Title: Review of IOTC MSE Process and Methods Meetings.

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Summary: An overview of the processes and OMs used for Albacore (ALB), Yellowfin (YFT) and Bigeye (BET) were examined. Skipjack (SKJ) was covered with respect to what needs to be developed next and what a full Management procedure (MP) would entail. Finally, swordfish (SWO) is initially being set up with regard to conditioning. The ALB, BET and YFT OMs are completed, and candidate HCR's are being tested currently. Issues with respect to projectiosn were discussed, and further clarity in the robustness tests to be examined were discussed, and reference set of OMs were also discussed.

Keywords: Integrated assessment, CPUE, likelihood, data weighting, plausibility, conditioning and Management procedure

Introduction

The WPM was held in Mahe, Seychelles between 25th October and 27th October, 2018. The participation at the meeting included representatives from CPCs involved in the Tropical tuna fisheries (Taiwan,China, EU.Spain, EU.France, Japan, Sri Lanka, Thailand, China, Australia, and Sweden). This report addresses various issues that are important to WPM and other issues being dealt with at the WPM. This report focuses on where the MSE is headed with various species currently being examined in the IOTC. The notes on each species are summarized below.

Bigeye Tuna (BET):

Plausibility criteria were investigated and presented at WPM. Some models in the grid structure examined didn't converge; it was noted that the gradient criteria was most appropriate criteria to use to examine convergence. Models were hitting bounds (lower bounds not an issue) is some cases. This is an issue that needs to be examined more thoroughly, as estimation procedures that were iteratively hitting bounds can influence the assessments quite dramatically. Out of 254 models, MSY distribution examined was similar to the distribution obtained from the 2016 assessment output. Depletion with respect to assessment were also centered around the median assessment. It was discussed at length whether to sample models from the grids such that the distributions on MSY obtained from the grid relative to assessments were similar. **But, then an issue was raided as to why bother with the MSE. Just do an assessment, and base your management advice on that.**

Issues with Conditioning on BET

Primary issues such as the spatial structures examined and BET growth equation used can have a large effect on the outcome of the assessment/grid. How good are the reported catch estimates and how does this effect the outcome of the MP? Other issues were the growth curve examined, area boundaries used, and catch uncertainties that were not examined. Re-evaluating the growth curves to be used should be part of the reference set of OMs examined. Robustness scenarios and alternative catch series (rather than make one up it has to be scientifically based) would also need to be provided. The effect of regional scaling factors on CPUE, and how it could affect the outcome of the conditioning could also be examined. Issues of what we can do with a "robustness trials".

Projections examined used initial population estimates with uncertainty, cpue cv=0.2, autocorrelation=0.5…etc, etc. selectivity stationary, catch fixed in 2019 to 87K set last catch value. These appear to be reasonable assumption for projections.

Possible issues with BET OMs examined:

- Not dealing with changing allocation scenarios have not been dealt with. This should be examined in future simulations.
- Robustness scenarios examined:
    - These were unlikely scenarios, but pushing limits on MPs examined so far. These scenarios need to be precisely defined. In addition, more dimensions should be added to the reference case OMs. Ricker, recruitment failure, alternative catchability and variability in parameters used could be some of the scenarios examined.
    - How well does fishery catch TAC is another issue that should be examined. Implementation error CV=10% vs 40% could be some other scenarios examined.

Note, that a partial factorial design for OM specifications could be used (3 way interactions maybe important and should be part of the grid). Note, reducing the dimensionality is key so other axis could be examined along with the factorial design, i.e. a main effect approach such as that examined by the IWC (Punt and Donovan 2007).

Robustness Test specs for BET

- If growth isn't part of the reference OM used, a growth misspecification not currently examined in the reference could be tested in the robustness scenarios. In addition the MP tested was robust to large uncertainties in catchability changes in the LL fisheries (3% over year).
- Focus on Implementation error 10% and underestimated catch histories as there were species identification issues between YFT and BET in some of the countries with large catches (e.g. Indonesia).

Yellowfin Tuna (YFT)

In the OMs examined, migration was not used in the way the assessment used it using environmental indices. This could be examined to force movement in the future between areas. In examining the OMs, many implausible models were detected when running the grid. This stems primarily from the different productivity estimated in the OM than assessment perception. The OM conditioning examined supports low M values, and a low steepness value that seem unrealistic.

