WESTERN PACIFIC STOCK ASSESSMENT REVIEW

Benchmark Review of the Stock Assessment of the Coral Reef Fishes of Guam, 2017

Consensus Panel Report

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PANEL SUMMARY

This document provides a consensus report of the Western Pacific Stock Assessment Review (WPSAR) of the "Stock Assessment of the Coral Reef Fishes of Guam, 2017". This WPSAR addresses a set of four (4) Terms of Reference (TOR) for benchmark stock assessments of 19 species of reef-associated fishes in the Guam, following guidelines established in the WPSAR framework. The panel consisted of two reviewers from the Center for Independent Experts (CIE): Dr. Cathy Dichmont and Dr. Joseph Powers, and a member of the Western Pacific Fisheries Management Council (WPRFMC) Science and Statistical Committee (SSC) who served as the chair of the review panel: Dr. Erik Franklin. The review was held February 6, 2018 through February 9, 2018 in the Western Pacific Regional Fishery Management Council Office, Suite 1401, Finance Factors Building, 1164 Bishop Street, Honolulu, Hawaii 96813. Brief descriptions of the TORs are: (1) TOR 1 is the review of the general approach to determine fishing mortalities, spawning potential ratios, and overfishing catch limits for each of the 19 species; (2) TOR 2 is the appropriateness of the results for management purposes; (3) TOR 3 provides recommendations for improvements and future research, and (4) TOR 4 is a report describing TORs 1-3 (i.e., this document). The content of this report addresses the consensus of responses from the three WPSAR panelists for the first three TORs applied to an examination of the length-based stock assessments of 19 coral reef fish species in Guam.

The Guam coral reef fish stock assessments incorporated population abundance estimates and length composition data from fishery-dependent catch statistics and fishery-independent diver surveys with life history parameters for longevity, growth, survivorship, and maturity. A stochastic simulation approach (called the "step-wise approach") was used to obtain demographic and life history parameters for species with no species-specific data available. The foundation of the assessment approach was the use of the growth-type-group length-based spawning potential ratio approach (GTG-LBSPR) to estimate fishing mortality rates and stock status metrics for each species. The method fits to the entire size structure of the data and estimates selectivity parameters and allows control for differences in fishing mortality rates within the same-age class. This approach, incorporating mortality estimates and demographic parameters, was used to generate probability distributions for metrics on stock status including spawning potential ratio (SPR), fishing mortality, fishing mortality at an SPR of 30% (F_{30}), and length at capture at an SPR of 30% (Lc_{30}). Probability distributions for Catch30 or C_{30} (i.e., catch for SPR of 30%) were determined from the population abundance estimates (using catch estimates or diver surveys) and the estimated F_{30} distribution. During the review, presentations were given on fishery operations, fishery-dependent and fishery-independent data, and the stock assessments. Detailed documents were provided describing each of these topics in advance of the review and other information or updated analyses were provided during the review to the panel by the assessment author and WPSAR coordinator. The panel appreciated the professionally prepared presentations and timely delivery of the requests for additional analyses and background documents.

The panel discussed and evaluated each stock assessment and the supporting materials relative to the terms of reference. Two issues were identified with the application of the terms of reference by the panel: (1) the lack of sufficient peer-review of the fishery-dependent and fishery-independent data used for the assessments, and (2) the request to suggest an existing alternative

assessment approach for species when the current assessment was not appropriate for management use when insufficient information was provided to evaluate the alternatives.

Following the in-person review panel, each panel member then wrote a detailed individual review of the assessments in the context of the terms of reference. The panel reached consensus for each species on all terms of reference expect for *Lutjanus gibbus*, which was a majority for TOR 1(b) and 2.

TOR 1(a), 1(b), 2: Application of assessment approach to calculate overfishing and catch limits for management use.

