SCIENTIFIC COMMITTEE
TWELFTH REGULAR SESSION

3-11 August 2016
Bali, Indonesia

Report from the SPC pre-assessment workshop, Noumea, April 2016

WCPFC-SC12-2016/SA-IP-01

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Secretariat of the Pacific Community, Noumea, New Caledonia

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Oceanic Fisheries Programme, Secretariat of the Pacific Community

Introduction

To help us undertake stock assessments for the WCPFC, the Oceanic Fisheries Programme of SPC has sought input from stock assessment scientists in the region through the SPC pre-assessment workshop process. The eighth pre-assessment workshop was held in Nouméa, New Caledonia, during 11-14 April 2016.

Eight scientists from seven organizations participated in the workshop: Francisco Abascal (IEO, Spain), SungKwon Soh (WCPFC Secretariat), Keith Bigelow (NOAA Fisheries, USA), Rob Campbell (CSIRO, Australia), Hidetada Kiyofuji (Far Seas Laboratory, Japan), Daisuke Ochi (Far Seas Laboratory, Japan), Eric Chang (National Sun Yat-sen University, Chinese Taipei) and Xiaoming Yang (Shanghai Ocean University, China), as well as SPC staff: Graham Pilling, Steve Brouwer, Nick Davies (Te Takina Ltd), Rob Scott, Sam McKechnie, Tom Peatman, Yukio Takeuchi, Peter Williams and Laura Tremblay Boyer.

The agenda focused on approaches for the stock assessments of WCPO skipjack and south Pacific blue shark in the WCPF Convention Area scheduled for 2016, developments to the MULTIFAN-CL modelling framework, methods for evaluating management options and reference points, and potential approaches for analysis of WCPO-wide operational CPUE data, pending agreement on the use of these data by OFP. Presentations were invited from all participants, with the majority made by SPC staff. The meeting operated under the terms of reference provided in Appendix 2, and was chaired by Graham Pilling and Steve Brouwer of the OFP Stock Assessment and Modelling section.

This report briefly describes the various presentations made and focuses on important issues discussed by participants, and any specific suggestions made. The report does not attribute comments to countries except where the comment related to the agreement to provide data or to undertake particular analyses. The suggestions are non-binding and will be incorporated to the extent possible but the final decision is in the hands of the assessment team.

The outcomes of this meeting will be reflected in the papers submitted to WCPFC-SC. Copies of most of the PowerPoint presentations prepared by SPC can be provided on request (contact grahamp@spc.int).

Developments in the MULTIFAN-CL software

Nick Davies of Te Takina Ltd presented the latest developments in the MULTIFAN-CL software, focusing on those areas of particular relevance for the upcoming skipjack and blue shark stock assessments, and areas highlighted through the bigeye peer review process. He also presented the work plan for MULTIFAN-CL development in the coming year. Workshop discussions noted that, as many of the developments arose from the bigeye peer review, it will be interesting to see their effect on the next bigeye assessment scheduled for 2017; the potential to use the new multi-species/sex/stock dimensions in future assessments to capture spatial differences in stock growth and the recent 'sub-stocks' suggested by genetic studies of yellowfin, although the need to fully understand the potential movement between those regions was noted; and the self-scaling multinomial M-estimator approach currently being developed and its application to other data sets beyond the size composition information.

The workshop suggested:

- **widening the application of the self-scaling Multinomial for size composition data to include the age at length data.**

Rob Scott of the Oceanic Fisheries Programme (OFP) presented developments to the R4MFCL library (http://www.spc.int/oceanfish/en/ofpsection/sam/research/274-r4mfcl), the development of FLR4MFCL (https://github.com/robscott3/FLR4MFCL) and its potential use within Management Strategy Evaluation (MSE). The workshop noted the activities occurring across tuna RFMOs in this area. The workshop made no suggestions.

Retrospective analyses of MULTIFAN-CL assessments

Rob Scott also presented work on retrospective analyses as requested by SC11, using the 2014 skipjack assessment (Rice et al., 2014; https://www.wcpfc.int/node/18998), and the process used within hindcasting (retrospective forecasting). The workshop discussed the preliminary results, noting the retrospective pattern in skipjack adult biomass, the potential influence of reduced tag data set time series on the model outputs as years of data were deleted, and the potential to examine other estimated time series such as recruitment. Within the hindcasting process, the use of status quo effort/catch conditions was noted.

