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Indian Ocean Bigeye Tuna Management Procedure Evaluation Update

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Executive summary

- The most recent bigeye OMs and candidate MPs were presented at the MSE taskforce meeting (March 2021) and TCMP (June 2021).
- The bigeye Operating Models (OMs) and the MP evaluation process are at a reasonably mature stage, with a suite of potentially viable candidate MPs that all achieve current tuning objectives
- Given this relative state of maturity, we seek a discussion within the WPM on endorsement of the OMs and selection of a set of candidate MPs for adoption of a final MP within the IOTC structure
- We do, however, note that a revision of the length-at-age relationship for this species is to be presented at the WPTT which could have potential implications for the robustness of the current suite of OMs. We discuss this in the context of having a data and OM “guillotine” requirement (as agreed at WPM MSE taskforce 2021) and a well-defined process for handling exceptional circumstances.

1 Background

The bigeye OM has changed very little since 2019 and, according to the most recent TCMP report (Anon. 2021a), is due for presentation to the SC this year for consideration. The only major substantive change to the suite of candidate OMs and MPs was the introduction of MPs (PT-Proj) that combined the state-space Pella-Tomlinson production model with a constant catch projection designed to mimic the key features of the Kobe strategy matrix K2SM (Kolody & Jumppanen, 2021). The addition of these MPs appeared to lower catch variation while maintaining the required performance in terms of attaining the key biomass objectives. There are 6 remaining candidate MPs that have been evaluated via the MSE process. The next step is to narrow this set down and make a recommendation for a single MP.

2 Current general OM ensemble structure

The OM is still as defined in Kolody & Jumppanen (2021a) with the reference set (OMrefB20.1) being a suite of 72 equally weighted models from the fractional factorial design, from which 500 realisations are drawn (with replacement). The accompanying suite of robustness tests cover the following alternative scenarios/hypotheses:

- Increased overall variability and autocorrelation in the key CPUE index used as an input to the candidate MPs
- A number of implementation error scenarios encompassing different levels of both overcatch and reporting accuracy
- An increased 3% trend in the catchability of the key CPUE index
- A recruitment “shock” scenario (55% of the expected level for 8 consecutive quarters)
- Reference set but using Pope’s approximation in the construction of the catch equation
- Reference set but with an “Effort Ceiling” set at 2 (Fs cannot be 2 times greater than 2016-2017 average) and also combined with uniform distribution of ages among regions each quarter

3 Current tuning objectives and candidate MPs

The 2021 meeting of the TCMP retained the previous two tuning objectives for bigeye tuna but requested that developers remove the reference years of 2030-2034 and replace them with relative placeholders, such as 11-15 years from model terminal year (Anon. 2021a). Accordingly, the bigeye tuna tuning objectives are:

B2: Pr(Kobe green zone 11-15 years) = 0.6. The stock status is in the Kobe green quadrant over the period 11-15 years from model terminal year exactly 60% of the time (averaged over all simulations).

B3: Pr(Kobe green zone 11-15 years) = 0.7. The stock status is in the Kobe green quadrant over the period 11-15 years from model terminal year exactly 70% of the time (averaged over all simulations).

The current suite of 6 candidate MPs is defined and evaluated against the tuning objectives in Kolody & Jumppanen (2021b). The 6 candidate MPs include one Harvest Control Rule (HCR) functional form from each of 3 MP classes:

- CPUE – an "empirical" MP that seeks to stabilize the standardized longline CPUE at a target level, that ideally should correspond to a desirable stock size.
- PT-HS – a model-based MP, which fits a simple population model, then prescribes the TAC as a hockeystick-shaped function of the estimated stock depletion.
- PT-Proj – a model-based MP, which fits a simple population model, then uses internal projections to solve for the constant TAC that is most likely to attain a pre-defined biomass depletion target in a specific number of years.

