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Meta-rules for implementation of CCSBT Management Procedure and consideration of exceptional circumstances and 2017 scheduled review of MP

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Contents

Abstract

The Meta-Rules for the CCSBT Management Procedure (MP) provide the agreed over-arching framework for the implementation of the Commission's MP. This framework includes 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).

This paper reviews the purpose and function of the Meta-rules in the implementation and review of the CCSBT MP, with a particular focus on: i) the identification of exceptional circumstances and the actions that may flow from this, ii) the events that have been identified, or may be identified, as exceptional circumstances by the ESC, and; iii) the issues that need to be considered in the context of the ESCs preparation for the first formal review of the performance of the MP against the Commission's objectives thus far (i.e. 2011-2015). This includes initial consideration of the recent requests from the 4th meeting of the Strategy and Fisheries Management Working Group (28-30 July 2015) and their potential implications for the current MP, TAC advice from the ESC and the ESC's short and medium term work program.

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 Mortality (UAM); iii) the shift in Indonesian size/age data (2013-2015), and; iv) the potential that the aerial survey may not continue beyond 2016. In our view, the first two items constitute exceptional circumstances. The missing 2015 aerial survey data point can be accommodated within the random effects component of the existing MP harvest control rule, and hence, the MP can be used to recommend the 2018-2020 TAC in 2016, assuming the 2016 aerial survey index is available. The MP testing assumed total removals were reported exactly and 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 can compromise the likely performance of the MP for stock rebuilding and future catches. The shift in Indonesian size/age data is yet to be fully considered by the ESC. However, CCSBT-ESC/1509/14 indicates a substantial change 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 (for the 2017 reconditioning) and for Close-kin abundance estimation. Consideration of the potential for the aerial survey 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 it. Such a situation would require the development of new recruitment indices, new MPs and full MSE testing at considerable addition cost and time before a robust MP could be used to

recommend TACs consistent with the Commissions objectives for minimising the risk of future declines and rebuilding the spawning stock.

The Meta-rules include a scheduled review of the MP in 2017, which will follow completion of 3 TAC decisions (2011; 2013 and 2016). The timing of the review was based on several considerations, including, passing of sufficient time for i) several TAC decisions to be made by the Commission and a reasonable probability of observing a response in the stock, and ii) development and testing of alternative monitoring series to allow for an orderly transition from the agreed MP to a modified/new MP if required. The recently reinstated CCSBT Scientific Research Plan was developed and prioritised with this focus and schedule in mind and the Commission and members have funded some of the work required to achieve these goals. This paper outlines some of the issues the ESC will need to consider at its 20th meeting in light of the decisions made by the Commission in 2015 and the requests from the July 2015 meeting of the SFMWG.

1 Introduction

The Management Procedure (MP) specifications and meta-rules for the CCSBT Management Procedure (Anon 2013, Attachment 10) provide the agreed, over-arching framework for the implementation of the Commission's MP. This framework includes 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, period assessments of stock status and formal review of MP performance; and the process identifying exceptional circumstances (i.e. circumstances or events outside the range for which the MP was tested during the Management Strategy Evaluation (MSE) phase of development) that indicate that following the TAC recommendations of the MP may be highly risky or highly inappropriate.

This paper reviews the purpose and function of the Meta-rules in the implementation and review of the CCSBT MP, with a particular focus on: i) the identification of exceptional circumstances and the actions that may flow from this, ii) the events that have been identified, or may be identified, as exceptional circumstances by the ESC, and; iii) the issues that need to be considered in the context of the ESCs preparation for the first formal review of the performance of the MP against the Commission's objectives thus far (i.e. 2011-2015). This includes initial consideration of the recent requests from the 4th meeting of the Strategy and Fisheries Management Working Group (SFMWG, 28-30 July 2015) and the potential implications for the current MP, TAC advice from the ESC and the ESC's short and medium term work program.

It is structured into the following four sections:

1. MP specification and role of meta-rules
2. Exceptional circumstances
3. Initial considerations on TORs and process for 2017 MP review
4. Preliminary considerations on request for advice from SFMWG

2 MP specification and role of meta-rules

2.1 Meta-rules and MP implementation

"*Meta-rules can be thought of as "rules" which pre-specify what should happen in unlikely, exceptional, circumstances when application of the total allowable catch (TAC) generated by the management procedure (MP) is considered to be highly risky or highly inappropriate."*

In essence, the meta-rules are intended to guide scientists and managers in the event that situations arise that are outside the range for which the management procedure was tested and, therefore, there is some likelihood that the TACs recommended by the MP may not result in the rebuilding of the stock with the probability specified by the Commission.

