Authors' response to Australian pearl perch assessment review

June 2022

This document is a response to the review of Lovett et al. (2022) by Klaer (2021). We appreciate the time and effort the reviewer has dedicated to examining the stock assessment of Australian pearl perch. The reviewer's report, knowledge of Stock Synthesis software and insightful comments provided valuable information to the stock assessment.Our response to individual issues made by the reviewer are presented consecutively. Changes that have been implemented in the stock assessment report are referenced.

Note that the review references the report as a 2021 report, however it is now being published in 2022.

Reviewers' Comments to the Authors

Reviewer: *'I believe that index standardisation falls into the category of data preparation for stock assessment and is a separate and specialised task. It may be an improvement to present the standardisations in a separate document to the assessment where the details could be more closely examined – for example to see the model selection process, plausibility of estimates of terms included in the models etc. Examination of those aspects would probably benefit from review by professional statisticians most familiar with such analyses. Data filtering is an important consideration for standardisation and requires description in such a document – for example, how non-pearl perch records may have been identified and excluded from analysis in a multi-species fishery.'* (page 6, Section 2.3.1b, paragraph 4)

Authors: A separate document detailing the index standardisations for 'rocky reef' species has been published (Wortmann 2020). The methods contained in Wortmann (2020) have been followed for this assessment and have been referenced in Section 2.3, paragraph 2 of the report. Wortmann (2020) repeated methods used in the previous snapper stock assessment (Wortmann et al. 2018) which has been peer reviewed.

Reviewer: *'One approach to examine potential bias caused by ignoring spatial structure could be separate assessments that use QLD and NSW data, with results then added together as a sensitivity analysis for comparison with the combined model.'* (page 8, Section 2.3.1d, paragraph 5)

Authors: We considered the reviewers suggestion of adding together separate assessments that use Queensland and New South Wales data. This approach would be straight forward if the only objective was to look at B_{2020} noting that estimated parameters would be different in different components. However, some combined outputs (which are required) such as RBC can not be obtained in a similarly simple way. This is because the combined F would need to be calculated and cannot simply be added across components. We leave this for future work.

Reviewer: *'The assessment has a start year of 1880. There are almost no data available (catch, CPUE or composition) for pearl perch prior to about 1988. The current assessment uses simple assumptions to hindcast historical catch to 1880 which appears to follow the procedure of Sumpton et al. (2017) who say, "although there are no reliable harvest data recorded before 1988, it was unrealistic to start the* *modelling in 1988 from an unexploited state (virgin population)". The authors also say that the 1880 start date was used for alignment with the snapper stock assessment. SS allows a model to start at a time supported by available data using an equilibrium starting F (not virgin), which seems to be a more appropriate procedure for this species.'* (page 9, Section 2.3.1d, paragraph 6)

Authors: A scenario where dead catch is input from 1988 with an assumed starting fishing mortality (F) is estimated has been added to the list of scenarios in Section 2.6.4 of the report. Results for this scenario can be found in Section 3.3 and a discussion in Section 4.1 of the report.

Reviewer: *'Pearl perch do not fit the profile of a species likely to allow robust steepness estimation. It does not provide long contrasting periods at different stock sizes that are informed by sufficient data to estimate recruitment deviations during those periods. This is highlighted by the likelihood profile for steepness provided in the assessment document (Fig D.13) that shows no significant difference across steepness values from 0.25 to 0.6 that were examined (a change in likelihood of two units is the commonly accepted level for statistical significance). On this basis, a prior fixed value for steepness is therefore required to be selected from sources external to the current or previous pearl perch assessments that were based on similar input data. My recommendation is to select an uninformed generic value as outlined above of 0.7 or 0.75 using those justifications. I also note that a new meta-analysis by Thorson (2020) provides similar values near 0.7 for comparable species in the family Glaucosomatidae, although additional work is required to justify which values might be selected from that source. The current assessment uses a fixed low value of 0.4 for steepness for the base-case which I do not consider is justified. Sensitivity analyses shown in the report suggest that results are not especially sensitive to the steepness value (Table 3.5) but a value near 0.7 was not tested and would be expected to vary from the base-case more than the 0.5 value examined.'* (page 9, Section 2.3.1d, paragraph 8)

Authors: The steepness likelihood profile (Figure D.12—previously Figure D.13) has been modified to range steepness values from 0.25 to 0.95 in 0.5 increments. This profile indicates a best case at a steepness of 0.4, however all values in this range are less than two likelihood units and hence we agree that certainty for this is low. As noted above, the meta-analysis by Thorson (2020) provides values for the species at around 0.7. Additional text has been included in Section 2.6.4, paragraph 3 of the report to state this. Steepness values ranging 0.217–0.485 were estimated by Sumpton et al. (2017).

