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Projections based on 2011 stock assessments

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Oceanic Fisheries Programme - SPC

Projections based on 2011 stock assessments

Oceanic Fisheries Programme

Summary

This paper provides a brief overview of the generic forward projections that were undertaken using the reference case models for the 2011 assessments for bigeye, skipjack, and yellowfin tunas. Similar methods were used as in previous years and the results are provided in the form of an excel spreadsheet with a separate worksheet for each species. Projections were run using two recruitment assumptions – spawner recruitment relationship-based estimates, and the ten year recent average. The former may be more appropriate for yellowfin and skipjack tuna.

There are many important data issues that, while likely having minimal impact on the stock status conclusions of the assessments, will have a critical bearing on the interpretation of the projections results summarized here. These issues arise partly because this is the first year that projections have been undertaken with the current assessment so early in the year (i.e. for the SC).

Depending on the outcomes of SC7 with respect to choosing those assessment model run(s) to be used for the provision of management advice, these projection results may be updated after the SC and, if necessary, a different (e.g. finer) grid could be used.

Introduction

The results from forward projections of stock status based upon stock assessment models outputs have formed one of the pieces of information used by the Commission to inform management decisions. In this paper we present projection results based on the 2011 stock assessments of bigeye, skipjack and yellowfin tuna within the WCPO. We provide an overview of the basic methodology employed and key assumptions made. The results themselves are not described in detail within this paper, but are provided in an accompanying excel spreadsheet.

Methods

Similar assumptions were made in the current projections as in previous analyses (e.g. OFP 2010). The main assumptions were:

- The reference case model from each stock assessment was used[1];

[1] See SA-WP-2 (bigeye), SA-WP-03 (yellowfin), and SA-WP-04 (skipjack) for further information

- The projections were deterministic in that no process or estimation error was assumed in the projections;
- The projections were run for ten years after the full implementation of CMM2008-01, i.e. from 2012-2021;
- Two alternative assumptions were assumed for future recruitment:
    - at the average of the level estimated over the last ten years of the model, as recommended by SC6 (actually we exclude the recruitment estimates from last year of the model and take the average of the proceeding ten years – ignoring seasonal patterns);
    - the mean levels predicted by the spawner recruitment relationship (SRR) assumed for the reference case model (steepness was fixed at 0.8 rather than estimated in the reference case models);
- Catchability (which can have a trend in the historical component of the model) was assumed to remain constant in the projection period.

The projections started from the beginning of 2012, after the final year of reductions in fishing impact under CMM2008-01, allowing the investigation of management options following on from that CMM's implementation. A key assumption was the levels of catch and effort for 2011 and we assumed that the levels of catch and effort observed in 2010 would continue through to 2011. There are no extra purse seine measures in 2011 over those in 2010 and longline catches for many of the major fleets were already below their 2011 limits in 2010. For each species catch was used in projections for all longline fisheries while effort was used for all others.

These conditions were then used as a base case (i.e. catch or effort scalar of 1.0) for the projections from 2012 through 2021. For the generic projections, we applied catch or effort scalars of 0.7 to 1.3 in 0.15 increments to each of the (grouped) longline fisheries, purse seine fisheries (associated sets) and Indonesia and Philippines domestic fisheries outside archipelagic waters.

The application of the five catch or effort scalars to each of the 3 fishery groups in all possible combinations resulted in 5^3 (125) projection scenarios for each of bigeye and yellowfin tuna, and 5^2 (25) projection scenarios for skipjack (since there are no commercially significant longline fisheries in the skipjack assessment, there are only two fishery groups). These scenarios were repeated for each of the two recruitment assumptions.

Note that the scalars for the purse seine fishery were applied only to the associated set component and total purse seine effort (days fished) was assumed to remain constant. This was done to mimic the use of FAD closures to modify purse seine effort. We allowed any reduction (or increase for the scalars 1.15-1.3) in associated set effort to result in a corresponding increase (or reduction) in unassociated set effort. This represents a transfer of effort from (or to) associated sets to (or from) unassociated sets. For example, for an associated set effort scalar of 0.7, it was assumed that the 30% of associated set effort removed from that component would transfer to the unassociated set purse seine component, as was observed during the 2009 FAD closure.

