

Response to the Center for Independent Experts Independent Peer Review of the Gulf of Alaska Demersal Shelf Rockfish Assessment

A Bayesian surplus production model (SPM) was presented to the GOA Plan Team at the September 2022 meeting for consideration as an alternative assessment model for Southeast Outside (SEO) yelloweye rockfish as part of the Demersal Shelf Rockfish (DSR) assessment, which the Alaska Department of Fish and Game (ADF&G) runs. The model was developed and presented by Phil Joy (ADF&G) as a research model in the development stage and he solicited advice on whether pursuing the model was in the interest of the Plan Team. The Team does not have the capacity to evaluate an entirely new assessment model and a CIE review was recommended by the Team and the SSC to determine if the model was worth pursuing, how it would fit into the North Pacific Fishery Management Council (NPFMC) tier system, and garner advice on advancing the model for use in management.

A CIE review was organized by the Alaska Fisheries Science Center (AFSC) and conducted on September 12th and 13th with Drs. Kotaro Ono, Robin Cook and Kevin Stokes as the panel of experts and was attended in part or in whole by Phil Joy, Chris Lunsford (AFSC), Kristen Omori (AFSC), Chris Siddon (ADF&G), Rhea Ehresmann (ADF&G), Laura Coleman (ADF&G), Jan Rumble (ADF&G), Jim Ianneli (AFSC), Alan Hicks (IPHC), and Ray Webster (IPHC). The CIE review was received and discussed with ADF&G and AFSC staff on January 18, 2024.

Reviewers were asked to address four Terms of Reference (ToRs) during the peer review and in the CIE reports. The four ToRs developed to help guide the review were:

- 1) Evaluate the use of the proposed Bayesian state-space surplus production models, and model methods for use in management of the yelloweye rockfish portion of the GOA Demersal Shelf Rockfish complex. Specifically, determine if results suggest that the NPFMC Tier 5 approach is appropriate. Should biomass estimates from such a model be used in place of the survey average method currently used for most Tier 5 stocks managed by the NPFMC?
- 2) Evaluate the management of the GOA Demersal Shelf Rockfish complex as a whole including examination of the use of available data for species other than yelloweye rockfish and determination of tier level designations.
- 3) Review the methods used for estimating yelloweye bycatch in the directed Pacific halibut fishery and for estimating total yelloweye catch removals.
- 4) Provide advice and recommendations on a framework for simulation testing the surplus production model to evaluate similarities between this application of surplus production models and age-structured methods typically used in the North Pacific Fishery Management Council Tier management system.

As a whole, the CIE reviewers were generally positive about developing a Bayesian SPM for management of SEO yelloweye rockfish. The reviewers felt that it could fit into the tier system as a potential improvement to the random effects model (REMA) for Tier 5 stocks and made recommendations for advancing the model. The reviewers recognized that the model is not ready for setting harvest specifications in its current state, which Dr. Joy and the Council review bodies acknowledge, and provided a generalized roadmap for next steps. Reviewers uniformly recommended that the SPM be developed in a stepwise process beginning with a simple model similar to REMA.

Complexity can then be added in stages and tested in a simulation framework to ensure the model correctly estimates underlying parameters and allows for comparison with the current REMA approach.

AFSC and ADF&G staff that met in January were generally encouraged by the CIE review, supported continued work on the SPM, and agreed on an approach for moving forward. Staff were encouraged by very similar conclusions from two of the reviewers, commented that this model aligns with efforts by the data-limited assessment group, and mentioned other assessments that could use this approach. However, staff was surprised by the response to ToR 4 and the skepticism expressed by the reviewers towards testing the SPM with an age-structured simulation model. Staff and reviewers both highlighted the importance of an MSE, suggesting that the SPM be tested using an age-structured operating model if the SPM is to be incorporated into the tier system. Staff believe that the age-structured comparison is still worth pursuing while recognizing the effort and time this would entail. There was some lack of clarity with regard to how the SPM would fit into the tier system; although it was generally agreed that it would fit in at Tier 5, but as a “more informed” Tier 5 approach relative to the REMA because of the inclusion of additional data and ability to directly estimate F_{MSY} .

