METARULES AND IMPLEMENTATION: NOTES FOR DISCUSSION OF THE SCIENTIFIC ISSUES.

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ABSTRACT

This paper summarises outcomes from previous discussions on metarules and implementation as a reminder for further discussions at the fourth CCSBT MP workshop, and lists some additional points of scientific relevance to the discussion.

We emphasise the importance of having a well-defined process for checking and deciding whether a metarule should be invoked or not, rather than trying to pre-empt or fully specify detailed circumstances and responses.

1. INTRODUCTION

The intention of this background paper is to assist discussion of metarules and implementation issues at the Fourth MP Workshop meeting. We consider the two items in turn, although there are some aspects common to both. As we, hopefully, move closer to the implementation of an MP, it is important to refine and finalise the approach to metarules and to identify any additional issues that need to be considered by the SAG/SC at its meeting in September 2005.

We have generally used the term 'management procedure' rather loosely, either to refer to the broader framework or primarily to the 'rule' which calculates a TAC (e.g. "candidate MPs"). Here we have tried to used the term 'MP rule' to refer to the component which calculates the TAC, and the term 'MP' to refer to the broader framework.

2. METARULES OF SCIENTIFIC RELEVANCE

2.1 Process for invoking a metarule

Previous Discussions

Discussions on metarules, special circumstances and implementation issues were started at the 3rd Management Procedure (MP) Workshop in Busan (Report of the 3rd meeting of the MP Workshop, April 2004). As noted in the report, in the context of the management procedure, metarules can be thought of as "rules" which prespecify what should happen in unexpected, exceptional circumstances. Although there is insufficient information to provide firm definitions of exceptional circumstances, examples of what might constitute an exceptional circumstance include: recruitment "Failure" (ie. below the changes predicted by the operating model (OM)) or CPUE changes that are notably outside the bounds of OM.

The discussion, as reflected in the MP workshop report, recognised that:

- the role and nature of metarules is a component of the management procedure process
- the establishment, review and implementation of metarules and/or safe guards should be seen as an element of the SAG/SC/Commission review process supporting the Management Procedure (MP)
- the implementation of a metarule would occur only in exceptional circumstances
- it was more important to have a clearly defined process for deciding whether the exceptional circumstances applied or not, and a response/action or process for arriving at an action, within a time frame, than to attempt to define the details of all possible exceptional circumstances and responses in advance

The Workshop therefore recommended a hierarchy of reviews to support the Management Procedure and set this within a decision tree framework (**Attachment 5 of the report, Figure 1 below**). Figure 1 outlines three levels of reviews:

• Annual reviews of stock indicators ("is there evidence of exceptional circumstances?")
• Every 3 years review in depth stock assessments ("are assessment results outside MP bounds?")
• Every 9 years review Management procedure (ie every 3rd stock assessment cycle) ("have we learned enough to appreciably improve the performance of the MP, or to warrant a change in the management objective?")

The idea is that the reviews (by the SAG/SC) would determine whether there is "evidence of exceptional circumstances" or whether "assessment results are outside MP bounds", or whether "we have learned enough" to warrant changes to the MP. If any of the reviews listed above generate a positive ("yes") response, a so-called "exceptional circumstances review" is triggered (see Figure 1). This would also be part of the SAG/SC process and would lead to advice to the Commission as to whether there is a need for an immediate action on the TAC, i.e. whether the TAC generated by the MP should or should not be implemented.

Further Discussion

After further consideration of Figure 1, we are concerned that two issues have been somewhat confounded in that framework: one is the process of regular/orderly revision of the MP based on updated data/analysis etc., and the other is the process for dealing with "true" meta-rule situations, in other words, with exceptional circumstances. It has already been recognised by the MP workshop (bullet point 3 above) that a metarule should only be invoked in exceptional circumstances. In this sense, metarules should be confined to situations in which the SC recommends that it would be inadvisable or too risky to set the TAC at the level specified by the MP so that IMMEDIATE action is required. If TACs are not set annually, this could occur in a year when a TAC change is expected, or a year within a block of TACs when no change is expected We consider it important to retain the distinction between 'exceptional circumstances' which would invoke a metarule and some form of immediate action, and the regular revision of the MP which would NOT invoke a metarule/immediate action. The revision of the MP should happen while the 'current' MP is still being used and there should be no need to intervene due to the revision. It is, of course true that a metarule situation could, in theory, trigger a revision, but we consider that there should be a clear distinction between the two processes: "exceptional circumstances" and "regular revision". Figures 2 and 3 are a slight modification of Figure 1, with the aim of clarify this distinction, presented as flowcharts of the two processes.

