Commission for the Conservation of Southern Bluefin Tuna

みなみまぐろ保存委員会

Report of the Sixth Operating Model and Management Procedure Technical Meeting

30 – 31 August 2015
Incheon, South Korea

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Opening

1. The Chair of the Sixth Operating Model and Management Procedure Technical Meeting (OMMP), Dr Ana Parma opened the meeting and welcomed participants.
2. The list of participants is shown at **Attachment 1.**
3. The terms of reference (CCSBT-OMMP/1508/01) agreed for OMMP6 by the ESC in 2014 were reviewed. The meeting agreed that agenda item 1 would be the focus of activities and topics within agenda item 2 would be addressed to the extent practical.
4. The draft agenda was discussed and amended, and the adopted agenda is shown in **Attachment 2**.
5. The list of documents for the meeting is shown at **Attachment 3**.
6. Ms Ann Preece, Dr Campbell Davies, Dr Belinda Barnes and Dr Simon Hoyle agreed to co-ordinate the preparation of the report with Dr Jim Ianelli.

Agenda Item 1. Technical Implications of changes in the scientific aerial survey on the MP process

7. The Chair introduced the background for this agenda item, including requests from the fourth meeting of the Strategy and Fisheries Management Working group (SFMWG 4) and intersessional discussion by the Management Procedure (MP) Technical Group.

Review of the metarule process and implications of changes in the aerial survey (AS) availability

8. Australia presented the paper CCSBT-OMMP/1508/04 on technical changes in the MP to account for missing aerial survey data. The recruitment point for the missing year in the MP model will be estimated to be close to the long-term mean of the estimates.
9. Review of the metarule process and full implications of changes in the scientific aerial survey (AS) availability were deferred to the Extended Scientific Committee (ESC).

Value of the AS as input to the MP

10. Japan presented CCSBT-ESC/1509/37. The consequences of the non-availability of the AS index in 2015, and of a future reduction in the scale of the survey providing this index, were examined by conducting some projections. It was found that non-availability of the 2015 AS index and reduction of the scale of the associated survey have almost no impact on the performance of the Bali MP with

respect to achievement of the interim management goal, stock conservation, and predicted TAC values.

11. Aspects of paper CCSBT-OMMP/1508/BGD01 (same as CCSBT-ESC/1509/09) were presented and the discussion is summarised below.

12. Performance of the Bali MP using an AS of reduced scale was also evaluated under combined robustness tests (low Recruitment combined with upq CPUE, omega75, robustness tests, and a higher CV on the aerial survey estimates). These tests indicated that a reduction in the precision of the AS resulted in minimal change in performance in terms of impacts on the SSB and catch trajectories, AAV, and probability of achieving the interim management target. The Bali MP is very robust to the tests performed because of the more optimistic operating model (OM) relative to that used for MP tuning in 2011 and how the biomass model in the MP uses the AS data.

13. Projections conducted using the reference set result in a very low probability of the stock falling below the predicted biomass in 2014 under the Bali MP. The year 2014 was predicted to be the lowest point in the SSB trajectory, as this coincides with the time when the series of very low recruitments in1999-2002 move into the spawning stock. The stock status conditions and parameters estimated from the 2014 reconditioned OM are different from those estimated in 2011 when the MP was tested and tuned. The OM now includes the Close-kin (CK) data, stock status estimates have improved, and the distribution of parameters in the reference set has shifted.

14. The random effects relative biomass model in the MP has been designed to use the AS data specifically, and to react to low recruitment (Hillary et al 2015; specs and pre MSE design performance). It is formulated to constrain variability (effectively acting as a smoother on the input data series), to act strongly to decrease catches if average recruitment is below a historical reference level (average over the years for which the estimates are based on the most up to date observed data (1993-2000 and 2005-2011)) and to increase catch slowly if recruitments are above that reference level. These constraints on variability within the MP decision rule act to dampen impacts of increasing the CV on the AS estimates –hence the lack of contrast in results from the tests examined to date in the inter-sessional work (i.e., CCSBT-SFM/1507/09). This was explicit in the design of the HCR of the MP to specifically accommodate the high variance of the AS.

15. Unaccounted mortalities (UAM) scenarios examined in 2014 had an appreciable impact on MP performance, and the evaluation of the value of the AS index in the MP has not taken UAM into account.

16. A set of additional tests were proposed to examine scenarios with longer periods of low recruitment, and a lower percentage of average recruitment than those examined in the inter-sessional work. This set also included reformulation of previous robustness tests relating to potential future changes in catchability of the longline index. The low recruitment scenarios cover the potential consequences for recruitment of the predicted low spawning biomass in 2013-2014, and the CPUE-changes scenario (called Upq 2018) relates to fishery changes that may occur from the anticipated future increase in TAC to the LL fishery in 2018. The robustness test used in 2011 for an estimated 35% increase in catchability in 2008

(Upq) is no longer having a large impact on the MP because the decision rule uses the most recent seven years to calculate a trend in biomass.

17. The more extreme robustness trials explored were:

- *R10*: first 10 years recruitment @ 50% of expected
- *R10noAS*: first 10 years recruitment @ 50% of expected with no aerial survey
- *R10p25*: first 10 years recruitment @ 25% of expected
- *R10p25noAS*: first 10 years recruitment @ 25% of expected with no aerial survey
- *R4p25*: first 4 years of recruitment @ 25% of expected
- *R4p25noAS*: first 4 years of recruitment @ 25% of expected with no aerial survey
- *lowR*: original with first 4 years of recruitment @ 50% of expected
- Base case (**base2013sqrt** grid configuration)
- *Upq2018* (35%) from 2018 onwards crossed with *R10 and R10noAS* scenarios

18. Summary statistics were:

- Average annual TAC from 2016-2025, 2026-2035, 2036-2040
- Probability of attaining the interim rebuilding target - p(B>0.2B0) - in 2035 and 2041 and Bmin(future)/B2014. The 2041 statistics were included to explore potential transitory effects on future catches.

19. Tables 1 and 2 show the SSB rebuilding and catch statistics, respectively, for the runs that assume that the CPUE is a consistent index of abundance, but with different future recruitment failure scenarios.

20. Tables 3 and 4 show the SSB rebuilding and catch statistics summaries including runs where the CPUE experiences a 35% catchability increase in 2018 (which continues to apply thereafter) (*upq2018*).

Table 1. SSB rebuilding statistics for recruitment failure scenarios but CPUE with status quo assumptions (i.e., that it provides an accurate abundance index). Bmin is the lowest value of the trajectory. Figures in parenthesis are 0.1-0.9 probability intervals.