A number of assumptions were identified with the methods that may present concerns relative to TOR 1. First, the assessments assume that each species was represented by a single stock around Guam and did not include potential segments of the stock that may reside at offshore banks (or other islands of the Mariana Archipelago). Second, the diver surveys and creel surveys are assumed to represent a random sample of the biomass or catch for each species but there were concerns that neither program has been sufficiently monitored or sampled in a systematic way through time which would influence the accuracy of the inter-annual expansion of these data to determine total catch and biomass. Third, the assessment methods assume a condition of stable equilibrium which implies a stability in recruitment, catch, and fishing but the evidence to support this assumption was weak for multiple species and that considerable "judgement" was needed to determine if equilibrium conditions were sufficient to allow acceptance of assessment outputs. Furthermore, the equilibrium assumption required that if a stock was experiencing overfishing, then it would also be overfished, which may not be an acceptable constraint for management purposes. Despite these caveats regarding the methodological assumptions, the panel found the methods to be generally sound and the assumptions well documented. The challenge of this data limited method lies in the fact that species-by-species determinations are necessary to assess how far the available data may stretch to meet the assumptions of the approach. The species-specific responses to the terms of reference 1 and 2 follow.

Naso unicornis. All members of the review panel answered "yes with caveats" to the method for determining overfishing status with F30 (TOR 1(a) and 2) and "no" to the assessment for setting catch limits with C30 (TOR 1(b) and 2) for *Naso unicornis* in Guam. To address the caveats, use the Guam longevity value for the base case. Potential existing alternatives for setting catch limits would by catch-MSY or percentile of catch trend.

Carangoides orthogrammus. All members of the review panel answered "yes" to the method for determining overfishing status with F30 (TOR 1(a) and 2) and "no" to the assessment for setting catch limits with C30 (TOR 1(b) and 2) for *Carangoides orthogrammus* in Guam. Potential existing alternatives for setting catch limits would by catch-MSY or percentile of catch trend.

Caranx melampygus. All members of the review panel answered "yes with caveats" to the method for determining overfishing status with F30 (TOR 1(a) and 2) and "no" to the assessment for setting catch limits with C30 (TOR 1(b) and 2) for *Caranx melampygus* in Guam. To address the caveats, use the stepwise approach for life history for the base case. Potential existing alternatives for setting catch limits would by catch-MSY or percentile of catch trend.

Elagatis bipinnulata All members of the review panel answered "no" to the method for determining overfishing status with F30 (TOR 1(a) and 2) and "no" to the assessment for setting catch limits with C30 (TOR 1(b) and 2) for *Elagatis bipinnulata* in Guam. Potential existing alternatives for setting catch limits would by catch-MSY or percentile of catch trend.

***Myripristis berndti*.** All members of the review panel answered "no" to the method for determining overfishing status with F30 (TOR 1(a) and 2) and "no" to the assessment for setting catch limits with C30 (TOR 1(b) and 2) for *Myripristis berndti* in Guam. Potential existing alternatives for setting catch limits would by catch-MSY or percentile of catch trend.

***Lethrinus erythacanthus*.** All members of the review panel answered "no" to the method for determining overfishing status with F30 (TOR 1(a) and 2) and "no" to the assessment for setting catch limits with C30 (TOR 1(b) and 2) for *Lethrinus erythacanthus* in Guam. Potential existing alternatives for setting catch limits would by catch-MSY or percentile of catch trend.

***Lethrinus olivaceus*.** All members of the review panel answered "yes with caveats" to the method for determining overfishing status with F30 (TOR 1(a) and 2) and "no" to the assessment for setting catch limits with C30 (TOR 1(b) and 2) for *Lethrinus olivaceus* in Guam. To address the caveats, use the expanded 2006-2017 data for the base case. Potential existing alternatives for setting catch limits would by catch-MSY or percentile of catch trend.

***Lethrinus xanthochilus*.** All members of the review panel answered "yes with caveats" to the method for determining overfishing status with F30 (TOR 1(a) and 2) and "no" to the assessment for setting catch limits with C30 (TOR 1(b) and 2) for *Lethrinus xanthochilus* in Guam. To address the caveats, use the expanded 2006-2017 data for the base case. Potential existing alternatives for setting catch limits would by catch-MSY or percentile of catch trend.

Monotaxis grandoculis. All members of the review panel answered "yes" to the method for determining overfishing status with F30 (TOR 1(a) and 2) and "yes" to the assessment for setting catch limits with C30 using survey derived biomass (TOR 1(b) and 2) for *Monotaxis grandoculis* in Guam.