Key issues here on conditioning for YFT:

- MSY was around 400K. Below 200Kt and greater than 800Kt MSY were discounted.
- Without tags, steepness assumed (0.8) caused a loss of fit. Don't fit SR curve well (systematic residual patterns were observed), and decline in Recruitment over time was also seen. Note, that when steepness was estimated, h=0.91 with tags and h=0.21 without tags. This shows the inherent conflict in the tagging data and how it influences the assessment.
- There was also possible issues on non-stationarity on recruitment levels in multi-areas.
- Nature of the timeseries is important to consider as filtered models may take out some axis that are important otherwise (just examining B0 or depletion or MSY may miss the nature of the timeseries and resonant cohort effects (Bjornstad et. al. 2004).

Note the way that models were weighted based on a posterior on the MSY distribution makes sense (similar to Martell et. al. 2008) and is recommended so that outlier models were discounted. However the range of uncertainty maybe too tight as it had narrower bounds. It would be good to compare this to feasible biomass estimates/trajectories based on available area (like ALB) or whether the range can vary between 0.5 to 2 of the median estimate like BET.

With regard to Robustness tests for YFT:

- Robustness tests examined gave expected outcomes, i.e. a high risk to the YFT stock if recruitment failure is modelled.
- Again an axis of OM conditioning is that growth is missing, we could either add that in robustness cases and would be discussed in WPTT. Note, rather than keeping life history parameters independent, options of grid specifications, i.e. fast growth should be coupled with high steepness & high natural mortality, M. This would examine a narrower set of OMs for testing.
- Projection characteristics examined need to produce sufficient uncertainty on the stock. Issues for projections examined were the following:
    - Initial population states (with added error) and most parameters defined by the SS specifications
    - stationary selectivity for all fleets, could be changed in some scenarios.
    - CPUE CV = 0.3 (quarterly, autocorrelation = 0.5)
    - quarterly recruitment CV = 0.6 (quarterly, auto-correlation = 0.5)
    - first TAC implemented in 2019; bridging catches 2016:2018 = 413Kt (2016 level)
    - catch implementation error CV = 0 seems overly optimistic and should have some uncertainty examined.

Possible additional Robustness tests for YFT:

Testing 2 scenarios that make biological sense could be examined in the reference or robustness grids. Older age biomass in some areas can be either due to lower M at older ages, or dome shaped selectivity in area 2-4. Possible scenarios for robustness testing could be examined here :i) choosing scenarios that look at low h, low M, and logistic selectivity could be and alternatively ii) look at high steepness, high M , and dome shaped selectivity could be another option (see Kolody and Herrera 2011 and/or Sharma and Herrera 2014).

Albacore Tuna (ALB)

There was no update for this meeting. However, there has been some work done on MP and performance. Pella Tomlinson Model need to be tested on convergence criteria and sensitivity to starting values. Exceptional circumstances needs to be incorporated with regard to how the assessment is done/data used/recruitment issues, etc. In addition, growth curve examined could be extended in a robustness scenario or be made part of the reference set of models examined.

Skipjack Tuna (SKJ)

A primary issues here was to review the current HCR and whether it meets all the criteria. Proceed with plan in 16-02, need to be provided a review (see Bentley and Adam 2015). Is this an exceptional circumstance, and thus needs re-evaluation. The issue of MP is not a WPM issue but COM issue.

Swordfish (SWO)

Swordfish has just initiated some preliminary OMs. There are issues with choosing the plausible runs as seen with ALB and YFT. How to eliminate unnecessary OMs is currently the topic of focus of this group and more work will be examined in the future.

OVERALL ISSUES with respect to MSEs

The CCSBT model (Hillary et. al. 2016) of grid based conditioning based on the assessment is the primary procedure that is being adopted. However, as pointed out in the joint tRFMO

process, this maybe an overkill as many runs are just scaling B0 and not providing any new information in the time series being analyzed. It was noted at the joint tRFMO that the whaling Commission approach with main effects being changed and examining in detail the sets of OMs used in a more viable approach as issues of plausibility and error checking are somewhat easier (Punt and Donovan 2007). Note, that this was not discussed at all in the context of what was being done at IOTC and should be examined in future to expedite OM design and focus on MP performance on a set of viable OM models setup.

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