

FIRST MEETING OF THE STANDING WORKING GROUP TO ENHANCE DIALOGUE BETWEEN FISHERIES SCIENTISTS AND MANAGERS (SWGSM)

(Barcelona, Spain, 26-28 May 2014)

1. Opening of the meeting

The Chair of the Standing Working Group (SWGSM), Dr. Martin Tsamenyi (Ghana), opened the meeting and welcomed all participants.

At the invitation of the SWGSM Chairman, the Commission Chairman, Mr. Stefaan Depypere (EU), took the floor to remind the SWGSM of the basic objective of this meeting. He referred to the general discussion on ocean governance (especially The Ocean Summit in San Francisco) and the criticism that is made of this RFMO. He emphasized that this criticism is not justified and that ICCAT functions well but it is for us to prove this. He noted that good science-based decision taking is part of our good practice and this is why this Working Group matters so much. He emphasized that reaching a good mutual understanding between scientists and managers is critical and that this is our challenge for the next three days and for the future. He encouraged the SWGSM to take on an open and proactive stance in their conversations. Finally, he stated that this is not a negotiation but a meeting to exchange views and explanations.

The Executive Secretary introduced the following CPCs to the meeting: Algeria, Angola, Brazil, Canada, Côte d'Ivoire, European Union, Ghana, Japan, Morocco, Namibia, Nigeria, Sao Tomé and Príncipe, Senegal, Tunisia, Turkey, United States Uruguay. In addition, Chinese Taipei attended as a Cooperating non-Contracting Party, Entity, or Fishing Entity. The following intergovernmental and non-governmental organizations also attended the meeting: Indian Ocean Tuna Commission, International Sustainable Seafood Foundation, Pew Environment Group, and WWF. The list of participants is appended as **Appendix 2**.

2. Adoption of agenda and meeting arrangements

It was proposed that item 5.3 (Possible Suggestions for Improvement) be combined with agenda item 12. The agenda was adopted without further changes and is appended as **Appendix 1**.

3. Nomination of the rapporteur

Dr. Alyson Fleming (US) served as rapporteur for the meeting.

4. Review of the objectives and expected meeting outcomes

The Chair reviewed the charge to the Working Group, as established in Rec. [13-18] and reiterated that the intention of the SWGSM is to improve the dialogue between scientists and managers to foster mutual understanding between these two groups and facilitate more streamlined science-based decision making.

It was agreed that ICCAT would benefit by giving SCRS clearer guidance and information on how the Commission needs could best be served while, at the same time, ensuring SCRS independence in its work in order to provide the best and most rigorous scientific advice possible. There was significant support for efforts to continue to strengthen a spirit of inclusivity, trust, and transparency in the SCRS process and in enhancing the communications between the SCRS and the Commission. Several CPCs identified expectations for the Working Group, many of which are further discussed in subsequent sections.

5. Overview of the ICCAT framework for decision-making, including inter alia, the Convention, Rec. [11-13], and other relevant international instruments

5.1 Current template and content of scientific advice and management recommendations and information on the current use by managers, when establishing management measures, of information provided by the SCRS

Dr. Fabio Hazin provided a presentation on this sub-agenda item. He noted that Rec. [11-13] established basic principles to guide the development of management measures, in accordance to stock status, and that Rec. [11-14] requires the SCRS annual report to provide statements characterizing the robustness of methods applied to the assessment of stock status as well as the main contents and format of the information to be provided to the Commission.

6. Overview of the basic components of precautionary management strategies, including precautionary and ecosystem-based approaches

6.1 Management objectives and timelines associated with rebuilding and the management of stocks under the purview of ICCAT

Ms. Kim Blankenbeker presented on this sub-item of the agenda. She presented a document that categorized the stocks into three major categories: 1) stocks under rebuilding programs, 2) stocks under management plans, including rebuilt stocks, and 3) assessed stocks but no (or no specific) ICCAT management measures in place. She indicated that ICCAT has not always been entirely consistent in what elements are included in recommendations to maintain or rebuild stocks.

The complexity of the science-to-management process was highlighted, and it was noted that management decisions are not always based on scientific advice on stock status alone but are influenced by other factors such as socio-economics. It was suggested that stock management decisions should take a comprehensive view. For instance, management decisions should not only consider TAC levels but also decisions to ensure effective implementation, such as strong monitoring, control, and surveillance requirements. The need for robust data from all fisheries was also stressed to improve the basis for taking management decisions. A concern was raised by some parties that basing management on MSY could be problematic as MSY may change including if the selectivity of the gear changes. Some suggested that, due to potential changes in the MSY level, flexibility on the part of management is critical to ensure the sustainability of the resources. Some parties stressed that MSY should be set as a limit that should not be exceeded. In this regard, particular concern was expressed at the fact that most stock assessments are always done with data that are already at least two years old.

It was suggested that a template of basic or core elements to be included in future management plans could be developed in order to create more cohesiveness and consistency in those recommendations and to clarify the important questions managers need to ask themselves. The importance of retaining some flexibility in the development of those recommendations, however, was stressed.

6.2 Basic concept of Harvest Control Rules, Limit, Threshold and Target Reference points as well as whether the current stock assessment methods in ICCAT can provide enough basis for considering such reference points

Mr. Masanori Miyahara presented on this sub-item of the agenda. He noted that under UNFSA, HCRs are defined as: 1) setting LRP (e.g. F_{MSY} as a minimum standard), 2) setting pre-agreed conservation and management actions, and 3) taking the pre-agreed action when the stock status reaches the LRP. He noted some confusion around the interpretation of LRP especially regarding B_{msy} , i.e. a B-based LRP below which a rebuilding programs should be established and B-based LRP below which severe management actions including suspension of fishing are needed.

