Report of the 14th Session of the IOTC Working Party on Methods

San Sebastian, Spain, 26 - 28 October 2023

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BIBLIOGRAPHIC ENTRY
IOTC–WPM14 2023. Report of the 14th Session of the IOTC Working Party on Methods. Online 26-28 October 2023. *IOTC–2023–WPM14–R[E]: 40.*

Contact details:

Indian Ocean Tuna Commission
Blend Building, Providence
PO Box 1011
Victoria, Mahé, Seychelles
Ph: +248 4225 494
Fax: +248 4224 364
Email: secretariat@iotc.org
Website: http://www.iotc.org

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.
ETP	Endangered, threatened and protected
F	Fishing mortality
FAD	Fish aggregating device
FOB	Floating Object
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})
SKJ	Skipjack tuna
SWO	Swordfish
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 14th Session of the Indian Ocean Tuna Commission's (IOTC) Working Party on Methods (WPM) was held in San Sebastian, Span 26-28 October 2023. A total of 46 participants (60 in 2022, 55 in 2021 and 55 in 2020) 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.

The following are the recommendations from the WPM14 to the Scientific Committee, and key outcomes of the WPM, which are provided in Appendix V.

Review of intersessional meetings related to the IOTC MSE process

WPM14.01: The WPM THANKED the participants of the Working Party on Methods Management Strategy Evaluation Task Force meeting for their informative discussions and input on the technical aspects of MSE and related topics. The WPM NOTED that the output of this meeting remains very important to the WPM as it provides an informal forum for the highly technical discussions necessary to advance the MSE process in IOTC for which there is insufficient time during the WPM meeting. The WPM further **RECOMMENDED** that the SC endorse this meeting being included in the schedule of meetings for 2024 (Para 13).

Albacore MSE: Update

WPM14.02: The WPM **RECOMMENDED** that this OM procedure be endorsed and a final version of a set of OMs be constructed for the evaluation of management procedures for the albacore stock. (Para 22).

Bigeye tuna MP (Resolution 22/03)

WPM14.03: The WPM agreed with the review findings that there was no evidence for exceptional circumstances and **RECOMMENDED** that the agreed TAC for 2024 and 2025 should remain unchanged. (Para 41).

Yellowfin tuna MSE: Update

WPM14.04: In concluding its discussion, the WPM **RECOMMENDED** that pursuing the development of the Close-Kin Mark Recapture project should be a high priority for the Commission and REQUESTED that the project developers present the pilot project to the 2023 Scientific Committee meeting. The WPM NOTED that such a presentation should also include firstly, a detailed overview of relevant IOTC data to highlight where adult and juvenile fish are caught, where they are landed and where they can be potentially sampled, and secondly, a more detailed costing of the pilot project. (Para 69).

General MSE issues

WPM14.05: The WPM NOTED that there is a need to ensure that any code and input files used for developing MPs is housed internally on an accessible platform, so it is available to other users and not lost when developers move on to other tasks. The WPM NOTED that ICES uses a Transparency and Assessment Framework (TAF) which is a useful frontend to direct users to the locations of relevant documents and code (e.g. Github repositories) that enable users to re-run assessments and other analyses, but that a much smaller system would be needed for the IOTC. The WPM NOTED that most important information to be curated would be the input files, executables, and control files (not the large volume of output files), and **RECOMMENDED** that the IOTC Secretariat is provided with the necessary resources to manage the curation of this information. (Para 74).

CPUE Standardisation

WPM14.06: The WPM NOTED that several longline fleets provided the CPUE indices (such as swordfish, blue marlin, and black marlin) that were used to assess the billfish stocks. These indices were standardised using widely disparate techniques and frequently showed contradictory trends. WPM AGREED that enhancing the transparency and credibility of the billfish stock assessments can be facilitated by a deliciated CPUE workshop that draws the experiences from the IOTC Joint CPUE standardisation procedure for the tropical tuan. Thus, the WPM **RECOMMENDED** holding a cross-cutting CPUE standardisation workshop in 2024 focusing on billfish (ideally prior to the WPB15 meeting) amongst the involved longline fleets to have focused discussions on standardising methods and processes for the primary billfish species. (Para 94).

Revision of the WPM Program of work (2024–2028)

WPM14.07: The WPM **RECOMMENDED** that the Scientific Committee consider and endorse the WPM Programme of Work (2024–2028), as provided in Appendix IV (Para 117).

Date and place of the 15th and 16th sessions of the WPM

WPM14.08: The WPM NOTED that international travel restrictions due the global Covid-19 pandemic has now been greatly eased and it is now possible to have arrangements for a physical meeting in 2024. The Secretariat will continue to liaise with CPCs to determine their interest in hosting these meetings in the future as the SC is encouraging a return to physical meetings in 2024. The WPM **RECOMMENDED** the SC consider mid-October 2024 as a preferred time period to hold the WPM15. As usual it was also AGREED that this meeting should continue to be held back-to-back with the WPTT, with the WPM taking place before the WPTT (Para 124).

Review of the draft, and adoption of the Report of the 13th Session of the WPM

WPM14.09: The WPM **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPM14, provided in Appendix V (Para 126).

1. OPENING OF THE MEETING

1. The 14th Session of the Indian Ocean Tuna Commission's (IOTC) Working Party on Methods (WPM) was held in San Sebastian, Span 26-28 October 2023. A total of 44 participants (60 in 2022, 55 in 2021 and 55 in 2020) 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. ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION

2. The WPM **ADOPTED** the Agenda provided at Appendix II. The documents presented to the WPM14 are listed in Appendix III.

3. THE IOTC PROCESS: OUTCOMES, UPDATES AND PROGRESS

3..1 Outcomes of the 25th Session of the Scientific Committee

3. The WPM **NOTED** paper IOTC–2023–WPM14–03 which outlined the main outcomes of the 25th Session of the Scientific Committee (SC25), specifically related to the work of the WPM.

4. The WPM **NOTED** that in 2022, the SC made a number of endorsements and recommendations in relation to the WPM13 report. These are provided below for reference:

7.6.1 Management Strategy Evaluation Progress

*(Para. 113). The SC **NOTED** the good progress made in Management Strategy Evaluations exercises for IOTC species in 2021, and the useful discussions of MSE work at the MSE Task Force meeting (a technical expert group of the WPM) and the TCMP meeting in 2022.*

7.6.2 Albacore MSE

*(Para. 114). The SC **NOTED** that the ALB operating model (OM) has been updated from the 2021 assessment models, which are now based on 2 model runs, each with a different CPUE index. The OM consists of a total of 432 models runs which are configured along similar sources of uncertainty levels as the previous one.*

*(Para. 115). The SC **NOTED** that alternate methods for conditioning OMs, such as Approximate Bayesian Computation (ABC), might provide a wide range of options to the many issues that can arise during conditioning. The SC agreed that it should first be tested, and albacore could serve as a useful case study for the use of ABC for OM conditioning. The SC further **NOTED** that if such a strategy is to be used in the future, prior distributions for parameters need to be established.*

7.6.3 Skipjack tuna MSE

*(Para. 116). The SC **NOTED** the recent SKJ MSE focused on addressing the TCMP05's request to incorporate implementation errors in the MSE framework and has evaluated MPs that are resilient to implementation errors. The MSE tested implementation errors ranging from 10% to 40% (the actual catches in 2018 and 2019 were 29% and 16% greater than the current TAC). As such, the magnitude of implementation errors adequately compensates for the discrepancy between the TAC and the actual catch.*

7.6.4 Yellowfin tuna MSE

*(Para. 117). The SC **NOTED** there has been no further progress on the OM development of yellowfin tuna, pending the results of the external review of the yellowfin stock assessment model which is scheduled to take place February in 2023.*

7.6.5 CKMR design study

*(Para. 118). The SC, However, **NOTED** that there has been further advancement of the CKMR design study for yellowfin tuna. The SC **NOTED** that the design study indicates that collection of 30,000 samples each year would provide useful population metrics (Total Reproductive Output (TRO, similar to spawning stock biomass), depletion in TRO, adult mortality and mean recruitment) with reasonable precision. Specifically, the depletion in total reproductive output (TRO), could be estimated with a coefficient of variation (CV) of 15% with 30,000 samples collected each year for 5 years. The logistics of sampling appear feasible given the size samples available throughout the IOTC fisheries, however, it is vital to account the variability in access and sampling quality between fisheries, therefore a phased approach is needed.*

*(Para. 119). The SC **NOTED** that the result of the design study is thought to be robust, which means that if targeted samples can be gathered and enough kinship pairs can be located, the intended precision of the population estimates can be achieved, to significantly improve the precision of assessment and robustness of management advice. Further collaborative work is needed to resolve logistical challenges of sampling, feasibility, costs and benefits.*

7.6.6 Bigeye tuna MSE

*(Para. 120). The SC **NOTED** that the running the BET MP and the calculation of the TAC has been presented to both the WPM13 and WPTT24 (see Section 7.4.3).*

*(Para. 121). The SC **NOTED** that the 1-year time gap between the running of an MP by the SC and its actual implementation is less than ideal. The SC **NOTED**, however, that such a delay in the implementation has been MSE tested for the adopted BET MP and thus its effect on the performances has been already taken into account. The SC **RECOMMENDED** that the Commission identify and adopt a decision-making process to shorten the delay in the implementation of the MP output.*

7.6.7 Swordfish MSE

*(Para. 122). The SC **NOTED** that the newly proposed simplified OM grid provides a comparable perspective on uncertainty to the existing OM. It was noted that there is a wide spread of uncertainty related to stock status in the swordfish OM.*

*(Para. 123). The SC **NOTED** that the value of 0.2 for sigmaR that came from the assessment is quite low and may not be appropriate for an oceanic species like swordfish. The SC agreed that higher values are explored as a robustness test of the OM*

7.6.8 Update on TCMP05

*(Para. 124). The SC **NOTED** document IOTC-2022-TCMP05-R on the Report of the 5th session of the TCMP held in May 2022. The SC **NOTED** that the WPM had taken into consideration the recommendations and discussions held at that meeting.*

*(Para. 125). The SC **QUERIED** whether it would be necessary to hold a virtual TCMP meeting early in the year if no MPs are considered ready for presentation to the TCMP that particular year. The SC **RECOMMENDED** that there is no need to organize a virtual TCMP as no candidate MPs will be ready for consideration for adoption in 2023.*

*(Para. 126). The SC however **CONSIDERED** that it is advisable to have focused dialogue with managers on those MSE which are more advanced such as that for SKJ. The SC **RECOMMENDED** that a virtual TCMP is tentatively convened early in 2024 with a special focus on MSE for SKJ.*

3..2 Outcomes of the 27th Session of the Commission

5. The WPM **NOTED** paper IOTC–2023–WPM14–04 which provided the main outcomes of the 27th Session of the Commission specifically related to the work of the WPM.

