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**Report from the SPC pre-assessment workshop, Noumea, April 2010**

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## Introduction

To assist it in undertaking its stock assessments for the WCPFC, OFP sought input from stock assessment scientists in the region. The fifth pre-assessment workshop was held in Nouméa, New Caledonia 6-10 April 2010. Seventeen scientists from twelve organizations participated in the workshop as well as OFP-SPC staff (see Appendix 1). The agenda was focused on stock assessment methods, the proposed approaches for the stock assessments for bigeye and skipjack tuna, and methods for evaluating management options and reference points (see Appendix 2). Presentations were made by SPC staff and some of the other participants. The meeting operated under the terms of reference provided in Appendix 3 and was chaired by Dr John Hampton, Head of the Oceanic Fisheries Programme.

Whilst the Terms of Reference indicated that the meeting report would be distributed within ten days of the end of the meeting, some meeting participants requested that aspects of the report relating to the proposed model runs for skipjack and bigeye tuna be reviewed and finalized within the meeting. It was recognized that this would reduce the scope for additional analyses to be undertaken during the week, but effort would be made to accommodate the request.

This report briefly describes the various presentations made and reports the conclusions. The outcomes of this meeting will be reflected in the papers submitted to WCPFC-SC and copies of the PowerPoint presentations prepared by SPC can be provided on request (but note that some are large).

## Management-related analyses

### Evaluation of Management Options

Dr Shelton Harley provided an overview[2] of the approaches that have been used for the evaluation of potential management measures and the bigeye and yellowfin conservation and management measure. The presentation covered analyses undertaken in 2008 using the yield-based approach[3] and those undertaken in 2009 using catch and effort based projections[4,5]. The purpose of the presentation was to

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[2] Pre-Assess [Projection methods].pptx

[3] SPC. 2008. Predicted impact of potential management measures on stock status and catches of bigeye, skipjack, and yellowfin tunas in the Western and Central Pacific Ocean. WCPFC-TCC4-2008/14 Suppl. (available at www.wcpfc.int)

[4] Hampton, J., and Harley, S.J. 2009. Assessment of the potential implications of application of CMM2008-01 for bigeye and yellowfin tuna. WCPFC-SC5-2009/GN-WP-17 (available at www.wcpfc.int)

[5] SPC. 2009. Further consideration of CMM2008-01 with respect to bigeye tuna. WCPFC6-2009/IP18 (available at www.wcpfc.int)

get a shared understanding among participants of some of the key strengths and weaknesses of the two approaches, in particular, an understanding of the differences between projecting reductions in effort and catch. One of the interesting results from the projections was the inability of some fisheries, constrained by catch limits, to actually achieve those limits due to reduced stock status. In such situations the fishery-specific fishing mortality (and therefore effort) required to take the catches increased.

The workshop:

- Noted that it would be useful to provide a similar presentation to SC-6 to improve the general level of understanding of the methods used to evaluate management options
- Recommended that plots of fishery-specific fishing mortality from the projections be produced to assist in understanding the implications of catch-based projections.
- Noted that the management option analyses requested at SC-5 (Appendix x) would be undertaken for SC-6 using the same model used for the 2009 evaluations. After SC, the analyses may be repeated for the Commission meeting using the 'best' model (or models) chosen at SC-6.

## Technical analyses in support of reference point work

Dr Shelton Harley presented an overview[6] of some of the technical aspects relating to the reference point work requests from SC 5. The focus of the work from SPC would be to evaluate firstly the probability that particular reference points have been exceeded in recent years, and secondly the impact of adopting particular reference points evaluated through stochastic projections. The importance of accounting for the dynamic nature of variance reference points, e.g. MSY and depletion-based reference points was emphasized. Dr Harley also noted the importance that many Commissioners (at WCPFC-6 in Tahiti) had placed on the multi-species impacts of reference points. There are several potential methods available within MULTIFAN-CL for evaluating probabilities associated with reference points, but not all methods are available for all the potential reference points that might be considered.

With respect to evaluating the impacts via projections of adopting particular reference points, the following approach was proposed:

- Use existing stock assessments
- Use some spawning biomass-based limit reference points, e.g. x%B0 and x%BMSY
- Use difference proportions associated with exceeding the reference points, e.g. 5% and 10%
- Under each scenario determine the fishing mortality scalar (f-mult) that meets that objective, i.e. combination of reference point and probability
- Output expected catch and biomass
- Apply that f-mult to the yellowfin and skipjack assessments and output catches etc.

## Bigeye tuna

There were several presentations covering various aspects of the BET assessment.

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[6] Pre-Assess [ref points].pptx

## Review of the 2009 bigeye assessment

Dr Shelton Harley provided a summary of the SC-5 presentation[7] of the 2009 assessment. Main features of note were the continued estimation of a strong increasing trend in recruitment, improvements to catch estimates from the Philippines, improved biological parameters, and estimates of stock status consistent with those from previous assessments.

The workshop:

- Noted that the shifting time window for estimating 'current' stock status had led to confusion amongst some, but that it was necessary to move this window for accurate determination of current status.
- Recommended that future assessments include a table showing F/FMSY and SB/SBMSY by year, including averages for key periods, e.g. 2001-2004, for recent assessments so to allow consideration of how our interpretation of stock status changes over time (with additional data and improvements to the assessments).