Dr. Yukio Takeuchi showed the sensitivity of SSB_{msy} for eastern Atlantic BFT through different recruitment scenarios used in the 2012 stock assessment and also explained the recent move of the IATTC scientific advisory committee in advocating an LRP associated with the point at which the risk of recruitment collapse is high.

6.3 Possible reference points associated with different management objectives; Limit, threshold, and target reference point; probability levels associated with different reference points

Mr. Antonio Cervantes presented on this sub-item of the agenda. He explained that any fisheries management framework needs to be supported by clear management objectives to be expressed by the policy makers through a specific decision-making process. In this context the different scenarios derived from the use of MSY either as a limit or as a target reference point as well as the probability levels that should be associated to them were explained.

6.4 Harvest Control Rules/management procedures that support management action e.g. TACs, effort or capacity limits and other aspects, including data collection and analyses

Dr. Victor Restrepo presented on this sub-item of the agenda. He explained Harvest Control Rules (HCRs) as one of many elements in a harvest strategy, including data collection, setting targets and limits and associated probabilities, and estimating stock status relative to the reference points. He noted that a comprehensive management strategy should consider the type of data collected and used in the assessment, and perhaps even evaluation of the benefit of collecting additional or new data.

Questions were posed regarding the current capacity for correctly estimating MSY-based reference points, especially in data-poor stocks scenarios. It was noted that alternatives or proxies are available and that HCRs allow for considerable flexibility and exploration of the most appropriate reference points. While it was noted that MSY may change over time, these changes in MSY can be detected and measured and, therefore, the reference points can be adjusted accordingly. Rec. [11-13] was highlighted as an excellent foundation that can now be elaborated on by the SWGSM. It was emphasized that managers should provide further guidance on terms that are undefined in Rec. [11-13] such as acceptable time lines and probability levels. Without prejudice to future management decisions, one CPC suggested that the SCRS could run some scenarios that looked at different probability levels of maintaining the stock in the green zone or recovering depleted stocks as called for in Rec. [11-13], such as 70%, 80%, and 90%, as examples to help illustrate the application of HCRs to inform future discussions.

7. Dealing with uncertainty and variability

7.1 Different sources of variability and uncertainties and their subsequent impact on (i) stock status relative to reference points, and (ii) the interpretation of the Kobe Strategy Matrices and general discussion, including input from managers on acceptable probability levels and from scientists on associated risk, for maintaining priority stocks at, or rebuilding them to, target levels

Dr. Gerald Scott presented on this sub-item of the agenda. Noting the underlying management objective in Rec. [11-13] is to maintain or attain the “green zone” of the Kobe chart with “high probability” in a “short time”, Dr. Scott indicated that choices about what is “high probability” and “short time” were areas of decision for the Commission while quantifying and characterizing the uncertainty in stock status and future prospects of the stock is a function of the Scientific Committee.

A number of points were raised during discussion. It was reiterated that Rec. [11-13] is an important underpinning for advancing the Precautionary Approach in fishery management decisions for ICCAT. As gaps in data used in stock assessments for determining status exist and significantly contribute to uncertainty, it was noted that one method to reduce uncertainty was to implement programs for near real-time data collection, especially for stocks undergoing rebuilding.

It has, however, been acknowledged that the uncertainties are inherent to the fisheries management process. Therefore, the dialogue between scientists and fishery managers will be better able to take into account these uncertainties in decision making. A number of CPCs also noted the importance of involving stakeholders in future dialogue on the setting of management objectives and including socio-economic and ecosystem considerations.

8. Framework for the development of Harvest Control Rules (HCRs)

8.1 Consideration of biological, ecological, social, economic and/or other information

Ms. Faith Scattolon presented on this sub-item of the agenda. She presented an overview of Canada's Precautionary Approach Framework, with a focus on the sources of information which managers should consider when developing Harvest Control Rules. Under the framework, HCRs and associated management actions are developed for each zone (i.e. critical, cautious, and healthy) as part of the overall harvest rate strategy. These rules and actions vary in relation to pre-determined target and limit reference points, and are designed to achieve the desired outcome by affecting the removal rate. To demonstrate the complexity of including socio-economic considerations in the development of HCRs, an overview of the Canadian management framework for its domestic Atlantic halibut fishery was presented.

8.2 Possible process for assessing HCRs, particularly in the context of the development of Management Strategy Evaluations (MSE)

Dr. Laurence Kell presented on this sub-item of the agenda. He presented the development of Management Strategy Evaluations (MSE) as a possible process for assessing HCRs. Considering that decisions need to be made in the face of incomplete information, Dr. Kell noted that a precautionary approach requires HCRs to avoid undesirable outcomes. He explained MSE as a simulation modeling tool to evaluate the impact of the main sources of uncertainty on management goals. He outlined the MSE process steps: identify objectives, select hypotheses, build models, identify alternative management strategies, run the simulations using HCRs, and agree on the management strategies that best accomplish goals.

The discussion that followed 8.1 and 8.2 reiterated the benefits of increased dialogue between scientists and managers and a need to consider the current working model of ICCAT and whether improvements could be made regarding interaction and communication within and between the SCRS and the Commission. There was significant interest in the MSE process and capabilities and how the application of MSE within ICCAT would occur on a practical level. It was announced that an interactive, hands-on exploration of MSE by both scientists and managers within ICCAT was planned for the near-future. It was noted that capacity building by each party would serve to create better understanding on the part of scientists to understand what options/parameters managers would want considered in the models and on the part of managers to understand how the scientists were utilizing the models. During the discussion, it was suggested that MSE could be a useful tool for managers when including social and economic considerations in the development of HCRs.

