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## REVIEW OF CONSERVATION AND MANAGEMENT MEASURES RELATING TO METHODS

PREPARED BY: IOTC SECRETARIAT, 06 OCTOBER 2023

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### PURPOSE

To encourage participants at the Working Party on Methods (WPM) to review the existing Conservation and Management Measures (CMM) relating to Methods, noting the CMMs contained in document IOTC–2023–WPM14–04; 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.

### BACKGROUND

In addition to the CMMs outlined in document IOTC–2023–WPM14–04, Methods are currently subject to several other CMMs adopted by the Commission, including:

**Recommendation 14/07** *To standardise the presentation of scientific information in the annual Scientific Committee report and in Working Party reports.* This Recommendation builds upon the excellent work to date by the Scientific Committee, its working parties and the IOTC Secretariat to standardise the presentation of scientific information in their annual reports, including via the 'Executive Summaries' for each stock. In this context and in order to support scientific advice made available by the IOTC Scientific Committee, the executive summaries of the annual IOTC Scientific Committee report which present the stock assessment results may include, when possible as defined in this proposal, clearly: Stock status; Model outlooks; Data quality and limitations of the assessment models; Alternative approach (data poor stocks).

**Resolution 15/10** *On target and limit reference points and a decision framework.* This Resolution establishes the general principles that would guide the application of the precautionary approach in the context of IOTC, including the adoption of provisional reference points that would apply until such time as the Commission decides to update the reference points after considering the advice of the Scientific Committee. The Resolution also considers a decision framework to facilitate management measures that are currently being undertaken by the Commission. This Resolution superseded Recommendation 13/10.

**Resolution 12/01** *On the implementation of the precautionary approach.* This Resolution establishes the general principles that would guide the application of the precautionary approach in the context of the IOTC. The basic tenet being: do not take actions that would have an unacceptably high risk of compromising the health of the resource or its environment in the long term. The provisions also include ecosystem considerations in the form of impacts on non-target and associated or dependent species and their environment, or the effects of unanticipated environmental events.

**Resolution 16/09** *On establishing a Technical Committee on Management Procedures.* This Resolution aims at enhancing the dialogue and mutual understanding between the Scientific Committee and the Commission on matters relating to management procedures, and the decision making response of the Commission in relation to management procedures, The Resolution addresses the priorities identified in Resolutions 14/03 *On enhancing the dialogue between fisheries scientists and managers*, and 15/10 *On target and limit reference points and a decision framework* or any subsequent resolutions addressing Management Strategy Evaluation and Management Procedures. This Resolution supersedes Resolution 14/03 *On enhancing the dialogue between fisheries scientists and managers*.

**Resolution 21/03** *On Harvest Control Rules for skipjack tuna in the IOTC area of competence.* This Resolution for a Harvest Control Rule (HCR) for skipjack draws on SC recommendations, including the guidance on reference points. It uses the biomass limit reference point of 20% of the unfished level (BLIM = 0.2B<sub>0</sub>) and the target biomass reference point of 40% of the unfished level (BTARG = 0.4B<sub>0</sub>), consistent with the SC advice that reference points based on depletion level should be used for stocks where MSY-based reference points cannot be robustly estimated. In addition the Resolution provides guidance on the HCR and incorporates a review and the concept of exceptional circumstances.

**Resolution 22/03** *On a Management Procedure for bigeye tuna in the IOTC area of competence.* This Resolution provides a management procedure for the bigeye tuna stock managed by the IOTC with a view of maintaining the stock biomass in the green zone of the Kobe plot (not overfished and not subject to overfishing) while maximizing the average catch from the fishery and reducing the variation in the total allowable catch (TAC) between management periods.

## DISCUSSION

As part of best practice, the WPM is obliged to review existing CMMs and consider whether their science-based components need to be updated. If this is the case, then the WPM should provide clear, science-based recommendations for the Scientific Committee's consideration.

## RECOMMENDATION

That the WPM **NOTE** paper IOTC–2023–WPM14–05 which aimed to encourage the WPM to review the existing Conservation and Management Measures (CMMs) relating to Methods, 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.

## APPENDICES

**Appendix A:** Recommendation 14/07 *To standardise the presentation of scientific information in the annual Scientific Committee report and in Working Party report*

**Appendix B:** Resolution 15/10 *On target and limit reference points and a decision framework*

**Appendix C:** Resolution 12/01 *On the implementation of the precautionary approach.*

**Appendix D:** Resolution 16/09 *On establishing a Technical Committee on Management Procedures*

**Appendix E:** Resolution 21/03 *On Harvest Control Rules for skipjack tuna in the IOTC area of competence*

**Appendix F:** Resolution 22/03 *On a Management Procedure for bigeye tuna in the IOTC area of competence.*

## APPENDIX A

### RECOMMENDATION 14/07

#### TO STANDARDISE THE PRESENTATION OF SCIENTIFIC INFORMATION IN THE ANNUAL SCIENTIFIC COMMITTEE REPORT AND IN WORKING PARTY REPORTS

##### The Indian Ocean Tuna Commission (IOTC),

RECOGNISING the importance of sound scientific advice as the centre piece for the conservation and management of tuna and tuna-like species in the Indian Ocean and adjacent seas in line with international law and the information needs of the Commission;

NOTING that participants of the first Global Summit of Tuna RFMOs in 2007 in Kobe, Japan agreed that stock assessment results be presented in a standardised "four quadrant, red-yellow-green-orange" format that is now referred as the "Kobe Plot" which is widely embraced as a practical, user-friendly method to present stock status information;

FURTHER NOTING that, at the Second Joint Meeting of Tuna RFMOs in June 2009 in San Sebastian, Spain, a "Strategy Matrix" was adopted to provide fisheries managers with the statistical probability of meeting management targets, including ending overfishing and rebuilding overfished stocks, in a standardised manner as a result of potential management actions;

ACKNOWLEDGING that the Strategy Matrix is a harmonised format for RFMO science bodies to convey advice, and that this format for presenting stock assessment results facilitates the application of the precautionary approach by providing Commissions with the basis to evaluate and adopt management options at various levels of probability of success;

RECALLING recommendations of the Kobe II Workshop of Experts to Share Best Practices on the Provision of Scientific Advice and of the Kobe III recommendations, in particular on development on research activities to better quantify the uncertainty and understand how this uncertainty is reflected in the risk assessment inherent in the Kobe II strategy matrix;

FURTHER RECALLING the provisions of the Recommendation 12/15 on the best available science, that requests the provision of clear, transparent, and standardised formats for scientific advice delivered to the Commission;

TAKING INTO ACCOUNT that Resolutions 12/01 on the implementation of the precautionary approach and 13/10 on interim target and limit reference points and a decision framework, make possible the implementation of the precautionary approach thanks to the adoption of interim target and limit reference points;

NOTING the excellent work to date by the Scientific Committee, its working parties and the IOTC Secretariat to standardise the presentation of scientific information in their annual reports, including via the '*Executive Summaries*' for each stock;

