

On the Development of a Roadmap for new formal Harvest Strategies for SIOFA

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ABSTRACT

The Consultants past experience with conducting assessments of and/or providing management advice for SIOFA fish stocks has indicated that a key problem has been the lack of background information on the data available and how they relate to the way the fishery operates. That missing information is a key input to the assessment process, and its ability to provide reliable results. The International Whaling Commission's "harvest strategy roadmap" is reviewed. Their first step for any stock of a "pre-assessment" process to compile the data to be used in the harvest strategy analyses and how they should be interpreted, is suggested to be an essential component of any similar SIOFA roadmap. This process should be put into practice by the appointment, for any stock for which a harvest strategy is to be developed, of a Technical Sub-Committee which would meet separately from the SIOFA Scientific Committee and report back to it. This Sub-Committee would include persons with the relevant expertise about the stock to provide this missing information and to develop ToR's for the basis on which the harvest strategy development should proceed. Overview comments are provided about the process that would then follow. An important decision to be made is whether the harvest strategy for a specific stock is to be based on the "best assessment plus harvest control rule" approach or on Management Strategy Evaluation (MSE). A table is provided summarising the details associated with this "Technical Sub-Committee" pre-assessment component of a harvest strategy development roadmap.

INTRODUCTION

This document is written in fulfilment of the second part (TOR2) of a consultancy with SIOFA to evaluate three provisional harvest strategies and to develop a roadmap for formal harvest strategies (Project Code: SER2021-05). The first part (TOR1, related to provisional harvest strategy evaluation) was addressed in Brandão *et al.* (2022). The key findings were that certain control parameter value choices for any harvest strategy would be likely to need to vary substantially from stock to stock; this would then necessitate stock-specific as well as generic analyses to proceed further with the investigation. Consequently, Brandão *et al.* (2022) concluded that the prospects for developing entirely generic approaches/harvest strategies (able to cover all the major resources in the SIOFA region) did not appear promising at this time, and advised that the coming "roadmap" document (now below) would provide suggestions about how SIOFA might best move forward towards adopting harvest strategies in these circumstances.

This document first summarises the process problems that have been encountered in previous

consultancies to advise on assessment and management options for SIOFA stocks. It then focuses on what is seen to be **the** key component missing from those earlier processes, drawing in particular from what is in effect the harvest strategy “roadmap” for another RFMO¹, the International Whaling Commission (IWC, 2005)². It describes how existing SIOFA processes might be modified to address this omission, and then concludes by explaining how the other issues raised in TOR2 about the development of harvest strategies would then be addressed.

PREVIOUS CONSULTANCY EXPERIENCE AND THE IWC APPROACH

In previous consultancies requesting assessments and/or management of SIOFA fish stocks to be addressed, the analyses to be conducted have generally been left in the hands of the consultants, who have been asked to obtain the data available for the resource in question from the SIOFA Secretariat. Apart from some technical delays that have arisen in the process of obtaining such data, little by way of background information on those data or how they relate to fishery operations has been available. That missing information is an essential input to the assessment process. For example, in the case of the toothfish stock considered in Brandão *et al.* (2022), it rapidly became apparent that the CPUE index available could not be an index of the overall stock abundance as would conventionally be assumed in a stock assessment; these data presumably also reflect the consequences of some complex changing distribution pattern of the fishing effort. Any analysts cannot be expected to be aware of details of this nature, which need to be made known to be able to assess the resource, if reliable results are to be obtained. A “pre-process” is needed to address this omission from the past SIOFA approach, and is illustrated below through reference to the “*Pre-implementation assessment*” component of the IWC’s overall roadmap for harvest strategy development.

The IWC’s “Roadmap”

The IWC’s “roadmap” (IWC, 2005) is reproduced as the Appendix to this document. It is, however, first necessary to explain some of the terminology and the approach in that Appendix so as to avoid confusion and to clarify better how this relates to the SIOFA situation.

- In this “roadmap”, the IWC is dealing with Management Procedures and their revision (Management Strategy Evaluation - MSE), rather than stock assessments *per se*, but the basic steps for all but the end of the process are essentially the same. What the IWC call an “Implementation” is, in SIOFA terms, a harvest strategy (or its revision) for a stock.
- The IWC document is lengthy and complex (indeed the IWC is one of very few RFMOs to have set out such a roadmap in writing). That is because it is a final product after two decades of development. A similar document for SIOFA would be one that evolves over time, and would commence from a much briefer and simpler base.

¹ Strictly the IWC is an International (IFMO), rather than a Regional Fishery Management Organisation (RFMO), but for the purposes under consideration in this document, the two function in an identical fashion, so that for simplicity the abbreviation RFMO is used in the balance of this document when referring to the IWC.

² The IWC is in fact one of the very few of these organisations which has set out a *generic* roadmap for its overall approach to harvest strategies. There might be something to be gained from components of often briefer and more case-specific approaches in those organisations; however, as will become evident from what follows, the argument is made there that what is the most required in SIOFA at this time is the adoption of elements of the initial part of such a roadmap (for which the IWC roadmap gives very pertinent guidance). Hence it is premature at this stage to get into other elements of a roadmap for SIOFA.

- The IWC often use the word “assessment” in a rather broad sense. It can, in addition to a mathematical stock assessment exercise, also refer to the associated evaluation of data inputs and assumptions about those data and stock dynamics that will be incorporated in the final quantitative stock assessment.

In the context of this document, the important component of the IWC’s roadmap, which has been omitted from earlier stock assessment initiatives in SIOFA, is section 1 concerning what the IWC term to be the “*Pre-implementation assessment*” – see the **yellow-highlighted** sections of the Appendix at pages 85-86 and 90.

In a SIOFA context, once the decision has been made to consider harvest strategy development for a particular stock, what this process (which is to precede the quantitative stock assessment and harvest strategy development components of that process) involves is the following.

1) Available data and related information summarisation

This is to include, as may be relevant:

- The manner in which the fishery operates
- The areas in which future fishing operations will take place
- Past catch, abundance and demographic (e.g. catch-at-length distribution) information
- Stock structure and migration patterns

2) Initial evaluation

This has two basic aims:

- To determine whether there is sufficient information available to warrant initiating the development of a harvest strategy for the stock.
- To agree a set of basic hypotheses concerning how the information available is to be interpreted in developing stock assessment models (this may extend beyond single interpretations of components of that information, and include alternatives for which sensitivities will need to be investigated).

Sections 2 and following of the Appendix then go on to detail the components of the IWC’s roadmap that follow the satisfactory completion of the *Pre-implementation assessment*.

INCORPORATING A “PRE-IMPLEMENTATION ASSESSMENT” EQUIVALENT INTO SIOFA’S HARVEST STRATEGY DEVELOPMENT PROCESS

The addition that a *Pre-implementation assessment* equivalent (which in a SIOFA context will henceforth be termed a “*Pre-assessment*”) brings to the SIOFA process is a necessary wider discussion between the decision to consider moving forward with harvest strategy development for a stock, and analysts later commencing the pursuit of the quantitative assessment computations for that stock.

