Commission for the Conservation of
Southern Bluefin Tuna

みなみまぐろ保存委員会

Report of the Fourth Meeting of the Management Procedure Workshop

16-21 May 2005
Canberra, Australia

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Agenda Item 1. Terms of Reference and adoption of Agenda

1. The Workshop was opened by Mr Penney, independent Chair of the Scientific Committee and Chair of the Workshop.
2. The draft agenda circulated prior to the workshop was accepted and is at **Attachment 1**. The Chair outlined the terms of reference for the workshop.
3. Participants introduced themselves and the list of participants is at **Attachment 2**.
4. The list of documents submitted to the workshop is at **Attachment 3**.

Agenda Item 2. Outcome of small technical meeting held in Seattle

5. Dr Ana Parma, the technical director for the development of the management procedure (MP), briefed the workshop on the outcome of the special technical meeting held in Seattle in February 2005.
6. Dr Parma explained that the meeting first discussed the criteria that would be used to specify the reference set. It was agreed that for a factor to be included in the reference set, it had to have relatively high plausibility and the outcomes should be sensitive to different levels of the factor across that range. Conversely, for inclusion in the robustness trials, the hypothesis could be less plausible, but should still have an important impact on performance.
7. Members had conducted substantial sensitivity analyses and the papers provided for the meeting represented the starting point. Further model runs were conducted during the meeting, which led to the final choice of reference set and robustness trials.
8. The final reference set has an expanded number of dimensions of uncertainty compared to the previous reference set and included

	Levels	Cumul N		Values		Prior	Simulation Weights
Steepness	3	3	0.385	0.55	0.73	0.2, 0.6, 0.2	Prior
M0	3	9	0.3	0.4	0.5	Uniform	Posterior
M10	2	18		0.1	0.14	Uniform	Posterior
Omega	2	36		0.75	1	0.4, 0.6	Posterior
CPUE	5	180				Uniform	Prior
q age-range	2	360		4-18	8-12	0.67, 0.33	Prior
Sample size	2	720		Sqrt	Original/2	Uniform	Prior

9. The following matters from the meeting report were identified:

   - Tagging data were included but with a different reporting rate. With the updated data and change in reporting rates, the undesirable properties (large preference for high values of M10) seen when the tagging data were previously included were less evident.
   - Figure 5a of the report showed recruitment and spawning biomass projections under constant catch set at current TAC. Two low recruitments corresponding to year classes of 2000 and 2001 led to decreased spawning biomass after 2010.
   - In recognition that these recruitment estimates are based on limited data only and are likely to change as the cohorts recruit into the long-line fishery, a number of robustness trials were selected to represent both more optimistic or more pessimistic scenarios.
   - In addition to the recruitment robustness trials, other factors included in robustness trials related to the possibility of trends in catchability and carrying capacity, and to different assumptions about selectivity of the Indonesian fishery and maximum exploitation rates considered possible for the surface fishery.

10. The special technical meeting concluded that the agreed reference set provides a sufficient basis to allow final recommendations on the choice of a MP. However, the basis for advice on a tuning level is dependent, at least in part, on the estimates for the 2000 and 2001 cohorts. The workshop noted that the 2000 and 2001 recruitment estimates are extreme and are supported by limited data only. This, combined with the potential sensitivity of performance at a given tuning level to the estimates for these two cohorts, means that final advice on the consequences of different tuning levels may require taking account of projection results from both the reference set and some of the robustness trials. The need or otherwise for this will depend on new data and the indicator analyses to be considered at the stock assessment group meeting in August 2005. How best to combine reference set and robustness trial results to provide advice on tuning levels is an important question that will need to be discussed later in the management procedure workshop (see agenda item 5.1).

Agenda Item 3. Performance of candidate management procedures

3.1 Review results of MP trials conducted after February 2005

11. Documents CCSBT-MP/0505/04, 06, 07, and 08 were considered under this agenda item. The MPs presented in these papers span a range of approaches, including purely CPUE-based rules and model-based rules that also integrate age composition data.

12. Results of the candidate decision FXR_01 rule and new versions of this rule (CGF) were presented in CCSBT-MP/0505/04. Differences between the original FXR_01 and the new versions include: TAC as a function of r instead of r^2 (all versions); additional constraints on TAC increases (some versions); inclusion of poor recruitment feedback (some versions). Additional constraints on TAC increases only had a very small effect on the 90^{th} percentiles of performance

measures (e.g. catch, biomass) because only few trajectories are affected by the constraint. The inclusion of poor recruitment feedback show lower risk in terms of biomass, traded off by poorer catch performance, particularly in the short term. Rules that include recruitment feedback also perform better in robustness trials, particularly the low recruitment trials. The paper notes that those variants which make larger cuts in TAC, and limits increases in TAC early in the period (prior to 2015) tend to show less risk and greater average catch overall.

13. Document CCSBT-MP/0505/06 describes the D&M MP. Two minor refinements were made to this procedure: TACs may not increase above their immediately previous levels for the first two TAC changes, and the TAC formula incorporates a function directly related to the recent CPUE level to reduce depletion risk. Best performance was achieved under option *b*): a three-year TAC-change interval commencing in 2008. The MP takes account of longline catch length distribution information during initial years, and this improves catch performance (while not compromising recovery performance) if recent recruitment is better than anticipated for the reference set trials. A preferred and an alternative version of this CMP were put forward. For the same recovery tuning the alternative involves less depletion risk for the reference set and some robustness trials, but the preferred candidate shows lesser variability in inter-interval TAC changes, and does not underachieve on the median spawning biomass recovery target if recent recruitment is appreciably higher (the triple R scenario) than assumed for the reference set trials.

14. Document CCSBT-MP/0505/07 describes HK5 MP. HK5 is an empirical decision rule depending on CPUE index of longline fisheries (LL1). TAC is set as a minimum of TAC values calculated from CPUE trend of age 4+ (overall stock) and CPUE level of age 4 (recruitment). The formulation of HK5 was the same as before and values of the control parameters only were changed for tuning. Performance of five variants was examined in the document. With a preferable parameter set assuming asymmetric TAC change (HK5_01), the HK5 was able to control stock properly without early large reductions in TAC and the inter-annual variation in catch was quite small. HK5_02 with symmetric TAC control was also regarded to be preferable, because it can increase TACs more when stock condition is good, though catch stability is lower.

15. Due to the low current state of the stock, CCSBT-MP/0505/08 shows that there is a high probability that the biomass will totally collapse in 2014 under current catches and therefore the TAC should be adjusted as soon as possible to prevent dramatic losses of biomass in the near future. Since both the total frozen SBT and NBT imports price in the Japanese market follow a decreasing trend after 1999 with a slight increase in quantity from 2003 to 2004 coincident with a dramatic drop in price. The total revenue will drop accordingly in the short run. The candidate TAI_decision rules minimize the percentage change of TAC in the first adjustment year, to adjust TAC fully during the intermediate run, and to recover the biomass. The TAI_decision rule specifies a simple empirical CPUE-based model with a built-in negative feedback component. Of the six rules explored, TAI_A4 and TAI_05 are recommended as moderate MPs with preferable performance.

16. A core set of performance statistics was selected to facilitate comparisons. The A-statistic was excluded because the additional constraints that developers had

added to their MPs made this less meaningful. The AAV statistics were compared on both relative and absolutes scales because the relative AAV misleadingly inflates when TACs are very low. A number of plots were also considered for the comparisons including trade-off plots (e.g., Document CCSBT-MP/0505/04 Figure 10) to examine various trade offs between biomass, catch, and catch stability over short and longer terms and cumulative probability plots and histograms for short-term TACs. **Attachment 4** contains a list of captions of the figures produced during the workshop. The actual figures are available electronically through the CCSBT secretariat.

17. The workshop agreed that a reduced set of procedures (two variants from each developer) should be used for the initial examination of MP performance. The workshop also agreed that it would first focus on results from tuning option *2b* (i.e. first TAC change in 2008 with three year changes and a tuning level of 1.1), and then evaluate if the relative performance of MPs changed when moving between different tuning levels and options. Each developer proposed two rules from their paper to use in this comparison (see below). A summary of the basic characteristics of each MP are provided in **Attachment 5**:

    - Document CCSBT-MP/0505/04 CGF_01 and CGF_42
    - Document CCSBT-MP/0505/06 D&M_02 and D&M_03
    - Document CCSBT-MP/0505/07 HK5_01 and HK5_02
    - Document CCSBT-MP/0505/08 TAI_05 and TAI_A4

18. The workshop noted that for the absolute AAV statistic the CGF and D&M MPs had higher values than the TAI and HK5.

19. On the other hand, CGF and D&M MPs had narrower ranges than HK5 and TAI MPs for the B_{2022}:B_{2004}. It was noted that two factors contributed to the difference in this trade-off axis: (i) developer's criterion on priority objectives and (ii) model-based or empirical based nature.

20. The results were similar for B_{2014}:B_{2004} and B_{MIN}:B_{2004} with the upper bound for all MPs being at or below 1. Again the ranges were narrower for the CGF and D&M MPs and the TAI MPs had the lowest medians (0.5 – 0.6), indicating that this MP has higher risk than other MPs.

21. For the Max TAC decrease, the TAI_A4 variant and both HK5 variants had lower TAC decreases with medians less than 5000t but the median for CGF and D&M MPs was close to 5000t, equal to the overall constraints on maximum TAC decrease.

22. Interesting patterns were found for some MPs in the comparisons of 10 and 20 year average catches. Over the short term, the TAI procedures had higher average catches, but this pattern was reversed over the longer term. This suggested that the TAI procedures favoured "late-pain" more than the other procedures. This "late-pain" was associated with higher risk in the early period as indicated in the B_{2014}:B_{2004} and B_{MIN}:B_{2004} comparisons. Rules that drop catches early (e.g. CGF) can capitalise on early stock rebuilding and thus achieve higher overall catch for the same level of rebuilding. This was also clearly shown in the trade-off plots.

23. The trade-off plots over the three core axes of average catch, maximum drop in TAC, and stock risk (10^{th} percentile of B_{2014} and B_{2022}) indicated that while the CGF MP outperformed the D&M MP on average catch versus risk it did so at the

expense of higher catch variation (from the comparison of AAV statistic). Of the empirical procedures, the HK5 procedures gave higher catch for lower risk and lower catch variation.