STRESSING the importance of further refining the presentation of scientific information to facilitate appropriate utilisation by the Commission;

RECOMMENDS, in accordance with paragraph 8 of Article IX of the IOTC Agreement, that:

1. In support of the scientific advice made available by the IOTC Scientific Committee, the '*Executive Summaries*' within the annual IOTC Scientific Committee report which present stock assessment results, include when possible:

##### **Stock status**

- a) A Kobe plot/chart showing:
  - i. Any Target and Limit Reference Points adopted by the Commission, e.g.  $F_{MSY}$  and  $F_{LIM}$ ,  $SB_{MSY}$  and  $SB_{LIM}$  or  $B_{MSY}$  and  $B_{LIM}$ , depending on the assessment models used by the Scientific Committee, or proxies where available;

- ii. The stock estimates, expressed in reference to Target Reference Points adopted by the Commission, e.g. as  $F_{CURRENT}$  on  $F_{MSY}$  and as  $SB_{CURRENT}$  on  $SB_{MSY}$  or as  $B_{CURRENT}$  on  $B_{MSY}$ ;
  - iii. The estimated uncertainty around estimates, provided that statistical methods to do so have been agreed upon the Scientific Committee and that sufficient data exist;
  - iv. The stock status trajectory.
- b) A graphical representation showing the proportion of model outputs of the years used for advice from the last stock assessment that are within the green quadrant of the Kobe plot/chart (not overfished, not subject to overfishing), the yellow and orange quadrants (overfished or subject to overfishing) and the red quadrant (overfished and subject to overfishing).

#### **Model outlooks**

- c) Two Kobe II strategy matrices:
- i. A first one indicating the probability of complying with the Target Reference Points adopted by the Commission, e.g. the probability of either  $SB > SB_{MSY}$  or  $B > B_{MSY}$  and of  $F < F_{MSY}$  for different levels of catch across multiple years;
  - ii. A second one indicating the probability of being inside safe biological limits expressed through Limit Reference Points adopted by the Commission, e.g. the probability of either  $SB > SB_{LIM}$  or  $B > B_{LIM}$  and of  $F < F_{LIM}$  for different levels of catch across multiple years;
  - iii. When the Commission agrees on acceptable probability levels associated with the target and limit reference points on a stock by stock basis, the Scientific Committee could prepare and include, in the annual report, the Kobe II strategy matrices using colour coding corresponding to these thresholds.

#### **Data quality and limitations of the assessment models**

- d) A statement qualifying the quality, the reliability and where relevant the representativeness of input data to stock assessments, such as, but not limited to:
- i. Fisheries statistics and fisheries indicators (e.g. catch and effort, catch-at size and catch at age matrices by sex and, when applicable, fisheries dependent indices of abundance);
  - ii. Biological information (e.g. growth parameters, natural mortality, maturity and fecundity, migration patterns and stock structure, fisheries independent indices of abundance);
  - iii. Complementary information (e.g. consistencies among available abundance indices, influence of the environmental factors on the dynamic of the stock, changes in fishing effort distribution, selectivity and fishing power, changes in target species).
- e) A statement qualifying the limits of the assessment model with respect to the type and the quality of the input data and expressing the possible biases in the assessment results associated with uncertainties of the input data;
- f) A statement concerning the reliability of the projections carried out over the long term.

#### **Alternative approach (data poor stocks)**

2. When, due to data or modelling limitations, the IOTC Scientific Committee is unable to develop Kobe II strategy matrices and associated charts or other estimates of current status relative to benchmarks, the IOTC Scientific Committee will develop its scientific advice on available fisheries-dependant and fisheries-independent indicators and provide similar caveats as those detailed in paragraph 1(d).

#### **Additional information and review of the structure and templates of the 'Executive Summaries'**

3. The Commission encourages the IOTC Scientific Committee to include either in its annual report or in the detailed reports, where possible and if considered as relevant and useful, any other tables and/or graphics

supporting scientific advice and management recommendations. In particular, the IOTC Scientific Committee will include, where possible, information on the recruitment trajectories, on the stock-recruitment relationship and some ratio such as yield per recruit or biomass per recruit.

4. As far as needed, the IOTC Scientific Committee shall review recommendations and templates for the Kobe II strategy matrices, plot and graphical representations as laid down in this Recommendation and will advise the Commission on possible improvements.

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**APPENDIX B****RESOLUTION 15/10****ON TARGET AND LIMIT REFERENCE POINTS AND A DECISION FRAMEWORK****The Indian Ocean Tuna Commission (IOTC),**

CONSIDERING the objectives of the Commission are to maintain stocks in perpetuity and with high probability, at levels not less than those capable of producing their maximum sustainable yield as qualified by relevant environmental and economic factors including the special requirements of developing States in the IOTC area of competence;

BEING MINDFUL of Article XVI of the IOTC Agreement regarding the rights of Coastal States and of Article 87 and 116 of the UN Convention of the Law of the Sea regarding the right to fish on the high seas;

RECALLING that Article 6, paragraph 3, of the Agreement for the Implementation of the Provisions of the United Nations Convention of the Law of the Sea of December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UNFSA), establishes the application of precautionary reference points as a general principle for sound fisheries management;

FURTHER RECALLING that Annex II of UNFSA provides guidelines for the application of precautionary reference points in the conservation and management of straddling fish stocks and highly migratory fish stocks, including the adoption of provisional reference points when information for establishing reference points is absent or poor;

NOTING that the Scientific Committee noted that the interim limit reference points contained in Resolution 13/10 [superseded by [Resolution 15/10](#)] are not consistent with FAO and UNFSA guidelines;

NOTING that Article 7.5.3 of the FAO Code of Conduct for Responsible Fisheries also recommends the implementation of stock specific target and limit reference points, *inter alia*, on the basis of the precautionary approach;

NOTING that recommendations 37 and 38 of the Performance Review Panel, adopted by the Commission as Resolution 09/01 [superseded by [Resolution 16/03](#)], indicate that pending the amendment or replacement of the IOTC Agreement to incorporate modern fisheries management principles, the Commission should implement the precautionary approach including, *inter alia*, precautionary reference points, as set forth in the UNFSA;

NOTING [Resolution 12/01](#) *On the implementation of the precautionary approach* that recommends adoption of provisional reference points, and that the IOTC Scientific Committee proposed provisional values at its 14<sup>th</sup> Session;

RECALLING ALSO that the IOTC Scientific Committee commenced a process leading to a management strategy evaluation (MSE) process to improve upon the provision of scientific advice on Harvest Control Rules (HCRs);

HIGHLIGHTING that the IOTC Scientific Committee is now in a position to provide advice on stock status relative to reference points for several stocks of tropical, temperate or neritic tunas and billfish;

FURTHER NOTING that the IOTC Scientific Committee at its 17<sup>th</sup> Session made recommendations on possible alternates to limit and target reference points derived from  $B_{MSY}$  and  $F_{MSY}$ , when those are considered as insufficiently robust, that are derived from proportions of  $B_0$ , being the estimated virgin biomass;

FURTHER NOTING the Scientific Committee also recommended that in cases where MSY-based reference points cannot be robustly estimated, biomass limit reference points be set at 20 % of the virgin biomass ( $B_{LIM}=0.2 B_0$ ).

