

Chair report of the 1st IOTC Technical Committee on Management Procedures

Yogyakarta, Indonesia, 20 May 2017

DISTRIBUTION:

Participants in the Session
Members of the Commission
Other interested Nations and International
Organizations
FAO Fisheries Department
FAO Regional Fishery Officers

BIBLIOGRAPHIC ENTRY

IOTC–TCMP01 2017. Report of the 1st IOTC Technical
Committee on Management Procedures. Yogyakarta,
Indonesia 20 May 2017. *IOTC–2017–TCMP01–R[E]*: 23
pp.



The designations employed and the presentation of material in this publication and its lists do not imply the expression of any opinion whatsoever on the part of the Indian Ocean Tuna Commission (IOTC) or the Food and Agriculture Organization (FAO) of the United Nations concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

This work is copyright. Fair dealing for study, research, news reporting, criticism or review is permitted. Selected passages, tables or diagrams may be reproduced for such purposes provided acknowledgment of the source is included. Major extracts or the entire document may not be reproduced by any process without the written permission of the Executive Secretary, IOTC.

The Indian Ocean Tuna Commission has exercised due care and skill in the preparation and compilation of the information and data set out in this publication. Notwithstanding, the Indian Ocean Tuna Commission, employees and advisers disclaim all liability, including liability for negligence, for any loss, damage, injury, expense or cost incurred by any person as a result of accessing, using or relying upon any of the information or data set out in this publication to the maximum extent permitted by law.

Contact details:

Indian Ocean Tuna Commission
Le Chantier Mall
PO Box 1011
Victoria, Mahé, Seychelles
Ph: +248 4225 494
Fax: +248 4224 364
Email: secretariat@iotc.org
Website: <http://www.iotc.org>

ACRONYMS

BET	Bigeye Tuna
BMSY	Biomass that achieves maximum sustainable yield
CMM	Conservation and Management Measure (of the IOTC; Resolutions and Recommendations)
CPCs	Contracting parties and cooperating non-contracting parties
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FAO	Food and Agriculture Organization of the United Nations
IOTC	Indian Ocean Tuna Commission
MP	Management Procedure
MPD	Management Procedures Dialogue
MSE	Management Strategy Evaluation
MSY	Maximum Sustainable Yield
SC	Scientific Committee, of the IOTC
SSB	Spawning stock biomass
SPC	Secretariat of the Pacific Community
tRFMO	tuna Regional Fisheries Management Organization
TAC	Total Allowable Catch
TCMP	Technical Committee on Management Procedures
WP	Working Party of the IOTC
WPB	Working Party on Billfish of the IOTC
WPEB	Working Party on Ecosystems and Bycatch of the IOTC
WPM	Working Party on Methods of the IOTC
WPNT	Working Party on Neritic Tunas of the IOTC
WPDCS	Working Party on Data Collection and Statistics of the IOTC
WPTmT	Working Party on Temperate Tunas of the IOTC
WPTT	Working Party on Tropical Tunas of the IOTC
YFT	Yellowfin Tuna

STANDARDISATION OF IOTC WORKING PARTY AND SCIENTIFIC COMMITTEE REPORT TERMINOLOGY

SC16.07 (para. 23) The SC **ADOPTED** the reporting terminology contained in [Appendix IV](#) and **RECOMMENDED** that the Commission considers adopting the standardised IOTC Report terminology, to further improve the clarity of information sharing from, and among its subsidiary bodies.

HOW TO INTERPRET TERMINOLOGY CONTAINED IN THIS REPORT

Level 1: From a subsidiary body of the Commission to the next level in the structure of the Commission:

RECOMMENDED, RECOMMENDATION: Any conclusion or request for an action to be undertaken, from a subsidiary body of the Commission (Committee or Working Party), which is to be formally provided to the next level in the structure of the Commission for its consideration/endorsement (e.g. from a Working Party to the Scientific Committee; from a Committee to the Commission). The intention is that the higher body will consider the recommended action for endorsement under its own mandate, if the subsidiary body does not already have the required mandate. Ideally this should be task specific and contain a timeframe for completion.

Level 2: From a subsidiary body of the Commission to a CPC, the IOTC Secretariat, or other body (not the Commission) to carry out a specified task:

REQUESTED: This term should only be used by a subsidiary body of the Commission if it does not wish to have the request formally adopted/endorsed by the next level in the structure of the Commission. For example, if a Committee wishes to seek additional input from a CPC on a particular topic, but does not wish to formalise the request beyond the mandate of the Committee, it may request that a set action be undertaken. Ideally this should be task specific and contain a timeframe for the completion.

Level 3: General terms to be used for consistency:

AGREED: Any point of discussion from a meeting which the IOTC body considers to be an agreed course of action covered by its mandate, which has not already been dealt with under Level 1 or level 2 above; a

general point of agreement among delegations/participants of a meeting which does not need to be considered/adopted by the next level in the Commission's structure.

NOTED/NOTING: Any point of discussion from a meeting which the IOTC body considers to be important enough to record in a meeting report for future reference.

Any other term: Any other term may be used in addition to the Level 3 terms to highlight to the reader of an IOTC report, the importance of the relevant paragraph. However, other terms used are considered for explanatory/informational purposes only and shall have no higher rating within the reporting terminology hierarchy than Level 3, described above (e.g. **CONSIDERED; URGED; ACKNOWLEDGED**).

TABLE OF CONTENTS

1.	Opening of the session and arrangement	7
2.	Adoption of the agenda and arrangements for the session.....	7
3.	Admission of observers	7
3.1.	<i>Intergovernmental Organisations (IGO)</i>	7
3.2.	<i>Members and Associate Members of the Organization that are not Members of the Commission</i> .7	
3.3.	<i>Non-governmental Organisations (NGO)</i>	7
3.4.	<i>Invited experts</i>	8
4.	Decision of the commission related to the work of the technical committee of management procedures	8
4.1.	Resolution 16/09 – Terms of Reference	8
4.2.	Outcomes of the 20th Session of the Commission and MPD meetings.....	8
5.	Overview of the evaluation of management procedure in the iotc	8
5.1.	The IOTC process on adoption of management procedures (Including the Resolution 15/10 on a Management Framework)	8
5.2.	Management Strategy Evaluation: basic principles	9
5.3.	Roles and responsibilities, dialogue tools and feedback mechanism	9
5.4.	SC proposal for the standard presentation of MSE results.....	9
6.	Status of the management procedure evaluation/operating models.....	11
6.1.	Albacore tuna.....	11
6.2.	Yellowfin and Bigeye tunas.....	11
6.3.	Skipjack tuna.....	11
6.4.	Swordfish	11
7.	Discussion of the actions needed for next iteration of management procedure development... 11	
7.1.	Albacore tuna.....	11
7.2.	Albacore, Yellowfin and Bigeye tunas	12
7.3.	Swordfish	12
8.	Future direction of the technical committee on management procedures	12
8.1.	Work plan (Including new timelines/budget and resources needed).....	12
8.2.	Process and future meetings of TCMP.....	12
	Appendix I List of participants.....	13
	Appendix II Agenda for 1st IOTC Technical Committee on Management Procedure	16
	Appendix III List of documents.....	17
	Appendix IV Presentation of management strategy evaluation results.....	18

EXECUTIVE SUMMARY

The Indian Ocean Tuna Commission has established a dedicated Technical Committee of Management Procedures (TCMP) as a formal communication channel between science and management to enhance decision-making response of the commission in relation to Management Procedures (MPs). The first session of the TCMP of the Indian Ocean Tuna Commission was held in Yogyakarta on May 20st, 2016. The TCMP provided a forum for discussion on the elements of Management Procedures that require a decision by the Commission, and included the presentation of Management Strategy Evaluation (MSE) results, which greatly facilitated the exchange of information and views between fishery scientists and managers.