The meta-rules process involves the following three steps:

1. Determining whether exceptional circumstances exist,
2. A "process for action" that examines the severity of the exceptional circumstances for the operation of the MP, and the types of actions that may be considered, and
3. "Principles for action" that determine how recommendations from the management procedure might be altered, if at all, based on the most recent reconditioning of the OM.

It also includes a schedule for review of indicators (annual), periodic assessments of the status of the stock via reconditioned operating models (3 year intervals) and in depth review of the MP performance (6 years intervals). The last assessment of stock status was completed in 2014. The first MP review is scheduled for 2017 (Anon. 2013, Attachment 10).

It is also worth noting, that while the simulation testing of the MP was done over a 40 year (projected) time horizon, the ESC did not have the expectation that the same MP would, necessarily, be used for the duration of the rebuilding period. The central consideration is that the total removals from the stock are consistent with the level of fishing mortality required to provide for the rebuilding, conditional on the perception of the status and productivity of the stock at the time of the MP testing and implementation.

In this context, the multiple frequency and "depth" of reviews specified in the Meta-rules provide a regular feedback mechanism to assess whether the MP is performing "as expected". That is, as we expected, given what we knew at the time.

It is also evident, from the CCSBT Scientific Research Plan recommended by the ESC in 2013 and adopted by the Commission, that appropriate consideration has been given to information and alternative monitoring series that are likely to a) improve the ESC's ability to assess stock status (Bravington and Davies 2012, Bravington 2014, Bravington et al 2015; Farley et al. 2015a) and, potentially, provide more accurate and/or cost-effective methods to monitor different components of the stock into the future (Harley et al 2008, Davies et al 2008; Basson and Davies 2008; Itoh and Takahashi 2014, Ping et al 2013, 2014; Preece et al 2013; Preece et al 2015).

3 Exceptional Circumstances

As noted above, exceptional circumstances are events, or observations, that are outside the range for which the management procedure was tested and, therefore, indicate that application of the total allowable catch (TAC) generated by the management procedure (MP) is considered to be highly risky or highly inappropriate.

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; ii) the identification, but uncertain scale, of Un-Accounted Mortality (UAM) since the implementation of the MP and, potentially into the future; iii) the marked and unexpected shift in Indonesian size/age data (2013-2015), and; iv) the potential that the aerial survey may not continue beyond 2016.

In considering the potential for exceptional circumstances arising from these events, we have examined whether: 1) the inputs to the MP are affected, 2) the population dynamics are potentially significantly different from those for which the MP was tested, 3) the fishery or fishing operations have changed substantially, 4) total removals are greater than the MP recommended TACs, and 5) if there are likely to be impacts on the performance of the SBT rebuilding plan as a result. The events are considered individually in the context of exceptional circumstances. However, the ESC will also discuss the implications of the combination of events for the performance of the MP and the ability of the ESC to provide robust advice on the status and trends of the stock..

3.1 Cancellation of the 2015 Aerial survey

The absence of the aerial survey data in 2015 triggers exceptional circumstances because these data are essential to the operation of the adopted management procedure, and it generates logistical vulnerabilities to re-starting the aerial survey. The latter could mean it is no longer possible to operate the agreed MP and hence directly impact on the tested SBT rebuilding plan.

The ESC has undertaken, inter-sessionally, a technical evaluation of running the MP without the 2015 data point and for a reduced aerial survey in 2016 at the request of the Commission. The ESC has agreed that if there is aerial survey data in 2016, the MP can be used to recommend TACs in 2016.

The 2016 and 2017 TACs (set in 2013) would not need to be altered due to the absence of aerial survey in 2015, i.e. the severity of the exceptional circumstances is low, because the MP can be run in 2016 if there is a 2016 aerial survey. However, the absence of all recruitment monitoring information in 2015 is of concern, as are the other sources of exceptional circumstances. These are addressed individually below.

