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Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien

Report of the 13th Session of the IOTC Working Party on Methods (Management Strategy Evaluation Task Force)

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ACRONYMS

ABNJ	Areas Beyond National Jurisdiction
ALB	Albacore
B	Biomass (total)
B_0	Unfished biomass
BET	Bigeye tuna
B_{MSY}	Biomass which produces MSY
CMM	Conservation and Management Measure (of the IOTC; Resolutions and Recommendations)
CPCs	Contracting parties and cooperating non-contracting parties
CPUE	Catch per unit of effort
current	Current period/time, i.e. $F_{current}$ means fishing mortality for the current assessment year.
F	Fishing mortality
FAD	Fish aggregating device
F_{MSY}	Fishing mortality at MSY
IOTC	Indian Ocean Tuna Commission
MP	Management Procedure
MPD	Management Procedures Dialogue
MSE	Management Strategy Evaluation
MSY	Maximum Sustainable Yield
OM	Operating Model
P	Probability
SC	Scientific Committee, of the IOTC
SB	Spawning biomass (sometimes expressed as SSB)
SB_{MSY}	Spawning stock biomass which produces MSY (sometimes expressed as SSB_{MSY})
TCMP	Technical Committee on Management Procedures
WPM	Working Party on Methods
WPNT	Working Party on Neritic Tunas
WPTT	Working Party on Tropical Tunas of the IOTC
YFT	Yellowfin tuna

GLOSSARY OF TERMS

The WPM decided to utilise the MSE Glossary developed by the Joint Tuna RFMO MSE Working Group in 2018.

Average Annual Variation - (in catch/TAC) The absolute value of the proportional TAC change each year, averaged over the projection period.

Biomass - Stock biomass, which may refer to various components of the stock. Often spawning stock biomass (SSB) of females is used, as the greatest conservation concern is to maintain the reproductive component of the resource.

Candidate Management Procedure - An MP (defined below) that has been proposed, but not yet adopted.

Conditioning - The process of fitting an Operating Model (OM) of the resource dynamics to the available data on the basis of some statistical criterion, such as a Maximum Likelihood. The aim of conditioning is to select those OMs consistent with the data and reject OMs that do not fit these data satisfactorily and, as such, are considered implausible.

Error - Differences, primarily reflecting uncertainties in the relationship between the actual dynamics of the resource (described by the OMs) and observations. Four types of error may be distinguished, and simulation trials may take account of one or more of these:
- Estimation error: differences between the actual values of the parameters of the OM and those provided by the estimator when fitting a model to the available data;
- Implementation error: differences between intended management actions (as output by an MP) and those actually achieved (e.g. reflecting over-catch);
- Observation error (or measurement error): differences between the measured value of some resource index and the corresponding value calculated by the OM;
- Process error: natural variations in resource dynamics (e.g., fluctuations about a stock-recruitment curve or variation in fishery or survey selectivity /catchability).

Estimator - The statistical estimation process within a population model (assessment or OM); in a Management Strategy Evaluation (MSE) context, the component that provides information on resource status and

productivity from past and generated future resource-monitoring data for input to the Harvest Control Rule (HCR) component of an MP in projections.

Exceptional circumstances - Specifications of circumstances (primarily related to future monitoring data falling outside the range covered by simulation testing) where overriding of the output from a Management Procedure should be considered, together with broad principles to govern the action to take in such an event.

Feedback Control - Rules or algorithms based, directly or indirectly, on trends in observations of resource indices, which adjust the management actions (such as a TAC change) in directions that will change resource abundance towards a level consistent with decision makers' objectives.

Harvest Control Rule - (also Decision Rule) A pre-agreed and well-defined rule or action(s) that describes how management should adjust management measures in response to the state of specified indicator(s) of stock status. This is described by a mathematical formula.

Harvest Strategy - Some combination of monitoring, assessment, harvest control rule and management action designed to meet the stated objectives of a fishery. Sometimes referred to as a Management Strategy (see below). A fully specified harvest strategy that has been simulation tested for performance and adequate robustness to uncertainties is often referred to as a Management Procedure.

Implementation - The practical application of a Harvest Strategy to provide a resource management recommendation.

Kobe Plot - A plot that shows the current stock status, or a trajectory over time for a fished population, with abundance on the horizontal axis and fishing mortality on the vertical axis. These are often shown relative to BMSY and to FMSY, respectively. A Kobe plot is often divided into four quadrants by a vertical line at B=BMSY and a horizontal line at F=FMSY.

Limit Reference Point - A level of biomass below, or fishing mortality above, which an actual value would be considered undesirable, and which management action should seek to avoid.

Management Objectives - The social, economic, biological, ecosystem, and political (or other) goals for a given management unit (i.e. stock). These typically conflict, and include concepts such as maximising catches over time, minimising the chance of unintended stock depletion, and enhancing industry stability through low inter-annual variability in catches. For the purposes of Management Strategy Evaluation (MSE) these objective need to be quantified in the form of Performance statistics (see below).

Management Plan - In a broad fisheries governance context, a Management Plan is the combination of policies, regulations and management approaches adopted by the management authority to reach established societal objectives. The management plan generally includes the combination of policy principles and forms of management measures, monitoring and compliance that will be used to regulate the fishery, such as the nature of access rights, allocation of resources to stakeholders, controls on inputs (e.g. fishing capacity, gear regulations), outputs (e.g. quotas, minimum size at landing), and fishing operations restrictions (e.g. closed areas and seasons). Ideally, the Management Plan will also include the Harvest Strategy for the fishery or a set of principles and guidelines for the specification, implementation and review of a formal Management Procedure for target and non-target species.

Management Procedure - A management procedure has the same components as a harvest strategy. The distinction is that each component of a Management Procedure is formally specified, and the combination of monitoring data, analysis method, harvest control rule and management measure has been simulation tested to demonstrate adequately robust performance in the face of plausible uncertainties about stock and fishery dynamics.

Management Strategy - Synonymous with harvest strategy. (But note that this is also used with a broader meaning in a range of other contexts.)

Management Strategy Evaluation - A process whereby the performances of alternative harvest strategies are tested and compared using stochastic simulations of stock and fishery dynamics against a set of performance statistics developed to quantify the attainment of management objectives.

Maximum Economic Yield - The (typically annual) yield that can be taken continuously from a stock sustainably (i.e. without reducing its size) that maximizes the economic yield of a fishery in equilibrium. This yield occurs at the effort level that creates the largest positive difference between total revenues and total costs of fishing (including the cost of labor, capital, management and research etc.), thus maximizing profits.

Maximum Sustainable Yield - The largest (typically annual) yield that can be taken continuously from a stock sustainably (i.e. without reducing its size). In real, and consequently stochastic situations, this is usually estimated as the largest average long-term yield that can be obtained by applying a constant fishing mortality F, where that F is denoted as FMSY.