ACKNOWLEDGING that continuing dialog between scientists and managers is necessary to define appropriate HCRs for the IOTC tuna and tuna-like stocks;

ADOPTS in accordance with paragraph 1 of Article IX of the IOTC Agreement, that:

**Interim Target and Limit Reference Points (TRPs and LRP)**

1. When assessing stock status and providing recommendations to the Commission, the IOTC Scientific Committee should, where possible, apply MSY-based target and limit reference points for tuna and tuna-like species and in particular the interim reference points agreed by the Commission in 2013 for albacore, swordfish and the three (3) tropical tunas (Bigeye tuna, Skipjack tuna, Yellowfin tuna) (per Resolution 13/10 *On interim target and limit reference points and a decision framework*) [superseded by [Resolution 15/10](#)], as listed in **Table 1**.  $B_{MSY}$  refers to the biomass level for the stock that would produce the Maximum Sustainable Yield;  $F_{MSY}$  refers to the level of fishing mortality that produces the Maximum Sustainable Yield.

**Table 1.** Interim target and limit reference points.

Stock	Target Reference Point	Limit Reference Point
Albacore		
Yellowfin tuna	$B_{TARGET} = B_{MSY}$ ;	$B_{LIM} = 0.40 B_{MSY}$
Swordfish	$F_{TARGET} = F_{MSY}$	$F_{LIM} = 1.40 F_{MSY}$
Bigeye tuna	$B_{TARGET} = B_{MSY}$ $F_{TARGET} = F_{MSY}$	$B_{LIM} = 0.50 B_{MSY}$ $F_{LIM} = 1.30 F_{MSY}$
Skipjack tuna	$B_{TARGET} = B_{MSY}$ $F_{TARGET} = F_{MSY}$	$B_{LIM} = 0.40 B_{MSY}$ $F_{LIM} = 1.50 F_{MSY}$

### Alternate interim Target and Limit Reference Points

2. Where the IOTC Scientific Committee considers that MSY-based reference points cannot be robustly estimated, biomass limit reference points will be set at a rate of  $B_0$ . Unless the IOTC Scientific Committee advises the Commission of more suitable limit reference point for a particular species, by default, the interim  $B_{LIM}$  will be set at  $0.2 B_0$  and fishing mortality rate limit reference point at  $F_{0.2 B_0}$  (the value corresponding to this biomass limit reference point). These interim limit reference points will be reviewed no later than 2018.
3. Where the IOTC Scientific Committee considers that MSY-based reference points cannot be robustly estimated, target reference points based on the depletion proportion (i.e. reference points with respect to the ratio of current biomass to  $B_0$ ,  $B_0$  being the virgin biomass estimate) should be used as a basis for  $B_{TARGET}$  and  $F_{TARGET}$ , as follows:
- the interim biomass target reference point  $B_{TARGET}$  could be set at a ratio of  $B_0$ , the virgin biomass;
  - the interim fishing mortality rate target reference point  $F_{TARGET}$  could be set at a level consistent with the target biomass reference point, the fishing mortality rate corresponding then to the adopted ratio of  $B_0$ , the virgin biomass).
4. These target and limit reference points, referred to in paragraphs 1, 2 and 3, shall be further reviewed by the IOTC Scientific Committee according to the program of work at **Annex 1** and in accordance with paragraph 6. The results shall be presented to the Commission for adoption of species-specific reference points.
5. The IOTC Scientific Committee shall continue to provide advice on the status of stocks and on recommendations for management measures in relation to the reference points referred to in paragraphs 1, 2 and 3, where available, until the Commission adopts other reference points that achieve the IOTC's conservation and management objectives and are consistent with paragraph 6.
6. The IOTC Scientific Committee shall recommend to the Commission for its consideration options for harvest control rules for IOTC species in relation to agreed reference points and, in doing so, shall take into account:
- the provisions set forth in the UNFSA and in Article V of the IOTC Agreement;
  - the following objectives and any other objective identified through the Science and Management Dialogue process designed in Resolution 14/03 [superseded by [Resolution 16/09](#)] (or any revision thereof) and agreed thereafter by the Commission:
    - Maintain the biomass at or above levels required to produce MSY or its proxy and maintain the fishing mortality rate at or below  $F_{MSY}$  or its proxy;

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- ii. Avoid the biomass being below  $B_{LIM}$  and the fishing mortality rate being above  $F_{LIM}$ ;
- c) the following guidelines:
- i. For a stock where the assessed status places it within the lower right (green) quadrant of the Kobe Plot, aim to maintain the stock with a high probability within this quadrant;
  - ii. For a stock where the assessed status places it within the upper right (orange) quadrant of the Kobe Plot, aim to end overfishing with a high probability in as short a period as possible;
  - iii. For a stock where the assessed status places it within the lower left (yellow) quadrant of the Kobe plot, aim to rebuild these stocks in as short a period as possible;
  - iv. For a stock where the assessed status places it within the upper left quadrant (red), aim to end overfishing with a high probability and to rebuild the biomass of the stock in as short a period as possible.

#### Final Clauses

- 7. Bearing in mind Article 64 of UNCLOS and Article 8 of UNFSA, the entirety of this Resolution is subject to Article XVI (Coastal States' Rights) of the IOTC Agreement for the Establishment of the Indian Ocean Tuna Commission, and Articles 87 and 116 of the UN Convention of the Law of the Sea regarding the right to fish on the high seas;
- 8. The IOTC Scientific Committee is requested to evaluate the performance of any harvest control rules with respect to the species specific target and limit reference points adopted for IOTC species, but not later than 10 years following their adoption, and the Commission will consider, as appropriate and consistent with the scientific advice, these harvest control rules.
- 9. As soon as advice from the IOTC Scientific Committee regarding the appropriateness of TRPs and LRPs, as required under **Annex 1**, is available to the Commission, and where possible no later than at the IOTC Commission meeting in 2020, this Resolution will be reviewed with the view to adopting revised TRPs and LRPs.
- 10. This Resolution supersedes Resolution 13/10 *On interim target and limit reference points and a decision framework*.