3.2 Lack of recruitment monitoring information

The lack of recruitment information in 2015 triggers exceptional circumstances. All recruitment monitoring programs ceased in 2015. There is no information on the level of recruitment to the youngest age classes (2-4 year olds) to inform the review of indicators or the most recent trends. These data would have been used as part of the annual assessment of whether the data used in the MP (and predicted likely values from the OM) are within or outside the bounds under which the MP was tested.

We consider the severity is “moderate”, given the recent trends in recruitment have been positive and above the historically low levels seen in the early-mid 2000s and 2012. However, if the ESC concludes that the aerial survey index is too variable or unreliable (i.e. as contended in CCSBT/ESC/0915/20), then this would also reflect on the recent trends from the OM, which are highly informed by the AS data. While we do not consider the latter to be the case (see Preece et al, 2015), it would also imply that the recruitment estimates from the OM are biased by the aerial survey index.

The actions that should be considered by the ESC are that new informative recruitment monitoring data need to be collected as soon as practical and a times series collated for use in OMs and future MPs. Actions on modifying TACs are not necessary, given that the MP can still be run effectively (assuming the 2016 survey index is available) and the Extended Commission has agreed to continue the survey for at least 2016.

3.3 Failure or cancellation of the aerial survey in 2016

Failure or cancellation of the aerial survey in 2016 will trigger exceptional circumstances in 2016 because the MP would not be able to be used to recommend 2018-2020 TACs. It would also mean i) a new management procedure would need to be developed and tested to continue the implementation of the rebuilding plan for the stock and ii) some form of ad hoc method for providing advice on TACs to the Commission would be required in lieu of new tested MP.

The ESC will need to develop specific principles and processes for action (as specified in the Meta-rules) to assess the implications for the 2017 TAC and develop an approach for how to advise on the setting of the 2018-2020 TACs. There will be no aerial survey information on recruitment in 2015 and 2016 and, at present, no other information on the strength of recent year classes. This would substantial limit the ESC’s ability assess changes to stock dynamics, and impacts of fishing operations, as required under the Meta-rules, particularly given that a large proportion of the global catch is on younger (1-4 yr) age classes (Preece et al 2015).

Inclusion of recruitment monitoring information in the MP has been considered important requirement by the ESC since 2008 and this will continue to be the case until the spawning stock has been rebuilt to a level that can maintain long-term average levels of recruitment. Currently there is no alternative recruitment monitoring series to replace the aerial survey (see Preece et al 2015) that could be used to develop and test a new MP before 2019. The timeframe for collection of sufficient new recruitment data to use in an MP may be in the order of 6-7 years. Should this scenario eventuate, we would consider this severe, as it would mean the current MP would be inoperable, there would be a lack of reliable recruitment monitoring and a substantial delay in

best-practice management while developing both a new monitoring series and MP at a time when the stock status remains depleted.

In summary the actions that the ESC would need to consider under this scenario are:

1. Develop a new recruitment monitoring time-series for use in OM and MP.
2. Develop a new MP and complete full MSE testing, adoption and implementation.
3. Develop options for interim TAC advice, including, but not restricted to: maintaining status quo, TAC reductions given the uncertainty in recent recruitment, "risk equivalent" constant-catch projections for interim TAC information, acting with precaution (by, for example, adjusting the 2017 TAC downwards and/ or recommending conservative 2018-2020 TACs).

3.4 Indonesian selectivity changes

The last 3 years has seen a substantial shift in the length and age frequency of fish in the catches of Indonesian longline fishery (Farley et al, 2015b). As part of the 2014 reconditioning of the OMs, the selectivity constraints in the SBT operating models were relaxed to provide the flexibility to fit the shift in the data (Anon 2014a). It is unclear whether this change has arisen from a change in the age-structure on the spawning grounds, or if a proportion of the fish landed in Indonesia is being caught away from the spawning grounds.

In 2015 we do not consider this issue, on its own, to represent exceptional circumstances. However, the issue will be important to address directly in the next stock assessment (2017), as part of the MP review, and hence may trigger exceptional circumstances at that time.

It should be a high priority to determine the likely cause of this shift and, in the interim, gather as much ancillary information as possible. Attempts to resolve the catch location of the small fish, thus far, have not been successful. CDS data could potentially resolve the issue if they are available. Micro-constituent analysis of the otoliths of a subsample of small and large fish in each recent year may also shed some light on whether or not they are being caught on the spawning ground (see Clear et al 2014). The ESC will need to make recommendations and a work plan in consultation with Indonesia to resolve this uncertainty in 2016, so that the required changes in the OMs can be agreed prior to the 2017 stock assessment.