Scenario	**p(B35>0.2B0)**	**p(B41>0.2B0)**	**Bmin/B2014**
Base	0.71	0.75	1.09 (1.07-1.11)
Base_noAS	0.73	0.80	1.09 (1.07-1.11)
lowR4	0.64	0.71	1.09 (1.07-1.11)
lowR4_noAS	0.62	0.72	1.09 (1.07-1.11)
lowR4p25	0.60	0.70	1.09 (1.07-1.11)
lowR4p25_noAS	0.55	0.69	1.09 (1.04-1.11)
lowR10	0.38	0.59	1.09 (1.02-1.11)
lowR10_noAS	0.32	0.50	1.09 (0.80-1.11)
lowR10p25	0.19	0.44	1.08 (0.66-1.11)
lowR10p25_noAS	0.10	0.30	0.90 (0.40-1.10)

Table 2. Catch statistics (in thousands of t) for recruitment failure scenarios but CPUE with status quo assumptions (i.e., that it provides an accurate abundance index).

Scenario	E(TAC) (2016-2025)	E(TAC) (2026-2035)	E(TAC) (2036-2040)
Base	18.2 (14.9-19.2)	23.8 (15.9-29)	28.3 (18.9-36.2)
Base_noAS	17.2 (15.2-19.1)	20.7 (15.2-26.1)	24.7 (17.4-31.1)
lowR4	15.7 (13.7-18.8)	19.0 (13-26.7)	25.0 (17.1-32.6)
lowR4_noAS	16.7 (14.9-18.5)	17.9 (13.3-23.6)	22.9 (15.8-29.2)
lowR4p25	14.9 (13.3-17.8)	17.0 (12-23.4)	24.0 (16-30.8)
lowR4p25_noAS	16.5 (14.6-18.2)	16.8 (12.7-21.9)	21.4 (14.5-27.6)
lowR10	14.9 (13.3-17.9)	12.8 (8.2-20.2)	18.9 (12.1-26.5)
lowR10_noAS	16.6 (14.8-18.5)	14.6 (11-19.6)	17.8 (12.2-23.6)
lowR10p25	14.9 (12.9-17.1)	9.3 (6.7-14.0)	14.5 (8.9-19.4)
lowR10p25_noAS	16.1 (14.2-18.0)	12.4 (9.4-16.4)	14.8 (9.9-19.7)

Table 3. SSB rebuilding statistics for recruitment failure scenarios including the *upq2018* robustness test as an example of CPUE failing to track abundance proportionally.

Scenario	p(B35>0.2B0)	p(B41>0.2B0)	Bmin/B2014
Base	0.71	0.75	1.09 (1.07-1.11)
Base_noAS	0.73	0.80	1.09 (1.07-1.11)
lowR4	0.64	0.71	1.09 (1.07-1.11)
lowR4_noAS	0.62	0.72	1.09 (1.07-1.11)
lowR10	0.38	0.59	1.09 (1.02-1.11)
lowR10_noAS	0.32	0.5	1.09 (0.8-1.11)
lowR10_upq2018	0.31	0.5	1.09 (0.97-1.11)
lowR10_upq2018_noAS	0.23	0.38	1.08 (0.63-1.11)

Table 4. Catch statistics (in thousands of t) for recruitment failure scenarios including the *upq2018* robustness test as an example of CPUE failing to track abundance proportionally.

Scenario	E(TAC) (2016-2025)	E(TAC) (2026-2035)	E(TAC) (2036-2040)
Base	18.2 (14.9-19.2)	23.8 (15.9-29)	28.3 (18.9-36.2)
Base_noAS	17.2 (15.2-19.1)	20.7 (15.2-26.1)	24.7 (17.4-31.1)
lowR4	15.7 (13.7-18.8)	19.0 (13.0-26.7)	25.0 (17.1-32.6)
lowR4_noAS	16.7 (14.9-18.5)	17.9 (13.3-23.6)	22.9 (15.8-29.2)
lowR10	14.9 (13.3-17.9)	12.8 (8.2-20.2)	18.9 (12.1-26.5)
lowR10_noAS	16.6 (14.8-18.5)	14.6 (11-19.6)	17.8 (12.2-23.6)
lowR10_upq2018	15.8 (13.5-18.7)	14.3 (8.6-23.0)	20.1 (13.0-29.3)
lowR10_upq2018_noAS	17.6 (15.5-19.1)	17.1 (12.5-22.7)	20.1 (13.5-27)

21. To summarise the results for the future recruitment failure scenarios where CPUE has been assumed to be a consistent abundance index (Tables 1 and 2):

- For the scenario where there are 4 years of future recruitment at 25% of the expected value (l*owR4p25*), the probability of achieving the SSB rebuilding target by 2035 is higher when the AS is used, but the effect is no longer there by 2041. There was, however, only very small probability of future biomass declines relative to 2014. For 10 years of future recruitment failure at 50% of the expected level (*lowR10*), the performance improvement brought about by including the AS becomes more apparent. Rebuilding statistics are clearly better by both 2035 and 2041 with the survey, and without the survey there is a substantial probability of future declines in SSB (relative to 2014) that is not the case when the survey is included.

- In terms of catch performance, for the more extreme future recruitment scenarios, the improved performance for SSB is obtained by the MP setting lower TACs over the 2016-2035 period. Catches are almost always higher in the 2035-2040 period when the AS is included in the MP, primarily because the AS detects the increase in average recruitment earlier and therefore increases catches sooner then reacting to the recovery of the stock from the low recruitment regime.

22. When combining the *upq2018* catchability-increase scenario with the 10 year recruitment failure scenario (*lowR10_upq2018*, Tables 3 and 4), the results are similar but the impact of lacking an early warning of recruitment failure and subsequent return to average recruitment are greater (Figure 1). The SSB rebuilding statistics by both 2035 and 2041 were significantly worse when the AS was not included. The probability of observing future declines in SSB (relative to 2014) were very small (0.04) when including the survey, but much higher (0.32) when not including the survey (calculated from the frequency with which the future minimum fell below the 2014 biomass level for each grid run).