That discussion process needs to include persons with the appropriate expertise in addition to the likely analysts. That expertise relates to how the fishery has and will be operating, together with the available data and how to interpret those data. The SIOFA Scientific Committee will probably not include all such persons, and there will likely not be sufficient time to undertake the process during its annual meetings. Note further that, as per the Appendix relating to the IWC process, completion of this process before the quantitative analysis can start can readily need longer than one year.

Hence the priority would seem to be for the SIOFA Scientific Committee, once it decides to initiate the process of developing a harvest strategy for a stock, to appoint a specific “Technical Sub-Committee” for that stock, drawn both from Scientific Committee members and outside persons with the relevant expertise, to pursue this “Pre-assessment” exercise in meetings separate from the annual Scientific Committee meetings. This Technical Sub-Committee would have a mandate to report back to the Scientific Committee when they consider that that process has been successfully completed to the stage that they would recommend that the quantitative assessment analyses can be initiated by, for example, a consultancy.

THE SPECIFICS OF TOR2

The specifics of TOR2 are reproduced below, with a response in italics after each section.

Note that in many cases, the basic message of this document is that providing many details at this stage would be premature – these should be developed on a case-by-case basis as part of the discussions related to the quantitative component of the harvest strategy development process to follow, during the “Pre-assessment” exercise for each stock.

1) Species

Priority species in the roadmap should be three most important fisheries (orange roughy, splendid alfonsino, and Patagonian toothfish). Timeline needs to be specified by species according to available information in the roadmap.

The analysis and conclusions in Brandão et al. (2022) make clear that although these three fisheries are the highest priorities for harvest strategy development, still much needs to be done before the quantitative component of that process could commence effectively. A priority for the Scientific Committee should therefore be to appoint Technical Sub-Committees for each of these three resources to commence the “Pre-assessment” exercises for each.

(2) Information

The roadmap should be developed according to available information toward the completion of the new formal Harvest Strategies. Such information is catch, abundance indices, results of stock assessments, scoping studies and other relevant information. The roadmap should specify necessary information by species and by timeline to complete the new formal Harvest Strategies (such as Harvest Control Rule, Management Evaluation Strategy, etc.).

As explained above, specification of the basic data and associated information is stock specific, and should first be elaborated upon by the Technical Sub-Committee appointed for that stock. Associated timelines will also be stock- and data available-specific. These are best set out by the Technical Sub-Committee concerned, once they have progressed sufficiently with their Pre-assessment exercise for the stock.

(3) Target and limit reference points

SIOFA has not yet adopted formal target and limit reference points, which will be the key information to establish the new formal Harvest Strategies (such as Harvest Control Rule, Management Evaluation Strategy, etc). In the roadmap, the timeline to develop the formal reference points should be specified, so that the roadmap will become more concrete.

The basic response here regarding timelines is as above: that these will be stock- and data available-specific, and are best set out by the Technical Sub-Committee concerned, which should also give broad advice on appropriate target and limit reference points. While values for such reference points might be specified before the quantitative component of the harvest strategy development process commences, it will in many cases be more appropriate to wait until that process is well underway before specifying those values, which could well be case-specific.

(4) New formal Harvest strategies

The roadmap should indicate the basic concept and elements on the new formal harvest strategies (for example, Harvest Control Rule, Management Evaluation Strategy, etc) incorporating following points and include in the timeline.

- Consider the current provisional Harvest Strategies and develop its broader scheme to suit available information by timeline. The new formal Harvest Strategies (for such as Harvest Control Rule, Management Evaluation Strategy, etc) should be the best practice in fisheries management in order to achieve SIOFA's objectives.

Again the associated details will be case-specific, and should be debated in full by the Technical Sub-Committee appointed. That Sub-committee should consider whether or not the timeline of activities need include the earlier specification of a provisional harvest strategy – in that regard, they should be guided by the Commission's advice regarding priorities and deadlines. Note that reaching the stage of a strategy consistent with "the best practice in fisheries management" will be a substantial task, likely requiring five years at least. Realism needs to play an important role in scheduling such initiatives: for example, the IWC Scientific Committee (despite its decades-long history with and substantial expertise in MSE) never allows more than two such development processes to be underway at the same time because of the pressure they place on person-resources.

- Consider sustainability of harvest and effort levels (number of active vessels etc).

These should clearly be factors considered in the harvest strategy development process. They should be included in ToR developed by the Technical Sub-Committee for analyses required for the stock concerned. Note that these ToR will in turn depend on the information available for the stock.

- Consider effectiveness, risks and precautionary principle. The new formal Harvest strategies (such as Harvest Control Rule, Management Evaluation Strategy, etc) should be efficient, well-balanced, and carefully thought-out and may be necessary to consider simpler approaches.

Again, the Technical Sub-Committee should enlarge on these factors in compiling the stock-specific ToR for the analyses required in developing the harvest strategy. This process may result in a range of options from simpler to more complex, with the latter needing a longer period to complete. The Scientific Committee and subsequently the Commission would then need to decide on which option is to be pursued in each case.

- Refer to Harvest Strategies (such as Harvest Control Rule, Management Evaluation Strategy, etc) developed and applied by other demersal international organizations (such as CCAMLR NAFO, NEAFC, SPRFMO, NPFC and SEAFO) and/or demersal fishing nations.

There is great variety of harvest strategies that have been implemented (or are in the process

of being implemented) by the organisations and nations mentioned. The key point on which an early decision will be needed for each stock will be whether to aim for a “best assessment plus harvest control rule approach” or for a full MSE, noting that the latter approach will initially require more time to put in place, but should (by providing an agreed automated rule) save time in the longer term. (Note also that the MSE option has now become more pertinent to RFMO’s, given the Marine Stewardship Council’s recent move to revise their rules to preclude (further) certification of an RFMO regulated fishery after at most 10 years, unless that fishery is managed using MSE.) Once the choice between these two approaches is made for a stock, the Technical Sub-Committee should give advice on further details regarding which variant within that approach should be pursued (e.g., for the best assessment approach, whether a production or age-structured assessment model is to be used) – here once again the data available will be a major factor in such a determination.

- Consider the enhanced cooperation between scientists and managers when the new formal Harvest Strategies (such as Harvest Control Rule, Management Evaluation Strategy, etc.) are developed.

Managers should be amongst those included in at least the initial meetings of the Technical Sub-Committee, so that their inputs and concerns are factored into the ToR developed for the subsequent quantitative analyses conducted in pursuit of finalizing the harvest strategy for a stock. The MSE process is specifically structured to be able to incorporate feedback at appropriate times from managers and other stakeholders, especially as regards desired trade-offs between conflicting performance objectives for a harvest strategy (e.g., the trade-off between larger catches and less risk of unintended depletion of the resource to a level at which future productivity will be substantially reduced).

RECOMMENDATIONS

The primary recommendation of this document for the SIOFA roadmap on harvest strategy development, centres on the specification of a pre-assessment process involving the appointment of a Technical Sub-Committee to oversee the collection of relevant data and to provide the interpretations of those data that are necessary before the assessment of and harvest strategy development for any stock can proceed. Further details related to this recommendation are set out in Table 1 below.