24. The workshop noted that the set of CMPs put forward spanned a wide range with respect to the extent to which the MPs imposed explicit constraints (for example in relation to restriction on the extent of TAC changes), and how these utilised information from the operating models in selecting values for the parameters of their control rates. The former aspect raised a concern that MPs which by design had not included such constraints may have performed differently if they had included such constraints. The latter aspect can lead to problems as MPs, while working well for the specific OMs agreed for the tests, may perform poorly if the parameters of these OMs are varied. This potential problem can be addressed by specifying additional trials against which to test CMPs further. Nevertheless, in both respects, the workshop considered that the likelihood of such problems for the CMPs put forward was not sufficiently high to justify pursuing additional analyses

25. A general conclusion put forward from the comparisons was that (except for the D&M candidates) the variation between variants of a single MP (of those put forward for the comparison) was generally much less than the variation among the different MPs. This was most clear from the trade-off plots and indicates that the different MPs generally occupied different space along some of the important axes, e.g. on the average catch/ risk to biomass axis.

26. The eight MPs were compared for their performance on the three robustness trials that reflected the greatest performance change: the no AC Triple-R (no autocorrelation and the 2000 and 2001 cohorts increased to threefold to about 75% of average recruitment), the low R four (four further weak cohorts after the 2000-01 cohorts), and the Indonesian selectivity trial (dome-shaped selectivity).

27. The two recruitment trials covered the extremes of optimistic and pessimistic scenarios. The trade-offs between short-term catch and risk were examined. In each case it was considered advantageous for a procedure to either increase (in the optimistic scenario) or decrease catches (in the pessimistic scenario) in order to maximise catches without increasing risk.

28. For the optimistic scenario there was a trade-off between not catching the extra recruitment or catching it. Using the trade-off plot of the 10^{th} percentile of B_{2014}:B_{2004} versus median ten year average catch, the TAI rules (without recruitment information) did not increase catch as much as the other rules. In all cases, the catches did not increase to maintain the same risk – so the short term risk was reduced. A slightly different pattern was observed in the plot of 50^{th} percentile of B_{2022}:B_{2004} versus median twenty year average catches. Here all but the TAI procedures kept the 50^{th} percentile of B_{2022}:B_{2004} close to the tuning level of 1.1, but the HK5_01 and D&M_02 showed an over-correction, i.e. did not achieve the rebuilding target in the optimistic scenario. For a comparison of catches in 2011, it was noted that the CGF variants had a very wide range of TACs

29. For the pessimistic scenario the interest is in which procedures “detected” and responded to this poor recruitment and started reducing catch early. The cumulative catch curves for 2011 showed that all MPs decreased catches as

expected. Also of note was the range of possible TACs. The D&M runs had the broadest range in the pessimistic case.

30. As regards likely TACs for 2008 and 2011, all MPs provide a range of likely outcomes and the range of responses differ among the four MPs under different scenarios. Within the reference set, three of the MPs had near certainty of a TAC reduction in the 2008 while D&M_03 had a probability of ~10% of no reduction in TAC. HK5_01 and TAI_05 have a narrow range of possible outcomes in terms of 2008 and 2011 TAC levels and neither procedure would result in the maximum TAC change in 2008. In contrast, with both CFG_42 and D&M_03 there is an appreciable probability of a maximum TAC change in 2008 (e.g. ~30% and ~20% respectively). For the other scenarios (e.g. no AC/Triple R and low R4), all of the MPs result in changes in their distribution of TACs for 2008 and 2011 relative to the reference set. This indicates that all procedures are responding to forthcoming data (either CPUE and/or the proportion of 4 year olds in the catch). Nevertheless, D&M_03 was generally, but not always, the most responsive to the forthcoming data in 2008 as manifested in its generally having the highest variance in its TAC distribution. This was a design criterion of the developers of this MP. However, by 2011 the degree of responsiveness as measured by the variance of the 2011 TAC distributions varies among the MP across the different scenarios.

31. There was considerable discussion regarding the performance of both individual MPs, and the MPs as a group, for the three tuning options that relate to start year and frequency of TAC changes. It was noted that the choice of MP and tuning option should ideally be independent. It was also noted analysts spent less time considering options *a* (implement first TAC change in 2006 with three year changes thereafter) and *c* (implement first TAC change in 2008 with five year changes thereafter). The CGF procedure was essentially unchanged across the options *a*, *b* and *c* (apart, naturally, from the value of its primary tuning parameter), while other analysts modified some of the other parameters of their MPs.

32. For option *c* there was a clear increase in risk, but with no obvious gains in average catch and catch stability.

33. Overall, there were some gains for option *a* when compared to tuning option *b*. In most procedures the short term risks were generally lower because they took an earlier cut in TAC. The exception was the CGF procedure, which showed no obvious difference in risk, but took the gain as extra catch. The D&M_03 procedure, which was the second most risk averse MP under option *b*, was the most risk averse procedure under option *a* in the short term.

34. Some of the differences observed, e.g. “crossover” behaviour (i.e. a changed order of the MPs along a key trade-off axis), were likely the results of differences in control parameters that lead to quite different performance across schedules for some procedures, e.g. a large immediate cut for D&M procedure under option *a* when compared to option *b*.

35. The workshop concluded that the current trial specifications were not adequate to answer the question of the impacts of early reduction of TAC requested by the Commission, i.e. what happens if we make TAC changes occur earlier. To better answer this question an additional option was agreed to be run for the 2005 SAG

where a TAC reduction in 2006 is hardwired into procedures with the first MP-generated TAC still occurring in 2008. While the primary interest is in the stock response to this scenario with respect to short term risk, the results of this analysis will also provide advice on the relative performance of MPs. This analysis was considered important because some MPs that currently may not be preferred due to their risk performance, may show better performance with respect to other trade-offs under the situation of an additional immediate TAC reduction.

36. When undertaking the projections of this scenario it was noted that the MPs will not be retuned or changed with regard to their other ad-hoc constraints and the analysis will be carried out for all MPs and tuning levels. The analysis will be conducted for the reference set and full set of robustness scenarios relating to recruitment.

37. For the implementation of this set of trials, two values for the TAC reductions would be considered: 5000t and 2500t reductions. The year for the reduction and the level are not meant to constrain decisions by the Commission, but would provide the information on what is the best that could be achieved. It will be possible to interpolate likely outcomes for intermediate TAC reductions and a cut in 2007 rather than 2006. The work will be undertaken by the consultant with code provided by analysts. It was noted that it will be important to check for potential minimization problems for the Fox model based MPs.

38. There were two important issues to consider when comparing the three tuning levels of SSB_{2022}/SSB_{2004} (0.9, 1.1, and 1.3). First, evidence for inter-relations between the relative performance of MPs and the tuning level. Second, the absolute levels of risk associated with each tuning level.

39. Under this first issue, the workshop noted two points:

    - there was little evidence of "cross-over" behaviour between MPs, before 2015. i.e. the order of the performance for short term risk did not change.
    - the rules begin to converge at the 1.3 scenario as there is not much scope for variation in TACs while still being able to achieve the tuning level.

40. Under the second issue it was considered important to indicate the levels of risk that would occur under no catch. It was also important to consider the extent to which the stock may be reduced under constraints that the TAC not drop by more than 5000t at any occasion for change.

41. The workshop agreed that various plots displaying projected CPUE patterns would be useful for providing important information to the Commissioners and industry on the consequences of changes in biomass to the economics and sustainability of the fisheries. These plots also provide a useful reality check for the predictions of the operating model, for 2004 and 2005. It was decided that CPUE data should be summarised for both the reference set and the optimistic recruitment scenario (no AC Triple-R). It should be noted that the projected CPUE trend is expected to show a decline to about 2009regardless of MPs and TAC change options, and even for the most optimistic recruitment scenario considered.

42. At the workshop it was found that MPs that use information on recruitment show improved performance in terms of risk and responsiveness. Different information

(e.g. ages chosen and CPUE at age versus proportions of catch at age) were used according to MPs. In considering the input data simulated by the OM for testing MPs it was noted that it was important that the variation in such data be compatible with what has been seen in the past. It was noted that previous comparisons were made on CPUE and age composition as a whole, rather than specific ages. A comparison was made for the variability in the age 4 CPUE data. This shows very similar levels of variability in historic data and future data generated by OM scenarios, so that the workshop concluded that the OM scenarios were satisfactory in this respect.

Agenda Item 4. Selection of candidate management procedures

4.1 Process for selecting MPs and selection of a reduced set of MPs

43. The workshop compiled a table of attributes to facilitate comparisons among MPs (Table 1). The attributes were categorized into several axes to guide the discussion and formulate ways to visualize trade-offs. The ideal MP would achieve high biomass, while maintaining high catch; but obviously these characteristics are not simultaneously achievable. Thus attributes must be chosen to measure separate important aspects of performance. The following attributes were considered for each MP, and an ideal result for that attribute is specified.

- Early TAC reduction – This is the extent to which catch is lowered in the years between 2008 and 2014. The ideal is low catch reduction.
- Longer term TAC levels – 20 year catch average. The ideal is high.
- Risk of low SSB (short) – The projected SSB in 2014. Ideal is low.
- Risk of low SSB (overall) – the minimum spawning biomass over the whole projection period. Ideal is low.
- Increasing trend in TAC 2022 – overall rate of increase in TAC in 2022, ideal is high.
- Increasing trend in TAC 2032 – overall rate of increase in TAC in 2032, ideal is high.
- Post 2022 median biomass – ideal is high.
- P(low TAC) prior to 2015 – The lower 10th percentile and 50th percentile of catches from worm plots over projection period. –ideal is low.
- P(low TAC) after 2015 – lower 10th percentile and 50th percentile of catches from worm plots over projection period. –ideal is low.
- AAV and max TAC change – The average variation and maximum variation in TAC. Ideal is low.
- For the scenarios of high and low productivity (i.e. steepness) and the robustness trials the workshop examined MP responsiveness in reaching the tuning levels and how catches and risk responded.

Table 1. Comparative performance for tuning level 1.1 and TAC-change frequency of 3 years starting in 2008.

Attribute Original name	**Ideal**	**CGF_01**	**CGF_42**	**D&M_02**	**D&M_03**	**HK5_01**	**HK5_02**	**TAI_A4**	**TAI_05**
Early TAC reductions	**L**	H	H	MH	MH	ML	ML	L	L
Probability of low TAC prior to 2015	**L**	M	M	MH	M	L	L	L	L
Probability of low TAC after 2015	**L**	M	M	MH	M	L	L	H	H
Longer term TAC levels	**H**	MH	MH	M	M	M	M	M	M
Risk of low SSB (short-term)	**L**	L	L	M	M	M	M	H	H
Risk of low SSB (overall)	**L**	L	L	ML	M	M	M	H	H
Increasing trend in TAC in 2022	**H**	H	H	H	M	ML	ML	M	M
Increasing trend in TAC in 2032	**H**	M	M	ML	ML	M	M	H	H
Post 2022 median biomass	**H**	L	L	ML	MH	H	H	H	MH
AAV and max TAC change	**L**	H	H	MH	ML	L	L	M	M
Steepness (high) effect on TAC	**H**	H	H	H	H	M	M	L	M
Steepness (low) effect on biomass	**H**	H	H	M	ML	L	L	L	L
Triple recruitment (No AC)	**H**	H	H	ML	H	L	ML	M	M
Recruitment low in 4 years	**H**	H	H	MH	ML	M	M	L	L
Indonesian selectivity (low and med steepness)	**H**	MH	MH	H	M	M	M	ML	L
Selected for reduced set			**X**		**X**	**X**			**X**
New Name			**CMP_1**		**CMP_2**	**CMP_3**			**CMP_4**

Categorization of Attributes

Time Patterns in Catch

44. Each of the MPs was tuned to produce a median biomass in 2022 which was a set proportion (0.9, 1.1 and 1.3) of the biomass in 2004. There are two contrasting strategies for achieving this. The first is to take early cuts in catch so that the biomass trend is as high as possible and then to subsequently trim this back as necessary to achieve the tuning level. The second is to hold catch as high as possible and then to take larger cuts in the future. These strategies obviously have markedly different time patterns for catch and overall average catch. The various MPs represent various mixtures of these two strategies. The mix adopted is reflected in scores of the performance attributes

    - "Early TAC reductions",
    - "Longer Term TAC levels",
    - "Increasing trend in TAC in 2022",
    - "Increasing trend in 2032".

