=0.24, SPR=0.48. The CV on F/F30 is relatively small (CV=0.47). These results indicate the stock is not undergoing overfishing. The biomass from the diver survey seems to have usable precision. This leads to usable precision for the diver based C30, as well. However, that C30 estimate is less than current catch which is not consistent with a F<F30 determination. Likely, this is the result of the variance in the catch and survey estimates. Given that, I determine that the C30 estimates are not useful and that CatchMSY and Catch%tiles be explored as alternatives.

Scaridae ***Chlorurus microrhinos***

Can analysis be used for determining overfishing status?	Yes
If not, what alternative might be used?	Not Applicable
Can analysis be used for determining C30 limits?	Yes
If not, what alternative might be used?	Not Applicable

Comments:

Estimates from the life history and size frequency data provide estimates of key statistics with adequate precision. The Guam longevity is probably more appropriate. Thus, the base case is as derived from that sensitivity test, where: F=0.34, F30=0.35, SPR=0.31. This

indicates that C30 is near close to current catches. The diver derived C30 is 1,127kg. The diver estimated biomass is much larger than the catch derived method and is the preferred estimate.

These results indicate the stock is not undergoing overfishing. The biomass from the diver survey seems to have usable precision. This leads to usable precision for the diver based C30, as well. However, that C30 estimate is less than current catch, which is not consistent with a F<F30 determination. Likely, this is the result of the variance in the catch and survey estimates. Given that, I determine that the C30 estimates are not useful and that CatchMSY and Catch%tiles be explored as alternatives.

Scaridae ***Hipposcarus longiceps***

Can analysis be used for determining overfishing status?	Yes
If not, what alternative might be used?	Not Applicable
Can analysis be used for determining C30 limits?	Yes
If not, what alternative might be used?	Not Applicable

Comments:

Estimates from the life history and size frequency data provide estimates of key statistics with adequate precision. The estimates from this were: F=0.21, F30=0.38, SPR=0.48 indicating the stock is not undergoing overfishing. The diver survey and the catch method provide biomass estimates that are close to one another. However, the catch method biomass is extremely imprecise. Therefore, C30 from the diver survey is more appropriate (C30 diver =1,580 kg). The probability distribution in the Nadon report providing risk estimates.

Scaridae ***Scarus altipinnis***

Can analysis be used for determining overfishing status?	Yes
If not, what alternative might be used?	Not Applicable
Can analysis be used for determining C30 limits?	No
If not, what alternative might be used?	CatchMSY, Catch%tile

Comments:

Estimates from the life history and size frequency data provide estimates of key statistics with adequate precision. The estimates from this were: F=0.21, F30=0.59, SPR=0.54. The CV on F/F30 is relatively large exceeding 1.0. However, the estimates of F/F30 are small enough that there is a high probability that the stock is not undergoing overfishing. However, they are so imprecise as to be not useful, and CatchMSY and Catch%tiles might be explored as alternatives.

Scaridae ***Scarus forsteni***

Can analysis be used for determining overfishing status?	No
If not, what alternative might be used?	Proxy Catch%tile
Can analysis be used for determining C30 limits?	No
If not, what alternative might be used?	CatchMSY, Catch%tile

Comments:

Total catch for this species is miniscule. F/F30 estimates are very imprecise, as are C30 estimates. Therefore, the analysis is not helpful in overfishing and C30 determinations. CatchMSY and Catch%tiles might be explored as alternatives including very small %tiles, since the catch is already likely to be very low.

Scaridae ***Scarus rubroviolaceus***

Can analysis be used for determining overfishing status?	Yes
If not, what alternative might be used?	Not Applicable
Can analysis be used for determining C30 limits?	No
If not, what alternative might be used?	CatchMSY, Catch%tile

Comments:

Estimates from the life history and size frequency data provide estimates of key statistics with adequate precision. The estimates from this were: F=0.38, F30=0.24, SPR=0.2. The CV on F/F30 is relatively large (approaching 1.0). This is likely due to the uncertainty in the life history parameters. Nevertheless, the precision is adequate to indicate a large probability that the stock is undergoing overfishing. The total catch and C30 estimates are very imprecise, such that those estimates are not useful. However, the diver biomass has potential, so it might be explored further in the context of CatchMSY and Catch%tiles alternatives.