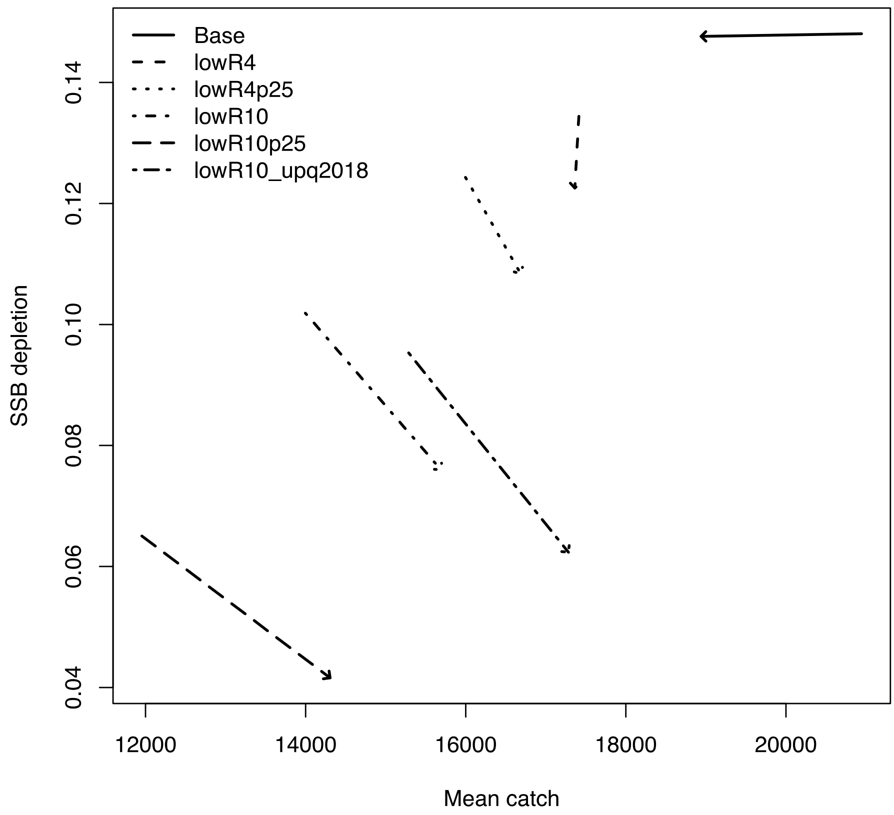

Figure 1. Tradeoff plot showing the consequence of removing the aerial survey (arrowhead) compared to projections with the aerial survey included (arrow start terminus). The vertical scale is the lower 10^{th} percentile of SSB in 2035 based on the grid.

23. Overall it was clear that, for some scenarios of more extreme future recruitment failure, having the AS in the MP can significantly improve both SSB rebuilding performance and effectively remove the possibility of future SSB declines relative to 2014. When combining these scenarios with the potential for the LL1 catchability to increase in 2018 (a possible outcome from a potential quota increase, as observed in 2008) the value of having the survey included was even more evident. The increase in rebuilding statistics was even more marked and any probability of future biomass declines was effectively avoided.

24. It was noted in discussion that the value of the catch from the AS component of historical TAC set (2012-2017), relative to the costs of the AS is substantial. Estimates of the information contribution from the AS component of the MP to potential future TAC changes, if the MP continues, also show high value relative to costs of the AS.

25. In summary, the quantitative analysis of AS data in the MP (Tables 1-4) demonstrates the value of the AS as a fishery independent recruitment index in the MP. Under plausible robustness tests for future poor recruitment and future CPUE catchability changes there is a performance benefit from including the AS data, particularly with respect to risk of further stock declines.

26. When AS data are included, the MP reacts sooner and more strongly to low recruitments, decreasing the risk to the stock (from decreases in biomass). This earlier and stronger responsiveness reduces the subsequent impact of very low recruitments on the spawning stock and, as a result, provides for earlier rebuilding later in the period. This, combined with the ability to detect the subsequent increase in average recruitment earlier (relative to the CPUE only comparisons) provides for increased catches in the latter stage of the rebuilding period. Hence, when the AS is included, the response is precautionary in terms of risks of further declines in spawning biomass.

Performance of the AS as an index of recruitment and as input to the OM

27. New Zealand presented relevant sections of the ESC paper CCSBT-ESC/1509/20. The objective of the paper was to promote a discussion at ESC on an approach to monitoring recruitment of SBT that is affordable within the Extended Commission’s budget and also effective in future management of the resource. The paper questioned the reliability of the AS, trolling and SAPUE recruitment indices, and suggested that more cost-effective options were required. The aerial survey data did not appear to match well with the individual year class strengths estimated by the OM. CPUE at age (based on length) shows some promise as a cost effective recruitment index.

28. Australia presented CCSBT-OMMP/1508/BGD01 (same as CCSBT-ESC/1509/09) which explored both the impact of the AS on the SBT OM, and the performance of the MP when either the survey precision is reduced, or AS is discontinued from 2016 onwards. In relation to the OM, the paper demonstrated that, when not actively fitting the survey, these data are consistent with the other year-class strength data in the OM (from 1993-2011). When actively fitting to the survey in the OM, this fit improves in terms of both the residual variance of the fits and the consistency for each grid sample in the reference set of OMs. The survey influences the OM estimates. From 1991-2004 the OM estimates of year-class strength are very similar whether including or excluding the survey. The

2005 and 2006 estimates of recruitment are lower when the survey is included. Given that the higher estimates are very likely influenced by the inferred catchability increase in the Japanese LL CPUE from 2008 onwards, this demonstrates the ability of fisheries independent monitoring to offset known issues with fishery dependent abundance indices. The latest estimates of recruitment (2011 and 2012) are really influenced by the survey only and are clearly higher when fitting to the survey given the above average 2013 and very high 2014 survey points. Overall, the analyses in paper CCSBT-OMMP/1508/BGD01 demonstrated that the AS is reasonably well explained by the OM, is consistent with the other recruitment data in the OM when they coincide in time, and clearly provides the earliest indications of year-class strength to the model.

29. In considering the comments in paper CCSBT-OMMP/1508/BGD01 on the value of the AS data for the OM, it was noted that the AS indices are used as relative trends in recruitment in the OM, not as individual year class strengths, and cover a range of 3 age classes (2-4) in the OM. The AS has a reasonable fit to the OM data, as shown in paper CCSBT-OMMP/1508/BGD01. The AS index is the only direct recruitment information in the OM. The overall consistency with other data in the OM was demonstrated by fits with and without the AS data (CCSBT-OMMP/1508/BGD01). The AS data are valuable as a fishery-independent index of recruitment given reliance on fishery dependent long-line CPUE in the OM, and problems with unresolved uncertainties related to the market anomaly in the past.

30. Because the AS design, data, standardisation, consistency with other data and ability to provide information on recruitment has been evaluated in a series of reviews, the ESC agreed in 2005 that the index be included in the OM and in 2008 it was agreed to include in the MP given historically low series of recruitments (1999-2002).

Alternative indices of recruitment

31. The SAPUE and trolling surveys have been reviewed in the past and have not been included in the OM. The SAPUE index data are from commercial targeted operations and therefore are subject to a range of potential biases that cannot be adequately addressed in the standardisation (Basson and Farley, 2015). Importantly, the coverage of the commercial spotting has shifted markedly to the east over the most recent 3-4 years, as the purse seine fishery has shifted area of operation to the east, almost entirely outside the area of the scientific aerial survey and beyond the “core” area for SAPUE prior to 2011. It was noted in the meeting that this shift was the result of economic considerations (i.e., being able to take catches closer to the farming and therefore substantially reducing catching and towing costs) and was unlikely to change in the foreseeable future. It was noted this substantially undermines the value of the SAPUE as a long-term series.