6. The WPM **NOTED** (IOTC-2023-S27-R):

*[Para 77] The Commission **SUPPORTED** the work conducted by the TCMP and its role in providing science-based advice for management. However, the Commission **AGREED** that the dialogue in the TCMP has become too technical and has limited the involvement of managers in recent years, as most of the discussions take place among the technical experts.*

*[Para 78] The Commission **URGED** the TCMP to continue with capacity building initiatives to facilitate understanding of the process and increase participation by all parties with the aim of managers being better able to contribute to the implementation of the MSE process. The Commission **ACKNOWLEDGED** that an MSE capacity building workshop is planned to be held in September 2023.*

*[Para 79] The Commission **REQUESTED** the MSE developers to communicate the results of their analyses in a less technical manner and **ENDORSED** the creation of a small working group to discuss and agree on ways to improve communication between the scientists and the managers. This could include modifying the existing templates for presentation of MSE outputs to increase understanding and better meet the needs of the managers.*

7. The WPM **NOTED** that the small working group had yet to meet to discuss ways to simplify the advice presented to the TCMP and Commission. The WPM **REQUESTED** that the Secretariat along with the SC Chair, reach out to the Commission Chair as well as a few Member country representatives to discuss ways in which this can be progressed. The WPM further **NOTED** that it would be best if these discussions could take place prior to the virtual meeting of the TCMP in February 2024.

8. The WPM **NOTED** that the coastal states capacity building workshop on MSE had not taken place in September as originally planned due to logistical difficulties. The Secretariat informed the WPM that a window in February 2024 was tentatively being discussed, and that the Secretariat would continue to inform the WPM chair of any developments.

9. Participants to WPM14 were **ENCOURAGED** to familiarise themselves with the previously adopted Resolutions, especially those most relevant to the WPM 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 WPM meeting.

3..3 Review of Conservation and Management Measures relevant to the WPM

10. The WPM **NOTED** paper IOTC–2023–WPM14–05 which aimed to encourage participants at the WPM14 to review some of the existing Conservation and Management Measures (CMM) relevant to the WPM and as necessary to 1) provide recommendations to the Scientific Committee on whether modifications may be required; and 2) recommend whether other CMMs may be required.

3..4 Progress on the recommendations of WPM13

11. The WPM **NOTED** paper IOTC–2023–WPM14–06 which provided an update on the progress made in implementing the recommendations from the previous WPM meeting which were endorsed by the Scientific Committee and **AGREED** to provide alternative recommendations during the WPM14 as appropriate given any progress.

12. The WPM **NOTED** paper IOTC-2023-WPM14(MSE)-R which provided the report of Report of the 14th Session of the IOTC Working Party on Methods Management Strategy Evaluation Task Force that took place from 28-31 March 2023.

13. The WPM **THANKED** the participants of the Working Party on Methods Management Strategy Evaluation Task Force meeting for their informative discussions and input on the technical aspects of MSE and related topics. The WPM **NOTED** that the output of this meeting remains very important to the WPM as it provides an informal forum for the highly technical discussions necessary to advance the MSE process in IOTC for which there is insufficient time during the WPM meeting. The WPM further **RECOMMENDED** that the SC endorse this meeting being included in the schedule of meetings for 2024.

4. ALBACORE MSE: UPDATE

4..1 Review of OM and candidate MP development

14. The WPM **NOTED** paper IOTC–2023–WPM14–13 which presented an update of the Indian Ocean albacore MSE, with the following summary provided by the authors:

> "In this paper we condition the Indian Ocean Albacore tuna OM that mirrors (biologically and structurally) the most recent stock assessment, utilises length composition and longline CPUE data, and is able to explore a wide range of stock status prior hypotheses, many of them built on information from the results of the stock assessment. The aim of this work was to cover the same range of factors/hypotheses covered in the previous suite of OMs" (see the paper for the full summary)

15. The WPM **WELCOMED** the development and application of this new methodology and **AGREED** that it provides a suitable procedure for conditioning of OMs that are not directly based on the stock assessment model.

16. The WPM **NOTED** that the uncertainties included in the OM are equivalent to those in the previous grid of stock assessment based model runs. The use of covariant priors for steepness and natural mortality was considered especially useful, to avoid conflicting combinations of biological parameters, which often lead to extreme estimates of stock status.

17. The WPM **AGREED** that the proposed implementation provides a good coverage of the main sources of uncertainty.

18. The WPM **NOTED** that the set of OMs presented explored the impact of some choices on the model dynamics: selection of CPUE series to be followed, use of priors on overfishing level, consideration of catchability trends in the CPUE fleet, and estimation or not of recruitment variance.

19. The WPM **NOTED** the fits to the data for a subset of OMs and AGREED that they appear to explain the data sufficiently well. The WPM **NOTED** that the simplification of the fleet structure appears to have no negative effect in model diagnostics, and instead simplifies obtaining useful information from the aggregated length-frequency data.

20. The WPM **NOTED** how models run based on the area 1 LL CPUE were clearly better informed on the scale of the population, and the fits were generally better. The WPM **AGREED** that LLCPUE in area 1 should form the basis for the evaluation of future candidate MPs. The WMP also asked how informative the assumption of equilibrium in 2000 is and **NOTED** that the approach assumed an equilibrium age structure at the start but that ultimately the impacts of that on outcomes are not significant.

21. The WPM **NOTED** that run R1b, using the CPUE from LL fleet in area 1, and with SSB and overfishing probability priors, appears to be a viable base case OM. The WPM also **NOTED** that the estimation of recruitment variance introduces some changes in dynamics that could be useful to consider. The WPM **SUGGESTED** the developers to combine both options under a single run (i.e. a R2b case).

4..2 Discussion and feedback on MSE development

22. The WPM **RECOMMENDED** that this OM procedure be endorsed and a final version of a set of OMs be constructed for the evaluation of management procedures for the albacore stock.

4..3 Future steps and timelines

23. The WPM **ENCOURAGED** the developers to finalize the development of the methodology and of the planned diagnostics based on cross-validation.

5. SKIPJACK TUNA MSE: UPDATE

5..1 Review of OM and candidate MP development

24. The WPM **NOTED** paper IOTC–2023–WPM14–16 which provided the Evaluation of empirical control rules for Indian Ocean Skipjack. The following abstract was provided by the authors:

> "Work on an updated Management Procedure for skipjack has been ongoing since 2019. The current phase of the work began in October 2023, and will continue for a period of one year, with the objective to: Develop a Management Procedure for Indian Ocean skipjack tuna, including specification of the data inputs, that has been fully tested using a Management Strategy Simulation framework. Specific objectives are: Re-visit the possibility of using a model-based Management Procedure based on the updated CPUE indices to be presented at WPTT25; Propose a set of candidate Management Procedures to the TCMP (2024) for potential adoption by the Commission. The current report provides a review of work to date, and proposed future directions, for discussion by the WPM"

25. The WPM **NOTED** that the main objectives of this study presented to the WPM are to facilitate discussion on (1) development of a new model-based MP (2) the use of environmental data in the robustness testing, and (3) decide what is to be presented at the next TCMP in 2024.

26. The WPM **NOTED** that the candidate MPs under development are based on CPUE data from the PL and PSLS fisheries and produce an output of a recommended Total Allowable Catch (TAC). It was noted that model-based MPs can be more understandable for managers, because they generate a measure of stock status whenever they are implemented. This provides managers with an intuitive diagnostic that can be monitored. On the other hand, empirical, data-based MPs rely more heavily on a comprehensive simulation process for their justification.

27. The WPM **RECALLED** that the TCMP06 requested that model-based approaches be revisited, and the analyst proposed to explore a new model that makes use of data from the regional tuna tagging program (RTTP-IO) and small scale (SS) tagging data to provide an estimate of abundance or fishing mortality. This would anchor a

biomass dynamic model and might allow dynamics to be resolved using biological data on productivity and catches only (i.e., independently of the CPUE time series). In contrast to the CPUE data, the tagging data will not change in the future. From this new model, a biomass depletion estimate might be able to be extracted for use in a candidate MP.

5..2 Discussion and Feedback on MSE development

28. The WPM **NOTED** that the TCMP didn't oppose an empirical MP but instead, required the developer to explore the model-based MPs in addition to the empirical MP. The WPM **NOTED** that attempts to develop model based MPs had been unsuccessful due to that the indices (including the new CPUE indices) are not informative of the biomass depletion (they are consistent with a fishery that is being driven by recruitment rather than the catch). The WPM **NOTED** that exploration of the biomass dynamic model is relatively straightforward and if future exploration is successful model-based MPs may then be reconsidered.
29. The WPM **NOTED** that the TCMP requested that the tuning period should be consistent with other stocks (by year 11-15 of the projection) and also, that the stability clause should include options for asymmetric limits. The scenarios for the maximum change of TAC agreed by the TCMP are: (1) a symmetric 15% (2) a symmetric 25% (3) asymmetric 25% (upward) and 15% (downward) (4) asymmetric 15% (upward) and 10% (downward). The TCMP also **AGREED** to consider stability clauses that are disabled when biomass (or the equivalent data-based biomass indicator) falls below certain safety values (e.g., Blim). The analyst noted that TAC changes in the OM projections are typically less than 15%, with the exception of robustness trials that include a recruitment failure. Evaluation of the different TCMP proposals is therefore unlikely to yield any difference in the projection outcomes. The WPM **AGREED** that these different scenarios should be presented even if the outcomes for each run are similar.
30. With regards to the CPUE standardization model, the WPM **AGREED** that the CPUEs used in the 2023 stock assessment are fairly similar to the indices developed for 2020. The group agreed that the MP should specify how the CPUEs are generated by the researchers responsible for standardizing the catch rate data. Fundamental changes in the standardization may eventually be considered exceptional circumstances and should be evaluated when this circumstance is identified.
31. With regards to the use of environmental drivers in the robustness testing, the WPM **AGREED** correlations between recruitment deviates and chlorophyll data suggest skipjack recruitment may be influenced by prevailing environmental conditions and that there may be cyclical trends in skipjack recruitment. The WPM suggested that the robustness of the MP should be evaluated with the incorporation of autocorrelation in the recruitment deviates comparable to the observed recruitment trends.
32. The WPM **AGREED** not to use the tag-recapture data to build a model for the MP. The WPM also **AGREED** that the HCRs with catch output are adequate.
33. The WPM **NOTED** that a new stock assessment for skipjack will be reviewed during the WPTT in 2023. The WPM asked the developer whether reconditioning the OM with same approach based on the 2023 will be possible. The WPM was informed by the developer that this will not take much time and it is feasible to do within the timeframe before TCMP presentation (if possible before the SC meeting). Thus, the WPM **REQUESTED** the developer, to recondition skipjack OMS based on the 2023 adopted stock assessment grid.