Scaridae ***Scarus schlegeli***

Can analysis be used for determining overfishing status?	No
If not, what alternative might be used?	Proxy Fmsy Catch%tile
Can analysis be used for determining C30 limits?	No
If not, what alternative might be used?	CatchMSY, Catch%tile

Comments:

The overall precision of both the F and C30 estimates are too large to make them useful. CatchMSY and Catch%tiles might be explored.

Serranidae ***Variola albimarginata***

Can analysis be used for determining overfishing status?	No
If not, what alternative might be used?	Proxy Fmsy Catch%tile
Can analysis be used for determining C30 limits?	No
If not, what alternative might be used?	CatchMSY, Catch%tile

Comments:

The overall precision of both the F and C30 estimates are too large to make them useful. CatchMSY and Catch%tiles might be explored.

Conclusions and Recommendations in accordance with the Terms of Reference

Determinations have been made above as to the usefulness of F30, SPR and C30 for each of the stocks. However, it must be reiterated that *there is no substitute for data*. These are data limited stocks and there are consequences of that. I have every expectation that if one were to revisit this issue in a few years using the same data streams that one would come up with some very different answers for some stocks, even the ones where it is deemed that the statistics are currently useful for management.

For those stocks for which F, SPR and C30 statistics are useful, the regulatory obligation has been fulfilled. However, I believe that in order to make meaningful management progress in data limited situations, there should be a shift in the underlying question from what is the overfishing rate and from what is the catch level of overfishing, to what are the management options that would maintain a high probability that a stock will not enter an overfishing or overfished condition and will, if overfishing is occurring or if the stock is overfished, recover to sustainable conditions within required time frames. This implies that the management process be better integrated. This might be done through the exploration of management strategy evaluation and management procedures. And perhaps through generic MSEs for Guam resources. I am sure that it would be argued that current regulatory guidelines would still require C30 determinations. However, I am not convinced that fishery/ecosystem plans are not allowed the flexibility to take these approaches. As it stands now, I would be extremely curious as to how C30 estimates we have determined might be used within the Guam management/implementation/enforcement context.

Finally, there remains the stocks where C30 estimates were not deemed to be useful. What should be done with those stocks? Generally, it is argued that those stocks might be addressed by catch only methods such as CatchMSY. But as noted above, these methods require some expert judgment on the history/level of catch and exploitation. The current Review Panel was reluctant to provide alternative C30 estimates based on catch only methods without being provided better background on the catch levels. In my opinion, this would be best handled by local experts (not just scientists, either).

With regards to recommendations, in my opinion, the determination of stock status would most likely immediately be improved by making improvements in the estimation of catch and catch at size and in the estimation of life history parameters. The former implies alternative reporting and monitoring requirements and a more rigorous design for Guam surveys such that total catch and catch at size can be better estimated from expanded samples. Statistical survey designs, post stratification and general linear modeling methods might be useful. For the latter, improvements in growth, maturity and length-weight would be the areas of focus. It is unlikely that meaningful improvements in natural mortality rates will be achieved, although alternative growth rates might change expert opinion somewhat. The time frame for doing this is of course dependent on funding. Life history studies can rely on more ad hoc sampling which means there is more flexibility in the running of these. Survey/monitoring design and implementation would require 2-3 years to get running given funding was available.

I also recommend that the relaxation of equilibrium assumptions be explored for some stocks where data might allow it. For example, one might still assume constant recruitment, but define blocks of years where catches and size frequencies are constant within a block but differing between blocks. I expect that there will be convergence problems for some stocks and parameter sets, but I think it is important to begin to evaluate how restrictive equilibrium assumptions might be. Also, this kind of study could begin almost immediately.

The development of generic management strategy evaluations (MSEs) and management procedures (MPs) for Guam resources would require a more extensive time horizon (3-5 years)

for testing, demonstration and implementation. It would also require more science/management dialog in the formulation of procedures. These cannot be driven by science alone. Guam resource users need to be drawn into the management process and use their expertise to guide choices. There would also be a need for a long-term commitment to the MSE MP process.

Apparently, there is an immediate short-term need to fulfill the regulatory requirement for F/F30 and C30 determinations for those stocks where this review was unable to support those determinations based on analysis. As suggested above, the default in these situations is to use catch only methods. But essentially, these require expert opinion since data are so limited as to render analysis not useful. This Panel feels that it would best be addressed by experts on the local fishery rather than to depend on data analysis.