Performance statistics for all projections included F_{2021}/F_{MSY}, total estimates of spawning biomass, and catches for different fisheries groups. For projections undertaken using SRR-based recruitment we also provide SB_{2021}/SB_{MSY} and SB_{2021}/SB_0 as performance statistics. For model runs where recent average recruitment was assumed, the historical estimates of SB_{MSY} and SB_0 are no longer valid, especially when there is a considerable difference between the two recruitment levels (e.g. bigeye tuna assessment). In such circumstances depletion estimates (e.g. $SB_y/SB_{F=0}$) would be more appropriate but we have not included these here due to time constraints.

Results and Discussion

Figures 1-3 provide recent historical and projected recruitment, F/F_{MSY}, SB/SB_{MSY} (SRR projection only), and total catches for the status quo projections under each recruitment hypothesis. Note, that as the MSY-based reference points were calculated based on the age-specific fishing mortality profile the end of the projection period, there is a difference in the MSY-based reference point estimate under the two recruitment scenarios. This is most notable in the bigeye projections where catch (e.g. longline) is more influential.

There is a requirement to mimic, as close as possible, the stepped reductions agreed under CMM2008-01. The stock assessments, and in particular the projection analyses, have become more reliant, and therefore more sensitive to, the pattern of fishing in the most recent year. Data from the most recent year are typically the least reliable and can be subject to under- or over-reporting due to data coverage issues. In the stock assessments we minimize the impact of these data by not including the estimate of fishing mortality in the final year in our calculations of stock status (uncertainty in recruitment is also a concern), but the desire to include this 'up-to-date' information in the projections can lead to problems in interpreting the projection results.

The following issues are likely impacting on the species-specific projection results:

<u>Bigeye tuna</u>

- After a query from SPC, Japan submitted revised LL catch estimates for 2010 after data were finalized for the assessments which were higher than those originally provided (Peter Williams, personal communication). It is likely that other DWFNs might also be in a position to provide revised catch estimates;
- There are very significant catches taken by Chinese flagged vessels in Kiribati waters in 2009 that appear to not be included in total catch statistics (or the assessment) and there are concerns about catch estimates for this fleet for other years (Williams 2011a)
- Indonesian longline catches have been revised considerably over time and the most recent estimates are based on species composition estimates which indicate a far lower proportion of BET in the longline catch than previous years (Williams 2011b). It is not yet clear if previous catch estimates should be reduced.
- There was been an increase in 2010 in the proportion of Chinese Taipei's longline catch which was taken from the WCPFC/IATTC overlap area (Peter Williams, personal communication) and

these catches are not included in the WCPO assessments. It might not be appropriate to assume that this reduction will continue.

- For most distant water longline fleets, the 2010 aggregate catch and effort data available at the time of the assessment appeared to be greatly skewed towards the first half of the year (Figure 4), with very low catches in the second half leading to a dramatic dip in estimated fishing mortality. This is most likely due to incomplete data – it is not clear if this also impacts on the total catch estimates
- We assumed 100% implementation of the FAD closure (and any future extended FAD closures) outside archipelagic waters in the projections, but this has not been observed in 2010 (Hampton and Williams 2011)

Skipjack tuna

- 2010 had the highest unassociated set catch of skipjack on record (Williams and Terawasi 2011). Related to this is the very high estimated catchability for this fishing type in Region 2 (western equatorial region), which is carried forward in the projections and reduces the impact on any further transfer of effort from the FAD fishery.
- Purse seine logsheet data is still being entered for 2010 and more precise estimates will be available as the current year progresses.

Yellowfin

The concerns regarding longline catches noted for BET above may have implications for the YFT projections, but the impact will be much less due to the lesser impact of this fleet on the YFT stock. Also, any updates to purse seine effort will have some impact.