Observation Model - The component of the OM that generates fishery-dependent and/or fishery-independent resource monitoring data from the underling true status of the resource provided by the OM, for input to an MP.

Operating Model(s) - A mathematical–statistical model (usually models) used to describe the fishery dynamics in simulation trials, including the specifications for generating simulated resource monitoring data when projecting forward in time. Multiple models will usually be considered to reflect the uncertainties about the dynamics of the resource and fishery.

Performance statistics/measures - A set of statistics used to evaluate the performance of Candidate MPs (CMPs) against specified management objectives, and the robustness of these MPs to important uncertainties in resource and fishery dynamics.

Plausibility (weights) - The likelihood of a scenario considered in simulation trials representing reality, relative to other scenarios also under consideration. Plausibility may be estimated formally based on some statistical approach, or specified based on expert judgement, and can be used to weight performance statistics when integrating over results for different scenarios (OMs).

Precautionary Approach - An approach to resource management in which, where there are threats of serious irreversible environmental damage, lack of full scientific certainty is not used as a reason for postponing cost-effective measures to prevent environmental degradation.

Reference case - (also termed reference scenario or base case) A single, typically central, conditioned OM for evaluating Candidate MPs (CMPs) that provides a pragmatic basis for comparison of performance statistics of the CMPs.

Reference set - (also termed base-case or evaluation scenarios) A limited set of scenarios, with their associated conditioned OMs, which include the most important uncertainties in the model structure, parameters, and data (i.e. alternative scenarios which have both high plausibility and major impacts on performance statistics of Candidate MPs).

Research-conditional option - Temporary application of an MP that does not satisfy conservation performance criteria, accompanied by both a research programme to check the plausibility of the scenarios that gave rise to this poor performance and an agreed subsequent reduction in catches should the research prove unable to demonstrate implausibility.

Robustness tests - Tests to examine the performance of an MP across a full range (i.e. beyond the range of the Reference Set of models alone) of plausible scenarios. While plausible, robustness test OMs are typically considered to be less likely than the reference set OMs, and often focus on particularly challenging circumstances with potentially negative consequences to be avoided.

Scenario- A hypothesis concerning resource status and dynamics or fishery operations, represented mathematically as an OM.

Simulation trial/test - A computer simulation to project stock and fishery dynamics for a particular scenario forward for a specified period, under controls specified by a HS or MP, to ascertain the performance of that HS or MP. Such projections will typically be repeated a large number of times to capture stochasticity.

Spawning Biomass, initial - Initial spawning biomass prior to fishing as estimated from a stock assessment.

Spawning Biomass, current - Spawning biomass (SSB) in the last year(s) of the stock assessment.

Spawning Biomass at MSY - The equilibrium spawning biomass that results from fishing at FMSY. In the presence of recruitment variability, fishing a stock at FMSY will result in a biomass that fluctuates above and below SSBMSY.

Stationarity - The assumption that population parameter values are fixed (at least in expectation), and not varying systematically, over time. This is a standard assumption for many aspects of stock assessments, OMs and management plans.

Stock assessment - The process of estimating stock abundance and the impact of fishing on the stock, similar in many respects to the process of conditioning OMs.

Target Reference Point - The point which corresponds to a state of a fishery and/or resource which is considered desirable and which management aims to achieve.

Trade-offs - A balance, or compromise, achieved between desirable but conflicting objectives when evaluating alternative MPs. Trade-offs arise because of the multiple objectives in fisheries management and the fact that some objectives conflict (e.g. maximizing catch vs minimizing risk of unintended depletion).

Tuning - The process of adjusting values of control parameters of the Harvest Control Rule in a Management Procedure to achieve a single, precisely-defined performance statistic in a specified simulation test. This reduces confounding effects to allow the performance of different candidate MPs to be compared more readily with respect to other management objectives. For example, in the case of evaluating rebuilding plans, all candidate MPs might be tuned to meet the rebuilding objective for a specified simulation trial; then the focus of comparisons among MPs is performance and behaviour with respect to catch and CPUE dimensions.

Weight(s) - Either qualitative (e.g. high, medium, low) or quantitative measures of relative plausibility accorded across a set of scenarios.

Worm plot - Time series plots showing a number of possible realizations of simulated projections of, for example, catch or spawning biomass under the application of an MP for a specific OM or weighted set of OMs.

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 and 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**).

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EXECUTIVE SUMMARY

The 13th Session of the Indian Ocean Tuna Commission's (IOTC) Working Party on Methods Management Strategy Evaluation Task Force (WPM(MSE)) was held online using Zoom from 7-10 March 2022. A total of 46 participants attended the Session. The list of participants is provided in Appendix I. The meeting was opened by the Chairperson, Dr Hilario Murua (ISSF) who welcomed participants.

1. OPENING OF THE MEETING

1. The 13th Session of the Indian Ocean Tuna Commission's (IOTC) Working Party on Methods Management Strategy Evaluation Task Force (WPM(MSE)) was held online using Zoom from 7-10 March 2022. A total of 46 participants attended the Session. The list of participants is provided in Appendix I. The meeting was opened by the Chairperson, Dr Hilario Murua (ISSF) who welcomed participants.

2. REVIEW OF MP PROCESS IN IOTC

2. The WPM(MSE) **ADOPTED** the Agenda provided at Appendix II. The documents presented to the WPM(MSE) are listed in Appendix III.

2.1 Review outcomes of TCMP04 and COM (S25) in 2021

3. The WPM **NOTED** a presentation by the Chair regarding the updates from the 2021 Session of the Commission (S25) as well as a recap of the deliberations during the 2021 TCMP04 and S25 meetings. The presentation summarised the information related to MSE found in documents IOTC-2021-TCMP04-R and IOTC-2021-S25-R.

4. The WPM(MSE) **NOTED** the TCMP observation that the MSE task force have been making minor modifications to the glossary provided by the joint RFMO MSE working group in order to make it relevant to the IOTC, however this has not been officially adopted and should therefore be reviewed by the Scientific Committee for approval by the Commission

5. The WPM(MSE) **NOTED** the Commission Adoption of Res 21/03 *On Harvest Control Rules for Skipjack Tuna In The IOTC Area Of Competence*. This Resolution supersedes Res 16/02.

2.2 Review outcomes of WPM, WPB, WPTT and SC in 2021

6. The WPM(MSE) **NOTED** a brief summary provided by the Secretariat on the discussions held at the 2021 sessions of the WPM, WPB, WPTT and SC all of which had taken place since the last WPM MSE Task Force meeting. The Secretariat summarised the information related to MSE contained in the documents, IOTC-2021-WPM12-R, IOTC-2021-WPB19-R, IOTC-2021-WPTT23-R, and IOTC-2021-SC24-R.