- The TCMP **RECOMMENDED** that the WPDCS become involved in the MSE process through the design and evaluation of improved data collection systems to assist the implementation of MPs through the provision of good quality data.
- The TCMP **RECOMMENDED** that the Commission considers establishing a procedure for implementing the results of application of the HCR contained in Resolution 16/02 as soon as the catch limit is estimated by the SC. Following the review by the SC of the stock assessment of skipjack tuna in 2017, such a procedure would lead to an administrative procedure by which the Secretariat notifies CPCs of the catch limit to be enforced from 1st January 2018.
- The TCMP **RECOMMENDED** that more science-related capacity building activities are conducted in future, especially to cover the concepts linked with the evaluation of MPs through MSE.
- The TCMP **NOTED** that there is currently insufficient budget to conduct the work plan agreed in resolution 15/10 and **RECOMMENDED** that a budget is developed and extra-budgetary funding is sought. The TCMP also **REQUESTED** a concrete workplan is drafted by the Scientific Committee in 2017.
- The TCMP **RECOMMENDED** that the Commission consider the duration of the TCMP session in 2018 relative to the other activities of the Commission. More than one day would help to improve the science-management communication.
- The TCMP **REQUESTED** that the potential for MSE results to be presented with some level of interactivity is explored by the SC, including offering participants access to result summaries during the course of the meeting.
- The TCMP **REQUESTED** that scientific presentations are further simplified for subsequent meetings through the provision of some practical examples of the results of specific MPs so that all delegations can be more actively involved.
- The TCMP **NOTED** that socio-economic factors were important to consider in the MSE analysis of MPs and **ACKNOWLEDGED** that to making MPs operational requires both realistic performance indicators, related to management actions that can actually be implemented, and sufficient data collection, able to reliably inform the MPs.
- The TCMP **DICUSSED** the concept of MSE “tuning”, i.e., the process of adjusting one or more control parameters within an MP, to attain an exact value for a single high priority management objective. This process helps focus the decision making on the most influential trade-off that the managers must consider and makes it is easier to compare performance with respect to the secondary priorities. TCMP **AGREED** that this is a useful concept, and a number of initial tuning criteria for the key tuna stocks were proposed based on IOTC Resolutions 15/10 and 16/01.

1. OPENING OF THE SESSION AND ARRANGEMENT

1. The first Technical Committee on Management Procedures meeting was held on the 20st May 2017, in Yogyakarta, Indonesia.
2. Dr Ahmed Mohammed Al-Mazroui, the Chair of the IOTC, and Dr Hilario Murua, the Chair of the Scientific Committee, opened the meeting and welcomed attendees. The interim Executive Secretary of the IOTC, Mr Alejandro Anganuzzi also welcomed the attendees to the meeting and emphasized the importance of a more formal, dedicated dialogue for engaging decision makers in the IOTC process of developing Management Procedures.
3. The meeting was facilitated by Dr Graham Pilling (SPC), who welcomed 70 delegates from 22 Contracting Parties of the Commission, 3 delegates from 3 Cooperating Non-Contracting Party and 15 Observers (including 4 invited experts) to the session. The list of participants is provided in Appendix I.

2. ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION

4. The SC Chair **NOTED** that the aim of the TCMP was to establish a formal communication channel to allow an effective dialogue between both science and management in an iterative process, and to enhance decision-making response of the commission in relation to management procedures. To this aim, scientists presented progress in developing and testing management procedures for the key tuna stocks in the Indian Ocean, as detailed in Resolution 15/10¹.
5. The adopted agenda for the meeting is presented in Appendix II. Documents presented to the TCMP are listed in Appendix III.

3. ADMISSION OF OBSERVERS

6. The TCMP **NOTED** that the applications by new Observers should continue to follow the procedure as outlined in Rule XIV of the IOTC Rules of Procedure (2014).

3.1. INTERGOVERNMENTAL ORGANISATIONS (IGO)

7. In accordance with Rule VI.1 and XIV.4 of the IOTC Rules of Procedure (2014), the TCMP **ADMITTED** the following Inter-governmental organisations (IGO) as observers to the 1st Session of the TCMP.
 - Food and Agriculture Organization of the United Nations (FAO)
 - Indian Ocean Commission (IOC)
 - SWIOFISH

3.2. MEMBERS AND ASSOCIATE MEMBERS OF THE ORGANIZATION THAT ARE NOT MEMBERS OF THE COMMISSION

8. In accordance with Rule VI.2 and XIV.4 of the IOTC Rules of Procedure (2014), the TCMP **ADMITTED** the following Members and associated members of the organization that are not members of the commission as observers to the 1st Session of the TCMP
 - United States Of America
 - Russian Federation

3.3. NON-GOVERNMENTAL ORGANISATIONS (NGO)

9. In accordance with Rule VI.1 and XIV.5 of the IOTC Rules of Procedure (2014), the TCMP **ADMITTED** the following Non-governmental organisations (NGO) as observers to the 1st Session of the TCMP.
 - International Seafood Sustainability Foundation (ISSF)
 - International Pole and Line Foundation (IPNLF)
 - The PEW Charitable Trusts (PEW)

¹ Resolution 15/10 *On Target and Limit Reference Points and a Decision Framework*

- Sustainable Fisheries Partnership (SFP)

3.4. INVITED EXPERTS

10. In accordance with Rules VI.1 and XIV.9 of the IOTC Rules of Procedure (2014), the Commission may invite consultants or experts, in their individual capacity, to attend the meetings or participate in the work of the Commission as well as the Scientific Committee and the other subsidiary bodies of the Commission. The TCMP **ADMITTED** the following invited experts as observers to the 1st Session of the TCMP.
11. • Taiwan, Province of China

4. DECISION OF THE COMMISSION RELATED TO THE WORK OF THE TECHNICAL COMMITTEE OF MANAGEMENT PROCEDURES

4.1. Resolution 16/09 – Terms of Reference

12. The TCMP **NOTED** paper IOTC–2017–TCMP01–03 which outlined the main aims of the Technical Committee on Management Procedures as established by the Commission through Resolution 16/09². This Resolution aims at enhancing the dialogue and mutual understanding between the Scientific Committee and the Commission on matters relating to management procedures, and the decision making response of the Commission in relation to management procedures.

4.2. Outcomes of the 20th Session of the Commission and MPD meetings

13. The TCMP **NOTED** paper IOTC–2017–TCMP01–04 which summarised the main outcomes of the 3rd Management Procedures Dialogue that *reviewed the progress of the MSE work on skipjack, albacore, yellowfin and bigeye*. It was noted that the Management Procedures Dialogue (MPD) was intended to be an informal communication mechanism, and that continuation of the dialogue between scientists and managers in developing Management Procedures was highly important and enhancement of the process though the TCMP was strongly encouraged.
14. The TCMP **NOTED** paper IOTC–2017– TCMP01–04 which outlined the main outcomes of previous Sessions of the Commission, specifically related to the work of the TCMP and **AGREED** to consider how best to provide the Scientific Committee with the information it needs, in order to satisfy the Commission’s requests, throughout the course of the current TCMC meeting.

5. OVERVIEW OF THE EVALUATION OF MANAGEMENT PROCEDURE IN THE IOTC

5.1. The IOTC process on adoption of management procedures (Including the Resolution 15/10 on a Management Framework)

15. The Chair of the SC provided an overview of the management procedures process in IOTC, including a timeline of actions taken to date and the roles and responsibilities of the Scientific Committee, the Commission, TCMP, and stakeholders in the iterative process of using MSE to guide selection of the best performing Management Procedure (MP) for a particular stock.
16. The TCMP **WELCOMED** the overview of the approach, and **NOTED** that MPs implement feedback controls allowing management to adapt to new information as it becomes available. They therefore differ from traditional stock assessment in the type of management advice provided, being a mechanism for managing the fishery rather than a particular course of action.
17. The TCMP **NOTED** that socio-economic factors were important to consider in MSE evaluation of MPs and that the best management practices to achieve the Commission’s management objectives may vary between CPCs, depending upon the needs and capabilities of the individual parties. The TCMP **ACKNOWLEDGED** that to making MPs operational requires both realistic performance indicators, related to management actions that can actually be implemented, and sufficient data collection, able to reliably inform the MPs.
18. The TCMP **AGREED** that the MSE/MP approach requires agreement on the overriding operational objectives of the Commission and the best pathway for achieving those objectives considering the uncertainties identified to be made in advance. In cases where stocks are in a healthy condition, the approach offers the advantage of avoiding depletion of stocks and in cases where stocks are in unhealthy condition, it provides an optimal pathway for rebuilding to the desired state, as agreed in Res 15/10, based upon pre-agreed actions. Conversely,

² Resolution 16/09 *On establishing a Technical Committee on Management Procedures*

the traditional approach often requires prolonged negotiation of management actions based upon stock assessment results.

