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Western Pacific Stock Assessment Review of the 2017 Benchmark stock Assessment for the Main Hawaiian Island Deep7 Bottomfish Complex

Summary

A benchmark assessment for the Main Hawaiian Island (MHI) Deep7 bottomfish complex was prepared for the Western Pacific Stock Assessment Review (WPSAR) process, which was conducted November 13-17, 2017 in Honolulu HI. The review panel consisted of two reviewers contracted through the Center for Independent Experts (CIE): Dr. Cathy Dichmont (Australia), Dr. Henrik Sparholt (Denmark), and a member of the Western Pacific Fisheries Management Council (WPFMC) Science and Statistical Committee (SSC) who also served as the chair of the review panel: Dr. Steven Martell. The primary documents under review documents data filtering, a new fisheries independent survey and the assessment of stock status for the deep 7 complex including opakapaka (hearafter, Deep7) and one assessment for opakapaka only. These documents were prepared by PIFSC staff (Yau et al. 2017; Langseth et. al., 2017).

Five major activities were conducted to complete this benchmark assessment: 1) data filtering, 2) CPUE standardization, 3) development of a fisheries independent survey index, 4) fitting a biomass production model to these data, and 5) undertaking stock and catch projections. Presentations and detailed documents were provided on each of these activities well in advance of the review.

All members of the review panel greatly appreciate the tremendous amount of effort by staff in preparing excellent documentation that is very well written, as well as clear and concise presentations that entirely complemented the written documentation. The panel also thanks all staff and members of the public for detailed discussions to bring this review panel up to speed on the nature of fisheries operations, data filtering, and describing the complete process of setting catch limits in the Deep7 bottomfish fishery. The panel appreciated the input from industry both as part of the data filtering and assessment process, and during the review workshop.

The panel discussed the assessment materials in the context of the terms of reference provided for this review. The following paragraphs summarizes the panels' views on each of the terms of reference. The panel were in agreement on all terms of references.

TOR 1: Data filtering methods.

All members of the review panel answered "yes". The review panel agreed that the new approach to filling the DAR-FRS data to develop a catch series and a fisheries-dependent CPUE index was an overall improvement on the previous methods used to filter the data in past assessments. The primary challenge with these data is developing a time series of fishing effort that is representative of targeting the Deep7 bottomfish complex. The vast majority of the modern records are based on single-day fishing events; however, historically the composition of the fishing vessels were mostly wooden sanpan's that conducted multiday-trips. Previously methods for identifying multi-day trips were based on reported catch (catches > 1500 lbs were assumed to come from multi-day trips). The new approach is independent of catch and is based on areas fished and distance from the port of landing, where trips greater than 30 NM were assumed to come from a multi-day trips.

TOR 2: CPUE standardization.

All members of the review panel answered "yes". The panel did discuss a number of issues related to technology creep that is likely not captured in the present standardization and the potential bias that may exist in cases where zero catch rates may be under-represented in the database because there is no requirement to report a zero catch to the state.

TOR 3: Assessment models: reliability, application and appropriateness.

All members of the review panel answered "yes". There was considerable discussion, however, regarding a structural limitation of the parameterization of the biomass production model being used in this assessment. Given the parameterization implemented, there is a lower bound for the Bmsy/K ratio at 0.3678 (or $1/e$) as the shape parameter (M) approaches zero. Results from meta-analytic studies suggest the mean Bmsy/K ratio for Perciformes is 0.353 (sd = 0.144, Thorson et. al. 2012).

TOR 4: Model specification and configuration.

All panel members agreed that the base model presented is **not** appropriately specified with respect to how the fisheries independent survey data was implemented in the model. The base case model presented an absolute abundance estimate from the survey along with an estimate of error. Under this implementation the answer to TOR 4 is "no".

However, the panel is recommending a new base model that implements a proper prior distribution for an additional scaling parameter for the 2016 fisheries-independent survey. If this new observation model formulation is adopted as the base case for decision making, then all panel members were in agreement that "yes", the model specification and configuration is appropriate.

The panel did not discuss in detail if it was possible to reliably estimate deviations in the commercial catchability coefficient (q) using a random walk model. Given only CPUE data, and no other fisheries-dependent or independent information, it is not likely that estimates of changes in catchability are reliably estimated. The model with random walk in q was not considered for use as a base model.

TOR 5: Input parameters and decision points.

All panel members agreed that the input parameters and prior pdfs are reasonable and the answer to this terms of reference is "yes". There is some concern about what is termed the "empirical Bayes" approach is circular. Philosophically, the same data are being used twice to develop the prior distribution and posterior distribution for the P1 parameter. This was demonstrated by changes in the RMSE profile for the P1 parameter under an alternative prior to r.

TOR 6: Assumptions.

All panel members answered "yes" and felt that the assumptions were "reasonably" satisfied. There are a number of critical assumptions that were briefly discussed by the review panel, namely the possibility that the fisheries CPUE may not be proportional to the biomass and some suggested further work were discussed. The panel felt that with the continued addition of annual fisheries-independent survey information that overlaps with CPUE data would assist in addressing potential violations in this assumption. The use of the survey as an (absolute) index of abundance with a point prior on catchability (through the radius of the bottom camera view) was not supported, but the proposed new base case formulation was supported.