7. The WPM(MSE) **NOTED** that the SC endorsed guidelines for exceptional circumstances and that these are included in Appendix 6a of the SC report (IOTC-2021-SC24-R).

8. The WPM(MSE) **NOTED** the revised schedule of MSE work included as Appendix 6b of the SC24 report to provide the timeframe for the development of management procedures for key IOTC species. The WPM(MSE) further **NOTED** that this timetable will be presented to the Commission for endorsement.

9. The WPM(MSE) **NOTED** that the SC had agreed to endorse the Bigeye Tuna OM. The SC considered that the OM is suitably mature to be used to form the basis of a Proposal for the adoption of an MP for this species by the Commission.

3. STATUS OF WORK ON ALBACORE OMS AND MPS

3.1 Review progress and difficulties

10. The WPM(MSE) **NOTED** the presentation of the work currently being carried out on MSE for albacore tuna, summarized by the authors as follows:

    "*The development of MSE of candidate management procedures for albacore tuna has continued, with the implementation of a different surplus production model (JABBA), used to provide input to two harvest control rules: a hockey-stick rule that provides a TAC according to the estimated depletion level, and one that sets a change in TAC according to the recent trend in depletion level. Tuning has been tentatively carried out for the three current management objectives, but only for a limited number of model iterations.*"

11. The WPM(MSE) **THANKED** the developers for this update and **REQUESTED** them to complete the analysis in due time for presentation to the TCMP.

12. The WPM(MSE) **ENCOURAGED** the adoption of a consistent terminology for naming the parameters of harvest control rules across stocks. For example, depletion-based biomass reference points were used in the hockey-stick HCR while MSY-based reference points are adopted for the status of the species, which may create some confusion. The WPM(MSE) **NOTED** that the control parameters of the HCR could be different from the biological

reference points adopted for the status of a particular species. Thus, the WPM(MSE) **AGREED** to use descriptive terms, such as 'depletion level', rather than specific formulations such as B/Bmsy or B/B0 to avoid confusion during TCMP presentation. However, this is without prejudice on the metric symbols to be reported on the graphical representation of an HCR.

13. The WPM(MSE) **DISCUSSED** potential values for setting the minimum catch level to apply when the stock is below the limit reference point in the hockey stick harvest control rule. This minimum catch is generally set to cover for the needs of the subsistence fisheries, likely to be very small for this stock, and could also take into consideration the possible unavoidable bycatch of ALB in other fisheries. The WPM(MSE) **AGREED** that the basis for such catches should be decided in consultation with the managers and the relevant Working Parties and would require an examination of bycatch data in other fisheries.

14. The WPM(MSE) **DISCUSSED** the relevancy of using predictive power (p-value of the MASE obtained from the Diebold-Mariano test) as a criterion to select a particular assessment model run for inclusion in the OM, as it was argued that a model does not need to have high predictive power to be useful for running stochastic simulations. The WPM(MSE) **NOTED** that, although predictive power was not essential as such to conduct the simulation, it was still a relevant criterion to assess the quality of a model, and as such could be used to rank model runs with respect to their capacity to explain observed past catch data and discard the runs that were the most problematic. The WPM(MSE) **AGREED** that the p-value of the MASE could be used as a weighting factor for resampling of model runs to be incorporated in the OM.

15. The WPM(MSE) **NOTED** that the JABBA model within the MP is currently being run from 1950 but as the combined longline CPUE series for all fleets starts in 1980, the WPM(MSE) discussed whether the model should run from that date. However, WPM (MSE) **NOTED** that most depletion occurred in the early period where the catch was high and, therefore, it is necessary to include the initial period in the model to better estimate depletion, which is used as a status metric by the hockey-stick HCR.

16. The WPM(MSE) **SUGGESTED** to include a reference to the temporal framework in the naming of the robustness tests, as done for SKJ (i.e. specifying the year range over which the specific factors are tested, may it be lower recruitment, trend in the catchability of a CPUE index, implementation error applies).

3.2 Future Work

17. The WPM(MSE) **NOTED** that the complete evaluation and tuning of MPs could not be completed in time for this meeting due to the still ongoing finalization of the contract for this work, and also to technical issues with the high-performance computing server used by the developers. The WPM(MSE) **NOTED** that the selection of the final OMs and MPs simulations necessary to tune the two proposed MPs for the 3 different probabilities of being in the green quadrant of the Kobe plot (50%, 60% and 70%) will be run soon. Initial results will be available for the TCMP to inspect, and a final set of candidate MPs, including robustness tests, will be presented to WPM in 2022.

4. STATUS OF WORK ON BIGEYE OMS AND MPS

4.1 Review progress and difficulties

18. The WPM(MSE) **NOTED** paper IOTC-2021-WPM12(MSE)-05, which provides an update of the Indian Ocean Bigeye Tuna Management Strategy Evaluation for the two candidate MPs being considered for adoption by the IOTC in 2022, including the following abstract provided by the authors:

"*This paper is an update of the Indian Ocean Bigeye Tuna Management Strategy Evaluation work. Given the recommendations of both the 2021 WPTT and Scientific Committee, we tuned the reduced set of two candidate MPs to the B2 and B3 risk criteria, with the tuning years now being defined as 2034-2038. Updated catch estimates were used to generate the 3-year average that is used to define catches taken between the last year of reported catch data and prior to the 2023 implementation of the MPs. The most influential robustness trials from the previous work (recruitment shock, longline catchability trend) were also useful for outlining the contrasts between the two candidate MPs and two tuning risk criteria combinations. As in previous evaluations, the largest differences in performance are between the tuning risk criteria. Results are very comparable to the previous suite of runs, with only very minor changes to early catch trajectories given the required extension of the tuning period.*"

19. The WPM(MSE) **THANKED** the author of this paper for providing the current mature status of the BET MP.

20. The WPM(MSE) **NOTED** that the MSE operating models were updated with the most recent catch data (up to 2020), and the two candidate MPs were re-tuned to each of the (two) tuning criteria (i.e., 60% and 70% probability of being in the Kobe green zone). There has been no further development of operating models as agreed at SC24.

21. The WPM(MSE) **NOTED** the two candidate MPs are: 1) PT41F (hockey-stick HCR) - A biomass dynamic model and hockey stick HCR, which uses the relative biomass and fishing mortality estimates, from the model, in the HCR to calculate TAC. 2) PTBoB0Targ - A biomass dynamic model with catch estimation and projection to achieve the pre-specified future biomass depletion level.