32. The NZ LF and CPUE data have been examined in the past and are not considered a reliable or consistent indicator of recruitment as they are on the extreme of the range of the young year classes; and there were spatio-temporal changes observed in the global spatial archival tagging project where the percentage of tagged fish travelling to the Tasman Sea from the GAB had

decreased. Age based CPUEs will be difficult to use because size data are already included in the OM, and correlations between ages.

33. Japan presented a comparison of alternative indices of recruitment in paper CCSBT-ESC/1509/29. These alternatives were the aerial survey index, SAPUE, grid-type trolling index (GTI), and average of w0.5 and w0.8 (Japanese longline CPUE) for ages 5-7 combined.

34. It was noted that ages 2-4 was not included in the CPUE age range considered in the paper because of variability from discard and release of age 4 fish in the Japanese LL fishery.

35. Japan presented information on the grid-type trolling index (GTI) from 2014 (see paper CCSBT-ESC/1409/34). It was noted that these data appear to be very noisy, but that the index shows some consistency with identifying the very low recruitments in 1999-2002. The trolling index has been considered as a qualitative indicator of recruitment in the past, because of spatial temporal limitations of the survey and unresolved uncertainties in age 1 spatial dynamics identified in the 2000s tagging work. The intent to continue to develop the troll survey (and GTI) as a potential quantitative index of 1 yr old recruitment was noted. Further work and thorough review of these data, standardisation, potential biases and uncertainty would be required before an updated index based on the troll survey could be considered for use in the OM.

36. The need for a fishery independent index of recruitment was highlighted, given the historical problems in the CPUE data. The AS and troll survey are the only current candidates further considered by the OMMP.

37. Additional analyses were undertaken in the meeting on the consistency of the AS, SAPUE, and trolling index as recruitment observations with the OM, and examination of systematic errors.

38. Plots for these recruitment indices were completed to assess their potential suitability. Each of the recruitment series was truncated (commencement of series through to 2011) to provide a consistent comparison with the recruitment estimates from the OM and are shown in Figures 2, 3, and 4 all without the aerial survey data included in the fitting. Comparing these figures for consistency confirms that the AS is more consistent with the assessment model conditioned to all other data except for the AS.

39. The truncation of the data series results in the most recent 4 years of the SAPUE being excluded from the series. As a result, the years in which the SAPUE coverage has shifted substantially to the east are excluded also.

40. The GTI index exhibits a trend in residuals from low negative residuals early in the series to high positive later in the series.

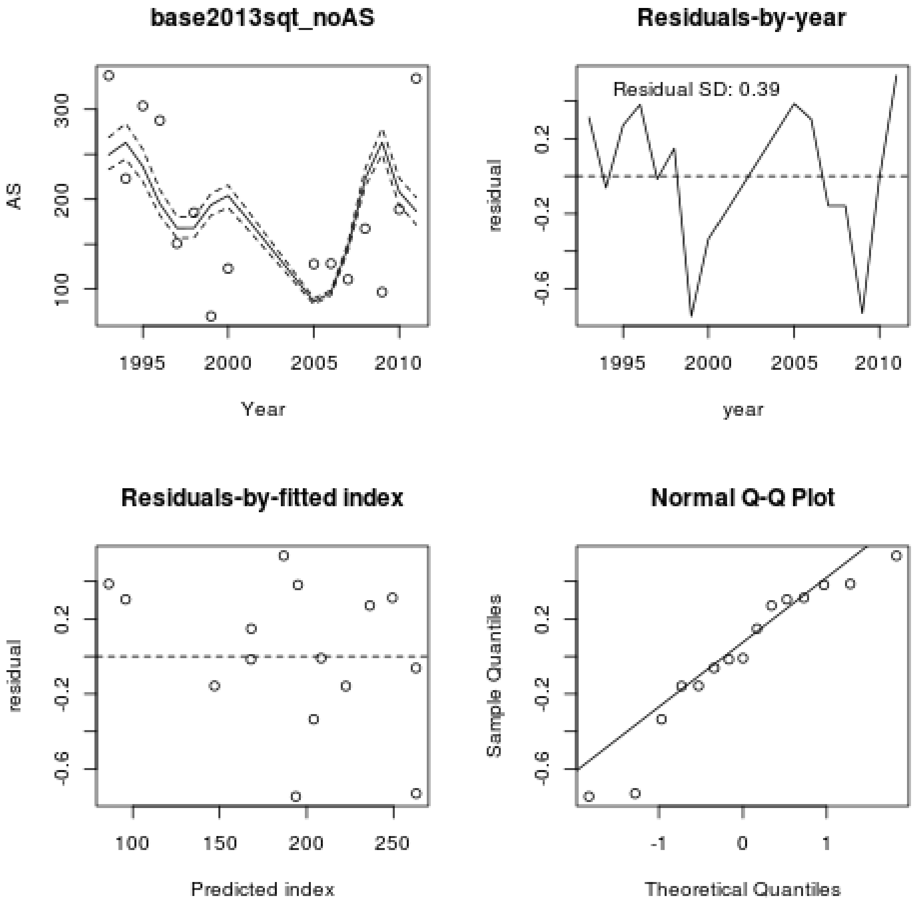

Figure 2. The baseline results here are for the OM conditioned on all the data customarily used except for the aerial survey. These results are then compared to the aerial survey by contrasting observed values with those predicted by the OM.

