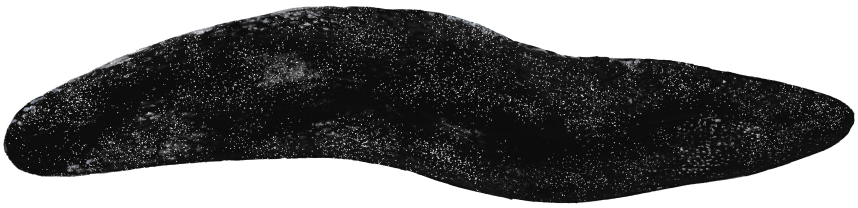

Response to ‘Independent Review of Sea Cucumber Stock Assessments’

March 2024

Queensland Government

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Contents

1 Preliminary remarks

This document is a response to the review of Smart et al. (2024a) and Smart et al. (2024b) by Buckworth et al. (2024). We thank the reviewers for their attendance at a two-day review workshop and for the engaging discussions that arose. The opportunity to transparently discuss detailed aspects of these stock assessments in person was very beneficial. It allowed us to leverage the reviewer's subject knowledge and discuss how to address their recommendations. The final stock assessment reports will address each of their recommendations and incorporate the knowledge gained from our interactive discussions with the reviewers.

The tight timeframe of the stock assessment schedule precludes finalising these two reports concurrently with the review process. Therefore, the planned responses to reviewer suggestions presented here are written in the future tense where not yet actioned.

2 Reviewers' current modelling recommendations to the authors

Reviewers: Test the assumption, for Prickly redfish at least, that the population had recovered from depletion caused by the early (1800s to 1940) east coast fishery to near virgin densities and quasi-equilibrium by the start of the modern fishery.

Authors: As noted during the workshop and in the review, it is possible that prickly redfish were harvested prior to 1940 but were not fished again until 1995. However, the magnitude of these pre-World War II catches is unknown and are unfeasible to reconstruct. Instead, two Stock Synthesis sensitivity scenarios will be added for prickly redfish with the population depletion in 1940 set at the target and limit reference points; 60% and 20% respectively. These scenarios would test the recovery potential of the species should catches have been large enough to sufficiently reduce the population to these pre-defined levels. As noted during the workshop and in the review, it is unlikely that any other species covered in these assessments were fished during this 1800s to 1940 period. Therefore, these scenarios will only be added for prickly redfish. The ability to set a historical depletion level is not currently a feature of DDUST. Therefore, this scenario will only be tested using Stock Synthesis.

Reviewers: Use salted weight conversion factors to convert to live weight for Burrowing blackfish rather than gutted weight – as the par-boiled and frozen product weights are likely to be closer to salted weight than gutted weight.

Authors: A salted weight conversion factor will be updated in place of the gutted weight conversion factor for par-boiled and frozen weight. It should be noted that this adds further conservatism to the results as this updated conversion factor will estimate larger whole weight catches. Advice from industry is that there is little weight loss between gutted weight and par-boiled and frozen weight. Therefore, while the initial catches may have been slight underestimates of whole weight catch, these updated catches will likely overestimate whole weight catch. Given the uncertainty in the true conversion factor, this suggestion seems appropriate and will therefore be accepted.

Reviewers: The plots of biological parameters provided in the workshop, used to evaluate the biological inputs for consistency, should be provided as appendices to the reports.

Authors: These plots will be added. We're encouraged to hear that you found them valuable during our discussions.

Reviewers: Advise whether variables other than those included were considered for the catch rate standardisation modelling. Were data available on catch rates by individuals or teams of divers, or skippers?

Authors: All available data was considered in the catch rate standardisation with valid and appropriate factors included in the final analyses. Additional detail on all the data available will be added to the reports. All records are aggregated by boat and therefore the catch rates of individuals could not be determined.

Reviewers: Potential changes in fishing power should be discussed briefly in the reports and identified as an area for future attention.

Authors: This suggestion will be addressed in the reports discussions by discussing the uncertainty in catch rates due to fishing power changes and hyperstability. As noted in the review, it is likely that potential increases to fishing power have been small and inconsequential. It is also probable that hyperstability has had a greater effect on catch rates than changes in fishing power. The value of future research will also be discussed.

Reviewers: Clarify the data filtering section in Smart et al. (2024b), indicating whether targeting of each species was dealt with, and so discuss whether target fishing for Prickly redfish and the Curryfish species might be significant and whether it can be evaluated in this assessment or in the future.

Authors: No target species is reported in logbooks, and therefore must be determined through other fields. In these analyses, species targeting was addressed through a catch percentage factor (expressed in quartiles) established for each fishing record. Here, it is assumed that lower species catch percentages account for lower rates of species targeting, although this was not made explicit in the GLM. Therefore, the effect sizes of different catch percent quartiles are freely estimated. This detail has been added to the report.