22. The WPM(MSE) **NOTED** that in terms of overall performance: the two candidate MPs were both able to tune to both the 60% and 70% tuning objectives; the choice of tuning objective has a relatively strong influence on performance of the two MPs, with the 60% tuning objective tending to realise slightly higher catches (and lower relative biomass) than the 70% tuning objective, for both MPs; differences in performance between the two MPs were also apparent (but less than the differences in performance due to tuning objectives).

23. In relation to the comparative performance of the two MPs, the WPM(MSE) **NOTED**:
    - PT41F had slightly higher average catches, but lower minimum catch levels and consistently higher overall TAC variability relative to PTBoB0Targ. In both cases long-term (20 year) average TACs were above the current level.
    - PTBoB0Targ exhibits 'soft-landing' dynamics with respect to MSY (approaching Bmsy and Fmsy from below and above, respectively); PT41F shows an apparent undershoot/overshoot of the Bmsy and Fmsy levels by the end of the projection period, with a higher risk of fishing mortality exceeding the LRP.
    - PTBoB0targ shows early median TACs very slightly below the current level, with PT41F showing a higher probability of initial decreases. Both show slowly increasing TACs after the first two TAC decisions.

24. The WPM(MSE) also **NOTED** the results from the two most influential MSE robustness tests:
    - For the 'recruitment shock' robustness test, PT41F showed slightly better initial performance in the years after the poor recruitment period (arguably the most important period), but the performance of the two MPs converged by the end of the tuning period.
    - For the 'increasing long-line catchability trend (3% p.a.)' robustness test, PTBoB0Targ showed slightly but consistently better SSB risk performance (i.e., probability of falling below the Blim reference point).

25. The WPM(MSE) **AGREED** that without ranking the robustness tests it would be hard to separate the two MPs based on robustness test performance. Across the suite of reference and robustness scenarios, the WPM(MSE) **NOTED** that PTBoB0Targ performed better in slightly more of the current suite of performance metrics.

26. Overall, the WPM(MSE) **AGREED** that the two candidate MPs can meet the tuning objectives and perform acceptably. The performance of the two MPs is very similar, with the strongest differentiator of MP performance being the tuning objective. The WPM further **NOTED** that the choice of tuning objective (2 options) and the choice of MP (2 options) are separate decisions that need to be made by the Commission.

27. The WPM(MSE) **DISCUSSED** some technical aspects of the two MPs and clarified the following:
    - That the PT41F MP scales the fishing mortality to an initial TAC via the biomass, and that the tuning process scales out any potential bias in the biomass from the MP population model.
    - That the 'PTBoB0Targ' is somewhat comparable to the current K2SM process. It was clarified that the advantage of the MP relative to current practice is that it has been tested against a wide range of uncertainties in the MSE operating models and tuned to the desired management objective.
    - That the tuning process factors in any overall bias in the biomass estimates, and that what is important is that the candidate MP can meet the tuning objectives and perform acceptably, not whether it is an unbiased estimator of abundance.
    - Some members of the WPM(MSE) **NOTED** that the median estimate of current biomass is below Bmsy in the OM (this is somewhat different to the reference grid in the 2019 stock assessment where the current biomass is estimated to be above Bmsy). This explains the short term catch reduction seen in the simulations. The WPM(MSE) was reminded that the process of OM conditioning has always explored a wider array of scenarios than the assessment – some of these are often more pessimistic in nature given it is often these scenarios we want an MP to be robust to.

28. The WPM(MSE) **NOTED** that a key communication issue for the TCMP and Commission is the difference in role and purposes of the stock assessment and MSE operating models. The candidate MPs are tuned to the reference set of OMs not the stock assessment model ensemble. The WPM(MSE) was reminded that maintaining a clear distinction between the role of the stock assessment, and the MSE operating models and subsequent MP management advice process is highly recommended so as to avoid this confusion.

4.2 Future Work

29. The WPM(MSE) **DISCUSSED** the state of the current MP and **AGREED** on its suitability for presentation to the TCMP for consideration of inclusion in a proposal for a CMM. The WPM(MSE) therefore **REQUESTED** that the developers present the two MPs and their performance statistics to the TCMP for comment/discussion and endorsement.

5. STATUS OF WORK ON SKIPJACK OMS AND MPS

5.1 Review progress and difficulties

30. The WPM(MSE) **NOTED** paper IOTC-2022-WPM13(MSE)-07, which provides a progress update on the skipjack tuna MSE. The current project conducted further simulations to evaluate an empirical HCR, extending the structural uncertainties in the Operating Model and including robustness trials for the MP, including the following abstract provided by the author:

   "*The primary objective of this work is to develop a Management Procedure (MP) for Indian Ocean Skipjack tuna (SKJ), which includes specification of the data inputs, harvest control rule (HCR) and management outputs, and that has been fully tested using an appropriate simulation framework.*

   Following the presentation of developmental work to the Working Party on Methods (Edwards, 2020, IOTC, 2020a) and the Technical Committee on Management Procedures (Edwards, 2021b, IOTC, 2021c), in which a suitable simulation framework was proposed, initial evaluations of an empirical MP were presented to the Working Party on Methods by Edwards (2021a). The current work presents further simulations, extending the structural uncertainties in the Operating Model and including robustness trials for the MP."

31. The WPM(MSE) **THANKED** the author for the good progress made in the skipjack Management Strategy Evaluation. The WPM(MSE) **RECALLED** that the project was to review and potentially revise the HCR as required by Res 16/02, with the aim of developing a full skipjack MP, in response to the request from WPM9 (endorsed by the SC).

32. The WPM(MSE) **NOTED** that the OMs included a total of 24 models that incorporated alternative spatial structure configuration (2 scenarios), stock-recruit steepness (3 levels), tag recapture data weighting (2 levels), and assumed PS CPUE catchability trend (2 levels). The WPM(MSE) further **NOTED** that the alternative two-area model implemented in the 2020 skipjack assessment is thought to better reflect the regional coverage of CPUE and the distribution of tag returns.

33. The WPM(MSE) **NOTED** that the previous iteration of the MP evaluation showed that available CPUE is uninformative of biomass, and that the model-based MP did not work well for the skipjack tuna stock. Therefore, an empirical MP was developed based on standardised CPUE indices (the mean of the log-normalized PL and PSLS abundance indices).

34. The WPM(MSE) **NOTED** the empirical HCR calculated a TAC that is a proportion of a target catch value (Ctarget). The target catch was currently set at 535,964 tonnes, being the median estimated value of C40% across the 2020 skipjack stock assessment model grid. The WPM(MSE) **AGREED** that C40% estimated from the assessment would provide a good basis for the target catch, but this doesn't mean that Ctarget needs to be changed each time the stock estimate is updated. The WPM(MSE) further **NOTED** that Ctarget is meant to represent an optimal sustainable catch level supported by the fishery historically, further moderated by the tuning parameter Imax in the HCR, which represents a level of uncertainty around the target catch level.