Appendix 1: Bibliography of materials provided for review

Benchmark stock assessment for review (not to be distributed beyond reviewers):

Nadon, M. O. 2016. (draft) Stock assessment of the coral reef fishes of Guam, 2017. U.S. Dep. Commer., NOAA Tech. Memo., NOAA- TM- NMFS- PIFSC- XX, ~200 p.

Relevant management information:

Western Pacific Regional Fishery Management Council. 2009. Fishery Ecosystem Plan of the Mariana Archipelago. Sections 4.4.2 and 5.6 only.

Western Pacific Regional Fishery Management Council. 2011. Omnibus Amendment for the Western Pacific Region to Establish a Process for Specifying Annual Catch Limits and Accountability Measures. Section 3.1 only.

References:

Hordyk, A.R., Ono, K., Prince, J.D., and Walters, C.J. (2016). A simple length- structured model based on life history ratios and incorporating size- dependent selectivity: application to spawning potential ratios for data- poor stocks. Can. J. Fish. Aquat. Sci. *73*, 1787–1799.

Kritzer, J.P., Davies, C.R., and Mapstone, B.D. (2001). Characterizing fish populations: effects of sample size and population structure on the precision of demographic parameter estimates. Can. J. Fish. Aquat. Sci. *58*, 1557–1568.

Nadon, M.O., and Ault, J.S. (2016). A stepwise stochastic simulation approach to estimate life history parameters for data- poor fisheries. Can. J. Fish. Aquat. Sci. *73*, 1874–1884.

Previous stock assessment:

Sabater, M, and Kleiber, P. 2013. Improving Specification of Acceptable Biological Catches of Data- Poor Reef Fish Stocks Using a Biomass- Augmented Catch- MSY Approach. Report of the Western Pacific Regional Fishery Management Council.

Hawaii assessment and independent peer review report:

Choat, JH, Franklin, EC, and Stokes, K. 2016. Benchmark review of the 2016 stock assessment of the main Hawaiian Islands reef- associated fish. Consensus panel report prepared by Erik C. Franklin.

Nadon, M.O. (2017). Stock assessment of the coral reef fishes of Hawaii, 2016. PIFSC Tech Memo 60. 200p.

References:

Nadon, M.O., Ault, J.S., Williams, I.D., Smith, S.G., and DiNardo, G.T. (2015). Length- based assessment of coral reef fish populations in the Main and Northwestern Hawaiian Islands. PLoS ONE *10*, e0133960.

Appendix 2: CIE Statement of Work

Statement of Work
National Oceanic and Atmospheric Administration (NOAA)
National Marine Fisheries Service (NMFS)
Center for Independent Experts (CIE) Program
External Independent Peer Review

Center for Independent Experts' Contribution of Reviewers to the Western Pacific Stock Assessment Review (WPSAR) of the 2018 Guam Reef Fish Stock Assessments

Background

The National Marine Fisheries Service (NMFS) is mandated by the Magnuson-Stevens Fishery Conservation and Management Act, Endangered Species Act, and Marine Mammal Protection Act to conserve, protect, and manage our nation's marine living resources based upon the best scientific information available (BSIA). NMFS science products, including scientific advice, are often controversial and may require timely scientific peer reviews that are strictly independent of all outside influences. A formal external process for independent expert reviews of the agency's scientific products and programs ensures their credibility. Therefore, external scientific peer reviews have been and continue to be essential to strengthening scientific quality assurance for fishery conservation and management actions.

Scientific peer review is defined as the organized review process where one or more qualified experts review scientific information to ensure quality and credibility. These expert(s) must conduct their peer review impartially, objectively, and without conflicts of interest. Each reviewer must also be independent from the development of the science, without influence from any position that the agency or constituent groups may have. Furthermore, the Office of Management and Budget (OMB), authorized by the Information Quality Act, requires all federal agencies to conduct peer reviews of highly influential and controversial science before dissemination, and that peer reviewers must be deemed qualified based on the OMB Peer Review Bulletin standards. (http://www.cio.noaa.gov/services_programs/pdfs/OMB_Peer_Review_Bulletin_m05-03.pdf). Further information on the CIE program may be obtained from www.ciereviews.org.