Since what would then follow for harvest strategy development would be highly dependent on the reports from such Technical Sub-Committees, it would be premature at this time to get into more details about the later stages of a harvest strategy roadmap for SIOFA.

ACKNOWLEDGEMENTS

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REFERENCES

- Brandão, A. Butterworth, D.S. and Johnston, S.J. 2022. Initial results for comparing three approaches to set TACs for the major fisheries in the SIOFA area of the Southern Indian Ocean. Report to SIOFA, January 2022, 31pp.
- International Whaling Commission. 2005. Appendix 2: Requirements and Guidelines for *Implementations*. Report of the Sub-Committee on the Revised Management Procedure. Journal of Cetacean Research and Management 7 (SUPPL.): 84-92.

Table 1: Elements of the initial stage of a recommended harvest strategy roadmap for SIOFA, focussing on the suggested pre-assessment process.

Step 1	The Scientific Committee selects a stock for the potential development of a harvest strategy. Note that at any one time, probably no more than two stocks should be in process towards such development (this in the light of likely resource limitations in terms of “person-power”).
Step 2	The Scientific Committee appoints a Technical Sub-Committee to initiate the harvest strategy development process for that stock through what is termed a “Pre-assessment”. In broad terms, the role of that Sub-Committee is to oversee the compilation of the data to be used in that process and to comment on how they are to be interpreted in developing stock assessment models and the basic hypotheses on which those models are to be based (this may extend beyond single interpretations of components of that information, and include alternatives for which sensitivities will need to be investigated).
Step 3	The Technical Sub-Committee is to comprise of persons with the appropriate expertise to advise on the data available for the stock and how they are to be interpreted. They are to be drawn both from Scientific Committee members and from outside persons with relevant expertise.
Step 4	At the start of the process, the Scientific Committee should appoint likely analysts, but at that stage “preliminarily”, i.e., for participation in the activities of the Technical Sub-Committee only.
Step 5	A primary role of the Technical Sub-Committee is to report back to the Scientific Committee when they consider that the pre-assessment process has been successfully completed to the stage that they would be prepared to recommend to the Scientific Committee that the quantitative assessment analyses by the analysts previously “provisionally” appointed can commence.

Step 6	<p>The Technical Sub-Committee must also advise the Scientific Committee on:</p> <ul style="list-style-type: none"> a) Likely timelines for completion of the harvest strategy development. b) If pertinent, broad indications of likely appropriate values for target and limit reference points. c) ToR for the analysts who will be developing the harvest strategy. d) Whether to aim for a “best assessment plus harvest control rule approach” or for a full MSE harvest strategy, with the addition of further details desirably specified immediately for whichever option is preferred.
Step 7	<p>The Scientific Committee then considers the recommendations/advice provided by the Technical Sub-Committee, and decides whether the harvest strategy development for the stock under consideration is to proceed, together with specifying the ToR for the analysts.</p>

Appendix

Extract from the 2005 Report of the IWC Scientific Committee's Sub-Committee on the Revised Management Procedure, which provides the IWC's "Roadmap" for the development of harvest strategies for whale stocks

Appendix 2

REQUIREMENTS AND GUIDELINES FOR IMPLEMENTATIONS¹

An *Implementation* for a species in a *Region* involves the delineation of *Small Areas* and, where appropriate, *Medium, Large, and Residual Areas*. A selection between possible options for *Catch-cascading* and/or *Catch-capping* is made during an *Implementation*, which includes the designation of *Combination Areas* as may be appropriate.

The overall *Implementation* process (Adjunct 1) involves deciding if there is sufficient information to begin a *pre-implementation assessment*, conducting a *pre-implementation assessment* and then after completing the *pre-implementation assessment*, proceeding to an *Implementation*, which should normally to be conducted over two Annual Meetings and two intersessional workshops. The outcome from an *Implementation* will be recommendations to the Commission regarding variants of the RMP (if there are any given current information) that can be used to set catch limits for the species in the *Region*. In this context, an RMP variant consists of specifications for where and when whaling is to occur (i.e. specifications for *management areas* and for temporal constraints on the whaling operation) and whether, for example, *Catch capping* or *Catch cascading* are to be applied. The recommendation to the Commission will be accompanied by suggestions for research needs. These suggestions may, for example, focus on research needed to eliminate some of the considered hypotheses or to confirm that hypotheses

considered to be of 'low' plausibility², but to which the RMP is not very robust in terms of conservation, are indeed 'low' plausibility. The Committee will prioritise the suggested research activities taking account of feasibility, cost and the likely utility of the results.

The Committee may decide to recommend more than one RMP variant to the Commission. This may take the form of recommending an RMP variant which did not perform 'acceptably'³ for all trials for application for a 10-year period, during which time a research programme, guided and approved by the Committee must be conducted. This 10-year research program would include both data collection and data analysis. An *Implementation Review* at the end of the 10-year period will evaluate the results of the research program. If this evaluation reveals that the research has shown that the trials for which the RMP variant did not perform 'acceptably' should be assigned 'low' weight, future catch limits will be based on this variant. However, if the research did not show that these trials should be assigned 'low' weight, future catch limits will be based on a more conservative RMP variant (see Section 4.1) than that applied over the first 10 years following a 5-year period in which the less conservative variant is phased-out, so that the performance over the 100-year period is still acceptable, i.e. the combination of the two RMP variants will be such that conservation performance over 100 years has acceptable

¹ Throughout this document, the term *Implementation* refers to the process leading to the Committee making a recommendation of catch limits (zero or otherwise) to the Commission, not an implementation by the Commission itself (which has not yet agreed an RMS).

² For ease of presentation, the term 'plausibility' will be used to refer to hypotheses and 'weight' to refer to trials.

³ Section 4.1 of this document provides guidelines for 'acceptable' performance.

risk. If an RMP variant which is linked to required research is adopted by the Commission, a progress report on the research programme must be submitted annually to the Scientific Committee. Failure to implement the research programme to the satisfaction of the Committee will result in catch limits immediately being based on the more conservative RMP variant that would have been put in place following the 10-year period.

In order for it to be possible to apply the RMP variant adopted by the Commission for a species and *Region* it is necessary for the Committee to define the catches, the bycatches and the estimates of abundance (and their variance-covariance matrix) for this species and *Region* (IWC, 1999) as well as future projected anthropogenic removals (IWC, 2001, p. 5). The process of defining these inputs to the *CLA* must occur in parallel with the specification of trials and RMP variants and the selection of a RMP variant. It must be completed by the Second Annual Meeting if it is intended that the *CLA* will be applied after the *Implementation* is complete. It is important that the set of catch histories and abundance estimates considered in trials is sufficiently broad that the catches and abundance estimates used when applying the *CLA* are encapsulated by this set.

1. Pre-implementation assessment

The purpose of a *pre-implementation assessment* is to try to answer specific questions agreed by the Committee to determine whether it is in a position to embark on the *Implementation* process. It is not the same as an in-depth assessment. Its primary objective is to develop a set of plausible stock structure hypotheses that will be specified in terms of an operating model to be used in the *Implementation Simulation Trials (ISTs)*. In addition, abundance estimates and the likely temporal and spatial aspects of intended whaling operations will be considered.