Further work

Depending on the outcomes of SC7 with respect to choosing those assessment model runs to be used for the provision of management advice, these projection results may be updated immediately after SC7. This will only be useful for bigeye tuna if the major data issues raised above can be addressed.

References

Hampton, J. and P. Williams. 2011. Analysis of purse seine set type behavior in 2009 and 2010. WCPFC-SC7-MI-WP-01.

OFP. 2010. Review of the implementation and effectiveness of CMM2008-01. WCPFC7-2010/15 (rev 1).

Williams, P. 2011a. Problems with longline aggregated catch and effort data submitted by China. WCPFC-SC7-ST-IP-03.

Williams, P. 2011b. Changes to the data available for stock assessment. WCPFC-SC7-SA-IP-04.

Williams, P. and P. Terawasi. 2011. Overview of tuna fisheries in the western and central Pacific Ocean, including economic conditions – 2010. WCPFC-SC7-GN-WP-1.

Figure 1: Recent historical and projected recruitment, F/F_{MSY}, SB/SB_{MSY} (SRR only), and total catches for bigeye tuna under the status quo projections for each recruitment hypothesis

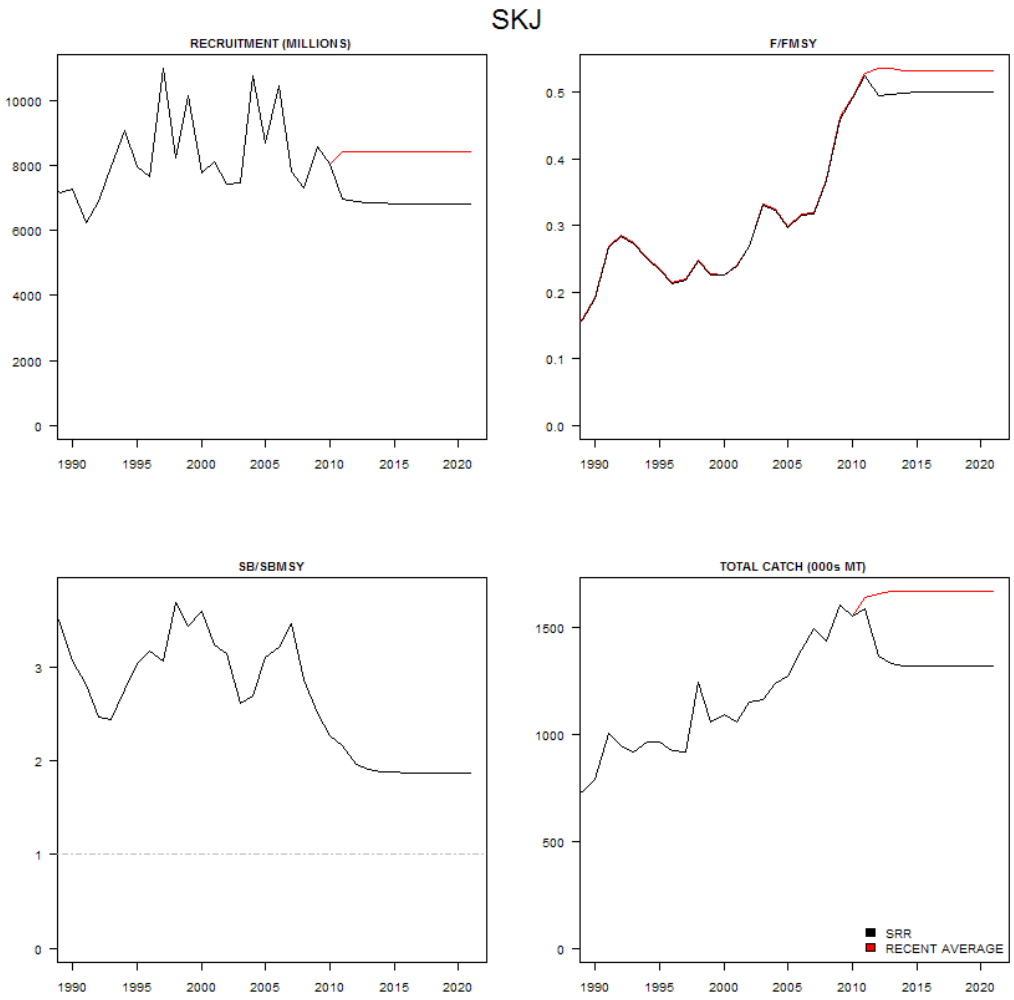

Figure 2: Recent historical and projected recruitment, F/F_{MSY}, SB/SB_{MSY} (SRR only), and total catches for skipjack tuna under the status quo projections for each recruitment hypothesis