3.5 Un-Accounted Mortalities

As noted above, the design and simulation testing of the MP assumed that all removals from the stock were accounted for, i.e. the TAC was exact. In light of information provided to the ESC and the request from the Commission in 2013, the ESC evaluated the impacts of scenarios for potential UAM from a variety of sources as part of 2014 the assessment of stock status and the implications for the rebuilding plan (Anon 2014). The results indicated, for the scenarios examined, that the UAM was likely to have little impact on current stock status; but substantial potential impacts on the performance of the MP and rebuilding of the SBT stock, if the unaccounted mortalities are occurring and continued into the future. The ESC could only use simple scenarios for the level and trajectory of potential UAM scenarios in the evaluation because there is very limited information or data on the specifics of the potential unaccounted mortalities.

In 2014 the ESC agreed that the scenarios considered for potential unaccounted mortalities, if they were in fact occurring, triggered exceptional circumstances but that no urgent management action on TAC setting was required, at that time. Resolving the veracity of the current set of scenarios and provision of more detailed data is urgent and essential for accurate assessment of these impacts on the stock and MP performance. Hence, the ESC advised the Extended Commission to continue to follow the MP but, as a matter of urgency, to take steps to quantify all sources of unaccounted SBT mortality.

Attachment 5 of the ESC report (Anon 2014) identifies initiatives (data collection and analysis) that could be undertaken to improve estimation of unaccounted mortalities. The ESC encouraged all countries to make their CDS data and information on market monitoring available to facilitate and improve analyses. Reduced uncertainty on the scale and nature (size composition, area/season of capture) of UAM prior to the next scheduled MP and assessment would enable the ESC to provide a more meaningfully assessment of the impact on the stock and MP performance.

In terms of potential UAM from non-member fleets, there is no additional information from the Compliance Committee or Extended Commission. The Extended Commission recommended a market review be undertaken and this is work is being commissioned by the secretariat.

There are two papers for the 2015 ESC that have attempted to quantify potential levels of non-member UAM in the Pacific and Indian oceans by indirect methods (CCSBT-ESC/1509/21 and CCSBT-ESC/1509/10). These papers indentified potential for low-levels of non-member catches in the Indian and Pacific Oceans, noting there were substantial uncertainties and assumptions made in these analyses.

In terms of potential UAM from member fleets (Attachment 5, ESC 2014 report), national reports and papers provide some updated information (such as: CCSBT-ESC/1509/32-rev1; CCSBT-ESC/1509/BGD01).

In considering all the potential sources of unaccounted mortality and unresolved access to data since the 2014 evaluation of the impacts of UAM on the MP, the ESC should consider principles and process for action on TACs. Incorporating implementation error in the MP TAC setting and testing. Re-tuning with this additional error could also be considered in future, with the MP review in 2017 being the most obvious next opportnuity.

3.6 Summary of review of potential meta-rules outcomes

The absence of the 2015 aerial survey data, no other recruitment information in 2015, UAM and Indonesian selectivity changes are all likely to be considered exceptional circumstances because of their impacts on the input data for the MP (Aerial Survey), the ESC's ability to monitor stock status (Aerial Survey and Indonesian fleet), changes in fishery operations (in the case of Indonesian fleet) or because of their impacts on the performance of the MP and rebuilding of the stock (UAM).

Each of these was assessed individually in terms of the principles and processes for action regarding recommendations for alteration of the 2016 and 2017 TACs that were set in 2013.

The lack of an aerial survey point in 2015 combined with no other recruitment information, results in increased uncertainty around the strength of the most recent year classes, which also constitute

a substantial proportion of total removals. The ESC should discuss whether more precautionary TACs are needed in the absence of robust recruitment monitoring.

The marked shift in the Indonesian size/age distribution does not currently suggest that there should be changes to the TAC, but the uncertainty in the mechanism causing this shift needs to be resolved; agreement on actions to resolve this need to be made at the 2015 ESC, so that appropriate changes can be made to the OM and data preparation to incorporate these data correctly in the 2017 stock assessment and MP review work.