5..3 Future steps and timeline

34. The WPM **NOTED** the requested modifications to the empirical-MP (new period to calculate performance metrics, stability clauses and robustness tests), and the analyst has been contracted to further develop the skipjack MSE in 2024.

6. BIGEYE TUNA MP (RESOLUTION 22/03)

6..1 Process for running Resolution 22/03 on Bigeye MP

35. The WPM **NOTED** that the bigeye tuna MP would be run in 2024 to recommend the TAC for 2026-2028, and therefore the bigeye tuna catch and CPUE data would need to be collated as part of the 2024 workplan. There is also a bigeye tuna stock assessment scheduled for 2025.

6..2 MP specifications including input data needed (e.g., joint CPUE)

36. the WPM **NOTED** feedback from the joint CPUE developers that due to time, resourcing and data security constraints as well as the necessary prioritisation of developing a yellowfin tuna CPUE for the 2024 yellowfin tuna assessment, it was possible that the developers may only have time to produce the 1 degree aggregated (not operational) CPUE index for bigeye tuna. However, the developers might prioritise developing an operational level index if work on the yellowfin CPUE index indicated the potential for significant differences between indices using either operational or aggregated data.

6..3 Tasks, responsibilities and timeline for running the MP

37. The WPM **AGREED** that the secretariat will be running the MP in the future, with support to be provided by the CPCs scientists.

6..4 Exceptional Circumstances

38. The WPM **NOTED** document IOTC-2023-WPM14_11, which discusses the consideration of exceptional circumstances for the Bigeye Tuna MP in 2023, with the following abstract provided by the author:

> "The IOTC adopted the bigeye tuna management procedure (MP) in 2022, which is used to recommend the Total Allowable Catch (TAC). As part of the MP schedule, the Commission has adopted an annual review of evidence for exceptional circumstances, to check for conditions that could make the implementation of the TAC advice risky to the stock or fishery. The Exceptional Circumstances Guidelines specify a three-stage process: (i) examining evidence for exceptional circumstances, (ii) determining severity and impact, and (iii) recommending any management or research action that should be taken. A wide range of information is reviewed to examine if there is evidence for exceptional circumstances, e.g., changes in the knowledge of stock or fishery uncertainties against which the MP was tested. The Exceptional Circumstances Guidelines (IOTC–2021–SC24 Appendix 6A) provide a scientific process for developing appropriate management responses to exceptional circumstances and, hence, provide transparency in TAC decision-making by the Commission. The MP was run in 2022. Changes in the data used in the CPUE standardisation, a new growth curve and an alternative natural mortality scenario used in the 2022 stock assessment models were items identified as potential exceptional circumstances in 2022. Severity and impact were considered low for these items and no actions were recommended. No new exceptional circumstances were detected in 2023, and therefore, no research or management actions are recommended"

39. The WPM **NOTED** that exceptional circumstances are conditions or data that fall outside the range of uncertainties that the MP was tested against (i.e., the reference set of operating models used for Management Strategy Evaluation (MSE), and the robustness tests) and that the annual review of evidence of exceptional circumstances is required to check for conditions that could make implementing the MP TAC advice risky.

40. The WPM **NOTED** that, as per the Exceptional Circumstances Guidelines (IOTC–2021–SC24 Appendix 6A), the review examined the following aspects and came to the following conclusions:
    - New knowledge about the stock, population dynamics or biology. No new information was identified.
    - Changes in fisheries or fishing operations. No major changes were identified.
    - Changes to input data to the MP, or missing data. No major changes were identified.
    - Inconsistent implementation of the MP advice (e.g., total catch is greater than, or less than, the TAC). No issues were identified as TACs are not implemented until 2024 and 2025.

41. The WPM agreed with the review findings that there was no evidence for exceptional circumstances and **RECOMMENDED** that the agreed TAC for 2024 and 2025 should remain unchanged.

42. The WPM **NOTED** that current catches of bigeye tuna are larger than the TAC set for 2024, and therefore, as noted in 2022, catches will need to be reduced as agreed in resolution (23/04). This is important given that the stock is estimated to be over-fished and subject to over-fishing.

43. The WPM **NOTED** that it is not advisable to try to create exceptional circumstance guidelines and checks that are too detailed or specific as it is not possible to anticipate all scenarios. The current general framework allows for an assessment to detect any changes that might impact advice on the TAC.

44. The WPM **NOTED** that there is some uncertainty in catch data for bigeye tuna from some fisheries (e.g., artisanal fisheries) arising from potential species mis-identification issues, in particular with yellowfin tuna, but that it is difficult to account for this uncertainty in MSE without any information or data on the potential magnitude of that issue.

7. SWORDFISH MSE: UPDATE

7..1 Review of OM and candidate MP development

45. The WPM **NOTED** paper IOTC–2023–WPM14–14 on an update on Indian Ocean swordfish MSE. The following abstract was provided by the authors:

> "*The reference operating model for the Indian Ocean swordfish stock was developed over the last three years and has been endorsed by the IOTC scientific committee. The OM was developed based on the 2020 WPB SS3 assessment and covered the dynamics of the swordfish until the year 2018. This OM was updated to the current year, 2023, by projecting the stock forward based on the reported catches for 2019, 2020 and 2021 and assuming a 2022 catch at the 2021 level. A comparison of the OM with the output of the new 2023 stock assessment shows that the OM remains appropriate to describe the dynamics of the Indian Ocean swordfish stock as well as its current status*" (see the document for the full abstract)

46. The WPM **NOTED** that while the swordfish OM was based on the 2020 assessment, it covered a far greater range of scenarios for uncertainty. The WPM **NOTED** that the swordfish assessment was updated in 2023 and that, while some reference quantities are closer to the tail of the OM distribution, the new stock assessment estimates are still well within the OM's confidence envelope. Therefore, the WPM **AGREED** that there isn't strong evidence to suggest that the OM should be reconditioned on the updated assessment (the Butterworth guillotine should apply). However, the WMP **NOTED** that the new assessment has revised the selectivity configuration for the main Japanese fleet to account for the spatial heterogeneity in size composition. It was therefore advised that the effect of this change could be assessed when evaluating the MP performance in the OM projection.

47. The WPM **NOTED** that the MSE has tested both a model-based candidate MP, and a data-based candidate MP, under three tuning objectives (Pr(Kobe green in 2034-2038) with a probability of 50%, 60% and 70%, respectively). The WPM also **NOTED** that two robustness tests were carried out, one with a catch implementation error (20% catch overshooting) and the other with a recruitment failure scenario (recruitment falling at 10% average recruitment estimated by the model).

48. The WMP **NOTED** that the data-based MP is based on the slope of the CPUE index and the divergence of the index from a target level (estimated through the tuning process), whereas the model-based MP is based on a JABBA surplus production model that used the CPUE as input. The WPM **NOTED** that the deviation from the target was measured in proportional terms rather than absolute terms, and this may be reviewed in the future.

49. The WPM **NOTED** that while the two types of MP performed very similarly for most of the biomass-related performance indicators (such as SB/SBmsy), there was a notable difference in the indicators related to the catches, with the data-based MP typically producing higher catches, greater inter-annual variability, and wider uncertainty in future catches. The WPM **NOTED** that the data-based MP is more responsive since it is more directly tied to the CPUE index, which could account for some of the difference. Additionally, it was noted that the data-based MP performs better in both robustness trials. However, the WPM **NOTED** that in practice the model-based MP's performance would not materialise if the scenarios in the robustness trials result in exceptional circumstances.

50. The WPM suggested that the performance of the JABBA model, which is used in the model MP, be examined, especially with regard to its ability to estimate stock depletion. The WMP also **NOTED** the suggestion of conducting a robustness test in the future to investigate the impact of a potential hyperstable relationship between CPUE and abundance on the MP performance.

51. The WPM **NOTED** that the initial OM grid that include full combinations of selected uncertainty axis options was initially reduced via a balanced partial factorial design, and the model runs were then further tested via a set of diagnostics, and the models that failed the tests were then excluded. The diagnostics used to accept/reject models included convergency tests and hindcasting analysis. Models with exceptionally high initial biomass were also rejected and the selected models were then resampled with replacement, with weights based on the p-value of the Diebold-Mariano test applied to the MASE values from the hindcasting. The WPM **NOTED** that the diagnostics tests are based on recommended best practice, which is currently a topic of active research. The WPM **NOTED** that the diagnostics need to be practical and efficient as the OM generally consists of a large number of models.

52. The WMP further **NOTED** the suggestion of the use of the invertibility of the Hessian Matrix instead of final gradient statistics for the convergency test.

7..2 Discussion and feedback on MSE development

53. The WPM discussed catch implementation error extensively. The WPM **NOTED** that catch implementation can be broadly fall into the following categories: persistent overcatch (e.g., IOTC skipjack), random variation in catch overshooting and/or undershooting; and strict compliance of TAC (e.g., ICCAT bluefin tuna). The WPM **NOTED** that the scenario of persistent overcatch for swordfish is probably unlikely given the characteristics of the fishery. However, if an MP is shown to be robust to the large catch overshooting, it is expected to also perform well under other implementation errors.