45. Clearly the first strategy will maintain a higher standing stock and spawning biomass per realisation (at least until 2022) than the second and thus will tend to be associated with lower risk to biomass and to CPUE.

Risks to Biomass and to CPUE

46. The current operating model suggests that even with zero catch after 2008 there is about a 40% probability of a dip in spawning biomass during the next 10 years and the median spawning stock in 2014 would be at only 5% above 2004 biomass. All MPs therefore indicate some decrease in spawning biomass in the next 10 years. Current spawning biomass is 3% to 14% of the unfished stock. By normal population dynamic standards this would be judged as a highly depleted state. Thus further depletion is undesirable but under the current operating model seems almost unavoidable if some reasonable catches are to be maintained. Clearly, at this state of the stock any drop in spawning biomass is undesirable and any decrease should be kept as low as possible. This requirement may be measured both with respect to the median performance and extreme lows measured by the lower 10th percentile of spawning biomass.

47. This attribute, which should be viewed as a critical criterion in the present circumstances, is measured by

    - The Risk of low SSB (short term),
    - Risk to SSB (Overall),
    - Post 2022 Spawning biomass.

48. Reduced fishable biomass will result in reductions of CPUE in the longline fisheries. If CPUE were to be much reduced this could make large parts of the longline fleets economically unviable unless there were equivalent compensations in price or increases in efficiency. Time trends indicate little difference in predicted CPUE trends between MPs over the next 10 years. The

median level drops to a low of 54% of its current value during this period. These predictions should be taken as indicative and do not take into account possible changes in fishing practices due to compensation for reduced abundance of fish.

Robustness/ Responsiveness

49. Robustness/responsiveness is a characteristic of different MPs. It is the ability to respond differently to different productivity scenarios. In this sense a constant catch rule is completely non responsive while a rule which perfectly discriminated between more productive and less productive scenarios and appropriately adjusts the TAC would get the highest score. This characteristic is measured by the attributes

    - "Steepness(high) effect on the TAC",
    - "Steepness (Low) effect on the biomass",
    - "Triple recruitment" effect on TAC,
    - "Low R effect on biomass"

Variability in catch

50. Responsive MPs tend to vary catch more from year to year and there is thus a trade off between responsiveness and catch variability. There will also be a trade off between variability and the broad strategies noted under time pattern of catch. This characteristic is measured by

    - "AAV and max TAC change"

51. Based on the analysis of MP performance, it was noted that the variation between variants (of those put forward for comparison) was in most cases less than that among procedures, so it was decided that it would be useful to choose a single variant for each MP. For example, the scoring on all axes was identical for the two CGF variants. In making the choices between variants, it was noted that it was more important to ensure that the remaining MPs spanned the important axes than simply put forward each MPs 'best" variant. The decisions and any discussion were as follows:

    - CGF – there was little difference in the performance as measured on the major axes, so CGF_42 was chosen as it did not include the penalty on TAC increases.
    - TAI – there was considerable discussion regarding the best variant to take for this MP. There was some discussion that TAI_05 was preferred as it did not have the high carryover of the TAI_A4 variant, however, it was noted that in this procedure, the sign of the first TAC changes was inverse to the slope of the CPUE, e.g. larger cuts under increasing CPUE. The workshop did not find this feature desirable, but noted that modifying this feature would be only a minor modification of this MP.
    - D&M – though after meeting discussions the developers preferred the D&M_02 variant, they put forward **D&M_03** as it would contribute to a better

spread across the important axes. The D&M_02 variant has less carryover which sets it closer to the CGF variants and more risk averse than D&M_03.

- HK – the variants had broadly similar performance, where the difference is the cap that is imposed on TAC increases. The decision was made to choose the **HK5_01** variant as it had more severe cap and this might be closer to the reality, but noting that extent of this cap could be revised.

52. The final selection of four CMPs were renamed (see Table 1).

Trade-offs between catch, catch variability, and risk

53. By considering the future dynamics of the SBT population (see above) and by comparing attributes it is clear there is a definite trade-off between good performance on the catch axis (both level of catch before 2015 and its variability) and risk to the stock (defined as the ratio of median biomass in 2014 to median biomass in 2004) and the short-term risk to the fisheries (defined as the ratio of LL1 CPUE in 2009 to the median LL1 CPUE in 2004). Comparisons were made for the reference set under the four CMPs at a tuning level of 1.1 and for robustness tests using high (triple R) and low (low R4) recruitment assumptions. In general, short term reductions in catch were compensated for by higher overall average catches.

Performance on the catch axis

54. For the reference set, when the median level of average 2004-2013 catch was compared to the ratio of median biomass in 2014 to median biomass in 2004, CMP_4 provided the highest median level of catch , followed by CMP_2 and CMP_3, which were similar to each other, with CMP_1 providing the lowest level. The order of the MP performance with regard to catch variability (as measured by the statistic AAV and maximum TAC change) going from low catch variability (regarded as the best) to high catch variability (regarded as the worst) was CMP_3 at low, CMP_2 at medium/low, CMP_4 at medium, and CMP_1 at high. It should be noted that the 20 year average catch performance reverses the order of the MPs (e.g. CMP_1 ~10500; CMP_4~9200).

Median ten year average catch and catch variability for the four CMPs tuned to 1.1 under option *b* and the reference set.

MP	Median 10 year catch (t)2004 to 2013	Catch variability
CMP_4	13,000	Medium
CMP_3	12,200	Low
CMP_2	12,000	Medium/low
CMP_1	11,300	High

Performance on the risk axis

55. For the reference set, performance on the risk axis was clearly the inverse to performance on the catch axis. When the ratio of median biomass in 2014 to median biomass in 2004 was examined, the CMP_1 MP was the least risky, followed by CMP_3 and CMP_2, with CMP_4 being the most risky. When the lowest 10th percentile was examined, the order remained the same (see table

below). When robustness to both high and low recruitment was examined, the order of performance also remained the same. The MPs indicated that during the next decade median LL1 CPUE will drop to about 50 – 60 % of its 2004 level. It was noted that the order of the MPs with respect to long term risk (10^{th} percentile of B_{2022}/B_{2004}) was the same as in the following table, and in particular for the Low R scenario, CMPs 2,3,4 all have values of ~0.0 whereas CMP_1 has a value of ~0.25.

Ratio of B_{2014}/B_{2004} for the various recruitment scenarios with 1.1 tuning level, option *b*.

	Reference set	**Reference set**	**Low R**	**High R**
CMP	Median	10^{th} Percentile	10^{th} Percentile	10^{th} Percentile
CMP_1	0.67	0.28	0.12	0.50
CMP_2	0.62	0.23	0.07	0.41
CMP_3	0.61	0.21	0.04	0.34
CMP_4	0.56	0.13	0.00	0.38

56. Two points are worth making with regard to stock and fishery risk:

- The stock assessment provided by the operating model produced for SAG 5 indicated the current biomass of SBT is about 3 – 14% of virgin biomass, which is considered risky in most fisheries management situations. All the MPs show a decrease in median spawning biomass by 2014 of 55 – 68%. This will place the stock below 10% of the virgin level, clearly in an even riskier situation. The 10^{th} percentiles are even lower at 2 – 3% of virgin biomass. Judging from examples of other highly eroded fish stocks, the risk of recruitment collapse at these levels is high and rebuilding prospects slow, uncertain and problematic.
- The MPs indicated that during the next decade median LL1 CPUE will drop to about 50 – 60 % of its 2004 level by about 2009. This will most likely jeopardize the future economic viability of a number of fisheries. CPUE is then expected to increase to 80-90% of its 2004 level by 2014.

Responsiveness and variability in catch

57. A second trade-off axis exists between catch variability and MP responsiveness to stock conditions. There are five attributes related to responsiveness. These were combined into an overall measure of responsiveness as follows. For each attribute and MP, a score was assigned based on the evaluation, a score of "H", the best, was given a value of 5, "MH" a 4, "M" a 3, "ML" a 2 and "L" a 1. Averages of these provided a "responsiveness" score for each MP. Figure 1 shows the relationship between responsiveness and the variability in catch. There is a general trade-off between responsiveness and variability (measured by AAV Average annual variation). CMP_1, the most responsive MP achieves the responsiveness by varying catch the most. The least responsive policies have the lowest variability in catch. The CMP_4 does not do well in comparison to the CMP_3 and CMP_2 —the same or lower level of AAV can be achieved by MPs with higher responsiveness.