TOR 7: Primary sources of uncertainty and documentation.

All panel members answered "yes". The only source of uncertainty that was not carried through in the assessment model was the conversion of standardized fishing CPUE into the same units used by the bottom camera. The panel noted that this relationship can change from year-to-year and location-to-location (via changes in fishing q, or the radius of the camera view). Continued paired sampling will have to occur in the future to ensure the relationship between the two sampling gears is quantified each year.

TOR 8: Results: estimation of stock-status and provision of scientific advice to management:

All panel members answered "no" to the base case model initially developed for the review. The panel felt that the absolute abundance estimates from the fisheries independent-survey did not incorporate uncertainty in the radius of the camera view.

All panel members answered "yes" to the recommended base model where a proper prior for re-scaling the absolute abundance estimate is used. This modification does not change the stock status. Moreover, future stock updates will be better informed with the accumulation of fisheries-independent survey data, and these data can also better address some of the assumptions in the fisheries-dependent data.

TOR 9: Stock projections and meeting management goals.

All panel members answered "yes". The panel did feel that the omission of process errors in the stock projections under-estimates uncertainty. To our understanding, this is an issue with the software used to conduct the Bayesian analysis, and that other, more modern, software tools can address these limitations.

TOR 10: Caveats. Which, if any, model results should not be applied. Alternatives?

All members of the review panel are recommending that the results from the base model presented not be applied for management. Uncertainty in the affective area searched by the fisheries-independent sampling gears (i.e., the scaling values (q) of the survey gears) was not well characterized.

The panel is recommending an alternative base model that was developed during the course of the present WPSAR review. This alternative base model is the same as the original base model, with the addition of a scaling parameter for the fishery-independent survey and an informative prior for the effective area searched.

The assessment model is data moderate with important uncertainties, mostly through the large unreported catch, the sensitivity to the how the survey index is treated and model fit statistics. The lack of process errors in the projection model runs and the lack of carrying through to the assessment the uncertainty in the conversion of standardized fishing CPUE into the same units used by the bottom camera, mean a small bias in the 50% risk to exceed the Hmsy in the projections. **For this reason, the panel recommends that an additional 10% buffer be taken into consideration in the ACL setting process to hedge against this potential bias.**

TOR 11: Recommendations

The panel supports the research recommendations outlined in the fisheries independent survey document. Specifically, continued work on increasing the view area in the camera surveys and re-evaluate the maxN method of estimation. In addition, the panel also discussed a number of other research recommendations outlined in bullet points below. These recommendations largely follow the order of the terms of reference

and we have organized these recommendations into short-term (the next 2 months), medium-term (1-5 years) and long-term (5+ years).

Short-term recommendations:

- Adopt the new-base case model using the proper prior for the fisheries-independent survey scaling parameter.
- Repeat RMSE profile for the initial biomass parameter (P1).
- Repeat the sensitivity tests in the document using the new base-case model.
- Redo the base model for opakapaka using the same approach as the Deep7 complex, where the fisheries independent survey is re-scaled.

Medium-term recommendations:

- Continue to implement the Fisheries Independent survey on an annual basis, ensuring there are a number of paired sampling blocks where both survey gears are deployed to monitor changes in gear conversion factor used to scale the two survey gears.
- Continue with field work and R&D for the bottom camera work. This work will be instrumental for monitoring BRFAs.
- Join vessel size database with FRS data with the objective of being able to assign each record to a vessel class (length on water, or horse power) and thus have a better basis for e.g. filtering single-day vs multi-day trips.
- Explore alternative classification models (e.g. regression trees, PCA, GAMs) for identifying trips targeting opakapaka.
- Increase effort to better estimate un-reported catches in future years. Uncertainty in the unreported catch is probably the single most important missing piece of data that informs overall population scale.
- Examine the residual patterns in the commercial CPUE and determine if these residuals are sensible, or is there still concern that multiday trips are not being filtered out correctly and further biasing the CPUE index.
- Continue with the life-history work (growth, maturity) for the remaining species in the Deep7 complex.

- Have a closer look at the year-area interactions in the CPUE data (e.g., contraction and expansion of the fishery, displacement of effort due to BRFAs), or other possible covariates (e.g., decadal scale environmental variables, currents).
- Continue with the CPUE standardization efforts in light of any new information.
- The panel discussed creating another data set where the CPUE series is continuous from 1949-2016. In this case, use the catch per day (by ignoring the hours fished) for the post 2002 data, such that there is only one overall q for fisheries-dependent CPUE data.
- Explore alternative parameterization of the surplus production model that allow the Bmsy/k ratio to fall below values of 0.378.
- Explore alternative models that make use of mean weight data (e.g., delay-difference model), especially for the opakapaka assessment given the recent life-history information.
- Explore a history of the gear changes over time and how the advent of modern reels, increased vessel speed, and loss of institutional memory has affected fishing power over time. For example, what proportion of the fishers land 90% of the total reported catch, and has this proportion decreased over time?
- Continue to address the life-history differences in the Deep7 that could result in changes in the prior distribution for r in this stock complex.
- Explore alternative software tools for conducting this stock assessment. Our recommendation is not restricted to Bayesian methods only.

Long-term recommendations:

Several of the medium-term recommendations will likely take longer than 5 years or are expected to be ongoing long-term, as long as this assessment is conducted.