1.1 Information required to initiate a pre-implementation assessment

At the outset, it is the responsibility of a member government or several member governments to propose that a species in a region should become a candidate for consideration for an eventual *Implementation*.

(1) Any IWC Member(s) who seek(s) an RMP *Implementation* shall develop a proposal and submit this to the Committee for consideration at least one meeting before the proposed meeting in which the *pre-implementation assessment* is to begin. This proposal must include a summary of data and related information including:

- (i) operational data;
- (ii) extent of likely whaling operations;
- (iii) abundance; and
- (iv) stock structure and movement.

The proposal must include an overall summary table of this information (Adjunct 2 includes a suggested format and a few hypothetical examples). The proposal need not be limited to this summary table and it is expected that narrative and additional tables would be included in a proposal. The Committee will evaluate the information in terms of:

- (a) whether the abundance and genetics data provide adequate geographic coverage of the entire *Region*

and particularly where abundance surveys and harvest are likely to occur; and

- (b) whether the data are in a suitable form for analysis by the Committee.

It is extremely important that discussions on plausible hypotheses begin at an early stage. Although not required, progress through the *pre-implementation assessment* will be facilitated if the stock structure data have been analysed and the proposal includes an initial suggestion for a set of inclusive stock structure hypotheses for consideration by the Committee. If requested, an e-mail correspondence group of the Committee will be established to provide guidance on this process.

- (2) The Committee will review the summary and, taking account of the advice of an e-mail correspondence group, determine if there is sufficient information to initiate a *pre-implementation assessment*.
- (3) If the Committee determines that there is insufficient information, it will specify additional data/information requirements.
- (4) If the Committee determines that there is sufficient information, the plans for a *pre-implementation assessment* (including data requirements at the appropriate resolution) will be included in its annual Work Plan submitted to the Commission.
- (5) If the Commission approves the Committee's Work Plan, then Procedure A regarding data availability will apply (see IWC, 2004, p.57).

If all the above conditions are met, the Committee will be in a position to begin to carry out the *pre-implementation assessment*.

1.2 Nature of the assessment

The *pre-implementation assessment* will focus on the following issues:

- (1) the establishment of plausible stock hypotheses⁴ consistent with the data (taken *inter alia* from an agreed list of archetypes [to be determined]) that are inclusive enough that it is deemed unlikely that the collection of new data during the *Implementation* process will suggest a major novel hypothesis (e.g. a different number of stocks) not already specified in the basic trial structure⁵;
- (2) examination of available abundance estimates;
- (3) information on the geographical and temporal nature of 'likely' whaling operations - taking into account the complexity of the situation with regard to spatio-temporal issues; and
- (4) information on the geographical and temporal nature of 'likely' future levels of anthropogenic removals other than due to commercial whaling.

During the *pre-implementation assessment*, the Committee may use a 'simple model filter' (e.g. Punt, 2003) to examine the importance of any hypothesised factors in a management context, in order to inform future work and the development of appropriate *Implementation Simulation Trials*.

⁴ At this stage, the hypotheses will only need to be specified in broad detail (hypothesised locations of breeding grounds, feeding grounds, movement corridors, numbers of stocks) - values for parameters related to, for example, dispersal and movement will not be expected at this stage.

⁵ This could be judged by evaluating the power of more (genetic) samples to identify additional stocks in the *Region*.

The *pre-implementation assessment* may take place over several Annual Meetings (although it is possible that it could be completed during a single Annual Meeting). Some iteration may occur as additional research is identified and conducted. Unlike later stages of the *Implementation* process, new data can be introduced during the *pre-implementation assessment* to refine the set of hypotheses.

1.2.1 OUTCOME

On the basis of this assessment, the Committee will make a recommendation as to whether or not to formally begin the *Implementation* process. This decision will be based on whether the following information is available.

(1) Abundance estimates:

- (i) abundance estimates for use in the *CLA* (data meeting the specifications for abundance estimates in the RMP);
- (ii) abundance estimates for use in conditioning *ISTs* (data need to have sufficient temporal and spatial resolution to allow estimates to be developed at the scale of the sub-areas that would be likely to be used in simulation trials);
- (iii) whether and how account is taken of $g(0)$ – e.g. when conditioning the trials/applying the *CLA*; and
- (iv) plans for future surveys (including spatial coverage and frequency).

(2) Catches:

- (i) catch history to be used in the *CLA* in the trials - as complete as possible at this stage (e.g. including incidental catch) and with sufficient spatial resolution for the *management areas* likely to be considered in the *Implementation*; and
- (ii) where appropriate, alternative possible catch histories for use in *ISTs* in cases of uncertainty over catch history including incidental catch.

- (3) An inclusive set of stock structure hypotheses which, it is agreed, cover the plausible range that needs to be tested in the trials.
- (4) Initial discussion of experimental ways to distinguish amongst competing stock hypotheses.
- (5) Any data to be used to estimate dispersal rates among putative stocks within the operating model.
- (6) Any data (e.g. values for biological parameters such as natural mortality and fishery selectivity) intended to be used when conditioning the operating model.

If the Committee does not recommend that the *Implementation* process can begin, it will formulate appropriate research recommendations to try to obtain necessary information. If it recommends favourably, then the *Implementation* timetable begins. The Committee will advise the Commission of the resource implications of starting the *Implementation* process and will indicate any delays that might result due to lack of resources (such as lack of staff/funding for intersessional meetings).

2. First intersessional workshop

The primary objective of the first intersessional workshop is to develop an appropriate *Implementation Simulation Trials* structure and to specify the associated conditioning so that it can be carried out before the following Annual Meeting.

The aim of such trials⁶ is to encompass the range of plausible scenarios involving *inter alia* stock structure, *MSY* rates (*MSYR*), removals and surveys. These trials are used to investigate the implications of various choices of RMP variants such as *Catch-cascading* from a risk- and catch-related perspective, with a view to recommending an appropriate variant for implementation of the RMP for a specific species/area.

Workshop discussions will include the items listed below.

- (1) A final review of the plausible hypotheses arising from the *pre-implementation assessment* (and, if appropriate, elimination of any hypotheses that are inconsistent with the data) – this will take into account the probable management implications of such hypotheses to try to avoid unnecessary work in the precise specifications of hypotheses for which these are very similar.
- (2) An examination of more detailed information in expected operations, including whether coastal, pelagic, on migration, on feeding, on breeding or combinations of these. When providing such information, users and scientists may provide options or suggest modifications to the pattern of operations.
- (3) The determination of the small geographical areas ('sub-areas') that will be used in specifying the stock structure hypotheses and operational pattern.
- (4) The development of (options for) potential *Small Areas*⁷ and management variants.
- (5) The specification of the data and methods for conditioning the trials that will be carried out before the next annual meeting (an e-mail correspondence group will be established to make revisions should any problems arise).
- (6) Further consideration of experimental ways to distinguish amongst competing stock hypotheses.