The limited new data available on UAM scenarios constrains the ability of the ESC to provide robust advice on the implications for stock status and performance of the MP. This lack of progress suggests that the ESC may need to revisit the basis of its 2014 ESC advice on this issue. The Extended Commission agreed to a work plan related to UAM, which should be considered as part of this issue, and in formulating the ESC 2015 advice to the EC.

The 2015 ESC will also need to consider the extent to which the co-occurrence of these events means that their combined impacts may be more severe, in the context of the meta-rules, than when they are assessed individually.. While we have reviewed the detail of each issue/event separately, the combination of them occurring simultaneously warrants explicit consideration by the ESC and advice to the EC.

4 Initial considerations on the TORs and preparation for 2017 MP Review

The CCSBT MP was designed to:

- Reduce the risk of further declines in SSB
- Reduce the risk of further very low recruitments
- Rebuild the SSB with a high probability (~0.7) to >20% by 2035
- Use aerial survey data series as a fisheries independent input to provide early index of recruitment and mitigate against uncertainties associated with the CPUE series.

Given these objectives and inputs, reasonable ToRs for the 2017 MP review might include:

1. Review of data, including
   - Input data series to the MP. This should include a review of data collection, reliability, costs, standardisation and potential alternative data sources.
   - Review of the data predicted by the OM versus those observed in the monitoring series.
   - Review of alternative indices and new information on population and fishery dynamics
2. Review of observed MP performance for stock rebuilding, including for example
   - Estimated SSB in 2017 and projected 5yr trend from the OM
   - Estimated average recruitment and 5yr trend from the OM
   - Estimated period to achieve Pr(>0.2 SSB_0) = 0.7., currently 2035
   - Updated Close-kin estimate of abundance and trend in spawning potential

For the purposes of the review, it may be worth giving some consideration to the likely performance of the MP relative to some plausible alternatives, such as, 3 yr risk-equivalent constant catch projections or constant catch projections at F=MSY, purely for comparative purposes.

3. Review of grid and other key assumptions used in in testing and tuning.
   - M, h and B_0 interaction.
   - Re-estimate of R_0.
   - Form and values of natural mortality schedule.
   - Initial consideration on Performance measures and MP for beyond rebuilding target.
   - Given the outcome of the above, is re-tuning of the MP warranted.
4. Timetable, priority and funding arrangements for future ESC MP work program.

5 Preliminary considerations on request for advice from SFMWG

The 4th meeting of the Strategy and Fisheries Management Working Group (Anon 2015) made the following additional requests for advice from the ESC:

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

In addition, the SFMWG, requested that the ESC provide as much advice as possible on the relative merits of the alternatives to our current approach to the MP. This should consider questions in relation to the suitability (e.g. data quality and cost effectiveness) of developing an MP with recruitment information from sources other than the aerial survey (e.g. gene tagging, trolling survey, CPUE from young age classes etc.) or only with long-line CPUE. This will assist the EC to make a decision in relation to continuation of the aerial survey and the current MP beyond 2016. It was noted that unaccounted SBT mortalities was another issue that would need to be considered in a review of the MP and its application. Preece et al 2015 (CCSBT-ESC/1509/9) considers potential alternative sources of information on recruitment, influence and fit of the aerial survey data in the SBT OM, and costs and benefits of historical and future aerial survey data in the MP. The unresolved issue of UAM is considered directly in the section above and in future research priorities below.

5.1 Future work program scenarios, costs and benefits

To address these requests we outlined 5 alternative future work programs that incorporate combinations of aerial survey, SRP projects and MP review activities, in the context of the meta-rules, and used this framework to identify priorities and schedules SRP activities:

Option 1 - Default: The AS proceeds in 2016 and beyond, gene-tagging (GT) trial commences (conditional on GT design study outcomes, Preece et al, 2015 (CCSBT-ESC/1509/18)), MP review 2017, new MP developed for implementation.

Option 2 - AS 2016 only, GT trial commences, MP review/development, potential exceptional circumstances and TAC review in 2016/2017; no MP for TAC setting for 2019.

Option 3 - AS 2016 only, members work on CPUE recruitment series, MP review/development, potential exceptional circumstances and TAC review in 2016/2017; no MP for TAC setting for 2019.

Option 4 - No AS 2016, Exceptional circumstances, no MP to set 2018-2020.