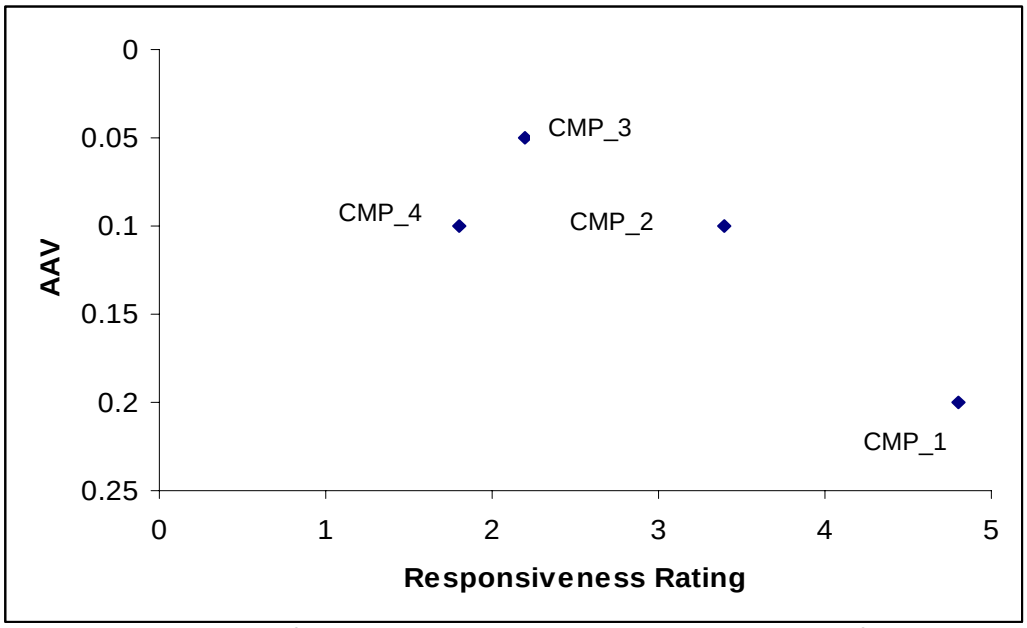

Figure 1. Comparison of catch variability (AAV) and responsiveness of the CMPs to stock differences

Conclusions

58. The most obvious conclusion from this analysis is that there is very high risk to the CPUE and stock biomass for all of the MP's considered under the reference set. Appreciable declines in CPUE are expected under all of the MPs considered, and this might have serious implications for the commercial viability of longline operations. Major declines in spawning stock biomass are also expected under all but the most optimistic robustness trials. Given that the current estimate is that the stock is 3-14% of virgin biomass, further declines of 50 to 90% would take the stock to very low levels that pose severe conservation risk. Concerns about economic viability of long lining and conservation risk suggest that there may be a need to explore a range of immediate TAC reductions combined with the MPs that would lead to much lower risk of CPUE and stock declines.

59. In summary, for the reference set

- There is a clear trade-off between maintaining high catches over the next 10 years and risk to the stock abundance and CPUE.
- Current stock size is already low at 3 -14 % of virgin biomass.
- For the reference set, all the MPs predict that median stock size will decline by a further 30 to 45% relative to 2004 by 2014.
- Even with zero catch after 2008, the median stock size would be expected to increase to only 105% of its 2004 biomass by 2014.
- Median LL1 CPUE (areas 4-9) is likely to decline to about 50 – 60 % of its 2004 level by about 2009, which will jeopardize the economic viability of a number of fisheries. It is expected to then increase to 80-90% of its 2004 level by 2014.

Advice on which management procedure rules to chose

60. The coming SC meeting will provide final advice to CCSBT in September 2005 on which MPs are most suitable to adopt. This advice will be made after SAG6 has reviewed the status of the SBT stock and after final runs of MPs have been examined. Between May and August, there will be additional runs of the MPs and further evaluation of options based on advice received at the special consultation held 23 May in Canberra. Thus any advice presented at the present time is provisional and based upon the view of the stock currently provided by the reference set.

61. Four MPs have now been chosen to form a final short list. These were designed to produce different choices of trade offs between risk avoidance, average catch, timing of catch reductions and catch stability. Two MPs were model-based while two were empirical. The former tend to be somewhat more responsive to changes in productivity while the latter have a simpler mathematical structure. All four performed well for the trade-offs they were designed to achieve. This can be judged from their near linear grouping along the Pareto frontier (Figure 2 below) which represents the primary trade off dimension between risk avoidance and average catch. Thus a final choice between these four MPs is primarily a choice of how various objectives should be traded off rather than a decision that one approach is inherently superior to another.

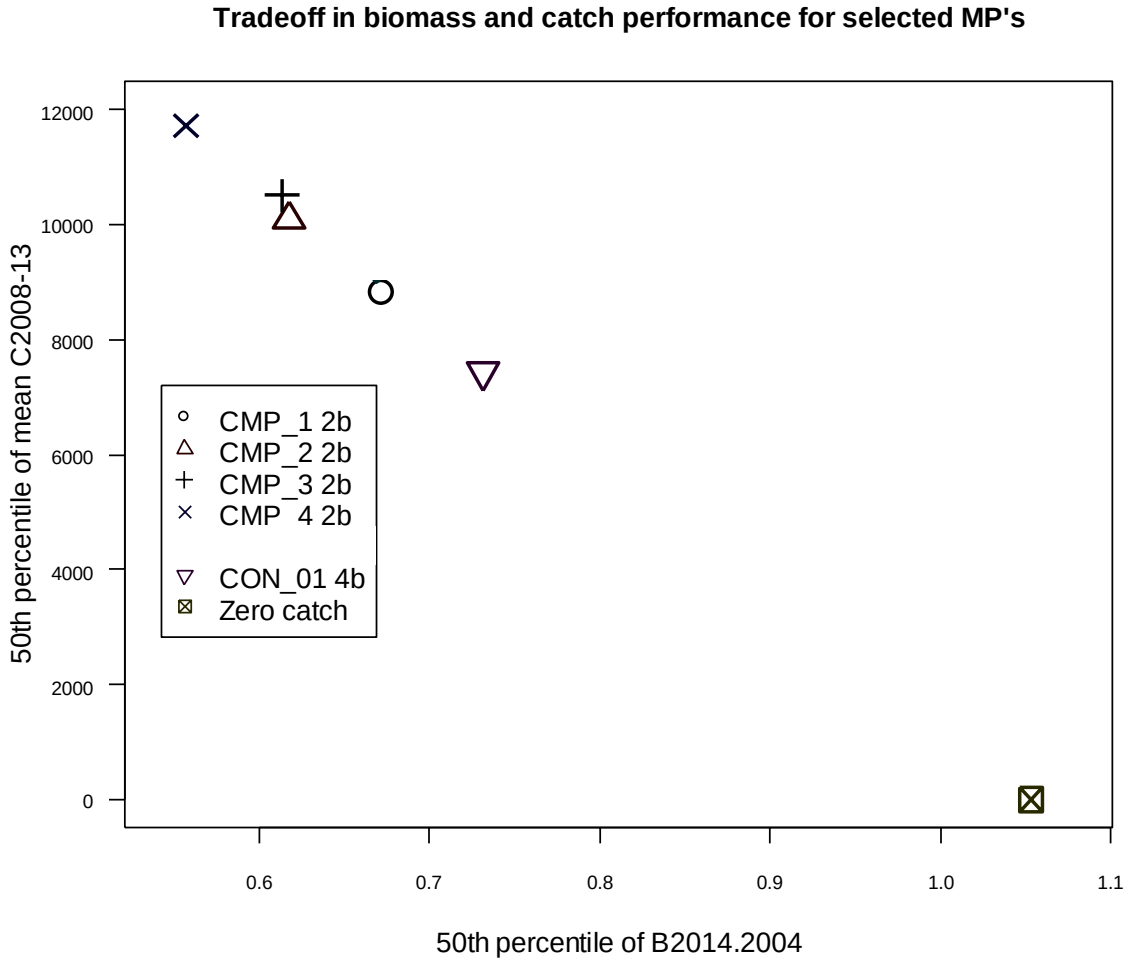

Figure 2. Trade-off plot of the Reference set tuned to 1.1 ("CON_01 4b" is maximum TAC reductions every three years down to zero in 2014).

62. As recorded in SC9 the present view of the SBT stock suggests that the stock is more likely to decline than increase under current catches. This view results from the markedly lower estimates of recruitment in recent years and these recruitment estimates are embedded in the reference set used for primary evaluation of MPs as shown in Figure 2 and the supplemental figures listed in **Attachment 4**. There is uncertainty associated with the most recent estimates of recruitment. This stock status will be reviewed at SAG6 where further data on year-class-strengths will be available from age sampling, length frequencies, and tagging. If the poor recruitments are confirmed at SAG6 then under all MPs tested the stock will be expected to decline in spawning stock biomass and also in CPUE. There is no experience on how recruitment will respond at such low stock levels but clearly the risk is increased and model predictions become even more uncertain. Hence, as far as possible, such low spawning levels should be avoided.

63. If the stock was in a healthier condition, then those procedures that emphasize catch stability would be more in tune with the Commission's generally stated

preference (CCSBT 03). However, in the present circumstances, as they appear based on the reference set, the procedures lead to spawning biomass that cannot be regarded as safe. Even the most conservative procedure has a 50% chance that the spawning biomass in 2014 will be below 72% of the current (2004) level. Furthermore, there is about a 10% probability that the stock will be below 33% of the current level. Thus, this procedure would likely lead to a spawning stock that will be substantially lower than ever recorded. Other CMPs would produce even more risky outcomes (Tables 2-5). Indeed, even if the maximum catch reduction rules were invoked, the stock would undergo similar declines. If after the SAG, the current view of the stock status is confirmed then avoidance of risk should play a large part in the choice of management procedure.

64. Clearly, if recent recruitment levels were higher or lower, then this view of the stock status would be altered correspondingly. Table 6 indicates how biomass and CPUE levels would change under the more optimistic and pessimistic recruitment scenarios that were examined at this workshop. Note that this assumes that the relationship between CPUE and abundance will remain unchanged. The workshop expressed concerns that unforeseen changes in fishery practises would likely impact on CPUE as a measure of relative abundance. This may compromise predictions and MP performance.

65. Because of the high risk posed by all MPs under the current reference set and the constraint of starting in 2008, the workshop recommended that MP's be evaluated assuming in addition a substantial reduction in TAC in 2006. It is possible that after a 2006 catch reduction, more of the MP's would lead to safer outcomes and give more scope for adopting procedures with more stable catch characteristics. Such a reduction would also help maintain CPUE at more viable levels.

66. These conclusions depend upon the current assessment of stock status, and particularly the estimated poor recent recruitments. If the indicator analysis considered at SAG 6 suggests more optimistic recruitment, then several of the current CMPs may provide more acceptable performance. As an example, under the optimistic scenario (noAC_tripleR) with recruitment slightly lower than recent averages, all four MPs achieve their 2022 rebuilding targets with minimal expected reduction in biomass over the intervening period, (80-95% of current). Nevertheless, even in this optimistic case, substantial risk remains and the lower 10^{th} percentile goes quite low (30-50% of current).

Table 2. 10^{th} percentile of biomass in 2014 (as a fraction of that in 2004) under the scenarios of zero catch, maximum possible catch reductions, and the four MPs. Using option *b* (3 year changes after 2008).

Tuning level	Zero catch	Max reduction	CMP_1	CMP_2	CMP_3	CMP_4
0.9			0.20	0.20	0.16	0.09
1.1	0.72	0.33	0.28	0.23	0.21	0.13
1.3			0.33	0.27	0.28	0.18

Table 3. 10th percentile of 2009 CPUE (as a fraction of the 2004 median value) under the scenarios of zero catch, maximum possible catch reductions, and the four MPs. Using option *b* (3 year changes after 2008).