## Review of some of the major data sets used in the 2009 bigeye assessment

Dr Shelton Harley presented a summary[8] of the main longline data inputs used in the 2009 bigeye assessment. The presentation examined the region specific trends in catch, CPUE, median length and weight to examine if there were potential data conflicts. In the high latitude regions there were clear long term reductions in CPUE and the sizes of fish taken, and in region 4 (eastern equatorial part of the WCPO) there were significant declines in fish sizes, but the CPUE was stable. The core part of the fishery (region 3) showed increasing catches and little to no decline in CPUE or fish sizes. The author hypothesized that this pattern could be consistent with density dependent habitat selection and potential range contraction or simply data problems.

The workshop:

- Noted the importance of examining the patterns in various data sets considered to be influential in the assessments, but also recommended further examination of the data sets themselves, e.g. sources of data both in terms of areas fished and fleets.
- Recommended that further examination of the data sets be undertaken to allow the workshop to provide guidance on the potential to restructure fisheries used in the BET assessment. Details of some of these explorations are considered under the agenda item considering the recruitment trend estimated in the bigeye assessment.

Dr Eric Chang provided a summary of the two Taiwanese fleets that are operating in the tropical part of the WCPO fishery, namely the offshore fleet which almost entirely fishes in region 3, and the distant water fleet that almost entirely fishes in region 4. There was an increasing trend in the mean length of bigeye tuna taken by the DW fleet in region 4 and the off-shore fleet in region 3. CPUE for the DW fleet were available for region 4, but due to changes in the fleet characteristics, was probably only useful for

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[7] Pre-Assess [BET 2009 review].pptx
[8] Pre-Assess [BET data inputs].pptx

the period post 1999-2000. There was a long time series of CPUE data available for the albacore target fleet in the south of region 6 which may be useful as an abundance index for this region.

The workshop:

- Noted that the trends in median lengths in regions 3 and 4 require further investigation
- Recommended that a bigeye CPUE index derived from the TW-DW albacore target fleet be considered for region 6 as a sensitivity analysis for the 2010 assessment

## Longline CPUE

Dr Simon Hoyle presented an overview[9] of the approaches used in the development of the standardized longline indices for the Japan fleets in the 2009 assessment. This was based around the document provided to SC5[10]. Key areas of the analysis included the various approaches to attempt to model differential targeting of bigeye versus yellowfin tuna and the approaches considered to incorporate one aspect of potential changes in catchability (i.e. vessel specific effects) into the longline indices. The author also provided a proposal for how CPUE indices might be derived for this year's assessment, and what approaches might be considered as part of the collaborative work between OFP and Japan on analysis of operational catch and effort data.

The workshop:

- Recommended that the YFT offset not be used in the calculation of indices for the 2010 assessment
- Recommended that a CPUE series should be estimated that does not include any targeting variables based on bycatch species, and that a stock assessment run be undertaken using this series to assess sensitivity
- Recommended that interaction terms be considered as part of data exploration (noting problems of interpretation)
- Recommended that for presentation purposes, indices aggregated at the annual level should be presented in addition to those at the same scale used in the assessment (e.g. quarterly in the case of bigeye and yellowfin tuna)
- Noted that it was preferable to include vessel effects into the CPUE standardization through the use of fine-scale data rather than the post-hoc analyses undertaken in 2009 to adjust the indices derived from 5x5 degree data
- Noted that in 2010 the SPC/Japan collaboration will focus on data familiarity and examining the effect of incorporating vessel factors. It is not expected that CPUE indices based on operational data will be developed to replace the 5x5-based indices in the 2010 assessment, but if significant progress is made any such CPUE indices could be used to support sensitivity analyses.
- Recommended that where possible information on fishing master be incorporated into CPUE indices in addition to vessel effects

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[9] Pre-Assess [LL CPUE].pptx
[10] Hoyle, S. 2009. CPUE standardisation for bigeye and yellowfin tuna in the Western and Central Pacific Ocean. WCPFC-SC5-2009/SA-WP-1

- Recommended that operational level analyses include consideration of mainline information in conjunction with hooks per basket – drawing on the analyses undertaken by Japanese scientists for the Indian Ocean fishery

Dr Shelton Harley presented an analysis which applied several spatial indices to longline data for Japan, Korea, and Taiwan. This analysis was motivated by comments at the 2009 pre-assessment workshop and had been submitted to SC5 as an information paper[11]. The analysis calculated indices which measured the extent to which effort in a given year was concentrated in the areas where the CPUE was the highest. Patterns in the indices identified possible targeting practices by different fleets in different regions through time.

## Update on the status of catch estimates for fisheries from Indonesian and the Philippines

Peter Williams provided an overview[12] of the current state of knowledge of tuna fisheries catches in Indonesia and Philippines, including details of the current and ongoing activities being undertaken to improve our understanding. The important issues for the Philippines were the different methodologies for estimating overall catches versus the information on catches for some of the important fisheries. It was considered that BET catches had been over-estimated and this was addressed in the 2009 assessment. For Indonesia there was also very strong suggestions that BET catches were overestimated and this would be considered in the 2010 assessment.

Peter Williams prepared a summary[13] of the different fisheries in Indonesia and the Philippines, the availability of their data, and how they had been treated (e.g. grouped in the 2009 assessment). There were insufficient data to consider splitting any of the small fish fisheries at this time, but there was merit in considering where the Indonesian longline fishery was best grouped.

The workshop:

- Recommended further examination of the Indonesian catches, particularly the reported small fish and longline catches with an aim to include more plausible time series in the 2010 assessment
- Recommended further examination of any available size and weight data from the Indonesian longline fishery to determine whether this fleet was more likely to have a selectivity pattern consistent with the DW or offshore fleets
- Recommended further examination of the Philippines overall catch estimates to help develop alternative catch histories that might be examined in sensitivity analyses.

