Indian Ocean Tuna Commission
Commission des Thons de l'Ocean Indien
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COMMON OCEANS

Report of the 2nd IOTC Management Procedure Dialogue (MPD02)

Busan, Rep. of Korea, 26& 28 April 2015.

DISTRIBUTION:
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ACRONYMS

ABNJ	Areas Beyond National Jurisdiction
BET	Bigeye Tuna
BMSY	Biomass that achieves maximum sustainable yield
CCSBT	Commission for the Conservation of Southern Bluefin Tuna
CPCs	Contracting parties and cooperating non-contracting parties
CPUE	Catch per unit of effort
EU	European Union
EEZ	Exclusive Economic Zone
ENV	Environmental Effect
FAD	Fish-aggregating device
FAO	Food and Agriculture Organization of the United Nations
FMSY	Fishing mortality that achieves maximum sustainable yield.
IATTC	Inter-American Tropical Tuna Commission
ICCAT	International Commission for the Conservation of Atlantic Tunas
IOTC	Indian Ocean Tuna Commission
IRD	Institut de recherchepour le dévelopement, France
IUU	Illegal Unreported and Unregulated
IWC	International Whaling Commission
LL	Longline
MFCL	Multifan-CL
MPD	Management Procedures Dialogue
MSC	Marine Stewardship Council
MSE	Management Strategy Evaluation
MSY	Maximum Sustainable Yield
OFCF	Overseas Fishery Cooperation Foundation of Japan
PL	Pole and Line
PS	Purse-seine
R	R Package for Statistical Computing
ROP	Regional Observer Programme
ROS	Regional Observer Scheme
SAS	Software for Analyzing Data
SC	Scientific Committee of the IOTC
STD	Standardized
tRFMO	tuna Regional Fisheries Management Organization
VMS	Vessel Monitoring System
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
WWF	World Wildlife Fund
YFT	Yellowfin Tuna

Executive Summary

The second Management Procedures Dialogue, as agreed to in Resolution 14–03 including participants from the IOTC CPCs took place in Busan, Rep. of Korea on April 26 and 28, 2015. Concepts of what the IOTC is developing to ensure the long term sustainability of the resource and the fishery were discussed, and put in the context of the Precautionary Approach to fisheries.

The discussions were aimed at providing clarification on the various elements of a management procedure, and how the process of Management Strategy Evaluation is utilised to assess the performance of candidate management procedures in fulfilling the management objectives identified in consultation with CPC's. The roles of the managers and scientists in this process were also discussed.

A comprehensive overview of what the MSE entails was presented by Dr. Doug Butterworth, an expert in the field. Current process and an overview of what has been done in the IOTC was provided by the invited experts. Following that detailed overviews of the current status of the MSE on albacore and skipjack tuna were presented and discussed.

An exercise to illustrate how a Management Procedure (MP) can be tuned on the basis of performance measures that evaluate the degree that the different objectives are met was presented.

The workshop considered the statistics shown in Table 1 as a possible first approximation to measure status, yield, safety, and stability in the evaluation of an initial set of candidate management measures.

Table 1: Performance statistics suggested for the evaluation of management procedures

Possible management objectives and associated performance statistics	**Performance measure/s**	**Summary statistic**
Status : *maximize probability of maintaining stock in the Kobe green zone*		
Mean spawner biomass relative to unfished	*B*/*B*0	Geometric mean over years
Minimum spawner biomass relative to unfished	*B*/*B*0	Minimum over years
Mean spawner biomass relative to *Bmsy*	*B*/*Bmsy*	Geometric mean over years
Mean fishing mortality relative to target	*F*/*Ftar*	Geometric mean over years
Mean fishing mortality relative to *Fmsy*	*F*/*Fmsy*	Geometric mean over years
Probability of being in Kobe green quadrant	*B*,*F*	Proportion of years that $B \geq Btar \& F \leq Ftar$
Probability of being in Kobe red quadrant	*B*,*F*	Proportion of years that $B < Btar \& F > Ftar$
Safety : *maximize the probability of the stock remaining above the biomass limit*		
Probability that spawner biomass is above B_{lim} (B_{lim}= 0.2 B0 or 0.4 B_{MSY})	*B*	Proportion of years that $B > B_{lim}$
Yield *: maximize catches across regions and gears*		
Mean catch	*C*	Mean over years
Mean catch by region and/or gear	*C*	Mean over years