54. The WPM also discussed the possibility of testing a range of implementation errors (i.e., 5%, 10%, and 20% overcatch) and **NOTED** that while this can help managers understand how well various MPs perform, it can also unintentionally encourage overcatch when they realise that some MP can withstand overcatch. The WPM **AGREED** that the key to understand these kinds of robustness trials is effective communication and ensuring that these trials are not perceived to be endorsing overcatch.

55. The WPM **NOTED** that it's important to ascertain the maximum implementation error threshold above which the model or MP will fail, potentially requiring management intervention. The WPM also **NOTED** that overcatch of TAC will always result in exceptional circumstances being triggered, but if the effects of catch overshooting have been fully investigated, management intervention may be reduced or avoided.

56. The WPM further **NOTED** that the positive implementation error (catch overshoot) can lead to very poor MP performance if implementation error is larger than the constraint on the TAC change because the effect of catch overshooting cannot be offset by the same level of catch reduction due to the constraint on TAC changes. The WPM also **AGREED** that the TAC change in the next management cycle should be relative to the previous TAC rather than the most recent catch. The WPM **NOTED** that these extra tests of different implementation errors may be done relatively quickly and pending the review of the results of these extra tests, the swordfish MSE could potentially be ready for consideration of adoption by the TCMP/Commission.

7..3 Future steps and timelines

57. In summary, the WPM **REQUESTED** to test a maximum implementation error of 15% for a single management cycle, or three years, in order to assess whether the swordfish MP can successfully bring the stock back to target over the projection horizon. Additionally, the WPM requested to test an implementation error of 10% over a longer period of time in order to better understand and compare the performance of various MP.

8. YELLOWFIN TUNA MSE: UPDATE

8..1 Review of the progress on development the OM

58. The WPM **NOTED** there has been no further progress on the OM development of yellowfin tuna, pending the results of the external review of the yellowfin stock assessment model which took place in February, 2023.

59. The WPM **NOTED** the brief verbal update provided by the developers on progress towards development and testing of OMs and candidate MPs for yellowfin tuna. The WPM was reminded that development work was paused two years ago, to allow time for the yellowfin tuna stock assessment to be independently reviewed and problems hindering its use hopefully resolved. The WPM **NOTED** that funding for MSE work for yellowfin runs out in June 2024 and additional funding will need to be sought.

60. The WPM **NOTED** that as a result of the problems with the yellowfin assessment, some preliminary work on an alternate approach to conditioning the Yellowfin Tuna OMs (the ABC approach as being currently applied to albacore tuna) was undertaken by the developers. However, the WPM agreed that no further work should be undertaken until the WPTT and SC have reviewed the findings of the independent review of the yellowfin assessment, and a new and hopefully improved yellowfin assessment is developed and reviewed by WPTT in 2024. That work, in addition to the review of the albacore tuna ABC approach, will provide a good basis upon which to assess whether it is best to continue development of the yellowfin tuna MSE work using the ABC approach, or using the previous approach using the yellowfin tuna stock assessment.

61. The WPM discussed the need to adopt a better approach to developing assessment model grids and weighting models within grids so as to avoid certain combinations of biological parameter values (e.g. steepness and natural mortality values) that result in unrealistic population dynamics. The WPM **AGREED** that it will be

important to explore the application of best practice approaches to this issue when developing the Yellowfin tuna assessment in 2024. These may include the approaches recommended by the best practice tuna assessment workshops and the approaches recently developed and applied in the WCPFC. The WPM **NOTED** that it is important that protocols for model selection and weighting are agreed based on best practice prior to results from assessments being viewed to avoid potential for bias in approach.

8..2 Future steps and timeline

62. The WPM **NOTED** paper IOTC–2023–WPM14–08 on a work plan for an Indian Ocean yellowfin tuna close-kin mark-recapture design study. The following abstract was provided by the authors:

> "*A close-kin mark-recapture (CKMR) design study completed in 2022 estimated that the collection of 25,000 to 30,000 samples per year from Indian Ocean yellowfin tuna, over a five-year period, would provide an estimate of absolute abundance with an acceptable level of precision. The Working Party on Methods (WPM) noted the logistical challenges in collecting this many samples and suggested a staged approach to the implementation of CKMR for yellowfin tuna. This paper outlines a proposal for the implementation of a CKMR pilot project for Indian Ocean yellowfin tuna to evaluate the logistics and feasibility of sampling, and levels of cross contamination of DNA. The WPM is invited to provide feedback on this proposal.*"

63. The WPM **NOTED** its previous support for this project but also the logistical challenges in implementing such a project means that it should be implemented in staged approach so as to demonstrate the ability to sample the required number of fish from the required fisheries and locations.

64. With respect to project design, the WPM discussed whether the project needs to implement a very rigorous sampling design that samples across representative fisheries, areas and age classes (juveniles v adults) in a very consistent manner year on year. The project developers explained that such strictly repeatable and random sampling is not required providing that at a higher level, the sampling is consistent with our understanding of the spatial breeding area dynamics (implications for stock structure) and that any important spawning or juvenile habitat areas are sampled. Outside of these issues then variation in sampling is not a problem.

65. The WPM **NOTED** that a CKMR project will require significant international collaboration, in particular in relation to sample collection across the fisheries and spatial extent of the IOTC, but also most likely scientific collaboration relating to the design and standard operating procedures for the sampling. There will also be a very significant need for training of international collaborators including from coastal states and in relation to ensuring sample collection methods are applied in a way that ensures cross contamination does not occur. The WPM **NOTED** that a range of countries have previous experience participating in sampling projects but **REQUESTED** the project put particular effort to organising collaboration with other countries with very significant fisheries that have not previously participated in sampling projects.

66. With respect to sample collection and analyses, it was clarified that the sampling medium is ethanol, muscle tissue samples (not fins) is preferred, in small tubes, and shipping is not considered difficult. The WPM **NOTED** that processing tissue samples through a single lab can reduce the potential for inconsistencies in sequencing but that other approaches could be considered and discussed if necessary. The project developers clarified that the initial project would not be doing large-scale tissue analyses, but focussed on proving the logistic feasibility of sufficient sample collection.

67. The WPM **NOTED** the recent development of epigenetic ageing methods, recently demonstrated and validated in research conducted in the Pacific to provide accurate age estimates for three different tuna species. The method has the potential to be tested and applied in the Indian Ocean and may offer a solution to significantly simplify sample collection requirements in a future CKMR project. It would mean that a single tissue sample from each fish could provide a genotype for close kin, fish age and sex information based on genetic information alone. This would avoid the logistically difficult and costly process of collecting, transporting and processing thousands of fish otoliths to provide fish ageing information.

68. The WPM **NOTED** that very preliminary estimates of project cost indicate it will cost more than $US 1 million, but that there was a need for the project developers to develop a more detailed and structured budget, after discussions highlighted some additional cost considerations encountered from other CKMR projects.

69. In concluding its discussion, the WPM **RECOMMENDED** that pursuing the development of a CKMP project should be a high priority for the Commission and **REQUESTED** that the project developers present the pilot project to the 2023 Scientific Committee meeting. The WPM **NOTED** that such a presentation should also include firstly, a detailed overview of relevant IOTC data to highlight where adult and juvenile fish are caught, where they are landed and where they can be potentially sampled, and secondly, a more detailed costing of the pilot project.

9. GENERAL MSE ISSUES

9..1 General discussion

70. The WPM **NOTED** that there is not much information available to define levels of catch uncertainty for evaluating in the MSE robustness tests. The WPM **NOTED** that the bias in catch uncertainty is likely to be more important that the scale of catch uncertainty, and that constructing different catch history scenarios is probably the best way to evaluate the impact of catch uncertainty in the OMs, while improving the catch reporting by CPCs should continue to be a priority.

71. The WPM **NOTED** that adding large errors to the historical catches, as has been previously suggested for yellowfin tuna, may help in solving the catch equation, but does not adequately address the uncertainty in catches.

72. The WPM **NOTED** that it would be useful to identify if it is likely that there have been, or will be, any biases or shifts in catches, as these could be captured by incorporating constant bias into the conditioning of the OMs.

73. The WPM **NOTED** that as the number of adopted MPs increases, additional resources are likely to be required to enable the Scientific Committee to evaluate the robustness of MPs when exceptional circumstances are triggered.

74. The WPM **NOTED** that there is a need to ensure that any code and input files used for developing MPs is housed internally on an accessible platform, so it is available to other users and not lost when developers move on to other tasks. The WPM **NOTED** that ICES had developed and uses a platform called the Transparent Assessment Framework (TAF) which is a useful frontend to direct users to the locations of relevant documents and code (e.g. Github repositories) that enable users to re-run assessments and other analyses, but that a much smaller system would be needed for the IOTC. The WPM **NOTED** that most important information to be curated would be the input files, executables, and control files (not the large volume of output files), and **RECOMMENDED** that the IOTC Secretariat is provided with the necessary resources to manage the curation of this information.

75. The WPM **NOTED** that some requests from the TCMP for the development of the OMs and MPs have not yet been addressed and **REQUESTED** that the developers ensure that all requests from May 2023 TCMP are addressed before the next TCMP meeting in February 2024.

76. The WPM **RECALLED** that the TCMP requested that developers present MSY reference points in addition to depletion reference points for swordfish. However, the WPM **NOTED** that the reference points used in the MPs and in the stock assessments are independent and, therefore, it is important to avoid referring to the MSY-based reference points that are used inside MPs as this can lead to confusion with the MSY reference points in the stock assessments. The WPM **AGREED** to report on this issue back to the next TCMP meeting in 2024.

9..2 Climate change scenarios in MSE

77. The WPM **NOTED** that the current MSEs consider short-term recruitment failure in the robustness tests, but do not consider longer term regime (productivity) shifts in recruitment that have been observed in some other demersal stocks. The WPM **NOTED** that it becomes complicated to capture these longer-term shifts in recruitment as change in recruitment not only affect the level of biomass, but also affect the reference points.

