

Summary of the 2021 CIE review of Gulf of Alaska Pacific Ocean perch

Pete Hulson

The Center for Independent Expert (CIE) review for Gulf of Alaska Pacific ocean perch was conducted virtually from March 30 to April 1, 2021. The panel of experts consisted of Drs Noel Cadigan, Saang-Yoon Hyun, and Geoff Tingley. Overall, the review was productive, resulting in a number of recommendations for future development and research into the assessment for GOA POP. By the conclusion of the review the experts found the assessment to be of high quality, and the reviews contained statements like, “The overall outcome of this assessment, as reviewed, is that it meets the description of best available science and exceeds the acceptability quality threshold to be used to inform management.” (Tingley).

Each of the reviewers provided research recommendations that should serve to improve the assessment model for GOA POP. A number of the recommendations focused on a variety of sensitivity analyses, while others involved more in-depth model development. Distilling these comments, the more in-depth recommendations included:

- Investigate data weighting of compositional data
- Develop a state-space model to be run in parallel to the current assessment
- Continue to investigate use of VAST estimates of survey biomass, in particular investigate reasons behind the divergence between design-based and model-based estimates of abundance

As it pertains to the use of VAST estimates of survey biomass, the consensus among the reviewers was that it is still premature to use this index in the assessment until it can be more thoroughly investigated. This was also the consensus with the use of acoustic survey biomass estimates as an additional index to the model. Due to the recommendations that further work be conducted before implementation into the assessment, and in conjunction with the work that the AFSC internal review team performed through 2020 and 2021 (which additionally identified different methods to estimate fishery selectivity as a topic to be considered in the assessment model development), the GOA POP assessment will not incorporate any substantial model changes for the 2021 assessment cycle, but will investigate and continue to develop these various recommendations to be potentially implemented in the next full assessment that will be conducted in 2023.

The following tables compile the main recommendations suggested by the reviewers and are organized by the terms of reference of the review.

Evaluate the data used in the assessments, specifically trawl survey estimates of biomass, and recommend how data should be treated within the assessment model

Reviewer	Recommendation
Tingley	Sensitivities to plausible alternative catch histories, particularly for the early years of the fishery, should be run, but only when there are substantive changes to the assessment model structure or major assumptions.
Tingley	Continue to explore different approaches to the appropriate weighting of the composition data, by using different statistical approaches but possibly also by careful quality control of these data, excluding data of known poorer quality.
Tingley	At a future assessment, it is recommended to try and incorporate all of the high-quality length composition data from both the survey and the commercial fishery, at least in a sensitivity.
Tingley	Prior to or as part of the next assessment, explore whether the plus group should continue to start at age 25 or whether an older plus group starting age is more appropriate.

Cadigan	Investigate if stock weights-at-age from the survey are significantly (i.e., in the statistical sense) different than fishery weights-at-age. Also, investigate if there is significant temporal variation in both stock and fishery weights-at-age. Provide figures of how mean weight-at-age changes over time, with different panels for groups of ages (i.e., 1-5, 6-10, 10+). Consider using more efficient and less bias methods for analyzing size-at-age from length-stratified age samples (e.g., Perreault et al., 2019). Investigate spatiotemporal variation in weight as a function of length.
Cadigan	Consider new sampling programs to collect information on POP maturity.
Cadigan	Investigate a bootstrap re-sampling procedure (e.g., Jourdain et al., 2020) to estimate uncertainty (i.e., covariance) in survey age compositions. This could also be considered for fishery compositions, although I recognize that it may be less straight-forward if there is data-borrowing for unsampled fishery “strata” (i.e., gears, areas, seasons, etc.).
Hyun	If the survey for the POP stock assessment continues to rely on a bottom trawl survey, they should consider increasing the current trawlable area.
Hyun	They should revise the calculation of the CV of annual bottom trawl survey indices (annual relative population sizes) because they failed to consider the covariances of survey indices from neighboring strata when calculating the variance of the annual survey index.

Evaluate the stock assessment model for GOA Pacific ocean perch in general and comment on appropriateness of parameter estimates to assess stock status determinations

Reviewer	Recommendation
Tingley	Exploration of additional information to better define the realistic range of M for Pacific ocean perch is recommended. This should consider data available for Pacific ocean perch and for other long-lived rockfish species.
Cadigan	Investigate a sensitivity model run with an initial age-structure derived using the assumed M and a few years of F like that estimated for 1961. For example, initial cumulative $Z = a \cdot M + \min(a,3) \cdot F_{init}$ will be appropriate if the stock experienced F_{init} fishing mortality for three years prior to the start of the assessment model.
Cadigan	Consider including a stock-recruit model with autocorrelated errors to improve the fit of the POP assessment model. Investigate possible drivers of patterns in recruitment deviations.
Cadigan	Consider removing priors for F Regularity and σ_R .
Cadigan, Hyun	A research (i.e., exploratory) state-space stock assessment model, run in tandem with the current stock assessment model, should be developed.
Cadigan	Consider including fishery length composition information in off-years when ages are not measured. However, this may not provide much additional information about recent recruitment trends because of the low selectivity of the fishery for ages less than seven.
Cadigan	Evaluate the quality of fishery and survey age compositions for tracking cohorts.
Cadigan	Provide a retrospective analysis of current status evaluations. This will provide additional information on the reliability of the status evaluations.
Cadigan	Provide convergence diagnostics, including the maximum absolute gradient and the results of a jitter test.

