Report of the 8th Session of the IOTC Working Party on Methods

Beau Vallon, Seychelles, 13-15 October 2017

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ACRONYMS

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

GLOSSARY OF TERMS

Control measure: the unit used to control the amount of fishing or resource extraction allowed (e.g. catch or effort) according to some indicator (e.g. stock status)

Harvest control rule (HCR): agreed response that management must make under pre-defined circumstances regarding stock status.

Harvest strategy: Strategy outlining how the catch in a fishery will be adjusted from year to year depending on the size of the stock, the economic or social conditions of the fishery, conditions of other interdependent stocks and uncertainty of biological knowledge. Well-managed fisheries have an unambiguous (explicit and quantitative) harvest strategy that is robust in the unpredictable biological fluctuations to which the stock may be subject. A harvest strategy sets out the management actions necessary to achieve defined biological and economic objectives in a given fishery. Harvest strategies must contain 1) a process for monitoring and conducting assessments of the biological and economic conditions of the fishery, and 2) rules that control the intensity of fishing activity according to the biological and economic conditions of the fishery (as defined by the assessment). These rules are referred to as harvest control rules.

Limit reference point (LRP): a benchmark which defines undesirable states of the system that should be avoided or achieved with very low probability.

Management objectives: the social, economic, biological, ecosystem, and political (or other) goals specified for a given management unit (e.g. stock).

Management options: alternative management procedures from which recommended management actions will be chosen.

Management procedure (MP): a set of formal actions, usually consisting of data collection, stock assessment, and harvest control rules, to iteratively and adaptively .adjust harvest controls (e.g. catch or effort quotas).

Management strategy evaluation (MSE): procedure whereby alternative management procedures' performance are tested and compared using stochastic simulations of stock and fishery dynamics against a set of management objectives.

Performance statistics: a set of consistent statistics used to evaluate how well management objectives have been achieved under each candidate MP over a pre-defined simulated period.

Simulation: an imitation of a real world system used to gain insight into how the system operates.

Target reference point (TRP): a benchmark which assesses the performance of management in achieving one or more operational management objectives.

Trigger reference point (TrRP): a particular state of the system that triggers a predefined change in the management response.

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 8th Session of the Indian Ocean Tuna Commission's (IOTC) Working Party on Methods (WPM) was held in Beau Vallon, Seychelles 13–15 October 2017. A total of 28 participants (29 in 2016, 26 in 2015) attended the Session. The list of participants is provided in Appendix I. The meeting was opened by the Chairperson, Dr Toshihide Kitakado (Japan) who welcomed participants to Seychelles. Dr Rishi Sharma was welcomed as the Invited Expert.

The following are a subset of the complete recommendations from the WPM07 to the Scientific Committee, which are provided in Appendix VI.

Outcomes of the 21st Session of the Commission

NOTING that the Commission considers the development of an MSE for swordfish to be a high priority activity, the WPM **RECOMMENDED** that this is reflected in the 2019 budget of the Commission (para. 10).

Skipjack tuna MSE: Update

The WPM **NOTED** some ambiguity in the interpretation of the approach for deriving median values for the stock status statistics used to calculate the TAC. To provide some clarity, the WPM **RECOMMENDED** that the SC apply the median value of the distribution of B_{curr}/B_0 outcomes from the stock assessment with associated characterised uncertainty for specifying the I value for use in TAC setting. Likewise, median values of estimates of B_{curr} and E_{targ} with associated characterised uncertainty should also be used in calculations of TAC (i.e. I x E_{targ} x B_{curr}) (para. 44).

Further, **NOTING** that the simulations used in testing robustness of the agreed HCR in Res 16/02 projected forward applying a first year catch level of 425,000 t (as documented in https://github.com/iotcwpm/SKJ/blob/master/procedures.hpp#L303), representing the recent reported catch, C_{recent} used in the simulations used for testing the HCR), and considering para 9.d in Res 16/02, the WPM **RECOMMENDED** that the SC consider that, in the event $B_{curr}/B_0 > 0.4$ (i.e. $> B_{thresh}$), the TAC for 2018-2020 should not exceed 1.3x C_{recent} or, in the event that $0.1 < B_{curr}/B_0 < 0.4$, the TAC for 2018-2020 should not be less than $0.7C_{recent}$. The WPM also noted that using C_{recent} values different to those used in the simulation trials could result in unexpected performance of the HCR (para. 45).