The workshop suggested:

- **noting the potential influence of the tagging information on the total population scale, that the retrospective analysis also be run assuming only the tagging information is 'lost' in each year;**

- **noting that the projections have been based upon status quo conditions in the retrospective year from which the projections begin, examining the implications of using actual future catch and/or effort within each projection period;**
- **that although the status quo projections presented to SC11 were generally considered to be of limited use for management advice, there was a desire to understand the potential implications of recent fishing levels on stocks not assessed in 2016, and hence for short term stochastic projections to be performed for yellowfin (YFT), bigeye (BET) and south Pacific albacore (SPA) under recent actual catch and effort levels. Those outputs should be presented relative to adopted reference points as well as MSY quantities.**

WCPO skipjack

Overall modelling approach and structure

Sam McKechnie of OFP presented the proposed modelling approach for the 2016 WCPO skipjack assessment, including general plans for the stock assessment data sets and model structures, which were discussed in more detail in later presentations. The workshop noted that additional size data should now be available from Pago Pago.

The workshop suggested:

- **that a figure of regional fishing mortality trends be plotted for juveniles and adults (i.e. a regional version of Figure 26 in the 2014 skipjack (SKJ) report).**

Tagging data

Sam McKechnie and Tom Peatman of OFP presented the proposed approach to developing the tagging data set held by SPC for the skipjack assessment and new approaches to estimating reporting rates. Workshop discussions focused on the estimation of reporting rates; the use of a beta-binomial distribution to better capture the variability in flag-based reporting rate from tag seeding trials; and the potential assessment implications of allowing greater model flexibility through the resulting wider reporting rate priors.

The workshop suggested:

- **noting the fixed values of tag shedding and base mortality rates used within the tag data preparation, a literature review of the values estimated for other fisheries, and the potential to update those values for the western and central Pacific Ocean (WCPO), be examined;**
- **alternative options to removing 100% of tags from compromised tag seeding events be considered, particularly where tag reporting events occur downstream from the compromised vessel (e.g. at port, processing plant).**

Sam McKechnie, with help from Hidetada Kiyofuji of the Far Seas Laboratory in Japan, presented the approach used in the 2014 assessment for analysing the Japanese tagging data, the approaches used to tagging fish within the Japanese trials, and the proposed approach for incorporating the Japanese tagging data in the 2016 skipjack assessment. The workshop noted some uncertainties within the Japanese tagging data sets, in particular the challenges in independently reproducing historical data sets (pre-1999). Within the Japanese data, it was noted that for assessment model region 4, the tagging occurred very close to the boundary with region 2, and that this may affect the model's estimate of movement between regions. The workshop noted that the tagging data for yellowfin would also be useful for the yellowfin assessment planned for 2017.

The workshop suggested:

- **events where there were no recapture length or growth in length was negative over time should be retained within the data set, where the scientists felt this was warranted;**
- **given the inability to re-create the Japanese tagging data for the period before 1999, that the reference case assessment run exclude that pre-1999 tagging data, and a sensitivity run be performed with these data included.**

CPUE time series

Laura Tremblay-Boyer of OFP presented an updated CPUE index for skipjack generated for purse seining in Papua New Guinea for Region 5 of the skipjack assessment model. The workshop noted changes in the pattern of fishing (in terms of vessels and catch) in the years since the previous CPUE standardisation, that skunk sets (no catch of tuna achieved) had been removed from the data set in the current analysis, and the use of clustering within the standardisation. The workshop agreed with the approach taken including the use of an expanded 'core fleet'. The workshop noted that discussions on 'FAD competition' made during the last pre-assessment workshop, where the size of schools might be smaller due to fish being distributed more thinly across increased numbers of anchored FADs, were still valid; the potential influence of MSC certification of free school sets influencing changes in recent fishing practices, along with potential impacts of recent ENSO conditions. The effect of ENSO was noted as something that should be considered within future CPUE examinations.