35. The WPM(MSE) **NOTED** that the current HCR generates a catch multiplier that will be applied to the target catch, and it may be more transparent to present the resultant catch from the HCR directly.

36. The WPM(MSE) **NOTED** that the empirical MP were evaluated against the reference set OM and are tuned to the three tuning objectives as agreed by the TCMP (namely achieving 50%, 60%, and 70% probability of Kobe green quadrant). The WPM(MSE) **NOTED** and discussed the MP performance against these tuning objectives.

37. The WPM(MSE) **NOTED** the depletion-based target (40% B0) and limit (20% B0) reference lines in the SSB plot and discussed whether that MSY-based reference points could also be displayed (the rationale is to show that when the stock is fluctuating around the target, there is minimal risk of violating the MSY biomass threshold). The WPM(MSE) **RECALLED** that the TCMP agreed that MP should be tuned only to the depletion-based target (the Kobe green quadrant referred in the tuning objectives is depletion-based) to avoid confusion. Adding additional MSY-based reference lines may complicate these plots. However, WPM(MSE) **AGREED** that it is necessary to determine what constitutes an "acceptable" stock status (e.g., in the context of defining overfishing or overfished status) for skipjack tuna in relation to different reference points measured (e.g., the depletion-based reference points as per 16/02 and the MSY based refence points as per 15/10) (See section 10.1).

38. The WPM(MSE) **NOTED** the robustness tests that included implementation error and recruitment decline. It has been clarified that the MP are not re-tuned to the tuning objectives in the robustness trials, and this is because the purpose of these trials is to examine the performance of the MP in these circumstances (rather than to design an MP that have included implementation error in the feed-back control loop). The WPM(MSE) **NOTED** that the positive implementation error of TAC significantly reduced the probability of achieving the tuning objective (e.g., the probability of achieving Kobe green was reduced to 44% against the tuning objective of 70% in the presence of a 30% positive implementation error). The WPM(MSE) **NOTED** that the TAC was overrun by 18% in 2020 (and 30% in 2018) and, thus, **AGREED** that it is important to communicate the possible consequence of the TAC implementation error to the Commission. However, the WPM(MSE) **NOTED** that robustness analysis was performed on the proposed MP, and the conclusion cannot be directly extrapolated to the current SKJ HCR (as per 16/02) evaluated the implementation error under a different MSE settings (e.g., as part of the MP). It is possible that the current SKJ HCR may have provided a relatively lower TAC to be robust to a certain level of implementation error.

5.2 Future Work

39. The WPM(MSE) **NOTED** that the suggestion to consider a robustness scenario that include both implementation error and recruitment decline together. The WPM(MSE) **AGREED** that this is scenario is worth to explore but **NOTED** that the number of robustness test runs can grow rapidly once the interactions amongst scenarios are being tested

40. The WPM(MSE) **NOTED** the need for future consistency in the generation of CPUE indices for input into the MP, and that both the timing with which these will be produced and specification of how they will be produced are important considerations that will impact validity of the MP.

6. STATUS OF WORK ON SWORDFISH OMS AND MPS

6.1 Review progress and difficulties

41. The WPM(MSE) **NOTED** the presentation of the work currently being carried out on MSE for swordfish, summarized by the authors as follows:

   "*The development of MSE of candidate management procedures for swordfish has continued, with the implementation of a different surplus production model (JABBA), used to provide input to two harvest control rules: a hockey-stick rule that provides a TAC according to the estimated depletion level, and one that sets a change in TAC according to the recent trend in depletion level. Tuning has been tentatively carried out for the three current management objectives, but only for a limited number of model iterations.*"

42. The WPM(MSE) **THANKED** the developers for this update and **REQUESTED** them to complete the analysis in due time for presentation to the TCMP.

43. The WPM(MSE) **NOTED** that similarly to the albacore MSE, the model developers decided to test JABBA as a biomass dynamic model for the swordfish MSE as a result of issues that were occurring with the previous model related to the estimation of B0, when the CPUE series was much shorter than the catch series and in situations when the biomass was very low. The WPM(MSE) further **NOTED** that JABBA is considered to be a robust model which is also relatively fast to run.

44. The WPM(MSE) **NOTED** that the JABBA model is based on the Pella-Tomlinson production curve with a fixed shape parameter and appears to have captured the trajectory of the stock fairly well compared with the OM including when tested against reference points. The WPM(MSE) **NOTED** that the MP used the standard hockey-stick HCR which needs to be tuned against the agreed tuning objectives.

45. The WPM (MSE) **NOTED** that the SWO MSE is developed under a modelling framework and methodology very similar to the ALB MSE. Therefore, many discussion topics that relevant to the ALB MSE are also relevant to the SWO MSE, such as the adoption of a consistent terminology for naming the HCR parameters (Para 12), the potential values for setting the minimum catch levels when the stock is below the LPR (Para 13), the use of predictive power for model selection (Para 14), and the temporal framework for naming the robustness trials (para 16).

46. The WPM(MSE) **SUGGESTED** including a reference to the temporal framework in the naming of the robustness tests, as done for SKJ (i.e., specifying the year range over which the specific factors are tested, may it be lower recruitment, trend in the catchability of a CPUE index, implementation error applies).

6.2 Future Work

47. The WPM(MSE) **NOTED** that the complete evaluation and tuning of MPs could not be completed in time for this meeting due to the still ongoing finalization of the contract for this work, and also to technical issues with the high-performance computing server used by the developers. The WPM(MSE) **NOTED** that the selection of the final OMs and MPs simulations to tune the two proposed MPs against the 3 different probabilities of being in the green KOBE quadrant (50%, 60% and 70%) will be run soon. Initial results will be available for the TCMP and a final set of candidate MPs will be presented to WPM in 2022.

48. The WPM(MSE) **NOTED** the request from the Working Party on Billfish (WPB) about how the changing catch trends in the south-west region of the Indian Ocean should be taken into account in the MSE OM but further **NOTED** that as this OM does not have a spatial component, there is no clear way to consider depletion levels in that particular area.

49. The WPM(MSE) **NOTED** that under the current format of the MPs there is a gap between the period for which the TACs will be set and the final year for which the catch data was used in the model, meaning that there may be some delay in the response of the stock to changing conditions which could be a concern for species with shorter lifespans.

7. STATUS OF WORK ON YELLOWFIN OMS AND MPS

7.1 Review progress and difficulties

50. The WPM(MSE) **NOTED** that discussion on the YFT OM would take place under section 8, as the modelers had suggested the need to consider alternate approaches to OM conditioning for this species which is covered under the following section.