Scope

Pacific Islands Fisheries Science Center (PIFSC) scientists are conducting stock assessments on exploited coral reef fish species in the Pacific Islands Region which are listed in the Western Pacific Regional Fishery Management Council (Council) Fishery Ecosystem Plans. These stocks are generally classified as data-poor due to a lack of reliable, long-term, catch and fishing effort data. Historically, the Council has set and NMFS has approved setting of annual catch limits (ACLs) using a percentile of median historical catch levels and more recently, a biomass-augmented catch-MSY method has been applied (Sabater and Kleiber 2014, NOAA 2015). In an effort to use additional available data sources for these stocks, scientists at PIFSC have

conducted new coral reef fish assessments using length composition data, abundance data from diver surveys, and certain key population demographic parameters related to growth, maturity, and longevity. PIFSC scientists have been implementing an approach that uses size structure data to obtain an estimate of total and fishing mortality rates for coral reef fish stocks (Beverton & Holt 1956; Ehrhardt & Ault 1992). These rates, combined with population demographic parameters, are used in a numerical population model to obtain stock sustainability metrics (e.g., spawning potential ratio, F/FMSY; see Ault et al. 1998, 2008). Overfishing limits can be generated by using recent total catch estimates and/or population size estimates from diver surveys. Furthermore, a meta-analytical approach using stochastic simulations was developed at PIFSC to obtain demographic parameter estimates for species with even less data than data-poor species ("data-less" species). These scientific methods passed a rigorous independent review by a panel organized by the Center for Independent Experts in 2015, were recently (2017) applied to individual species in the main Hawaiian Islands, and now this general approach will be used to assess 20 species from the U.S. territory of Guam. Per WPSAR, there is a need to independently review these species-specific stock assessments prior to submission to a fishery management organization for consideration.

Section 301(a)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) requires that fishery conservation and management measures be based upon the best scientific information available. MSA § 302(g)(1)(E) provides that the Secretary of Commerce (Secretary) and each regional fishery management council "may establish a peer review process for that Council for scientific information used to advise the Council about the conservation and management of a fishery." Consistent with this provision, the Council, PIFSC, and the Pacific Islands Regional Office (PIRO) have established the WPSAR process in an effort to improve the quality, timeliness, objectivity, and integrity of stock assessments and other scientific information used in managing fishery resources in the Pacific Islands Region. CIE reviewers are being sought to participate in a peer review under this WPSAR framework: https://www.pifsc.noaa.gov/peer_reviews/wpsar/index.php. The specified format and contents of the individual peer review reports are found in **Annex 1**. The Terms of Reference (ToRs) of this peer review are listed in **Annex 2**. Lastly, the tentative agenda of the panel review meeting is attached in **Annex 3**.

Requirements

Two CIE reviewers are requested to serve as panel members (with a third, non-CIE reviewer serving as chair of the WPSAR panel) and conduct an impartial and independent peer review in accordance with the Statement of Work (SoW) and ToRs herein. CIE reviewers shall have working knowledge and recent experience in the application of data-poor stock assessment models (preferably length-based assessment models) and general fishery stock assessment methods. They will also have familiarity with requirements of fishery stock assessments under the MSA, and will have familiarity with reef fish fisheries.

Tasks for Reviewers

This Benchmark Review consists of an in-person panel of one review chair who is also a member of the Council's Scientific and Statistical Committee (SSC), plus two additional reviewers in accordance with the CIE conflict of interest policy. The panelists shall serve as independent and impartial scientific experts, and in their roles as reviewers they are not representing their respective institutions or affiliations. The panelists are expected to fulfill and comply with all elements specified in the ToRs. The panelists are expected to review all required provided documents in advance of the meeting, actively contribute during the meeting and review further provided documents as needed, offer solutions with constructive criticism, and conduct themselves respectfully and professionally.

Prior to the Peer Review: Review the following background materials and reports prior to the review meeting. Two weeks before the peer review, the NMFS Project Contact will send by electronic mail or make available at an FTP site to the CIE reviewers all necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE on where to send documents. The CIE reviewers shall read all documents in preparation for the peer review, for example:

Benchmark stock assessment for review (not to be distributed beyond reviewers):

Nadon, M. O. 2016. (draft) Stock assessment of the coral reef fishes of Guam, 2017. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-PIFSC-XX, ~200 p.