78. The WPM **NOTED** that one approach to evaluate impacts of climate change is to evaluate the robustness of MPs to potential changes in growth, mortality, and recruitment. The idea behind is to evaluate if the MPs will be able to detect a change in the stocks' population dynamics (natural mortality, growth and recruitment) and produce advice that will allow achieving management objectives. The group discussed the experience in ICCAT to evaluate the HCR adopted for North Atlantic albacore in a climate change context (Merino et al., 2019).

79. The WPM **NOTED** paper IOTC–2023–WPTT25-22 to be presented at the WPTT which demonstrates a positive response in skipjack recruitment with positive anomalies of sea surface chlorophyll which are associated to

negative Indian Ocean Dipoles, and that these results could be used in developing climate change scenarios for the skipjack tuna MSE work.

80. The WPM **NOTED** that it can be difficult to predict the likely effects of climate change on fish stocks due to the complex interactions between the climate, environment and fish populations. Therefore, it is important to develop a reasonable range of plausible scenarios that capture the likely impacts of climate change. The WPM also **NOTED** that it may also be important to think about how adaptive the MPs can be to a shifting climate. For example, need to adapt data collection processes with shifting distributions.

81. The WPM **NOTED** the importance of timeframes when trying to capture the potential effects of climate change in the MSEs. Current projection timeframes for the OMs are 10-15 years and it may be difficult to incorporate a climate change signal in such a short time period, as the signal over this period may be weak. The WPM also **NOTED** that the current approach is to review MPs every 6 years or so. Therefore, there is the opportunity to adapt or modify the MP in response to climate change. Furthermore, there is an annual process to evaluate exceptional circumstances that could also evaluate if there is evidence of any significant climate effects.

9..3 MSE Capacity Building

82. The WPM **NOTED** the request from the TCMP and Commission for MSE developers to improve the communication of the MSE results by reducing the amount of technical content and for the creation of a small working group to discuss and agree on ways to improve communication between scientists and managers.

83. The WPM **AGREED** that a way to move forward with convening the small working group would be for the Secretariat, along with the SC Chair, WPM Chair and Vice Chair, to contact the Commission Chair to arrange a few candidate Commissioners to participate, and to hold a first virtual meeting sometime in November 2023.

84. The WPM **NOTED** that in some CPC domestic fisheries, communication between scientists and managers has been improved by preparing potential questions that might be asked by stakeholders in advance of the meetings. The potential questions are developed by surveying participants before the meetings. The WPM **NOTED** also noted that in other RFMOs, a small number of ambassador scientists meet individually with CPC managers to explain the details of the MSE process, and that this also allows communication in other official languages.

85. The WPM **NOTED** the need to keep the communication of MSE results relatively simple and focussed on the main results of importance to the Commission and **RECALLED** that the SC has adopted standardised guidelines for the reporting and presenting of MSE results that would assist in keeping the communication consistent, simple and clear.

86. The WPM **NOTED** that the coastal states capacity building workshop that was scheduled for September 2023 has been postponed until at least early 2024.

3 Internal and External Peer Review

87. The WPM were **INFORMED** that the proposed YFT assessment review took place at the FAO headquarters in Rome from the 6 – 10 February 2023. Four independent experts conducted the review.

88. The WPM were also **INFORMED** that the proposed BET MSE review had not yet been performed but that the Terms of Reference for an expert to conduct the review had been endorsed by the SC in 2021 and the Secretariat have contracted a suitable expert to conduct the review in 2024.

10.CPUE STANDARDISATION

10..1 Update on the development of the joint CPUE indices for 2024/2025.

89. The WPM **NOTED** that during COVID (2020-2022) the trilateral Group (Japan, Korea and Taiwan,China) was not able to meet in person and therefore was not able to share the operational data electronically due to a confidentiality agreement. The Group instead reached a compromise to use some aggregated data as an alternative approach (CPUE over 10 days and 1*1 degree with cluster information for extracting the target species), which might result in reduction of quality of the standardized index compared to those based on the operational data set.

90. The WPM **NOTED** that the trilateral Group met in person in autumn 2023 to develop a work plan, particularly on the standardisation main target species including Indian Ocean yellowfin tuna and Atlantic Ocean yellowfin tuna.

The workplan includes: comparing the data across the three fleets in detail, using clustering methods to account for targeting effect, developing a procedure to reduce the size of the operational data; exploring the use of VAST in addition to delta-GLM for estimating regional scaling factors and better understanding inter-annual variation in species distribution, using intra-network systems for data protection, and updating the MOU.

91. The WPM **THANKED** the trilateral Group for the update on the progress made for the joint CPUE work, particularly with regard to the potential use the operational dataset for yellowfin tuna for the 2024 stock assessment. The WPM also **NOTED** that the trilateral Group requested that the WPTT(DP) in 2024 be held slightly later than usual (preferably in late May) for preparation and logistical reasons.

10..2 Advice on CPUE standardisation

92. The WPM **NOTED** that the joint CPUE index for bigeye tuna needs to be updated for the MP application in 2024 to set TAC for 2026-2028) and **REQUESTED** the trilateral Group to produce required index in time (preferably based on operational data if time allows).

10..3 Future workplan

93. The WPM **NOTED** the Program of Work developed by the WPB21 regarding CPUE standardisation:

(Para. 141). The WPB NOTED that several Working Parties had identified CPUE standardisation as a priority and therefore REQUESTED that the WPM consider facilitating a cross-cutting CPUE standardisation workshop.

94. The WPM **NOTED** that several longline fleets provided the CPUE indices (such as swordfish, blue marlin, and black marlin) that were used to assess the billfish stocks. These indices were standardised using widely disparate techniques and frequently showed contradictory trends. WPM **AGREED** that enhancing the transparency and credibility of the billfish stock assessments can be facilitated by a deliciated CPUE workshop that draws the experiences from the IOTC Joint CPUE standardisation procedure for the tropical tuan. Thus, the WPM **RECOMMENDED** holding a cross-cutting CPUE standardisation workshop in 2024 focusing on billfish (ideally prior to the WPB15 meeting) amongst the involved longline fleets to have focused discussions on standardising methods and processes for the primary billfish species.

11.STOCK ASSESSMENT AND STOCK STATUS GUIDANCE (CHAIRPERSON)

11..1 Model selection and weighting

95. The WPM **NOTED** that the WCPFC (Ducharme et al 2022) and the IATTC have used a model weighting scheme and suggested that a suitable ensemble weighting scheme could be developed for IOTC stock assessments.

96. The WPM **NOTED** a presentation from Mark Maunder (IATTC) on the outcomes from a recent workshop of the Center for the Advancement of Population Assessment Methodology (CAPAM) in collaboration with NIWA and ISSF on “Tuna Stock Assessment Good Practices” held on 7 – 10 March 2023 in Wellington, New Zealand.

97. The WPM **NOTED** that estimating autocorrelation in recruitment requires the use of a random effects, and that this might not be required for tuna assessments that usually have a large amount of length frequency data available. However, estimating autocorrelation in recruitment outside the assessment model to derive fixed values might be useful when less (i.e. sparse) length frequency data are available or when using for MSE projections.

98. The WPM **NOTED** that there is an asymmetrical risk to setting future sustainable catches when setting steepness to a value of 1, but that this risk is more important for setting appropriate reference points and fishing mortality rates than for estimating stock status. The WPM **NOTED** the presenters statement that when steepness is set to 1, precaution can be built into setting the reference points by setting more precautionary proxy reference points.

99. The WPM **NOTED** that the McAllister and Ianelli and Dirichlet-multinomial methods for model weighting are essentially the same, except that the Dirichlet-multinomial approach is automated and easier to apply. The WPM also **NOTED** that the Francis method to model weighting is a better approach, but requires many years of length frequency data, and therefore is not always possible to be applied.

11..2 Data poor and/or other approaches

100. The WPM **NOTED** paper IOTC-2023-WPM14-10 on Utilizing the capacities of international organizations to accelerate catch modifications in Iran. The following abstract was provided by the authors:

"*In recent years, there has been a steady policy to shift the method of hook fishing to modern fishing techniques, such as long-line fishing. As a result, a project was implemented through the United Nations Industrial Development Organization (UNIDO) office in Iran and under the supervision of the UNIDO office in Vienna, which aimed to upgrade the entire value chain of tuna species in Chabahar. The project was initiated in 2017, with the objective of effectively achieving the set goals and objectives with proper planning" (see the paper for the full abstract)*

101. The WPM **THANKED** the author for the presentation and **NOTED** that the reduction of bycatch from the use of longline fishing compared to gillnet fishing and the increase in price per kilo for longline caught fish sold to the Asian sashimi market have been incentives for fishers to shift to longlines.

102. The WPM also **NOTED** that there is already a well-established fleet of 300 longline vessels converted from gillnet in the area and these vessels have changed their target to yellowfin due to its higher price.

103. The WPM **NOTED** paper IOTC–2023–WPM14–12 on a maximum sustainable yield assessment for Pelagic Fish in the Andaman Sea Thailand. The following abstract was provided by the authors:

"Thailand is located in a tropical sea and is the habitat of multiple fish species. Thailand therefore classifies aquatic animals into 3 groups: demersal fish, pelagic fish, and anchovies for the convenience of management. Maximum sustainable yield (MSY) assessments are conducted annually for three groups of fish. Fox surplus production model was used to estimate the MSY of the aquatic species group. Among pelagic fish, the important economic fish are mackerel, sardines, and scads. The MSY of pelagic fish group in Andaman Sea was 118,042 tons at the fishing effort (Fmsy) of 64,524 days.While, the catch in 2022 was 114,231 tons with the fishing effort of 49,264 days. Results showed that pelagic fishing is currently being conducted at fishing effort levels consistent with Fmsy. For monitoring a status of some species of pelagic fish that by using length-based Tomson and bells model. Three species were selected to estimate: short mackerel (Rastrelliger brachysoma), Indian mackerel (R. kanagurta) and goldstripe sardinella (Sardinella gibbose) using length-frequency data in 2022. The results showed F-factor values of 3.2, 3.2, and 0.4 respectively indicating that the current fishing effort of short mackerel and Indian mackerel were lower than their fishing effort level which could produce MSY (Fmsy) while the current fishing effort of goldstripe sardinella was over its Fmsy level.".