Possible management objectives and associated performance statistics	Performance measure/s	Summary statistic
***Abundance**: maximize catch rates to enhance fishery profitability*		
Mean catch rates by region and gear	*A*	Geometric mean over years
***Stability**: maximize stability in catches to reduce commercial uncertainty*		
Mean absolute proportional change (MAPC) in catch	*C*	Mean over years of abs($C_t/C_{t-1}-1$)
Variance in catch	*C*	Variance over years
Probability of shutdown	*C*	Proportion of years that $C=0$

The workshop considered, and some participants indicated, support for the following road map proposed to guide the next steps of the process:

i. At its Session in 2015, the SC should review the simulation models to be used as the basis for the evaluation of management procedures for albacore and skipjack tuna.
ii. A set of initial candidate management procedures, ranging from more conservative to less conservative, and considering both catch and effort based management measures, should be presented for comments at the next meeting of the Management Procedures Dialogue group in 2016.
iii. To facilitate a more interactive environment, after the regular 2016 Management Procedure Dialogue held in conjunction with the Commission, the following dialogue sessions should preferably work with smaller sub-groups of scientists and managers. Results of such sub-groups will nevertheless be shared among all CPCs and will be compiled, consolidated and presented, as appropriate, to the Commission for further consideration and discussion.
iv. The MPD should continue to meet in subsequent years to advance the process until such a time that a management procedure is identified that best meets the management objectives agreed upon.

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1. OPENING OF THE MEETING AND ADOPTION OF THE AGENDA

1. A workshop to discuss Management Procedures and their objectives was conducted on April 26th, 2015 in Busan, Rep. of Korea. The meeting was facilitated by Dr Doug Butterworth who welcomed participants (85 participants from 31 CPC's). The list of participants is provided at Appendix I. Mr Rondolph Payet, Executive Secretary of the IOTC, introduced the workshop, and welcomed participants.

2. The workshop was sponsored by the ABNJ GEF project Common Oceans to facilitate the dialogue on setting management objectives across the different RFMO's. This support included sponsoring various experts and participants to the workshop.

3. The agenda for the MPD02 was adopted as provided at Appendix II.

2. BASIC OVERVIEW OF THE PROCESS

2.1 What is A Management Procedure ?

4. Dr Doug Butterworth gave an overview presentation entitled: What is a Management Procedure (MP)/Management Strategy Evaluation (MSE) and why is it important? This first explained that a Management Procedure is a pre-agreed formula, with a pre-agreed set of data inputs, which is then used to calculate a recommendation for a fisheries management measure – typically a TAC, though this could also be a TAE - and which has been simulation tested to check that it achieves the objectives sought for the fishery under a range of plausible hypotheses for the dynamics of the stock. Management Strategy Evaluation is the process of developing and reaching agreement on the Management Procedure.

5. The Management Procedure approach was contrasted with the more traditional best-assessment-based paradigm for developing management advice, pointing out the problem areas of the traditional approach and how the implementation of a Management Procedure could resolve these. A financial analogy was used to explain the feedback control basis of Management Procedures which enables them to achieve their goals of robust management of a resource in the face of uncertainties about its dynamics. The concept that the output from a Management Procedure should replace the typical default position of "no change" in uncertain situations when managing a fishery was emphasised.

6. The presentation explained the circumstances under which commencing MSE for a fishery would be appropriate. It further summarised key considerations as regards the typical objectives for fisheries management, their conflicting nature necessitating trade-off decisions by managers, and how such objectives could be translated into quantitative performance statistics/indicators. It concluded with an illustration of the application of the approach to the South African hake resource over the last decade.

2.2 Overfishing, overfished and Risk

7. In a presentation by the IOTC Secretariat (Dr Rishi Sharma), tuna stocks were put in context through comparison with other terrestrial species. They are an apex predator and have a key function in an ecosystem, and as such are important to conserve; hence the need for harvest control rules. The concepts of overfishing, and overfished were presented; Overfishing means that stocks are experiencing higher than an optimum fishing mortality, though still in a healthy state, i.e. are above optimal spawning stock size; overfished means that stocks are at lower than optimal spawning biomass size.
8. The concepts of having some procedures in place, when stocks are threatened either due to a high rate of fishing or due to a low spawning biomass, to reduce fishing mortality so as to rebuild the stocks. i.e. a Management Procedure (MP), was explained. The idea was illustrated using some simple examples.
9. IOTC Resolution 13/10 with its key tenets (namely point 4) were discussed in the context of the IOTC:
    4. *In addition the IOTC Scientific Committee shall develop and assess potential harvest control rules (HCRs) to be applied, considering the status of the stocks against the reference points assessed in paragraph 3 for albacore, bigeye tuna, skipjack tuna, yellowfin tuna and swordfish. Based on the results of the MSE and considering the guidelines set forth in the UNFSA and in Article V of the IOTC*