Bigeye and yellowfin tuna MSE

Due to the project funding delays, the WPM **NOTED** that there will be no opportunity for scientific review of the BET MSE work before the SC20 takes place in November 2017 so the informal technical MSE workshop represents the only review opportunity before the TCMP02 in 2018. Therefore the WPM **RECOMMENDED** the SC schedule the next informal technical MSE workshop to take place between March-April 2018 to facilitate review ahead of the TCMP02 (para. 49).

Swordfish MSE: update

The WPM **NOTED** the large number of independent CPUE indices, and **AGREED** that it would be useful to bring the datasets together and undertake a joint analysis as a joint CPUE series based on operational data should increase spatio-temporal coverage, as well as better handle changes in targeting. The WPM therefore **RECOMMENDED** that future stock assessments of swordfish are based on a joint standardised CPUE series (para. 55).

The WPM **RECOMMENDED** that stock assessment results should include both MSY and depletion-based indicators. The WPM **NOTED** that the current stock assessment of swordfish shows a stock in the green area of the Kobe plot, given the current value of B/B_{MSY} ratio, while the stock is estimated to be at around 30% of virgin biomass. This latter value would be generally considered to indicate a stock is likely to be overexploited (para. 56).

Visualisation of MSE results

The WPM **RECOMMENDED** the proposed revisions to the standardised methods for the presentation of MSE results (Appendix IV) are submitted to the SC20 for discussion, revision and endorsement, as appropriate. This should still be considered a living document that will benefit from revision based upon ongoing feedback received from the SC and the TCMP (para. 65)

Update on the status of the joint CPUE indices (yellowfin tuna, bigeye tuna & albacore)

WPM **RECOGNISED** the importance of normalizing these procedures and approaches into the various Working Party stock assessments making use of longline catch rate indices and **RECOMMENDED** that the SC endorse such joint analyses and **REQUESTED** these continue into the future as a normal course of business. It was **NOTED** that additional time for more detailed analysis is still needed and WPM **SUGGESTED** that methods to increase analysis time, such as the use of secure, cloud-based data exchange and increased use of electronic communication between analysts be investigated (para. 79).

The WPM **THANKED** the authors for the investigation selectivity changes and spatial size patterns of bigeye and yellowfin tuna in the early years of the Japanese longline fishery and **AGREED** that this work is important in terms of improving understanding of the trends in CPUE. **NOTING** that various issues have been identified that could be explored further, the WPM **RECOMMENDED** that this work is continued (para.86).

Priorities for future development of the joint CPUE indices

The WPM **NOTED** that a substantial amount of work has already been completed for the tropical tunas and that it may be more worthwhile to focus on some other species for which this approach would be useful. The WPM therefore **RECOMMENDED** that a similar joint analysis approach is explored for key IOTC billfish and shark species (para. 92).

Revision of the WPM Program of work (2018–2022)

The WPM **RECOMMENDED** that the Scientific Committee consider and endorse the WPM Programme of Work (2018–2022), as provided in Appendix V (para. 119).

Presentation of stock status advice for data limited stocks

The WPM **AGREED** that work on the presentation of stock status advice for data limited stocks will need to be carried out inter-sessionally, and that this will require some level of preparation and planning. The WPM **REQUESTED** the Chairperson liaise with the Chairs of the species WPs (WPNT and WPB) in order to draft a study proposal on this issue and **RECOMMENDED** the SC allocate funding to this project (para.121).

Election of a Chairperson and Vice-Chairperson for the next biennium

The WPM **RECOMMENDED** that the SC note the Chairperson, Dr Toshihide Kitakado and Vice-Chairperson, Dr Iago Mosqueira, of the WPM for the next biennium (para. 130).

Development of priorities for Invited Expert(s) at the next WPM meeting

Given the importance of external peer review, the WPM **RECOMMENDED** that the Commission continues to allocate sufficient budget for a regular invited expert to be invited to meetings of the WPM (para. 132).

Review of the draft, and adoption of the Report of the 8th Session of the WPM

The WPM **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPM08, provided in Appendix VI.