8. GENERAL DISCUSSION ON OMS AND MPS

8.1 Alternative OM conditioning approaches

51. The WPM(MSE) **NOTED** paper IOTC-2022-WPM13MSE-04_Rev1 on Exploring a wider approach to OM conditioning in IOTC MSE work, including the following summary provided by the authors.

   "*IOTC has been conditioning various OMs based on a grid of alternative stock assessment runs. A complimentary approach is outlined here that attempts to separate the stock assessment and operating models given their different intentions. A suite of possible prior states for past dynamics and current status are combined with available data using the Approximate Bayesian Computation (ABC) paradigm. A relatively simple example is provided on how this methodology could be used to construct flexible OM.*"

52. The WPM(MSE) **NOTED** a proposed approach to conditioning OMs without using a stock assessment model structure as the basis for the OM further **NOTING** that the authors are proposing to use this approach in cases when the existing stock assessment is not considered to be robust to condition the OM as has been the case for the yellowfin, for example. The WPM(MSE) **NOTED** that this approach obtains samples from an approximating posterior distribution of the key variables required to condition the OMs using an emerging suite of statistical sampling techniques

53. The WPM(MSE) **NOTED** that the concept behind this complementary approach is the Approximate Bayesian Computation (ABC) method which integrates data, biology and stock status priors as inputs into the OM. The WPM(MSE) **NOTED** that something similar was done by the IOTC for the original skipjack OM in 2016 so there is precedent for taking this approach within IOTC. The WPM(MSE) **NOTED** that this approach is a generalization of

the current approach with some relaxation in the parameterization of the model but that it has the additional benefit of the fact that prior knowledge of stock status and other parameters can also be incorporated.

54. The WPM(MSE) **NOTED** that broadly speaking, the models following this complementary approach do a good job of fitting to the data and replicating the key features of the stock status information. However, the WPM (MSE) **AGREED** that sufficient evidence that the approach works well is required through further diagnostic analyses. This can be achieved by performing diagnostic analyses (e.g., a retrospective analysis) to models built using this approach and comparing the results to the diagnostics of a stock assessment model that is considered robust.

55. The WPM(MSE) **NOTED** that the benefits of taking this approach include: the ability to circumvent the usual dependence on stock assessments which may be considered to be not robust or feasible; the ability to include both data and priors and jointly characterize uncertainty; and the fact that this approach provides key elements for OM construction. The WPM(MSE) **NOTED** that it may also be possible to apply this approach to model averaging to cover uncertainty in models.

56. The WPM(MSE) **NOTED** that a drawback of taking this approach is that we would be supplying strong prior information on status which, when combined with the model structures and the catches and observed data, has a strong impact on the estimated stock status but **AGREED** that the idea is to take this approach when there are ongoing issues with the stock assessment model that cannot be satisfactorily resolved.

57. The WPM(MSE) **NOTED** the challenges that may be faced when applying this approach to IOTC stocks including the need to rationally combine fisheries, assess spatial and stock structure and migration scenarios and the complexity that these would introduce, and the need to consider how additional data such as tagging data could be incorporated.

58. The WPM(MSE) **NOTED** that some data poor methods take a similar approach to this proposed approach where priors for parameters and an estimation of current status are input into the OM.

59. The WPM(MSE) **NOTED** that criteria would need to be defined for what is/is not considered to be a robust assessment before the complementary approach is taken and further **NOTED** that it would be necessary to carefully explain the reason for taking the complementary approach in each case where it is used. As such, the WPM (MSE) **AGREED** to perform a series of diagnostics analyses using this approach and compared with stock assessment model results in order to ensure the robustness of this approach for yellowfin.

60. The WPM(MSE) **NOTED** generally there is support for taking this approach for stocks for which stock assessment are not considered to be robust enough to condition their OMs. The WPM(MSE) further **NOTED** that taking this approach would make meeting the timeline for the yellowfin MSE as requested by the Commission a lot more feasible than if the group continues trying to recondition the existing OM. Therefore, the WPM(MSE) **AGREED** that this approach could be applied to conditioning the yellowfin OM while its robustness if evaluated but also the attempts to recondition the existing assessment for this stock could continue to be explored.

61. The WPM(MSE) **NOTED** that this approach would not necessarily be adopted across all stocks, it would be applied on a case-by-case basis depending on need and further **NOTED** that there is a strong case for applying this approach to albacore and yellowfin to get past the ongoing cycle of reconditioning which has been occurring for a long time. The WPM(MSE) **AGREED** that this approach will be further evaluated while the existing yellowfin stock assessment continues to be assessed for its suitability for use as an OM.

8.2 Consideration of multi-species OMs/MPs

62. The WPM(MSE) **NOTED** that as the group is still struggling to finalise MSEs for individual species, the focus will remain on this for now rather than trying to develop multi-species OMs/MPs which will add further complexities and complications.

63. The WPM(MSE) **NOTED** that there is currently one HCR in place for skipjack and the bigeye MSE work has progressed and is mature for the Commission to consider/discuss this year and further **NOTED** that there are considerable interactions between their fisheries which will need to be considered in MSEs in the future.

64. The WPM(MSE) **NOTED** that taking a multi-species approach is an important avenue for future development. The WPM(MSE) **NOTED** that the current approach focuses on management of the outputs of MSEs i.e., TAC but **NOTED** that alternative measures in addition to catch limits could be explored in the future.

65. The WPM(MSE) **NOTED** that a tool for multi-species MSEs is being developed in the Atlantic Ocean and this will be presented to the WPM.

8.3 Exceptional circumstances

66. The WPM(MSE) **NOTED** that in 2021 the SC endorsed Exceptional Circumstances guidelinens (IOTC-2021-WPM12-17) which provided conditions for exceptional circumstances as well as actions that can be considered in order to provide a scientific process for handling any concerns with implementing MPs and increase transparency in TAC decision by the Commission.

67. The WPM(MSE) **NOTED** paper IOTC-2022-WPM13MSE-06 on MP Implementation – schedule of activities, including the following abstract provided by the authors:

   "*As identified in the endorsed Schedule of Work for the Development of Management Procedures, the IOTC may select and adopt a Management Procedure (MP) for Bigeye Tuna in 2022, to provide science-based Total Allowable Catch recommendations to the Commission in 2023. A clear understanding of the timing of aspects of the process and endorsement of the schedule of activities is required for successful implementation of the adopted MP. This document outlines a proposal for the schedule of activities, the timing and responsibility for flow of information in each step, and clarifies the role of the MP, operating models (OMs)and the stock assessment once an MP is adopted. It is good practice for the MP decision making year (when the MP is run to provide a TAC recommendation) to be offset from the year in which an assessment of stock status is conducted, so that these two processes remain distinct. This outline of the process also provides information on the time period (i.e. lag) between data exchange and TAC advice.*"

68. The WPM(MSE) **NOTED** the proposed schedule in the paper of adopting an MP and putting it into practice within the IOTC framework and timetable.