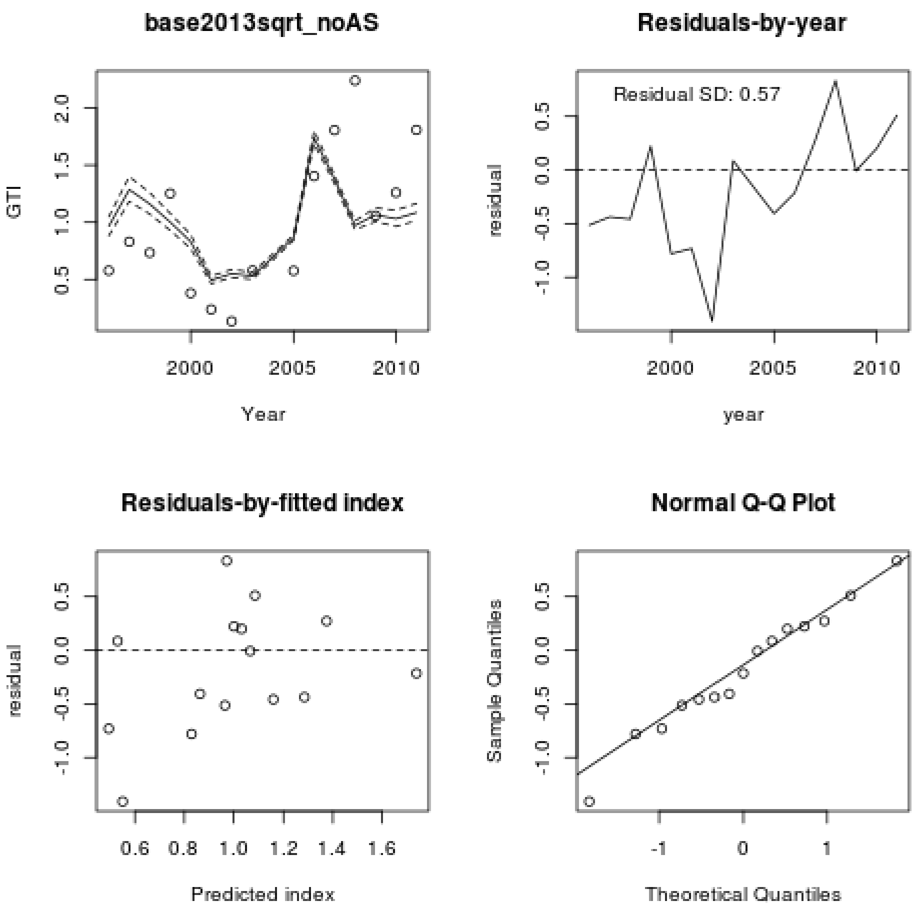

Figure 3. As in Figure 2 but here the predictions from the OM are contrasted with the GTI index.

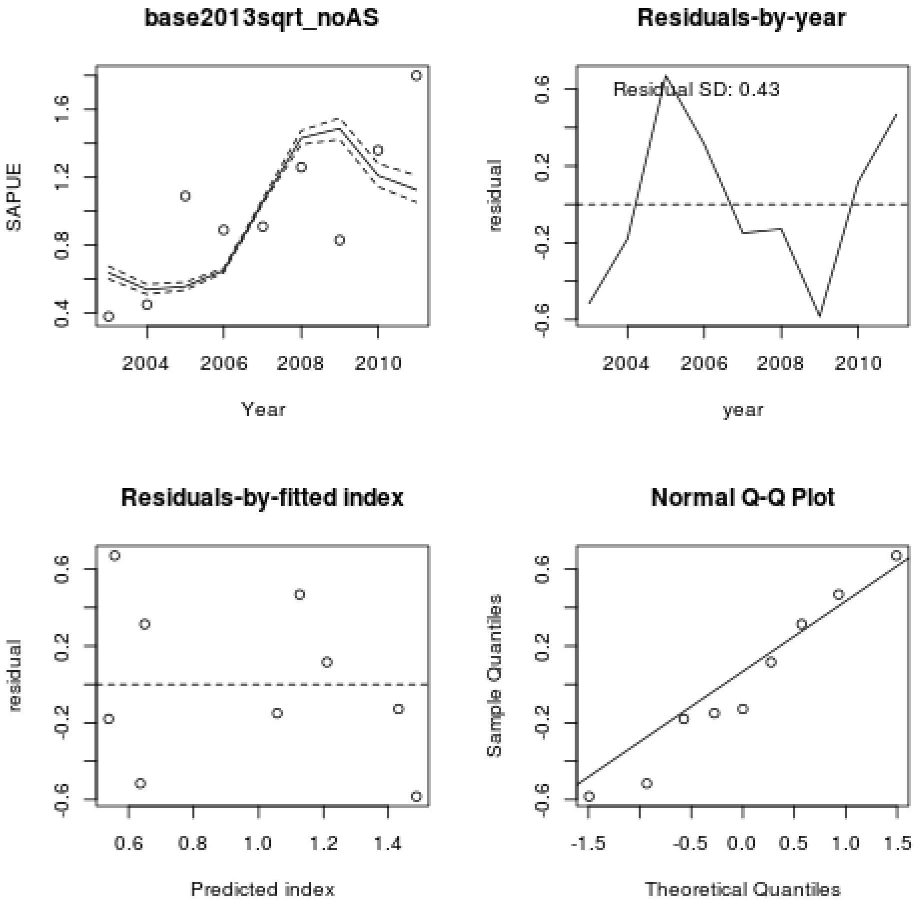

Figure 4. As in Figure 2 but here predictions from the OM are contrasted with the SAPUE index.

36. The meeting participants collated the information on all of the potential alternative recruitment indices. This would include their limitations and benefits, spatial temporal coverage, consistency over time, scales on which the data were collected and component of the stock that they cover.

37. The following tables were compiled to summarise qualitative attribute of different recruitment indices discussed at the meeting.

Table 5. Alternative recruitment indices qualitative summary.

	Inform stock trend/status?	How useful for MP?	Useful in stock Assessment?	Improvements needed to be useful within an MP
	Attribute	**Input to 'Decision Rule'**	**Input to Stock assessment**	**Research needed**
Aerial Survey	2-4 year olds (aggregated)	Yes – fishery independent recruitment index in Bali MP	Yes – fishery independent recruitment index	Nil
SAPUE	2-4 year olds (aggregated)	Unlikely, also currently unavailable and may continue to be so in future	No, used qualitatively as indicator	Constraints unlikely to be resolved. Shift in coverage compromises interpretation as index.
Gene tagging	Juveniles (2yr old, possibly 3yr olds)	Yes, good prospect subject to pilot study outcome.	Yes–fishery independent recruitment estimate, estimation of F & M	Initial experiment to provide initial rec estimate and refine field operations
LL CPUE (age-specific)	Juveniles (2,3,4 yr olds)	Unlikely	No, used qualitatively as indicator	Formal design study including estimation of CV and process error Careful age-composition estimation
Grid-type Troll Index (GTI)	Age 1	Potentially, contingent on results of additional research	No, used in robustness test and qualitatively as indicator, potential in future application	Field method details Design study to determine required sampling effort for desired CV, including process error and alternative forms for incorporation in MP Further evaluation of environmental covariates, and temporal trend in residuals

Table 6. Alternative recruitment indices key issues.

	Key issues and comments
Aerial Survey Index	1. Substantial review and testing undertaken 2. Calibration factors estimated 3. Process error estimated 4. Predictive ability tested 5. Fit consistent and moderating influence 6. Earliest estimates of recruitment in OM 7. Provides early response to recruitment trend in MP 8. Logistics vulnerable (expert spotters) 9. Budget issue 10. Change of fishing ground
SAPUE	1. Dependent on fishery operations; difficult to standardise for changes in fishery operation 2. Considerable exploration of model structure and error properties 3. Peer reviewed publication 4. Substantial change in spatial coverage over recent years 5. Repeated counting of schools 6. Changes in spotters over series
Gene tagging	1. Tagging (mark release recapture (MRR)) estimator and statistical properties well understood in literature. 2. General method (MRR) provided valuable stand alone estimates and model inputs in past. 3. GT option overcomes limitations of previous SBT tagging studies. 4. Simulation design study for specific GT designs completed 5. Tools for sample collection and handling developed 6. Genetic markers and processing "pipelines" established 7. Requires at sea "tagging" and associated field logistics 8. Pilot study at this time 9. Fisher independent 10. Mixing issue might be considered in a robustness test going forward
CPUE (age-specific)	1. Unquantifiable uncertainty due to historic overcatch 2. Some CPUE at age are model-inferred rather than based on data 3. Autocorrelation in estimating catch at age from length distributions 4. Possible bias (e.g. catchability changes) 5. Discarding/released impact 6. Availability of CDS data 7. Under development
Grid-type Troll Index (GTI)	1. Area covered limited (only one third of that covered by the aerial survey) 2. Relatively low level of survey effort and number of observations 3. Likely influenced by environmental covariates 4. Potential for autocorrelation from multiple encounters of individual schools 5. Unclear how to deal with trend in residuals over time

Table 7. Alternative recruitment indices characteristics.