Relevant management information:

Western Pacific Regional Fishery Management Council. 2009. Fishery Ecosystem Plan of the Mariana Archipelago. Sections 4.4.2 and 5.6 only.

Western Pacific Regional Fishery Management Council. 2011. Omnibus Amendment for the Western Pacific Region to Establish a Process for Specifying Annual Catch Limits and Accountability Measures. Section 3.1 only.

References:

Hordyk, A.R., Ono, K., Prince, J.D., and Walters, C.J. (2016). A simple length-structured model based on life history ratios and incorporating size-dependent selectivity: application to spawning potential ratios for data-poor stocks. Can. J. Fish. Aquat. Sci. *73*, 1787–1799.

Kritzer, J.P., Davies, C.R., and Mapstone, B.D. (2001). Characterizing fish populations: effects of sample size and population structure on the precision of demographic parameter estimates. Can. J. Fish. Aquat. Sci. *58*, 1557–1568.

Nadon, M.O., and Ault, J.S. (2016). A stepwise stochastic simulation approach to estimate life history parameters for data-poor fisheries. Can. J. Fish. Aquat. Sci. *73*, 1874–1884.

Previous stock assessment:

Sabater, M, and Kleiber, P. 2013. Improving Specification of Acceptable Biological Catches of Data-Poor Reef Fish Stocks Using a Biomass-Augmented Catch-MSY Approach. Report of the Western Pacific Regional Fishery Management Council.

Supplemental Background Documents:

Hawaii assessment and independent peer review report:

Choat, JH, Franklin, EC, and Stokes, K. 2016. Benchmark review of the 2016 stock assessment of the main Hawaiian Islands reef-associated fish. Consensus panel report prepared by Erik C. Franklin.

Nadon, M.O. (2017). Stock assessment of the coral reef fishes of Hawaii, 2016. PIFSC Tech Memo 60. 200p.

References:

Nadon, M.O., Ault, J.S., Williams, I.D., Smith, S.G., and DiNardo, G.T. (2015). Length-based assessment of coral reef fish populations in the Main and Northwestern Hawaiian Islands. PLoS ONE *10*, e0133960.

Panel Review Meeting: Each CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs, and shall not serve in any other role unless specified herein. Each CIE reviewer shall actively participate in a professional and respectful manner as a member of the meeting review panel, and their peer review tasks shall be focused on the ToRs as specified herein. The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). The NMFS Project Contact is responsible for ensuring that the Chair understands the contractual role of the CIE reviewers as specified herein. The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements, including the meeting facility arrangements.

Independent CIE Peer Review Reports: Each CIE reviewer shall complete an independent peer review report in accordance with this SoW. Each CIE reviewer shall complete the independent peer review according to required format and content as described in **Annex 1**. Each CIE reviewer shall complete the independent peer review addressing each ToR as described in **Annex 2**.

Contribution to the Summary Report: Each CIE reviewer may assist the Chair of the panel review meeting with contributions to the Summary Report, based on the ToRs of this review. Each CIE reviewer is not required to reach a consensus, and should provide a brief summary of the reviewer's views on the summary of findings and conclusions reached by the review panel in accordance with the ToRs.

Foreign National Security Clearance

When reviewers participate during a panel review meeting at a government facility, the NMFS Project Contact is responsible for obtaining the Foreign National Security Clearance approval for reviewers who are non-US citizens. For this reason, the reviewers shall provide requested information (e.g., first and last name, contact information, gender, birth date, passport number, country of passport, travel dates, country of citizenship, country of current residence, and home country) to the NMFS Project Contact for the purpose of their security clearance, and this information shall be submitted at least 40 days before the peer review in accordance with the

NOAA Deemed Export Technology Control Program NAO 207-12 regulations available at the Deemed Exports NAO website: http://deemedexports.noaa.gov/ and http://deemedexports.noaa.gov/compliance_access_control_procedures/noaa-foreign-national-registration-system.html. The contractor is required to use all appropriate methods to safeguard Personally Identifiable Information (PII).

Place of Performance

The place of performance shall be at the contractor's facilities, and in Honolulu, HI.

Period of Performance

The period of performance shall be from the time of award through March 31, 2018. Each reviewer's duties shall not exceed 14 days to complete all required tasks.