Metarules for exceptional circumstances

In addition to having a defined process for deciding whether 'exceptional circumstances' apply or not, some principles should apply in terms of the required action. If the risk of setting the TAC on the basis of the MP is in terms of the stock, then the following principles might be considered: (a) the calculation should be performed to determine what the TAC would be if the MP was followed (this would already be known if it is in a year within a 'block' of TACs), and this would serve as an upper bound for what

the TAC should be set at; (b) the SC would attempt to judge the severity of the exceptional circumstances and would recommend a percentage reduction below that of the MP-derived TAC mentioned in (a). Since metarules are meant be "special" measures, and not mechanisms for tinkering with the TAC, it would be reasonable to specify some minimum percentage reduction, for example at least 25%.

It is debatable whether there is a similar need for metarules that would lead to immediate action to increase a TAC above the MP-derived TAC. There are several reasons why such metarules may not be appropriate. First, in the light of the emphasis placed on stability in catch (through limits on the magnitude of increases and through multi-year TACs) and on the need for announcing/setting the TAC in advance to allow for forward planning, it seems inappropriate to consider metarules which increase the TAC by a substantial amount as a sudden or immediate action. Second, increases in the stock which might warrant an increase in TAC should be reflected in the next MP-derived TAC due to the feedback nature of the MP. Given the life-span of SBT, such increases are highly unlikely to "lost opportunities" if not immediately taken as catch.

2.2 Dealing with missing or incomplete data

CCSBT-MP/0404/05 considered several categories of issues or events which could invoke a metarule, and one of these was: 'no data or circumstances which lead to an inability to calculate a TAC from the MP'. This is not well covered by the framework shown in Figure 1.

We consider that there are some aspects which could be treated as implementation issues and others which require a little more thought, but which may have to be treated as metarule issues. For example, "no data" could be consider as an implementation issue and can, in principle, be dealt with as such. The decision rule itself could be specified so that it can cope with missing data (in the sense that the software still runs) and appropriately deals with the increased uncertainty due to missing data. For example, if the data in year "y" are not available, the TAC based on data up to year "y-1" could be calculated and then reduced by a predefined "penalty" (or whatever one might choose to call it) to reflect the increased uncertainty due to the missing data. This is given as an example rather than being the main point of the discussion, because ideally, the fully defined rule should be tested under scenarios with missing data and its performance evaluated. It can obviously become rather 'messy' to fully specify the working of a rule under different scenarios of missing data, particularly for rules which use short time-series of data (e.g. last 5 year's), and/or where multiple years of data and data type are missing. We consider that there are, however, many advantages in attempting to treat this as an implementation issue and to fully predefine what happens when data (used in the decision rule) are missing. First, the circumstances when it applies would be fully pre-define and the process for generating a TAC would be fully pre-defined. This would minimise the chances of a situation where a metarule leading to immediate action would be invoked. Section 3 below contains further discussion about implementation issues.

Examples which require a little more thought include: incomplete data (e.g. only some members' catch data, partial CPUE data) or, in the current context, a situation where one or more of the CPUE standardisations fail substantially, so that not all CPUE series are available from which to calculate the median. Would this be "deemed" missing data and treated as such, or would some other solution be more appropriate? There may also be other unforseen circumstances (which are hard to imagine or provide examples of) which could lead to an inability to calculate the TAC. We suggest that most of these issues could be dealt with relatively simply by adding it to the "annual review" process. In other words, part of the annual review would be to "consider whether there are any circumstances that could lead to an inability to calculate the TAC from the MP". Although it is most likely that the MP would not re-calculate annual TACs (but rather 3-year or 5-year blocks of

TACs), it would be prudent to review this annually. This would provide a chance to resolve issues and possibly prevent having to invoke a metarule. This approach would provide a mechanism for potentially minimising situations of "missing data".

3. IMPLEMENTATION ISSUES

3.1 Previous Discussions

Implementation issues were considered under agenda item 6 of the third MP workshop (Report of the 3rd Meeting of the MP Workshop, April 2004). Discussion paper CCSBT-MP/0404/05 to that workshop considered that "implementation issues primarily pertain to the data and other inputs required to run the decision rule, and safeguards to avoid or minimise the chances of failure of the decision rule (DR) code." As reflected in the report, the workshop noted that the integrity and consistency of the data inputs are critical with respect to the implementation of an MP. The workshop recognised that, although mechanisms and types of data verification are largely management issues, the scientific advice about a DR's performance is under the assumption that this issue is appropriately handled. The need for the SAG/SC to develop a specific data implementation plan for the Commissions' consideration was identified and it was suggested that the plan should present information covering:

- Specification of input data requirements for the MP;
- Review of indicators and metarules;
- Data quality assumptions and verification requirements;
- Process for providing the data;
- Administrative framework for implementing the MP;
- Process for dealing with incomplete or inaccurate data. This may include coding processes into the DR;
- Implications of a large mismatch between the TAC recommended by the MP and actual catches; and
- Timeframe issues.