	Summary of characteristics (spatial & temporal coverage)	Current status and possible future development	Points for further improvement
Aerial survey	Informative for age 2-4 Formal survey design Broad spatial and temporal coverage (entire GAB, 5000-15000 nm and January – March (peak time of abundance in GAB) Standardised for spotter and environmental effects	Used in OM and MP currently	Calibration of new spotter
SAPUE	Commercial index, spatial and temporal coverage dependent on fishery operations (e.g. shift in spatial coverage since 2009)	Unlikely to be useful beyond qualitative use in annual indicators review	
Gene tagging	An estimate of abundance for age 2, formal survey design conducted, and fishery independent	Design study completed. Pilot tagging to commence. Method completed for inclusion of data in OM (see paper 18). Genotyping methods developed in CK project. Investment required	
CPUE (age-specific)	Fishery dependent Depending on available size data some series are highly derived Changing discarding practices	Issues relating to incorporation in current OM Cheaper but less reliable Under development and discussion within CPUE WG	Formal design study including estimation of CV and process error and consideration of potential bias.
Grid-type trolling index	Limited coverage spatially and temporally (Area, 9-14 trolls, ~21 days January) Based on composite, smoothed data from trolling surveys Fishery independent index. Based on troll monitoring survey off southern WA. Standardised catch by number of age-1 per search distance.	Review and consideration of analysis approach for composite index It would be necessary to include in the OM to allow for possible use as a candidate index of next MP.	Review of spatial temporal coverage and consideration of potential uncertainty and bias from 1) unresolved issues of age 1+ fish movement down the WA coast; 2) limited coverage of inshore and offshore strata; 3) temporal issues such as time of day, tide cycle, and period within migration season; 4) analysis methods to address the potential for autocorrelation from multiple encounters of individual schools. More statistical analysis for standardisation to include other covariates. Oceanographic factors may influence the migration to the survey area. Two sub-cohorts in age-1 fish.

Alternatives to current MP

38. In considering the alternatives to the current MP, the agreed MP metarule process of review was discussed, together with options for future work programs and their implications.

39. CCSBT-OMMP/1508/BGD02 reviewed the MP Specification and Meta-rules is the agreed framework for the implementation of the Bali Procedure (ESC18, Attachment 10). These include the objectives and performance measures for the rebuilding of the stock; the detailed specification of the MP itself (monitoring series, analyses, harvest control rule and implementation); the schedule for TAC recommendations, periodic assessments of stock status, formal review of MP performance; and the process and criteria for identifying exceptional circumstances (i.e. circumstances/events outside the range for which the MP was tested during the Management Strategy Evaluation (MSE) phase of development). The paper reviewed the purpose and function of the Meta-rules with a particular focus on: i) the identification of exceptional circumstances and the actions that may flow when they are identified. It presented four potential options, in terms of implications for the MP, TAC recommendations and, depending on the Extended Commission's decision on the AS beyond 2016.

40. CCSBT-OMMP/1508/BGD02 also commented that the 20th meeting of the ESC will consider whether the following events represent exceptional circumstances under the meta-rules for the MP: i) The missing 2015 aerial survey data point; ii) the identification, but uncertain quantification, of un-accounted mortalities (UAM); iii) the shift in Indonesian size/age data (2013-2015), and; iv) the potential that the AS may not continue beyond 2016. In our view, the first two items may constitute exceptional circumstances, however, the actions that may follow are different. The missing 2015 aerial survey data point can be accommodated within the state-space component of the MP, and hence, it does not prevent the MP being used to recommend the 2018-2020 TAC in 2016, assuming the 2016 AS index is available. In the case of the UAM, the MP testing assumed total removals were reported exactly. No allowance was provided for UAM beyond 2011. Hence, in principle, UAM is exceptional circumstances and, in practice, the work completed by OMMP Working Group and ESC in 2014 indicated that plausible ranges of UAM would compromise the predicted performance of the MP, if they were occurring at that level. The shift in Indonesian size/age data is yet to be fully considered by the ESC. However, CCSBT-ESC/1509/14 indicates a substantial difference that has implications for the impact of the Indonesian fleet on the stock. It also has implications for the use of these data in the OM and for Close-kin abundance estimation. Consideration of the implications of the AS not to continue beyond 2016 is less straightforward in the context of exceptional circumstances, as it is a potential future event. However, were it to transpire, it would clearly represent exceptional circumstances as: i) it would not be possible to use the agreed MP to recommend future TACs, and; ii) there would be no recognised source of recruitment monitoring available to replace the survey index. Such a situation would require the development of new recruitment indices, new MPs and full MSE testing. This would entail considerable addition cost and time before a robust MP could be used to recommend TACs consistent with the Extended Commission's objectives for minimising the risk of future declines and rebuilding the spawning stock.

41. It was noted that if there is no AS after 2016, then the annual TAC review, for the TACs which will be set by the current MP up to 2020, will be lacking the essential information on recruitment from the AS.

42. Furthermore, the continuity of the MP is important as it contributes to performance in that the feedback mechanism in the MP will correct future TACs. If there is no AS, i.e. recruitment monitoring, after 2016 and no MP in place, this will need to be considered at the ESC of 2016 in the deliberations about exceptional circumstances and associated possible actions including possible changes in the TAC for 2017 and beyond.

43. Japan presented the paper CCSBT-OMMP/1508/BGD05 (same as CCSBT-ESC/1509/38). In the paper, several alternatives to the current MP are considered in terms of data quality, the cost of alternative indices, the future availability of data, the development cost and the time required.

44. The OMMP working group concluded that there was no replacement MP that could be rapidly developed in the list in paper CCSBT-OMMP/1508/BGD05. It was agreed that an MP based only on fishery dependent data, CPUE only, was unacceptable given the low status of the spawning stock and in the absence of a reliable recruitment index. The risks associated with the current MP without the AS mean that it is not a candidate. There is also no alternative fishery independent recruitment data series that is fully developed for use in an MP. In discussion of the details of the formulation of the current MP it was noted that the MP design is specific to the AS data and that alternative recruitment indices cannot simply be used as a replacement to the AS data in the MP. A new MP would need to be designed, or potentially modified from the current MP design. It was acknowledged that the development of a new MP would be a costly and time-consuming exercise.