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**APPENDIX C****RESOLUTION 12/01****ON THE IMPLEMENTATION OF THE PRECAUTIONARY APPROACH****The Indian Ocean Tuna Commission (IOTC),**

RECALLING that Article 5, paragraph c, of the Agreement for the Implementation of the Provisions of the United Nations Convention of the Law of the Sea of December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UNFSA), establishes the application of the precautionary approach as a general principle for sound fisheries management;

FURTHER RECALLING that Article 6, and Annex II, of UNFSA provide guidelines for the implementation of the precautionary approach, including the adoption of provisional reference points when information for establishing reference points is absent or poor;

NOTING that Article 7.5 of the FAO Code of Conduct for Responsible Fisheries also recommends the implementation of the precautionary approach, *inter alia*, on the basis of stock-based target and limit reference points;

NOTING that recommendations 37 and 38 of the Performance Review Panel, adopted by the Commission as Resolution 09/01, indicate that pending the amendment or replacement of the IOTC Agreement to incorporate modern fisheries management principles, the Commission should implement the precautionary approach as set forth in the UNFSA;

MINDFUL that Paragraph 29.6 of the FAO Guidelines for the Eco-labelling of Fish and Fishery Products from Marine Capture Fisheries, revision 1, 2009, and other eco-certification initiatives highlight the implementation of the precautionary approach as an important criterion to assess the sustainability of a fishery;

RECALLING the time–area closure adopted by the Commission towards the conservation of tropical tuna stocks, described in Resolution 10/01 [superseded by Resolution 12/13, then Resolution 14/02];

RECALLING that the IOTC Scientific Committee has initiated a process of management strategy evaluation to focus the provision of scientific advice on the information needs of the Commission;

RECOGNISING the need to ensure the sustainability of fisheries for tunas and tuna-like species for food security, livelihoods, economic development, multispecies interactions and environmental impacts in its decisions;

AGREES, in accordance with paragraph 1 of Article IX of the IOTC Agreement, to the following:

1. To apply the precautionary approach, in accordance with relevant internationally agreed standards, in particular with the guidelines set forth in the UNFSA, and to ensure the sustainable utilisation of fisheries resources as set forth in Article V of the IOTC Agreement.
2. In applying the precautionary approach, the Commission shall adopt, after due consideration of the advice supplied by the IOTC Scientific Committee,
  - a) stock-specific reference points (including, but not necessarily limited to, target and limit reference points<sup>1</sup>), relative to fishing mortality and biomass, and
  - b) associated harvest control rules<sup>2</sup>, that is, management actions to be taken as the reference points for stock status are approached or if they are breached.

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<sup>1</sup> Target Reference Points corresponds to a state of a fishery and / or a resource which is considered desirable; Limit Reference Points indicates the limit beyond which the state of a fishery and / or a resource is not considered desirable. Source: <http://www.fao.org/fi/glossary> (accessed 25 April 2012).

<sup>2</sup> Harvest Control Rule: A rule that describes how harvest is intended to be controlled by management in relation to the state of some indicator of stock status. Source: <http://www.fao.org/fi/glossary> (accessed 25 April 2012).

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Reference points and harvest control rules shall be determined so that, according to the best available science, the risk of a negative impact on the sustainability of Indian Ocean resources of tuna and tuna-like species is minimised.

3. In the determination of appropriate reference points and harvest control rules, consideration must be given to major uncertainties, including the uncertainty about the status of the stocks relative to the reference points, uncertainty about biological, environmental and socio-economic events and the effects of fishing activities on non-target and associated or dependent species.
4. If an unanticipated event, such as a natural phenomenon has a significant adverse impact on the status of a stock or its associated environment, the Commission shall adopt Conservation and Management Measures on an emergency basis to ensure that fishing activity does not exacerbate such adverse impacts.
5. Initially and as an interim measure, the Commission may adopt provisional reference points and harvest control rules, taking into account the advice of the IOTC Scientific Committee; such measures would remain current until such time as the Commission chooses to update them.
6. Instruct the IOTC Scientific Committee to assess, through the management strategy evaluation process, the performance of reference points, including any interim reference points, and of potential harvest control rules to be applied as the status of the stocks approaches the reference points.
7. After completion of the management strategy evaluation, the IOTC Scientific Committee should provide the Commission with recommended reference points for all major stocks, and cast future advice on the status of the stocks relative to the adopted reference points, on the basis of the best available scientific evidence.
8. The IOTC Scientific Committee will report on the progress of the management strategy evaluation process at the Commission Session in 2014, with a view to confirming or updating any interim reference points and associated harvest control rules.

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**APPENDIX D****RESOLUTION 16/09****ON ESTABLISHING A TECHNICAL COMMITTEE ON MANAGEMENT PROCEDURES****The Indian Ocean Tuna Commission (IOTC),**

HAVING responsibility for the sustainable utilisation of tuna and tuna-like species in the Indian Ocean;

RECOGNISING the need for action to ensure the achievement of IOTC objectives to conserve and manage tuna resources in the IOTC area of competence;

RECALLING Article 6, paragraph 3, of the Agreement for the Implementation of the Provisions of the United Nations Convention of the Law of the Sea of December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UNFSA), on the strengthening of existing organisations and arrangements;

RECALLING that the IOTC Scientific Committee has initiated a process leading to a Management Strategy Evaluation process to improve upon the provision of scientific advice on Harvest Control Rules (HCRs);

FURTHER RECALLING that the IOTC has embarked upon a dialogue process as agreed in Resolution 14/03 *on enhancing the dialogue between fisheries scientists and managers*, which required that a series of three Science and Management Dialogue Workshops is held between 2014 and 2017;

NOTING the need, expressed by the Scientific Committee, to strengthen the communication on the MSE process between the Scientific Committee and the Commission, in order to facilitate consideration of the elements of the MSE that require endorsement by the Commission ;

RECOGNISING that the Scientific Committee RECOMMENDED that the Commission consider establishing a formal communication channel for the science and management dialogue to enhance decision-making through a dedicated Technical Committee on Management Procedures (SC18.18);

ADOPTS in accordance with paragraph 1 of Article IX of the IOTC Agreement, that:

1. A Technical Committee on Management Procedures (TCMP) co-chaired by the Commission Chair (or designee) and the Scientific Committee Chair (or designee) and facilitated, if possible, by an independent expert, is established with the objective of addressing the priorities identified in Resolutions 14/03 *on enhancing the dialogue between fisheries scientists and managers*, and 15/10 *on target and limit reference points and a decision framework* or any subsequent resolutions addressing Management Strategy Evaluation and Management Procedures.
2. The objectives of the TCMP shall be to:
  - a) Enhance the decision making response of the Commission in relation to management procedures, including recommendations made by the Scientific Committee;
  - b) Enhance communication and foster dialogue and mutual understanding between the Scientific Committee and the Commission on matters relating to management procedures; and
  - c) Assist the Commission to obtain and promote the effective use of scientific resources and information.
3. The TCMP shall meet prior to and in conjunction with the annual Commission Session, to facilitate full attendance by CPCs.
4. The outcomes of the TCMP will be considered by the annual Commission Session under a standing agenda item for that purpose, as well as through the Commission's consideration of proposals relating to management procedures.