4 Remaining issues

The only major request from the TCMP report was for the WPM to consider asymmetric TAC constraints (e.g 15% for increases and 10% for decreases) (Anon. 2021a). Ultimately, the only true way to test such a change is to actually include them in the suite of MSE simulations. However, previous experience would suggest that such a minor change is unlikely to result in a meaningful and – hopefully – positive change in the MP performance metrics. Given the MPs are being tuned to attain a particular objective, a small change to the operational constraints such as this will tend to be absorbed into whatever changes are required in the key Harvest Control Rule (HCR) parameters. All other things biological and fishery being equal, a given OM scenario will have some kind of average cumulative catch that will meet the tuning objectives for candidate MPs that have similar performance attributes. If we make such a minor change (increases are 5% bigger than decreases at the extrema) the tuning process will usually change what it needs to so that the required cumulative catch is met so that tuning is achieved. We wouldn't expect to see any meaningful change in say average catches, simply a small increase/decrease in the TAC variability if the asymmetry increased/decreased at the relevant upper or lower level. The only time asymmetry like this tends to be beneficial when tuning is being done is when the MP must move the biomass in a specific direction over a possibly restricted timeframe. If an MP has to significantly increase/decrease the SSB over time, having larger maximum TAC decreases/increases, respectively, can be useful. The current suite of candidate MPs all tend to increase the TAC from the current level some 10-20% over the 2023-2037 period (Kolody & Jumppanen, 2021b) so perhaps some asymmetry allowing larger increases and then decreases would be beneficial. The counterpoint is that they are able to tune to the objectives and result in

TAC variability levels around the 5% level (Kolody & Jumppanen, 2021b) and, particularly for the PT-Proj candidate MP, doesn't appear to be hitting the boundaries overly regularly. This suggests it doesn't require additional flexibility to achieve the tuning objectives and produce acceptable performance across the other metrics.

Given there is no new information on population dynamics parameters or historical stock status estimates from a stock assessment of bigeye tuna this year, the only potential change to any of the key OM variables is the update of the length-at-age distribution due to be presented to the WPTT after the WPM has concluded. It is obviously the initial role of the stock assessment to ascertain what difference – if any – potential changes to the length-at-age relationship will have on the estimates of stock status. The question that the WPM might want to discuss is whether this will affect the current state of the bigeye MP evaluation and its potential consideration at this year's SC. To assist in this discussion, we would suggest that a defined process for handling exceptional circumstances is the currently accepted best-practice approach to planning for future outcomes outside of the MSE testing domain, without attempting to pre-emptively define exactly what one has to do for a particular exceptional circumstance. Preece et al. (2021) has more detail on this matter and the key role that a well-defined process has in a functional and efficient implemented MP. We would stress the importance of both time "guillotines" (pre-agreed dates where no further data or OM updates are permitted without very compelling reasons) and a well-defined but not overly prescriptive process for handling exceptional circumstances in a measured and organised fashion.

5 Summary

The most recent suite of bigeye OMs and candidate MPs were presented at the taskforce meeting (March 2021) and TCMP (June 2021). In this paper, we discussed the request to consider asymmetric maximum TAC changes that came from the TCMP (Anon. 2021a). Given the current performance metrics for the leading candidate MPs and previous MSE experience relating to these kinds of factors, we suggest that such a minor change is unlikely to either meaningfully improve MP performance or give additional required flexibility to the current suite of candidate MPs to meet the tuning objectives. However, the only way to truly demonstrate this is through including these asymmetric limits into the MPs and evaluate via MSE. There will be an update to the length-at-age relationship presented to the WPTT after the WPM concludes, but no new information on other parameters and variables in the OMs. New information can be considered in the wider context of ensuring we have well-defined data and OM time "guillotines" (pre-agreed dates past which data and OM changes are not permitted unless crucial) and a well-defined process to deal with the potential emergence of scenarios outside the MSE testing space. The next step is to narrow down the 6 remaining candidate MPs that have been evaluated via the MSE process and make a recommendation for a single MP.

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