The workshop recognised the substantial amount of work required prior to implementation. Two additional points were made (paragraphs 68, 69 of the report of the 3rd meeting of the MP workshop): 1. The Commission has already adopted administrative procedures for general data exchange and indicator analysis that provide a basis for the development of a specific MP data implementation plan.
2. Members were encouraged to present examples of implementation guidelines to the SAG5/SC9.

3.2 Further Discussion

CCSBT-MP/0404/05 identified 5 headings wrt implementation issues and discussed these in some detail:

1. data related issues
2. implementing the DR code
3. mismatch between TAC and actual Catches
4. making performance measures operational
5. timeframe issues

Here we highlight some additional issues under these headings. At this point it is worth recalling that MP evaluation has, appropriately, concentrated on overall performance, for example, median catch or biomass trajectories and lower and upper percentiles. Although we look at plots of single trajectories ("worms" in the wormplots), the focus is on overall performance of a decision rule.

When it comes to implementation, there will only be one set of inputs, and the output will be a single catch trajectory.

Data related issues

The issue of missing or incomplete data was raised above under metarules, and we considered that some aspects of this could (and possibly should) be treated as implementation issues. It is therefore relevant to consider under what circumstances we would "deem" data to be missing (compared to incomplete) and which types of missing data would be handled in the specification of the rule. We are not suggesting that this be done with respect to all candidate rules, but rather once a rule has been chosen. This issue was also discussed under heading 2 in CCSBT-MP/0404/05.

Implementing the code for the MP rule

As noted in CCSBT-MP/0505/04, MP rules which involve fitting a model to data (e.g. the Fox stock-production model) can run into problems in the fitting phase. In the case of the Fox model which estimates two parameters, we have found that by implementing a grid search for one of the parameters and then optimising with respect to the second, avoids some of the obvious convergence failure problems. In testing we have not used a very fine grid in order to keep the run-time down. In implementation, however, the grid can be specified as finely as one wants.

Other issues which should be considered (even with a grid implementation) include:

- checking the optimisation (e.g. for bimodality in the likelihood surface), probably as part of the review process (e.g. every 9 years)
- incorporating some safeguards (e.g. using different starting values, but this would require an automated, or at least pre-specified, procedure for handling outputs if they are different).
- checking for 'boundary problems', particularly when *r* falls on the lower bound, close to zero
- checking whether the model ventures into parameter space where it estimates negative biomass (generally dealt with by imposing a penalty on the likelihood and should therefore generally be avoided with the grid implementation)

There are likely to be different issues for other types of MP rules. Below we consider the potential for mismatch between the TAC and actual catches. For all rules, it would be important to distinguish when the TAC should be 'used', and when the catch should be 'used'. In the Fox model-based rules for example, it makes more sense to use the actual catches rather than TACs when fitting the model.

Mismatch between TAC and actual Catches

As noted in CCSBT MP/0404/05, the current set of evaluations are all based on the assumption that the catches taken are equal to the TAC set by the MP, and a substantial mismatch between the TAC and actual catches would require the consideration of two issues: (1) whether the MP needs to and/or does properly distinguish between the two (e.g. should the limits on changes in TACs apply to the TAC rather than to the actual catch? and see above) and (2) the fact that a large mismatch between TACs and actual catches would affect the actual performance of the MP compared to its expected performance evaluated via simulations. The first is an implementation issue, whereas the second could form part of the metarule review process.

Making performance measures operational

This heading refers to the notion that the CCSBT is likely to want to be able to assess periodically, whether they are likely to achieve the agreed management objectives, i.e. whether the DR is performing as indicated by the simulation results. This would require the definition of sensible operational performance measure which can be reviewed as part of the metarule review process.

Timeframe issues

The process for review has essentially taken care of most of the timeframe issues that were raised in CCSBT-MP/0404/05. It is, however, worth emphasising again that if frequent changes are made to any aspect of the MP rule, its control parameters or its TAC-output (e.g. via reconditioning, retuning or 'overriding' of the TAC by a metarule), then the actual performance of the MP rule could be very different from what was assessed during simulation evaluations.