104. The WPM **THANKED** the author for the presentation and **NOTED** that the analysis was limited to Andaman Sea, but the species distributions extend beyond this area.

105. The WPM **NOTED** that there have been recent developments in data poor methods for the assessment of neritic species, and that the application of some of these methods to these stocks in the Andaman Sea would likely provide some useful results

106. The WPM **NOTED** the paper IOTC–2023–WPM14–15 on the effort creep of the CPUE standardisation was not presented .

11..3 Review the approach used to provide stock status and management advice relative to reference points

107. The WPM **NOTED the paper** IOTC-2023-WPM14-09 that review the application of DPSIR framework in tuna fisheries management in the Indian Ocean with special reference to Sri Lanka. The following abstract was provided by the authors:

"*A Social-Ecological System (SES) is formed when humans interact with their environment. Thus, an SES is an ecological system intricately linked with and affected by one or more social systems. Exclusive Economic Zones (EEZs) can be considered as vibrant SESs in which human societies and other organisms interact with the physical environments. Particularly human-fish interactions could also be considered as an SES and decisions for tuna fisheries management are mainly borne after the analysis based on fish and fisheries data that hardly addressed information on SES. Therefore, the present analysis was conducted for Sri Lankan tuna fisheries using the Driver-Pressure-State-Impact-Response (DPSIR) framework which was developed and used for the adaptive management of various SESs. "Driving forces" such as high dependency for fish, economies of the stakeholders, climate change, urbanization and industrialization through the "pressures"; increased fishing effort, overexploitation, use of destructive gears, Illegal, Unreported and Unregulated fishing practices, changing oceanographic conditions to "state" of, depleted fish stocks and low fish production deviation of fish distribution and fishing grounds, and more warm pools and 'impacts' on declining catch, loss of early life stages,*

marine environment degradation and eventually leading to 'responses' of fisheries and environmental laws and regulations as well as novel technological applications. This showed that the important steps in the process where catch data analysis, could not support alone to support the system. Therefore, a comprehensive analysis using DPSIR is recommended to find out the facts for fisheries management both in terms of regional and national scales."

108. The WPM **THANKED** the author for the presentation and NOTED that the Driver-Pressure-State-Impact-Response approach was at the conceptual stage with respect the Sri Lankan tuna fisheries, but the desire is to implement it.

109. The WPM **NOTED** that Sri Lanka has developed a fishing ground forecasting tool for yellowfin tuna based on sea surface temperature, salinity and chlorophyll, and this information is provided to fishers 3 times per week. Positive feedback has been received from fishers who have used those forecasting tool. Sri Lanka also has a similar fishing ground forecasting tool for skipjack tuna that is currently in the pilot stage.

11..4 Stock status categorization for Indian Ocean skipjack.

110. The WPM **NOTED** that previous problems with the skipjack stock assessment model have been resolved such that the model is now able to provide estimates of B_{MSY}. However, the question for some scientific participants to the WPM remains as to whether the estimates of B_{MSY} from the assessment model are robust, as required by Resolution 15/10.

111. The WPM discussed the best way to report on stock status for the 2023 stock assessment of skipjack. There was agreement to not characterize stock status (i.e., overfished) based on the target reference point of 40% B_0 and suggested two alternative options: First, to categorize status based on MSY-based reference points (B_{MSY} and F_{MSY}) as is done for other IOTC stocks, and the second to report status against the adopted limit reference point (20% B_0) (an approach used in WCPFC). It was noted that the depletion level associated with BMSY is close to but just above 20%B0.

112. The WPM also **AGREED** to reinitiate discussions on the reference points framework that should be used in the IOTC, which is currently described in Resolution 15/10. In this regard, the group **AGREED** to report and document the relative benefits and shortcomings of the MSY-based (Kobe) and depletion based (Majuro) frameworks, and their application within Resolution 15/10, to facilitate further discussions at Commission level. Also, there was discussion of the potential need of consistency when adopting the different components of the IOTC reference points framework described in Resolution 15/10 (scientific approach, reference points, stock status categories, probabilities and MP tuning options). The WPM also **NOTED** the need to distinguish between HCR coordinates or control parameters and management reference points.

12. WPM PROGRAM OF WORK

12..1 Revision of the timeline of the MSE development

113. The WPM **NOTED** paper IOTC-2023-WPM14-17 that provides an update the most recent timeline for MSE development that will need to be reviewed and endorse by the SC in 2023 and the Commission in 2024. The updated schedule of MSE work is provided in Appendix IV (as part of the WPM Program of Work)

12..2 Revision of the WPM Program of work (2024–2028)

114. The WPM **NOTED** paper IOTC–2023–WPM14–07 presenting the draft WPM Programme of Work (2024–2028).

115. The WPM **RECALLED** that the SC, at its 17th Session, made the following request to its working parties:

"The SC REQUESTED that during the 2015 Working Party meetings, each group not only develop a Draft Program of Work for the next five years containing low, medium and high priority projects, but that all High Priority projects are ranked. The intention is that the SC would then be able to review the rankings and develop a consolidated list of the highest priority projects to meet the needs of the Commission. Where possible, budget estimates should be determined, as well as the identification of potential funding sources." (SC17, Para. 178)

116. The WPM **REQUESTED** that the Chairperson and Vice-Chairperson of the WPM, in consultation with the IOTC Secretariat, develop Terms of Reference (ToR) for each of the projects detailed on the WPM Programme of Work (2024–2028) that are yet to be funded, for circulation to potential funding bodies.

117. The WPM **RECOMMENDED** that the Scientific Committee consider and endorse the WPM Programme of Work (2024–2028), as provided in Appendix IV.

118. The WPM reviewed the progress of the MSE work conducted to date, and subject to the comments held in this report, endorsed the MSE conducted thus far and **REQUESTED** additional work to address the comments made.

13. OTHER BUSINESS

13..1 Election of the Chair and Vice-chair for the Working Party on Methods (all)

Chairperson

119. The WPM **NOTED** that the second term of the current Chairperson, Dr Hilario Murua, is due to expire at the end of the current WPM meeting and, as per the IOTC Rules of Procedure (2014), participants are required to elect a new Chairperson for the next biennium.

120. The WPM **THANKED** Dr Hilario Murua for his Chairmanship over the past four years and looked forward to his continued engagement in the activities of the WPM in the future.

121. **NOTING** the Rules of Procedure (2014), the WPM **CALLED** for nominations for the newly vacated position of Chairperson of the IOTC WPM. No new nomination was received. Dr Hilario Murua (ISSF) was recommended, nominated, and seconded to continue to be the Chairperson of the WPM for the next biennium.

Vice-Chairperson

122. The WPM **NOTED** that Vice-Chair for the WPM has been vacant for the last four years. As per the IOTC Rules of Procedure (2014), participants are required to elect a Vice-Chairperson for the next biennium.

123. **NOTING** the Rules of Procedure (2014), the WPM CALLED for nominations for the position of the Vice Chairperson of the IOTC WPM. Dr Ann Preece (AUS) was nominated, seconded and elected as Vice-Chairperson of the WPM for the next biennium.

13..2 Date and place of the 15th and 16th sessions of the WPM

124. The WPM **NOTED** that international travel restrictions due the global Covid-19 pandemic has now been greatly eased and it is now possible to have arrangements for a physical meeting in 2024. The Secretariat will continue to liaise with CPCs to determine their interest in hosting these meetings in the future as the SC is encouraging a return to physical meetings in 2024. The WPM **RECOMMENDED** the SC consider mid-October 2024 as a preferred time period to hold the WPM15. As usual it was also **AGREED** that this meeting should continue to be held back-to-back with the WPTT, with the WPM taking place before the WPTT.

125. The WPM also **NOTED** the MSE task force meeting to be held in 2024 should continue taking place. The Secretariat will liaise with CPCs to determine their interest in hosting the meeting. The WPM **AGREED** that this task force meeting is crucial for providing technical feedback to the TCMP.

13..3 Review of the draft, and adoption of the Report of the 14th Session of the WPM

126. The WPM **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPM14, provided in Appendix V.

127. The WPM **THANKED** the Chair for his excellent running of the meeting as well as his contributions to the intersessional work conducted to expedite the MSE of the Indian Ocean stocks.

128. The Chair **THANKED** all the participants for their dedicated discussion during the session. The Chair also expressed his appreciation to the rapporteurs and Secretariat for their hard work.

129. The report of the 14th Session of the Working Party on Methods (IOTC–2023–WPM14–R) was **ADOPTED** via correspondence.

APPENDIX I
LIST OF PARTICIPANTS

Chairperson
Dr Hilario **Murua**
International Seafood Sustainability Foundation
hmurua@iss-foundation.org

Vice Chairperson
Vacant

Other Participants

Mr Shiham Adam
IPNLF
shiham.adam@ipnlf.org

Mr Haritz Arrizabalaga
AZTI
harri@azti.es

Ms Cindy Assan
Seychelles Fishing Authority
cassan@sfa.sc

Ms Kishara Bandaranayake
NARA
kisharabandaranayake@gmail.com

Mr Don Bromhead
ABARES
Don.Bromhead@aff.gov.au

Mr Thomas Brunel
Wageningen Marine Research
thomas.brunel@wur.nl

Mr John Burton
SFACT
john.burton@SFACT.org

Mr Massimiliano Cardinale
SLU
massimiliano.cardinale@slu.se

Ms Emma Gee
UC Santa Cruz
emma.kc.gee@gmail.com

Mr Richard Hillary
CSIRO
rich.hillary@csiro.au

Mr Glen Holmes
PEW charitable trusts
gholmes@pewtrusts.org

Mr Farhad Kaymaram
Iranian Fisheries Science Research I Institute
farhadkaymaram@gmail.com

Ms Beatrice Kinyua
SFACT
beatrice.kinyua@sfact.org

Mr Toshihide Kitakado
Tokyo University of Marine Science and Technology
kitakado@kaiyodai.ac.jp