9. Overview of relevant work by SCRS

Dr. Santiago, the SCRS Chair, presented on this item of the agenda. He presented ongoing work by the SCRS addressing development of Harvest Control Rules and Management Strategy Evaluations. Dr. Santiago noted that Rec. [11-13] establishes the guiding principles for adoption of management measures, based on scientific stock status evaluations and likewise considers uncertainties in those evaluations. These guiding principles provide a basis for the design of Harvest Control Rules (HCRs) and the SCRS has recommended development of a generic Harvest Control Rule framework upon which stock-specific robustness testing will be conducted. Work on North Atlantic swordfish, northern Albacore and bluefin tuna is underway and work on skipjack will be initiated during 2014. Dr. Santiago reiterated that progressing this work requires feedback from the Commission, through the type of dialogue initiated by the Working Group, on the concepts of 'high probability' and 'short period' as described in Rec. [11-13].

10. Overview of relevant work by the SCRS Strategic Plan and annual work programme

In response to Rec. [13-18], establishing the Terms of Reference for the Working Group, Dr. Santiago provided information on a draft Strategic Plan on Science for the functioning and orientation of the SCRS from 2015-2020. This draft Plan identifies possible further improvements in ICCAT science and research needs and priorities, and will be further refined at this year's SCRS meeting before being provided to the Commission for consideration in November 2014. The intent of presenting this information was to elicit suggestions for improvement and to gain feedback on how well the draft Plan meets the needs of the Commission.

Summaries of the presentations given under items 5 to 10 are included in **Appendix 3**.

11. Suggestions for further improvements in ICCAT science and management processes and the identification of research needs and priorities

CPCs expressed appreciation for the work of the SCRS and the draft Strategic Plan and provided some suggestions for improving its clarity before it is presented for formal consideration by the Commission. It was noted that understanding the budgetary and workload implications of this draft as well as a better linkage to the conservation objectives of ICCAT would be quite useful in prioritizing the elements identified in the document.

In addition, some noted that for certain areas of research proposed in the draft Strategic Plan it is important to gain feedback from managers and stakeholders. Such feedback could relate to important elements of the Ecosystem Approach for Fisheries Management as well as socio-economic objectives for consideration in incorporating such objectives into Harvest Control Rules. It is understood that there should be a broader participation of stakeholders on these issues. One party noted that CPCs should play a primary role for engaging stakeholders on these matters.

It was noted that management strategy evaluation can be a useful tool in evaluating potential Harvest Control Rules. The Chair of the SCRS reported that the SCRS is refining methods related to MSE processes. It is important that a strong dialogue take place between scientists and managers on the use of MSE in evaluating Harvest Control Rules.

12. Identification of matters for presentation to and consideration by the Commission, including any recommendations as well as proposed next steps for SWGSM

There was broad agreement that the first meeting of the Working Group was very successful and the SWGSM made the following recommendations:

- 1) There should be another meeting of the Working Group in 2015. On the issue of the possible subject matters to be discussed at the next meeting, many delegations were of the view that it would be useful to proceed with practical examples that could help advance the dialogue for individual stocks. However, it was also suggested that dialogue of a general nature continue on issues such as acceptable levels of risk, targets, limits and time horizons based on Rec. [11-13].
- 2) To further improve participation, it was recommended that in future meetings of the SWGSM the Commission consider providing funds for two members per delegation (one manager and one scientist) for those CPCs needing assistance. It was also suggested that the next meeting should have a balance in the numbers of participating scientists and managers in order to meet the objectives of Rec. [13-18].

Many participants suggested that skipjack, which will be assessed in 2014, will provide a good example to examine Harvest Control Rules. North Atlantic albacore and North Atlantic swordfish, stocks for which the SCRS has already advanced HCR development and testing, were also considered as good candidates. Many delegations also proposed that Atlantic bluefin tuna be considered as a priority species and the working group recommended that it be discussed at the next meeting. The management of the eastern bluefin tuna stock has required substantial quota reductions. The development of an HCR for eastern bluefin tuna may be useful so that future TAC adjustments can be made in a reliable and defensible fashion. In order to eliminate data gaps that affect the timeliness of stock assessments, it would be important to also consider improvements in fishery and recruitment monitoring, including real-time reporting.

Finally, there was broad support for including social and economic factors in the evaluation of Harvest Control Rules, and for the involvement of the fishing industry and other stakeholders in the dialogue, which need to be taken into account within the context of the management objectives defined in Rec. [11-13]. The Working Group also noted the need for improved data collection and need to reconcile their use within a compliance setting.

13. Other matters

The EU referred to the large tagging program for tropical tunas for which a feasibility study was currently under finalization. It informed that it was most likely in a position to finance up to 80% of the 15 million euros required for that program for a period of 5 years. It called upon other parties to look into possibilities to cover the remaining 20% of funding needs.

14. Adoption of Report and adjournment

During the adoption of the report, the Group agreed to adapt the different items to the presentations and discussions that had taken place in the course of the meeting and, for purposes of consistency, to incorporate those changes into the agenda.

The report was adopted and the Chairman adjourned the meeting.