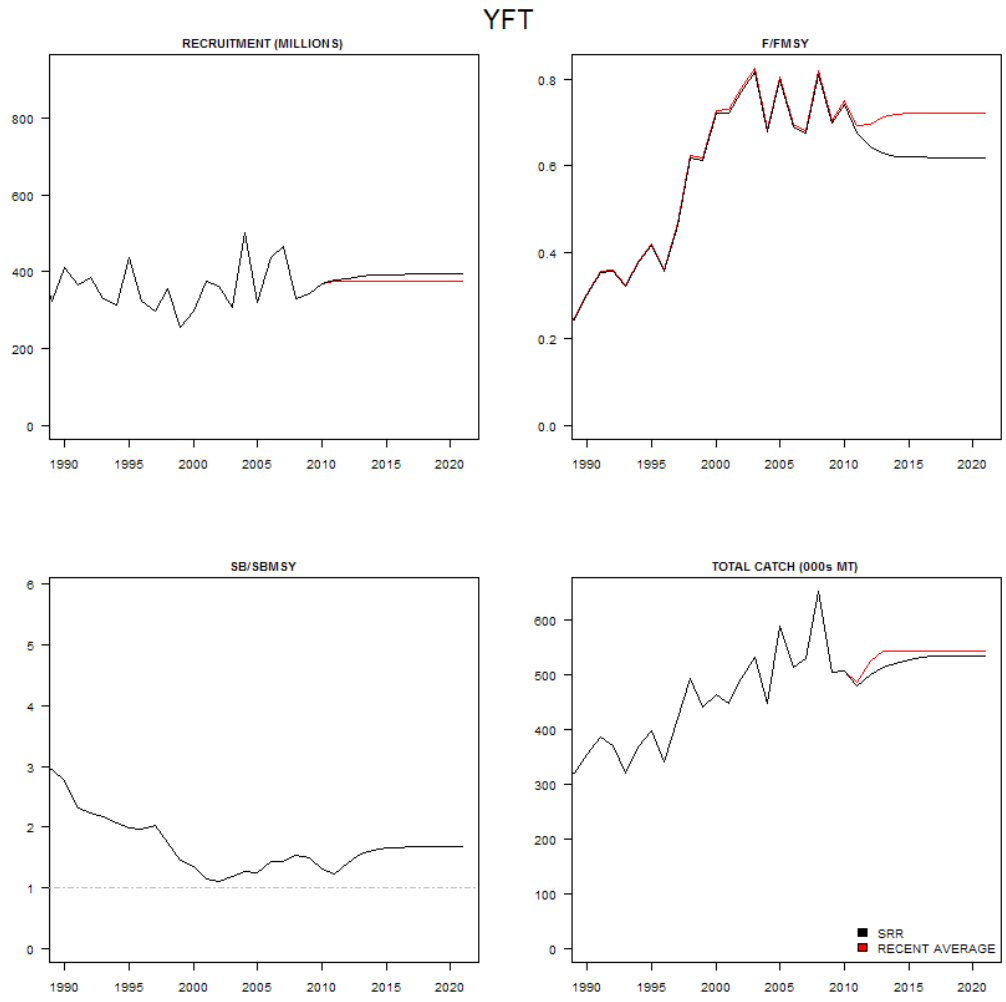

Figure 3: Recent historical and projected recruitment, F/F_{MSY}, SB/SB_{MSY} (SRR only), and total catches for yellowfin tuna under the status quo projections for each recruitment hypothesis