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[11] Harley, S.J. 2009. Spatial distribution measures for the analysis of longline catch and effort data. WCPFC-SC5-2009/SA-IP-2.
[12] Philippine and Indonesia data (April 2010).ppt
[13] idph_bet_2010.docx

## Update on the spill sampling work to correct for grab sample bias in purse seine catch estimates

Dr John Hampton provided an update of the work undertaken since the SC-5 paper[14]. This included further experimental work on New Zealand, PNG, Solomon Island, and US flagged purse seine vessels. Once the data from these experiments becomes available further exploration of the grab sample bias will be undertaken.

Examination of the total purse seine catch estimates for skipjack based on S_BEST and the spill sampling correction (provided in the SC5 paper) indicated that the reduction in the estimated purse seine catch based on the spill sampling correction was significant – in the order of 20%.

The workshop:

- Noted the increasing view that these new, and higher (in the case of BET and YFT), catch estimates are probably closer to the real situation that the previous estimates (S_BEST)
- Noted that estimates in the S_BEST data base incorporate a variety of data sources, e.g. Japanese and US catch estimates based on port sampling, logsheet estimates for those fleets that also fish in the IATTC convention area, and grab-sample based estimates for other fleets
- Recommended that the spill sampling corrections also be applied to the length frequency data used in the assessments to ensure consistency with the new catch estimates
- Recommended that model runs be undertaken using the spill sampling estimates for both the bigeye and skipjack assessments in 2010
- Noted the need to test the spill sampling technique across as wide a range of vessels as possible

## Examination of the recruitment trend for bigeye

Several presentations were provided throughout the week as additional analyses were undertaken and presented to the workshop.

Dr Shelton Harley provided an initial overview[15] of the recruitment issue in the bigeye assessment. The presentation provided some background on the issue, including how this pattern is observed in other bigeye assessments; suggested that in a multi-region model, the first priority should be to focus on overall recruitment levels rather than those at the regional level (but recognizing that these should be looked at in the future); and the effects that increasing recruitment trend have on important reference points estimated within the assessment. Previous investigation of this issue was reviewed and an approach to address the matter outlined. This approach involved examining which data sources seemed to be influential in the estimated trend and then examining those data in further detail to determine if they are accurate/reliable and are being treated appropriately in the assessment.

Two diagnostics were developed in the analysis: 1) the ratio of recruitment for the second half of the model period to that in the first; and 2) the slope of the effort deviates for the LL-ALL 3 fishery (the

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[14] Lawson, T. 2009. Selectivity bias in grab samples and other factors affecting the analysis of species composition data collected by observers on purse seiners in the Western and Central Pacific Ocean. WCPFC-SC5-2009/ST-WP-3.

[15] Pre-Assess [recruitment trend].pptx

major abundance index for region 3) from 1970 to 2007. The runs considered a variety of model assumptions from regional weightings, natural mortality, growth, and the impact of various data sets. Model runs that reduced both trends the most was down-weighting the length and weight data for fishery 5 and 8 (Chinese and Taiwanese offshore longlining in regions 3 and 4) indicating that these data were influential and warranted closer examination.

The workshop:

- Recommended further examination of the length and weight-frequency data used in the assessment model, with a priority on those data for region 3, but expanded to other areas in the longer term
- Recommended that a diagnostic also be developed to summarize the model fit to the key size data inputs
- Recommended that the various scenarios be examined including interactions, i.e., do all possible combinations.

Dr Simon Hoyle presented further analyses[16] of aspects of the size data for the key longline fisheries in region 3, their potential influence on the patterns in recruitment, and the residuals in the fit to the size data. There were changes across years in the fleets contributing to the LL-ALL 3 size data. In particular, prior to 1991 there was only size data from the Japanese fleet, but since that time data have been available for several fleets. Of particular note was the increasing proportion of data that came from the FSM flagged vessels operating in Micronesia. Excluding the non-Japan data did not improve the recruitment trend, but further examination of the Japanese data indicated spatial differentiation in the sizes of fish taken. Restricting the Japanese data to eliminate the northeastern area resulted in more consistent patterns, and the subsequent model resulted in a reduced recruitment trend.

Considering the LL-TWCH 3 fishery, it was also shown that there were changes over time in the contribution of the different fleets, with an increasing contribution of TW-offshore data. Data for China indicate a declining trend in median sizes, whereas increases were observed for the TW-offshore fleet. Further examination of the TW-offshore data indicated changes in the spatial distribution of the samples, with more of the recent samples coming from the western area in which larger fish were observed in both the TW offshore and Japanese size data.

The workshop:

- Recommended that consideration be given to the following changes to fisheries groupings
  - removing the FSM-flagged vessels from the LL-ALL 3 fishery and instead group with the TW-offshore vessels
  - splitting the Chinese and TW-offshore flagged vessel
  - splitting the TW-offshore into eastern and western components

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[16] Pre-Assess [Bigeye size structure in region 3].pptx

## Proposed approach for the 2010 assessment of bigeye tuna

Dr Shelton Harley presented[17] (<mark>PP FILE</mark>) a two stage approach for the 2010 bigeye assessment. Two assessment papers were proposed:

- Model development: a paper describing an examination of alternative model and data structures (e.g. fisheries configurations), including any analyses that supported alternative model structures. This paper would mostly focus on addressing the current estimated recruitment trends and some of the estimated patterns in the fit to important CPUE and size data sets.
- Stock assessment: this paper would focus on the main stock assessment results and involve stepwise changes from the 2009 assessment to a new 'base model' from which several one-change sensitivity analyses would be undertaken. If time and resources allowed a full grid of runs would be undertaken covering all possible combinations of the components of the base model and sensitivity analyses. Table 1 below provides the proposed plan for the assessment.