5.2. Management Strategy Evaluation: basic principles

19. The TCMP agreed that management objectives should be made operational (e.g. probability of being in the Kobe green zone) for them to be tested within an MSE framework, taking into account uncertainty. The TCMP also **NOTED** that discussion on the tradeoff amongst objectives is a crucial step during the MSE process.
20. The TCMP **NOTED** that while it is difficult for CPCs to specify a management procedure before evaluating the results of the tradeoffs among different objectives, a management procedure tested through MSE allows managers to select a robust MP which will foster pre-agreed management actions in response to new data.
21. The TCMP **NOTED** that a HCR could be agreed without undertaking an MSE, but that process may not identify an MP that is robust to the range of uncertainties considered important.
22. The TCMP **NOTED** that the Commission has currently only explored MSE for single stocks of target species. While it is theoretically possible to use a multispecies operating model to account for bycatch species, the data required to condition this are not available and it may be more appropriate to manage bycatch species through other methods such as mitigation measures.
23. The TCMP **RECOMMENDED** that the WPDCS become involved in the MSE process through designing and supporting improved data collection systems to assist the MSE process through the provision of good quality data.
24. The TCMP **NOTED** that CPUE-based controls are generally based on standardized indices, but **AGREED** that their use depends on how well they represent population abundance. The TCMP **NOTED** it might not be feasible for an MP to be solely based on length data, but **AGREED** that length data can potentially be complementary to CPUE-based MPs (e.g. by providing additional information about incoming cohort strength).

5.3. Roles and responsibilities, dialogue tools and feedback mechanism

25. The Chair of the SC outlined the roles and responsibilities of scientists and managers in the iterative process of undertaking MSE for IOTC species. The TCMP **AGREED** that MSE requires effective communication between scientists, managers and stakeholders at many steps in the process.
26. The TCMP **AGREED** that managers have the primary role of defining management objectives, and working with scientists to ensure that quantitative performance statistics can be defined which allow decision makers to evaluate MP performance with respect to management objectives. Managers also have the responsibility of determining the types of management actions to be adopted (e.g. input or output controls), the data collection methods that they are willing to support, and are responsible for selecting the final MP to be adopted. The scientists have the primary responsibility of quantifying the system uncertainty, developing candidate MPs, conducting the MSE, and reporting the results in a format that will help the decision makers choose an MP. Managers and scientists need to communicate to understand the options and limits faced by the other group.
27. The TCMP **NOTED** that MPs need to be agreed by IOTC, but implemented at the CPC level.

5.4. SC proposal for the standard presentation of MSE results

28. The TCMP **WELCOMED** the standard approach to the presentation of MSE results agreed by the SC. Noting this is a living document the TCMP **NOTED** that different/additional figures and tables will also allow managers to further understand the tradeoffs between contrasting management objectives, and that these will be requested by managers during the iterative MSE process. For example, TCMP **AGREED** that performance indicators to present the number of years in which the stock has fallen into the red zone ($B < B_{msy}$ and $F > F_{msy}$) of the Kobe plot should also be developed.
29. The TCMP **SUGGESTED** that individual realizations from MSE simulations should be presented to better reveal the potential outcome of an MP (Figure 4, Appendix IV), and to avoid the focus being placed only on the average trajectory (which will be more stable than any individual run). However, it was noted that MSE involves hundreds or thousands of realizations, and it is not possible to view more than a few in a single plot.
30. The TCMP **AGREED** that uncertainty ranges should be added to the performance indicators listed in Table 1 (Appendix IV) where appropriate, or included in a separate table if found to be a clearer approach to presenting the results.
31. The TCMP **SUGGESTED** that the potential for the inclusion of trigger reference points for each MP in the Kobe plot be explored. However it was noted that this approach is only applicable to a certain class of Harvest

Control Rule, and hence cannot be consistently applied. It was noted that while an understanding of the form of the HCR is important, the focus of managers should be on whether the results are meeting their objectives.

32.

33. The TCMP **AGREED** that in addition to the time series projections provided for biomass (B) and fishing mortality (F), projections of trends in catches should also be presented.

34. The TCMP **AGREED** that the boxplots (Figure 2, Appendix IV) provide a useful representation of the results and that this approach to presenting the performance indicators should be maintained.

35. The TCMP **AGREED** that the summary of all performance indicators for all MPs for four different time periods in Table 2 (Appendix IV) is somewhat confusing and should be modified for clarity (e.g., by separating out the years by rows rather than by columns for each performance indicator, or using separate tables).

36. The TCMP **DISCUSSED** the amount of detail that needs to be placed in figures showing MSE results and **SUGGESTED** that more details on how performance measures are derived are included in the tables.

37. The TCMP **DISCUSSED** the potential for incorporating spider plots to show some of the trade-offs among management objectives in a multi-dimensional space. However, there are various issues associated with these plots, including the inferred relationships between management objectives based solely on their position within the plot which can be misleading, and the overcrowding that is likely when 16 objectives are considered. It was therefore **AGREED** that spider plots would not be used to present MSE results.

5.5. MSE Tuning: adjusting the MPs to objectives

38. The TCMP **NOTED** the presentation that introduced the concept of “tuning”, i.e., the process of adjusting one or more control parameters within an MP, to attain an exact value for a single high priority management objective (e.g. rebuilding biomass to a target level in a specific timeframe with a specific probability). TCMP **AGREED** that this process is helpful because:

- It helps focus the decision making on the most influential trade-off that the managers must consider (e.g. - the relationship between the risk of exceeding Biomass reference points and catch).
- Once MPs are tuned to achieve identical performance in the highest priority performance statistic, it is easier to compare performance with respect to the secondary priorities.
- This allows MP developers to focus on improving performance in a particular region of the trade-off relationship, and avoid evaluating MPs that are of little interest to managers.
- This reduction in the number of candidate MPs greatly simplifies the process of communication and selection of an MP for adoption by the managers

39. The TCMP **AGREED** that preliminary tuning targets can be based on IOTC Resolutions and suggested a number of initial tuning criteria.

40. TCMP **NOTED** although target and reference points are established in the Resolution 15/10, there is a lack of clarity between on how to reach them:

- “...achieve target reference points on average” (Resolution 15/10; para. 2, Annex I)
- “Maintain stock within green KOBE zone with “high probability” (Resolution 15/10; para. 6c)”

while the Resolution refers to yellowfin, bigeye, skipjack, albacore and swordfish, the different management objectives might be seen as suitable for species with differing life history traits as appropriate, e.g. the second objective and associated more precautionary management might be more preferable for a less resilient species. It was observed that using the same tuning process for different species may not make sense given the differing status of stocks, e.g., rebuilding or not fully exploited.