5.1.1 **Option 1:**

This is the default option agreed by the Commission when adopting the management procedure and meta-rules process in 2011 and the SRP in 2013 and 2014 (Anon 2014): The AS proceeds in 2016 and beyond, GT trial commences, MP review 2017, new MP developed for implementation.

- AS continues: As an essential data source for the MP the aerial survey data should continue to be collected until a review of the MP and a timetable for a new MP is developed and the ESC agrees that the AS data are no longer needed. This implies that the Aerial survey should continue in 2016 and Jan-Mar 2017, at least, as the MP is scheduled for review in Sept 2017.
- GT trial commences. The SRP for 2014-2018 was finalised in 2014, and the 3 year work plan included a gene-tagging design study (completed) and a pilot study to commence in 2016, subject to outcomes of the design study. The data from gene-tagging should provide estimates of absolute abundance of juveniles, and could potentially replace the aerial survey for recruitment monitoring and potentially be used in future MP's (Preece et al, 2015).
- MP review in 2017. The review of the MP in 2017 would evaluate the performance of the current MP. In considering the data inputs to the MP, the aerial survey and CPUE data would be reviewed and if the ESC recommends that a new MP should be developed, then the agreed process is that a timetable of activities to develop, collect required data, test and implement the MP will be developed. This timetable should indicate whether or not the aerial survey data are still required and when it can stop being collected, because aerial survey data will be needed for the 2019 MP calculations if a new MP is not in place in that amount of time.
- Development of a new MP. If following the review of the MP the ESC agrees to develop a new MP then work can proceed as scheduled in the agreed timetable. The costs and time for development for the current MP were substantial. If the decision is made in 2017, it is very unlikely that a fully tested and agreed MP could be implemented in time for the 2019 TAC setting, using the new MP in 2022 may be a more realistic timeframe.

The Option 1 combination of future activities does not breach the agreed management procedure schedule of events and therefore would not trigger exceptional circumstances under the meta-rules processes. The SRP priorities agreed in 2016 would be maintained, and the development of a recruitment monitoring program based on gene-tagging could be considered as a data input for a new MP. Costs will involve; Annual AS, GT design study, and potential annual GT for recruitment monitoring, costs of MP review, significant costs for MP development, including costs of other data collection activities, OMMP meetings, special meeting of the Commission, and Advisory Panel and consultant advice. There would be no TAC reductions based on this plan, however other sources of exceptional circumstances, for example the unresolved unaccounted mortalities issue, will still need to be evaluated.

5.1.2 **Option 2.**

Option 2 involves conducting the aerial survey in 2016 but not beyond, commencing the GT trial, cancellation of the MP review, development of a new MP, potential exceptional circumstances and TAC review in 2016 and 2017, no MP for TAC setting for 2019.

- Aerial survey in 2016 only. If the aerial survey is only conducted in 2016 and there are no plans for continuation, then the MP can be used to set TACs in 2016 (for 2018-2020), but the MP will then be unusable.
- Commence GT trial. As above.
- Cancellation of MP review. The adopted MP and rebuilding plan will have been abandoned with the cessation of the aerial survey after 2016, and therefore there will be no need for an MP review.
- New MP development. A new MP will need to be urgently developed and the data sources required for use in it will need to be collected. It may not be possible to develop a new MP before 2019. Timeframes and costs are discussed above.
- Potential exceptional circumstances and TAC review. The cancellation of the AS in 2015 will potentially trigger exceptional circumstances and need for TAC review, given the lack of recruitment monitoring information and data for the MP. The cancellation of the AS after 2016 will also trigger exceptional circumstances because this leads to the cessation of the adopted MP and SBT rebuilding plan. The ESC will need to discuss the implications of these exceptional circumstances in providing the recommendation for the current 2016 and 2017 TACs and the yet to be determined 2018-2020 TAC block.
- No MP for 2019 TAC setting. There may be no replacement MP in place to set TACs in 2019.

Option 2 involves the complete loss of the adopted MP, and requires development of a new MP. Costs will involve costs for the AS 2016 only, GT design study and potential future ongoing monitoring costs, significant costs of development of a new MP (including OMMP meeting, commission meetings, advisory panel expertise). An additional cost of this approach is that there will also be potential TAC losses from exceptional circumstances considerations and precautionary management in the absence of an agreed MP (Preece et al 2015).