Tuning level	Zero catch	Max reduction	CMP_1	CMP_2	CMP_3	CMP_4
0.9			0.28	0.29	0.28	0.27
1.1	0.36	0.30	0.29	0.29	0.29	0.27
1.3			0.30	0.29	0.29	0.28

Table 4. 50th percentile of biomass in 2014 (as a fraction of that in 2004) under the scenarios of zero catch, maximum possible catch reductions, and the four MPs. Using option *b* (3 year changes after 2008)

Tuning level	Zero catch	Max reduction	CMP_1	CMP_2	CMP_3	CMP_4
0.9			0.60	0.59	0.56	0.52
1.1	1.05	0.73	0.67	0.62	0.61	0.56
1.3			0.73	0.65	0.67	0.60

Table 5. 50th percentile of 2009 CPUE (as a fraction of the 2004 median value) under the scenarios of zero catch, maximum possible catch reductions, and the four MPs. Using option *b* (3 year changes after 2008)

Tuning level	Zero catch	Max reduction	CMP_1	CMP_2	CMP_3	CMP_4
0.9			0.53	0.53	0.53	0.52
1.1	0.64	0.55	0.54	0.54	0.54	0.53
1.3			0.55	0.54	0.55	0.53

Table 6. Results under alternative recruitment scenarios ("Low R4" is more pessimistic than the reference set while "Triple R is more optimistic). The values are of biomass and 2009 CPUE (as fractions of the median 2004 levels) and based on option *b* (3 year TAC changes after 2008) and 1.1 tunings.

Ratio of B_{2014}:B_{2004}

%-ile / scenario	Zero catch	Max reduction	CMP_1	CMP_2	CMP_3	CMP_4
50th Low R4	0.80	0.46	0.39	0.34	0.34	0.27
10th Low R4	0.63	0.19	0.12	0.07	0.04	0.00
50th Triple_R	1.50	1.13	0.96	0.90	0.84	0.89
10th Triple_R	0.97	0.62	0.50	0.41	0.34	0.38

CPUE 2009:median CPUE 2004

%-ile / scenario	Zero catch	Max reduction	CMP_1	CMP_2	CMP_3	CMP_4
50th Low R4	0.37	0.32	0.31	0.31	0.31	0.30
10th Low R4	0.23	0.19	0.19	0.19	0.19	0.18
50th Triple_R	0.88	0.79	0.77	0.77	0.76	0.76
10th Triple_R	0.54	0.46	0.45	0.44	0.43	0.43

Agenda Item 5. Indicator analyses and metarules

67. Documents CCSBT-MP/0505/05 and 09 were considered under this agenda item.

68. CCSBT-MP/0505/05 summarises previous discussions on metarules in CCSBT MP workshops. Those discussions concluded that metarules should be invoked only in exceptional circumstances, and that it is important to have a clearly defined process for deciding whether exceptional circumstances applied or not, and for arriving at a recommended action. The paper notes that the distinction between 'exceptional circumstances' and the 'regular review' of the MP is important, since the first requires a metarule to be invoked, whereas the second does not, and that this distinction is not clear in the process for review described in Attachment 5 of the Report of the 3rd meeting of the MP Workshop (Figure 1). Suggestions for minor modifications to that framework to clarify this distinction are made (Figures 2 & 3 of the paper). It is also suggested that the action implied by invoking a metarule should follow principles which ought to emphasise the notion that metarules are not meant for 'tinkering' with the TAC, and not meant to be invoked frequently.

69. CCSBT-MP/0505/05 also summarised past discussion on MP implementation issues, noting that further consideration should probably be given to how to deal with MPs in situations of mismatch in TAC and Catch (over- or under-harvests of the TAC recommended by the MP).

70. CCSBT-MP/0505/09 considered a number of issues related to the MP development and evaluation process, resulting from various 'reality checks' conducted on OM results. Whereas observed CPUE values lie within the range of those predicted by the OM, some 20% of the predicted age 4 recruitment scenarios were less than the actual catch taken in 2004, suggesting some shortcomings in the OM. Regarding MP design, the paper noted the need for caution in including *ad-hoc* constraints in MPs, which might degrade MP performance under some alternate future OM scenarios. MPs should be as generally applicable as possible.

71. Regarding implementation issues, CCSBT-MP/0505/09 noted that substantial changes in fishing patterns were likely to result from any early catch reductions arising from MP implementation, and that this would substantially alter CPUE data. Given the important role that the LL CPUE indices played in all CMPs, it was important to prepare now for how to deal with such CPUE changes in the MP implementation and revision process. The paper also noted the tight schedule required for implementation of the MP, and the need for presentation of a clear work schedule in this regard to the Commission.

72. CCSBT-MP/0505/09 also suggested that the coming SAG6 / SC10 meetings should evaluate the possible implications of six years of low recruitment, from 1999 to 2004.

73. Discussion of these papers is given under items 5.1 and 5.2 below.

5.1 Use of future indicators in connection to MP

74. Discussion of this topic was primarily motivated by the outcomes from the technical meeting of the MP workshop in Seattle (February 2005). That meeting

noted that the current reference set is strongly influenced by the low estimates of recent recruitments which are based on limited data, and that new information on recent recruitments will be presented at this year's SAG/SC meeting, primarily in terms of analyses of indicators. The question is how that information is to be used to assist in providing advice on tuning levels and associated risks of different CMPs.

75. Many of the robustness robustness scenarios were designed to address this issue of uncertainty in recent recruitment. Some robustness scenarios (lowR2, lowR4) are more pessimistic than the reference set (Cfull2), whereas others are more optimistic (noAC, noAC_tripleR and expl), and together they span a wide range of possibilities, particularly for recruitments in 2002 and 2003. The hope is that results from the indicator analyses to be presented at the SAG/SC would provide more clarity, at least in a qualitative sense, on where the true situation is most likely to be within that range.

76. The workshop agreed that, on the basis of results from the indicator analyses, it should be possible to assign weights to the reference set and the different robustness scenarios (Cfull2, lowR2 etc.). The weights should reflect the relative plausibility of the reference or robustness scenario. The full set of scenarios are: Cfull2, lowR2, lowR4, expl, and noAC_tripleR. The noAC scenario was omitted since it was considered to be very close to the 'expl' scenario which limits the exploitation rate of the surface fishery in the years of very low recruitment, and hence more directly attempts to address this particular concern.

77. Each CMP, already tuned to the reference set, Cfull2, at the three levels (0.9, 1.1, 1.3) would be run with those tuning parameters on the full set of scenarios. The relevant performance statistics for the CMPs would then be calculated as weighted sums or statistics over the full set of scenarios.

78. It was also agreed that there was a clear need to evaluate the effects of immediate TAC cuts (in 2006). The 'reference set' would be no (0) cut in TAC, and two additional evaluations are: (1) a cut of 2500Mt in 2006, with the same TAC applying in 2007, and (2) a cut of 5000Mt in 2006, with the same TAC applying in 2007. In all these evaluations, the MP would start being applied in 2008 as in the original "option b". The TAC cuts in 2006 and maintaining the same TAC for 2007 requires a change to the projection code.

79. The workshop agreed that Trevor Branch (technical support to the MP process) would conduct the necessary runs prior to the SAG/SC meeting. Table 7 summarises the required runs. Developers would provide their MP code which would be used to do the runs. Each CMP should first be run with the tuning parameters on Cfull2 to check whether there are any differences between results, given observations that AD Model Builder has sometimes been known to give different results under different compilers, even for the same version of ADMB.

Table 7. Runs to be conducted on the 4 CMPs for consideration at the next SAG/SC meetings. All runs start the CMP in 2008, with 3-year blocks of TAC.

	'Factors'/'levels'	Number of levels/factors	Cumulative total
MP	CMP_1, CMP_2, CMP_3, CMP_4	4	4
Tuning levels	0.9, 1.1, 1.3; tuned to Cfull2 (with NO TAC cut in 2006)	3	12
'Scenarios'	Cfull2, lowR2, lowR4, expl, noAC_tripleR	5	60
TAC cuts in 2006	cuts of 0, 2500, 5000Mt in 2006 (same TAC applies in 2007)	3	180

80. All runs would be available at SAG6 to enable the meeting to calculate statistics weighted over all scenarios, but summaries of performance for the individual scenarios will be presented in a paper to the meeting (Trevor Branch and Ana Parma).

81. A further important point, raised in CCSBT-MP/0505/09, concerned the 2000 and 2001 cohorts. The paper pointed out that under the reference set (Cfull2), about 20% of the population trajectories (this refers to the two thousand 'scenarios' involved in the tuned runs; to avoid confusion these will now be termed 'trajectories') estimated recruitment in the year 2000 at such low levels that they would not have been able to sustain the catches of 4-year olds which are known to have been taken by the Japanese longline fishery in 2004. These trajectories in the reference set are clearly implausible. In the 'expl' robustness scenario there are fewer of such implausible scenarios (about 7%).

82. It was suggested that the trend information with respect to the 2000 and 2001 cohorts was likely to be reasonably robust (i.e. they were low relative to other years), but that information on the scale (i.e. absolute level) was probably not very informative.

83. The workshop discussed how to deal with the problem of implausibly low recruitment estimates in the context of MP evaluation given the time constraints. It considered that performance statistics could be based on scenarios (listed in Table 7) amended by removing the implausible trajectories. There were, however, concerns about the effect this might have on the prior weights assigned to different steepness values. However, further information presented at the workshop showed that the proportions of retained trajectories in each steepness category (summed over the two omega values) were not substantially different from the priors on steepness.

84. It was also noted that this analysis had been conducted prior to the data-exchange and therefore did not include all catches of 4-year olds, only Japanese longline catches. The expectation was that a re-analysis with all the catch data would lead to larger numbers of trajectories becoming implausible and it was not clear what the effect on the relative weightings of steepness would be. Therefore, it was agreed to handle this problem in the following way. Each scenario (listed in Table 7) would be amended by removing those trajectories which are implausible.

The catch at age data to use in order to identify the 'implausible' trajectories is specified **Attachment 7**. The remaining set of trajectories would be re-sampled with replacement to generate a new set of 2000 trajectories reflecting the prior weights on steepness.

85. The 2003 size frequency distribution of the Japanese longline catch shows very low proportions of 2, 3 and 4 year olds. A shortage of 4-year olds could mean that the 1999 cohort was also very weak. The operating model estimates this cohort at an average level, and the workshop considered why this might be the case. The timing of the last selectivity change in the model occurs in 2001 and was therefore not considered to be the cause, though the 'smoothing' constraint on selectivity changes could be playing a role. There was some indication of over-estimation of 4 (and possibly 3) year olds in the 2003 size frequency. The most plausible reason for the OM estimate appeared to be the fact that there are relatively high numbers of 2-year olds in the 2001 size frequency (LL1). It was also noted that there are several indicators/data on recruitment which are not taken into account in the operating model.