Ms Joanne Lucas
Seychelles Fishing Authority
j.alucas@sfa.sc

Ms Juliette Lucas
Seychelles Fishing Authority
jlucas@sfa.sc

Mr Javad Mahdaviroshan
Iran Fisheries Organization
javadmahdavi51@gmail.com

Mr Francis Marsac
IRD
francis.marsac@ird.fr

Mr Takayuki Matsumoto
Fisheries Resources Institute
matsumoto_takayuki77@fra.go.jp

Mr Mark Maunder
IATTC
mmaunder@iattc.org

Mr Gorka Merino
AZTI
gmerino@azti.es

Mr Giancarlo Helar Morón Correa
AZTI
gmoron@azti.es

Mr Iago Mosqueira
Wageningen Marine Research
iago.mosqueira@wur.nl

Ms Dulce Panguana
FAO
dulce.panguana@fao.org

Mr Tiburtius Antony Pillai
Fishery survey of India
zd.chennai@fsi.gov.in

Ms Ann Preece
CSIROann.preece@csiro.au

Mr Patrick Sachs
Department of Agriculture Fisheries and Forestry
patrick.sachs@aff.gov.au

Mr Umair Shahid
WWF
ushahid@wwf.org.pk

Mr Mohamed Shimal
Maldives Marine Research Institute

mohamed.shimal@mmri.gov.mv

Mr Wen-Pei Tsai
National Kaohsiung University of Science and Technology
wptsai@nkust.edu.tw

Mr Agurtzane Urtizberea
Azti
aurtizberea@azti.es

Ms Nicola Walker
Cefas
nicola.walker@cefas.gov.uk

Mr Sheng-Ping Wang
National Taiwan Ocean University
wsp@mail.ntou.edu.tw

Mr Ashley Williams
CSIRO
ashley.williams@csiro.au

Mr Ashley Wilson
Pew charitable trusts
awilson@pewtrusts.org

IOTC SECRETARIAT

Mr Paul De Bruyn
Paul.DeBruyn@fao.org

Mr Fabio Fiorellato
Fabio.Fiorellato@fao.org

Mr Emmanuel Chassot
Emmanuel.Chassot@fao.org

Mr Dan Fu
Dan.Fu@fao.org

Ms Lauren Nelson
Lauren.Nelson@fao.org

Ms Lucia Pierre
Lucia.Pierre@fao.org

Ms Cynthia Fernandez Diaz
Cynthia.FernandezDiaz@fao.org

Mr Simon Hoyle
IOTC Consultant
simon.hoyle@gmail.com

Mr Adam Langley
IOTC Consultant
adam_langley@xtra.co.nz

Mr Charles Edwards
IOTC Consultant
cescapecs@gmail.com

APPENDIX II
AGENDA FOR THE 14TH WORKING PARTY ON METHODS

Date: 26-28 October 2023
Location: Hybrid
Venue: Donostia – San Sebastián (Spain)
Time: 09:00 – 17:00 daily
Chairperson: Dr. Hilario Murua; **Vice-Chairperson**: Vacant

1. **OPENING OF THE MEETING** (Chairperson)
2. **ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION** (Chairperson)
3. **THE IOTC PROCESS: OUTCOMES, UPDATES AND PROGRESS**
   - 3.1 Outcomes of the 25th Session of the Scientific Committee (IOTC Secretariat)
   - 3.2 Outcomes of the 6th Session of the Technical Committee on Management Procedures (IOTC Secretariat)
   - 3.3 Outcomes of the 27th Session of the Commission (IOTC Secretariat)
   - 3.4 Review of Conservation and Management Measures relevant to the WPM (IOTC Secretariat)
   - 3.5 Progress on the recommendations of WPM13 (IOTC Secretariat and Chairperson)
   - 3.6 Review of intersessional meetings related to the IOTC MSE process
4. **ALBACORE MSE: UPDATE** (Developers)
   - 4.1 Review of OM and candidate MP development
   - 4.2 Discussion and feedback on MSE development
   - 4.3 Future steps and timelines
5. **SKIPJACK TUNA MSE: UPDATE** (Developers)
   - 5.1 Candidate MP development
   - 5.2 Discussion and feedback on MSE development
   - 5.3 Future steps and timelines
6. **BIGEYE TUNA MP (Resolution 22/03)**
   - 6.1 MP implementation: review of exceptional circumstances
   - 6.2 Future workplan
   - 6.3 External peer-review
7. **SWORDFISH MSE: UPDATE** (Developers)
   - 7.1 Review of OM and candidate MP development
   - 7.2 Discussion and feedback on MSE development
   - 7.3 Future steps and timelines
8. **YELLOWFIN TUNA MSE: UPDATE** (Developers)
   - 8.1 Future workplan
9. **GENERAL MSE ISSUES** (Chairperson and Vice-chairperson)
   - 9.1 General discussion (e.g. catch uncertainty)
   - 9.2 Climate change scenarios in MSE
   - 9.3 MSE capacity building
10. **CPUE STANDARDISATION (**Chairperson)
    - 10.1 Update on the development of the joint CPUE indices for 2024/2025

10.2 Advice on CPUE standardisation

11. Stock ASSESSMENT and STOCK STATUS GUIDANCE (Chairperson and IOTC Secretariat)

11.1 Model selection and weighting
11.2 Data poor and/or other approaches.
11.3 Review the approach used to provide stock status and management advice relative to reference points
11.4 Stock status categorization for Indian Ocean skipjack

12. WPM PROGRAM OF WORK (Chairperson and IOTC Secretariat)

12.1 Revision of the timeline of the MSE development
12.2 Revision of the WPM Program of Work (2022–2026), research priorities and priorities for invited experts
12.3 Date and place of the 14th and 15th Sessions of the WPM (Chairperson and IOTC Secretariat)
12.4 Review of the draft, and adoption of the Report of the 13th Session of the WPM (Chairperson)

13. OTHER BUSINESS

13.1. Election of the Chair and Vice-chair for the Working Party on Methods (all)
13.2. Date and place of the 15th and 16th Sessions of the WPM (Chairperson and IOTC Secretariat)
13.3. Development of priorities for Invited Expert(s) at the next WPM meeting (Chairperson)
13.4. Review of the draft, and adoption of the Report of the 14th Session of the WPM (Chairperson)

APPENDIX III
LIST OF DOCUMENTS FOR THE 14TH WORKING PARTY ON METHODS

Document	Title
IOTC–2023–WPM14–01a	Agenda of the 14th Working Party on Methods
IOTC–2023–WPM14–01b	Annotated agenda of the 14th Working Party on Methods
IOTC–2023–WPM14–02	List of documents of the 14th Working Party on Methods
IOTC–2023–WPM14–03	Outcomes of the 25th Session of the Scientific Committee (IOTC Secretariat)
IOTC–2023–WPM14–04	Outcomes of the 27th Session of the Commission (IOTC Secretariat)
IOTC–2023–WPM14–05	Review of Conservation and Management Measures relating to methods (IOTC Secretariat)
IOTC–2023–WPM14–06	Progress made on the recommendations and requests of WPM13 and SC25 (IOTC Secretariat)
IOTC–2023–WPM14–07	Revision of the WPM Program of Work (2024–2028) (IOTC Secretariat & Chairpersons)
IOTC–2023–WPM14–08	A close-kin mark-recapture pilot study for Indian Ocean yellowfin tuna (Williams A, Tremblay-Boyer L, Hillary R, Preece A)
IOTC–2023–WPM14–09	Application of DPSIR framework in tuna fisheries management in the Indian Ocean with special reference to Sri Lanka (Jayasinghe RPPK, Bandaranayake KHK, Thanusanth S)
IOTC–2023–WPM14–10	Utilizing the capacities of international organizations to accelerate catch modifications, UNIDO project in Iran as a case study (Roshan JM)
IOTC–2023–WPM14–11	Consideration of Exceptional Circumstances for the Bigeye Tuna MP 2023 (Preece A, Williams A)
IOTC–2023–WPM14–12	Maximum Sustainable Yield Assessment for Pelagic Fish in the Andaman Sea Thailand (Prasertsook O)
IOTC–2023–WPM14–13	Conditioning IOTC Albacore OMs using the ABC approach (Hillary R, Mosqueira I)
IOTC–2023–WPM14–14	IOTC Swordfish Management Strategy Evaluation Update (Brunel T, Mosqueira I)
IOTC–2023–WPM14–15	Effort creep in tuna fishery stock assessments: preliminary investigation (Hoyle S)
IOTC–2023–WPM14–16	Status of the Skipjack OM (Edwards C)
IOTC–2023–WPM14–17	Schedule of Work for the Development of Management Procedures for Key Species in the IOTC Area
IOTC-2023-WPM14(MSE)-R	Report of the 14th Session of the IOTC Working Party on Methods Management Strategy Evaluation Task Force (Anon)
IOTC-2023-TCMP06-R	Report of the 6th Session of the Technical Committee on Management Procedures (IOTC Secretariat)

APPENDIX IV
WORKING PARTY ON METHODS PROGRAM OF WORK (2024–2028)

The Program of Work consists of the following, noting that a timeline for implementation would be developed by the SC once it has agreed to the priority projects across all of its Working Parties:

Table 1. Priority topics for obtaining the information necessary to deliver the necessary advice to the Commission. Resolution 15/10 elements have been incorporated as required by the Commission.