1. OPENING OF THE MEETING

1. The 8th Session of the Indian Ocean Tuna Commission's (IOTC) Working Party on Methods (WPM) was held in Beau Vallon, Seychelles 13–15 October 2017. A total of 28 participants (29 in 2016, 26 in 2015) attended the Session. The list of participants is provided in Appendix I. The meeting was opened by the Chairperson, Dr Toshihide Kitakado (Japan) who welcomed participants to Seychelles. Dr Rishi Sharma was welcomed as the Invited Expert.

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 WPM08 are listed in Appendix III.

3. THE IOTC PROCESS: OUTCOMES, UPDATES AND PROGRESS

3.1 Outcomes of the 19th Session of the Scientific Committee

3. The WPM **NOTED** paper IOTC–2019–WPM08–03 which outlined the main outcomes of the 19th Session of the Scientific Committee (SC19), specifically related to the work of the WPM.

4. The WPM **NOTED** that in 2016, the SC made a number of endorsements and recommendations in relation to the WPM07 report. These are provided below for reference

- ***Presentation and evaluation of MSE results***
    - *The SC **ENDORSED** the revised list of performance statistics representing a suite of candidate management objectives, provided in Appendix VIa which provides a means of measuring the performance of alternative management procedures against different objectives.*
    - *The SC **RECOMMENDED** the proposed standardised methods for the presentation of MSE results (Appendix VIb) are submitted to TCMP and S21 for discussion, revision and endorsement, as appropriate. Subsequently, this should be considered a living document that will benefit from revision based upon feedback received from the TCMP, which will first meet in 2017.*

- ***Operational definition of TRPs and LRPs***
    - *The SC **NOTED** that if stock status advice changes as soon as the target reference points are exceeded, it is likely for advice to change based purely on natural fluctuations in stock abundance or other expected sources of variability. The SC **RECOMMENDED** that the operational definition of TRPs and LRPs is included for discussion at the Technical Committee on Management Procedures.*

- ***Revision of the WPM Program of work (2017–2021)***
    - *The SC **NOTED** that the next stock assessment of Indian Ocean swordfish is due to take place in 2017 and **RECOMMENDED** that the development of MSE of swordfish is considered as a high priority in the revised WPM Program of Work and that funding is allocated for this activity, to start the conditioning of an OM for this stock.*

5. The WPM **NOTED** that the WPB15 have proposed to undertake the next swordfish assessment in 2020 (IOTC-2017-WPB15-R).

3.2 Outcomes of the 21st Session of the Commission

6. The WPM **NOTED** paper IOTC–2017–WPM08–04 which outlined the main outcomes of the 21st Session of the Commission, specifically related to the work of 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.

7. The WPM **NOTED** the 8 Conservation and Management Measures (CMMs) adopted at the 21st Session of the Commission (consisting of 8 Resolutions and 0 Recommendations) as listed below:

IOTC Resolutions

- Resolution 17/01 *On an interim plan for rebuilding the Indian Ocean yellowfin tuna stock in the IOTC Area of Competence*
- Resolution 17/02 *Working party on the implementation of Conservation and Management Measures (WPICMM).*

- Resolution 17/03 *On establishing a list of vessels presumed to have carried out illegal, unreported and unregulated fishing in the IOTC Area of competence.*
- Resolution 17/04 *On a ban on discards of Bigeye tuna, Skipjack tuna, Yellowfin tuna, and non-targeted species caught by purse seine vessels in the IOTC Area of Competence*
- Resolution 17/05 *On the conservation of sharks caught in association with fisheries managed by the IOTC.*
- Resolution 17/06 *On establishing a programme for transhipment by large-scale fishing vessels*
- Resolution 17/07 *On the prohibition to use large-scale driftnets in the IOTC Area*
- Resolution 17/08 *Procedures on a fish aggregating devices (FADs) management plan, including a limitation on the number of FADs, more detailed specifications of catch reporting from FAD sets, and the development of improved FAD designs to reduce the incidence of entanglement of non-target species*

8. The WPM **NOTED** that these Conservation and Management Measures shall become binding on Members 120 days from the date of the notification communicated by the IOTC Secretariat in IOTC Circular 2017–061 (i.e. 3 October 2017)[1].

9. The WPM **NOTED** that the Commission also made a number of general comments and requests regarding the recommendations made by the Scientific Committee in 2016, which have relevance for the WPM (details as follows: paragraph numbers refer to the report of the Commission IOTC–2017–S21–R).