The workshop suggested:

- **examining the Papua New Guinea port sampling information to see whether species composition changes matched those seen in logsheets in recent years;**
- **raising the quarter threshold for inclusion of data within the model – to for example 6 quarters;**
- **developing the standardised time series using the new approach with data up to 2012, to compare directly with the time series used within the 2014 assessment;**
- **plotting the nominal CPUE by geographic areas of the region as 1°x1° nominals by quarter to see if there have been shifts over time;**

- **examining the effect of removing the cluster factor from the model, noting that as an extreme example a decline in skipjack abundance could lead to the clustering assigning sets to the yellowfin cluster as a change in targeting, although it was noted that the cluster approach was an improvement on the inclusion of YFT catch as a variable, as used in 2014.**

Keith Bigelow of NOAA Fisheries presented an updated CPUE index developed for purse seine and ringnet fisheries operating in the Philippines and in the western high seas pocket. The workshop noted the spatial patterns in the data, driven by management decisions excluding fishing in some areas, and a paucity of historical logsheet data from some areas. It was suggested that the ringnet data series pre-2010 be excluded, noting the small sample sizes in those years. The workshop noted the assumption that these data were representative of region 4 of the skipjack model, noting that there was some potential overlap with region 2.

The workshop suggested:

- **the inclusion of a spatial factor within the model that combines the Moro Gulf regions into a single group, and the high seas region into a separate group;**
- **using a quarterly, rather than monthly, term in the model (Yr + qtr and Yr*qtr). Using this approach, time variant precision should be estimated;**
- **using the purse seine fishery standardised series within the model for region 4, given the greater quantity of data and the longer time series available.**

Hidetada Kiyofuji presented the updated pole and line CPUE indices, as used within the last two skipjack assessments. The approach used in 2014 was again applied (delta-lognormal approach) and preliminary results presented. Workshop discussions noted that these are key indices for the assessment; that technology has been relatively consistent in the recent period; and that further investigations into the standardisation approach are warranted.

The workshop suggested:

- **the use of a threshold level of fishing effort for the inclusion of specific year/quarter periods within the data set, noting that the binomial model would be strongly influenced by periods of limited data where that data were all zeros or ones.**

Model structure and key sensitivities

Sam McKechnie presented the fishery data time series available for the 2016 skipjack assessment, and highlighted some fisheries where further data considerations were necessary and the potential to expand the longline fleets included within the assessment model. The workshop noted issues with the size composition data, and discussed the fishery compositions in model region 4.

The workshop suggested:

- **examining the spatial distribution of length composition data within large model regions, as this might influence data trends (e.g. PL JP1);**
- **removing the anomalously low length frequency data values in 2009-2010 in L-JP-1;**
- **plotting the catch data for region 4 by fleet/fishery using finer scale (5°x5°) data to ensure all data from fleets are included within the model (e.g. F18 IDID_PHPH);**
- **confirming size data for the ID/PH fleets for recent years (post 2010) are included within the model;**
- **adding further longline flags within the model fleets to increase the amount of length data within the model, potentially stabilising the selectivity curve.**

Sam McKechnie also presented the proposed model structure, developments from the 2014 model, and suggested key sensitivities to be examined within the 2016 skipjack assessment. The workshop noted the proposed approach and the potential uncertainties to be examined, acknowledging that other uncertainties for examination may arise during the model development phase.

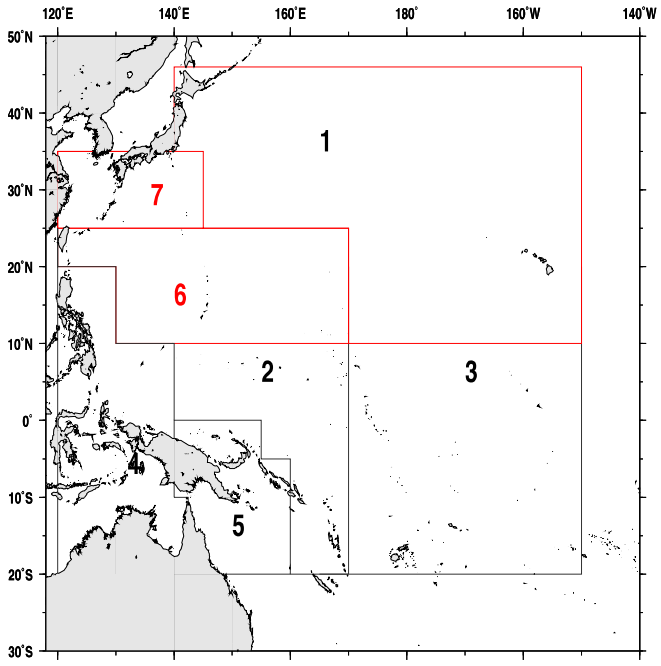
The workshop suggested:

- **examining the influence of growth, including a run where growth is estimated within MULTIFAN-CL;**
- **confirming the basis of 0.9 as the upper bound on the tag reporting prior;**
- **examining the alternative tag reporting rate priors within a sensitivity analysis.**

Hidetada Kiyofuji presented an alternative regional structure for the skipjack assessment, which was based upon the results of analyses of their tagging programme data. This alternative structure was proposed as a sensitivity run within the 2016 assessment. Sam McKechnie summarised the information that would be available within the model if such a structure were pursued. The workshop noted that the proposed structure would mean the standardised CPUE time series for region 4 would be split between new regions 4 and 2, and that the series for region 2 would be very short. Data issues could also arise, given an expansion of the number of fisheries from 23 to 30.

The workshop suggested:

- **some modifications to the boundaries of suggested regions 4 and 6 and movement of the southerly boundaries in the north Pacific to 10°N (see figure below). Japan would produce corresponding standardised CPUE time series for the new regional structure;**
- **that the alternative regional structure be examined only if there are sufficient data in each new region to support the analysis, and sufficient time available following completion of the skipjack assessment using the existing 5-region spatial structure.**



Yukio Takeuchi of OFP presented preliminary results of a comparison between an assessment of WCPO skipjack using the stock synthesis assessment package and the corresponding results from the 2014 MULTIFAN-CL assessment. The workshop had no further suggestions for the work.

Southwest Pacific blue shark stock assessment

Yukio Takeuchi and Laura Tremblay-Boyer presented the proposed approach for and progress towards a southwest Pacific blue shark stock assessment. This is the first assessment of blue shark in the southern WCPO, and there are a number of uncertainties in biology and data that were presented. Blue sharks are primarily caught as bycatch, albeit with some significant targeting. CPUE data exists but catch data are generally of poor quality. Despite this the goal of the assessment is to establish and examine key areas of uncertainty and stock status.

Yukio Takeuchi summarised the assessment for blue shark in the North Pacific, experiences gained from that process, available biological information, and summarised potential values to be used within the 2016 assessment. The workshop noted that the north Pacific blue shark assessment was highly sensitive to the SRR assumed within the model, and that steepness values higher than 0.75 may imply that the stock is too resilient, although the mean steepness used within ICCAT for blue shark was 0.73.

The workshop suggested:

- **consulting with ISC shark scientists on the steepness value they may consider using within future assessments. The response gained during the workshop was that although this issue was not being discussed by ISC specifically, a steepness of 0.9 was considered too high;**
- **that, acknowledging blue shark is amongst the most fecund pelagic shark species, and given the values used in previous shark assessments, values of 0.4, 0.6, 0.8 might be assumed for steepness in alternative model runs, to capture the considerable uncertainty in this parameter. The assessment scientists should ensure consistency with other assessments for this species around the world;**
- **examining whether 0.4 or 0.8 are compatible with the longevity and survival of the species;**
- **plotting all available growth curves and data on the same graph (and in the same units e.g. TL) to compare North Pacific and South Pacific information, to help inform the suitability or uncertainty in growth estimates.**

Laura Tremblay-Boyer summarised the data sets that have been identified for the assessment, noting that the 2013 pre-assessment workshop agreed that data were insufficient for a stock assessment at that time. The workshop acknowledged that additional data were now available. The workshop also noted the potential for under-reporting of blue sharks within the logsheet information based upon studies in Australia, and higher discarding rates than anticipated from preliminary electronic monitoring information from longliners, with catches potentially 1.8 times higher than reported. This issue was covered in detail during discussions of catch reconstruction.

The workshop suggested:

- **examining the American Samoa data for further information;**
- **considering adjusting logsheet data for under-reporting (see below).**

Laura Tremblay-Boyer presented the available catch and CPUE data trends by fishery, discarding patterns, and proposed approaches to reconstructing catch histories. The workshop noted the challenges in catch reconstruction and in CPUE standardisation for key fleets where auxiliary data are not available.