Reviewers: Provide some focussed discussion on the low mortality scenario – in response to recent research that has indicated that, for the adult population at least, there is slow growth and potentially low mortality (e.g. Prickly redfish; Purcell et al. (2016)).

Authors: A section of the discussion has been dedicated to the low mortality scenarios. These scenarios (applied to all six stocks) represent one of the few model options where more pessimistic (but still not concerning) estimates of stock status were produced. However, these scenarios provided the poorest fits to the data (especially biomass) and had little model support as a plausible option. Likelihood profile figures added to the report further demonstrate this. We also note that slow growth is specified in the Stock Synthesis model for prickly redfish based on the results from Conand (1989). That study used these same growth estimates to estimate natural mortality which we used as the base case in this assessment. The results of Purcell et al. (2016) do not provide contrary estimates of natural mortality but rather general statements around life history correlates.

Reviewers: Investigate potential to include the survey data from the early fishery population surveys for Burrowing blackfish, for Lizard/Waining and Gould Reef as this would strengthen the assessments.

Authors: This was discussed in detail during the workshop, and we thank their reviewers for their detailed contributions on this topic. Historical biomass estimates from Lizard/Waining in 2005 and Gould Reef in 2004 will be added to both Stock Synthesis and DDUST models.

Reviewers: Address the inconsistency between the relatively optimistic finding in the stock assessment modelling that the current population is at 78% of B_0 (Smart et al. 2024a) and the industry survey report that concludes that 'the low densities of BBF recorded in the current survey of commercially fished areas of the Primary Waining Reef stratum and Primary Lizard Island stratum are of concern' (Koopman et al. 2022) and the implementation of a voluntary closure by industry.

Authors: We will expand the discussion on this topic. The addition of the historical survey data will provide more model certainty for this stock which will also be incorporated into this section. We have added a figure displaying raw catch rates by boat day. These show that catch rates declined in Lizard

in recent years and are now lower than the other BBZ. Lizard therefore represents a large population that is spread over a greater area at lower densities. Accordingly, this BBZ, while having the largest population, appears to be the least economically viable in 2023. Industry also noted the retirement of a drift boat from the fleet in 2023 that would normally fish the Lizard BBZ and attain more profitable catch rates. The timing of this removal does not impact the catch rates used in this assessment, but it does demonstrate the multi-faceted nature of this situation. This will be better captured in the discussion to explain this discrepancy.

3 Reviewers' future stock assessments recommendations for authors

Reviewers: Develop spatial explicit population models to address possible localised depletion.

Authors: While we agree with the reviewers that spatially explicit models are preferable for these species and the QSCF, there is insufficient data available to support this level of model complexity. It is also unlikely that sufficient information will be obtained in the future. One key reason for this is the size of the fishery (when considering individual species) and its large geographic range. There is simply insufficient fishing activity through time and space to attain the level of data required to support a spatially explicit model.

Reviewers: Address possible size-dependent mortality.

Authors: We agree that this would be valuable and if researched could be incorporated in future Stock Synthesis models. However, this would likely need to be undertaken as part of a larger research program rather than a component of the stock assessment modelling process.

Reviewers: Investigate potential assessment and management approaches for 'dynamic' population patches (for BBF only).

Authors: At this stage, this topic is best addressed through ongoing biomass surveys. Changes in the population over time can be considered with the corresponding removals (i.e., catches) between surveys. However, a greater time-series than is currently available would be needed for definitive conclusions to be made. Once multiple biomass surveys are available, the potential for dynamic populations could be considered within the stock assessment process and management recommendations could be made.

Reviewers: Consider investigating environmental drivers of these sea cucumber populations and potentially incorporating the drivers into stock assessments.

Authors: Research by Macquarie University scientists is currently being undertaken to better understand the ecology of key species in the QSCF. This research is intended to inform, and be incorporated into, future assessments once it is complete.

Reviewers: Consider joint assessments among all three east coast fisheries to help reduce risk to species in the region.

Authors: We agree that this would be beneficial for any stocks shared across the three fisheries.

4 Additional points raised in the review

Reviewers: It was suggested that a Ricker stock recruitment relationship, in which recruitment rates are suppressed at high adult densities, could be included as a scenario.

Authors: A Ricker stock recruitment relationship has been included as an alternative to the Beverton and Holt relationship as a scenario for Stock Synthesis. This option is not yet available in DDUST and cannot be tested.

Reviewers: How the rho parameter was derived for the DDUST models also needs to be made explicit in the report.

Authors: This detail will be added to the reports. Some sensitivity scenarios for the rho calculations will also be included.

References

Buckworth, R and T Skewes (2024). *Independent Review of Sea Cucumber Stock Assessments Report to Fisheries Queensland, Department of Agriculture and Fisheries, FQ24013 Unpublished. 28p. Sea Sense Australia Pty Ltd, Mission Beach, Qld Australia.* report.

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