There was some discussion of the appropriateness of fixing steepness at 0.75 in the base case. Steepness estimated by the model (0.98) was used in the base case of the last bigeye assessment (2009). Steepness estimates from stock assessment models are generally very unreliable. The yellowfin stock assessment estimates steepness at a low value (0.52), and the contrast seems implausible given the two species' life histories. The 2009 WCPFC yellowfin and albacore base case stock assessments assumed steepness of 0.75. This value is at the lower end of steepness estimates used for bigeye by other RFMO's: the IATTC use model runs with steepness of 1 and 0.75.

The workshop:

- Noted that the base case would not necessarily be the best single model – this would be determined by SC-6 after consideration of available scientific evidence.
- Noted with respect to steepness:
  - That there was no consensus on the use of a steepness of 0.75 for the base case model.
  - The value or values of steepness in the model runs used to prepare management advice for the Commission would be considered at SC6.

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[17] Pre-Assess [BET plan for 2010].pptx

**TABLE 1: PROPOSED WORKPLAN FOR THE BIGEYE TUNA ASSESSMENT IN 2010**

| Factor | 2009 (Run10) | Base 2010 model | Sensitivity analyses |
|---|---|---|---|
| Purse seine catch | S_best estimates | Spill sampling estimates | S_best estimates |
| Catches for Indonesia and Philippines fisheries<br>- OFP to work with Indonesia to determine the best estimate of small fish and longline catches. Both catch series showed a dramatic increase in the most recent years which appears to not be plausible | As submitted by ID and new PH estimates determined by joint work between OFP and PHI | Revised 'best' estimates for ID domestic fisheries and longline fishery | 2009 estimates |
| Steepness:<br>- Steepness is very difficult to estimate, particularly in the face of the estimated recruitment trend. Fixed value considered in 2009 ranged from 0.55 to 0.95 with a midpoint of 0.75. | Estimated | Fixed at 0.75 | Fixed at other values and estimated |
| CPUE indices | Based on 5x5 degree aggregated Japanese LL data including the YFT-offset and the targeting variable | As in 2009, but with YFT-offset removed | - As with base model, but with targeting variables based on bycatch species excluded<br>- Any indices from the joint SPC/OFP collaborative analyses of operational data<br>- Include the TW-DW indices for region 6 to replace the LL-ALL 6 index |
| Longline vessel effect<br>- While the CPUE indices based on 5x5 degree aggregated data do consider many factors know to impact longline | No vessel effect | Vessel effects as estimated by Hoyle (2009) and only applied to region 3 | - No vessel effect<br>- Apply the region 3 effect to other areas<br>- Use any estimates |

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|---|---|---|---|
| catchability that do not consider vessel-specific effects which are often significant in analyses where these data are available. The current approach is to separately estimate the fleet composition effect using a subset of operational-level data use the estimated effect to correct the 5x5-based indices. Such corrections will not be required if the CPUE indices incorporate individual vessel effects. | | | from the joint SPC/OFP collaborative analyses of operational data |
| Fishery definitions<br>- Inappropriate grouping of fleets within MFCL-defined fisheries appear to have the potential to cause problems in the assessment. This is particularly the case where there might be differences in selectivity. | As used in 2008 | Any revised fishery definitions for the major longline fisheries that are supported by detailed analyses[#] | Same as 2009 |
| Selectivity | Age-based | Age-based | Length-based for some longline and small fish fisheries |
| Natural mortality | | | - Increased juvenile mortality<br>- Increased adult mortality |

[#]Possible changes that may be considered based on the outcomes of detailed analysis of length, weight, and spatial patterns in fishing include:

- Consider splitting CH and TW-Offshore fleets currently modeled together in region 3
- Consider including the FSM-flagged vessels with the TW-Offshore in region 3
- Consider including the Indonesian longline fishery with the TW-Offshore in region 3. This new fishery might be called LL-OFF 3.
- Consider splitting the 'new' LL-OFF 3 fleet into eastern and western components in region 3
- Consider separate spatially-defined fisheries for LL-ALL 3
- As above as appropriate for region4 fisheries

# Skipjack tuna

Presentations were provided on various aspects of the skipjack assessment:

## Review of the 2008 skipjack assessment

Dr Simon Hoyle presented a review of the 2008 stock assessment[18]. Significant features noted were the trend of increasing recruitment throughout the assessment, and lack of fit to the generally increasing sizes observed in the pole and line fisheries. Results of the discussions that began here are summarized in the sections below.

## Catch data

There was a discussion of the catch data to be used in the skipjack assessment, with particular attention to the data from Indonesia and the Philippines, and revision of the purse seine data as a result of spill sampling analyses. Information about the Indonesia and Philippines data was provided by Mr Peter Williams, who indicated that changes to the Philippines catch data were likely to be minor. A lower bound could be placed on the Philippines catch estimates by using the BAS estimate, and this could be used as a sensitivity analysis. Dr Shelton Harley presented a table of changes to skipjack catch estimates as a result of spill sampling. Total catch was estimated to change by approximately 20%.