Appendix 1

AGENDA

1. Opening of the meeting
2. Adoption of agenda and meeting arrangements
3. Nomination of Rapporteur
4. Review of the objectives of SWGSM and expected meeting outcomes
5. Overview of the ICCAT framework for decision-making, including, inter alia, the Convention, Recommendation [11-13], and other relevant international instruments
 - 5.1 Current template and content of scientific advice and management recommendations and information on the current use by managers, when establishing management measures, of information provided by the SCRS
6. Overview of the basic components of precautionary management strategies, including precautionary and ecosystem-based approaches:
 - 6.1 Management objectives and timelines associated with rebuilding and the management of stocks under the purview of ICCAT
 - 6.2 Basic concept of Harvest Control Rules, Limit, Threshold and Target Reference points as well as whether the current stock assessment methods in ICCAT can provide enough basis for considering such reference points
 - 6.3 Possible reference points associated with different management objectives; Limit, threshold, and target reference points; Probability levels associated with different reference points
 - 6.4 Harvest Control Rules/management procedures that support management action e.g. TACs, effort or capacity limits and other aspects, including data collection and analyses
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13. Other matters
14. Adoption of Report and adjournment

Appendix 2

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Appendix 3

SUMMARIES OF THE PRESENTATION GIVEN UNDER ITEMS 5 TO 10

5. Overview of the ICCAT framework for decision-making, including, inter alia, the Convention, Recommendation [11-13], and other relevant international instruments

5.1 Current template and content of scientific advice and management recommendations and information on the current use by managers when establishing management measures of information provided by the SCRS (Fabio Hazin)

Article VIII was cited as a central part of the Convention related to the management of ICCAT species. Dr. Hazin explained that the current language of the Convention sets Maximum Sustainable Yield (MSY) as a target rather than a limit, and that management in this way can lead to fluctuations of stock biomass above and below MSY over time. He suggested that Article VIII could be rephrased to “*the level of exploitation that will not exceed the one compatible with Maximum Sustainable Yield*”. He noted that Recommendation 11-13 established basic principles to guide the development of management measures, including for stocks that are overfished and/or overfishing is occurring and that Recommendation 11-14 requires the SCRS annual report to provide statements characterizing the robustness of methods applied to stock status and for the development of scientific advice as well as a Kobe plot and strategy matrix. Prior to this, guidance provided to the Commission by the SCRS was sometimes difficult for managers to understand and interpret. Now, the Kobe plot and strategy matrix have become a well-accepted basis for management decisions. Still, they may not be able to characterize all uncertainties fully, in particular unquantified uncertainties, and they should be viewed taking this into account.

6. Overview of the basic components of precautionary management strategies, including precautionary and ecosystem-based approaches

6.1 Management objectives and timelines associated with rebuilding and the management of stocks under the purview of ICCAT (Kim Blankenbeker)

Ms. Blankenbeker presented a document summarizing past and present management decisions taken by the Commission for various stocks as well as information on assessed stocks that do not yet have direct management measures in place. She explained that the information included in the document was intended to allow for easy comparison of management approaches taken to date and assessment of their efficacy, where such information was available, as well as to see where action has not been taken together with the condition of those stocks. The summary document organized the stocks into three major categories: 1) stocks under rebuilding programs, 2) stocks under management plans, including rebuilt stocks, and 3) assessed stocks but no (or no specific) ICCAT management measures in place. It set out, by species, the basic elements found in the recommendations. These included: rebuilding time horizon (where applicable), management objective, minimum probability for reaching the management objective, and TAC level. Also included was information on the current status of the stocks as per the latest scientific assessment and the probability of reaching objective under current TAC, where this information was available.

Ms. Blankenbeker offered a few observations that she gleaned from compiling the summary document. In particular, she indicated that ICCAT has not always been entirely consistent in what elements are included in recommendations to maintain or rebuild stocks, which can limit the ability of the organization to assess progress. She noted that the SWG might wish to consider whether and how to improve coherency both across and within its recommendations. She noted that part of that discussion would include assessing the appropriateness of the minimum probability levels for reaching or maintaining management objectives that already exist in various recommendations, particularly in light of Rec. [11-13]. She also noted that some of the assessed stocks that are overfished and/or subject to overfishing do not have basic management measures in place and that the issues under consideration by the SWG may be relevant to these stocks as well. Notwithstanding the important substantive stock management questions, such as appropriate risk levels or rebuilding timelines, Ms. Blankenbeker suggested that the SWGSM could consider whether it would be useful to develop minimum elements that management recommendations should contain, perhaps along the lines of those identified in the summary paper.

6.2 Basic concept of HCRs, Limit, Threshold and Target Reference Points as well as whether the current stock assessment methods in ICCAT can provide enough basis for considering such reference points (Masanori Miyahara and Yukio Takeuchi)

Sharing the basic concept of Harvest Control Rules (HCRs) among CPCs is the main purpose of this presentation.

Under the UN Fish Stocks Agreement (UNFSA), HCRs are defined as: 1) setting LRP (e.g. F_{MSY} as a minimum standard), 2) setting pre-agreed conservation and management actions, and 3) taking the pre-agreed actions when the stock status reaches the LRP. Subject to the UNFSA, the CPC has to consider the most appropriate LRP and pre-agreed actions for ICCAT fish species. The purpose of the ICCAT Convention is to maintain the fish stock at MSY level. Discussion should take place on whether F_{MSY} (or B_{MSY}) should be LRP or Target Reference Point as stipulated in the ICCAT Convention.

ICCAT has already introduced HCRs to a certain degree for northern Atlantic swordfish (Rec. 13-02) and eastern Atlantic bluefin tuna (Rec. 13-07), and already has good guidance for stock recovery (Rec. 11-13). Rec. [13-07] directs suspension of all fisheries (pre-agreed action) for eastern Atlantic bluefin tuna when serious threat of the stock (not-quantified LRP) is detected. So, under the HCRs, very severe conservation and management actions, such as suspension of fishing, may be automatically introduced without any consideration of the socio-economic situation, which the Commission currently considers when introducing management measures.

Before starting the discussion about introduction of Harvest Control Rules to fish species subject to ICCAT, all CPCs must clearly understand the difference between the current practices of the Commission and actions to be taken under HCRs.

6.3 Possible reference points associated with different management objectives; limit, threshold, and target reference points; probability levels associated with different reference points (Antonio Cervantes)

Any fisheries management framework needs to be supported by clear management objectives expressed by the policy makers through a specific decision-making process.