Topic	Sub-topic and project	Timing				
		2024	2025	2026	2027	2028
1. Management Strategy Evaluation	Continuation of Management Strategy Evaluation for Albacore, Skipjack, Yellowfin, Bigeye tunas as well as Swordfish					
	Peer review of BET MSE as per the ToRs endorsed by the SC					
Future Research Requirements (not in order of priority)						
Management Strategy Evaluation	1.1 Albacore					
	1.1.1 Revision of Operating Models based on WPM and SC feedback, including possible robustness tests					
	1.1.2 Implementation of simulation runs and presentation of results at the TCMP					
	1.1.3 Revision and evaluation of new set of Management Procedures after presentation of MP runs to TCMP and Commission (as needed)					

1.1.5 External peer review					
1.2 Skipjack tuna					
1.2.1 Implementation of simulation runs and presentation of results at the TCMP					
1.2.2 Revision and evaluation of new set of Management Procedures after presentation of MP runs to TCMP and Commission (as needed)					
1.2.3 External peer review (2025-2026)					
1.3 Bigeye tuna					
1.3.1 Run MP using the catch and CPUE standardisation input data, consider exceptional circumstances, and provide the TAC advice					
1.3.2 External peer review					
1.3.3 Presentation of MP application and exceptional circumstances and resulting TAC to the TCMP and Commission meeting for adoption of the TAC					
1.3.4 Stock assessment to provide information on stock status					
1.4 Yellowfin tuna					
1.4.1 Update OM & present preliminary MP results to TCMP, WPTT/WPM review of new OM					
1.4.2 Present revised MP results to TCMP; iteratively update development if required)					

1.4.3 additional iterations if required						
1.5 Swordfish						
1.5.1 Implementation of simulation runs and presentation of results at the TCMP						
1.5.2 Revision and evaluation of new set of Management Procedures after presentation of MP runs to TCMP and Commission (as needed)						
1.5.3 External Peer-review						
Multiple stock status derived from different model structures	Develop specific guidance for the most appropriate models to be used or how to synthesize the results when multiple stock assessment models are presented: model selection and weighting. (*see IOTC-2016-WPTT18-R, para.91*)					
Stock status guidance and reference points.	Review IOTC stock status characterization against reference points and the framework for the provision of management advice (Resolution 15/10) to address the TORs of ad hoc reference point WG.					
CKMR pilot project	Implementation of a CKMR pilot project for Indian Ocean yellowfin tuna to evaluate the logistics and feasibility of sampling, and levels of cross contamination of DNA.					
Capacity Building	Ongoing development of tools, materials and courses to continue Capacity Building for increasing participation in the MSE process and develop improved MSE communication					

to fishery managers.					

SCHEDULE OF WORK FOR THE DEVELOPMENT OF MANAGEMENT PROCEDURES FOR KEY SPECIES IN THE IOTC AREA

A more detailed explanation of the roles of the Working Parties (WPs), Scientific Committee (SC), Technical Committee on Management Procedures (TCMP) and the Commission are provided below

Year	Albacore	Skipjack	Yellowfin	Bigeye	Swordfish
2023	**WPs/SC**: Consider recommendations from the Commission and undertake MSE to provide advice on the performance of candidate MPs.	**WPs/SC**: Consider recommendations from the Commission, review and refine further MSE work if needed and provide advice on the performance of candidate MPs.	**WPs/SC**: Consider recommendations from the Commission and consider outcomes of the independent review of the Yellowfin assessment. Discuss and agree on a plan for further development of MSE and candidate MPs.	**WPs/SC**:	**WPs/SC**: Consider recommendations from the Commission, review and refine further MSE work if needed and provide advice on the performance of candidate MPs.
2024	**TCMP**: Provide advice to Commission on elements of candidate MPs, and any proposed Resolutions for an MP, that require a decision by the Commission, including the performance of candidate MPs against Commission objectives.	**TCMP**: Provide advice to Commission on elements of candidate MPs, and any proposed Resolutions for an MP, that require a decision by the Commission, including the performance of candidate MPs against Commission objectives.	**TCMP**: Provide advice to Commission on elements of OMs and, if possible, candidate MPs, that require a decision by the Commission, including the performance of candidate MPs against Commission objectives.	**TCMP**:	**TCMP**: Provide advice to the Commission on elements of candidate MPs, and any proposed Resolutions for an MP, that require a decision by the Commission, including the performance of candidate MPs against Commission objectives.
	Commission: Consider work and advice from subsidiary bodies and provide direction to the WPs/SC on the need to undertake further MSE of candidate or alternative MPs.	**Commission:** Consider work and advice from subsidiary bodies. Decision and adoption of an MP.	**Commission**: Consider work and advice from subsidiary bodies and provide direction to the WPs/SC on the need to undertake further MSE.	**Commission**:	**Commission**: Consider work and advice from subsidiary bodies. Decision and adoption of an MP.

	WPs/SC: Consider recommendations from the Commission and undertake MSE to provide advice on the performance of candidate MPs.	**WPs/SC**: Consider recommendations from the Commission	**WPs/SC**: Consider recommendations from the Commission and undertake MSE to provide advice on the performance of candidate MPs.	**WPs/SC**: Consider outcomes of BET MSE review and provide advice to TCMP/Commission	**WPs/SC**: Consider recommendations from the Commission
2025	**TCMP**: Provide advice to Commission on elements of candidate MPs, and any proposed Resolutions for an MP, that require a decision by the Commission, including the performance of candidate MPs against Commission objectives.	**TCMP**:	**TCMP**: Provide advice to Commission on elements of candidate MPs, and any proposed Resolutions for an MP, that require a decision by the Commission, including the performance of candidate MPs against Commission objectives.	**TCMP**: Provide advice to Commission on the outcomes of the BET MSE review	**TCMP**:
	Commission: Consider work and advice from subsidiary bodies. Decision and adoption of an MP.	**Commission:**	**Commission**: Consider work and advice from subsidiary bodies and provide direction to the WPs/SC on the need to undertake further MSE of candidate or alternative MPs.	**Commission**: Consider advice from subsidiary bodies on the outcomes of the BET MSE review and provide direction to WP/SC, if required.	**Commission**:
	WPs/SC: Consider recommendations from the Commission	**WPs/SC**:	**WPs/SC**: Consider recommendations from the Commission and undertake MSE to provide advice on the performance of candidate MPs.	**WPs/SC**: Consider recommendations from the Commission (if any).	**WPs/SC**:
2026	**TCMP**:	**TCMP**:	**TCMP**: Provide advice to Commission on elements of candidate MPs, and any proposed Resolutions for an MP, that require a decision by the Commission, including the performance of	**TCMP**:	**TCMP**:

			candidate MPs against Commission objectives.		
	Commission:	**Commission:**	**Commission**: Consider work and advice from subsidiary bodies. Decision and adoption of an MP.	**Commission**:	**Commission**:
	WPs/SC:	**WPs/SC**:	**WPs/SC**: Consider recommendations from the Commission	**WPs/SC**:	**WPs/SC**:

APPENDIX V
CONSOLIDATED RECOMMENDATIONS OF THE 14TH SESSION OF THE WORKING PARTY ON METHODS

Note: Appendix references refer to the Report of the 14th Session of the Working Party on Methods (IOTC–2023–WPM14–R)

Review of intersessional meetings related to the IOTC MSE process

WPM14.01: The WPM THANKED the participants of the Working Party on Methods Management Strategy Evaluation Task Force meeting for their informative discussions and input on the technical aspects of MSE and related topics. The WPM NOTED that the output of this meeting remains very important to the WPM as it provides an informal forum for the highly technical discussions necessary to advance the MSE process in IOTC for which there is insufficient time during the WPM meeting. The WPM further **RECOMMENDED** that the SC endorse this meeting being included in the schedule of meetings for 2024 (Para 13).

Albacore MSE: Update

WPM14.02: The WPM **RECOMMENDED** that this OM procedure be endorsed and a final version of a set of OMs be constructed for the evaluation of management procedures for the albacore stock. (Para 22).

Bigeye tuna MP (Resolution 22/03)

WPM14.03: The WPM agreed with the review findings that there was no evidence for exceptional circumstances and **RECOMMENDED** that the agreed TAC for 2024 and 2025 should remain unchanged. (Para 41).

Yellowfin tuna MSE: Update

WPM14.04: In concluding its discussion, the WPM **RECOMMENDED** that pursuing the development of the Close-Kin Mark Recapture project should be a high priority for the Commission and REQUESTED that the project developers present the pilot project to the 2023 Scientific Committee meeting. The WPM NOTED that such a presentation should also include firstly, a detailed overview of relevant IOTC data to highlight where adult and juvenile fish are caught, where they are landed and where they can be potentially sampled, and secondly, a more detailed costing of the pilot project. (Para 69).

General MSE issues

WPM14.05: The WPM NOTED that there is a need to ensure that any code and input files used for developing MPs is housed internally on an accessible platform, so it is available to other users and not lost when developers move on to other tasks. The WPM NOTED that ICES uses a Transparency and Assessment Framework (TAF) which is a useful frontend to direct users to the locations of relevant documents and code (e.g. Github repositories) that enable users to re-run assessments and other analyses, but that a much smaller system would be needed for the IOTC. The WPM NOTED that most important information to be curated would be the input files, executables, and control files (not the large volume of output files), and **RECOMMENDED** that the IOTC Secretariat is provided with the necessary resources to manage the curation of this information. (Para 75).

CPUE Standardisation

WPM14.06: The WPM NOTED that several longline fleets provided the CPUE indices (such as swordfish, blue marlin, and black marlin) that were used to assess the billfish stocks. These indices were standardised using widely disparate techniques and frequently showed contradictory trends. WPM AGREED that enhancing the transparency and credibility of the billfish stock assessments can be facilitated by a deliciated CPUE workshop that draws the experiences from the IOTC Joint CPUE standardisation procedure for the tropical tuan. Thus, the WPM **RECOMMENDED** holding a cross-cutting CPUE standardisation workshop in 2024 focusing on billfish (ideally prior to the WPB15 meeting) amongst the involved longline fleets to have focused discussions on standardising methods and processes for the primary billfish species. (Para 94).

Revision of the WPM Program of work (2024–2028)

WPM14.07: The WPM **RECOMMENDED** that the Scientific Committee consider and endorse the WPM Programme of Work (2024–2028), as provided in Appendix IV (Para 117).

Date and place of the 15th and 16th sessions of the WPM

WPM14.08: The WPM NOTED that international travel restrictions due the global Covid-19 pandemic has now been greatly eased and it is now possible to have arrangements for a physical meeting in 2024. The Secretariat will continue to liaise with CPCs to determine their interest in hosting these meetings in the future as the SC is encouraging a return to physical meetings in 2024. The WPM **RECOMMENDED** the SC consider mid-October 2024 as a preferred time period to hold the WPM15. As usual it was also AGREED that this meeting should continue to be held back-to-back with the WPTT, with the WPM taking place before the WPTT (Para 124).

Review of the draft, and adoption of the Report of the 13th Session of the WPM

WPM14.09: The WPM **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPM14, provided in Appendix V (Para 126).