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5. The TCMP shall focus on the presentation of results and exchange of information necessary for the Commission to consider possible adoption of Management Procedures. Standard formats for the presentation of results should be used, to facilitate understanding of the material by a non-technical audience.
  6. The agenda of the TCMP shall place emphasis on the elements of each Management Procedure that require a decision by the Commission. The adoption of Management Procedures is an iterative process that allows for adjustments as the work, and the understanding of the elements involved, progresses.
  7. The TCMP should undertake the following:
    - a) Identifying, evaluating, and discussing management procedures for the IOTC fisheries, which help meet the objectives of the IOTC Agreement, including socioeconomics, food security, etc., identified by the Commission, the ecosystem-based approach to fisheries and the precautionary approach for the consideration of the Commission. Specifically, consideration of the following:
      - i. Overarching management objectives to guide the development of management procedures for the IOTC fisheries;
      - ii. Target and Limit Reference Points with reference to Resolution 15/10 on interim target and limit reference points and a decision framework (or any subsequent revision);
      - iii. Harvest Control Rules (HCRs), including: the extent to which HCRs meet management objectives; the probabilities of achieving target reference points, avoiding limit reference points, or rebuilding; the risks to the fishery and the resource at these limit and target reference points; and allowing, in particular, the implementation of a precautionary approach as required by Resolution 15/10 on interim target and limit reference points and a decision framework (or any subsequent revision);
    - b) Considering current scientific advice relating to management procedures and the need for additional scientific advice to support the Commission's consideration of management procedures.
    - c) Specifications for the roles and responsibilities of the Commission and its subcommittees, particularly the Scientific Committee and working parties, and clarifications for possible interactions and feedback between them, for each step of the management procedure development process (e.g., from technical work to be developed in WP/SC to the decision making process in the Commission).
    - d) Considering data monitoring systems and management procedure implementation mechanisms to assure the effectiveness of any of the management procedures agreed.
  8. The need for a continuation of the Technical Committee on Management Procedures shall be reviewed no later than at the Annual Session of the Commission in 2019.
  9. This Resolution supersedes Resolution 14/03 *On enhancing the dialogue between fisheries scientists and managers*.
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**APPENDIX E****RESOLUTION 21/03****ON HARVEST CONTROL RULES FOR SKIPJACK TUNA IN THE IOTC AREA OF  
COMPETENCE**

**Keywords:** Skipjack tuna; Reference Points; Harvest Control Rules; Precautionary Approach; Management Strategy Evaluation.

**The Indian Ocean Tuna Commission (IOTC),**

NOTING Article V, paragraph 2(c), of the IOTC Agreement is to adopt, in accordance with Article IX and on the basis of scientific evidence, Conservation and Management Measures to ensure the conservation of the stocks covered by the Agreement;

BEING MINDFUL of Article XVI of the IOTC Agreement regarding the rights of Coastal States, Article 87 and 116 of the UN Convention of the Law of the Sea regarding the right to fish on the high seas and of Article 24 of the Agreement for the Implementation of the Provisions of the United Nations Convention of the Law of the Sea of December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UNFSA) regarding recognition of the special requirements of developing states;

RECOGNISING Resolution 12/01 *On the implementation of the precautionary approach* calls on the Indian Ocean Tuna Commission to implement and apply the precautionary approach, in accordance Article 6 of the Agreement for the Implementation of the Provisions of the United Nations Convention of the Law of the Sea of December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UNFSA);

RECOGNISING the ongoing discussions on allocation and the need to avoid prejudicing future decision of the Commission;

FURTHER CONSIDERING the call by the United Nations General Assembly Resolution 70/75 upon the states to increase the reliance on scientific advice in developing, adopting and implementing conservation and management measures and to take into account the special requirements of developing states, including Small Island developing States as highlighted in the SIDS Accelerated Modalities of Action (SAMOA) Pathway;

CONSIDERING the recommendations adopted by the KOBE II, held in San Sebastian, Spain, June 23 – July 3 2009; implementing where appropriate a freeze on fishing capacity on a fishery by fishery basis and such a freeze should not constrain the access to, development of, and benefit from sustainable tuna fisheries by developing coastal States;

TAKING INTO ACCOUNT the need to have due regard for the interests of all Members concerned, in conformity with the rights and obligations of those Members under international law and in particular, to the rights and obligations for developing countries;

RECALLING Article 6, paragraph 3(b) of UNFSA that calls on States to implement the precautionary approach using the best scientific information available, using stock-specific reference points and outlining the action to be taken if they are exceeded;

FURTHER RECALLING that Article 7.5.3 of the FAO Code of Conduct for Responsible Fisheries also recommends the implementation of stock specific target and limit reference points, inter alia, on the basis of the precautionary approach;

ACKNOWLEDGING that implementing pre-agreed harvest strategies including harvest control rules is considered a critical component of modern fisheries management and international best practices for fisheries management;

FURTHER NOTING that a harvest control rule encompasses a set of well-defined, pre-agreed rules or actions used for determining a management action in response to changes in indicators of stock status with respect to reference points;

NOTING that the Scientific Committee at its 17<sup>th</sup> Session, recommended the Commission consider an alternative approach to identify biomass limit reference points, such as those based on biomass depletion levels, when the MSY-

based reference points are difficult to estimate. In cases where MSY-based reference points can be robustly estimated, limit reference points may be based around MSY;

FURTHER NOTING that the Scientific Committee also recommended that in cases where MSY-based reference points cannot be robustly estimated, biomass limit reference points be set at 20% of unfished levels ( $B_{LIM} = 0.2B_0$ );

ACKNOWLEDGING that the IOTC Scientific Committee has initiated a Commission requested process leading to a management strategy evaluation (MSE) process to improve upon the provision of scientific advice on HCRs;

RECALLING obligations and agreements under Resolutions 12/02<sup>3</sup>, 15/01<sup>4</sup>, 15/02<sup>5</sup>, and 15/10<sup>6</sup>;

RECOGNIZING the SC20 advice that the total catches of skipjack tuna in 2018 were 30% larger than the resulting catch limit from the skipjack HCR for the period 2018-2020 (470,029 t);

RECALLING that the 2019 skipjack catch from the Indian Ocean was 547,248t and the maximum catch limit calculated applying the HCR specified in Resolution 16/02 is 513,572t for the period 2021-2023;

FURTHER RECOGNIZING that reaching the management objectives defined in Resolution 16/02 requires that the catch limits adopted by the skipjack HCR are implemented effectively and the need for the Commission to ensure that catches of skipjack tuna during this period do not exceed the agreed limit.

ADOPTS in accordance with paragraph 1 of Article IX of the IOTC Agreement, that:

### Objectives

1. To maintain the Indian Ocean Tuna Commission skipjack tuna stock in perpetuity, at levels not less than those capable of producing maximum sustainable yield (MSY) as qualified by relevant environmental and economic factors including the special requirements of Developing Coastal States and Small Island Developing States in the IOTC area of competence and considering the general objectives identified in Resolution 15/10 (or any subsequent revision).
2. To use a pre-agreed harvest control rule (HCR) to maintain the skipjack tuna stock at, or above, the target reference point (TRP) and well above the limit reference point (LRP), specified in Resolution 15/10 (or any subsequent revision).

### Reference Points

3. Consistent with paragraph 2 of Resolution 15/10, the biomass limit reference point,  $B_{lim}$ , shall be 20% of unfished spawning biomass<sup>7</sup> (i.e.  $0.2B_0$ ).
4. Consistent with paragraph 3 of Resolution 15/10, the biomass target reference point,  $B_{targ}$ , shall be 40% of unfished spawning biomass (i.e.  $0.4B_0$ ).
5. The HCR described in paragraphs 6–12 seeks to maintain the skipjack tuna stock biomass at, or above, the target reference point while avoiding the limit reference point.