45. In the event that a new MP is needed, the process steps, meetings required and an estimate of costs for these were discussed. Table 8 below provides a schedule for reviewing and developing alternative recruitment monitoring indices, and MP development, testing, adoption and implementation. This would constitute substantial additional work for the ESC and approximate costs will be developed at the ESC20.

Table 8. Preliminary schedule and approximate costs for development of alternative recruitment monitoring series and MP development and testing assuming that aerial survey is discontinued beyond 2016. Note shaded events (numbered with suffix "*i*") represents an inter-sessional activity.

No.	Activity/Meeting	Purpose	Timing
1i	Evaluation of potential recruitment indices	Provide detailed evaluation of the statistical properties of potential recruitment indices	Nov 2015-May 2016
2	OMMP7	Evaluate and select candidate indices	June-July 2016
2i	Initial conditioning	Initial conditioning, data generation etc	
3	OMMP-ESC21	Review of initial conditioning, data generation for projection models and form of potential MPs. These MPs may need to be quite different from the existing MP.	Sept 2016
3i	Finalise conditioning	Update OM with most recent data. Complete data-generation and specification of candidate MPs.	
4	OMMP8	Finalise conditioning (coinciding with scheduled OM reconditioning), data generation and initial MP runs	June-July 2017
4i	Refine MP performance	Refine MP performance and robustness tests	
5	OMMP-ESC22	MP selection	Sept 2017
5*i*	MP TAC recommendation	Any refinements required from ESC	
6	Sp. Commission	MP adoption	
7	OMMP9	Refinement and final tuning, if required	June-July 2018
8	ESC23	Final review	Sept 2018
9	Commission	Final Adoption/Implementation	Oct 2018

Agenda Item 2. Reconsideration of OM structure

46. Most items under the agenda for reconsideration of the OM were deferred given the immediate concerns related to the AS and future of the MP.

47. The progress made in 2014 in handling of within-cell uncertainty was presented. Point estimates from sampling the grid of structural uncertainties are used in projections. Code issues were resolved last year and estimation of the Hessian matrix can be used to approximate posterior distributions for the parameter estimates, or within-cell uncertainty. These are small relative to the structural uncertainties, but sampling from a posterior can now be combined with the sampling from the structural uncertainty grid, to improve representation of the uncertainty in the model estimates.

48. It was recommended that this be included in the next MP evaluation noting that inter-sessional work is required to incorporate these changes.

Agenda Item 3. Technical issues for evaluation of unaccounted sources of mortality

49. This agenda item was deferred to the ESC.

Agenda Item 4. Code refinements and version control system

50. A small group met to discuss managing code changes in the github version control system, and will continue to work intersessionally.

Adoption of report

51. The meeting deferred report adoption to become part of the ESC presentation.

Close of meeting

52. The meeting closed at 17:30 pm, 31st August 2015.

List of Attachments

Attachments

1 List of Participants
2 Agenda
3 List of Documents
4 Consideration of within-grid cell variance estimates

Attachment 1

List of participants
The Sixth Operating Model and Management Procedure Technical Meeting

First name	Last name	Email
CHAIR		
Ana	PARMA	parma@cenpat.edu.ar
ESC CHAIR		
John	ANNALA	annala@snap.net.nz
ADVISORY PANEL		
John	POPE	popeJG@aol.com
James	IANELLI	jim.ianelli@noaa.gov
MEMBERS		
AUSTRALIA		
Ilona	STOBUTZKI	ilona.stobutzki@agriculture.gov.au
Belinda	BARNES	belinda.barnes@agriculture.gov.au
Campbell	DAVIES	Campbell.Davies@csiro.au
Ann	PREECE	Ann.Preece@csiro.au
Rich	HILLARY	Rich.Hillary@csiro.au
Matt	DANIEL	Matthew.Daniel@afma.gov.au
Brian	JEFFRIESS	austuna@bigpond.com
FISHING ENTITY OF TAIWAN		
Sheng-Ping	WANG	wsp@mail.ntou.edu.tw
JAPAN		
Tomoyuki	ITOH	itou@fra.affrc.go.jp
Norio	TAKAHASHI	norio@fra.affrc.go.jp
Osamu	SAKAI	sakaios@fra.affrc.go.jp
Izumi	YAMASAKI	izyam@fra.affrc.go.jp
Hiroyuki	KUROTA	kurota@fra.affrc.go.jp
Doug	BUTTERWORTH	Doug.Butterworth@uct.ac.za
Yuji	UOZUMI	uozumi@japantuna.or.jp
Michio	SHIMIZU	ms-shimizu@zengyoren.jf-net.ne.jp
NEW ZEALAND		
Kevin	SULLIVAN	Kevin.Sullivan@mpi.govt.nz
Simon	HOYLE	simon.hoyle@niwa.co.nz
REPUBLIC OF KOREA		
Doo Nam	KIM	doonam@korea.kr
Sung Il	LEE	k.sungillee@gmail.com
You Jung	KWON	kwonuj@korea.kr
Mi Kyung	LEE	cc.mklee@gmail.com
Hee Won	PARK	heewon81@gmail.com
CCSBT SECRETARIAT		
Akira	SOMA	asoma@ccsbt.org
Colin	MILLAR	CMillar@ccsbt.org
Glen	HONG	GHong@ccsbt.org

Attachment 2

Agenda for the Operating Model and Management Procedure Technical Meeting

Korea, 30-31 August 2015

Terms of Reference

A 2-day technical meeting, to take place immediately prior to ESC20, was recommended by the ESC19 with the goal of evaluating possible changes in the Operating Model (OM) structure for the MP review to be conducted in 2017. Since then, the 2015 scientific aerial survey (AS) was suspended and CCSBT21 requested the ESC to conduct analyses on the implications of the lack of one or more AS for the MP process. The MP Technical Working Group agreed on a specific analysis to evaluate the implications of decreasing the precision of the AS and/or decreasing the frequency of the AS. Results of the analyses conducted inter-sessionally by Members were be reported at the SFMWG meeting in July.

From the SFMWG meeting report:

The meeting requested that the ESC provide advice to the EC in 2015 on:

- *The ESC's relative research priorities for 2016 to 2018 inclusive, noting that the research budget is limited;*
- *The costs and benefits of continuing with the current MP including conducting the aerial survey from 2017 to 2019; and*
- *Any preliminary consideration of alternatives to the current MP approach including an indication of their relative costs and benefits if possible.*

13. The meeting, recognising the ESC's task to run the MP in 2016 and that a review of the MP is scheduled for 2017, requested that the ESC commence assessment and provide as much advice as possible on the relative merits of the alternatives to our current approach to the MP for reporting back to the EC in 2016.

Adopted Agenda

1. Technical implications of changes in the scientific aerial survey on the MP process

1.1- Value of the AS as input to the MP.