41. The TCMP **NOTED** that the objective of rebuilding and/or maintaining a stock in ‘green’ implied attaining an objective of both $B > B_{MSY}$ and $F < F_{MSY}$. In contrast, attaining a B_{MSY} target on average over the projection time frame alone did not necessarily require limiting F. It was pointed out that not constraining F in achieving a biomass target on average could result in the stock being depleted to the Kobe ‘red’ zone by the end of the projection time frame while still achieving on average, B_{MSY} , across the projection time-frame. However, in those cases it would be important to look at B/B_{MSY} trajectories (e.g. years that B/B_{MSY} is over 1). The TCMP also **NOTED** that if the objective is to maintain Biomass over B_{MSY} , to this does not necessarily require a fishing mortality tuning objective (i.e. if the biomass objective is carefully defined, it will implicitly require fishing mortality to be effectively constrained).

6. STATUS OF THE MANAGEMENT PROCEDURE EVALUATION/OPERATING MODELS

6.1. Albacore tuna

42. The TCMP **NOTED** that the current status of work of MSE for the albacore stock was presented, together with an initial set of simulation results. These results compared the performance of various MPs when tuned for two different management objectives: achieving a spawning biomass level equal to that at MSY with a 50% probability, and having the stock in the green area of the Kobe plot with a 75% probability).
43. The TCMP **NOTED** that the tuning objective of achieving an average of $\text{Pr.}(SSB > SSB_{MSY}) = 50\%$ over a long period could lead to the selection of an MP that produces high yields but a declining trend in SSB if the stock has started out considerably above B_{MSY} .
44. The TCMP **AGREED** that even preliminary results, if coming from a real stock and fishery, were very useful for showing the consequences and trade-offs of alternative management objectives.
45. The TCMP **REQUESTED** that the potential for MSE results to be presented with some level of interactivity is explored by the SC, including offering participants access to result summaries during the course of the meeting.

6.2. Yellowfin and Bigeye tunas

46. The TCMP **NOTED** the progress of MSE for Indian Ocean bigeye and yellowfin tuna. Progress halted in June 2016 when the phase 1 funding ran out, however, the TCMP **NOTED** that a Phase 2 ABNJ-CSIRO contract is under development (July 2017 – Dec 2018) to support the continuation of MSE of Bigeye and Yellowfin tunas.
47. The TCMP **NOTED** the default Yellowfin tuna MP assumptions, including 3 year TAC setting, 15% TAC change constraint, and tuning objectives proposed for phase 2:
- a) 50% probability of rebuilding to $B(\text{target})$ by 2024 (interpretation from Resolution 16/01³)
 - b) 50% probability $B > B(\text{target})$ from 2019-2039 (interpretation from Resolution 15/10)
48. The TCMP **NOTED** the default bigeye tuna MP assumptions, including 3 year TAC setting, 15% TAC change constraint, and tuning objectives proposed for phase 2:
- a) 50% probability $B > B(\text{target})$ from 2019-2039 (interpretation from Resolution 15/10)
 - b) 75% probability in Kobe green zone from 2019-2039 (interpretation from Resolution 15/10)

6.3. Skipjack tuna

49. The TCMP **RECOMMENDED** that the Commission considers establishing a procedure for implementing the results of application of the HCR contained in Resolution 16/02 as soon as the catch limit is estimated by the SC. Following the review by the SC of the stock assessment of skipjack tuna in 2017, such a procedure would lead to an administrative procedure by which the Secretariat notifies CPCs of the catch limit to be enforced from 1st January 2018.

6.4. Swordfish

50. The TCMP **NOTED** that there is currently no funding to carry out the MSE for swordfish, however, the WPM will begin to develop the MSE based on results from the 2017 assessment using existing platforms to minimize development time and associated costs.

7. DISCUSSION OF THE ACTIONS NEEDED FOR NEXT ITERATION OF MANAGEMENT PROCEDURE DEVELOPMENT

7.1. Albacore tuna

51. The TCMP **NOTED** that the time period for providing new advice in the simulations is based on current assessment cycles (i.e. 3 years for albacore, 3 years for tropical tunas). It may be more appropriate to revise the frequency of advice based on the life history traits of the species so that shorter-lived species, or those with more variable recruitment, are assessed more regularly than longer-lived species and for stocks that have a poor status to be amended more regularly. The TCMP **REQUESTED** the SC test the effect on risk levels of advice for the stock being given at different time lags, **NOTING** that in a fully pre-specified MP calculating a new TAC every year is relatively simple if the necessary data are available.

³ Resolution 16/01 *On an interim plan for rebuilding the Indian Ocean yellowfin tuna stock*

7.2. Albacore, Yellowfin and Bigeye tunas

52. The TCMP **AGREED** that based upon the two objectives specified in Resolution 15/10, the following be used as the basis for preliminary tuning for these stocks, to span an informative range of the catch-risk trade-off space, and explore the results of each:

- $P(SSB > SSB_{MSY}) = 50\%$
- $P(\text{being in the green zone of the Kobe plot}) = 50\%, 60\%, 70\%$

7.3. Swordfish

53. The TCMP **NOTED** that work should start after the stock assessment of the stock is carried out in 2017.

8. FUTURE DIRECTION OF THE TECHNICAL COMMITTEE ON MANAGEMENT PROCEDURES

8.1. WORK PLAN (Including new timelines/budget and resources needed)

54. The TCMP **NOTED** that there is currently insufficient budget to conduct the work plan agreed in resolution 15/10 and **RECOMMENDED** that a budget is developed and that extra-budgetary funding is sought.

55. The TCMP **REQUESTED** a concrete workplan be drafted by the Scientific Committee in 2017.

56. The TCMP **NOTED** that while it is possible to develop some robust MPs with relatively little data, the operating models that are used are still complex and have substantial data requirements, so good quality data are still a high priority. Additional data also allows the exploration of more complex MPs.

57. The TCMP **NOTED** that improved data (including carefully designed fisheries independent research) can lead to reductions in uncertainty about stock status and likely future conditions of the stock, leading to a lessened need for precaution in management to achieve the Commission's objectives.

8.2. Process and future meetings of TCMP

58. The TCMP **NOTED** that although the IOTC Management Procedure Dialogues have now concluded, capacity building activities will still take place in parallel to the TCMP, such as the capacity building workshop between scientists and managers that took place with the support of the FAO-GEF ABNJ Common Oceans Tuna Project in March 2017.

59. The TCMP **NOTED** the pledge of the FAO-GEF ABNJ Common Oceans Tuna Project to support another MSE dialogue workshop in 2018, further **NOTING** that there are other methods of improving understanding and communication such as materials that could be produced and made available online.

60. The TCMP **REQUESTED** that scientific presentations are further simplified for subsequent meetings through the provision of some practical examples of the results of specific MPs so that all delegations can be more actively involved. While the meeting was based around presentations rather than papers, the timely provision of papers and explanatory materials in advance of the meeting would be needed to assist participants in better understanding the results of different MPs presented.

61. The TCMP **NOTED** that there is a large discrepancy in the levels of scientific expertise amongst the various CPCs within the Commission and **RECOMMENDED** that more science-related capacity building activities are conducted in future, especially to cover the concepts linked with the evaluation of MPs through MSE.

62. The TCMP **NOTED** that one day is unlikely to be sufficient for the high number of tasks already allocated to the meeting and **RECOMMENDED** that the Commission consider the duration of the TCMP session in 2018 relative to the other activities of the Commission. More than one day would help to improve the science-management communication.