- The workshop concluded that catch data revised on the basis of the spill sampling data should be used in the base model.
- The latest estimates of Indonesia and Philippines catches should be included in the base model, with the BAS Philippines estimate used as a sensitivity analysis.

## Pole and Line CPUE

Dr Hiroshi Shono presented an overview of the approach used for analyzing CPUE data and estimating regional indices of abundance for the Japanese skipjack pole and line fisheries, both offshore and distant water[19]. The approach was first applied in 1999, and subsequently in 2005. A more limited approach that was applied in 2008 did not include operational variables. SPC and Japan's National Research institute of Far Seas Fisheries have arranged to collaborate on analyzing the operational CPUE data in May 2010, with a visit to Shimizu, Japan by Adam Langley and Simon Hoyle.

Dr Miki Ogura presented additional slides showing changes in the composition of the fleet through time[20].

Dr Hoyle presented some suggestions for changes to the analysis approach[21].

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[18] Pre-Assess [SKJ 2008 review].pptx
[19] Shono et al_ICCAT-1999 for Skipjcak.pptx
[20] Pre-Assess [SKJ 2010 Japan].pptx
[21] Pre-Assess [SKJ CPUE2].pptx

*Effects of fishing devices*

Fishing devices including low temperature bait tanks, sonar, and satellite image receivers have significantly affected catch rates. Their degrees of representation in the fishery have changed through time. Data on fishing devices has been prepared and will be available for the operational CPUE analysis.

- Fishing devices are an important factor in CPUE, and data on their use will be included in the CPUE analysis this year.

*Spatial configuration*

The 1999 and subsequent analyses included all data in a single analysis, with interaction terms used to estimate different biomass trends for different regions. This approach results in a very complex model for which the results can be difficult to interpret. It also assumes that error distributions and parameter estimates are shared across the model, except where different parameter relationships are specified. This more traditional approach contrasts with the approach now used for analyzing longline CPUE data in the WCPO and EPO, where regions are analyzed separately. This increases flexibility and makes it easier to examine residuals.

- The workshop agreed that regions should be analyzed individually.

Catch rates are often found to vary spatially, which is why five degree square is always included in longline CPUE analyses for the WCPO and EPO. Analyses of SLKJ PL CPUE have not previously included five degree square.

- The workshop agreed that 5-degree square should be included as a factor in the analysis.

*Individual vessel*

Operational data provide information on the individual fishing vessel, and vessel_id is often explains a significant amount of variation in CPUE.

- The workshop recommended that individual vessel should be trialed as a factor in the pole and line CPUE standardization.

*Response variable*

The response variable has previously been catch per day per pole. However, modeling catch per day per vessel and including number of poles as an explanatory variable would increase the flexibility of the model, and permit non-linearity in this relationship to be considered. Zeroes have previously been modeled by adding a small constant to each data point. However, the choice of such constants is somewhat arbitrary an can be influential.

- The workshop agreed that the more flexible approach of modeling catch per day should be applied.
- The workshop advised that a zero-inflated model should be considered, and/or that the sensitivity of model to the added constant should be examined.

## Issues to address in the 2010 skipjack assessment

Dr Simon Hoyle presented a description of issues to be investigated in the 2010 skipjack stock assessment[22]. These included the spatial structure of the model, the fishery structure, the data inputs, the time structure, regional weighting, the tagging data, and the size data. This was followed by a presentation from Dr Miki Ogura of Japan raising several further ideas[23].

### Spatial structure

Using the same spatial stratification as the other tuna models would simplify management strategy evaluations and bring the model into line with CMMs. However, modeling the dynamics is the primary objective.

The following changes were discussed:

- Altering the spatial stratification of the model to better match the BET/YFT structure, e.g. by shifting the northern boundary of regions 5 and 6 north to 20N and the equatorial boundary east to 170E.
- Combining regions 1-3 to create a single northern region, as suggested by Dr Ogura.
- There was some discussion about whether to maintain the transitional region (4), to maintain biological realism regarding the seasonal movement associated with temperate water dynamics. However, this region has very low catch and its biomass is a major source of uncertainty in the analysis. If different sized fish are observed in this region then defining fisheries may be sufficient, rather than specifying an extra region. It was decided to extend absorb region 4 into the other regions.

Running models with different region and/or fishery stratification would require doing separate CPUE standardizations.

- Dr Hoyle suggested sub-stratifying the regions and doing standardizations for each component; this is to capture the effects of fisheries having differing selectivity and hence differing CPUE trends. Dr Ogura agreed that Japan will support CPUE analyses for the current spatial stratification and a simpler stratification.

Finally, three models were agreed:

- The simplified 3 region WCPO structure, with boundaries similar to some of the BET/YFT boundaries.
- The previous assessment's six-region WCPO approach.
- The equatorial model based on regions 5 and 6 of the six-region WCPO model.

### Fishery structure

In previous assessments an important objective has been to keep things simple and consistent between the SKJ and YFT models.

In the 2008 assessment, the purse seine fisheries were split into log and FAD fisheries. The reason for this split is not clear.

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[22] Pre-Assess [SKJ plan 2010].pptx
[23] Pre-Assess [SKJ 2010 Japan].pptx

- The fishery may be simplified into 1 associated fishery (as in the BET and YFT models).

In the 2008 assessment drifting and anchored FAD fisheries were not separated. Size data for these fisheries have not previously been compared, because the FAD type has not been reported in the length frequency database.