4. SUMMARY

Given the above discussion, we still consider that a clearly defined process and/or fewer general metarules are preferable to a large number of very detailed metarules. The agreed process for review on 3 different time-scales, as set out in Figure 1 (Attachment 5 of the Report of the 3rd meeting of the MP Workshop) provides a good starting point for a framework to deal with both exceptional circumstances and regular review. We note, however, that the distinction between 'exceptional circumstances' and the 'orderly review' of the MP is important since the first requires a metarule to be invoked, whereas the second does not. This distinction is not clear in Figure 1, and suggested modifications to clarify this are shown in Figures 2 and 3.

We consider 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.

In terms of reviewing the MP, small changes that make very little difference to outcomes and/or frequent changes to the MP rule should be avoided. This includes frequent re-tuning which could lead to performance quite different from that evaluated in simulations which did not include frequent retuning. The temptation to retune the MP rule whenever new data becomes available should be resisted.

Several implementation issues which require further discussion are identified. It would be particularly important to ensure that an MP rule is unlikely to suffer a 'software' failure and to minimise the chances that it would be unable to calculate a TAC.

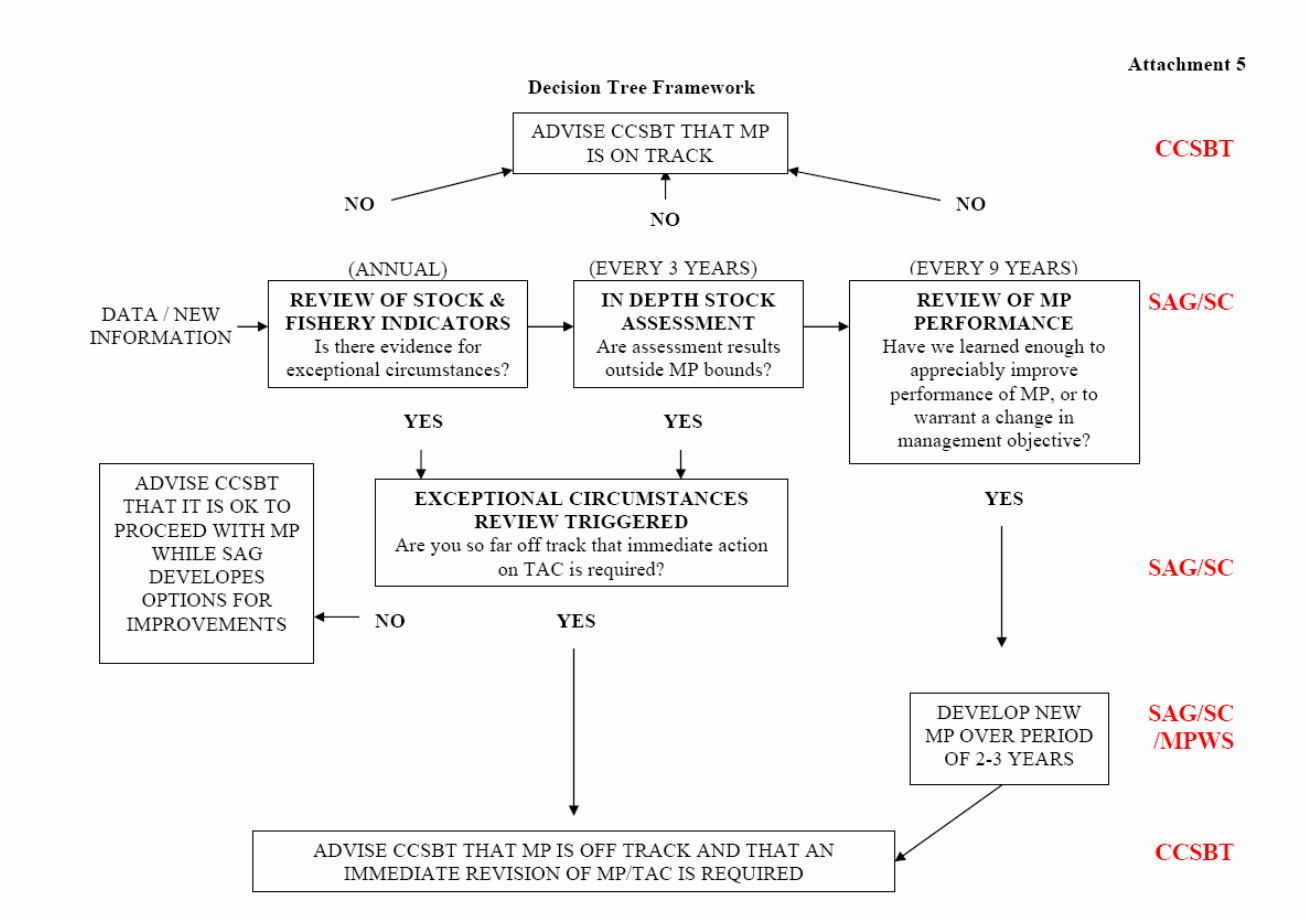

Figure 1. Extract from Attachment 5 of the Report of the Third meeting of the Management Procedure Workshop.