It is **important** to note that after this stage:

- (1) there shall be no changes to the agreed trials structure that implements the agreed plausible hypotheses; and
- (2) no new data will be considered, although new analyses of existing data may be presented to the First Annual Meeting (see below).

3. First Annual Meeting

The primary purpose of the first Annual Meeting is to review the results of conditioning and to finalise the *ISTs*. It is expected that failure to achieve adequate conditioning will be avoided through revisions to the trials specifications by the e-mail correspondence group. However, if some trials cannot be conditioned, this may or may not influence the relative weights assigned to the trials (e.g. if a specific instance of a stock structure hypothesis cannot be conditioned adequately, this does not imply that the stock structure hypothesis concerned is implausible).

This review may include new analyses of data available up to the time of the previous workshop but new data may **not** be introduced at this stage. After reviewing the results of the conditioning, the *Trials* themselves may be changed, but the overall structure can **not** be changed.

The primary output will be the detailed specifications of the final *ISTs*. These will be determined on the basis of:

⁶ A trial is the combination of a set of 'hypotheses' (e.g. about stock structure, *MSYR*).

⁷ *Small Areas* cannot be smaller than sub-areas.

- (1) final consideration of the plausibility of the various hypotheses and hence the weight assigned to each of the trials (the overall balance of the *ISTs* will be accounted for when weights are assigned);
- (2) discussion of what data/research may reduce the number of hypotheses and possible time-frames for this research/data collection;
- (3) updates/improvements to standard data sets (i.e. abundance, catches, bycatches) for use by the *CLA* in final trials and when evaluating the plausibility of hypotheses and hence assigning weights to trials (new data would not be used when conditioning the trials); and
- (4) specification of operational features (geographical and temporal) and management variants.

The specification of final trials will:

- (1) include trials to examine effects of using one RMP variant over an initial period (up to 10 years) followed, after a 5-year phase-out period, by a more conservative variant (see discussion below);
- (2) exclude potential 'low' weight trials (e.g. those where at least one factor is considered to have 'low' plausibility); and
- (3) assign weights to the remaining trials of 'high', 'medium', or 'no agreement'⁸.

A timetable for the remaining work (including circulation of trial results and format) will be developed – the timetable will be determined so that there is a reasonable expectation that the results of the trials will be available well before the second intersessional workshop.

The Committee will also commence discussions related to defining the inputs for actual application of the *CLA* (catches, bycatches, estimates of abundance and projected future anthropogenic removals).

4. Second intersessional workshop

The primary objective of this workshop is to review the results of the final trials and develop recommendations for consideration by the full Committee on:

- (1) management areas;
- (2) RMP variants (e.g. Catch-cascading, Catch-capping);
- (3) associated operational constraints (e.g. temporal restrictions);
- (4) suggestions for future research (either within or outside whaling operations) to narrow the range of plausible hypotheses/eliminate some hypotheses; and
- (5) 'less conservative' variant(s) with their associated required research programs and associated duration.

Discussions regarding the inputs to the actual application of the *CLA* will continue.

4.1 Guidelines for the review of *ISTs*

It is to be hoped that the attention to the development of final *ISTs* will have ensured that the number of trials is minimised. In order to extract the most information out of the results of the *ISTs*, conservation performance should be examined for each RMP variant and trial. The set of decision rules listed below is semi-automatic. It is not, however, fully automatic because some 'human integration'

of results will be necessary, particularly in order to inform decisions about whether future research is needed. During review of the results, discussions will continue on the development of a research programme to try to distinguish amongst hypotheses, for final recommendation at the Second Annual Meeting.

The steps involved in reviewing the *ISTs* (see Fig. 1 for a flowchart of the overall process) will be as follows. Adjunct 3 applies each of these steps to an illustrative example.

- (1) The conservation performance (given the highest priority by the Commission) for each trial and variant will be examined using predetermined guidelines (e.g. those in Table 1), and each combination of variant and trial will be classified as either 'acceptable', 'borderline' or 'unacceptable' (box 1 of Fig. 1). This will result in the initial ranking of the variants. Note that this classification step only considers trials weighted as 'high', 'medium' or 'no agreement' because the 'low' weight trials were excluded during the First Annual Meeting⁹. The exact numerical specifications for the thresholds used when defining 'acceptable' and 'borderline' will be based on the values for relevant performance measures for the single stock trials. Specifically, the values for 'acceptable' performance are based on the results for the D1 and R1 base-case trials for the 0.72 tuning of the *CLA*, while those for 'borderline' performance are based on the results for these trials for the 0.60 tuning of the *CLA*¹⁰. The results for the D1 trial will be used to specify the thresholds related to final depletion while those for the R1 trial will be used to specify the thresholds related to the minimum ratio of the population size with catches compared to that with only incidental catches.
- (2) Variants that are classified as 'acceptable' for *all* trials can be recommended to the Commission without any additional research (although there may be some suggestions related to future research) (see box '2' on Fig. 1).
- (3) Variants that are classified as 'unacceptable' for any 'high' weight trials are unacceptable and will be eliminated¹¹ from consideration at this stage (see box '3' on Fig. 1).
- (4) The detailed performance of the variants which performed acceptably for most (taking the balance of the trials into account) of the trials but 'borderline' for a small number of the 'medium' weighted trials will be examined. If performance on the conservative-related performance statistics for these trials is close to 'acceptable' (e.g. lower z %-ile of final depletion $\sim \chi K$)

⁹ Some 'low' weight trials may be run to confirm which of these trials have a large impact on the performance of the RMP. The results of these trials will not, however, be used to select an RMP variant to select to the Commission but may play a role in the development of suggestions for future research.

¹⁰ The Committee implicitly agreed that tunings from 0.60 to 0.72 for the D1 base-case trial were acceptable for the single stock *CLA* by providing the Commission with this range of alternatives. The Commission chose 0.72.

¹¹ Note that although a variant may be classified as unacceptable, this does not preclude a member government from conducting research which could show that the trial on which performance was unacceptable should have been a 'low' weight trial. Information from such research will be evaluated during the regular *Implementation Reviews*. If the results of research show that some trials initially assigned 'high' weight are actually quite unlikely (and deserve 'low' weight), this could result in reconsideration of previously rejected RMP variants.

⁸ 'No agreement' trials are trials for which a reasonable case is made that the weight should be 'high' although this is in disagreement. Trials for which there is disagreement on whether a trial is 'medium' or 'low' would normally be treated as 'medium' in the process of reviewing trial results.

Table 1
Categories of conservation performance.

Acceptable	Borderline	Unacceptable
Either: lower $v\%$ -ile of final depletion $>\alpha K$; and/or the lower $x\%$ -ile of the minimum over each of the 100 years of the ratio of the population size to that in the same scenario but there are only incidental catches, remains $>\gamma$ (Fig. 2).	Either: lower $w\%$ -ile of final depletion $>\beta K$; and/or the lower $y\%$ -ile of the minimum over each of the 100 years of the ratio of the population size to that in the same scenario but there are only incidental catches, remains $>\delta$.	Anything that cannot be classified as 'acceptable' or 'borderline'.

these variants could be judged 'acceptable' by the Committee and could be recommended to the Commission without a required research program (see the two box 4's in Fig. 1). If this performance is not close to 'acceptable', these variants are considered further as described in step (5).

