September 2020 Plan Team Update on GOA Pacific Ocean Perch Assessment

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Background

In the 2019 SAFE for the Pacific Ocean perch stock in the Gulf of Alaska it was noted that the statistical model used for this assessment has consistently underestimated increasing trends in the AFSC Bottom Trawl Survey estimates of abundance (Hulson et al. 2019). At the December 2019 NPFMC meeting trawl fishery representatives requested that an internal review of this assessment be conducted in 2020 which was endorsed by the SSC, "The SSC agrees that the formation of an internal assessment review team prior to the CIE review would be beneficial" (SSC, December 2019). In addition, the AP in Motion 6 stated, "The AP recommends the CIE review of Gulf Pacific Ocean Perch in April of 2020, and the terms of reference for the CIE need to prioritize fixing the models' performance and exploring the VAST model. The model should be revised before the September Plan Team meeting to move forward with the new ABC for the November Plan Team and 2021 Specs" (AP, December 2019). Council minutes reflected agreement, "The Council recommends the Center of Independent Experts (CIE) review the Gulf of Alaska Pacific Ocean Perch stock assessment in April of 2020. The terms of reference for the CIE review should prioritize fixing the models' performance and exploring the VAST model. The model should be revised before the September Plan Team meeting" (NPFMC, December 2019).

In response to the recommendations by the SSC, AP and Council an internal review team was formed that consisted of Pete Hulson (AFSC, senior author of GOA Pacific Ocean perch assessment), Jim Ianelli (AFSC), Paul Spencer (AFSC), Chris Lunsford (AFSC), Curry Cunningham (UAF), and Ben Williams (AFSC). Unfortunately, due to the COVID-19 pandemic the planned CIE review in April 2020 had to be postponed until spring of 2021. Regardless, the internal review team has routinely met since March 2020 and has identified potential improvements to the assessment model. Author recommended improvements to the assessment model are presented here for further investigation in preparation for a full assessment in the fall of 2020 and the planned CIE in the spring of 2021.

Progress of Internal Review

As recommended by the SSC, AP, and Council, the focus of the internal review team was to improve the performance of the GOA Pacific Ocean perch assessment model. Several areas were identified in the assessment model to investigate and a collaborative effort with the members of the team ensued to add various options and estimation methods. Two primary categories were identified by the internal review team to improve the performance of the assessment model: (1) update of parameter priors and input data, and (2) investigation of alternative modeling methods.

Within category 1, update of parameter priors and input data, the following updates were considered:

- Update prior for catchability from 1 to 1.15 following from Jones et al. (in review)
- Update prior for natural mortality from 0.05 to 0.0614 following from Hamel (2015)
- Estimate fishery age composition through use of age-length key (common method in AFSC assessments)
- Update ageing error matrix with additional reader-tester agreement data

Within category 2, investigation of alternative modeling methods, the following explorations were conducted:

- Estimate initial abundance-at-age under equilibrium conditions
- Estimate fishery selectivity within current assessment time blocks with double logistic selectivity and cubic spline selectivity
- Estimate mean recruitment and recruitment variability parameters within distinct time-blocks that are determined by positive or negative periods in the Pacific Decadal Oscillation index
- Incorporate VAST estimates of biomass and implement estimation of a variance inflation parameter to be applied to uncertainty estimates in VAST biomass index

Other collaborations within the internal review team, besides direct implementation of changes to the assessment model, included developing a GitHub repository for the assessment model that provided an organized framework for code to be stored and developed collaboratively and implementation of code to streamline model evaluation and presentation of results.

Results and Recommendations

A number of alternative models were investigated by the internal review team. Some of the primary findings by the team were:

- The estimates of catchability, and subsequently other model parameters, are surprisingly sensitive to the method for estimating initial abundance, whether stochastic (current method) or equilibrium (newly investigated)
- The exponential function currently used to estimate fishery selectivity seems restrictive, as both the double logistic and cubic spline selectivity curves suggest that the fishery selectivity curve is not as dome-shaped as previously estimated
- Estimating mean recruitment and recruitment variability within time-blocks that coincide with positive or negative periods in the Pacific Decadal Oscillation serve to improve the model's fit to the trawl survey biomass, allowing more flexibility in recruitment parameters, and indicates the mean recruitment has increased in the Pacific Ocean perch population through time
- Implementing VAST biomass estimates results in large changes to the estimate of catchability. This results in an estimate of catchability ~2.5, which is larger than the catchability previously estimated in this assessment. Implementing a parameter to estimate inflation in the variance of biomass estimates from VAST results in a model that again largely underestimates recent increases in survey biomass.

Taken together, the model changes that have been investigated by the internal review team identified how sensitive the assessment model is to various modeling assumptions, many of which are unresolved and produce biomass estimates that are unrealistic. The internal review team recommends that these modeling methods continue to be investigated before using them in management recommendations. We plan to further refine and present these alternatives in the 2021 CIE review prior to recommending implementation into the stock assessment model. However, the review team recommends bringing forth the four updates on priors and input data based on using priors that are supported by recent research. We recommend that the Plan Team consider a full assessment for Pacific Ocean perch in 2020 that implements the parameter prior and data updates as a step towards improving the stock assessment model. Further model development will be explored and brought forth in the 2021 full assessment.

Literature Cited

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