The workshop suggested:

- **noting the uncertainty in the pre-1990s data, and from attendee experience uncertainties in the driftnet fishery data, only the data over the period 1994-2014 be used;**

- **given the uncertainty in blue shark catch estimates, alternative catch series that bracket the uncertainty in those estimates should be developed, along with a 'best' catch estimate based upon clearly presented assumptions[1];**
- **within this process, the observer data be used preferentially to incorporate discarding practices, and the logsheet data be used only if no other information is available;**
- **post-release mortality should be included within catch estimates where possible, particularly for fleets where high levels of discarding have been observed;**
- **the assessment scientists liaise with the relevant national scientist over the catch time series developed for each flag, with a May 15th deadline for the final agreed series.**

Chinese Taipei noted they would check to see whether blue shark data existed within their albacore-focused fishery in the south of the WCP-CA, with a May 15th deadline.

Yukio Takeuchi presented a proposed model structure for the assessment, and preliminary consideration of model runs and key areas of uncertainty to be examined. The workshop noted the limited data and acknowledged that a relatively simple model structure be used as a result.

The workshop suggested:

- **given the sparse tagging information and potentially biased movement estimates, the tagging information was not sufficient to support separate regions within the model and that a single-region model be used;**
- **a single sex structure be used within the model, with a sex-structured model as a one-off sensitivity if time allows;**
- **a recommendation be made to the SC to improve the sex-separation of data to support the development of sex structured models, and greater observer coverage of longline fleets to support this activity;**
- **one CPUE time series be used per model. This could be a combined index with fleet weighting based upon catch/observer data, one fleet that is representative of the widest geographical area, or one taken from the 'core' region of the catch distribution.**

Proposed analytical framework for MSE and HCR testing

Rob Scott described the harvest strategy process within WCPFC, the methods currently used by OFP for examining the performance of harvest control rules to date, and plans for expanding to full Management Strategy Evaluation (MSE) analyses in 2016, including the expert consultation meeting in June.

[1] The use of an approach consistent with the OCS/silky shark assessment (a CPUE surface scaled by effort), or using data from a core area of the fishery, could be considered.

Analysis of operational CPUE data

Laura Tremblay-Boyer presented potential CPUE analyses based upon operational data, noting that these data are currently not available for use by OFP as no agreement had yet been reached with key DWFNs. The workshop noted with interest the use of geo-statistical approaches for CPUE standardisation based on operational data and pointed out recent work in this field by Jim Thorson and colleagues. The work on approaches to account for fishing patterns that led to rapid declines in CPUE early in the operational data time series were also of particular interest.

Francisco Abascal (IEO, Spain) and Tom Peatman presented recent work examining oceanographic influences on bigeye vertical behaviour across the Pacific, and the implications when considering catchability and availability. The workshop noted the information provided and the implications for management considerations. The potential to use results from the approach of Scutt-Phillips et al. for independently defining shallow and deep behaviour was noted.

Sam McKechnie presented a background on spatial simulation models to test the robustness of different CPUE standardisation approaches. The workshop noted that testing CPUE standardisation approaches, a key input in the stock assessments, is a very important area of work to develop.

The workshop suggested:

- **noting the complexity of the work and potentially long timeframe required to pursue it, the objectives should be clearly defined in order to help define the level of complexity/time required. The potential to gain donor funding to take this forward was noted;**
- **noting the parallels between the simulator and the MSE framework, the potential overlap between the two work streams should be examined;**
- **discussing this activity at both SC12 and at the MSE workshop in June, with the potential to hold a future expert workshop on this subject if SC decided the area of work should be pursued.**

Rob Campbell of CSIRO presented a CPUE simulator for an Australian domestic fishery. The approach was based upon the habitat approach for standardising CPUE, incorporating archival tag information and information on the depth of fishing activity, and a smoothed surface of nominal CPUE over the area. The workshop noted the work with interest.

Other matters

Graham Pilling presented a very preliminary list of papers for the SC12 meeting, with thoughts on the paper status (working paper for presentation or information paper), noting that the final composition of papers and their status at Scientific Committee would be defined by the relevant theme convenors (see Appendix 3).

Final remarks

Graham Pilling and Steve Brouwer thanked participants for a fruitful workshop and indicated that a draft workshop report would be circulated for comment among meeting participants prior to finalization and submission to SC12.