AFSC and ADF&G staff agreed on a plan to keep the SPM as a research model to be presented again at the September 2024 plan team meeting following the recommendations of the CIE reviewers. The model will be presented with simulation testing (within a production model context and with comparisons to REMA estimates) and bridging models following the recommendations of the CIE panel. It was agreed that while the SPM will not be ready to set harvest specifications it could be used as a research model to evaluate Tier 5 ABC recommendations and provide additional context for setting harvest recommendations. Updated natural mortality (M) estimates for yelloweye rockfish will also be presented at the September meeting as well as an inventory of the available age data to reevaluate the applicability of a traditional age-structured assessment. Dr. Joy will be collaborating with Dr. Ono and his colleague Dr. Sam Subbey at the Institute of Marine Research in Norway on developing the SPM.

What follows is a summary of the CIE review by ToR and includes discussion points from the January 18, 2024 meeting. More detailed comments are covered in the appendix.

ToR 1. *Evaluate the use of the proposed Bayesian state-space surplus production models, and model methods for use in management of the yelloweye rockfish portion of the GOA Demersal shelf rockfish complex. Specifically, determine if results suggest that the NPFMC Tier 5 approach is appropriate. Should biomass estimates from such a model be used in place of the survey average method currently used for most Tier 5 stocks managed by the NPFMC?*

In general, the reviewers were positive about using a Bayesian SPM as a potential improvement of the current REMA model through its ability to estimate F_{MSY} directly from the data. They stated that the current REMA approach is vulnerable to *ad hoc* revisions in the estimate of M which may result in undesirable changes to management advice. All reviewers pointed out that M may be higher than F_{MSY} for long lived groundfish species and that the current estimate is outdated and in need of revision. There was agreement from the reviewers that the current model should be deconstructed to a simpler state and then use bridging models that extend from the REMA to a SPM suitable for management. The reviewers agreed that it was not necessary to reconstruct a catch history back through 1880 and suggested that using data from 1980 onward would suffice, with sensitivity testing in regard to stock status (relative to unfished biomass) in 1980. Additionally, the reviewers recommended that the reconstructed model be developed in a simulation framework to ensure that the model accurately estimates underlying parameters and allows for comparisons to the REMA approach.

Reviewer	Recommendation
Cook, Ono, Stokes	Update M value
Cook, Ono	Supportive of using SPM as an assessment model. The SPM is noted to be an improvement over the current REMA model by directly estimating F_{MSY} not depending on assumed M values to set harvest limits. Specifically, the advantage of directly estimating F_{MSY} from the data is supported by the National Standard 2 for using the best scientific advice.
Cook, Ono	Simply the model by constraining the time period to 1980 – present to focus on the high-quality data, rather than recreating older lower quality data and attempting a 3-stage approach.
Cook, Ono	Strip the model down to a very simple SPM that fits only the biomass data and ignores catch data as a direct comparison to the REMA. Then make incremental additions to the model by adding catch data and more complexity to determine the limits of the model.
Cook, Ono	Move the model from the Bayesian <i>Jags</i> package to <i>Stan</i> to speed up run time and access better diagnostics.
Cook, Ono	Reparametrize the model in terms of F_{MSY} and derive a prior for F_{MSY} by assuming $F_{MSY} = M$ and use Hamel’s method for deriving M (Hamel, 2015).
Ono	Reparametrize the model in terms of B/K (Meyer and Millar 1999) or MSY and gamma (Fletcher 1978).
Cook	Change the prior on $\log K$ to a square root uniform (Cook et al. 2021) and the prior on the error distribution variance to a uniform prior on the standard deviation (Gelman 2006).
Cook	Consideration should be given to using the IPHC data once in the model and reconstructing the discards and bycatch internally from the fitted index rather than externally.
Ono	Change the CPUE index from the IPHC longline survey from a design-based estimator to a model-based estimator that accommodates zero-inflation (i.e., Tweedie distributions) and thus reduces the need to evaluate which survey stations to include in the analysis.
Ono	The model should be developed in a simulation framework to evaluate parameter bias, risk of overestimating F_{MSY} , and ultimately extended to a management strategy evaluation.