5.1.3 **Option 3.**

Option 3 involves running the AS in 2016 only, no GT trial, members work on CPUE recruitment series, cancellation of MP review, MP development, potential exceptional circumstances and TAC review in 2016/2017, no MP for TAC setting for 2019.

- AS in 2016 only. As above in option 2. This leads to the adopted MP being unusable.
- No GT trial. Delays in developing new and informative methods for recruitment monitoring.
- Members work on CPUE recruitment series. Some initial advice has been provided on the feasibility and reliability problems of using CPUE data for recruitment monitoring (Preece et al, 2015). It is unclear how these will be addressed and the implications for any future MP.
- No MP review. As above in option 2, no need for review given that the MP no longer functioning.
- New MP development. As above.
- Potential exceptional circumstances and TAC review. As above.
- No MP for 2019 TAC setting. As above, there may be no replacement MP in place to set TACs in 2019.

Option 3 is similar to option 2 and also involves the complete loss of the adopted MP. There are cost savings from delaying or not conducting the gene-tagging and future recruitment monitoring via GT, but additional costs in developing and reviewing alternative recruitment indices.

5.1.4 **Option 4**

Option 4 involves no AS in 2016, exceptional circumstances triggered, no MP to set 2018-2020 or beyond.

- No aerial survey in 2016. This means the adopted MP is unusable, and there is no MP and SBT rebuilding plan.
- Exceptional circumstances would be triggered, with potential precautionary adjustments to TACs that have already been set.
- No MP to set 2018-2020 TACs. There would be no MP based method for setting the 2018-2020 TACs and non-MP based methods would need to be considered and agreed.

Option 4 involves immediate cancellation of the adopted MP. Costs would be for development of non-MP based advice for setting TACs in 2016, plus costs of development of a new MP. This scenario is likely to require additional ESC/OMMP meetings and resources, and possible special meetings of the Commission. An additional cost of this approach is that the TACs developed without a rebuilding plan are likely to be lower than current given the need to be precautionary and the current depleted state of the stock.

5.2 Research priorities

Priorities for CCSBT funding are suggested below, based on the high priority activities identified in the three-year SRP outlined at the 2014 ESC (Anon 2014, Tables 2A and 2B). We have not included here the member country obligations to collect and collate data on their fleets and catches. The catch characterisation, size sampling, observer programs and other essential and high priority monitoring, member research projects and ESC preparation work is already undertaken and funded by members and is not included in this list. Should any of these items need to be considered for CCSBT funding, then members will need to make that clear and add it to the list for consideration of SRP priorities.

The list below is in suggested priority order and immediate need for continuing operation of the current MP, resolving UAM, and an orderly transition to a new MP over the coming years (all have been identified as essential or high priorities by the ESC) for discussion at the ESC. The prioritisation is based on necessity for running the MP, resolving uncertainties that affect performance of the MP, data essential for the OM, data for future monitoring programs, projects that are investigating cost-effective abundance estimation and monitoring methods. The priorities and scheduling, and the level of likely increase in performance and robustness of the MP, needs to be part of an active dialogue with the Extended Commission on a regular basis.

1. Scientific aerial survey. Essential data for implementing the MP (2014 ESC Report, Table 2A). Data should continue to be collected until a new MP is developed and implemented, or exceptional circumstances will occur (as discussed above). Cost effective relative to the costs of

development of new MPs, and potential TAC reductions in the absence of an MP and rebuilding plan.