APPENDIX 1: Preliminary Agenda

Monday 11th		
09:00 – 09:15	Introductions and general meeting arrangements Reminder of the TOR for the preparatory workshop Agreement of agenda	GP
09:15 – 10:00	MULTIFAN-CL • Update of the features implemented in recent years • Review of MFCL work plan	ND
10:30 – 12:00	MULTIFAN-CL • R4MFCL • Retrospective analyses	RS
Lunch		
13:30 – 15:00	Skipjack stock assessment • Proposed overall modelling approach and structure • Preparation of SPC tagging data	SM SM & TP
15:30 – 16:30	Skipjack stock assessment • Preparation of Japanese tagging data • Standardisation of PNG CPUE	SM & HK LTB
Tuesday 12th		
09:00 – 10:00	Skipjack stock assessment • Standardisation of Philippines CPUE • Japan pole and line standardised CPUE indices	KB HK
10:30 – 12:00	Skipjack stock assessment • Data summary and any fishery changes • Proposed approach for reference case model and key sensitivities	SM
Lunch		
13:30 – 15:00	Skipjack stock assessment • Proposed approach for reference case model and key sensitivities • Alternative spatial structure	SM HK & SM
15:30 – 16:30	Skipjack stock assessment • 2014 skipjack MFCL/SS comparison	YT
Wednesday 13th		
09:00 – 10:00	Blue shark in the southwest Pacific • Background • Biological information • Summary of available data sets	YT LTB
10:30 – 12:00	Blue shark in the southwest Pacific • Proposed approaches to develop catch and CPUE series	LTB
Lunch		
13:30 – 15:00	Blue shark in the southwest Pacific • Proposed model structure • Consideration of model runs and uncertainty	YT & LTB
15:30 – 16:30	Proposed analytical framework for MSE and HCR testing (harvest strategy) • Description of the methods used to date for HCR testing • Overview of the issues to be considered at the MSE expert consultation	RS

Thursday 14th		
09:00 – 10:00	Operational CPUE analysis (in the current absence of a new data agreement) • Proposed methodological developments - if data become available • Analysis of longline CPUE with oceanographic influences	 LTB FAC & LTB
10:30 – 12:00	Operational CPUE analysis (in the current absence of a new data agreement) • Spatial simulation model for evaluating modelling framework	 SM
Lunch		
13:30 – 15:00	TBC	
15:30 – 16:30	TBC	

APPENDIX 2: 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 preliminary 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.

Appendix 3. Draft list of SPC OFP papers for WCPFC SC12.

Theme	Draft Title	Lead	Status
Stock assessment	Assessment of SKJ in the WCPO	SM	WP
	Standardised CPUE for SKJ (regional papers)	LTB/KB/HK	IP
	Analysis of tagging data (SPC & JP)	SM/TP/HK/DO/SC	IP
	Analysis of reporting rates	TP	?
	Assessment of blue shark in the SW Pacific	YT/LTB	WP
	Other BSH papers on supporting input data	YT/LTB	IPs
	Simulation testing of CPUE	Rob C/SM	WP
	Retrospective analyses for BET [& SKJ]	RS	WP
	Report on the Pre-assessment workshop	GP/SB	IP
	MULTIFAN CL developments	ND	IP
	Indicators paper for tuna stocks not assessed in 2016 (incl recent history stock projections)		WP
	Recent trends in the SPA fishery	GP	IP
	Comparison of MFCL and SS skipjack 2014 assessment results	YT	WP?
Management issues	Recommended settings for stock projections within WCPFC work	GP	IP
	Candidate SPA TRPs (MOW4 paper) and alternative fishery trajectories to achieve candidate SPA TRP	GP	WP
	Proposed MSE framework for the WCPFC – outputs of an SPC expert workshop	RS	WP
	Candidate HCRs for SKJ	RS	WP
	Effort creep in the WCPO purse seine fishery	AT/GP	?
	Fleet capacity analyses for WCPO PS fishery	AT/GP	?
	BET hotspots analysis		
	SKJ PS ASS/UNA effort combinations (non-linear dynamics)	GP/RS	
	Rebuilding timeframes for bigeye tuna		
	Catch based HCR for south Pacific albacore – MOW4 paper		
	Monitoring strategy to assess system performance against ref points and performance indicators for HCRs (SKJ and SPA)		
Ecosystem and bycatch	Shark monte carlo longline mitigation analysis update		
	Shark monte carlo shark purse seine mitigation		
	Review of available information on non-key shark spp, incl. mobulid species, and fisheries interactions	LTB	

Appendix 4. Meeting photo