***Aphareus furca*.** All members of the review panel answered "no" to the method for determining overfishing status with F30 (TOR 1(a) and 2) and "no" to the assessment for setting catch limits with C30 (TOR 1(b) and 2) for *Aphareus furca* in Guam. Potential existing alternatives for setting catch limits would by catch-MSY or percentile of catch trend.

***Lutjanus fulvus*.** All members of the review panel answered "yes" to the method for determining overfishing status with F30 (TOR 1(a) and 2) and "yes" to the assessment for setting catch limits with C30 using survey derived biomass (TOR 1(b) and 2) for *Lutjanus fulvus* in Guam.

***Lutjanus gibbus*.** All members of the review panel answered "yes" to the method for determining overfishing status with F30 (TOR 1(a) and 2) and the majority of the panel answered "yes" to the assessment for setting catch limits with C30 using survey derived biomass (TOR 1(b) and 2) for *Lutajnus gibbus* in Guam.

***Chlorurus microrhinos*.** All members of the review panel answered "yes with caveats" to the method for determining overfishing status with F30 (TOR 1(a) and 2) and "yes" to the assessment for setting catch limits with C30 using survey derived biomass (TOR 1(b) and 2) for *Chlorurus microrhinos* in Guam. To address the caveats, use the Guam longevity for the base case.

***Hipposcarus longiceps*.** All members of the review panel answered "yes" to the method for determining overfishing status with F30 (TOR 1(a) and 2) and "yes" to the assessment for setting catch limits with C30 using survey derived biomass (TOR 1(b) and 2) for *Hipposcarus longiceps* in Guam.

***Scarus altipinnis*.** All members of the review panel answered "yes" to the method for determining overfishing status with F30 (TOR 1(a) and 2) and "no" to the assessment for setting catch limits with C30 (TOR 1(b) and 2) for *Scarus altipinnis* in Guam. Potential existing alternatives for setting catch limits would by catch-MSY or percentile of catch trend.

Scarus forsteni. All members of the review panel answered "no with caveats" to the method for determining overfishing status with F30 (TOR 1(a) and 2) and "no with caveats" to the assessment for setting catch limits with C30 (TOR 1(b) and 2) for *Scarus forstenii* in Guam. To address the caveats, update the life history with local values from the NOAA PIFSC biosampling program. Potential existing alternatives for setting catch limits would by catch-MSY or percentile of catch trend.

***Scarus rubroviolaceus*.** All members of the review panel answered "yes" to the method for determining overfishing status with F30 (TOR 1(a) and 2) and "no" to the assessment for setting catch limits with C30 (TOR 1(b) and 2) for *Scarus rubroviolaceus* in Guam. Potential existing alternatives for setting catch limits would by catch-MSY or percentile of catch trend.

***Scarus schlegeli*.** All members of the review panel answered "no with caveats" to the method for determining overfishing status with F30 (TOR 1(a) and 2) and "no with caveats" to the assessment for setting catch limits with C30 (TOR 1(b) and 2) for *Scarus schlegeli* in Guam. To address the caveats, update the life history with local values form the NOAA PIFSC biosampling program. Potential existing alternatives for setting catch limits would by catch-MSY or percentile of catch trend.

***Variola albimarginata*.** All members of the review panel answered "no" to the method for determining overfishing status with F30 (TOR 1(a) and 2) and "no" to the assessment for setting catch limits with C30 (TOR 1(b) and 2) for *Variola albimarginata* in Guam. Potential existing alternatives for setting catch limits would by catch-MSY or percentile of catch trend.

Table 1. Summary of findings for TORs 1 and 2 for each of 19 reef fish species assessments in Guam. The findings reflect if the assessment can be used to determine overfishing status (i.e., F/F_{30}) and set catch limits (i.e., C_{30}). The responses to TOR 1(a), 1(b), and 2 are "YES", "NO", "YES+", or "NO+". The "+" in a response means that the assessment has caveats that need to be addressed in order to achieve that response. Bolded entries in shaded rows are assessments accepted for both TOR 1 and 2.