Figure 2: Flowchart for process of 'exceptional circumstances'

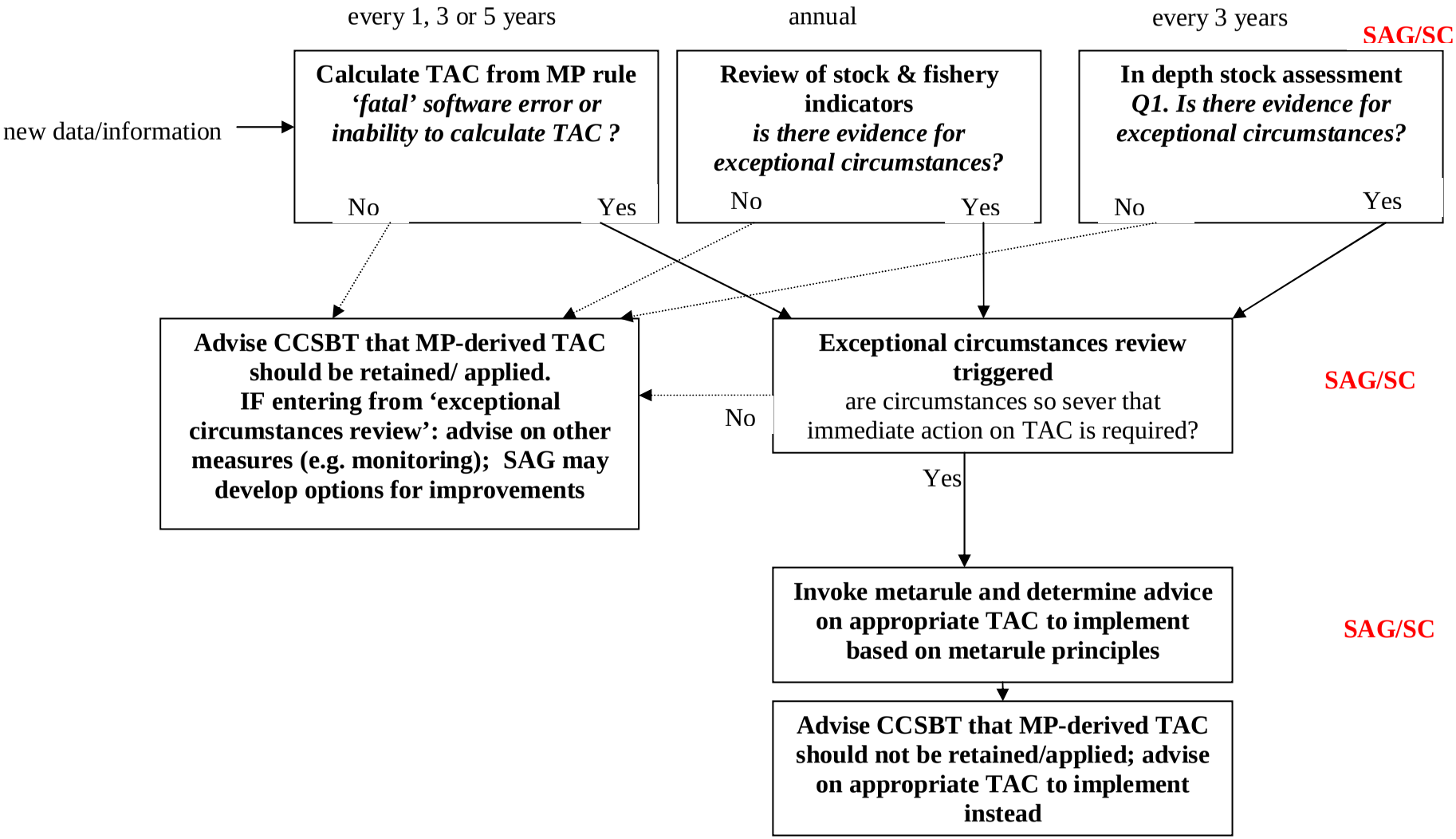

Figure 3: Flowchart for process of 'regular review'