86. The approach to dealing with the two types of Taiwanese fishery data (targeted and bycatch) and how to assign data to LL1 or LL2 was raised. In the context of the 1999 cohort, however, it was suggested that assigning the Taiwanese data to LL1 instead of LL2, as is currently the case, would be unlikely to have a large effect on the estimate of cohort strength. How these data are to be treated should nonetheless be revisited.

87. There was some discussion on how to present results of these further CMP evaluations to the Commission after the next SAG/SC. Previous discussions had assumed that it would be possible to present the different choices associated with an MP in sequence to the Commission, so that they might, for example, first choose an MP, then a tuning level and then a TAC change schedule. The results considered at this workshop, and those that are likely to be presented at the SAG/SC, showed inter-relations between these components/choices, and it was no longer considered feasible to take these decisions sequentially. The choices which the Commission will face will be along two rather than one axis, and care would need to be taken to ensure that results are clearly presented.

88. It was considered that advice would still need to be given to draw attention to the trade-offs and indicate which regions along the trade-off axes are acceptable from a scientific perspective on stock conservation, noting that nevertheless "acceptable" is a multi-dimensional concept. Aspects other than those reflected in the trade-off axes should also be qualitatively characterised.

5.2 Metarules

89. In discussion of CCSBT-MP/0505/05, the workshop noted that the responsibility for identifying exceptional circumstances would lie with the SC, and that the SC would be expected to reach consensus on such circumstances based on adequate proof. It was also noted that economic factors may either generate situations where management advice might need to be tailored to take account of market-related conditions, and not just the state of the stock. However, such decisions were the mandate of the Commission, and not the SC. In terms of designing metarules, it was also suggested that they should not be 'one-sided', but should

consider the option of deviating from MP recommended TACs either upwards or downwards, depending on the nature of the exceptional circumstance. Small changes in risk should not be seen as a justification for invoking a metarule that would result in small changes in the TAC. It was again emphasised that decisions about whether to invoke a metarule should be data driven.

90. The workshop noted that, if a metarule is invoked, the intention would be to take immediate and adequate corrective action. Under such circumstances, any delays in taking action would be strongly discouraged. If further work on the MP is required, it should be pursued as part of the MP revision process.

91. Concerns were expressed about the potential for large changes in fishing pattern when the MP is implemented. This could affect, for example, CPUE and selectivity patterns. Information and data on fishing patterns should be reviewed, together with the other indicators, to establish whether the effects of changes are small or not, and whether there is a need to invoke a metarule, or a revision, or neither.

92. The workshop agreed to start the process of putting together a document that would form the metarule specification for the MP, and a similar document that would form the specification for the review and revision process for the MP. These documents are still being developed, but preliminary drafts are attached as **Attachments 8 and 9**.

5.3 Further analyses/software modifications needed in preparation for SAG

93. Further analyses and software modifications are covered under agenda items 5.1 and 7.

94. The workshop encouraged members to provide as many analyses as possible with respect to recent recruitment to the SAG/SC. Any data or information, in addition to the agreed indicators, that could help inform the SAG about relative weights for the different operating model scenarios (discussed above) would be particularly welcome, and would greatly facilitate the completion of the MP work.

Agenda Item 6. Implementation issues and other considerations

6.1 Specification of input data needed to implement candidate MPs and process for providing the data

95. It was noted that the four CMPs all have basically the same data inputs, primarily relying on total catch, longline CPUE and catch-at-size data. As the CCSBT moved towards implementation of an MP, it will be necessary to develop a detailed specification document for the final MP, including detailed specification of the required data inputs. The workshop noted that it would be preferable for data required to run the MP to be provided, so that all members can verify the inputs into the MP. However, the Commission may need to address resultant data provision and confidentiality issues.

96. This MP specification should address the process for provision of data required by the MP. In this regard, it was specifically noted that reliable information on the catch of non-members would be an important part of the required total catch

data, and it needs to be decided how this will be collected, and who will provide such data.

97. The Data Manager was requested to conduct inter-sessional canvassing of opinions in preparation for SAG6 / SC10 regarding the process for provision of data for running the MP, such as who will be responsible for providing data for the MP, where it will be stored, how and by whom the data will actually be prepared, who will run the MP, etc. Some thought will also have to be given at SAG6 / SC10 to options for validating and improving the reliability of the data to be input to the MP.

98. With regard to the option of the CCSBT Secretariat being responsible for running the MP at the intervals eventually agreed by the Commission, it was noted that preparation of the input CPUE series was complex, and currently conducted by member scientists. Some of the data used are not provided because of confidentiality issues. There will probably therefore be a continuing need for member scientists to participate in preparation of the CPUE series, and provide these to the Secretariat for use in MP runs. However, it was also noted that all data inputs to the MP, including the CPUE series, would have to be tightly specified, with far more stringent requirements than for the past assessment processes.

99. The workshop noted that the MP would not be run annually, but only when required to provide a recommended TAC in accordance with the agreed MP TAC revision schedule, such as every three years. However, past experience has shown that the required MP input data should still be provided on an annual basis, to allow the SC to review the data and detect any problems as soon as possible. It was suggested that the annual data provision requirements be amended as necessary to provide for any additional data required for implementation of the final chosen MP.

100. The workshop noted that there are differences between quota or fishing years for the various members, and therefore potential mis-matches between MP TAC years and member's quota years or fishing seasons. Decisions will be requested as to exactly what 'years' are used for the various members for these inputs into the MP. Some of the potential ambiguities in these inputs are summarised in **Attachment 6**, with initial suggestions as to how these may be resolved.

101. The Data Manager was also requested to further summarise these potential mismatches in preparation for further consideration at the next SAG/SC meetings. Specific questions that needed to be addressed include:

- In the four CMPs, what do the developers each mean by 'catch'? When does this mean TAC and when does this mean actual catch?
- What 'years' are used by CMP developers for inputs into their CMPs, and when would an CMP recommended TAC change actually be implemented for the various fisheries?
- The model-based CMPs need the process of catch calculation for each year to continue as has been done in the OMs used to develop these CMPs. How this was done needs to be clearly documented.

102. It was **recommended** that the SAG6 / SC10 meetings use the information summarised inter-sessionally by the Data Manager to develop a flowchart of

options for timing of data, lag times, fishing years, exactly what data are available when, how data are fed into the MP, etc.

6.2 Specification input data needed to implement metarules

103. It was noted that the implementation of metarules may well require different or additional data or information from those used for standard MP inputs, or for the regular assessments. Some of this may be provided as part of the annual development of the agreed list of fisheries indicators. However, it was likely that the identification of 'exceptional circumstances' that might trigger the invocation of the metarule could require additional data, perhaps generated from future developments in research or fisheries monitoring.

104. The workshop emphasized that the SC would be required to objectively demonstrate or 'prove' the occurrence of an exceptional circumstance in order to trigger a metarule, and that this will require data and scientific analysis. Member scientists would be required to provide analyses to future SAG/SC meetings in support of any proposal by them for identification of an exceptional circumstance.

105. It was agreed that CCSBT-MP/0505/05 provided a useful starting point for preparation of a first draft of a document outlining a proposed CCSBT Metarule Process. The authors were requested to prepare such a first draft for inter-sessional consideration, and revision at the SAG6 / SC10 meetings. In doing so, it was noted that the flowchart of the proposed MP review process would need to be revised to allow for incorporation of new or improved data or indices into MPs, should these become available in future. The draft documents are shown in **Attachments 8** and **9**.

106. The workshop noted that the Commission was likely to request some process to review and report on the performance of the final MP in managing the SBT stock towards some goal after implementation. However, it was emphasized that this not straight forward. Given the substantial uncertainties incorporated into the Operating Model and the MP Reference Set, the stock cannot be expected to recover along a specific trajectory under MP management, but could be anywhere within the estimated uncertainty envelopes.

107. Nonetheless, the workshop acknowledged that some process to monitor MP performance will be required, particularly to respond to improved understanding regarding the uncertainties incorporated into the OM, and to determine whether revision of the OM or re-tuning of the MP may be required. Member scientists were asked to evaluate options and submit proposals to the SAG6 / SC10 meetings for ways to meaningfully monitor and report on MP performance after implementation.

6.3 Management Procedure Implementation Timetable

108. The workshop noted that there would be a number of important decisions to be made and tasks to be carried out as part of the process to implement the final CCSBT MP, both by the SAG/SC and by the Commission. These would require time to implement, and a summary of the main implementation tasks and timetable are shown in the table below for implementation for the MP in 2008, and for the option of an additional TAC cut in 2006.

	MP TAC Start in 2008	**Option for additional TAC cut in 2006 or 2007**	**By whom**
Decision regarding additional TAC cut in 2006 or 2007		CCSBT12	Commission
Decision of tuning level	CCSBT12	-	Commission
Final selection of MP	CCSBT12	-	Commission
Agree to details in implementation	Prior to CCSBT13	-	Scientific Committee
TAC calculation with selected MP	SC11	-	To be decided
TAC agreement	CCSBT13	-	Commission
New TAC based on MP	Oct. of 2007 for the earliest quota year start	-	Members and cooperating non-members

Agenda Item 7. Workplan and timetable

109. The tasks to be completed prior to SAG6 are listed below.

Task	By Whom	By When
Provide total catch at age in 2004 to amend the reference set and recruitment scenarios (see **Attachment 7**)	Secretariat	15 June
Refine CMP_4 change the k2 parameter and cap the first and second period TACs	Taiwan	15 June
Provide consultant with MP code and documentation with user instructions	MP Developers	-Code at MP4 -Documentation by 15 June
Examine the MP code and to the extent possible, verify that the code is doing what it was defined to do	MP Consultant	30 June
Run each MP on cfull2 for 1.1 tuning and schedule b and compare with MPWS4 results	MP Consultant	15 July
Final submission of list of SAG papers	All members	30 July
Prepare code for amending the input files for projections (excluding the unrealistic low abundance runs) and conduct full evaluation of alternate initial year quota cut scenarios (5 scenarios, 3 tuning levels, 3 TAC options for 2006) and prepare paper for submission to SAG	MP Consultant	5 August
Develop proposals for evaluating and reporting MP performance after implementation (see paragraph 106), for consideration by SAG	Members	15 August
Final submission of papers for SAG	All members	15 August
Prepare code for re-sampling for combining results from different scenarios	MP Consultant	29 August
Start of SAG		29 August

Agenda Item 8. Design and presentation to the Special Consultation

8.1 Prepare presentation for Special Consultation

110. Ray Hilborn proposed two main objectives for the presentation to the Special MP Consultation:

- A review of the purpose and benefits of implementing a MP for SBT, followed by a summary of progress made with evaluating and selecting CMPs at this workshop.
- A specific set of questions to the Commissioners requesting feedback on issues such as preferred MP tuning levels, to help guide final MP evaluation work in preparation for SAG6 / SC10.