Schedule of Milestones and Deliverables: CIE shall complete the tasks and deliverables described in this SoW in accordance with the following schedule.

Within two weeks of award	Contractor selects and confirms reviewers
Approximately 2 weeks later	The NMFS Project Contact in consultation with the CIE provides the pre-review documents to the reviewers
February 5-9, 2018	each reviewer participates and conducts an independent peer review during the panel review meeting
Within two weeks of panel review meeting	Contractor receives draft reports
Within two weeks of receiving draft reports	Contractor submits final reports to the Government

Applicable Performance Standards

The acceptance of the contract deliverables shall be based on three performance standards: (1) The reports shall be completed in accordance with the required formatting and content (2) The reports shall address each ToR as specified (3) The reports shall be delivered as specified in the schedule of milestones and deliverables.

Travel

All travel expenses shall be reimbursable in accordance with Federal Travel Regulations (http://www.gsa.gov/portal/content/104790). International travel is authorized for this contract. Travel is not to exceed $8,000.

Restricted or Limited Use of Data
The contractors may be required to sign and adhere to a non-disclosure agreement.

NMFS Project Contact:
Beth Lumsden
Beth.Lumsden@noaa.gov
FRMD/PIFSC/NMFS/NOAA
1845 Wasp Boulevard., Bldg. #176
Honolulu, Hawaii 96818
808.725.5330

Annex 1: Format and Contents of CIE Independent Peer Review Report

1. Each CIE independent report (and the consensus and individual reports of the Panel Chair) shall be prefaced with an Executive Summary providing a concise summary of the findings and recommendations.
2. The main body of each report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Summary of Findings for each ToR in which the weaknesses and strengths are described, and Conclusions and Recommendations in accordance with the ToRs.
    a. Reviewers should describe in their own words the review activities completed during the panel review meeting, including providing a brief summary of findings, of the science, conclusions, and recommendations.
    b. Reviewers should discuss their independent views on each ToR even if these were consistent with those of other panelists, and especially where there were divergent views. The exception is the Panel Chair's consensus report, which shall provide only consensus views or in cases where consensus cannot be reached, can provide majority views.
    c. Reviewers should elaborate on any points raised in the Summary Report that they feel might require further clarification.
    d. Reviewers shall provide a critique of the NMFS review process, including suggestions for improvements of both process and products.
    e. Each individual report shall be a stand-alone document for others to understand the weaknesses and strengths of the science reviewed, regardless of whether or not they read the consensus report. The CIE independent report shall be an independent peer review of each ToRs, and shall not simply repeat the contents of the consensus report.
3. The individual and consensus reports shall each include the following appendices:

Appendix 1: Bibliography of materials provided for review
Appendix 2: A copy of the CIE Statement of Work
Appendix 3: Panel Membership or other pertinent information from the panel review meeting.

Annex 2: Terms of Reference for the Peer Review

Western Pacific Stock Assessment Review
Benchmark Review of Guam Reef Fish Assessment
Conducted in part using CIE reviewers

For questions 1-2 and their subcomponents, reviewers shall provide a "yes" or "no" answer and will not provide an answer of "maybe". Only if necessary, caveats may be provided to these yes or no answers, but when provided they must be as specific as possible to provide direction and clarification. Examples for specific caveats include specific species names, life history types as defined by specific parameter values, and data or method decision points.

1. For each individual species, review the application of the general approach for each of the following calculations. For each calculation, consider decisions points, input parameters, assumptions, and primary sources of uncertainty.
    a. Fishing mortality (F), spawning potential ratio (SPR), and corresponding overfishing limit (F at SPR=30%, aka F_{30}).
    b. Generation of overfishing limit from C_{30} (catch levels corresponding to F_{30}) distribution calculation.
2. Determine whether the results for individual species from question 1 can be used for management purposes under the Magnuson-Stevens Act and relevant Fishery Ecosystem Plan (FEP) with no or minor further analyses or changes (considering that the data itself and the general approach have been accepted for stock assessment purposes). If results of this analysis should not be applied for management purposes with or without minor further analyses, indicate which alternative set of existing results should be used to inform setting fishery catch limits instead and describe why.
3. As needed, suggest recommendations for future improvements and research priorities. Indicate whether each recommendation should be addressed in the short/immediate term (2 months), mid-term (3-5 years), and long-term (5-10 years). Also indicate whether each recommendation is high priority (likely most affecting results and/or interpretation), mid priority, or low priority.
4. Draft a report (individual report from Chair and review members, and additional consensus report from Chair) addressing the above TOR questions.