- (5) The performance statistics for the variants for which no decision has yet been made (i.e. they are neither 'acceptable' nor 'unacceptable') are evaluated to determine whether these variants fall into one of three categories: 'rejected/unacceptable', 'acceptable', and 'possibly acceptable with required research'¹².
 - (a) The values of the catch-related performance measures for these variants will be examined and

compared with those for the variants which are acceptable (box 5 of Fig. 1). In addition to the usual statistics: i.e. median, 5th and 95th percentiles for 'Total Catch', 'Catch by *Small Area, Medium Area*' and 'Average Catch over the last 10 years of the 100-year Management Period', the Committee might wish to consider catch statistics for an initial period of management (say 20 years).

- (b) The IWC Member(s) who made the proposal will be requested to state¹³ whether, based on the comparison of the catch-related performance measures, they remain interested in the remaining variants given that application of these variants will require that a research programme guided and

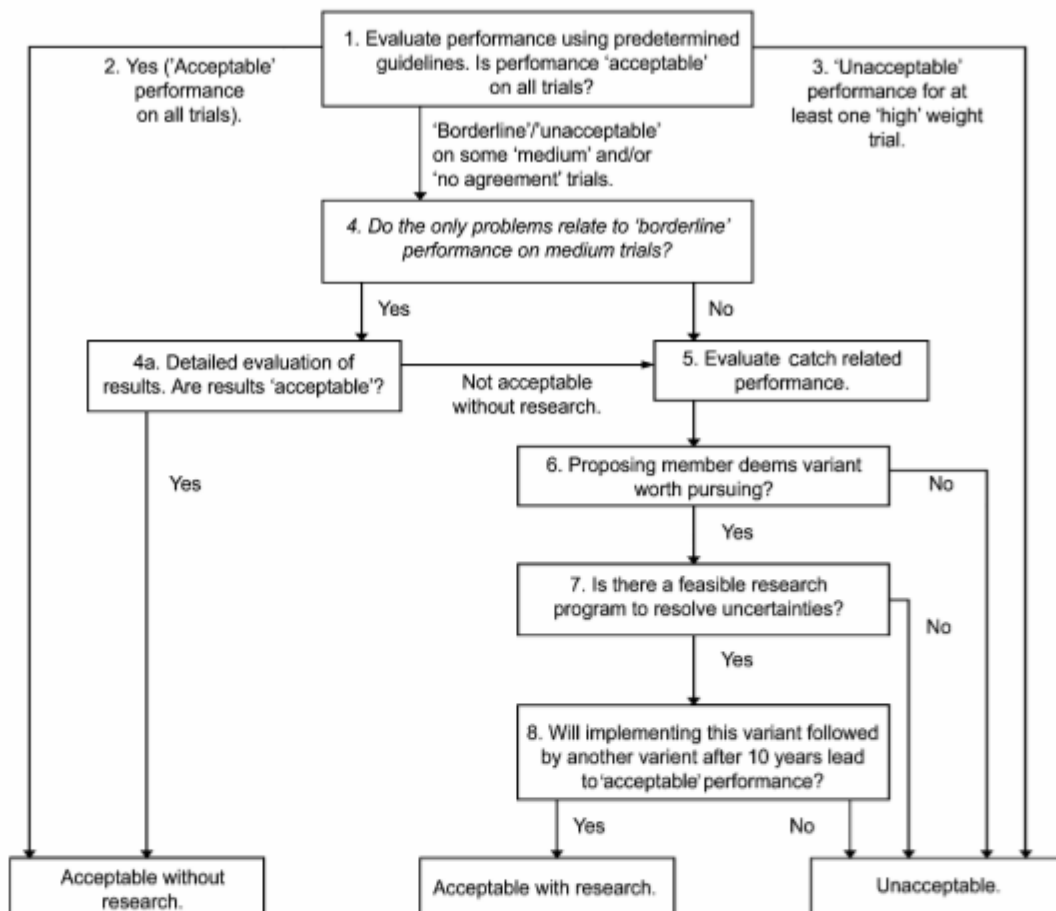


Fig. 1. Flowchart.

¹² Note that only variants which achieved 'borderline' performance on 'high', 'medium' or 'no agreement' weighted trials or 'unacceptable' performance on 'medium' or 'no agreement' trials will be considered at this stage because any variants which achieved 'unacceptable' performance for a 'high' weight trial will already be rejected (see step 3).

¹³ Via their Scientific Committee representative.

approved by the Committee be implemented (box 6 of Fig. 1). Only variants in which interest has been expressed will be retained.

- (c) For each of the remaining variants, the Committee will then decide whether a research programme can be developed that provides information that can be used to assess whether the combination of factors on which the trials for which these variants perform poorly should have been 'low' rather than 'medium' or 'high' weight (box 7 of Fig. 1). The aspects considered during such an evaluation will include:
- (i) feasibility of addressing the uncertainties concerned over a 10-year period;
 - (ii) the number and nature of trials for which the variants did not perform 'acceptably'¹⁴; and
 - (iii) the extent to which the variant failed to perform 'acceptably'.
- (d) If the Committee decides that it is feasible to design a research programme for any of the variants, it will establish additional trials to examine conservation performance, assuming management is based on these variants for 10 years after which management will revert, via a five-year phase-out process, to being based on one of the acceptable variants¹⁵. The results of these trials will be considered at the Second Annual Meeting.

5. Second Annual Meeting

The primary purpose of this meeting is to review the results of the Second Intersessional Workshop (including any additional trials) and agree recommendations for implementation including the specifications of the inputs to the *CLA*.

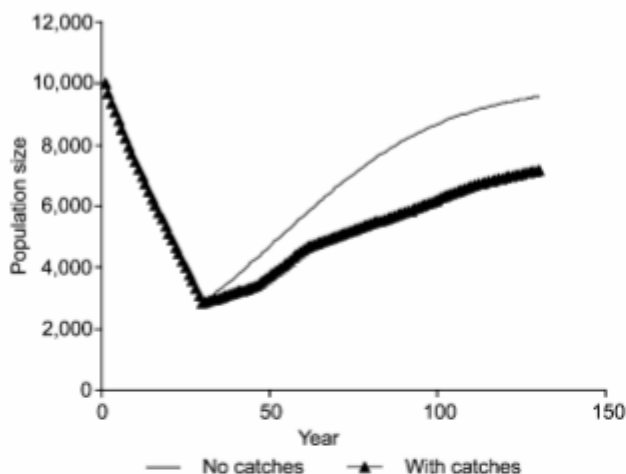


Fig. 2a. Two example population size trajectories. The population is initially depleted to 3,000 animals. The solid line corresponds to a no-catch scenario and the triangles to a scenario in which there are catches.

¹⁴ A large number of trials need not lead to immediate rejection of the possibility of a research program if all the trials concerned involve a small number of uncertainties which lead to poor performance.