- ***On the status of billfish***
  - *(Para 40) : The Commission noted that the development of a MSE of swordfish is considered as a high priority in the revised WPM Program of Work, and that possible funding has been identified to begin this activity.*
- ***Schedule of work for the development of management procedures for key species in the IOTC Area***
  - *(Para. 58): The Commission noted the presentation by Australia on the schedule of work for the development of management procedures for key species in the IOTC Area (IOTC-2017-S21-14). The schedule provides information on when and how the Commission ought to be engaged in the management procedures process, and was developed with inputs from CPC's, relevant IOTC working parties, the Scientific Committee, and uses, as its basis, the work plan of the Scientific Committee.*
  - *(Para. 59): The Commission **ENDORSED** the schedule that was revised during S21 (provided in Appendix 9), noting it is a 'living document' to guide the work of the Commission and its subsidiary bodies in the future. The Commission also **REQUESTED** that a budget for implementation of the schedule be reviewed by the SCAF in 2018.*

10. **NOTING** that the Commission considers the development of an MSE for swordfish to be a high priority activity, the WPM **RECOMMENDED** that this is reflected in the 2019 budget of the Commission.

3.3 Review of Conservation and Management Measures relevant to the WPM

11. The WPM **NOTED** paper IOTC–2017–WPM08–05 which aimed to encourage participants at the WPM08 to review some of the existing Conservation and Management Measures (CMM) relevant to the WPM, noting the CMMs referred to in document IOTC–2017–WPM08–04, 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 WPM07

12. The WPM **NOTED** paper IOTC–2017–WPM08–06 Rev_1 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 WPM08 as appropriate given any progress.

3.5 Review of intersessional meetings related to the IOTC MSE process

13. The WPM **NOTED** the presentation of the report of the 6th MSE workshop of IOTC WPM scientists that took place in Bangkok from 1-4 April 2017 (IOTC–2017–WPM08–INF01).

[1] As per Article IX.4 of the IOTC Agreement

14. The WPM **THANKED** the participants of this workshop for their informative discussions on the technical aspects of MSE and related topics The WPM **NOTED** the need to hold a further *ad hoc* meeting of this group to prepare materials for TCPM02 in advance of the TCMP meeting in 2018. The WPM **AGREED** that the timing and location of this meeting will be further discussed and refined in advance of the SC20 meeting (see also Item 6 and 12.3).

15. The WPM also **NOTED** the presentation on the report of the TCMP01 that took place in Indonesia in May 2017 of (IOTC–2017–WPM08–INF02).

Tuning

16. The WPM **NOTED** the presentation given on the MSE tuning process to the TCMP01. During this presentation, the procedure to tune the MPs was explained, along with the specific tuning objectives identified by the TCMP. Tuning consists of adjusting the control parameters of MPs to achieve an exact performance level with respect to a single high priority management objective. This removes one dimension from the MP selection process, making it easier to compare MP performance with respect to secondary objectives. The conflicts between target and secondary objectives were discussed and the group noted that the TCMP would need to provide further guidance on tuning objectives. Each species initially has two tuning objectives, which reflect conflicting objectives in the resolutions. It is expected that an improved understanding of the management performance trade-off space, as revealed by the initial MP results, might lead to a single tuning objective in the next iteration. The presentation was made with specific examples corresponding to skipjack, yellowfin, bigeye and albacore MSEs being developed in the IOTC. The presentation also clarified the advantages of MP tuning, which includes:
    1) Helps clarify Commission objectives
    2) Simplifies communication results
    3) Allows MP developers to focus on the appropriate trade-off space.

17. The WPM **NOTED** that there are still issues with communication between the IOTC scientists and managers and that there is probably still room for improvement on both sides. Given that there are still major issues with the understanding of the MSE process and results by managers, the WPM **AGREED** that greater effort needs to be made to further improve communication methods at the next TCMP.

18. The WPM **AGREED** that capacity building activities are also needed in parallel with the TCMP to improve the level of understanding of this committee, though the WPM further **NOTED** that this type of training should not focus only on developing economies but should include managers from all CPCs.

19. The WPM **NOTED** the presentation on the report of ABNJ capacity building workshop on Indian Ocean tuna harvest strategies **(**IOTC–2017–WPM08–INF05).

20. The WPM **NOTED** that this capacity building workshop has been held in a number of locations globally and the communication approach has evolved over time, resulting in a set of very effective materials which were made available to the WPM for consideration.