### Harvest Control Rule (HCR)

<sup>3</sup> 12/02: Data Confidentiality, policy and procedures

<sup>4</sup> 15/01: On the recording of catch and effort data by fishing vessels in the IOTC Area of competence

<sup>5</sup> 15/02: Mandatory statistical reporting requirements for IOTC Contracting Parties and Cooperating Non- Contracting Parties (CPCs)

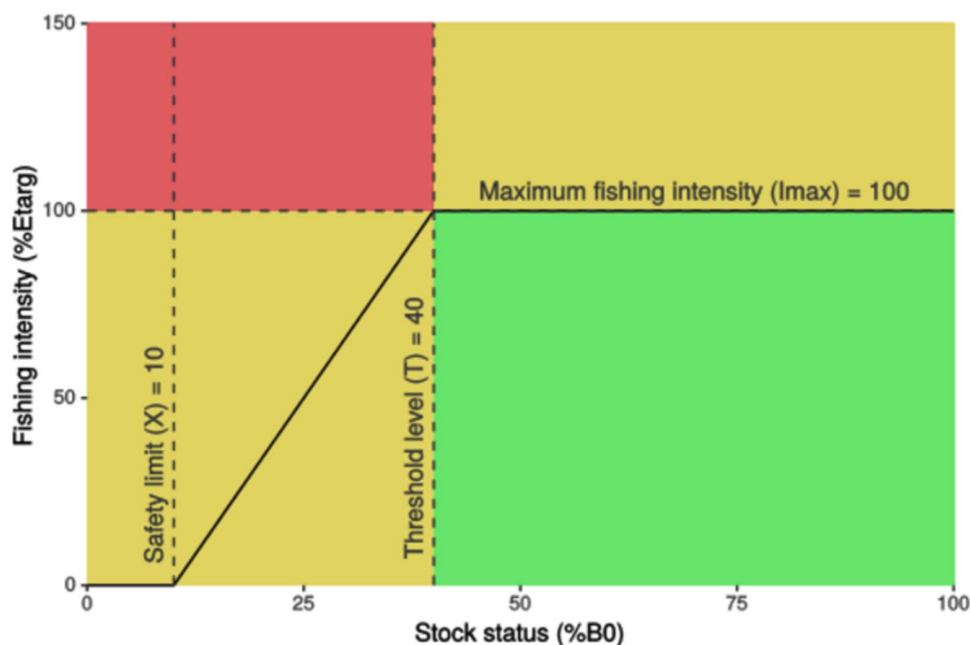
<sup>6</sup> 15/10: On Target and Limit Reference Points and a decision framework

<sup>7</sup> The symbol B is used to refer to spawning biomass, the total mass of mature fish, i.e.  $B_0$ ,  $B_{lim}$ ,  $B_{targ}$  and  $B_{curr}$  all refer to different levels of spawning biomass.

6. The skipjack tuna stock assessment shall be conducted every three (3) years, with the next stock assessment to occur in 2023. Estimates of 7(a–c) shall be taken from a model-based stock assessment that has been reviewed by the Working Party on Tropical Tunas and endorsed by the Scientific Committee via its advice to the Commission.
7. The skipjack tuna HCR shall recommend a total annual catch limit using the following three (3) values estimated from each skipjack stock assessment. For each value, the reported median from the reference case adopted by the Scientific Committee for advising the Commission shall be used.
  - a) The estimate of current spawning stock biomass ( $B_{curr}$ );
  - b) The estimate of the unfished spawning stock biomass ( $B_0$ );
  - c) The estimate of the equilibrium exploitation rate ( $E_{targ}$ ) associated with sustaining the stock at  $B_{targ}$ .
8. The HCR shall have five control parameters set as follows:
  - b) Threshold level, the percentage of  $B_0$  below which reductions in fishing mortality are required,  $B_{thresh} = 40\%B_0$ . If biomass is estimated to be below the threshold level, then fishing mortality reductions, as output by the HCR, will occur.
  - c) Maximum fishing intensity, the percentage of  $E_{targ}$  that will be applied when the stock status is at, or above, the threshold level  $I_{max} = 100\%$ . When the stock is at or above the threshold level, then fishing intensity ( $I$ ) =  $I_{max}$
  - d) Safety level, the percentage of  $B_0$  below which non-subsistence catches are set to zero i.e. the non-subsistence<sup>86</sup> fishery is closed  $B_{saftey} = 10\%B_0$ .
  - e) Maximum catch limit ( $C_{max}$ ), the maximum recommended catch limit = 900,000t. To avoid adverse effects of potentially inaccurate stock assessments, the HCR shall not recommend a catch limit greater than  $C_{max}$ . This value is based upon the estimated upper limit of the MSY range in the 2014 skipjack stock assessment.
  - f) Maximum change in catch limit ( $D_{max}$ ), the maximum percentage change in the catch limit = 30%. To enhance the stability of management measures the HCR shall not recommend a catch limit that is 30% higher, or 30% lower, than the previous recommended catch limit.
9. The recommended total annual catch limit shall be set as follows:
  - a) If the current spawning biomass ( $B_{curr}$ ) is estimated to be at or above the threshold spawning biomass i.e.,  $B_{curr} \geq 0.4B_0$ , then the catch limit shall be set at  $[ I_{max} \times E_{targ} \times B_{curr} ]$
  - b) If the current spawning biomass ( $B_{curr}$ ) is estimated to be below the threshold biomass i.e,  $B_{curr} < 0.4B_0$ , but greater than the safety level i.e.,  $B_{curr} > 0.1B_0$ , then the catch limit shall be set at  $[ I \times E_{targ} \times B_{curr} ]$ . See Table 1 in Appendix 1 for values of fishing intensity ( $I$ ) for specific  $B_{curr}/B_0$ .
  - c) If the spawning biomass is estimated to be at, or below, the safety level, i.e.  $B_{curr} \leq 0.1B_0$  then the catch limit shall be at 0 for all fisheries other than subsistence fisheries.

<sup>8</sup> A subsistence fishery is a fishery where the fish caught are consumed directly by the families of the fishers rather than being bought by middle-(wo)men and sold at the next larger market, per the FAO Guidelines for the routine collection of capture fishery data. FAO Fisheries Technical Paper. No. 382. Rome, FAO. 1999. 113p.