ToR 2. Evaluate the management of the GOA demersal shelf rockfish complex as a whole including examination of the use of available data for species other than yelloweye rockfish and determination of Tier level designations.

The reviewers agreed that the Tier 6 approach for the non-yelloweye rockfish DSR species was the best available and supported the approach of combining the harvest recommendations from each tier to obtain a single harvest recommendation for the complex (i.e., Tier 5 + Tier 6= DSR total). One reviewer did point out that using the SPM for Tier 5 falls in line the National Standard 2 of using the best scientific information available and National Standard 7 of costs and benefits given the challenges of fitting an age structured assessment to this stock.

Reviewer	Recommendation
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Cook, Ono, Stokes	The Tier 6 approach for the non-yelloweye rockfish DSR species was the best available and there is no reason why ABCs should not be summed together simply because they arise from different methods.
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ToR 3. *Review the methods used for estimating yelloweye bycatch in the directed Pacific halibut fishery and for estimating total yelloweye catch removals.*

In general, the reviewers were positive about the approach taken to estimate yelloweye discards in the halibut fishery, given that the uncertainty in the estimates is considered in the assessment. They were encouraged that the derived estimates were similar to contemporary landings of yelloweye in the halibut fishery under full retention rules. The reviewers were appreciative of the in-depth analysis the author completed to reconstruct catch estimates and the IPHC staff’s review of methods. As mentioned previously, the reviewers do not believe it is necessary to construct a time series back to the beginning of the halibut fishery in the 1880s.

One of the reviewers expressed some concern about correlations between the bycatch rate calculated from the IPHC data and the CPUE index from the same survey. However, another reviewer disagreed with this concern given the different response variables taken from the IPHC survey.

Reviewer	Recommendation
Cook, Ono, Stokes	Overall, the method appears appropriate provided uncertainty inherent in the estimates is carried into the assessment and investigated.
Cook	Concern with using the IPHC FISS data in the bycatch estimation and as an index of abundance if the errors in those two variables are correlated. Investigate thoroughly, whether this use of data is appropriate.

ToR 4. *Provide advice and recommendations on a framework for simulation testing the surplus production model to evaluate similarities between this application of surplus production models and age-structured methods typically used in the North Pacific Fishery Management Council Tier management system.*

The reviewers expressed some skepticism about the utility of simulating age-structured dynamics to determine how the SPM would perform compared to a more realistic model that explicitly considers age structure. Two of the reviewers highlighted that such a comparison presupposes that a well-informed operating model could be constructed despite uncertainty in the biology that underpins age structured dynamics. The reviewers felt that such an exercise would require strong assumptions that would make interpretation of the assessment model much more difficult given potential flaws in the operating model. The reviewers also recognized the large amount of work that this would entail and felt that the primary question was whether the SPM was better than the REMA approach and efforts should be focused on this comparison.

Nevertheless, the reviewers also encouraged an MSE be performed to determine the performance of the SPM in a management context and offered suggestions on conducting a comparison of SPMs to age-structured dynamics. Reviewers suggested using other published age-structured assessments of similar species or fitting the SEO yelloweye stock as best as possible and using those results in an operating model. Two reviewers also cited methods used by Winker et al. (2020) as the most appropriate for tackling this challenge.