	Species	**Can be used for determining overfishing status?**	**Can be used for setting catch limits?**
1	*Naso unicornis*	YES	NO
2	*Carangoides orthogrammus*	YES	NO
3	*Caranx melampygus*	YES+	NO
4	*Elagatis bipinnulata*	NO	NO
5	*Myripristis berndti*	NO	NO
6	*Lethrinus erythacanthus*	NO	NO
7	*Lethrinus olivaceus*	YES+	NO
8	*Lethrinus xanthochilus*	YES+	NO
10	*Aphareus furca*	NO	NO
15	*Scarus altipinnis*	YES	NO
16	*Scarus forsteni*	NO+	NO+
17	*Scarus rubroviolaceus*	YES	NO
18	*Scarus schlegeli*	NO+	NO+
19	*Variola albimarginata*	NO	NO

TOR 3: Recommendations

Short/immediate term:

- For *Naso unicornis*, change the Base Case (BC) to use Guam longevity
- For *Caranx melampygus*, change the BC to use the stepwise approach
- For *Lethrinus erythacanthus*, change the BC to use the 2006-2017 data
- For *L. olivaceus*, change the BC to use the 2006-2017 data
- For *L. xanthochilus*, change BC to use the 2006-2017 data
- For *C. microrhinus*, change BC to use Guam longevity
- Update life history parameters with local Guam data for *Scarus forsteni* and *S. schlegeli*, better information may allow use of GTG-LBSPR assessment method for determining overfishing status and setting catch limits using survey biomass data.
- To set catch limits for species with assessments that were not deemed adequate using the proposed method, the use of a CatchMSY approach or catch trend percentile is suggested. Application of these methods does not necessarilty need to be for individual species but could be species groupings, especially for species with similar life history traits.
- Update with available "local" life history information from the NOAA biosampling program any assessment for fish species that use "non-local" studies or the stepwise

approach.
- Examine and correct the error in the Lc30 distributions (i.e., bi-modal peaks)
- Include all software scripts/code used for the analyses as an appendix in the assessment

Medium-term:

- Improve the quality of the biomass estimates from diver surveys through review of the survey sampling design and performance to improve population estimates from past data and inform future surveys. (high)
- Improve the quality of the catch and effort data from creel surveys following improvements suggested in Bak (2012) and by the panel with a focus on improving information from the spearfishing sector of the fishery. (high)
- Collect data to generate "local" life history information for fish species that use "non-local" studies or the stepwise approach for Guam. (high)
- In general, for the data-limited coral reef fish stocks, perform a peer-review of the data used in the assessments that generates data report that describes in detail the catch surveys and fisheries-independent diver survey sampling design, performance statistics, and population estimates (e.g., density, biomass, length composition). This report should include an exploration of *a posteriori* post-stratification attempts made to improve survey performances to minimize strata variance for survey statistics. (high)
- Increase detail in the description of the methods used for this stock assessment approach. In particular, clarify the decision points for input parameters, sensitivity tests, and size distribution data, in text descriptions and diagrams (as needed) to assist the reader in understanding how and why certain steps are selected.
- Increase the sample size of length composition data for species assessed with the length-based approach. Five of the species assessed had sample sizes of less than 100 individuals which is inadequate for these methods. A low sample size introduces a strong possibility of departures from the true population structure especially when samples are collected over multiple years.
- Formally explore the use of a CatchMSY approach for Guam species groupings in instances when the length-based methods are inappropriate. The species groupings should share similar life history traits and not be aggregated solely based on taxonomic classifications (e.g., not all parrotfish species at a Family level would be grouped).
- Perform a management strategy evaluation (MSE) for Guam reef fish stocks to compare a variety of assessment methods to determine a best set of options to achieve management objectives. The WPSAR panel was requested to provide alternatives methods when those utilized in the assessment were found inadequate for determining overfishing status of and setting catch limits for a species. This process is rather ad hoc as the reviewers were presented with very limited information to fully consider the merits of other alternatives. An MSE could provide the necessary framework to better accomplish the request to compare among alternative assessment methods.
- Explore methods to improve survey biomass estimates for fisheries-independent data for additional segments of the population (i.e., the offshore banks) and depth ranges beyond diver depths using advanced technologies such as U/W cameras

Long-term:

- Collect data to generate “local” life history information for fish species that use “non-local” studies or the stepwise approach for Guam.
  - With improved catch and effort data over time (see Medium-term recommendation), the evaluation of stocks using alternative methods such as surplus production approaches may be feasible.