69. The WPM(MSE) **NOTED** that following this proposed schedule may lead to a need for the joint longline CPUE series to be generated almost every year as it forms a basis for the majority of the stock assessments and MPs.

70. The WPM(MSE) **NOTED** that if an updated joint longline CPUE series is required for the application of the MP and TAC advice as well as stock assessments, a procedure would need to be developed to update the joint CPUE.

71. The WPM(MSE) discussed the stock assessment scheduling issues that may arise if the Commission decided to adopt the bigeye MP this year as the group considered it important to ensure that the stock assessment (planned for 2022) and MP processes are kept separate and, hence, they should not be conducted in the same year. The WPM(MSE) suggested that the stock assessment could be pushed back a year (to 2023) but **NOTED** that this could cause issues as the skipjack assessment is currently scheduled for next year and this scheduling cannot be altered as the skipjack HCR will be depending on the next year stock assessment outcomes. The WPM(MSE) **NOTED** that the 3-year assessment cycle for tropical tunas should be maintained with a single stock assessment carry out every year. The WPM(MSE) **NOTED** the need to discuss this proposed schedule with the TCMP before the Commission meeting.

72. The WPM(MSE) **NOTED** the need for careful drafting of Resolutions relating to HCR to minimize the time lag between the year data was collected and input into MPs and the year that the TAC will be set for (as it was done in the case of SKJ).

8.4 Internal peer-review and BET external peer-review

73. The WPM(MSE) **NOTED** that the SC has developed terms of reference for a peer review for the bigeye MSE which has been endorsed by the SC and this will be presented to the Commission.

74. The WPM(MSE) **NOTED** that a proposal to continue funding for MSE work including peer reviews has been submitted to the SCAF and further **NOTED** that it is anticipated that additional funding from the EU will be made available which can also go towards this work.

9. PREPARATION OF TCMP05 AND COMMISSION (S26)

9.1 Agenda for TCMP05

75. The WPM(MSE) **DISCUSSED** the agenda for the TCMP05 and **AGREED** to the version provided in Appendix IV of this report.

9.2   Organization, tasks and responsibilities

76. The WPM(MSE) **DISCUSSED** the organization of TCMP05 meeting with associated tasks and responsibilities prior to and during the meeting and **AGREED** that introductory materials on the MSE would be useful to facilitate subsequent discussions although the presentations would not be as detailed as for the TCMP04. The WPM(MSE) asked SC Chair to prepare such introductory products by liaising with the WPM(MSE) Chair, the Secretariat and the contractors hired to develop the MSE Capacity Building tools and present them at the TCMP05.

9.3   Presentations of results

77. The WPM(MSE) **DISCUSSED** the contents of the presentations for the various species. The WPM(MSE) **SUGGESTED** that the presentations should consist of the standard agreed format of MP performance summary graphics (time-aggregated performance statistics and time series plots), tables and document as presented to the TCMP03 and TCMP04.

78. The WPM(MSE) **NOTED** paper IOTC-2022-WPM13(MSE)-03, which provided a template for the structure and core concepts of the various species management strategy evaluation (MSE), the current status of that work and associated results to date.

79. The WPM(MSE) **THANKED** the author for drafting the template and **AGREED** that it should be used to present the results of the Bigeye MSE to the TCMP05. The WPM(MSE) **NOTED** that although the modelers would follow the template for presenting the bigeye results, they would be allowed some flexibility in the final format. Additionally, the template could be revised or modified based on feedback from the TCMP.

80. The WPM(MSE) **NOTED** that the TCMP should be advised of the status of funding support (e.g. tentative CPC funds and/or Commission budget).

9.4   Capacity building on MSE at IOTC

81. The WPM(MSE) **NOTED** a presentation by the FAO Consultants hired under a contribution by Australia to provide MSE Capacity Building Tools.

82. The WPM(MSE) **NOTED** that the consultants will contribute to the IOTC webpage, providing visualisation tools as well as a possible shiny app to clarify and explain the MSE process to IOTC Members. The WPM further **NOTED** that the consultants are due to present their progress to the TCMP05 and revise the content based on feedback at that meeting.

83. The WPM(MSE) **THANKED** the consultants for the interesting presentation and **NOTED** the utility of the work for increasing the understanding of the MSE process at the IOTC and **ENCOURAGED** the consultants to reach out to the modelers and other participants of the WPM(MSE) (including the chair and SC chair) to obtain feedback on the tools to be presented to the TCMP.

9.5   Workplan

84. The WPM(MSE) **NOTED** the workplan for MSE that was endorsed by the SC in 2021 (IOTC-2021-SC24-R Appendix 6b) and that the SC had recommended that the Commission adopt the revised timeline.

10. OTHER ISSUES FOR WPM 2022

10.1   Stock status guidance

85. The WPM(MSE) **NOTED** paper IOTC-2022-WPM13(MSE)-08, which provides guidance on Management benchmarks, reference points and Management Strategy Evaluation for IOTC stocks, including the following summary provided by the author:

“*The document reviews the two main management frameworks used in tuna RFMOs, the reference points adopted in the IOTC and potential ways for improving the characterization of stock status that are consistent with management benchmarks and management objectives. The document also identifies a number of issues with the current characterization of stock status for skipjack. The document is aimed to be a discussion document within the ad-hoc Working Group on Reference Points.*”

86. The WPM(MSE) **THANKED** the author of this paper for summarising some of the important issues that need to be addressed for refining reference points and their use in determining stock status.

87.   The WPM(MSE) **NOTED** that reference points for determining stock status were not necessarily the same as those used to tune management procedures and, therefore, it will be important to keep the issues related to developing reference points for stock assessments and stock status separate from those for developing MPs. However, it was clarified that the adoption reference points are linked with the development of MPs.

88.   The WPM(MSE) **NOTED** that SS3 assessments tend to produce relatively low estimates of the ratio of Bmsy/B0 (e.g., range from 0.14 to 0.28 for albacore) and produce production curves that are more skewed than the Fox model.

89.   The WPM(MSE) **NOTED** that target reference points are currently used to determine stock status for IOTC stocks, rather than limit reference points. This can result in the classification of a stock as overfished approximately 50% of the time when being managed to achieve the target reference point on average. Furthermore, currently there is no change in stock status or management action when a stock breaches the limit reference point. The WPM(MSE) **AGREED** that this needs to be further discussed/defined by the ad hoc working group on reference points.