This ToR was where staff at the January meeting differed from the opinion of the reviewers. Given that the reviewers encouraged an MSE (despite skepticism about the methods) and the Council would likely need an MSE to fully adopt an SPM for setting harvest specifications, there was a general consensus that this would ultimately need to be accomplished. Reviewers and staff were in agreement that an MSE and age-structured comparison would entail a substantial amount of work and see it as a long-term goal that will not be achievable in the current (2024) cycle.

Reviewer	Recommendation
Cook, Ono, Stokes	Simulation-testing should be performed that initially focuses on comparing the REMA with the SPM, followed by examining the contribution of different “components” to each layer of complexity in the SPM. Recognized the need for an MSE to evaluate the performance of the SPM for management.
Cook, Ono	Reviewers were more interested in seeing the SPM developed in a simulation framework that tests the model’s ability to accurately estimate the ABC in comparison to the <i>M</i> -REMA approach.
Cook, Ono	Reviewers were not convinced that an age-structured comparison was necessary or useful given the uncertainty that would be inherent in any age-structured operating model.
Ono	If an age-structured comparison is to be performed, recommend an approach similar to Winker et al. (2020).

Literature Cited

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Appendix. Detailed comments from CIE reviewers by ToR.

ToR 1. Evaluate the use of the proposed Bayesian state-space surplus production models, and model methods for use in management of the yelloweye rockfish portion of the GOA Demersal shelf rockfish complex. Specifically, determine if results suggest that the NPFMC Tier 5 approach is appropriate. Should biomass estimates from such a model be used in place of the survey average method currently used for most Tier 5 stocks managed by the NPFMC?

Reviewer	Recommendation
Cook	Although the model is still in developmental state, it offers advantages over the use of the REMA and assumed M values by estimating F_{MSY} directly from the data and is a worthwhile pursuit as an improvement to Teir 5 assessments.
	Rather than attempting to deal with all data going back to the 1880s, the model should be simplified, and optimization should focus on the high-quality data going back to 1980.
	Reparameterize the model in terms of F_{MSY} and derive a prior for F_{MSY} by assuming $F_{MSY} = M$ and use Hamel’s method for deriving M (Hamel, 2015).
	Change the prior on $\log K$ to a square root uniform (Cook et al. 2021) and the prior on the error distribution variance to a uniform prior on the standard deviation (Gelman 2006).
	Consideration should be given to using the IPHC data once in the model and reconstructing the discards and bycatch internally from the fitted index rather than externally.
	Move the model from the Bayesian <i>Jags</i> package to <i>Stan</i> to speed up run time and access better diagnostics.
	Strip the model down to a very simple SPM that fits only the biomass data and ignores catch data as a direct comparison to the REMA. Then make incremental elaboration of the model by adding catch data and more complexity to help bridge from the REMA model and see where the limits of model complexity lie.
Ono	The SPM offers a rational framework for devising quota advice for a stock where information on catch and abundance indices exist but with insufficient information to build an age-structure assessment model. It is an improvement to the REMA and assumed M approach to setting harvest limits given its ability to directly estimate F_{MSY} from the data and it is more in line with National Standard 2 for using the best scientific advice.
	The SPM should initially be simplified such that it is similar to the REMA for direct comparison, and then add catch data and other model complexity once those comparisons have been made.
	The analysis should initially be constrained to the period from 1980 onward as part of the simplification and avoid the 3-stage approach used in the presented model.
	The model should be developed in a simulation framework to evaluate parameter bias, risk of overestimating F_{MSY} , and ultimately extended to a management strategy evaluation.
	Change the CPUE index from the IPHC longline survey from a design-based estimator to a model-based estimator that accommodates zero-inflation (i.e, Tweedie distributions) and thus reduces the need to evaluate which survey stations to include in the analysis.
	To speed processing time the model should be rewritten in <i>Stan</i> and the model reparameterized in terms of Biomass/ K (Meyer and Millar 1999) or in terms of MSY and γ (Fletcher 1978)
Stokes	Using biomass and CPUE in the REMA approach is a valid way of estimating as best possible the most recent biomass to be used in TAC setting. Use of an SPM adds little to the estimation of recent biomass but may in principle ensure consistency of an F_{MSY} estimate with the estimated biomass. However, there will be uncertainty in any such estimate, and it is not immediately obvious that there will be a benefit compared to the current approach using an estimate of M .