At international levels, several texts (the Geneva Convention, UNCLOS, UNFSA, and WSSD) have paved the way to MSY approaches through the objective of maintaining or restoring populations of harvested species at levels which can produce the maximum sustainable yield. Later on, other texts opened avenues for additional and complementary approaches to fisheries management (Precautionary and Ecosystem-based Approaches).

MSY Objectives and Approaches and the two complementary Precautionary and Ecosystem Approaches have been included to different extents and in different forms in fisheries policies and management frameworks of both RFMOs and coastal States.

Two types of indicators are commonly expressed in the fisheries management framework which are to be used under the MSY and the precautionary approaches, namely, fishing mortality rates (F) and the levels of biomass (B).

The assessment process, both of the current status of fish stocks and fisheries or of impacts of possible new or updated management measures, requires the definition of specific benchmark values – the Reference Points – for each of these indicators associated either to the MSY and Precautionary Approaches or to the Ecosystem Approach.

The Reference Points may refer either to a specific objective that the policy makers and managers wish to achieve or to specific circumstances they want to avoid. In implementing the MSY Approach, policy makers have adopted specific, well-known Reference Points based on either the fishing mortality indicator or a biomass indicator, like F_{MSY} or its proxies and B_{MSY} .

One difficulty remains with the status of the selected Reference Points, particularly those used to implement the main goal agreed at international levels: to maintain or restore populations of harvested species at levels which can produce the MSY. Where F_{PA} , B_{PA} or $B_{TRIGGER}$ are clearly considered to be Limit Reference Points (LRPs), the status of F_{MSY} and B_{MSY} is far less clear when differentiating between LRPs and Target Reference Points (TRPs).

It is interesting to note that B_{MSY} can be considered to be a TRP during the rebuilding phase (rebuilding plans) and a LRP (management plans).

If a metric of a specific indicator is taken as a threshold to fix an LRP, it means that this indicator is expected to exceed this metric with a very low probability (e.g. less than 5 %). For instance, if F_{PA} and B_{PA} are taken as LRPs, management measures should be discussed by fisheries policy makers and managers in the light of a probability of less than 5% for F to be over F_{PA} or for B to be below B_{PA} .

In the same vein, if a metric of a specific indicator is taken as a threshold to fix a TRP, it means that this indicator is expected to exceed this metric with a probability of around 50%. For instance, if F_{MSY} and B_{MSY} were taken as TRPs, management measures should be discussed by fisheries policy makers and managers in the light of a probability of around 50 % for F to be over F_{MSY} or for B to be below B_{MSY} .

Through the adoption of the Rec. [11-13], ICCAT explicitly decided to consider both F_{MSY} and B_{MSY} as LRPs, given that that management measures should be designed to result in a high probability of ending overfishing and rebuilding fish stocks in as short a period as possible and of maintaining stocks in the green quadrant of the Kobe plot. The green quadrant is defined as the area of the Kobe plot where $F < F_{MSY}$ and $B > B_{MSY}$. When establishing the Kobe plot, it seems that both F_{MSY} and B_{MSY} were taken as boundaries to fix the area where the most likely value of F and B should be observed.

As highlighted above, the Recommendation continues to have two limits, i.e. the timeline and the status of the RPs. In other words, what do policy makers consider to be “as short a period as possible” and “a high probability”?

Indeed, in most of the timelines and probabilities expressed in the different ICCAT recommendations designing conservation measures on tuna and tuna-like species it is not so clear that both F_{MSY} and B_{MSY} are taken as TRPs.

The most usual approach would be to take B_{MSY} as a TRP. In doing so, however, it would appear to be highly useful to fix a threshold, B_{LIM} and/or B_{PA} , associated to the Precautionary Approach and to a probability $p[B_{2020} \geq B_{MSY}] \geq 50\%$.

Both approaches would imply thinking about the link between TRPs and LRPs, and more particularly about how they should be fixed and about the level of probabilities to be taken into account when discussing acceptable risks (e.g. by establishing a table categorizing risks to be used in the decision-making process) either for not reaching the TRPs or for breaching the LRPs.

6.4 Harvest Control Rules/management procedures that support management action e.g. TACs, effort or capacity limits (Victor Restrepo)

A harvest strategy (management procedure) specifies the management actions necessary to achieve defined resource objectives in a given fishery, resulting in a formal and proactive management approach that is transparent to all stakeholders.

A Harvest Control Rule (HCR) is part of an overall harvest strategy. The HCR is an agreed rule that describes how fishing is intended to be controlled by management in relation to the state of some indicator of stock status. In the ICCAT context, Rec. [11-13] is a framework for a HCR that intends to maintain or rebuild stocks to the "green" quadrant of the Kobe plot.

A "typical" HCR describes how fishing effort should be managed such that the target reference point is achieved on average, while the limit reference point is avoided with high probability (Anonymous, 2013). This will depend on the stock abundance: at high abundance (at or above the target), the HCR may set fishing effort or TAC to the level corresponding to MSY; at low abundance (approaching the limit), the HCR may set fishing effort or TAC at a low level such that the stock can rebuild to high abundance in a given time period.

The above example of a HCR includes important elements of the harvest strategy which would need to be decided explicitly by managers, such as: the limit and target reference points, the probability with which the target should be achieved, the probability with which the limit should be avoided, the acceptable time to rebuild a stock from the limit to the target, etc.

The example HCR above also includes other implicit factors, such as the ability to estimate stock abundance, reference points and probability levels, and the ability to implement certain management controls. It is important to consider these factors because the HCR should be tailored to a specific situation. The types of management actions contemplated (TACs, effort limits, capacity limits, closed seasons, closed areas, etc.) may depend on each specific fishery.