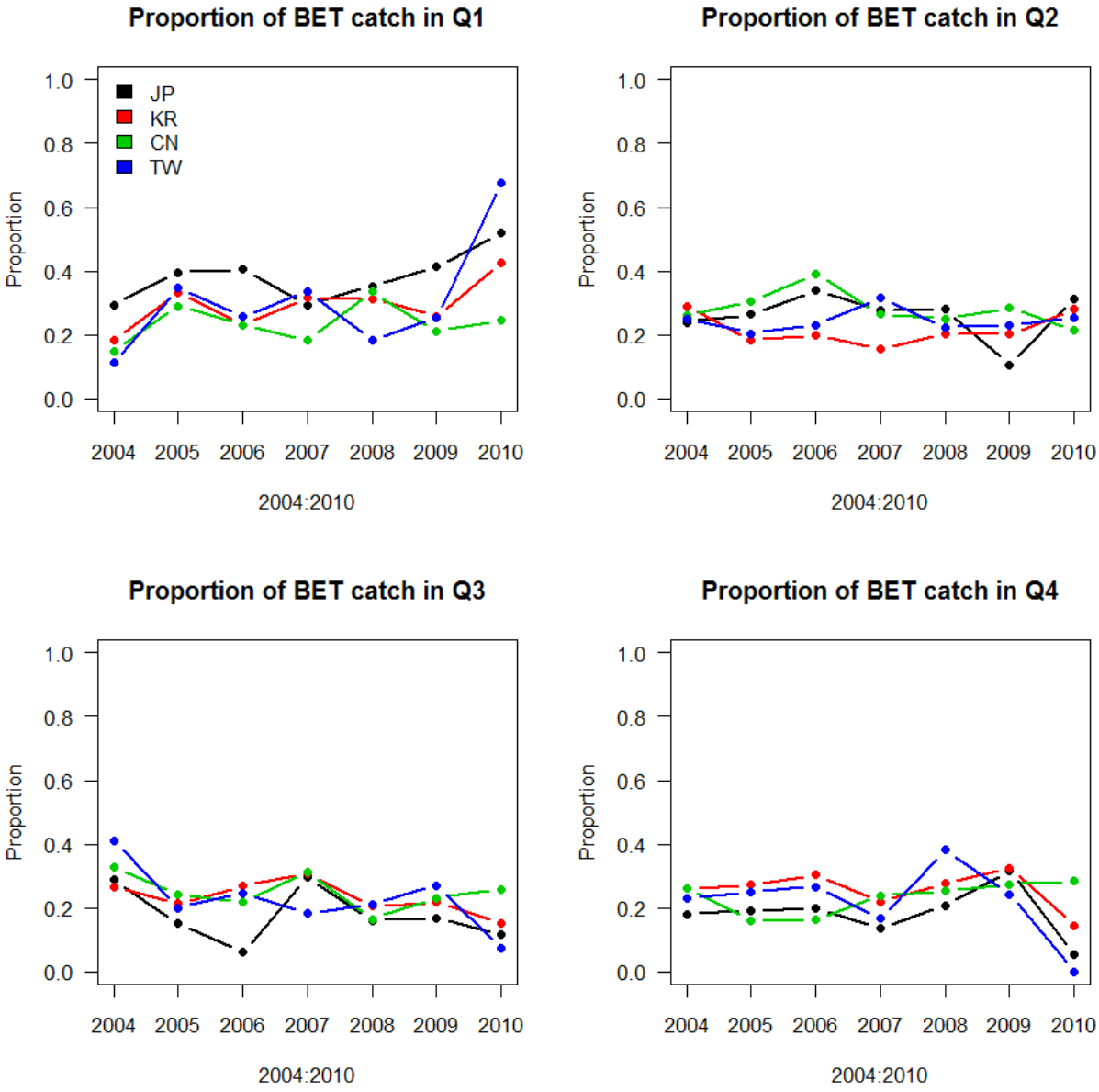

Figure 4: Proportion of total annual longline catch of bigeye tuna from Region 4 (central equatorial region) that is reported for each quarter.