APPENDIX I

LIST OF PARTICIPANTS

CO-CHAIRPERSONS

Dr Ahmed **Al-Mazrouai**
Ministry of Agriculture and Fisheries
Email: ahmed.almazrouai20@gmail.com

Dr Hilario **Murua**
AZTI Technalia
Email: hmurua@azti.es

IOTC MEMBERS

AUSTRALIA

Head of Delegation
Ms Susan **Howell**
Department of Agriculture and Water Resources
Email: susan.howell@agriculture.gov.au

Alternate

Mr Ashley **Williams**
Department of Agriculture and Water Resources
Email: Ashley.williams@agriculture.gov.au

Advisor(s)

Angela **Abolhassani**
University of Tasmania
Email: angela.abolhassani@utas.edu.au
<mailto:trent.timmiss@afma.gov.au>

Mr Trent **Timmiss**
Australian Fisheries Management Authority
Email: Trent.timmiss@dfat.gov.au

Ms Laura **Timmins**
Department of Agriculture and Water Resources
Email: laura.timmins@dfat.gov.au

Mr Stuart **Curran**
Department of Agriculture and Water Resources
Email: Stuart.Curran@agriculture.gov.au

CHINA

Head of Delegation
Mr Xu **Liuxiong**
Shanghai Ocean University
Email: lxu@shou.edu.cn

Alternate

Dr Liu **Xiaobing**
Shanghai Ocean University
Email: xiaobing.liu@hotmail.com

Advisor(s)

Dr Zhu **Jianfeng**
Shanghai Ocean University
Email: jfzhu@shou.edu.cn

Ms Zhang **Kairui**
China Overseas Fisheries Association
Email: admin1@tuna.org.cn

COMOROS

Head of Delegation
Mr. Ahmed Said **Soilihi**
Direction Générale de Ressources Halieutiques
Email: ahmed.ndevou@yahoo.fr

Advisor(s)

Mr. Said **Boina**
Direction Générale de Ressources Halieutiques
Email: dalaili@live.fr

ERITREA

ABSENT

EUROPEAN UNION (MEMBER ORGANIZATION)

Head of Delegation
Mr Orlando **Fachada**
Maritime Affairs and Fisheries
Email: orlando.fachada@ec.europa.eu

Alternate

Mr Patrick **Daniel**
DG Mare
Email: Patrick.daniel@ec.europa.eu

Advisor(s)

Dr. Iago Mosqueira
European Commission Joint Research Centre
iago.mosqueira@ec.europa.eu

Mr Anders **Jessen**
European Union
Email: anders.jessen@ec.europa.eu

Mr Seppo **Nurmi**
European Commission
Email: seppo.nurmi@ec.europa.eu

FRANCE

Head of Delegation
Mrs Anne-France **Mattlet**
Ministry of Environment, Sustainable development and Sea
Email: anne-france.mattelet@developpement-durable.gov.fr

Alternate

Mr Thierry **Clot**
Terres australes et antarctiques françaises (TAAF)
Email: Thierry.clot@taaf.fr

GUINEA

ABSENT

INDIA

ABSENT

INDONESIA
Head of Delegation
Mr Saut **Tampubolon**
Ministry of Marine Affairs and Fisheries
Email: s.tampubolon@yahoo.com

Alternate

Mr Agustinus Anung **Widodo**
Ministry of Marine Affairs and Fisheries
Email: anungwd@yahoo.co.id

Advisor(s)

Mr Zulkarnaen **Fahmi**
Tuna Fisheries Research Center
Email: fahmi.paksi@gmail.com

Prof. Wudianto
Ministry of Marine Affairs and Fisheries
Email: wudianto59@gmail.com

Mr Wawan **Rowandi**
Fish Resources Management
Email: sayakanou@gmail.com

Mr Fayakun **Satria**
Ministry of Marine Affairs and Fisheries
Email: fasatria70@gmail.com

Ms Lilis **Sadiyah**
Ministry of Marine Affairs and Fisheries
Email: sadiyah.lilis2@gmail.com

IRAN (ISLAMIC REPUBLIC OF)

Head of Delegation
Mr Fariborz **Rajaei**
Fisheries Department
Email: rajaeif@gmail.com

Alternate

Mr Mokhtar **Akhondi**
Fisheries Department
Email: akhondi2200@yahoo.com

JAPAN

Head of Delegation
Mr Shingo **Ota**
Resources Management Department
Email: shingo_ota810@maff.go.jp

Alternate

Mr Ryo **Omori**
Resources Management Department
Email: ryo_omori330@maff.go.jp

Advisor(s)

Mr Takeru **Iida**
Fisheries Management Division
Email: takeru_iida150@maff.go.jp

Mr Kiyoshi **Katsuyama**
Japan Tuna Association
Email: katsuyama@japantuna.or.jp

Mr Hiroyuki **Yoshida**
Japan Tuna Association
Email: yoshida@japantuna.or.jp

Mr Sakae **Terao**
Japan Far Seas Purse seine Fishing Association
Email: japan@kaimaki.or.jp

Dr Takayuki **Matsumoto**
National Research Institute of Far Seas
Fisheries
Email: matumot@affrc.go.jp

KENYA**Head of Delegation**

Mr Benedict **Kiilu**
Kenya Fisheries Service
Email: kiilub@yahoo.com

MADAGASCAR**Head of Delegation**

Mr Desire **Tilahy**
Ministère des Ressources Halieutiques et de la
Pêche
Email: tilahydesire@yahoo.fr

MALAYSIA**Head of Delegation**

Ms Tengku Balkis Binti **Tunku Shahar**
Department of Fisheries Malaysia
Email: balkis@dof.gov.my

Alternate

Mr, Sallehudin Bin **Jamon**
Department of Fisheries Malaysia
Email: sallehudin_jamon@dof.gov.my

MALDIVES**Head of Delegation**

Dr Shiham **Adam**
Ministry of Fisheries and Agriculture
Email: msadam@mrc.gov.mv

Alternate

Mr Hussain **Sinan**
Ministry of Fisheries and Agriculture
Email: hussain.sinan@fishagri.gov.mv

Advisor(s)

Mr Adam **Ziyad**
Ministry of Fisheries and Agriculture
Email: adam.ziyad@fishagri.gov.mv

MAURITIUS**Head of Delegation**

Mr Devanaand **Norungee**
Ministry of Ocean Economy, Marine
Resources, Fisheries and Shipping
Email: dnorungee@gmail.com

MOZAMBIQUE**Head of Delegation**

Ms Claudia **Tomas de Souza**
Ministry of Sea, Inland Waters and Fisheries
Email: ctomas2013@gmail.com

Advisor(s)

Mr Erudito **Malate**
Ministry of Sea, Inland Waters and Fisheries
Email: malateerudito@gamil.com

Mr Avelino Munwane

Ministry of Sea, Inland Waters and Fisheries
Email: avelinoalfiado@hotmail.co.uk

OMAN

Mr Ahmed **Al-Mazrouai**
Ministry of Agriculture and Fisheries
Email: ahmed.almazrouai20@gmail.com

PAKISTAN**Head of Delegation**

Mr Muhammad Farhan **Khan**
Ministry of Ports and Shipping
Email: farhankhan704@gmail.com

PHILIPPINES**Head of Delegation**

Mr Rafael **Ramiscal**
Capture Fisheries Division
Email: rv_ram55@yahoo.com

Alternate

Ms Rosanna Bernadette **Contreras**
Socksargen Federation of Fishing and Allied
Industries. Inc
Email: fishing.federation@gmail.com

Advisor(s)

Ms Elaine **Garvilles**
Bureau of Fisheries and Aquatic Resources
Email: egarvilles@yahoo.com

REPUBLIC OF KOREA**Head of Delegation**

Ms Kim **Jung-re**
Ministry of Oceans and Fisheries
Email: riley1126@korea.kr

Alternate

Ms. Miyoung **Choi**
Ministry of Oceans and Fisheries
Email: choimi@korea.kr

Advisor(s)

Mr. Ilkang **Na**
Korea Overseas Fisheries Association
Email: ikna@kosfa.org

Mr Jung-hee Yoo

Dongwon Industries
Email: gagame2@dongwon.com

SEYCHELLES**Head of Delegation**

Mr Roy **Clarisse**
Ministry of Agriculture and Fisheries
Email: rclarisse@gov.sc

Alternate

Mr. Vincent **Lucas**
Seychelles Fishing Authority
Email: vlucas@sfa.sc

SIERRA LEONE**ABSENT****SOMALIA****Head of Delegation**

H.E Abdullahi Omar **Abshir**
Ministry of Fisheries and Marine Resources
Email: abshirow@mfmr.gov.so