Expand the discussion of numerical results initiated at the webinars and consider any further analyses (either tabled for the meeting or to be conducted during the meeting) that may inform the discussion.

1.2- Performance of the AS as an index of recruitment and as input to the OM.

Documents CCSBT-ESC/1509/20 and OMMP6_BGD01_AU.

1.3- Alternative indices of recruitment.

Strengths, limitations and availability of different candidates, including new indices.

1.4- Alternatives to current MP.

An evaluation of MP performance is planned for 2017. Discuss the scope of the MSE work needed to provide advice on alternatives to the current MP. What would be involved?

2. Reconsideration of OM structure

1.1.Data inputs

1.2.Model structure (size-age, fleets, seasons, etc).

Consider how to address changes in the size-age composition of the Indonesian catch and whether part of the catch could be allocated to a different fleet.

Modelling selectivity (current approach) versus cohort-slicing for variable fishery components.

2.3 Assumptions about selectivity, catchability, recruitment, growth, etc.

2.4 Likelihoods

Capability to use alternative likelihood components for the CK data (e.g., the Beta-Binomial)

2.5 Handling of within-cell uncertainty.

Substantial progress was made during ESC19 to incorporate within-cell uncertainty in some key dependent variables. Needs further evaluation and documentation.

2.6 Other?

3. Technical issues for evaluation of unaccounted sources of mortality

4. Code refinements and version control system

Attachment 3

List of Documents

(CCSBT-OMMP/1508/)

1. Provisional Agenda
2. List of Participants
3. List of Documents
4. (Australia) Technical changes in the MP to account for missing aerial survey data

(CCSBT-OMMP/1508/BGD)

1. (Australia) Implications of cessation of the aerial survey for the MP and TAC setting (*same as* **CCSBT-ESC/1509/9**)
2. (Australia) Meta-rules for implementation of CCSBT management Procedure and consideration of exceptional circumstances and 2017 scheduled review of MP (*same as* **CCSBT-ESC/1509/12**)
4. (Japan) A Check of Operating Model Predictions with Discussion of Aerial Survey Index Issues Related to Continuing Use of the Bali Management Procedure (*same as* **CCSBT-ESC/1509/37**)
5. (Japan) Some initial considerations for the review of the Bali Management Procedure in 2017 (*same as* **CCSBT-ESC/1509/38**)

(CCSBT-OMMP/1508/Rep)

1. Report from the Fourth Meeting of the Strategy and Fisheries Management Working Group (July 2015)
2. Report of the Eleventh Meeting of the Ecologically Related Species Working Group (March 2015)
3. Report of the Effectiveness of Seabird Mitigation Measures Technical Group (November 2014)
4. Report of the Twenty First Annual Meeting of the Commission (October 2014)
5. Report of the Ninth Meeting of the Compliance Committee (October 2014)
6. Report of the Nineteenth Meeting of the Scientific Committee (September 2014)
7. Report of the Fifth Operating Model and Management Procedure Technical Meeting (June 2014)
8. Report of the Twentieth Annual Meeting of the Commission (October 2013)
9. Report of the Eighteenth Meeting of the Scientific Committee (September 2013)
10. Report of the Fourth Operating Model and Management Procedure Technical Meeting (July 2013)
11. Report of the Seventeenth Meeting of the Scientific Committee (August 2012)
12. Report of the Special Meeting of the Commission (August 2011)
13. Report of the Sixteenth Meeting of the Scientific Committee (July 2011)

Attachment 4

Consideration of within-grid cell variance estimates

At the SC19 work progressed on evaluating additional sources of variation defined by the OM. In particular, the within-grid estimation error was completed so that it could be accounted along with the structural error represented by the model grid (currently representing 320 different model configurations). A sequence of plots showing the joint probability distribution for projected numbers at age was shown for a single element of the grid (to show a characteristic magnitude of estimation uncertainty) compared to the joint distribution of the 320 point estimates which displays the unweighted range of the structural uncertainty (in practice, the projections involve selecting from the grid based on statistical weights). The figure below shows a comparison of the structural uncertainty (using point estimates only) with results from structural uncertainty and estimation uncertainty combined (by resampling from each of the 320 posterior distributions). The vertical scale is based on the ratio of spawning biomass relative to the annualised estimates of the spawning biomass where MSY is estimated to be achieved. Figure 5 below shows an example envelope of uncertainty of the grid with and without uncertainty estimates.

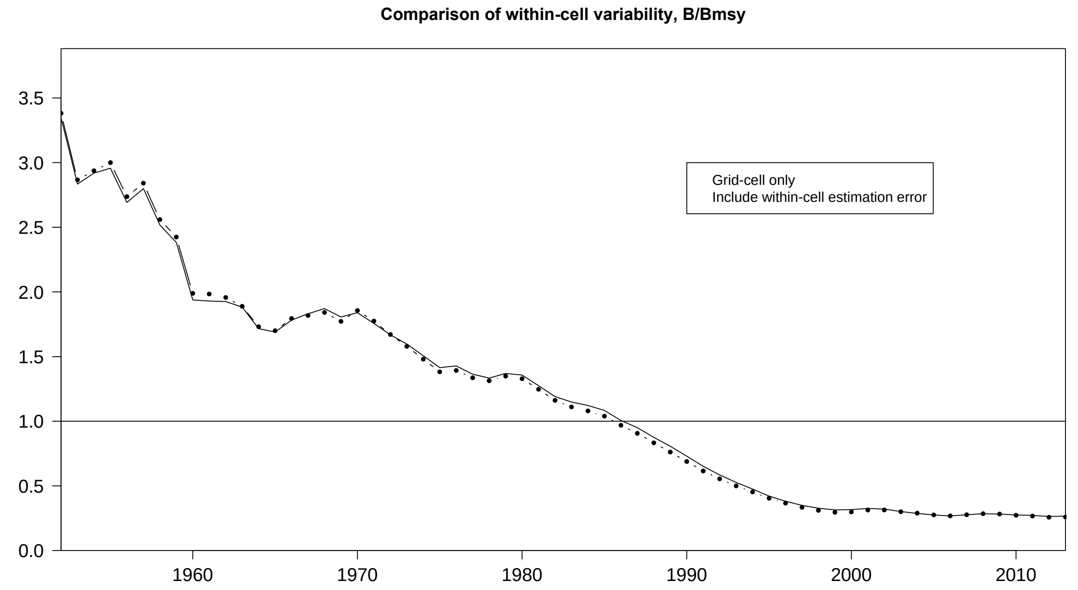

Figure 5. Comparison of the structural uncertainty (using point estimates only) with results from structural uncertainty and estimation uncertainty combined (by resampling from each of the 320 posterior distributions). The vertical scale is the ratio of spawning biomass relative to the annualised estimates of the spawning biomass where MSY is expected to be achieved.