Agreement, the IOTC Scientific Committee will recommend to the Commission HCRs for these tuna and tuna-like species, which among other factors, taking account of the following objectives:

*a) For stocks which assessed status will match with the lower right (green) quadrant of the Kobe Plot, aim at maintaining the stocks in a **high probability** within this quadrant;*

*b) For stocks which assessed status will match with the upper right (orange) quadrant of the Kobe Plot, aim at ending overfishing with a **high probability** in as **short a period as possible;***

*c) For stocks which assessed status will match with the lower left (yellow) quadrant of the Kobe plot, **aim at rebuilding these stocks in as short a period as possible**;*

d) *For stocks which assessed status will match with the upper left quadrant (red), aim at ending overfishing with **a high probability and at rebuilding the biomass of these stocks in as short a period as possible**.*

10. The presentation suggested that concepts of "***as short a period as possible***", and "***high probability***" needed to be explicitly defined, and that was one of the main reasons the dialogue had been initiated. In addition, the point was made that if we manage to F_{MSY}, we inherently run the risk of falling below the optimal biomass target, and if we manage to some target below optimal fishing mortality F_{MSY}, the chances that we would drop below the optimal biomass targets substantially reduces. Thus, the presentation suggested that the Commission may want to consider some targets other than optimal fishing mortality if it is to be more in line with the Precautionary Approach to management. The concept of risk was introduced where for a fisheries manager risk is the probability of making the wrong decision, either i) of failing to detect a problem with a stock when there is one, or ii) unnecessarily restricting a fishery when fishing is optimal or could even be increased. Ultimately, it is a risk based decision or choice where one has to balance the long term yield from the stock with the long term spawning biomass that may eventuate and may threaten future recruitment success if too low.

2.3 Harvest Control Rules and Management Procedures

11. A presentation by Dr Butterworth was given on Harvest Control Rules (HCR), which noted that HCRs form an integral part of fisheries management strategies by explicitly linking outputs from monitoring and assessment to the management actions required to achieve the management objectives. Management Strategy Evaluation (MSE) is a strategic risk assessment tool that can be used to prospectively evaluate the likely performance of alternative Management Procedures.
12. The presentation by Dr. Butterworth noted that a substantial advantage of adopting formal Management Procedures is the definition and agreement on management decisions and associated measures to change levels of fishing prior to the need for substantial action. This assists timely and responsive action when required and avoids the inertia that has often characterised fisheries management historically, to the detriment of the resources. Experience in a range of nations and internationally has demonstrated the benefits of this approach through improved stock status and returns from fisheries.

3. Current Status of MSE within IOTC

3.1 IOTC Scientific Committee Update

13. MSE related IOTC SC recommendations and process justifications (achievements) were presented by SC Chair (Dr. Tom Nishida). First appearance of and an associated proposal for MSE occurred in 2002, but meaningful activities were initiated only in 2009 after five tuna RFMO meetings (Kobe process). Until now, a number of keystone recommendations have been made by the SC, i.e., "precautionary approach", "interim target & limit reference point" and "science and mangers dialogue". These recommendations are adopted as IOTC resolutions 12/01, 13/10 and 14/03 respectively, and have been addressed by WPM to some extent. The presentation noted that the SC and Commissioners (COM) will likely continue to make further recommendations in order to continue the MSE process for skipjack and albacore in 2015/12016 and yellowfin and bigeye tuna in subsequent years.

3.2 IOTC Working Party Methods: Update

14. An update on the current status of work for the development of MSE simulations for IOTC stocks was presented by the Chairperson of the Working Party on Methods (Dr Iago Mosqueira). Work on the development and testing of MSE simulations for albacore and skipjack tuna have been initiated by WPM, and work has progressed in developing Operating Models for both stocks, using slightly different platforms but with a common aim: characterize, to the extent current knowledge allows, the dynamics of these stocks and the unavoidable uncertainties in estimation of associated parameters and prediction.
15. The timeline of work commenced in 2012 after a request from the SC. Work has progressed inter-sessionally via a small group of experts in the field. Initial simulation models are now available for albacore and skipjack tuna, while work for bigeye tuna and yellowfin tuna is about to start.
16. Future steps include the finalization of a full set of albacore and skipjack tuna simulations and work on improved tools for presenting MSE results to the Scientific Committee and Commission.
17. The SC recommendation for extra resources to be devoted to this work was discussed at the MPD02. A process of peer review of the WPM work will take place this year.