- d) In the case of (a) or (b), the recommended catch limit shall not exceed the maximum catch limit ( $C_{max}$ ) and shall not increase by more than 30% or decrease by more than 30% from the previous catch limit.
- e) In the case of (c) the recommended catch limit shall always be 0 regardless of the previous catch limit.
10. The HCR described in 8(a-e) produces a relationship between stock status (spawning biomass relative to unfished levels) and fishing intensity (exploitation rate relative to target exploitation rate) as shown below (See Table 1 in **Appendix 1** for specific values):



11. The catch limit shall by default, be implemented in accordance with the allocation scheme agreed for skipjack tuna by the Commission. In the absence of an allocation scheme, the HCR shall be applied as follows:
- If the stock is at or above the Threshold level (i.e.,  $B_{curr} \geq 0.4B_0$ ), then the HCR shall establish an overall catch limit and catches of skipjack tuna for any given year shall be maintained at or below the overall catch limit established by the HCR.
  - If the stock falls below the Threshold level (i.e.,  $B_{curr} < 0.4B_0$ ), the fishing mortality reductions shall be implemented proportionally by CPCs for catches over 1 percent of the catch limit established by the HCR with due consideration to the aspirations and special requirements of Developing Coastal States and Small Island Developing States.
  - The Commission may consider to develop and adopt Conservation and Management Measure(s) to ensure catches of skipjack tuna are maintained at or below the overall catch limit established by the HCR and to apply fishing mortality reductions if the stock falls below the Threshold level (i.e.  $B_{curr} < 0.4B_0$ ), with due consideration to the aspirations and special requirements of Developing Coastal States and Small Island Developing States, no later than the annual session of the IOTC in 2022.
  - This paragraph shall not pre-empt or prejudice future allocation negotiations.

#### Review and exceptional circumstances

12. The HCR, including the control parameters, will be reviewed through further Management Strategy Evaluation (MSE).



13. In the case that the estimated spawning biomass falls below the limit reference point, the HCR will be reviewed, and consideration given to replacing it with an alternative HCR specifically designed to meet a rebuilding plan as advised by the Commission.
14. The recommended total annual catch produced by the HCR will be applied continuously as set forth in paragraph 11 above, except in case of exceptional circumstances, such as caused by severe environmental perturbations. In such circumstances, the Scientific Committee shall advise on appropriate measures.

#### Scientific Advice

15. The IOTC Scientific Committee shall:
- a) Include the LRP and TRP as part of any analysis when undertaking all future assessments of the status of the IOTC skipjack tuna stock.
  - b) Undertake and report to the Commission a model-based skipjack tuna stock assessment every three (3) years, commencing with the next stock assessment in 2023.
  - c) Undertake a programme of work to further refine Management Strategy Evaluation (MSE) for the IOTC skipjack tuna fishery as required in paragraph 12 including, but not limited to,
    - i. Refinement of operating model(s)/ used,
    - ii. Alternative management procedures,
    - iii. Refining performance statistics.

#### Final Clause

16. The Commission shall review this measure at its annual session in 2022, or before if there is reason and/or evidence to suggest that the skipjack tuna stock is at risk of breaching the LRP.

#### Appendix 1

**Table 1.** Values of fishing intensity for alternative levels of estimated stock status ( $B_{curr}/B_0$ ) produced by the HCR

Stock status ( $B_{curr}/B_0$ )	Fishing Intensity (I)		Stock status ( $B_{curr}/B_0$ )	Fishing Intensity (I)
At or above 0.40	100%		0.24	46.7%
0.39	96.7%		0.23	43.3%
0.38	93.3%		0.22	40.0%
0.37	90.0%		0.21	36.7%
0.36	86.7%		0.20	33.3%
0.35	83.3%		0.19	30.0%
0.34	80.0%		0.18	26.7%
0.33	76.7%		0.17	23.3%
0.32	73.3%		0.16	20.0%
0.31	70.0%		0.15	16.7%

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0.30	66.7%		0.14	13.3%
0.29	63.3%		0.13	10.0%
0.28	60.0%		0.12	6.7%
0.27	56.7%		0.11	3.3%
0.26	53.3%		0.10 or below	0%
0.25	50.0%			

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**APPENDIX F****RESOLUTION 22/03****ON A MANAGEMENT PROCEDURE FOR BIGEYE TUNA IN THE IOTC AREA OF COMPETENCE.**

**Keywords:** *Bigeye tuna, Management Procedure, Harvest Strategy, Target reference point, MSY.*

**The Indian Ocean Tuna Commission (IOTC),**

**HAVING** responsibility for the conservation and optimum utilization of tuna and tuna-like species in the Indian Ocean;

**RECOGNISING** the need for action to ensure the achievement of IOTC objectives to conserve and manage tuna resources in the IOTC area of competence;

**RECOGNISING** the adopted management objectives of the Commission set out in Resolution 15/10 are to: 1) maintain the biomass at or above levels required to produce MSY or its proxy, 2) maintain the fishing mortality rate at or below  $F_{MSY}$  or its proxy, and 3) avoid the biomass being below  $B_{LIM}$  and the fishing mortality rate being above  $F_{LIM}$ ;

**MINDFUL** of Article XVI of the IOTC Agreement regarding the rights of Coastal States and of Articles 87 and 116 of the UN Convention on the Law of the Sea regarding the right to fish on the high seas;

**RECOGNISING** the special requirements of developing States, particularly Small Island developing States, in Article 24 of the Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UNFSA);

**RECOGNISING** *Resolution 12/01* On the implementation of the precautionary approach calls on the Indian Ocean Tuna Commission to implement and apply the precautionary approach, in accordance with Article 6 of UNFSA;

**RECALLING** *Resolution 15/10 On Target and Limit Reference Points and a Decision Framework*, which identifies objectives of the Commission to maintain stocks in perpetuity and with high probability, at levels not less than those capable of producing their maximum sustainable yield as qualified by relevant environmental and economic factors including the special requirements of developing States in the IOTC area of competence; and identifies reference points for IOTC stocks including bigeye tuna;

**RECOGNIZING** the intent of the Commission to adopt management procedures aimed at achieving the objectives of the IOTC Agreement (Resolution 15/10) aided by advice of the Technical Committee on Management Procedures (TCMP), as established in *Resolution 16/09* and as further expounded in the *Schedule of work for the development of management procedures for key species in the IOTC Area*;

**ACKNOWLEDGING** the Scientific Committee advice that the most recent stock assessment in 2019 determined bigeye tuna is not overfished but subject to overfishing;

**FURTHER CONSIDERING** the endorsement of the bigeye tuna operating model by the 24th meeting of the Scientific Committee (December 2021, SC24) and the SC24's advice that the key technical work (management strategy evaluation) required to test the performance of candidate management procedures had been completed;

**FURTHER CONSIDERING** the advice and recommendations of the 5th Session of the Technical Committee on Management Procedures (TCMP) regarding a management procedure for bigeye tuna which noted that both candidate management procedures for bigeye tuna presented to the TCMP achieved the management objective and recommended the 26<sup>th</sup> Session of the Commission discuss and select a candidate management procedure for adoption.

**ADOPTS** in accordance with paragraph 1 of Article IX of the IOTC Agreement:

1. A management procedure for the bigeye tuna stock managed by the IOTC with a view of maintaining the stock biomass in the green zone of the Kobe plot (not overfished and not subject to overfishing) while maximizing the average catch from the fishery and reducing the variation in the total allowable catch (TAC) between management periods.