Finally, the HCR exemplified above is based on a stock assessment. But, there are species for which stock assessments are not available, as well as those for which the assessment may lack robustness. In these situations, HCRs can be built based on empirical indicators (e.g. catch rates, size distributions, catch trends, etc. See Dowling *et al.*, 2008).

6.5 Other aspects, including data collection and analyses (Victor Restrepo)

A comprehensive management strategy should consider the type of data collected and used in the assessment, and perhaps even evaluation of the benefit of collecting additional or new data.

The types and quality of data available have substantial impacts on the entire management strategy. Importantly, the available data determines the types of stock assessment methods that can be applied and their reliability. In turn, the assessment methods used and the information content of the data determine the types of reference points that can be estimated, as well as the evaluation of probability levels associated with stock status relative to those reference points.

The Precautionary Approach calls for more conservative actions in situations of higher uncertainty. When a precautionary management strategy is implemented, there can be cost-effective benefits to reducing uncertainty

because management actions will not necessarily need to be as conservative. Thus, higher catches could be achieved for a similar level of risk (Powers and Restrepo, 1993).

In terms of new data, the focus should be on how to improve the estimates of the key quantities that strongly affect the performance of the management strategy. For stocks with analytical stock assessments, this will usually involve research on quantities that significantly affect the estimates of key management variables such as MSY and associated reference points.

7. Dealing with uncertainty and variability

7.1 *Different sources of variability and uncertainties and their subsequent impacts on (i) stock status relative to reference point and (ii) the interpretation of the Kobe Strategy Matrices (Gerald Scott)*

There are a number of sources of variability leading to uncertainties in stock status evaluations and projections of possible futures for the stock which include:

- How well we observe/measure/estimate stock dynamics
 - Measurement uncertainty is the error in the observed quantities such as the catch or biological parameters;
 - Model uncertainty is the misspecification of model structure.
- Natural variability in processes, environmental impacts, etc.
 - Process uncertainty is the underlying stochasticity in the population dynamics such as the variability in recruitment.
- Estimation uncertainty can result from any, or a combination of the above uncertainties and is the inaccuracy and imprecision in abundance or fishing mortality rate;
- Implementation uncertainty results from variability in the resulting implementation of a management policy, i.e. inability to exactly achieve a target harvest strategy, including:
 - Responses of the fishery to changes in how it is pursued
 - Effectiveness of management measures
 - Definition of objectives
 - Decisions by management

At Kobe I, tRFMOs recommended (and ICCAT has adopted) standardization of presentation of stock assessments and to base management decisions upon the scientific advice, including the application of the precautionary approach. It was agreed that stock assessment results across all five tRFMOs should be presented in the “four quadrant, red-yellow-green” format now referred to as the Kobe Plot. This graphical aid has been widely embraced in ICCAT and across the other tRFMOs as a practical, user-friendly method for presenting stock status information. Quantified uncertainties in stock status relative to two reference points (biomass which can produce Maximum Sustainable Yield (MSY) and fishing mortality rate that would result in MSY) are displayed in a number of ways, including scattered across the Kobe plot and, in the case of ICCAT, a pie chart displaying the proportion of assessment outcomes that reside in each of the Kobe quadrants.

Subsequently, at Kobe II, it was agreed (and ICCAT and some other tRFMOs adopted) that the next logical step in implementing precautionary fishery management is a “strategy matrix” for managers that lays out options for meeting management targets, including if necessary, ending overfishing or rebuilding overfished stocks. The Strategy Matrix was envisioned to be a harmonized format for RFMO science bodies to convey advice. Based on targets specified by the Commission for each fishery, the matrix would present the specific management measures that would achieve the intended management target with a certain probability by a certain time. Probabilities and timeframes to be evaluated would be determined by the Commission. In the case of fisheries

managed under TACs, the outputs would be the various TACs that would achieve a given result. In the case of fisheries managed by effort limitations, the outputs would be expressed as, for example, fishing effort levels or time/area closures, as specified by the Commission. ICCAT makes frequent use of the Strategy Matrix as a decision support tool for fisheries management.

Further advancing the precautionary approach within ICCAT requires significant feedback (dialogue) between scientists and policy makers. What is needed from the tRFMO policy makers are definitions of the management objectives, timeframes, and tolerable risk-of-failure levels (degree of precaution) in achieving objectives. This has been established to some degree in ICCAT Recommendation [11-13] that provides a decision framework for implementation of the precautionary approach. What is needed from tRFMO scientists is continued work toward full characterization of uncertainty in stock status evaluations and future forecasts to improve advice on the odds of achieving management objectives. While there are a number of methods employed to characterize and quantify these uncertainties, there remains a range of unquantified uncertainties that can be reasonably captured in Management Strategy Evaluations to move this process forward.

8. Framework for the development of Harvest Control Rules (HCRs)

8.1 Consideration of biological, ecological, social, economic and/or other information (Faith Scattolon)

Background

It is widely understood that the implementation of the precautionary approach is not solely focused on biological and ecological constraints. Indeed, the United Nations Fisheries Agreement notes (Article 6 3(c)) that in implementing the precautionary approach, States shall take into account various factors, including socio-economic considerations.

Socio-economic factors can include (but are not limited to) issues related to access and allocation, the need for relatively consistent total allowable catches (TACs) over an extended period (i.e. to avoid any drastic change in catch from year to year), wealth distribution, employment, balancing stock growth while minimizing negative socio-economic impacts, and fishing objectives for other species (bycatch, predator-prey interaction and competition between stocks).