90.   The WPM(MSE) **AGREED** that the Ad-Hoc Reference Point Working Group would meet intersessional and use this paper and the previous working document produced by the Ad-Hoc Reference Point Working Group (IOTC-2021-TCMP04-12 rev1) to progress this work and decide if an updated paper would be provided to the TCMP in 2022. It was also **AGREED** that further technical discussion of these issues would take place at the WPM and SC in 2022.

91.   With regards to the potential misspecification of the TRP adopted for skipjack (40%SB0) which was initially set as a proxy of Bmsy, the WPM(MSE) **NOTED** that when using stochastic deviations of recruitment under approaches such as the Maximum Average Yield (MAY), the Bmsy may move away from the deterministic level (23%SB0) towards higher levels.

92.   The WPM(MSE) further **NOTED** that estimates of SB0 may also be influenced by stochastic stock dynamics, and that a dynamic SB0 (i.e. biomass in the absence of fishing, SBF=0) has been used in other tuna RFMOs to account for this. The recent stock assessment models used for skipjack estimate SBmsy at 23%SB0 on average.

11. OTHER BUSINESS

93.   There was no other business

12. ADOPTION OF REPORT

94.   The WPM(MSE) **NOTED** that the report would be adopted via correspondence.

APPENDIX I
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APPENDIX II

MEETING AGENDA

Date: 7-10 March 2022
Location: Online
Platform: Zoom
Time: 12:00 – 16:00 daily (Seychelles time)
Chair: Hilario Murua (ISSF);**Vice-chair**: Vacant

1. **Opening and adoption of agenda**
2. **Review of MP process in IOTC**
   2.1. Review outcomes of TCMP04 and COM (S25) in 2021
   2.2. Review outcomes of WPM, WPTT and SC in 2021
   2.3. Process of MSE development, discussion and adoption at IOTC
3. **Status of work on Albacore OMs and MPs**
   3.1. Review progress and difficulties
   3.2. Future work
4. **Status of work on Bigeye OMs and MPs**
   4.1. Review progress and difficulties
   4.2. Future work
5. **Status of work on Skipjack OMs and MPs**
   5.1. Review progress and difficulties
   5.2. Future work
6. **Status of work on Swordfish OMs and MPs**
   6.1. Review progress and difficulties
   6.2. Future work
7. **Status of work on Yellowfin OMs and MPs**
   7.1. Review progress and difficulties
   7.2. Future work
8. **General discussion on OMs and MPs**
   8.1. Alternative OM conditioning approaches
   8.2. Consideration of multi-species OMs/MPs
   8.3. Exceptional circumstances
   8.4. Internal peer-review and BET external peer-review
   8.5. Workload, priorities, and resources
   8.6. Workplan and roadmap 2022-2024
   8.7. Other issues
9. **Preparation of TCMP05 and Commission (S26)**
   9.1. Agenda for TCMP05
   9.2. Organization, tasks and responsibilities
   9.3. Presentations of results
   9.4. Capacity building on MSE at IOTC
   9.5. Workplan
10. **Other issues for WPM 2022**
    10.1.   Stock status guidance
11. **Other business**
12. **Adoption of Report**

APPENDIX III
LIST OF DOCUMENTS

Document	Title
IOTC–2022–WPM13(MSE)–01a	Agenda of the 13th Working Party on Methods Management Strategy Evaluation Task Force
IOTC–2022–WPM13(MSE)–02	List of documents for the 13th Working Party on Methods Management Strategy Evaluation Task Force
IOTC–2022–WPM13(MSE)–03	MSE – Structure & Status (Template) (Holmes G)
IOTC–2022–WPM13(MSE)–04	MP Implementation – schedule of activities (Hillary R and Mosqueira I)
IOTC–2022–WPM13(MSE)–05	IOTC bigeye tuna management procedure evaluation update (Hillary R, Williams A, Preece A and Jumppanen P)
IOTC–2022–WPM13(MSE)–06	Alternative approach for conditioning operating models (Preece A. Williams A and Hillary R)
IOTC–2022–WPM13(MSE)–07	Further evaluations of an empirical MP for Indian Ocean skipjack tuna (Edwards C)
IOTC–2022–WPM13(MSE)–08	Management benchmarks, reference points and Management Strategy Evaluation for IOTC stocks (Merino G)

APPENDIX IV
PROPOSED AGENDA FOR THE TECHNICAL COMMITTEE ON MANAGEMENT PROCEDURES (TCMP)

Date: 13-14 May 2022
Location: Eden Bleu Hotel, Seychelles
Co-Chairs: Ms. Riley Kim Jung-re (Commission Chair) and Dr. Toshihide Kitakado (SC Chair)

1. OPENING OF THE SESSION AND ARRANGEMENTS (Co-Chairs)

2. ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION (Co-Chairs)

3. ADMISSION OF OBSERVERS (Co-Chairs)

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 4th Session of TCMP
  4.3   Outcomes of the 25th Session of the Commission
  4.4   Outcomes of the 24th Session of the Scientific Committee

5. INTRODUCTION TO MSE

  5.1   Brief introduction of Management Procedures and MSE (SC Chair)
          5.1.1   Basic principles
          5.1.2   Roles and responsibilities and feedback mechanism
  5.2   Demonstration of MSE capacity building tools (Contract developer)
  5.3   SC proposal for the standard presentation of MSE results (SC Chair)

6 STATUS OF THE MANAGEMENT STRATEGY EVALUATION/OPERATING MODELS (Developers)

  6.1   Bigeye tuna (Rich Hilary)
  6.2   Albacore tuna (Iago Mosqueira)
  6.3   Skipjack tuna (Charlie Edwards)
  6.4   Yellowfin tunas (Rich Hilary)
  6.5   Swordfish (Thomas Brunel)

7 DISCUSSION ON THE ACTIONS NEEDED FOR THE ADOPTION OF MANAGEMENT PROCEDURES, INCLUDING BUDGET
(Co-Chairs and Secretariat)

  7.1   Bigeye tuna
  7.2   Albacore tuna
  7.3   Skipjack tuna
  7.4   Yellowfin tuna
  7.5   Swordfish
  7.6   General issues
          7.6.1   Exceptional circumstances
          7.6.2   MP implementation, actions and regular implementation review

8 STOCK STATUS GUIDANCE AND REFERENCE POINTS (SC Chair and WPM Chair)

9 FUTURE DIRECTION OF THE TECHNICAL COMMITTEE ON MANAGEMENT PROCEDURES (Co-Chairs)

  9.1   Workplan
          9.1.1   New timelines
          9.1.2   budget and resources needed for technical developments
          9.1.3   External review
  9.2   Priorities
  9.3   Process and future meetings of TCMP

10 ADOPTION OF REPORT (CO-CHAIRS)