#### **Management procedure**

2. The adopted management procedure for bigeye tuna known as MP1 Harvest is described in Annex I (MP).
3. Consistent with the adopted management objectives of the Commission, the management procedure is designed to achieve:
  - a) a 60% probability that the bigeye tuna spawning stock biomass achieves the target reference point of  $SB_{MSY}^9$  by 2034-2038;
  - b) the bigeye tuna spawning stock biomass avoids breaching the interim limit reference point specified in Resolution 15/10 with a high probability;
 and operates with the following constraint:
  - c) the maximum increase or decrease in the TAC shall be 15% relative to the previous TAC.

#### **Total Allowable Catch setting**

4. The Scientific Committee shall run the MP and advise the Commission of the outcome, including a recommended TAC and any advice on exceptional circumstances in accordance with the Commission endorsed Guidelines for the Provisions of Exceptional Circumstances for IOTC MPs as documented in Appendix 6a of IOTC-2021-SC24-R.
5. The Commission shall adopt the TAC based on the outcome of the MP, unless the Scientific Committee identifies exceptional circumstances that require consideration of alternate management actions to be taken by the Commission.
6. The first TAC derived from the MP shall apply in 2024 and 2025. After 2025, the TAC shall apply in each of the subsequent three years following the year it is set by the Commission<sup>10</sup>.
7. The schedule for setting and applying the TAC, beginning the calendar year immediately following adoption of this Resolution, is shown in Annex II.
8. If exceptional circumstances are triggered, the pre-existing TAC shall remain in place until a new TAC or other management action is agreed by the Commission.

#### **TAC allocation**

9. Allocation of the TAC among CPCs will take place according to a process agreed external to this measure.
10. The Commission will develop a mechanism to constrain catch to the MP derived TAC for bigeye tuna no later than 2025, if an allocation scheme has not yet been agreed and implemented by the Commission.

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<sup>9</sup> The spawning stock biomass associated with achieving maximum sustainable yield.

<sup>10</sup> E.g. the Scientific Committee runs the MP in 2022, the TAC is set by the Commission in 2023, the TAC applies in 2024 and 2025. The Scientific Committee runs the MP in 2024, the TAC is set by the Commission in 2025, the TAC applies from 2026-2028.

**Review**

11. A review of performance of the MP by the Commission and its subcommittees is to occur in 2030. The aim of the review is to ensure the MP is performing as expected and whether there are any conditions that warrant reconditioning the operating models, retuning the existing MP, or consideration of alternate candidate MPs and a new full management strategy evaluation.
12. The Scientific Committee is requested to review, and if necessary, further develop and refine (not later than 2024), the exceptional circumstances guidelines (adopted by SC24 and S26), taking into account, *inter alia*, the need for an appropriate balance between specificity versus flexibility in defining exceptional circumstances, and the appropriate level of robustness to ensure that exceptional circumstances are triggered only when necessary.
13. The IOTC, through the Technical Committee on Management Procedures, is requested to review the need for, and if necessary, develop at latest by 2025, guidance on a range of appropriate management responses should those exceptional circumstances be found to occur.

## ANNEX I

## DESCRIPTION AND FORMULAE FOR CALCULATING TACS FOR MP1\_HARVEST

MP1 Harvest has two data inputs: total catch biomass and spatially aggregated longline CPUE from 1980 to the most recent year of catch data. It then fits a Pella-Tomlinson biomass dynamic model to the CPUE data given the catch biomass. Estimated parameters are carrying capacity ( $K$ ), intrinsic rate of increase ( $r$ ), initial biomass depletion ( $\delta$ ), the production curve shape parameter ( $m$ ), and finally annual biomass  $B$  and its stochastic variability  $\sigma_B$ . From these parameters we derive the key variables used in the harvest control rule (HCR):

1. Ratio of fishing mortality to the value which produces MSY ( $F_{MSY}$  ratio)
2. Relative biomass or depletion:  $B/K$

The HCR is a simple hockey stick type: for biomass depletion above 0.4 the HCR multiplier ( $HCR_{mult}$ ) is 1, it decreases to (almost) zero linearly by a biomass depletion of 0.1. The overall fishing mortality used to estimate the TAC is calculated as follows:  $F_{MSY}$  ratio  $\times$   $HCR_{mult}$   $\times$  tuning parameter ( $F_{mult}$ ). This fishing mortality is used in conjunction with the estimated biomass  $B$  to calculate the new TAC. A symmetric maximum change of 15% is then applied to calculate the actual recommended TAC. The main suite of equations that define the HCR are as follows:

$$HCR_{mult} = 1 \text{ if } \frac{B_y}{K} \geq 0.4$$

$$HCR_{mult} = \frac{\frac{B_y}{K} - 0.1}{0.3} \text{ if } 0.1 < \frac{B_y}{K} < 0.4$$

$$HCR_{mult} = 0.0001 \text{ if } \frac{B_y}{K} \leq 0.1$$

$$TAC_{new} = B_y(1 - \exp(-F_{mult} \times HCR_{mult} \times F_{MSY} \text{ ratio}))$$



## DATA SPECIFICATION

The input data for MP1\_Harvest are:

- b) Total catches of bigeye tuna in the IOTC Area of Competence. These are collated by the IOTC Secretariat and prepared annually for the IOTC Working Party on Tropical Tuna. Data used are from 1980 to the most recent year of data available.
- c) Standardised and spatially aggregated longline catch per unit effort (CPUE). These are derived from the joint standardisation analysis approach described in Hoyle *et al* (2019)<sup>11</sup> applied to catch and effort data from 1980 to the most recent year of data available.

<sup>11</sup> Hoyle, S., Chang, S.T, Fu, D., Kim, D.N., Lee, S.I., Matsumoto, T., Chassot, E., Yeh, Y.M. 2019. Collaborative study of bigeye and yellowfin tuna CPUE from multiple Indian Ocean longline fleets in 2019, with consideration of discarding. IOTC–2019–WPM10–16.

**ANNEX II**  
**SCHEDULE FOR MP IMPLEMENTATION**

IOTC COMMITTEE	2022	2023	2024	2025	2026	2027	2028	2029
<b>Commission (May/June)</b>	<b>Select and adopt BET MP</b>	Annual Review of SC advice 						
		<b>Set TAC (2024-2025)</b>	<b>Set TAC (2026-2028)</b>				<b>Set TAC (2029-2031)</b>	
<b>WPTT and WPM (Oct)</b>	Collate catch data and CPUE series used in MP	Collate data used in MP		Collate data used in MP				
		Consider exceptional circumstances (EC), advise SC	Consider EC	Consider EC				
<b>SC (Dec)</b>	<b>Run MP</b>	<b>Run MP</b>		<b>Run MP</b>				
	Assess* stock status				Assess stock status	Assess stock status		
	<b>Annual Review of Exceptional Circumstances</b> 							
	Provide TAC advice to the Commission	Provide TAC advice		Provide TAC advice				

- The assessment of stock status has a distinct role and purpose from the management procedure and is not used for TAC advice. It is included in this schedule to identify best practice in the timing of running of the assessment, i.e. in the year after MP TAC decisions have been made.