- The distinction between drifting and anchored FADs will be added to the database, and the selectivity in these two fisheries will be compared.

*Time structure*

Previous assessments were run at a quarterly time interval. Dr Hoyle presented some arguments for assessing the fishery at a monthly time scale.

- The workshop agreed that it would be useful to change from quarterly to monthly time strata, which is likely to improve the resolution of growth in the size data. It was, however, noted that this would result in many more parameters (3x), so the primary change should be to the fishery structure rather than to the timing of recruitment.
- Changing the fishery time structure would result in a mismatch with the quarterly standardised CPUE. Therefore CPUE may be estimated monthly. Alternatively, quarterly CPUE may be applied in the middle month of each quarter with missing effort in all other months. The missing values are estimated using a catch conditioned approach and do not affect the likelihood. The logistics of how to reconcile the monthly model with the standardised CPUE time-stratification will be investigated.

*Data inputs*

Catch per unit effort data from pole and line fisheries has already been discussed above. Purse seine and longline CPUE data were also discussed.

- Purse seine CPUE does not influence the assessment a great deal, and will not be estimated.
- The method for estimating catchability trends in non-PL fisheries will be altered to be consistent with the ALB and BET models. We will estimate catchability deviates every quarter and reduce the penalties on these deviates. Alternatively, instead of estimating more q deviates, the effort deviate penalty will be reduced, which has an equivalent effect but requires fewer parameters to be estimated.

*Regional weighting*

The current regional weighting approach is based on the standardized pole and line CPUE, scaled by the size of each region. In the bigeye and yellowfin assessments the area fished is considered, as well as the size of the region.

- Agreed to adopt the same approach used for BET/YFT models.
- An additional run will not use regional weighting but allow regional pole and line catchabilities to be freely estimated.

*Size (length) data*

Size data are highly influential in length-based stock assessment models such as MFCL. Temporal trends are apparent in residuals for the JPOS pole and line fisheries, indicating that the sizes of fish caught in the fisheries are increasing in a way that the model cannot accommodate. This indicates a structural problem in the model that may be related to the estimated recruitment trend.

- Dr Ogura supported the view that fleet fishing location has changed through time, that fish size tends to vary spatially, and that this will have affected size composition data.
- Dr Hoyle also presented information on potential for density-dependant growth effects (with faster growth result in larger fish on average). It was suggested that tagging data would be a direct way to examine this effect. This could be examined by testing for cohort-specific density-dependent growth in the model.

*Recruitment distribution*

Dr Ogura reminded the meeting that there is no recruitment in areas 1, 2, and3 because recruitment occurs only in tropical waters. Skipjack move north with the warming water in the second quarter of the year, and move south again in the third and fourth quarters. Fish at very small sizes are not found in northern areas. Therefore the model's estimates of recruitment into temperate zones are incorrect.

- The model should be changed to constrain the recruitment in these regions to be very low.

## Tagging data for skipjack tuna

Dr Simon Nicol presented an overview of the tagging data available for use in the skipjack model[24]. In particular, he focused on the new data obtained from the PTTP tagging program. He outlined differences between this and previous tagging programs. These tagging data have now been included in the data inputs for the MFCL model, and preliminary analyses were presented. Short term and long term approaches for including these data in MFCL were presented for discussion. These included new approaches for modeling movement, estimating reporting rates, and accounting for tag loss and tagging mortality.

*Tagging programs*

This is the first year when PTTP data will be available for including in the model. In previous assessments, Japanese tagging releases from equatorial regions have not been included due to concern about reporting rates that may differ both temporally and from the SPC tagging programs. The workshop endorsed the following plans:

- Include the PTTP tagging data in the SKJ assessment
- Include equatorial JP releases in the assessment

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[24] Pre-Assess [SKJ tagging] - revised.pptx

*Reporting rates*

In previous assessments all tagging programs were constrained to have the same reporting rate within a fishery. This prevented use of some tagging data – e.g. JP equatorial. Reporting rates (RRs) for the PTTP may differ from previous tagging programs. The workshop endorsed the following approach:

- Multifan-CL will be modified to permit different reporting rates by tagging program and by fishery
- Apply a different reporting rate for each SPC tagging program
- Include Japanese equatorial releases with a different reporting rate
- Assume a higher RR by Japanese fleets for all releases than has been assumed previously.

Longer term
- Model alternative scenarios for RR
- Modify MFCL to model RR by release group

*Release mortality*

Release mortality and tag loss have been estimated through statistical analyses of return rates. If practical, these results may be included in this year's stock assessment.

- Consider adjusting release numbers for tagging mortality, with a 'base' mortality rate.

## Proposed approach for the 2010 assessment of skipjack tuna

Dr Simon Hoyle presented[25] the two stage approach proposed for the 2010 skipjack assessment. Two assessment papers were proposed:

- Model development: a paper describing an examination of alternative model and data structures (e.g. fisheries configurations), including any analyses that support alternative model structures.
- Stock assessment: this paper will focus on the main stock assessment results, including stepwise changes from the 2009 assessment to a new 'base model' from which several one-change sensitivity analyses will be undertaken. If time and resources allow, a full grid of runs will be undertaken covering combinations of the components of the base model and selected sensitivity analyses. Table 2 below provides the proposed plan for the assessment.