	Updating and improving the estimate of M is overdue and should be done.
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ToR 2. Evaluate the management of the GOA demersal shelf rockfish complex as a whole including examination of the use of available data for species other than yelloweye rockfish and determination of Tier level designations.

Reviewer	Recommendation
Cook	The approach to the Tier 6 stocks is pragmatic and there is no reason why ABCs should not be summed together simply because they arise from different methods.
Ono	There is no reason why the ABC from different tiers cannot be combined. Although the SPM does not fall neatly into the tier system it provides a good compromise between the REMA model and a potential age-structured assessment which may not be achievable with the current data.
Stokes	Setting ABC based on a 0.75 multiplier of average catch can only lead to reducing ABC over time if catches are actually constrained by the ABCs. In contrast, using the maximum catch by stock over a period when the catch may be unconstrained due to a combined, larger DSR ABC which includes yelloweye, could in principle lead to increasing stock-specific ABC over time. Whether or not combining the ABC for all species is reasonable will depend on the specifics of exploitation pattern(s), fisheries management, and biology/ecology of the species.

ToR 3. Review the methods used for estimating yelloweye bycatch in the directed Pacific halibut fishery and for estimating total yelloweye catch removals.

Reviewer	Recommendation
Cook	Overall, the method appears appropriate.
	There is some concern about using the IPHC FISS data in the bycatch estimation and as an index of abundance if the errors in those two variables are correlated.
Ono	Overall, the method appears appropriate provided uncertainty inherent in the estimates is carried into the assessment
	Dr. Ono differed from Dr. Cook regarding the use of the IPHC FISS data in the cpue index and in estimating bycatch rates. Given that the FISS follows proper sampling design and the response variables being used are different Dr. Ono does not believe this is a problem.
Stokes	Overall, the approach is sufficient for exploring the SPM so long as uncertainties are recognized and investigated.

ToR 4. Provide advice and recommendations on a framework for simulation testing the surplus production model to evaluate similarities between this application of surplus production models and age-structured methods typically used in the North Pacific Fishery Management Council Tier management system.

Reviewer	Recommendation
Cook	The initial focus should be on comparing the REMA model to the SPM using an appropriate operating model. The latter could be either age structured, or biomass dynamic based on a SPM. The performance of the assessment models could be judged by their ability to accurately estimate the ABC using the M-REMA biomass formula or F_{MSY} -SPM biomass approach.
Ono	The authors should perform some simulation-estimation testing to examine the contribution of different “components” of the SS-SPM to the different outcomes (e.g.

	<p>biomass trajectory) but also conduct an MSE to determine the performance of SS-SPM in management context.</p>
	<p>The reviewer was not convinced that an age structured comparison is necessary, but if such if it is to be pursued, it is recommended that methods similar Winker et al.'s (2020).</p>
<p>Stokes</p>	<p>The reviewer reported that he found the motivation and the intent of the ToR unclear.</p>
	<p>If simulations are to be used to test the equivalence of the SPM with an age-structured model an operating model could be developed with stock synthesis simulation package (ss3sim). However, given the difficulty in past efforts to develop an age-structured assessment and major uncertainties in life histories, any operating model would need to capture considerable process and observation error and it is not clear to the reviewer how this would assist in the development of a SPM.</p>
	<p>Without a proper MSE it is hard to see how an SPM for just yelloweye would be used.</p>
	<p>If a SPM is to be pursued it would be helpful to proceed in a stepwise fashion from ROV, CPUE only, ROV + CPUE, etc. as suggested by the other reviewers in Tor1.</p>