111. Following brief discussion of the proposed content of the presentation, Ray Hilborn prepared a draft presentation for consideration by the workshop.

112. This was then reviewed by workshop participants and revised based on comments and suggestions received.

Agenda Item 9. Other business

113. There was no other business.

Agenda Item 10. Finalisation of report

114. The report was adopted.

Agenda Item 11. Close of meeting

115. The meeting closed at 6:55pm, 21 May 2005.

List of Attachments

Attachments

1 Agenda

2 List of Participants

3 List of Documents

4 List of figures for MP evaluation

5 Comparisons of the final four candidate management procedures

6 A scenario to illustrate possible ambiguities and one potential solution regarding some MP inputs

7 Specification of total catch at age data for 2004 to be provided by the Secretariat

8 CCSBT Management Procedure: METARULE Process

9 CCSBT Management Procedure: Regular REVIEW and REVISION Process

Attachment 1

Agenda
Fourth Meeting of the Management Procedure Workshop
16 - 21 May 2005
Canberra, Australia

Terms of Reference

1. Evaluate performance of Management Procedures (MP) tested on trials specified at the Small Technical Meeting held in Seattle in February 2005.
2. Select a reduced set of preferred candidate MPs.
3. Devise an approach for presenting results of evaluation trials to the Commission.
4. Discuss approaches for taking into account projection results from both reference and some of the robustness set (prior to giving final advice on the consequences of different tuning levels) if the need arises based on new indicators of stock status and define a plan to be able to do this at SAG 6.
5. Discuss metarules that will be used to evaluate stock status and special circumstances that would require departing from the implemented MP.

Agenda

1. Terms of Reference and Adoption of Agenda

2. Outcome of Small Technical Meeting held in Seattle

3. Performance of Candidate Management Procedures

3.1 Review results of MP trials conducted after February 2005.

4. Selection of Candidate Management Procedures

4.1 Process for selecting a reduced set of MPs.

4.2 Selection of MPs.

5. Indicator Analyses and Metarules

5.1 Use of future indicators in connection to MP

5.2 Metarules.

5.3 Further analyses/software modifications needed in preparation for SAG.

6. Implementation issues and other considerations

6.1 Specification of input data needed to implement candidate MPs and process for providing the data.

6.2 Specification of input data needed to implement metarules.

7. Workplan and timetable

8 Design and content of presentation to the Special Consultation

8.1 Prepare presentation for Special Consultation.
8.2 Strategy for presenting results to CCSBT
8.3 Documentation of process for testing and selecting a set of MPs.

9. Other Business

10. Finalisation of Report

11. Close of Meeting

Attachment 2

List of Participants
Fourth Meeting of the Management Procedure Workshop
16 - 21 May 2005
Canberra, Australia

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Attachment 3

List of Documents
Fourth Meeting of the Management Procedure Workshop

(CCSBT-MP/0505/)

01. Draft Agenda of 4th MPWS
02. List of Participants of 4th MPWS
03. Draft List of Documents of 4th MPWS
04. (Australia) Further exploration and evaluation of the FXR_01 candidate management procedure rule under the new reference and robustness sets.: M. Basson, P. Eveson, J. Hartog, D. Kolody and T. Polacheck
05. (Australia) Metarules and Implementation: notes for discussion of the scientific issues.: M. Basson, T. Polacheck
06. (Japan) Results of a refined D&M Management Procedure applied to the Seattle 2005 Trials.: D.S. Butterworth & M. Mori
07. (Japan) Performance of the HK5 management procedure under the new operating models.: H. Kurota
08. (Taiwan) An evaluation of the TAI candidate management procedure rules for southern bluefin tuna based on the updated reference set and robustness trails.: Chin Hwa Sun
09. (Japan) Issues noted during the Management Development process in 2004/2005.: S. Tsuji, N. Takahashi and H. Kurota

(CCSBT-MP/0505/Rep)

01. Report of the Special Management Procedure Technical Meeting (February 2005)
02. Report of the Eleventh Annual Meeting of the Commission (October 2004)
03. Report of the Ninth Meeting of the Scientific Committee (September 2004)
04. Report of the Fifth Meeting of the Stock Assessment Group (September 2004)
05. Report of the Special Meeting of the Commission (April 2004)
06. Report of the Third Meeting of the Management Procedure Workshop (April 2004)
07. Report of the Eight Meeting of the Scientific Committee (September 2003)
08. Report of the Fourth Meeting of the Stock Assessment Group (August 2003)
09. Report of the Indonesian Catch Monitoring Review Workshop (April 2003)
10. Report of the Second Meeting of the Management Procedure Workshop (April 2003)
11. Report of the First Meeting of the Management Procedure Workshop (March 2002)

Attachment 4

Comparisons of the final four candidate management procedures

Attachment 5

Preliminary list of MPs for comparison
Option *b*, (2008 first change) 1.1 tuning C

Management Procedure	Empirical or model	Recruitment information	Carryover	Additional TAC Constraints	Other
D&M_02	Fox	Proportions of young fish in catch (till 2011)	*w = 0.5*	No increases in 2008 and 2011	*h; Additional TAC decreases for low r estimates*
D&M_03	Fox	Proportions of young fish in catch (till 2011)	*w = 0.65*	No increases in 2008 and 2011	*h; Additional TAC decreases for low r estimates*
HK5_01	CPUE Age 4+	CPUE Age 4 over 3-yrs	*w = 0*	Max increase 10%	
HK5_02	CPUE Age 4+	CPUE Age 4 over 3-yrs	*w = 0*	Max increase 25%	
TAI_05	CPUE Age 4+		*w = 0*	Default	CCSBT-MP/ 0505/08 Eq 6, p19, no interaction
TAI_A4	CPUE Age 4+		*w = 0.85*	Default	CCSBT-MP/ 0505/08 Eq 3, p14, CPUE slope-TAC change interaction
CGF_01	Fox	Proportion of Age 4 in catch recent years	*w = 0*	Cap on TAC till 2015; any increase no more than half of default max (till 2015)	
CGF_42	Fox	Proportion of Age 4 in catch recent years	*w = 0*	Cap on TAC till 2015	

Attachment 6

A scenario to illustrate possible ambiguities and one potential solution regarding some MP inputs.

Consider the situation in September 2006 when a TAC is being agreed for 2008.

1) If a model based approach is used, what inputs are used for the annual catches in this model?

- Annual catches are defined "per year" in exactly the same way as for the operating model used for MP testing;
- Agreed estimates from information available for such total annual catches up to the year ending in 2005 are input; and
- Beyond 2005, no catch inputs are needed as the population model goes no farther than 2005.

2) In carry-over formulations for the TAC for 2008, what value is used for TAC_{2007} as indicated in such formulae?

- TAC_{2007} will be as determined by the Commission at its 2006 meeting; this would normally be identical to TAC_{2006}

3) To what quota years does the TAC determined for 2008 apply?

- Assuming quota years as current:
    - Australia: 1/12/2007 to 30/11/2008
    - Taiwan: 1/1/2008 to 31/12/2008
    - Philippines: 1/1/2008 to 31/12/2008
    - Japan: 1/3/2008 to 28/2/2009
    - Korea: 1/3/2008 to 28/2/2009
    - New Zealand: 1/10/2007 to 30/9/2008

(Note: Decisions will be required regarding non-member catch years to use.)

Attachment 7

Specification of total catch at age data for 2004 to be provided by the Secretariat

The global total catch in number of SBT per age class for 2004 is to be calculated from the data submitted in the 2005 data exchange as specified below:

(1) Sum of the 2004 calendar year catch at age provided for Australian longline, and the entire catch of Taiwan, Japan and New Zealand; and add the

(2) Sum of the 2003/04 fishing season (July 2003 to June 2004) catch at age for Indonesia and the Australian surface fishery; and add the

(3) 2004 calendar year calculated catch at age for Korea, the Philippines and Miscellaneous catches. This calculation will be done by:

- Converting the catch weights to numbers for these fisheries using the same procedure as used for these fisheries when providing input data for the operating model; and
- Apportioning these numbers amongst age classes in the same proportion as the Japanese catch at age for areas 8 and 9 in 2004.

Attachment 8

DRAFT in PROGRESS

CCSBT Management Procedure: METARULE Process

Preamble

Metarules can be thought of as "rules" which prespecify what should happen in unlikely, exceptional circumstances when application of the TAC generated by the MP is considered to be highly risky or highly inappropriate. Metarules are not a mechanism for making small adjustments, or 'tinkering' with the TAC from the MP. It is difficult to provide firm definitions of, and be sure of including all possible, exceptional circumstances. Instead, a process for determining whether exceptional circumstances exists is described below. The need for invoking a metarule should only be evaluated at the SAG/SC based on information presented and reviewed at the SAG/SC.

All examples given in this document are meant to be illustrative, and NOT meant as complete or exhaustive lists.

1. Description of process to determine whether exceptional circumstances exist

Every year the SAG will:

review stock and fishery indicators, and any other relevant data or information on the stock and fishery.

on the basis of this, determine whether there is evidence for exceptional circumstances.

Examples of what might constitute an exceptional circumstance include, but are not limited to: recruitment well outside the ranges for which the MP was tested), CPUE trends that are notably outside the bounds predicted in the MP testing.

Every three years (not coinciding with years when a new TAC is calculated from the MP) the SAG will:

conduct an in depth stock assessment

on the basis of the assessment, indicators and any other relevant information, determine whether there is evidence for exceptional circumstances (a core example of exceptional circumstances here is if the stock assessment is substantially outside the range of simulated stock trajectories considered in MP evaluations)

(Every year) IF the SAG concludes that there is no or insufficient evidence for exceptional circumstances, the SAG will:

report to the SC that exceptional circumstances do not exist

The SC will consider the advice from the SAG and report to the Commission

IF the SAG has agreed that exceptional circumstances exist, the SAG will:

determine the severity of the exceptional circumstances

follow the "Process for action"

2. Description of process for action

Having determined that there is evidence of exceptional circumstances, the SAG will, at the same meeting/ in the same year:
consider the severity of the exceptional circumstances (for example, how severely "out of bounds" are the CPUEs or recruitment)
follow the principles for action (see examples below)
formulate advice on the action required (There may be occasions, if there appears to be 'exceptional circumstances', but the severity is deemed to be low, when the advice is not for an immediate change in TAC, but rather a trigger for a review of the MP or collection of ancillary data to be reviewed at the next SAG)
report to the SC on their suggested advice for action

The SC will:
review the advice from the SAG
report to the Commission that exceptional circumstances exist and provide advice on the action to take.