Annex 3: Tentative Agenda

Tentative Agenda for Benchmark Review:
Assessment of Guam Coral Reef Fishes, 2017
Honolulu, HI 96813
February 5-9, 2018

Day 1 Monday February 5, 2018

1. Welcome and Introductions
2. Background information - Objectives and Terms of Reference
3. Fishery Operation and Management
4. History of stock assessments and reviews
5. Data
    a. Guam: Division of Aquatic and Wildlife Resources data collection
    b. Commercial Fisheries Biosampling Program
    c. Coral Reef Ecosystem Division surveys
    d. Biological data
    e. Other data
6. Presentation and review of stock assessment

Day 2 Tuesday February 6, 2018

7. Continue review of stock assessment

Day 3 Wednesday February 7, 2018

8. Continue review of stock assessment

Day 4 Thursday February 8, 2018

9. Continue review of stock assessment
10. Public comment period
11. Panel Discussions (Closed)

Day 5 Friday February 9, 2018

12. Panel Discussions (Closed)
13. Present Panel Recommendations (afternoon)
14. Adjourn

Appendix 3: Panel Membership or other pertinent information from the panel review Meeting

Panel Membership included:

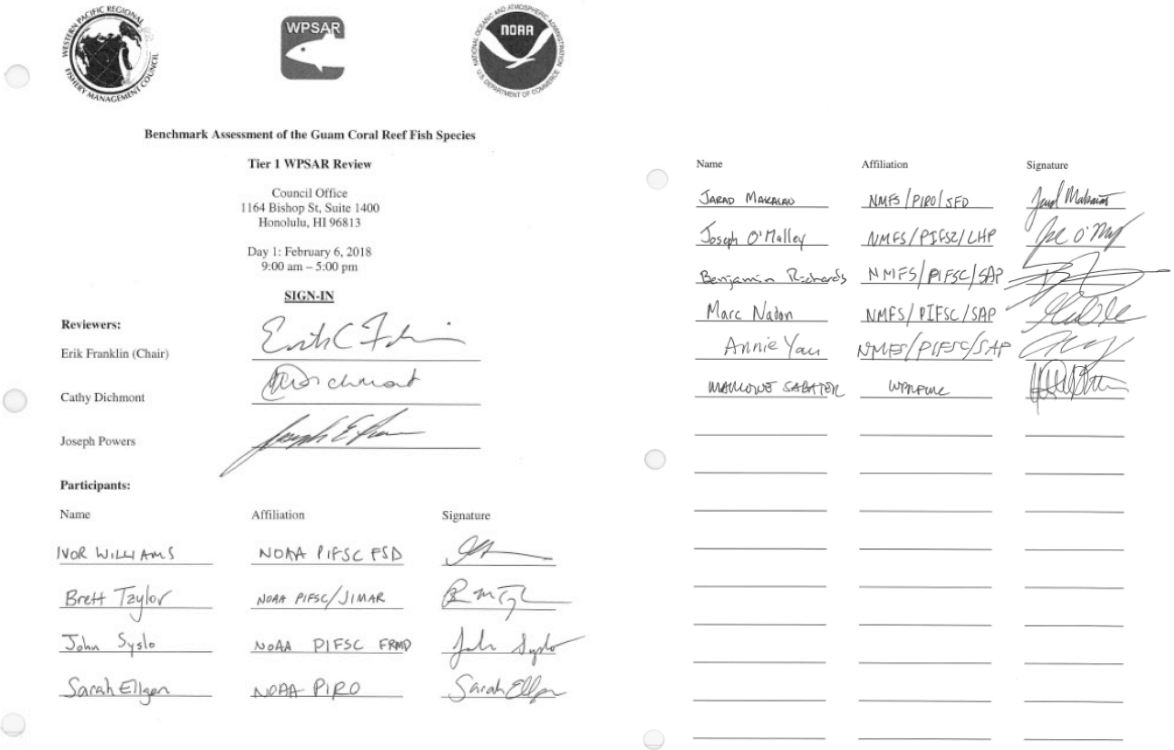
Erik Franklin	WPSAR Chair
Cathy Dichmont	CIE Reviewer
Joseph Powers	CIE Reviewer