21. The WPM **NOTED** that the workshop held in Sri Lanka was attended mostly by participants other than the intended audience of Commissioners. However, these engagement activities are still considered useful as there is likely to be subsequent transfer of understanding through informal internal communication mechanisms between scientists and managers within national fisheries departments.

4. ALBACORE MSE: UPDATE

22. The WPM **NOTED** paper IOTC–2017–WPM08–13 describing progress on the MSE for Indian Ocean albacore tuna, including the following abstract provided by the author:

    "This document presents the current status of development of the technical platform, and a set of initial results, for the Management Strategy Evaluation of the Indian Ocean albacore tuna stock. The work includes the development of a reference case Operating Model for the stock, an open source computational platform for the evaluation of alternative Management Procedures, an initial set of simulations for two MPs, and the presentation and output for inspection and analysis of the results. The Operating Model is based around the Stock Synthesis stock assessment conducted by WPTmT in 2016 and incorporates the main sources of uncertainty identified in the estimation of population trajectories and dynamics."

23. The WPM **THANKED** the author for the continued progress on the albacore MSE.

4.1 Conditioning of operating models

24. The WPM **NOTED** that the habitat-based approach for identifying models with plausible production dynamics has some circular reasoning. All albacore assessments potentially have to make somewhat arbitrary judgements about plausibility, and rely on other assessments; it is a self-reinforcing cycle. However, it is likely that detailed examination of a small number of models in the stock assessment context will use more in-depth reasoning than the automated filtering required for screening the OM grid.

25. The WPM **REQUESTED** a comparison of the OM grid before and after model filtering, to illustrate the effect of filtering.

26. The WPM **DISCUSSED** the possibility of adding an alternative catch history robustness scenario. The largest sources of uncertainty were thought to be the driftnet fisheries (which caught large numbers of very small fish before being banned), and the rapidly developing Indonesian longline fishery (where under-reporting has been identified). No specific scenario was proposed, but it was further noted that ISSF industry members can provide an independent source of catch statistics.

27. The WPM **REQUESTED** that the ALB OM reference set is modified so that projections include the same CPUE catchability trends (0, 1% per year) that were assumed in the conditioning (to be consistent with the YFT and BET reference case OMs).

28. The WPM **REQUESTED** that the south Pacific albacore growth curve is included as a robustness scenario.

29. The WPM **NOTED** paper IOTC–2017–WPM08–14 describing methods employed to examine which factors and interactions were important for inclusion in the Indian Ocean albacore and East Atlantic Bluefin Oms, including the following summary:

    "MSEs often use complicated grid based platforms to test alternative states of nature (e.g. CCSBT, Hillary et al. 2016). This was the case in initial development for Albacore in the Indian Ocean (Mosqueira and Sharma 2014 IOTC 2014-WPM 05) based on the Synthesis Assessment. In that case 720 models were examined as the basis of the operating model. The objective of this work is to first examine the grid structure using GLM based methods to determine which variables effect the derived parameters like B0 and current stock size. Once the main and interaction effects that are important are figured a refined grid could be examined. The objective here is to examine whether main and lower level interaction effects used in the grid are sufficient for robustness testing of the MP, and provide adequate contrast in the states of nature or do we need to apply all possible interactions in the grid as well, and can the variance co-variance matrix inform us of the scenarios that could be used".

30. The WPM **THANKED** the authors for conducting this analysis and presenting it to the meeting, and **NOTED** that this approach might be very helpful in OM formulation, and further **SUGGESTED** that similar analyses using cluster analyses, classification trees or random forest models might be even more effective.

31. The WPM **NOTED** that fourth level interactions tended to be very weak, such that the use of partially-confounded experimental design could probably be used to explore OM uncertainty in up to 20 dimensions.

32. The WPM **SUGGESTED** that the albacore MSE developers might consider trying this approach in parallel with the approach already in use.

33. The WPM **NOTED** that this approach for OM formulation helps identify the factors that are important for representing the uncertainty in the stock assessment, but these are not necessarily the same factors that are most influential on MP performance.