Unfortunately, the incorporation of socio-economic factors into the development of Harvest Control Rules has often been rather *ad hoc*, and applied without clear, consistent methodologies (e.g. poorly defined socio-economic objectives). As such, various jurisdictions are seeking transparent and objective ways to incorporate socio-economic factors into the management of fisheries.

Canada's domestic policy

Under Canada's Precautionary Approach Framework, pre-agreed harvest control rules and associated management actions are developed for each zone (i.e. critical, cautious, and healthy) as part of the overall harvest rate strategy. These rules and actions vary in relation to pre-determined reference points, and are designed to achieve the desired outcome by affecting the removal rate.

Socio-economic considerations play a role in the development of harvest control rules for stocks in both the cautious and healthy zones. Within the cautious zone, socio-economic and conservation considerations should be balanced in a manner that reflects location in the zone and stock trajectory. In the healthy zone, socio-economic considerations prevail, with conservation measures consistent with sustainable use apply. Within the critical zone, conservation considerations prevail.

Rebuilding Plan Guidelines have been developed to assist in the development of Canada's precautionary approach. These guidelines acknowledge that rebuilding plan objectives should take into account socio-economic impacts and requirements, including the potential impacts on current and future business opportunities for harvesters, the impacts on ongoing opportunities for the recreational sector, and the importance of continued access for Aboriginal communities to support both economic opportunities and food, social and ceremonial fisheries.

8.2 Possible process for assessing HCRs, particularly in the context of the development of Management Strategy Evaluations (MSE) (Laurence Kell)

8.2.1 Precautionary Approach

When managing fisheries decisions have to be made with incomplete knowledge, which is often the case, the Precautionary Approach (PA) requires that:

- Undesirable outcomes be anticipated, measures be taken to reduce their risk of occurring and corrective measures be applied immediately which are effective within an acceptable time frame;
- Limit and threshold Reference Points be used as part of a Harvest Control Rule; and
- Consideration be given to major uncertainties, e.g. status of the stocks relative to reference points, biology and environmental events.

However, HCRs will not necessarily be precautionary if they are not formally evaluated to determine how well they actually achieve their goals given uncertainty. Therefore, at the Third Joint Tuna RFMO Meeting (Kobe III), it was recognised that Management Strategy Evaluation (MSE) needs to be widely implemented in the Tuna Regional Fisheries Management Organisations (tRFMOs) in order to implement a Precautionary Approach for tuna fisheries management.

8.2.2 Management Strategy Evaluation

Management Strategy Evaluation involves the use of simulation modelling to evaluate the impact of the main sources of uncertainty. Benefits of the approach are:

- It allows a fuller consideration of uncertainty as required by the Precautionary Approach;
- It provides stability if management objectives and how to evaluate how well alternative management strategies which meet them are agreed through a dialogue between scientists and stakeholders; and
- It can be used to guide the scientific process by identifying where the reduction of scientific uncertainty improves management and so help to ensure that expenditure is prioritised to provide the best research, monitoring and enforcement.

8.2.3 Process

Conducting an MSE requires various steps:

1. Identification of management objectives and mapping these to performance measures to quantify how well they are achieved;
2. Selection of hypotheses about system dynamics;
3. Conditioning of OMs on data and knowledge and possible rejecting and weighting of the different hypotheses;
4. Identifying candidate management strategies and coding these up as MPs, i.e. the combination of predefined data, together with an algorithm to which such data are input to set control measures;
5. Projecting the OMs forward using the MPs as feedback control procedures; and
6. Agreeing the MPs that best meet management objectives.

8.2.4 Examples

Currently there are various initiatives being conducted by the SCRS related to MSE, i.e. the development of a Generic MSE that can be applied to the albacore and swordfish stocks in the North and South Atlantic and the Mediterranean as well as the work under the GBYP.

Generic MSE

A framework that can be used for highly migratory tuna stocks is being developed. This uses an Operating Model conditioned on a range of assumptions about biological processes. The OM can be based either on an existing age based stock assessment, e.g. Multifan-CL for North Atlantic albacore, or life history characteristics for data poor stocks. The Management Procedure is based on a biomass dynamic stock assessment model, which is currently being used to provide management advice in the form of the Kobe II Strategy Matrix (K2SM) for northern and southern Atlantic stocks of albacore and swordfish, and potentially for the Mediterranean stocks as well.

Mediterranean bluefin tuna

An initial MSE is being developed and is intended to identify the impact of the main sources of quantified and unquantified uncertainties on management. In this work the relative value-of-information for model-based and empirical Management Procedures will be compared. This is done by conditioning an Operating Model on alternative hypotheses about population and fishery dynamics. Data, fisheries and fisheries independent are then sampled from the Operating Model to evaluate different Harvest Control Rules as part of a Management Procedure. This allows scenarios and data sets to be simulated that reflect uncertainty about our knowledge of biology, ecology and our ability to observe and control the fisheries. Different Management Strategies will be evaluated with respect to their ability to meet multiple management objectives. This is done by considering the trade-offs between the objectives for different choices (e.g. to invest in fisheries independent surveys, tagging studies to estimate natural mortality) and the robustness of the MPs, e.g. to environmental variability. This allows the relative benefits of improving knowledge on population and fishery dynamics to be evaluated.

9. Overview of relevant work by SCRS (Josu Santiago)

Recommendation by ICCAT on the Principles of Decision Making for ICCAT Conservation and Management Measures [Rec. 11-13] establishes the guiding principles for adoption of management measures, based on scientific stock status evaluations and likewise considers uncertainties in those evaluations. These guiding principles provide a basis for the design of Harvest Control Rules (HCRs) and the SCRS has recommended a generic HCR framework upon which stock-specific robustness testing can and will be conducted. Indeed, the SCRS has initiated work on conducting Management Strategy Evaluations (MSE) for several species in support of identifying HCRs that are robust to a large range of scientific uncertainties and consistent with the above principles.