The Commission will:
consider the advice from the SC
decide on the action to take

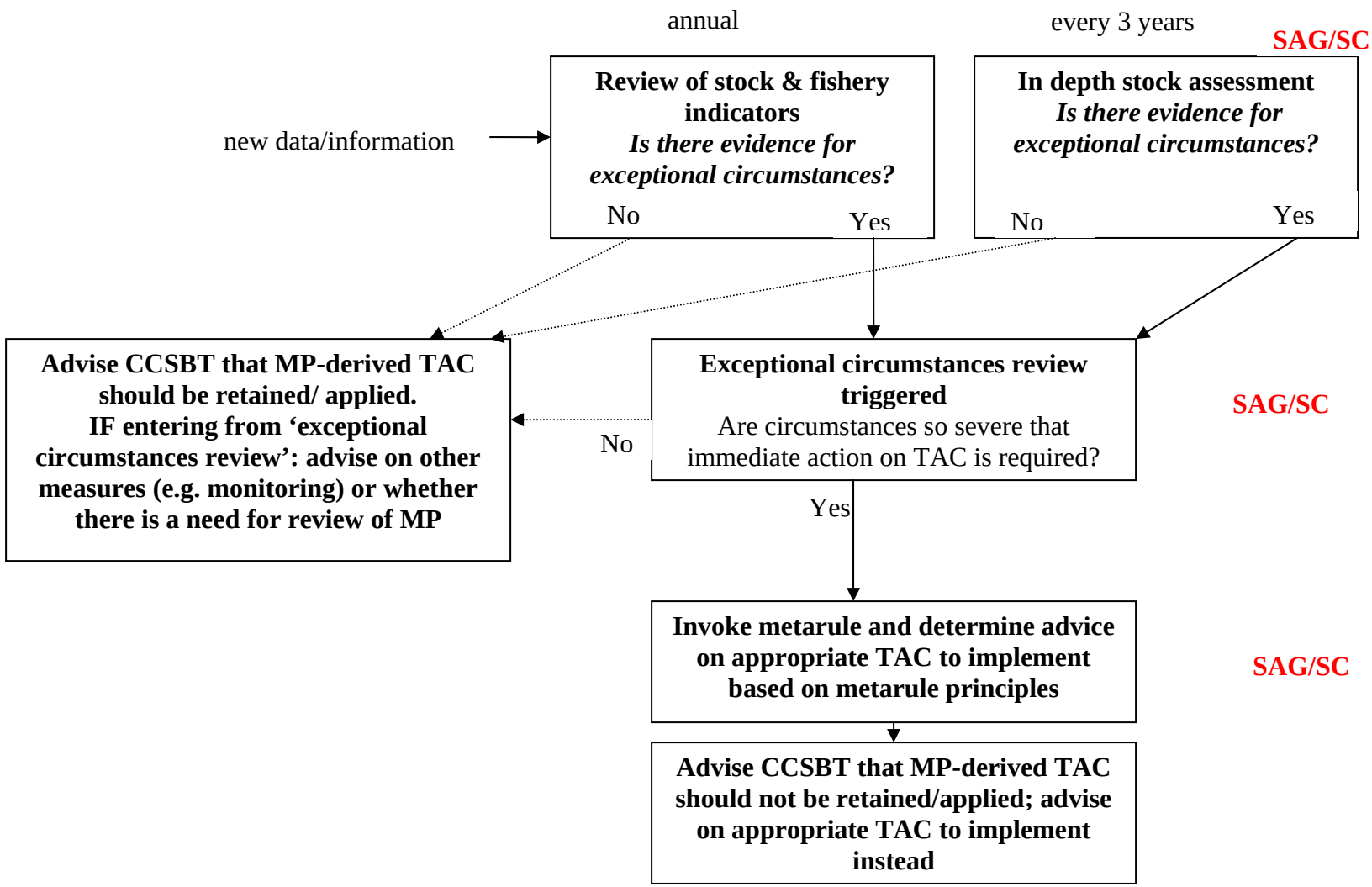
EXAMPLES of 'Principles for action'

Examples which we still need to develop / discuss

If the risk is to the stock, principles may be:
a) the MP-derived TAC should be an upper bound
b) action should be at least an x% change to the TAC, depending on severity

If the risk is to the fishery, principles may be:
a) the MP-derived TAC could be a minimum
b) action should be at least an x% change to the TAC, depending on severity

Figure 1: Flowchart for Metarules process



Attachment 9

CCSBT Management Procedure: Regular REVIEW and REVISION Process

Preamble

The procedure for regular review and potential revision of the MP is the process for updating and incorporating new data, new information and knowledge into the management procedure, including the operating model. This process should happen on a relatively long time-scale to avoid jeopardising the performance of the MP, but can be initiated at any time if the SAG/SC consider that there is sufficient reason for this, and that the effect of the revision would be substantial. During the revision process the MP should still be used unless a metarule is invoked.

All examples given in this document are meant to be illustrative, and NOT meant as complete or exhaustive lists.

1. Description of process for regular review

Every year the SAG will:
consider whether the procedure for Metarule Process has triggered a review/revision of the MP

Every three years the SAG will:
conduct an in depth stock assessment and review stock and fishery indicators, and any other relevant data or information on the stock and fishery
on the basis of this, determine whether the assessment (or other) results are outside the ranges for which the MP was tested (NOTE that evaluation for exceptional circumstances would be in parallell with this process; see procedure for Metarule Process)
and whether this is sufficient to trigger a review/revision of the MP
consider whether the procedure for Metarule Process triggered a review/revision of the MP

Every nine years since the last revision of the MP the SAG will:
review whether we have learned enough to appreciably improve/change the operating model, or improve the performance of the MP, or to provide new advice on tuning level (the achievability of management objectives)
on the basis of this, whether the new information is sufficient to trigger a review/revision of the MP

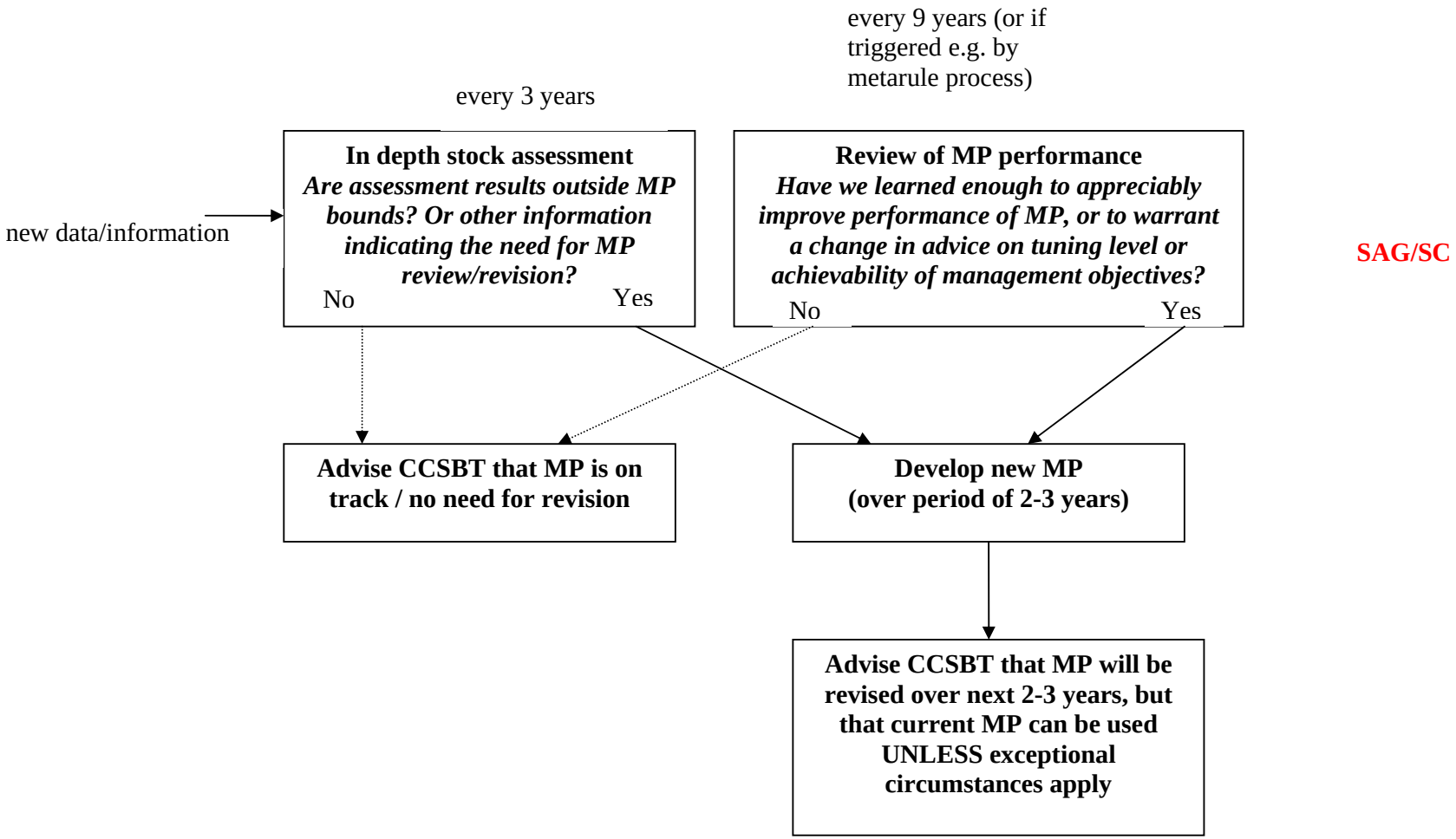
In any year, IF the SAG concludes that there is sufficient new information to trigger a review/revision of the MP, the SAG will:
outline the workplan and timeline (e.g. over a period of 2-3 years) envisaged for conducting a review
report to the SC that a review/revision of the MP is required with details of the proposed workplan and timeline
confirm to the SC that the MP can still be applied while the revision process is being completed

In any year, IF the SAG concludes that there is no need to commence a review/revision of the MP, the SAG will:

report to the SC that a review/revision of the MP is not yet required

The SC will:
consider the advice from the SAG, and if the SC agrees with the SAG, prepare a report to the Commission:
summarising the need for a review/revision
proposed workplan and timeline
budgetary implications
confirm to the Commission that the MP can still be applied while the revision process is being completed

The Commission will:
review the report from the SC
decide whether to initiate the review/revision process


every 9 years (or if triggered e.g. by metarule process)
every 3 years
new data/information
In depth stock assessment
Are assessment results outside MP bounds? Or other information indicating the need for MP review/revision?
No
Yes
Review of MP performance
Have we learned enough to appreciably improve performance of MP, or to warrant a change in advice on tuning level or achievability of management objectives?
No
Yes
SAG/SC
Advise CCSBT that MP is on track / no need for revision
Develop new MP (over period of 2-3 years)
Advise CCSBT that MP will be revised over next 2-3 years, but that current MP can be used UNLESS exceptional circumstances apply