SOUTH AFRICA**Head of Delegation**

Mr Asanda **Njobeni**
Department of Agriculture Forestry and
Fisheries
Email: AssandaN@daff.gov.za

Alternate

Mr Saasa **Phecha**
Ministry of Agriculture, Forestry and Fisheries
Email: saasaP@daff.gov.za

Advisor(s)

Mr Qayiso **Mketsu**
Department of Agriculture Forestry and
Fisheries
Email: QayisoMK@daff.gov.za

SRI LANKA**Head of Delegation**

Mrs H.P.K **Hewapathirana**
Department of Fisheries and Aquatic
Resources
Email: hewakal2012@gmail.com

THAILAND**Head of Delegation**

Mrs. Pattira **Lirdwitayaprasit**
Overseas Fisheries and Transshipment Control
Division
Email: pattiral@hotmail.com

Alternate

Ms. Sampan **Panjarat**
Marine fisheries Research and Development
Center
Email: spanjarat@yahoo.com

LT. Chirat Nuangsang

Overseas Fisheries and Transshipment Control
Division
Email: capt.chirat@gmail.com

UNITED KINGDOM (OT)**Head of Delegation**

Dr Chris **Mees**
MRAG LTD.
Email: c.mees@mrags.co.uk

UNITED REPUBLIC OF TANZANIA**Head of Delegation**

Mr Hosea Gonza **Mbilinyi**
Deep Sea Fishing Authority
Email: hoseagonza86@gmail.com

Alternate (s)

Mr Christian **Nzowa**
Deep Sea Fishing Authority
Email: christiannzowa@gmail.com

Advisor(s)

Mr Juma Omar **Haji**
Deep Sea Fishing Authority
Email: changaaweni@gmail.com

COOPERATING NON-CONTRACTING PARTIES**SENEGAL****Head of Delegation**

Mr Mamadou Seye
 Ministry of Fisheries and Maritime
 Economy
 Email: mdseye@gmail.com

LIBERIA**Head of Delegation**

Mr Rafael Cigarruista
 Liberia Maritime Authority
 Email: rcigarruista@liscr.com

OBSERVERS**FOOD AND AGRICULTURE ORGANISATION**

Mr Christopher O'Brien
 Email: Chris.O'Brien@fao.org

RUSSIAN FEDERATION

Dr Sergei Leontiev
 Email: leon@vniro.ru

UNITED STATES OF AMERICA

Mr Michael Brakke
 Email: Brakkem@state.gov

Ms Melanie King

Email: Melanie.king@noaa.gov

INTERNATIONAL POLE AND LINE FOUNDATION

Mr Adam Baske
 Email: adam.baske@ipnlf.org

INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION

Ms Claire van der Geest
 Email: cvandergeest@iss-foundation.org
 Mr Gerald Scott
 Email: gpscott_fish@hotmail.com

PEW CHARITABLE TRUSTS

Mr. Ryan Orgera
 Email: rorgera@pewtrusts.org

SUSTAINABLE FISHERIES PARTNERSHIP

Mr Geoff Tingley
 Email: Geoff.tingley@sustainablefish.org

INDIAN OCEAN COMMISSION

Mrs Jeronime Fanjanirina
 Email: jeronime.fanjanirina@coi-ioc.org

SWIOFISH

Mr Daroomalingum Mauree
 Email: daroomalingum.mauree@coi-ioc.org

INVITED EXPERTS

Mr Ming-Fen Wu
 Fisheries Agency
 Email: mingfen@mssl.ta

Mr Ken Chien-Nan Lin
 Fisheries Agency
 Email: chiennan@mssl.fao.tw

Ms Shan-Wen Yang
 Fisheries Agency
 Email: shenwen@ofdc.org.tw

Dr Shih-Ming Kao
 Fisheries Agency
 Email: kaosm@udel.edu

IOTC SECRETARIAT

Dr Alejandro Anganuzzi
 Indian Ocean Tuna Commission
 Email: Alejandro.Anganuzzi@fao.org

Mr Dan Fu
 Indian Ocean Tuna Commission
 Email: Dan.Fu@fao.org

Mr Olivier Roux
 Indian Ocean Tuna Commission
 Email: Olivier@otolith.com

Dr Sarah Martin
 Indian Ocean Tuna Commission
 Email: sarah.martin@fao.org

Mr Howard Whalley
 Indian Ocean Tuna Commission
 Email: Howard.Whalley@fao.org

Ms Mirose Govinden
 Indian Ocean Tuna Commission
 Email: mirose.govinden@iotc.org

INTERPRETERS

Ms Anne Helene Tottier
 Email: a.tottier@aiic.net

Mr Tyrone Carbone
 Email: t.carbone@aiic.net

Mr Olivier Bonifacio
 Email: bonifacio@aiic.net

Mr Guillaume Fleury
 Email: gfleury_sg@yahoo.com.sg

Ms Claire Keefe-fox
 Email: claire.keefe@gmail.com

APPENDIX II
AGENDA FOR 1ST IOTC TECHNICAL COMMITTEE ON MANAGEMENT PROCEDURE

Date: 20 May 2017

Location: Yogyakarta

Venue: Royal Ambarukmo, Yogyakarta, Indonesia

Time: 09:00 – 17:00

Co-Chairs: Ahmed Al-Mazroui (Commission Chair); Hilario Murua (SC Chair)

Facilitator: Graham Pilling

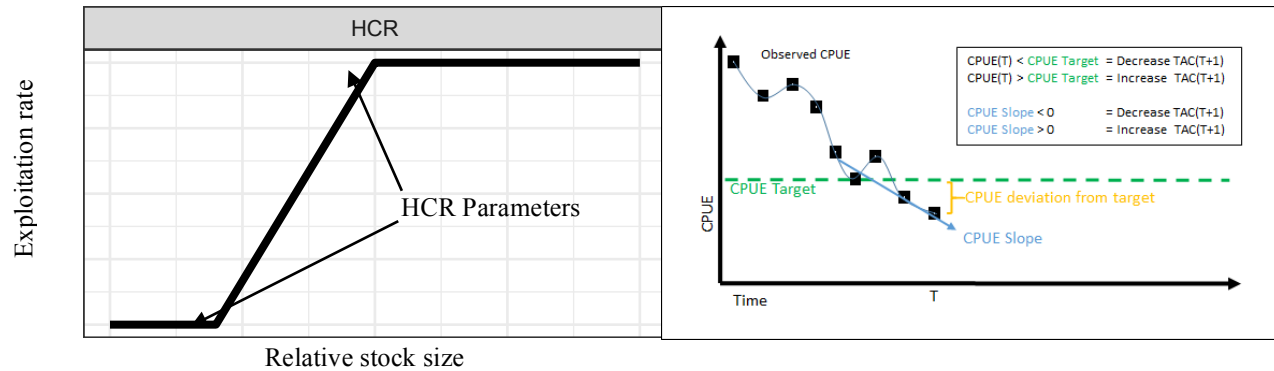
- 1. OPENING OF THE SESSION AND ARRANGEMENTS (Co-Chairs)**
- 2. ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION (Chairperson)**
- 3. ADMISSION OF OBSERVERS**
- 4. DECISIONS OF THE COMMISSION RELATED TO THE WORK OF THE TECHNICAL COMMITTEE ON MANAGEMENT PROCEDURES (IOTC Secretariat)**
 - 4.1. Resolution 16/09 – Terms of Reference
 - 4.2. Outcomes of the 20th Session of the Commission and MPD meetings
- 5. OVERVIEW OF THE EVALUATION OF MANAGEMENT PROCEDURES IN THE IOTC (SC Chairperson)**
 - 5.1. The IOTC Process on adoption of management procedures (Including the Resolution 15/10 of the Management Framework) (SC Chairperson).
 - 5.2. Management Strategy Evaluation: basic principles
 - 5.3. Roles and responsibilities,
 - 5.4. SC proposal for the standard presentation of MSE results
 - 5.5. MSE tuning: adjusting MP to objectives
- 6. STATUS OF THE MANAGEMENT PROCEDURE EVALUATION/OPERATING MODELS (Chairperson of WPM)**
 - 6.1. Albacore tuna (Iago Mosqueira, Vice-Chairperson of the WPM).
 - 6.2. Yellowfin and Bigeye tunas (Dale Kolody)
 - 6.3. Skipjack tuna (Hilario Murua, Chairperson of the SC)
 - 6.4. Swordfish (Iago Mosqueira, Vice-Chairperson of the WPM)
- 7. DISCUSSION ON THE ACTIONS NEEDED FOR THE ADOPTION OF MANAGEMENT PROCEDURES (Facilitator)**
 - 7.1. Albacore tuna
 - 7.2. Yellowfin and Bigeye tunas
 - 7.3. Skipjack tuna
- 8. FUTURE DIRECTION OF THE TECHNICAL COMMITTEE ON MANAGEMENT PROCEDURES (Facilitators)**
 - 8.1. Workplan (Including new timelines/budget and resources needed)
 - 8.2. Process and future meetings of TCMP