¹⁵ This is to simulate a situation where the recommended research programme does not yield results that show the initial variant to be acceptable (i.e. that the trials for which it was not robust had 'low' weight). Note that the 'acceptable' variant might involve zero catches.

If the Second Workshop had recommended additional trials, these will be reviewed at the Second Annual Meeting. Particular attention will be given to the conservation performance of those trials where a 'less conservative' RMP variant is assumed for the first 10 years, followed by a phase-out period, after which catches are set by a 'more conservative' variant¹⁶. If conservation performance for these trials satisfies the requirements of adequate performance, that variant [or variants] will be presented as acceptable in association with a research programme agreed by the Committee. The associated research programme will be formulated such that it identifies expected progress in a manner that will allow the Committee to review annually whether the programme is being adequately followed.

When presenting such variants, it will be explicit that:

- (1) if at any time the research programme associated with the RMP variant has not progressed to the satisfaction of the Committee, the Committee will recommend that catch limits immediately be based on the 'more conservative' RMP variant; and
- (2) the option to choose a 'less conservative variant + research programme' can only be invoked once.

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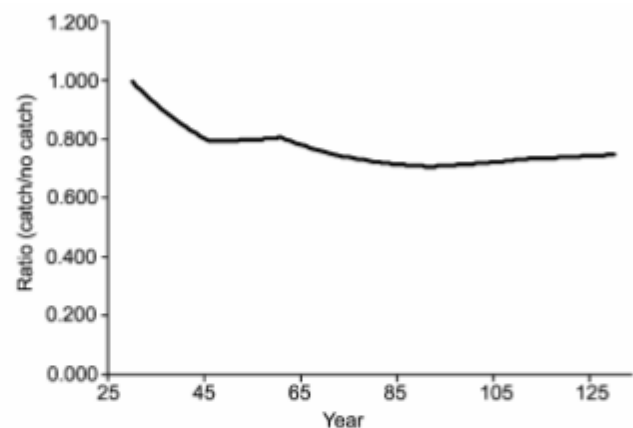


Fig. 2b. The time-trajectory of the ratio of the population size with catch to that without catch. 'Acceptable' performance corresponds to this ratio remaining above γ for the duration of the 100-year period while 'borderline' performance corresponds to this ratio remaining about δ for the duration of the 100-year period.

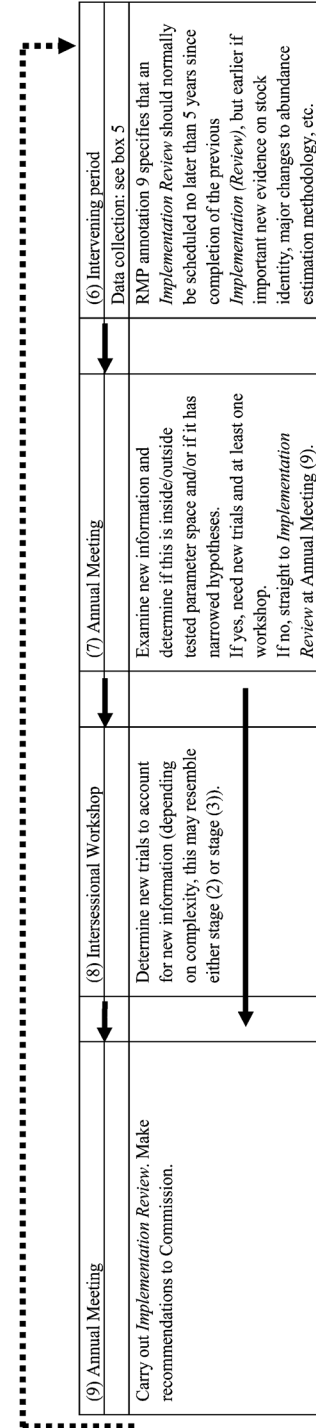
¹⁶ This variant is one those which is acceptable without a required research program and which, when tested in combination with the 'less conservative' RMP variant, was found to achieve 'acceptable' performance for all trials. This variant need not be the variant among those that are 'acceptable' without a research program that leads to the highest catches.

Adjunct 1

Recommended schedule for an *Implementation* and subsequent *Implementation Reviews*

Fig. 2. Recommended schedule for an *Implementation* and subsequent *Implementation Reviews*.

(1) x+ Annual Meetings <i>'Pre-implementation assessment'</i>	(2) First Interseasonal Workshop Trial structure development	(3) First Annual Meeting Conditioning and final trial structure	(4) Second Interseasonal Workshop Review results of final trials	(5) Second Annual Meeting Committee recommendations
<p>The <i>pre-implementation assessment</i> will take place during one or more Annual Meetings and will focus on the following issues:</p> <ul style="list-style-type: none"> (1) the establishment of plausible stock hypotheses consistent with the data (taken <i>inter alia</i> from an agreed list of archetypes) that are inclusive enough that it is deemed unlikely that the collection of new data during the <i>Implementation</i> process would suggest a major novel hypothesis (e.g. a different number of stocks) not already specified in the basic trial structure; (2) examination of available abundance estimates; and (3) information on the geographical and temporal nature of 'likely' whaling operations - taking into account the complexity of the situation with regard to spatio-temporal issues. <p>On the basis of this assessment, the Committee will make a recommendation as to whether or not to formally begin the <i>Implementation</i> process.</p>	<p>The primary objective is to develop an appropriate <i>Implementation Simulation Trials</i> structure and to specify the associated conditioning so that it can be carried out before the First Annual Meeting. Workshop discussions will include:</p> <ul style="list-style-type: none"> (1) A final review of the plausible hypotheses taking into account the probable management implications to avoid unnecessary work; (2) An examination of more detailed information on expected operations; (3) The determination of the small geographical areas that will be used in specifying the stock structure hypotheses and operational pattern; (4) The development of (options for) potential <i>Small Areas</i> and management variants; (5) The specification of the data and methods for conditioning the trials; (6) Further consideration of experimental ways to distinguish amongst competing stock hypotheses. <p>It is important to note that after this stage:</p> <ul style="list-style-type: none"> (1) there shall be no changes to the agreed trials structure that implements the agreed plausible hypotheses; (2) no new data will be considered. 	<p>The primary objective is to review the results of conditioning and to finalise the <i>IS/T's</i>. This review may include new analyses of data but not new data. The <i>Trials</i> may be changed but not the overall structure. Final <i>IS/T's</i> based on:</p> <ul style="list-style-type: none"> (1) final consideration of plausibility, including weighting trials in terms of the overall balance of the <i>IS/T's</i>; (2) discussion of what data/research may reduce number of hypotheses; (3) updates to standard data sets (i.e. abundance, catches, bycatches) for use in final trials; (4) specification of operational features and management variants; (5) specification and classification of final trials; (6) develop timetable for remaining work 	<p>The primary objective is to review the results of the final trials and develop recommendations for consideration by the full Committee on:</p> <ul style="list-style-type: none"> (1) management areas; (2) RMP variants (e.g. <i>Catch-cascading, Catch-capping</i>); (3) associated operational constraints (e.g. temporal restrictions); (4) research needs (either within or outside operations) to narrow range of plausible hypotheses; (5) use of 'a less conservative' variant with appropriate research and associated time period. 	<p>The primary objective is to review the results of the Second Interseasonal Workshop (including any additional trials) and agree recommendations for <i>Implementation</i>.</p> <ul style="list-style-type: none"> 'less conservative' option, integral to this will be an agreed research programme guided and approved by the Committee. A progress report on this programme must be submitted annually to the Scientific Committee.