The evaluation of Limit Reference Points (LRP) and HCR through the use of MSE has been recognized by the SCRS and the scientific committees of other tuna RFMOs as the most effective means to advance their fishery management process. The SCRS plans to continue this effort by:

- continuing to refine the methods within the MSE process,
- introducing MSE in more assessments when and where appropriate, and
- fostering lines of communication that keep managers informed of their benefits and weaknesses.

These objectives are core elements of the 2015-2020 SCRS Science Strategic Plan (agenda item 10). Relevant work that has been conducted in recent years by the SCRS in relation to LRP, HCR and their evaluation through MSE has been mainly focused on North Atlantic albacore and swordfish and Atlantic bluefin tuna.

The SCRS defined in 2013 an interim LRP of $0.4 \cdot B_{MSY}$ for North Atlantic swordfish and North Atlantic albacore following Recommendations 11-02 and 11-04. The robustness of this LRP will be evaluated before the next assessment of both stocks. The main objective will be to prepare the next assessments for these stocks (not yet scheduled), by reducing uncertainty around datasets and parameters, and in addition by developing robust management procedures that cope with the remaining uncertainty.

According to *Supplemental Recommendation by ICCAT Concerning the North Atlantic Albacore Rebuilding Program* [Rec. 13-05] as a matter of priority, the SCRS shall continue the development of a Limit Reference Point (LRP) and Harvest Control Rules (HCRs) for this stock with input from the Commission. Future decisions on the management of this stock should be in accordance with the LRP and HCRs.

According to *Recommendation by ICCAT for the Conservation of North Atlantic Swordfish* [Rec. 13-02], when assessing stock status and providing management recommendations to the Commission in 2016, the SCRS shall consider the interim limit reference (LRP) of $0.4 \cdot B_{MSY}$ or any more robust LRP established through further analysis.

Regarding other stocks, the SCRS developed in 2013 a workplan to conduct the 2014 and 2015 bluefin tuna assessments and to evaluate a management procedure using an operating model. To implement the operating model two contracts for providing external support for a number of years have been awarded. A core steering group will soon be established to oversee this work.

10. Overview of relevant work by the SCRS Strategic Plan and annual work programme (Josu Santiago)

The purpose of the SCRS Strategic Plan is to provide the overall framework and goals for development and coordination of science and science-related activities needed to support provision of sound scientific advice as the centrepiece for the conservation and management of tuna and tuna-like species in the Atlantic and the Mediterranean.

During the meeting of the Working Group for the Development of the SCRS Strategic Plan (Madrid, Spain, 14-16 April 2014) the SCRS culminated a process that started in 2012 as a logical consequence of the *Resolution by ICCAT on Best Available Science* [Res. 11-17]. In order to give answer to the necessity for providing appropriate and best scientific advice on current and future requests, the development of a strategic research plan appears the best way to provide timely, appropriate and best responses in a structured manner. An agreed research plan will also allow effectively adapting and adjusting the SCRS activities to funding sources, anticipating changes and necessities as well as preparing for them. Planning also should contribute towards a more efficient functioning and a better utilization of the always limited existing assets, resources and capabilities of the SCRS and the Secretariat.

The proposed 2015-2020 SCRS Science Strategic Plan is the result of coordinated and integrated work conducted by the officers of the SCRS, the ICCAT Secretariat and the scientists of the CPCs. (http://www.iccat.int/Documents/Meetings/Docs/2014_Strategic_Plan_report.pdf)

The Plan contemplates the period 2015-2020 and includes the following components:

- Mission: Outline the purpose of the SCRS, in line with the Rules of Procedure defined in the ICCAT Convention, its values and the necessities of the Commission.
- Vision: A statement describing where the SCRS desires to be in 2020; the target around which the SCRS pursues to focus the attention and energies.
- Values: The guiding principles of the SCRS.
- Goals, objectives, strategies and measurable targets classified in five Thematic Areas: Data Collection, Dialog and Communication, Participation and Capacity Building, Research Priorities and Stock Assessment and Advice.

The main goals that have been identified for the 2015-2020 period includes:

- Data Collection
 - Improve fishery data collection and reporting
 - Institute biological sampling programs
 - Develop programs for collection/compilation of additional data
- Dialog and Communication
 - Improve the dialog with the Commission
 - Promote open dialog with the COM and interested parties
 - Improve dialog within the SCRS
 - Improve dialog with the scientific community

- Improve dialog with society
- Improve the mechanisms of communication of the SCRS

- Participation and Capacity Building
 - Preserve and promote the independence and excellence of the SCRS and WGs
 - Improve science capabilities of the SCRS objectives
 - Enhance and improve participation in the SCRS, and in particular enhancing the active involvement of developing economies in SCRS activities

- Research Priorities
 - Quantify the major uncertainties affecting stock assessment and management advice
 - Acquire the necessary biological knowledge in tuna-like species, as well as in critical by-catch species commensurate to the needs for the assessment of the different stocks under the Convention
 - Improve the standardization of the fishery dependent information
 - Apply approaches which provide information to improve stock assessment and monitor the effect of management regulations
 - Seek the adequacy between models used and quality of data and knowledge
 - Evaluate management measures and strategies in achieving the objectives of the Commission
 - Cover research needs so as to be able to include Ecosystem Considerations in the provision of scientific advice

- Stock Assessment and Advice
 - Provide objective, reliable and robust scientific advice to the Commission in support of the Convention objectives
 - Evaluate precautionary management references and robust Harvest Control Rules through Management Strategy Evaluations
 - Advance Ecosystem Based Fishery Management Advice
 - Broaden the scientific advice to include economic and social aspects of various management measures

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