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[25] Pre-Assess [SKJ 2010 overview].pptx

**TABLE 2: PROPOSED WORK PLAN FOR SKIPJACK TUNA STOCK ASSESSMENT**

| Factor | 2008 | Base 2010 Model | Sensitivity analyses |
|---|---|---|---|
| Purse seine catch | S_best estimates | Spill sampling estimates | S_best estimates |
| Tagging data | OFP (except PTTP) + JP subtropical | OFP (all) + JP (all) | 2008 approach in 2 stages |
| Reporting rates are thought to vary among tagging programs. | One RR per fishery | Program-specific reporting rates | 2008 approach |
| Steepness , which is difficult to estimate, should be modeled at the same array of fixed levels used in the bigeye and yellowfin stock assessments | Estimated | Fixed at 0.75 | Fixed at 0.55, 0.65, 0.85, 0.95; and estimated |
| Standardized CPUE indices | JP PL 2008 operational data GLM. Equatorial PS GLM. | JP PL 2010 operational data GLM based on collaboration with NRIFSF. No equatorial PS GLM indices, and reduce the influence of random variation by increasing rate of time series catchability variation. | JP PL 2008 operational data GLM |
| PL efficiency | 2% per year | None if considered in GLM of operational data | None if considered in GLM of operational data |
| Fishery definitions | | Any changes to the major fishery definitions (supported by detailed analysis). | Similar to 2008 |

| Factor | 2008 | Base 2010 Model | Sensitivity analyses |
|---|---|---|---|
| Time structure | Quarterly | Monthly for fishery data, quarterly recruitment. | Quarterly |
| Regional structure should, first, permit stock dynamics to be modeled appropriately, and second, be suitable for examining the consequences of management options. | Equatorial + WCPO | WCPO model with single region north of 20N and two southern regions divided at 170E. | Equatorial + 6 region WCPO |

## OTHER MATTERS

Dr Simon Hoyle presented a prototype of the PRFP-funded interface for evaluating projections of Multifan-CL stock assessments under alternative management options. The working title for this software package is 'MOViT'.

The meeting also provided a opportunity to discuss other matters in the margins of the meeting. Topics included: ideas for restructuring the SC, the nature and extent of science involvement in the Commissions Management Objectives meeting.

## Final remarks

Dr John Hampton thanked participants for a fruitful workshop.

Dr Harley indicated that the proceedings from this WS would be compiled and circulated to participants within ten days of the completion of the meeting and then after comments were received, the report, along with all of the presentations would be provided to the WCPFC Secretariat to put on the SC-6 website.

# APPENDIX 1: List of participants

| Participant | Affiliation |
|---|---|
| SungKwon Soh | WCPFC, Federated States of Micronesia |
| Rob Campbell | CSIRO, Australia |
| Jae Bong Lee | National Fisheries Research and Development Institute, Korea |
| Pam Maru | Ministry of Marine Resources, Cook Islands |
| Jone Amoe | Department of Fisheries, Fiji |
| Berry Muller | Marshall Islands Marine Resources Authority, RMI |
| Stephen Brouwer | Ministry of Fisheries, New Zealand |
| Tim Adams | Nauru Fisheries and Marine Resources, Nauru |
| Regis Etaix-Bonnin | Fisheries Department, New Caledonia |
| Naozumi Miyabe | National Research Institute of Far Seas Fisheries Research Agency, Japan |
| Miki Ogura | National Research Institute of Far Seas Fisheries Research Agency, Japan |
| Hiroshi Shono | National Research Institute of Far Seas Fisheries Research Agency, Japan |
| Makato Miyake | National Research Institute of Far Seas Fisheries Research Agency, Japan |
| Hiroaki Okamoto | National Research Institute of Far Seas Fisheries Research Agency |
| Ann Preece | CSIRO, Australia |
| Shui-kai (Eric) Chang | National Sun Yat-sen University, Chinese Taipei |
| Keith Bigelow | National Marine Fisheries Service, United States |
| Francisco Abascal | Spanish Institute of Oceanography, Spain |
| **SPC** | |
| Shelton Harley | |
| John Hampton | |
| Nick Davies | |
| Don Bromhead | |
| Jesus Jurado-Molina | |
| Simon Nicol | |

## APPENDIX 2: Agenda

| Tuesday, 6<sup>th</sup> April | |
|---|---|
| Morning (0830-1200) | **Introduction**<br>*Participants will be welcomed and the process for the meeting and documenting outcomes discussed*<br>**Projection methodology**<br>*The methods used to conduct the analyses described in WCPFC-SC5-GN-WP-17 and WCPFC6-2009/IP-18 will be presented and discussed*<br>**Bigeye tuna – review of 2009 assessment**<br>*A summary of the 2009 bigeye tuna assessment will be presented, in particular the major areas of uncertainty and recommendations for future work* |
| Afternoon (1300-1630) | **Bigeye tuna – catch data**<br>*Catch and effort for Indonesia and the Philippines: an overview will be given of the current state of knowledge for the fisheries from these two countries. Discussion should focus on:*<br><br>• *Suggested definition of fisheries*<br>• *Best estimates for each fishery*<br>• *Plausible ranges of catches to be considered*<br><br>*An update will be given of the corrections to purse seine catches for sampling biases (e.g. spill sampling trials). Discussion should focus on:*<br>• *Best estimates to be used and any alternative scenarios*<br>• *Correction of length-frequency data consistent with the catch estimates* |
| **Wednesday** | |
| Morning (0830-1200) | **Bigeye tuna – CPUE data**<br>*SC-5 indicated that SPC should collaborate to examine the estimates of effort creep estimated by Hoyle (2009). A brief presentation of the analysis will be provided including progress on the collaboration with Japan. Discussion will focus on methods to be used for future analyses and the proposed approach to be used in the 2010 assessment.*<br>**Bigeye tuna – recruitment trends**<br>*The most noticeable feature of the BET assessment has been the recruitment trend for region three which drives the overall recruitment patterns. A presentation will be given of the major data sources in this region, and the effects on the trend of a range of alternative model structures will be considered. Discussion should focus on:*<br>• *The plausibility of alternative data sources driving these patterns*<br>• *The plausibility of alternative model structures considered*<br>• *Suggestions for a alternative model runs to consider in the 2010 assessment* |
| Afternoon (1300-1630) | **Bigeye tuna – model runs for 2010**<br>*Preliminary analyses will be presented. A set of key model runs to be conducted for bigeye tuna in 2010 will be considered drawing on previous discussions and recommendations from the 2009 assessment. Alternative models may be* |