Adjunct 2

Example summary table for proposals for pre-implementation assessment with a few hypothetical illustrations

Item	Details	Raw format	Where held	Analytical methods	Key papers	Comments
Operational data						
Catch history	E.g. Nation, operation, date, length, sex, other	E.g. Electronic	IWC	-	E.g. Wright-Phillips, 20??; Anelka, 20??	Being updated
Effort data	E.g. Simple (e.g. CDW), time budget	E.g. Paper	National lab	-	IWC, 19??	-
Abundance						
Shipboard	E.g. Dates, tracks, what recorded, methodology	E.g. Electronic suitable for Distance	IWC-DESS	E.g. Line-transect, no g(0) correction	-	Already accepted by SC
Aerial	E.g. As for shipboard	E.g. Electronic suitable for Distance	IWC-DESS	E.g. Cue-counting	-	-
Stock structure and dispersal rates						
Genetic	E.g. n, allozyme, microsatellite, etc.	See Section 9.1	-	E.g. Hypothesis testing, boundary rank, dispersal rates	-	-
Morphometric	E.g. What measured, n, positions, sex, etc.	-	-	E.g. PCA	-	-
Discovery marks	E.g. Releases, recoveries (dates, positions, effort etc.)	See Table 99.99	-	E.g. Simple plots, Effort based probabilities	-	-
Telemetry	E.g. n, tracks, dive times etc.	-	-	E.g. Simple plots, input to aerial survey analysis	-	-
Biological parameters	E.g. Reproductive data (foetal, dates, positions, n etc.)	-	-	-	-	-
Ecological	E.g. Pollutant, parasites	-	-	-	-	-

Adjunct 3

An illustrative example of reviewing the results of a set of ISTs

The decision rules outlined in Fig. 1 and Section 4.1 are applied to the illustrative example in Table 1. In this example, there are six RMP variants and 11 trials (four of which have 'high' weight, five 'medium' weight and there was no agreement on the weight for the last two trials).

Table 1
Conservation performance by management variant and trial.

Trial	Weight	Variant						Trial	Weight	Variant					
		1	2	3	4	5	6			1	2	3	4	5	6
1	High	A	A	A	U	A	A	7	Medium	U	A	A	A	B	A
2	High	A	A	A	B	B	A	8	Medium	A	A	A	U	A	B
3	High	A	A	A	B	A	A	9	Medium	B	A	A	U	A	B
4	High	A	A	A	B	A	A	10	No agreement	B	A	A	U	U	A
5	Medium	A	A	B	U	A	A	11	No agreement	A	A	A	A	A	A
6	Medium	A	A	A	B	A	A								

Results: A=acceptable, B=borderline, U=unacceptable.

The initial ranking of the variants in Table 1 (see boxes 1, 2 and 3 of Fig. 1) suggests that only variant 2 is acceptable without additional research because it is the only variant that achieved 'acceptable' performance for all of the trials. One possible outcome at this point is that variant 2 could be recommended to the Commission. This recommendation would not involve any required research (although there may be some suggestions for research). This initial ranking would also result in rejection of variant 4 as unacceptable because it performs unacceptably on Trial 1 (which has 'high' weight). A summary of the situation at this point is:

Variant	1	2	3	4	5	6
Status	No decision yet	Acceptable	No decision yet	Unacceptable	No decision yet	No decision yet

The performance of the remaining variants (1, 3, 5 and 6) in Table 1 for each trial would now be examined in detail (step 4 in Section 4.1). Variant 3 performed acceptably for all of the trials except trial 5 where its performance was 'borderline'. The detailed results for this trial would be examined by the Committee. Assuming that variant 3 was judged acceptable following detailed examination of the performance statistics because its results are close to 'acceptable', variant 3 would be deemed acceptable. The summary of the status of the various variants becomes:

Variant	1	2	3	4	5	6
Status	No decision yet	<u>Acceptable</u>	<u>Acceptable</u>	<u>Unacceptable</u>	No decision yet	No decision yet

The decision rule has now reached the point at which decisions need to be made regarding whether any of the remaining variants (i.e. variants 1, 5 and 6 in the example) are acceptable if they are accompanied by required research (step 5 in Section 4.1). The catch-related performance statistics would now be examined and the IWC Member(s) who made the proposal for *Implementation* would be requested to state whether they remain interested in variants 1, 5 and 6. Let us assume that the Member(s) proposing *Implementation* decide that variant 6 does not provide sufficient additional catch to warrant the cost of the large research program that would be needed to show that the factors that underlie trials 8 and 9 are 'low' weight. The summary table now becomes:

Variant	1	2	3	4	5	6
Status	No decision yet	<u>Acceptable</u>	<u>Acceptable</u>	<u>Unacceptable</u>	No decision yet	<u>Not worth pursuing</u>

The Committee would then decide for each of the remaining variants (1 and 5) whether a research program could be developed that provides information that could be used to assess whether that the combination of factors on which the trials for which variants 1 and 5 performed poorly (trials 7, 9 and 10 for variant 1 and trials 2, 7 and 10 for variant 5) should have been 'low' rather than 'medium' or 'high' weight (box 7 of Fig. 1). A possible outcome of this is that there is no feasible 10-year research program to revise the weight for trial 9 (which say involves a low value for *MSYR*) so variant 1 (which achieved 'borderline' performance for trial 9) would be omitted from consideration. The summary table is now:

Variant	1	2	3	4	5	6
Status	<u>No feasible research</u>	<u>Acceptable</u>	<u>Acceptable</u>	<u>Unacceptable</u>	No decision yet	<u>Not worth pursuing</u>

The Committee would then establish additional trials to examine conservation performance if management was based on variant 5 for 10 years (box 8 of Fig. 1). These trials would involve using variant 5 for ten years followed by one of the acceptable variants. In the case under consideration, there would be two ways to running these trials: i) variant 5 followed by variant 3, and ii) variant 5 followed by variant 2. These calculations would be conducted assuming that the catch limits for years 1-10 are calculated using variant 5, the catch limits for years 11-15 are calculated using a weighted average of those from variant 5 and one of variants 2 or 3 (where the weight changes from 1 in year 10 to 0 in year 15), and the catch limit for years 15+ are calculated using variants 2 or 3. If these calculations lead to performance measures for all of the trials that would be classified as 'acceptable' (using the classification scheme in Table 1), variant 5 would be judged to be 'acceptable' if accompanied by a research program. The final summary table is then:

Variant	1	2	3	4	5	6
Status	<u>No feasible research</u>	<u>Acceptable</u>	<u>Acceptable</u>	<u>Unacceptable</u>	<u>Acceptable with required research</u>	<u>Not worth pursuing</u>