APPENDIX III
LIST OF DOCUMENTS

Document	Title	Availability
IOTC-2017- TCMP01-01a	Draft: Agenda of the 1 st Technical Committee on Management Procedure Meeting	✓ (6 May)
IOTC-2017- TCMP01-01b	Final Agenda of the 1 st Technical Committee on Management Procedure Meeting	✓ (20 May)
IOTC-2017- TCMP01-02a	Draft: List of documents of the 1st Technical Committee on Management Procedure (TCMP01)	✓ (15 May)
IOTC-2017- TCMP01-03	IOTC Resolution 16/09	✓ (15 May)
IOTC-2017- TCMP01-04	Outcomes of the 3 rd Management Procedure Dialogue Workshop	63. (15 May)
IOTC-2017- TCMP01-05	Outcomes of the 20 th Session of the Commission	✓ (15 May) 64.
IOTC-2017- TCMP01-06	A Glossary of some terms referred to in presentations and discussion at the TCMP01	✓ (15 May)
IOTC-2017- TCMP01-07	Presentation of Management Strategy Evaluation Results	✓ (15 May) 65.

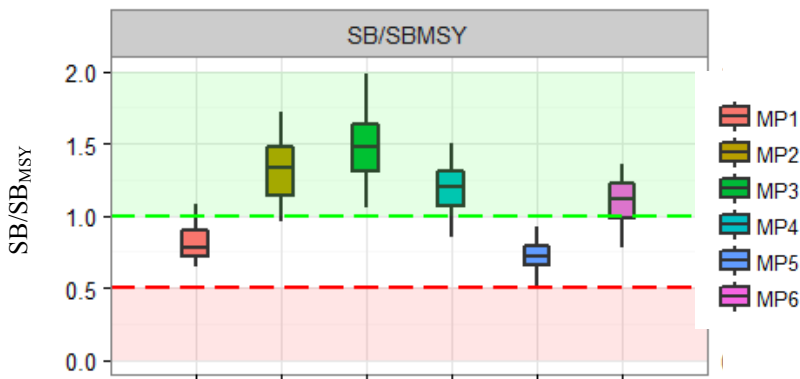
APPENDIX IV PRESENTATION OF MANAGEMENT STRATEGY EVALUATION RESULTS

Figure 1. Harvest Control Rule (HCR)

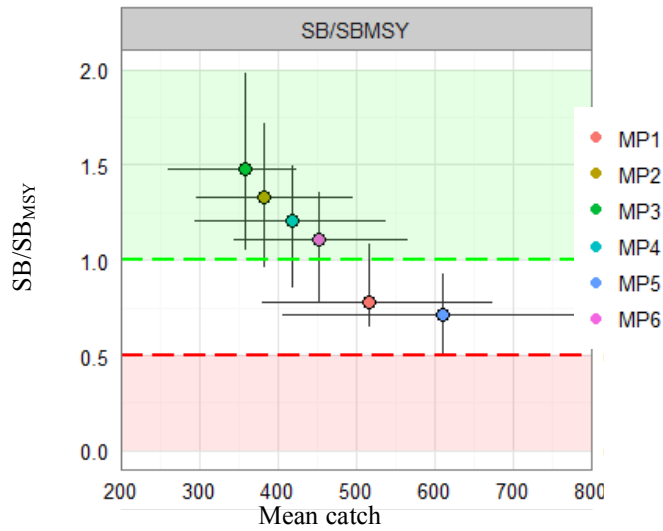


Examples of two different types of harvest control rules: Biomass-based HCR relating exploitation rate to relative stock size (left), and cpue-based HCR relating observed cpue to a target level cpue. (right).

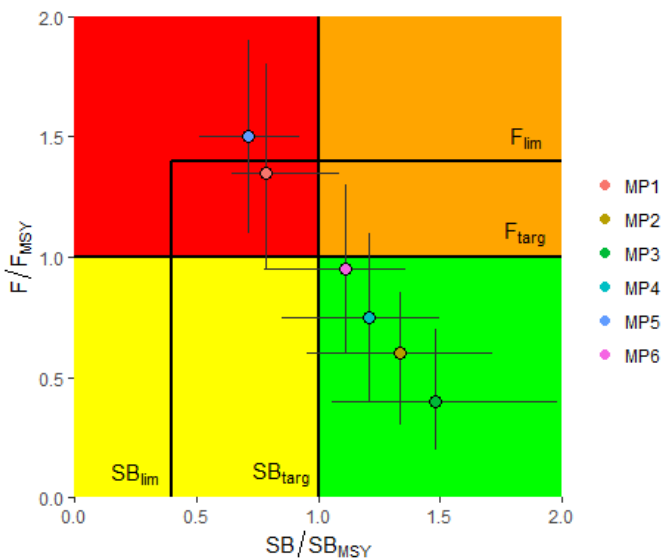
Figure 2. Boxplot comparing performance of Management Procedures (MPs)



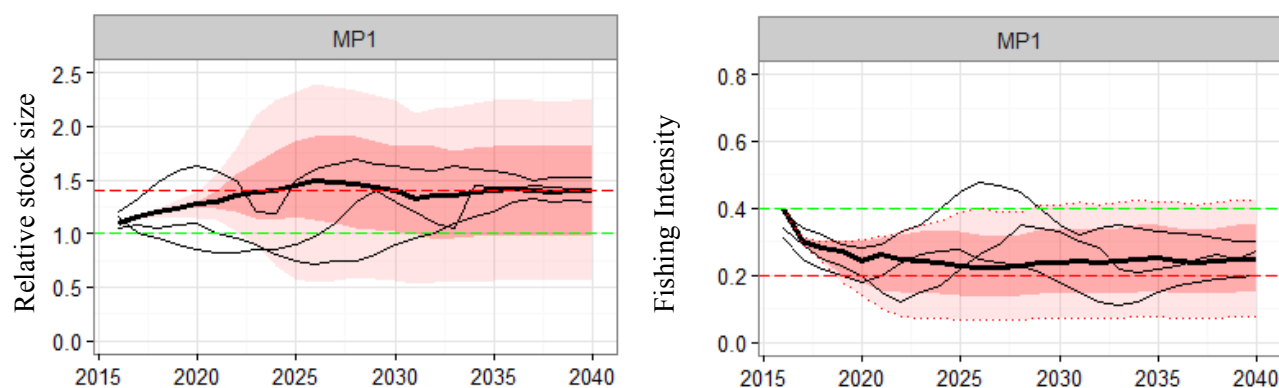
This example boxplot compares the performance of 6 MPs against SB/SB_{MSY} . Each data point represents the median over the last 20 years of the projection period as the horizontal line, 25th - 75th percentiles as coloured bars, and 5th -95th percentiles as thin lines. Limit and target reference points are indicated by red and green dashed lines respectively.