| | |
|---|---|
| | *discussed.* |
| **Thursday** | |
| Morning (0830-1200) | **Skipjack tuna – review of 2008 assessment**<br><br>*A summary of the 2008 skipjack tuna assessment will be presented, in particular the major areas of uncertainty and recommendations for future work*<br><br>**Skipjack tuna – catch data**<br><br>*Any implications of the bigeye catch discussions on estimates of catches used in the skipjack assessment will be discussed.*<br><br>**Skipjack tuna – CPUE data**<br><br>*SC-5 indicated that SPC should collaborate on pole and line CPUE. A brief presentation of the previous analyses will be provided including progress on the collaboration with Japan. Discussion will focus on methods to be used for future analyses and the proposed approach to be used in the 2010 assessment.* |
| Afternoon (1300-1630) | **Skipjack tuna – tagging data**<br><br>*A presentation will be made of the PTTP tagging data including the short term (e.g. 2010 assessment) and medium term (e.g. future assessments) plans to incorporate these data into the stock assessment (primarily for skipjack, but including bigeye and yellowfin for future assessments. The presentation will also consider changes to MFCL to accommodate these new data and any critical auxiliary analyses that relate to using these data in the assessments (i.e. reporting rates).* |
| **Friday** | |
| Morning (0830-1200) | **Skipjack tuna – model runs for 2010**<br><br>*Preliminary analyses will be presented. Discussion will focus on a key set of model runs to be undertaken for the 2010 assessment, drawing on previous discussions and recommendations from the 2008 assessment. Alternative models may be discussed.* |
| Afternoon (1300-1630) | **Other issues that could be considered**<br><br>• Technical aspects of analyses to support the consideration of limit reference points (e.g. how to best incorporate uncertainty in historical and future conditions)<br><br>• Technical support of the Commission's consideration of management objectives – what background information could best inform the meetings discussion<br><br>• "MOViT" project update – an brief update could be provided of OFP's PFRP-funded project to allow users to undertake simple projections using MFCL<br><br>• Longer term model development plans – improvements to the assessments which may not be feasible in 2009 |
| **Saturday** | |
| Morning (0830-1200) | **Review of meeting outcomes**<br><br>*A summary of the key meeting outcomes will be produced for initial discussion if time allows*<br><br>**Other issues or recap** |
| Afternoon (1300-1630) | **Other issues or recap** |

# APPENDIX 3: Terms of Reference

The Oceanic Fisheries Programme (OFP) of SPC is contracted by WCPFC to undertake stock assessments. The results of these assessments will be presented at the WCPFC Scientific Committee. In preparation for these assessments, OFP is hosting a pre-assessment workshop to discuss key issues related to the assessments. The terms of reference for this workshop are provided below.

*Terms of Reference*
- Review the most recent completed assessments, in particular, any concerns, suggestions and/or recommendations raised by the Scientific Committee, the Commission, research providers, individual CCMs, or any independent reviews;
- Review <u>preliminary</u> work undertaken by the service provider relating to the stock assessments, including any proposed:
  - revisions to biological parameters
  - revisions to historical data
  - changes to structural assumptions in the model
  - methodological issues, e.g. characterization of uncertainty
  - standardized CPUE analysis
  - incorporation of tagging data or other auxiliary data
- Provides guidance to the OFP on:
  - the suitability of any proposed changes and any suggested additional work
  - a minimum set model runs to be undertaken, in particular the range of key sensitivity analyses
  - desired model diagnostics to be presented
  - alternative modeling approaches that could be considered

The outcomes of the meeting will be documented in two ways, a report of the meeting and in the assessment working papers themselves. The report of the meeting will be distributed to workshop participants for comment within 10 working days of the meeting and revised and provided to WCPFC Scientific Committee members 30 days after the meeting. It will also be submitted to the next Scientific Committee as a Working Paper. Many of the matters discussed to the workshop will be the subject of meeting papers to the Scientific Committee.

Due to the timing of the meeting, any model runs presented will be based on previous assessment data sets, and therefore no preliminary stock assessment runs will be undertaken. Further, the workshop will occur prior to the submission of data and completion of supporting analyses (e.g CPUE analyses). Therefore, any major changes to historical data submitted by CMM's, or new data could result in a need to consider alternative model runs or structures not considered previously. In such instances, supporting documentation will be provided to the SC via working papers to allow the SC to determine the merits of any proposed changes.

The consultation will be open to participation by all CCMs and to other experts, by invitation. CCMs will be expected to fund their participation although SIDS and participating territories may seek support from the Commission's Special Requirements Fund or other sources, as appropriate.