3.3 Albacore MSE Update

18. The ongoing work on developing simulation models for MSE of albacore was introduced by the Chairperson of the WPM (Dr Iago Mosqueira). A simplified version of the model and an example candidate Management Procedure were used to draw the attention of participants to various issues. First, the ability of the model to reflect different states of nature in future years, in this case through different levels of future recruitment. Secondly, the use of performance statistics to compare across various scenarios in terms of how close to some management objectives the given procedure would take the stock and the fishery.
19. This example demonstrated the possible use of a Management Procedure whose main input does not depend on stock assessment output but instead uses trends in an index of abundance, for example a CPUE series. The need to maintain, or if possible improve, the quality of the data used for generating this index was touched upon.
20. Special emphasis was laid on the effect of time lags in a management system like the IOTC one. Decisions will be made on stock status or trends using data that are not completely current, given the delay in assembling and transmitting to the scientific bodies of IOTC. Then, management decisions will only be made after the necessary discussion and decision process. Put together, a lag of 4 or 5 years is a realistic possibility, and this is likely to increase the instability of the fishery-resource system.
21. Comments were made at the MPD about possible ways for IOTC to explore in the future mechanisms for decreasing this time lag, if it is found to be important for the successful management of IO tuna fisheries.

3.4 Skipjack tuna MSE Update

22. A consultant (Dr Nokome Bentley) presented an overview of the concepts involved in the design and evaluation of Management Procedures (MPs) with specific reference to the Indian Ocean skipjack tuna fishery. He emphasised that MPs are a mechanism for converting fisheries data into fisheries management decisions. MPs belong to several classes, or families, and each class of MP has control parameters which can be tuned.
23. A MP class, was used for illustration. It was explained that this MP class has four control parameters which can be tuned to produce management outcomes to suit the management objectives and the population dynamics of the stock.
24. A simple spreadsheet was introduced to illustrate the tuning and evaluation of a simple management procedure for skipjack. Some examples of tuning were given and the resulting performance statistics were discussed. Participants were given the opportunity to experiment with the spreadsheet themselves and partake in a "homework challenge" to see if they could achieve better performance statistics through their own tunings.

4. OBJECTIVES FOR MANAGEMENT AND PERFORMANCE MEASURES DISCUSSED

25. The following few paragraphs, extracted from the WPM report, intend to define some of the criteria relevant to management objectives and performance statistics. All these ideas were discussed at the MPD workshop and informal feedback was given on these criteria based on a survey.

Management Objectives: The WPM **NOTED** the potential management objectives developed for skipjack and the associated performance statistics, some of which are stock specific whereas other are more generic. Table 1 lists five broad management objectives that are commonly used in fisheries management. Each is described as seeking to maximize some aspect of the fishery but often there are trade-offs amongst these objectives and it is not possible to maximize all simultaneously. (WPM05 para. 30)

Performance Statistic: The WPM **NOTED** that a *performance statistic* is a quantitative expression of a management objective. It translates a management objective into an indicator that can be quantified within the simulation model of the fishery. For each management objective, Table 1 [of the WPM05 Report) suggests a suite of performance statistics that could be used to assess the performance of a MP. This is not intended to be an exhaustive list and additional performance statistics (e.g. proportional increase in spawner biomass over next 10 years) may be appropriate for particular cases (e.g. for stocks in need of rebuilding). (WPM05 para. 31)

Table1: Performance statistics suggested for the evaluation of management procedures

Management objective and associated performance statistics	***Performance measure/s***	***Summary statistic***
Status : maximize probability of maintaining stock in the Kobe green zone		
Mean spawner biomass relative to unfished	*B*/*B*0	Geometric mean over years
Minimum spawner biomass relative to unfished	*B*/*B*0	Minimum over years
Mean spawner biomass relative to *Bmsy*	*B*/*Bmsy*	Geometric mean over years
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Mean fishing mortality relative to *Fmsy*	*F*/*Fmsy*	Geometric mean over years
Probability of being in Kobe green quadrant	*B*,*F*	Proportion of years that $B \geq Btar \& F \leq Ftar$
Probability of being in Kobe red quadrant	*B*,*F*	Proportion of years that $B < Btar \& F > Ftar$
Safety : m*aximize the probability of the stock remaining above the biomass limit*		
Probability that spawner biomass is above B_{lim} (B_{lim}= 0.2 B0 or 0.4 B_{MSY})	*B*	Proportion of years that $B > B_{lim}$
Yield : maximize catches across regions and gears		
Mean catch	*C*	Mean over years
Mean catch by region and/or gear	*C*	Mean over years
Abundance: maximize catch rates to enhance fishery profitability		
Mean catch rates by region and gear	*A*	Geometric mean over years