It was decided to maintain our base case steepness at 0.4 to maintain comparability with Sumpton et al. (2017) and this is somewhat supported by the steepness likelihood profile. We have now run additional scenarios at h=0.6, 0.7 and 0.8, and we note that the stock status result changes only very marginally for the h=0.6 and 0.7 scenarios: both produce a biomass ratio of 24%. Given the steepness estimates in Sumpton et al. (2017), the h=0.8 scenario we consider to be *a-priori* less likely, as well as non-precautionary; it produced a biomass ratio of 41%.

Additional text has been added to this effect in Section 2.6.4, results for these scenarios have been added to Section 3.3, Table 3.5, Figure 3.11 and discussed in Section 4.1 of the report.

Reviewer: *'A plot that summarises the assumptions made for historical harvest reconstruction would be a beneficial inclusion.'* (page 13, Section 2.3.4, paragraph 2)

Authors: The suggested data sources plot (Figure 2.1) has been added to Section 2.2 of the report.

Reviewer: *'A standard inclusion for most stock assessments that provides key information is the stock-recruitment plot as shown below for the base-case.'* (page 13, Section 2.3.4, paragraph 3)

Authors: The suggested stock-recruitment plot (Figure D.10) has been added to Appendix D.4 of the report.

Reviewer: *'Although the previous stock assessment for pearl perch by Sumpton et al. (2017) did not use SS, there may still have been an opportunity to construct a bridging analysis by commencing with a model that attempted to replicate those results – at least for a selected representative case. Provision of such a bridging analysis gives confidence to interested groups (e.g., managers or industry) that there is consistency among stock assessments for the same species. It also highlights where differences have arisen from – either via changes in modelling approach, or new data.'* (page 14, Section 2.3.4, paragraph 5)

Authors: A suggestion to perform a bridging analysis has been added to the recommendations for future assessments found in Section 4.2.4 of the report.

Reviewer: *'A likelihood profile for R0 could be produced as a standard stock assessment procedure to investigate data influences more comprehensively on that important estimate.'* (page 14, Section 2.3.4, paragraph 6)

Authors: The suggested likelihood profile for $\ln(R_0)$ (Figure D.13) has been added to Appendix D.6 of the report.

Reviewer: *'Inclusion of the overall likelihood values in the summary table of sensitivity analysis results (Table 3.5) is useful, although differences in model structure and tuning sometimes make those statistically incomparable. A separate table with likelihood components further broken down into subcomponents such as CPUE or composition fit often still allows much insight into model behaviour that is unobtainable otherwise.'*

Authors: Table D.2 containing likelihood components further broken down has been added to the report in Appendix D.5.

Reviewer: *'Evidence for model convergence should be considered and can be based on jittering starting values for estimated parameters. An improvement on this is via MCMC or bootstrap runs, although the additional time required for such procedures is recognised.'*

Authors: This suggestion has been added to the recommendations for future assessments found in Section 4.2.4 of the report.

Reviewer: *'Model mis-specification and bias can also be examined via retrospective analyses - e.g. see Hurtado-Ferro et al. (2014).'*

Authors: The stock assessment team are considering inclusion of this diagnostic for future assessments.

References

Hurtado-Ferro, Felipe, Cody S. Szuwalski, Juan L. Valero, Sean C. Anderson, Curry J. Cunningham, Kelli F. Johnson, Roberto Licandeo, Carey R. McGilliard, Cole C. Monnahan, Melissa L. Muradian, Kotaro Ono, Katyana A. Vert-Pre, Athol R. Whitten, and André E. Punt (2014). "Looking in the rearview mirror: bias and retrospective patterns in integrated, age-structured stock assessment models". In: *ICES Journal of Marine Science* 72.1, pp. 99–110.

Klaer, N. (2021). *Independent review of the 2021 stock assessment of Australian pearl perch.* Brisbane, Australia: Department of Agriculture and Fisheries.

Lovett, R., A. Northrop, and J. Stewart (2022). *Stock assessment of Australian pearl perch (*Glaucosoma scapulare*) with data to December 2019*. Brisbane, Australia: Department of Agriculture and Fisheries.

Sumpton, W., M. F. O'Neill, M. J. Campbell, M. F. McLennan, A. B. Campbell, and J. Stewart (2017). *Stock assessment of the Queensland and New South Wales pearl perch (*Glaucosoma scapulare*) fishery*. Brisbane,Australia: Department of Agriculture and Fisheries.

Thorson, J. T. (2020). "Predicting recruitment density dependence and intrinsic growth rate for all fishes worldwide using a data-integrated life-history model". In: *Fish and Fisheries* 21.2, pp. 237–251.

Wortmann, J. (2020). *Queensland rocky reef finfish harvest and catch rates*. Brisbane: Department of Agriculture and Fisheries.

Wortmann, J., M. F. O'Neill, W. Sumpton, M. J. Campbell, and J. Stewart (2018). *Stock assessment of Australian east coast snapper, Chrysophrys auratus: Predictions of stock status and reference points for 2016*. Brisbane, Australia: Department of Agriculture and Fisheries.