34. The WPM **NOTED** paper IOTC–2017–WPM08–15 which summarizes exploratory work on assessment model performance diagnostics for Indian Ocean albacore and East Atlantic bluefin, including the following summary:

    "Cross validation evaluates the predictive error of a model by testing it on a set of data not used in fitting. There is often insufficient data, however, in stock assessment datasets to allow some of it to be kept back for testing. A more sophisticated way to create test datasets is, like the jack-knife, to leave out one (or more) observation at a time. Cross validation then allows prediction residuals to be calculated, i.e. the difference between fitted and predicted values where the latter is calculated from the out-of-sample predictions. Prediction residuals can either be for historical or future observations. In the latter case for example a one-step forward prediction is where data points are made available to the model one measurement at a time, and the model is evaluated by its ability to predict the next data point. This is the general principle of frequentist statistics (Dawid, 1984). In this study we show how prediction residuals can be used to validate stock

assessment scenarios, using 2 examples; i) Indian Ocean Albacore and ii) East Atlantic and Mediterranean bluefin. Model validation examines if the model family should be modified or extended, and is complementary to model selection and hypothesis testing. Model selection searches for the most suitable model within a family, whilst hypothesis testing examines if the model structure can be reduced."

35. The WPM **NOTED** that the approach offers a method for evaluating and comparing models that are structurally different and/or use different data sources, which cannot be achieved with traditional likelihood-based comparison methods.

36. The WPM **THANKED** the authors for their investigation of this crucial topic and look forward to seeing any progress/updates.

4.2 Simulation platform

37. The WPM **NOTED** that the current simulation platform and software is available at the development website, http://github.com/iotcwpm/ALB.

4.3 Candidate Management Procedures

38. The WPM **DISCUSSED** different options for how the multiple standardised CPUE series might be used in the MP, which requires only one series. The initial approach was to use the series from region 3 (south-west) only, as it is the region with the highest catch and abundance. A weighted combination of series is another option. The core area CPUE developed by joint CPCs maybe another approach to pursue for a single index. The complication is the selectivity difference among regions, with southern regions catching more juveniles than adults.

39. The WPM **NOTED** that random effects surplus production models might be better in the MP than the current observation error only model. However, it was noted that this would probably be computationally prohibitive in an MSE context, e.g. 1 minute per model fitting X 10 fittings per realization X 2000 realizations = 14 days computing time for a single MP evaluation.

5. SKIPJACK TUNA MSE: UPDATE

40. The WPM **NOTED** that the Commission adopted Res 16/02 on Harvest Control Rules for Skipjack in the IOTC Area of Competence based upon simulation trials of a number of Harvest Control Rules conducted, reviewed and endorsed by WPM and the SC in 2015. As the first implementation of the HCR will be based upon the 2017 Skipjack stock assessment, no additional simulation testing has been done. Further review and possible modification of the HCR is possible after several iterations of applying the HCR, but no later than 2021 as per Res 16/02.

41. The WPM **NOTED** the Recommendation from TCMP01 and agreement by S21 that *"when establishing a catch limit for skipjack tuna using the Harvest Control Rule (HCR) adopted in Resolution 16/02, the following procedure will be applied: after the review of the assessment of skipjack tuna by the SC, the result of the assessment will be used by the SC in the calculation of a catch limit using the adopted HCR. The Secretariat will then notify CPCs of the new catch limit for skipjack tuna that will apply for 2018"* (IOTC-2017-S21-R, Para. 56).

42. The WPM further **NOTED** that the process of TAC setting in Res 16/02 is not entirely clear when read in the absence of the supporting documentation and discussed clarifying some terms used in Res 16/02 as follows:

Expected stock status statistics from the 2017 SKJ assessment:

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}.

43. The WPM **NOTED** that B_{targ} is set at 40% of B_0 ($0.4B_0$) and similarly E_{targ} is set as the annual exploitation rate expected to result in an equilibrium at $0.4B_0$, *i.e.* $1- \exp(-F_{0.4B0})$ in Res 16/02. Further, Res 16/02 established a fishing intensity parameter (I) as a function of the ratio of B_{curr}/B_0 (*Appendix 1* of Res 16/02).

44. The WPM **NOTED** some ambiguity in the interpretation of the approach for deriving median values for the stock status statistics used to calculate the TAC. To provide some clarity, the WPM **RECOMMENDED** that the SC apply the median value of the distribution of B_{curr}/B_0 outcomes from the stock assessment with associated

characterised uncertainty for specifying the I value for use in TAC setting. Likewise, median values of estimates of B_{curr} and E_{targ} with associated characterised uncertainty should also be used in calculations of TAC (i.e. I x E_{targ} x B_{curr}).