2. Research and monitoring for resolving UAM. A high priority given the relevance to the performance of the management procedure and OM. The 2014 ESC advised that, as a matter of urgency, steps should be taken to quantify all sources of unaccounted SBT mortality. The 2014 EC directed the ESC to undertake research in this area and agreed to a timeline. Resolving this issue also requires consideration and information from the Compliance Committee. In the absence of data, the ESC will need to discuss the implications for exceptional circumstances, or inclusion of implementation error in the MP and in MSE testing and tuning the MP.
3. Indonesian otolith collection, ageing and archiving. Essential data for the age frequency of Indonesian catch in the OM, for including the close-kin data in the OM, and for the independent assessment of spawning abundance using the close-kin method (e.g. Hillary et al 2012). Normally, this would be the member's responsibility, however this is an area of identified capacity development for Indonesia.
4. Close kin sample collection. High priority for the close-kin genetics monitoring of spawning abundance. Collection costs are small relative to the value of the data for the OM.
5. Resolution of the Indonesian small fish issue. This is a high priority for resolution before the 2017 full stock assessment. This is needed to resolve potential changes in size/age at maturity and/or which fish are caught on the spawning ground, for use in close-kin abundance estimation. Costs may be nil if Indonesia can provide data to resolve the issue.
6. Gene-tagging pilot study and consideration of ongoing monitoring. High priority for development of cost-effective fishery independent recruitment monitoring program. Data for use in OM and potential future MPs.
7. Close-kin genotyping for spawning stock abundance estimation. High priority for close-kin data for inclusion in OM, the next full stock assessment is scheduled for 2017, and for independent assessment of spawning biomass.
8. Age validation workshop. Remains a high priority for ensuring scientists undertaking ageing are consistent in their estimates, to resolve issues regarding ageing fish caught in the winter and to discuss spatial distribution of sampling in terms of potential future use of the direct age data in SBT OMs.
9. Maturity workshop. Remains a medium priority for defining spawning abundance in the OM and close-kin abundance estimates. Scheduling could occur after the next full stock assessment depending on the method of CK used (see Bravington et al 2015).

We note that the Extended Commission budget is not unlimited and there is the need to fund other activities, including those central to the operation of the MP, in addition to those identified by the ESC for under the CCSBT SRP.

The role of the ESC is to advise the EC on the activities, and their relative priority, required to maintain a robust, precautionary scientific basis for rebuilding the stock, through the current MP, consistent with the EC's objectives, and being able to report with appropriate confidence on progress against the rebuilding plan. The latter requires periodic estimates of the spawning stock and, while the spawning stock remains depleted, trends in recent recruitment. The proposed

prioritisation is provided to promote discussion at the ESC and EC on the budget and schedule of tasks for the SRP in light of the potential trade-offs in uncertainty about stock status, rebuilding and ability to assess the performance of the MP and likely future levels of catch. We also consider it worth considering that items which may not be directly funded by the EC, through SRP, may still be progressed by collaboration between members and co-operating non-members, as has been undertaken previously for the development of monitoring and assessment approaches.

6 Summary and Recommendations

1. CCSBT MP should continue in current form through to, at least, 2017. This is the most cost-effective option in the context of the operational cost invested in MP development, testing and implementation and in terms of value of likely foregone catches and rebuilding.

2. EC should consider results of analyses presented to ESC 20, in particular the relative value of information versus the costs of monitoring and the risks to rebuilding and level and stability of future catches.

3. The decision not to fund the 2015 AS and not to confirm funding beyond 2016 has materially weakened the AS (logistically). Given this, a priority must be put on developing and securing ongoing funding from the Commission for robust estimates of recruitment. This will remain an essential priority until such time that the spawning stock is rebuilt to a level that can maintain long-term average levels of recruitment.

4. The changing nature of the SBT fisheries mean that it is highly desirable to base long-term monitoring of the stock for assessment and MP purposes on consistent, transparent monitoring methods which all members have confidence in. The ESC has identified a number of approaches that have the potential to meet these criteria and initiated design studies. We strongly urge all members and the ESC to actively participate in the development of these approaches so that they may be appropriately tested, refined and implemented as soon as practical.

5. We do not consider that fisheries dependent (i.e. CPUE) indices of recruitment are appropriate for monitoring recruitment of SBT. As previously noted by the ESC, they are subject to unquantifiable uncertainties due to the market anomalies, historical and future changes in spatial and temporal coverage, which are very difficult to address satisfactorily through standardisation, and, unknown biases due to changes in targeting and other behavioural factors.

6. The current MP should continue to be implemented until such time that an orderly transition can be made to a new MP that has been simulation tested and shown to have a high probability of meeting the objectives of the ECs rebuilding program.

7. The recommended priorities for the CCSBT Scientific Research Program are based on necessity for running the MP, resolving uncertainties that affect performance of the MP, data essential for the OM, data for future monitoring programs, projects that are investigating cost-effective abundance estimation and monitoring methods. As these projects have been identified as high[1] priorities, their scheduling and funding should be part of an active and regular dialogue with the Extended Commission.

[1] With the exception of the Maturity workshop, which was ranked as medium.

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