REVIEW OF STOCK ASSESSMENT UPDATE FOR THE MAIN HAWAIIAN ISLANDS DEEP 7 BOTTOMFISH COMPLEX IN 2021, WITH CATCH PROJECTIONS THROUGH 2025

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SUMMARY

Un update to the benchmark assessment for the Main Hawaiian Island Deep 7 bottomfish complex, with 3 years of additional data, was submitted for a WPSAR review. The same Bayesian Surplus Production Model was fit to standardized CPUE data for the deep 7 BMUS complex and to single species data for opakapaka. Results of both assessments indicate that the deep 7 complex is not overfished and overfishing is not occurring.

Electronic access to all of the necessary documentation, historical assessment, was provided well in advance of the review. I found this year's assessment to be accurate and very well written. All data and model code were provided, and this assessment can easily be precisely repeated by an independent author. I find this to be of the highest standard. The assessment contained a very thorough investigation into the sensitivity of all key model parameters, priors, and the input catch data. I requested no additional simulations, as I felt the presentation of the data and results fully addressed potentially confounding results that would impact management. In short, the Catch and CPUE data appear to be very informative about estimates of MSY; uncertainty in MSY scales proportionally with uncertainty in unreported catch.

The primary axes of uncertainty in this assessment is the absolute estimates of total catch and the lack of contrasting information in the relative abundance indices. There have been a number of historical workshops, research projects, and investigations that have examined the reported catch issue. The use of a bounded uniform prior for the catch proportions is an appropriate method for propagating this uncertainty into the catch decision making process.

The only minor change to the model code and likelihood functions was the inclusion of the recommendations from the previous review panel. These recommendations were implemented prior to the 2018 assessment being submitted. The minor change involved a more appropriate structural change to the assessment, where the uncertainty in the effective area swept by the BFISH was properly included in the joint posterior distribution. After reflecting on this model change 3 years later, I'm still satisfied that this is a more objective method for combining information from both data sources and makes less of an assumption that the BFISH survey is an absolute abundance estimate.

In summary, I find this assessment to be the best scientific information available on the status and abundance of the deep 7 Hawaiian bottomfish stock complex and the status of the opakapaka stock.

RESPONSE TO QUESTION IN THE TOR

1. Is uncertainty with respect to input data quality and filtering methods well documented, including its potential effect on results?

Yes, the uncertainty with respect to the input data quality, and methods used to filter the data are well documented. The primary axis of uncertainty in this assessment is the global scale stemming from the uncertainty in unreported catch. A sensitivity analysis based on 4 different catch scenarios clearly demonstrates that increasing the unreported catch results in increasing the biomass almost proportionally. There is some influence of the new fishery-independent BFISH survey providing an additional source of global scaling.

Key to this assessment is the data filtering process where over 5 million records are reduced to 214,846, spanning a period of 1949-2018. This equates to an average of approximately 15,000 observations per year. Through a series of workshops conducted with stakeholders, these data have been thoroughly vetted and the logic in filtering the data makes sense. The basic data filtering algorithm is based on: selecting trips targeting bottom fish based on gear, removing multiday trips, selecting trips that accurately reflect fisheries trends based on fisher experience, and including only records with additional variables (e.g., experience, pounds of uku), including environmental variables on wind speed to each record. I commend the authors for integrating the output of a public workshop to improve the overall utility of these data for use in assessment.

2. Is the CPUE standardization properly applied and appropriate for this species, fishery, and available data?

Yes, CPUE standardization is performed using Generalized Linear Mixed Effects models. There are a number of categorical and continuous variables that are known to affect the catchability of the deep-7 bottomfish complex: vessel size, distance travelled, wind & weather, season and experience to name a few. Where possible these covariates were joined onto the raw catch effort data to be included as covariates in a GLM. There were a few convergence problems for models on the older data sets that included time:area interactions as a result of insufficient data during protracted period of time.

The BFISH survey is a 2-gear survey that attempts to measure absolute abundance based on the density of fish in an effective area searched using a underwater camera system. The effective area searched is a key scaling parameter that is proportional to survey estimate of absolute abundance.

3. Are the assessment model and methodology the same as those used in the 2018 benchmark stock assessment?

Yes, the same process model was used for this stock assessment as that was used in the 2018 benchmark. The only substantial modification was the result of the review of the 2018 assessment, where the review process recommended using an informative prior distribution for the effective area searched by the MOUSS camera stations.

Both the bottomfish complex and the single species opakapaka assessment were based on a Bayesian Surplus production model. Uncertainty in model outputs is quantified by integrating over the uncertainty in prior distributions and the likelihood of the data conditional on model structure. The joint posterior distribution is integrated over all model parameters, including variance terms for observation and process errors; no parameters were fixed. In addition, uncertainty in biomass and harvest rate estimates were inflated based on the assumed uncertainty in the reported catch ratios. Sensitivity analyses explored almost all of the model dimensions and was found to be logically consistent and the uncertainty in policy advice is well characterized.

4. Are primary sources of uncertainty documented and presented?

Yes, the primary sources of uncertainty are well documented, presented, and discussed in the assessment document. The largest source of uncertainty is the fraction of the total catch that is unreported. The assessment model integrates over a range of possible unreported catch rates. This effectively inflates uncertainty in proportion to the uncertainty in catch.

Uncertainty in the scaling of the assessment is improved when including the fisheries independent survey (BFISH) data. But it is unclear how much the role of the prior on the radius parameter or the data influences global scaling with just 4 years of data that currently trends in the same direction as the commercial CPUE.

5. Do results include estimated stock status in relation to the estimated biological reference points, and other results required to address management goals stated in the relevant FEP or other documents provided to the review panel?

Yes, the assessment does include estimates of MSY-based reference points based on the output of a 3-parameter surplus production model where the underlying production function may be asymmetric. Estimates of MSY are more robust than estimates of FMSY. Estimates of Fmsy are largely informed by the lognormal prior distribution assumed for R and the shape parameter.

6. Are methods used to project future population state the same as those used in the 2018 benchmark stock assessment?

Yes, the stock projections are based on the uncertainty in parameter estimates, but do not include future simulated process error. Estimates of P*at 50% should be unaffected by the shrinkage in variance in the simulated projections. However, estimates of P* 40% would be biased based on the amount of process error variance that is omitted in the future projections, but I suspect this bias to be infintesimal.

7. If responses to questions 1-6 are “no”, indicate for each:
   NA

8. For consideration in future benchmark assessments, suggest and prioritize recommendations for improvements and research. For each recommendation prioritize to three categories (high, medium, low) dependent on importance to interpretation of this and future assessment results.

Low Priority

Software: there is a minor limitation in propagating process errors in the stock projections. There may be other modelling platforms that more suitably capture the process error component. However, relative to the magnitude in the errors associated with the reported catch, this additional error may be infinitesimal.

Medium Priority

Spatial heatmaps using the HDAR grid of the catch and CPUE data by decade. This would be a nice tool for eliciting discussion from stakeholders and the public. Seeing the data on a map is more stimulating that a time trend, or table of numbers. Given the nature of the collaborative survey, stakeholder engagement will critical for public relations an generating these data long into future data.