Evaluate the strengths and weaknesses in the stock assessment model for GOA Pacific ocean perch, and recommend any improvements to the assessment model

Reviewer	Recommendation
-----------------	-----------------------

Tingley	In the absence of better information about the likely magnitude of M, sensitivities using values of fixed M that bracket the estimated value M should be run in future stock assessments to inform on the level of risk inherent in the current assumptions about M.
Hyun	They should incorporate the annual fishery cpue's into the assessment model framework.
Hyun	They should improve the model fit to the survey indices. One of the efficient ways to improve the goodness-of-fit might be to consider process errors in state variables (random effects).
Hyun	The penalized likelihood form as the prior of M, q, and σ_r must be revised (beyond the typo). The revised form, which I suggest above, might improve the model performance.
Hyun	They should do formal model validation, setting true values of free parameters, generating pseudo data, feeding those simulated data into the assessment model, estimating parameters, and comparing estimates of free parameters with the corresponding true values. Such model validation would help us to judge the reliability of parameter estimates and the resultant derived quantities made by the model.
Hyun	For the retrospective error analysis, they should also examine estimates of annual fishing mortality.

Evaluate and recommend how survey data are used for biomass indices within the assessment. Specifically, advise on trawl survey indices arising from design-based methods versus model-based approaches.

Reviewer	Recommendation
Tingley	Continue to exclude the 1984 and 1987 survey biomass estimates and survey composition data from all future assessments as these are clearly not part of the longer survey timeseries due to the use of differences in vessels, trawl gear, tow duration and survey timing.
Tingley, Cadigan	Exclude the 1990 and 1993 Gulf of Alaska Bottom Trawl Survey biomass estimates and the survey composition data from all future Pacific ocean perch (and other species) assessments (or include them only in sensitivities, possibly including them as a separate timeseries). These two years do not appear to be part of the longer survey timeseries due to different timing, tow duration and survey structure.
Tingley	It is recommended that the current approach of estimating the missing eastern data from the 2001 Gulf of Alaska Bottom Trawl Survey is discontinued for all future assessments of Pacific ocean perch and that one of the proposed approaches, or an alternative approach, is used so as to reduce uncertainty in the next assessment.
Tingley	Continue to support the development and application of spatio-temporal models (such as VAST) for use in stock assessments. In order to make this effective, there need to be a rapid development of a suite of informative diagnostics for spatio-temporal models in a fisheries stock assessment context. Until such time as suitable diagnostics are available, it is recommended that these spatio-temporal models are only used in sensitivity model runs and not in the base case from which management advice is developed.
Cadigan	It was premature to use VAST biomass indices in the POP stock assessment. There are several diagnostic analyses that need to be explored.
Cadigan	Provide the stratum size-weighted averages of the VAST ordinary raw residuals.
Cadigan	Provide trawlable biomass values aggregated over survey strata. This should include time-series of maps indicating strata, where each stratum is colored to indicate the area-expanded VAST biomass. Also useful are time-series plots of VAST biomass aggregated

	over sets of strata for standard depth ranges shown in Table 2. It will also be informative if this could be further divided into trawlable and untrawlable grounds.
Cadigan	Account for potential vessel and tow time effects in a VAST model. Examine the statistical significance of vessel and tow duration effects. Consider including vessel as a random effect.
Cadigan	Consider including the 1984 and 1987 survey catches in the VAST model, to extend the survey biomass indices back to those years. This VAST model should include those effects that were different or less standardized in the 1984 and 1987 surveys. Consider the potential confounding of year effects with other effects.
Cadigan	Investigate methods to produce length and size compositions that are weighted by VAST spatial density estimates.

Evaluate abundance estimates from summer acoustic-trawl data, and recommend how it may be used within the assessment.

Reviewer	Recommendation
Tingley	It is recommended that attempts to develop an acoustic abundance index for Pacific ocean perch from the MACE Acoustic Survey data for use in assessments should be discontinued until the evidence base supports a substantially increased likelihood that the processed acoustic backscatter represents a reliable abundance index for Pacific ocean perch.
Tingley	It is, however, also recommended that the existing MACE acoustic and trawl data are further explored in detail to ascertain whether the backscatter data can be reliably and robustly be decomposed into Pacific ocean perch and other species or not.
Cadigan	More years of acoustic survey data are needed before deciding how it could be included in the POP assessment. However, having an additional fishery-independent abundance index, and in particular an acoustic survey of the off-bottom (i.e., 0.5m) water column, can be quite valuable for detecting changes in availability of POP to the bottom-trawl survey.
Cadigan	Continue and improve research on the sources of uncertainty and possibly bias listed above. This should include quantification and incorporation of these sources of uncertainty into acoustic biomass and age/size compositions.