Figure 3. Trade-off plot comparing performance of Management Procedures (MPs)

This example trade-off plot indicates the trade-offs in performance of 6 management procedures (MPs) between catch and SB/SB_{MSY}. Each data point represents the median over the last 20 years of the projection period and the errors bars represent 5th and 95th percentiles. Limit and target reference points are indicated by red and green dashed lines respectively.

Figure 4. Kobe plot comparing Management Procedures (MPs) against B_{MSY} and F_{MSY} reference points

This example Kobe plot compares 6 management procedures (MPs) against performance measures for SB/SB_{MSY} and F/F_{MSY}. Each data point represents the median in the final year of the projection period and the error bars represent the 95th percentiles. Target (SB_{targ} and F_{targ}) and limit (SB_{lim} and F_{lim}) reference points are indicated by black lines.

Figure 4. Time series projections for the performance of Management Procedures (MPs)

These example time series plots indicate the performance of 1 MP against the stock size (left) and fishing intensity (right) performance measures projected over the years 2016-2040. The median is represented by the bold black lines, a dark ribbon shades the 25th - 75th percentile region and a light ribbon shades the 10th - 90th percentile region. Three additional thin black.

Table 1. Summary table of performance of Management Procedures (MPs). Performance of 6 MPs against 5 performance measures averaged over the last 20 years of the projection period. Shading indicates the relative performance for each MP (dark = better, light = worse).

Management Procedure	Performance Measure				
	SB/SB _{MSY}	Probability(Green)	Probability(SB>limit)	Mean Catch	Catch variability
MP1	0.78	0.05	0.84	516	0.16
MP2	1.33	0.94	0.96	383	0.28
MP3	1.48	0.96	1	358	0.3
MP4	1.21	0.84	0.93	419	0.22
MP5	0.72	0	0.71	611	0.1
MP6	1.11	0.61	0.91	452	0.21

Table 2. Hypothetical example of MSE outputs comparing the performance of 6 management procedures (MPs) against all IOTC performance measures for 2 time periods (1 years and 5 years).

Status : maximize stock status		1 year						5 years					
		MP1	MP2	MP3	MP4	MP5	MP6	MP1	MP2	MP3	MP4	MP5	MP6
1. Mean spawner biomass relative to pristine	SB/SB0	0.5	0.8	0.9	0.7	0.4	0.6	0.5	0.8	1.0	0.7	0.4	0.6
2. Minimum spawner biomass relative to pristine	SB/SB0	0.3	0.6	0.6	0.5	0.2	0.4	0.3	0.5	0.6	0.5	0.2	0.4
3. Mean spawner biomass relative to SBMSY	SB/SBMSY	0.8	1.3	1.4	1.2	0.7	1.1	0.9	1.2	1.3	1.1	0.7	1.2
4. Mean fishing mortality relative to target	F/Ftar	1.4	0.6	0.4	0.8	1.5	0.9	1.4	0.6	0.4	0.8	1.5	0.9
5. Mean fishing mortality relative to FMSY	F/FMSY	1.4	0.6	0.4	0.8	1.5	0.9	1.5	0.5	0.4	0.8	1.6	0.9
6. Probability of being in Kobe green quadrant	SB,F	0.5	0.9	1	0.8	0.3	0.7	0.5	0.9	0.9	0.8	0.3	0.7
7. Probability of being in Kobe red quadrant	SB,F	0.3	0.1	0	0.1	0.5	0.2	0.3	0.1	0.0	0.1	0.5	0.2
Safety : maximize the probability of remaining above low stock status (i.e. minimize risk)													
8. Probability of spawner biomass being above 20% of SB0	SB	0.8	0.9	0.9	0.8	0.7	0.8	0.8	0.8	0.9	0.8	0.7	0.8
9. Probability of spawner biomass being above BLim	SB	0.8	1.0	1.0	0.9	0.7	0.9	0.8	1.0	1.0	0.9	0.7	0.8
Yield : maximize catches across regions and gears													
10. Mean catch (1'000 t)	C	520	390	350	430	600	460	551	417	378	434	600	460
11. Mean catch by region and/or gear (1'000 t)	C	250	200	180	210	310	220	248	194	176	229	335	218
12. Mean catch relative to MSY	C/MSY	1.1	0.7	0.6	0.8	1.2	0.9	1.2	0.6	0.6	0.8	1.3	1.0
Abundance: maximize catch rates to enhance fishery profitability													
13. Mean catch rates (by region and gear) (for fisheries with meaningful catch-effort relationship)	I	3.2	3.8	3.9	2.7	2.5	2.6	3.0	3.8	4.0	2.6	2.3	2.8
Stability: maximize stability in catches to reduce commercial uncertainty													
14. Mean absolute proportional change in catch	C	0.2	0.3	0.3	0.2	0.1	0.2	0.2	0.3	0.3	0.2	0.1	0.2

15. % Catch coefficient of variation	C	20	25	24	18	12	21	19.4	27.3	26.2	17.6	11.5	21.0
16. Probability of shutdown	C	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Status : maximize stock status		10 years						20 years					
		MP1	MP2	MP3	MP4	MP5	MP6	MP1	MP2	MP3	MP4	MP5	MP6
1. Mean spawner biomass relative to pristine	SB/SB0	0.5	0.8	0.9	0.7	0.4	0.6	0.5	0.8	1.0	0.7	0.4	0.6
2. Minimum spawner biomass relative to pristine	SB/SB0	0.3	0.6	0.6	0.5	0.2	0.4	0.3	0.5	0.6	0.5	0.2	0.4
3. Mean spawner biomass relative to SBMSY	SB/SBMSY	0.8	1.3	1.4	1.2	0.7	1.1	0.9	1.2	1.3	1.1	0.7	1.2
4. Mean fishing mortality relative to target	F/Ftar	1.4	0.6	0.4	0.8	1.5	0.9	1.4	0.6	0.4	0.8	1.5	0.9
5. Mean fishing mortality relative to FMSY	F/FMSY	1.4	0.6	0.4	0.8	1.5	0.9	1.5	0.5	0.4	0.8	1.6	0.9
6. Probability of being in Kobe green quadrant	SB,F	0.5	0.9	1	0.8	0.3	0.7	0.5	0.9	0.9	0.8	0.3	0.7
7. Probability of being in Kobe red quadrant	SB,F	0.3	0.1	0	0.1	0.5	0.2	0.3	0.1	0.0	0.1	0.5	0.2
Safety : maximize the probability of remaining above low stock status (i.e. minimize risk)													
8. Probability of spawner biomass being above 20% of SB0	SB	0.8	0.9	0.9	0.8	0.7	0.8	0.8	0.8	0.9	0.8	0.7	0.8
9. Probability of spawner biomass being above BLim	SB	0.8	1.0	1.0	0.9	0.7	0.9	0.8	1.0	1.0	0.9	0.7	0.8
Yield : maximize catches across regions and gears													
10. Mean catch (1'000 t)	C	520	390	350	430	600	460	551	417	378	434	600	460
11. Mean catch by region and/or gear (1'000 t)	C	250	200	180	210	310	220	248	194	176	229	335	218
12. Mean catch relative to MSY	C/MSY	1.1	0.7	0.6	0.8	1.2	0.9	1.2	0.6	0.6	0.8	1.3	1.0
Abundance: maximize catch rates to enhance fishery profitability													
13. Mean catch rates (by region and gear) (for fisheries with meaningful catch-effort relationship)	I	3.2	3.8	3.9	2.7	2.5	2.6	3.0	3.8	4.0	2.6	2.3	2.8
Stability: maximize stability in catches to reduce commercial uncertainty													

14. Mean absolute proportional change in catch	C	0.2	0.3	0.3	0.2	0.1	0.2	0.2	0.3	0.3	0.2	0.1	0.2
15. % Catch coefficient of variation	C	20	25	24	18	12	21	19.4	27.3	26.2	17.6	11.5	21.0
16. Probability of shutdown	C	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01