Presentations were made according to the Day 1 Agenda provided at the opening of the meeting:

Welcome and Introductions (Benjamin Richards -PIFSC SAP)
Background Information – Objectives and Terms of Reference (Annie Yau – PIFSC SAP)
Fishery Operation and Management (Sarah Ellgen – PIRO)
History of stock assessments and reviews (Annie Yau – PIFSC SAP)
Data
- Guam: Division of Aquatic and Wildlife Resources data collection (Toby Mathews – PIFSC WPACFIN)
- Commercial Fisheries Biosampling Program (Toby Mathews – PIFSC WPACFIN)
- Coral Reef Ecosystem Division surveys (Ivor Williams – PIFSC ESD)
- Biological data (Brett Taylor – PIFSC LHP)

Presentations and review of stock assessment (Marc Nadon – PIFSC SAP)

Attendee sign-in sheets for the meeting was provided to the reviewers and is as follows:



Benchmark Assessment of the Guam Coral Reef Fish Species

Tier 1 WPSAR Review

Council Office
1164 Bishop St, Suite 1400
Honolulu, HI 96813

Day 1: February 6, 2018
9:00 am – 5:00 pm

SIGN-IN

Reviewers:

Erik Franklin (Chair)	Erik C Franklin
Cathy Dichmont	Cathy Dichmont
Joseph Powers	Joseph E Powers

Participants:

Name	Affiliation	Signature
IVOR WILLIAMS	NOAA PIFSC FSD	
Brett Taylor	NOAA PIFSC/JIMAR	
John Syslo	NOAA PIFSC FRMD	
Sarah Ellgen	NOAA PIRO	Sarah Ellgen

Name	Affiliation	Signature
Jarad Makaiau	NMFS/PIRO/SFD	
Joseph O'Malley	NMFS/PIFSC/LHP	
Benjamin Richards	NMFS/PIFSC/SAP	
Marc Nadon	NMFS/PIFSC/SAP	
Annie Yau	NMFS/PIFSC/SAP	
MATTHEW SABATON	WPACFIN	

Benchmark Assessment of the Guam Coral Reef Fish Species

Tier 1 WPSAR Review

Council Office
1164 Bishop St, Suite 1400
Honolulu, HI 96813

Day 2: February 7, 2018
9:00 am – 5:00 pm

SIGN-IN

Reviewers:

Erik Franklin (Chair)	
Cathy Dichmont	
Joseph Powers	

Participants:

Name	Affiliation	Signature
John Syslo	NOAA/PIFSC/FRMD	
Sarah Ellgen	NOAA/PIRO/SFD	
Ben Richards	NOAA/PIFSC/SAP	
Annie Yau	NOAA-PIFSC	

Name	Affiliation	Signature

Benchmark Assessment of the Guam Coral Reef Fish Species

Tier 1 WPSAR Review

Council Office
1164 Bishop St, Suite 1400
Honolulu, HI 96813

Day 3: February 8, 2018
9:00 am – 5:00 pm

SIGN-IN

Reviewers:

Erik Franklin (Chair)	
Cathy Dichmont	
Joseph Powers	

Participants:

Name	Affiliation	Signature
John Syslo	NOAA/PIFSC/FRMD	
Benjamin Richards	NOAA/PIFSC/SAP	
Annie Yau	PIFSC	
Marc Nadon	PIFSC/SAP	

Name	Affiliation	Signature

Benchmark Assessment of the Guam Coral Reef Fish Species

Tier 1 WPSAR Review

Council Office
1164 Bishop St, Suite 1400
Honolulu, HI 96813

Day 4: February 9, 2018
9:00 am – 5:00 pm

SIGN-IN

Reviewers:

Erik Franklin (Chair)	
Cathy Dichmont	
Joseph Powers	

Participants:

Name	Affiliation	Signature
Marc Nadon	PIFSC - SAP	
Annie Yau	PIFSC	
Benjamin Richards	NOAA/PIFSC/SAP	

Name	Affiliation	Signature
John Syslo	NOAA/PIFSC/SAP	
Chris Boggs	NOAA/PIFSC/FRMD	