Management objective and associated performance statistics	*Performance measure/s*	*Summary statistic*
Stability: maximize stability in catches to reduce commercial uncertainty		
Mean absolute proportional change (MAPC) in catch	C	Mean over years of abs($C_t/C_{t-1}-1$)
Variance in catch	C	Variance over years
Probability of shutdown	C	Proportion of years that C=0

5. MPD WORKSHOP DISCUSSIONS

26. The MPD **DISCUSSED** and **NOTED** the statistics shown above (Table 1) as a first approximation to measure status, yield, safety, and stability in the evaluation of an initial set of candidate management measures. The MPD **CONSIDERED** and some participants indicated support for using these metrics when evaluating alternative MP's.
27. The workshop considered, and some participants indicated, support for the following road map proposed to guide the next steps of the process:

i. At its Session in 2015, the SC should review the simulation models to be used as the basis for the evaluation of management procedures for albacore and skipjack tuna.
ii. A set of initial candidate management procedures, ranging from more conservative to less conservative, and considering both catch and effort based management measures, should be presented for comments at the next meeting of the Management Procedures Dialogue group in 2016.
iii. To facilitate a more interactive environment, after the regular 2016 Management Procedure Dialogue held in conjunction with the Commission, the following dialogue sessions should preferably work with smaller sub-groups of scientists and managers. Results of such sub-groups will nevertheless be shared among all CPCs and will be compiled, consolidated and presented, as appropriate, to the Commission for further consideration and discussion.
iv. The MPD should continue to meet in subsequent years to advance the process until such a time that a management procedure is identified that best meets the management objectives agreed upon.

ADOPTION OF THE REPORT

26. The Report of the 2nd MPD was adopted on 10th June, 2015 via correspondence.

APPENDIX I
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APPENDIX II
AGENDA FOR THE 2ND MANAGEMENT PROCEDURES DIALOGUE

Date: 26 & 28 April 2015

Location: Busan, Rep. of Korea

Venue: Westin Chosun Hotel, Haeundae Beach

Time: 26th: 09:00 – 17:00; 28th: 09:00 – 10:30

Facilitator: Dr. Doug Butterworth

1. **OPENING OF THE SESSION AND ARRANGEMENTS** (Facilitator)
2. **OVERVIEW OF THE EVALUATION OF MANAGEMENT PROCEDURES IN THE IOTC** (Scientific Committee Chairperson and IOTC Secretariat)
3. **IOTC SCIENTIFIC COMMITTEE RECOMMENDATIONS AND PROCESS JUSTIFICATION** (Scientific Committee Chairperson and IOTC Secretariat)
4. **WHAT IS A MANAGEMENT PROCEDURE (MP) / MANAGEMENT STRATEGY EVALUATION (MSE) AND WHY IS IT IMPORTANT?** (Facilitator)
5. **INTRODUCING THE NOTION OF OVERFISHING, OVERFISHED AND RISK TO THE FISHERY AND THE RESOURCE: AN EVALUATION OF THE INTERIM REFERENCE POINTS USING THESE CONCEPTS** (IOTC Secretariat)
6. **STATUS OF THE MANAGEMENT PROCEDURE EVALUATION/OPERATING MODELS FOR ALBACORE** (Chairperson of the WPM)
7. **STATUS OF THE MANAGEMENT PROCEDURE EVALUATION/OPERATING MODELS FOR SKIPJACK TUNA** (Dr N Bentley: Consultant)
8. **DEFINING OBJECTIVES FOR MANAGEMENT PROCEDURES (PERFORMANCE MEASURES WITH CRITERIA PROPOSED BY THE SCIENTIFIC COMMITTEE)** (All)
9. **GROUP DISCUSSION ON WHAT OBJECTIVES COULD BE DEFINED FOR MANAGEMENT PROCEDURES – EXAMPLES** (All)
10. **PRACTICAL/OVERNIGHT GROUP WORK: WHAT PERFORMANCE MEASURES ARE IMPORTANT FOR YOU AS AN IOTC CPC?** (All)
11. **DEFINE YOUR OBJECTIVES** (All)
12. **GROUP EXERCISES: WITH MANAGEMENT PROCEDURES AND OUTCOMES OF THEM USING ALBACORE AND SKIPJACK TUNA OPERATING MODELS WITH RESPECT TO THE OBJECTIVES** (All)
13. **SUMMARY: DISCUSSION ON A POTENTIAL SET OF OBJECTIVES AND MANAGEMENT PROCEDURES FOR THE EVALUATION OF ALBACORE AND SKIPJACK TUNA** (All)