45. Further, **NOTING** that the simulations used in testing robustness of the agreed HCR in Res 16/02 projected forward applying a first year catch level of 425,000 t (as documented in https://github.com/iotcwpm/SKJ/blob/master/procedures.hpp#L303), representing the recent reported catch, C_{recent} used in the simulations used for testing the HCR), and considering para 9.d in Res 16/02, the WPM **RECOMMENDED** that the SC consider that, in the event B_{curr} /B_0 >0.4 (i.e. >B_{thresh}), the TAC for 2018-2020 should not exceed 1.3x C_{recent} or, in the event that 0.1<B_{curr} / B_0<0.4, the TAC for 2018-2020 should not be less than 0.7C_{recent}. The WPM also noted that using C_{recent} values different to those used in the simulation trials could result in unexpected performance of the HCR.

6. BIGEYE TUNA AND YELLOWFIN TUNA MSE: UPDATE

6.1 Bigeye and yellowfin tuna MSE

46. The WPM **NOTED** paper IOTC–2017–WPM08–17 which provided an update on the bigeye tuna and yellowfin tuna management strategy evaluation development framework. The following abstract was provided by the authors:

"Since completion of the phase 1 BET/YFT MSE project un 2016), various IOTC technical groups provided requests for the next iteration of the process, including i) refined definitions for yellowfin and bigeye tuna reference set and robustness set Operating Models (OMs), ii) new candidate MP definitions, and iii) MP tuning objectives. Phase 2 commenced Sep 2017, initially focusing on the yellowfin tuna OMs. The revised reference set of OMs (referred to in aggregate as OM-ref) is composed of an ensemble of 216 stock assessment models, conditioned in relation to the 2016 stock assessment, and representing uncertainty in 6 dimensions in an equally-weighted design:

- *3 X Beverton-Holt stock recruit relationship steepness*
- *3 X Natural mortality vectors*
- *3 X tag likelihood weighting*
- *2 X tag mixing period*
- *2 X CPUE standardization method*
- *2 X CPUE catchability trend*

The revised OM-ref is more optimistic than the phase 1 demonstration case, in part reflecting the improved perception of stock status in the 2016 assessment. However, the central tendency of OM-ref tends to be considerably more optimistic than the 2016 assessment. The difference in the quality of fit to CPUE and size composition data does not vary much among the OM-ref models. The tag fits are sensitive to the tag weighting option (tag λ = 1.0, 0.1, 0.0) and the tags are very influential in constraining model dynamics. Models with down-weighted tagging data are generally more optimistic in terms of stock status and productivity, with MSY often estimated to be implausibly high (greater than double the base case assessment MSY, and peak historical catches, in ~10% of specifications). The higher productivity scenarios are questionable in that they tend to explain much of the declining CPUE trend as a result of a downward trend in recruitment deviations (systematic failure to fit the stock recruit relationship). However, there are also recognized problems with the tags in the current model structure (notably low tag mixing rates), such that full weighting of the tags is questionable. Recognizing the complicated interactions in the model, additional model options were explored (not in the working paper) to see if they could achieve plausible MSY without the tags. Higher weighting of the CPUE series (CV = 0.10) substantially reduces MSY, as does estimation of the steepness parameter (which reduces the MSY and stock-recruit lack of fit with implausibly low steepness in the scenarios tested). Introducing temporal variability in longline selectivity resulted in a modest reduction in MSY. Environmentally-linked migration had no effect on MSY. Further consideration of OM-ref plausibility is required.

The following OM robustness scenarios were explored:

- *Two attempts were made to formulate OM robustness scenarios that admit a potential tendency for longline fisheries to shift toward targeting younger individuals over time: i) estimating selectivity in 10 year blocks, and ii) estimating changes in selectivity as a logistic function of time). While there was evidence for selectivity changes, neither option resulted in a management situation that was substantially different from the OM-ref stationary selectivity assumption, and hence may not meet the expectations for robustness trials.*

- *Up-weighting the tagging data (tag $\lambda = 1.5$), results in similar, but slightly more pessimistic OM than the 2016 assessment tag weighting assumption ($\lambda = 1.0$). It is not clear that the $\lambda = 1.5$ robustness scenario adds a fundamentally different challenge for the MP than the $\lambda = 1.0$ option. However, it does emphasize the importance of the tag-weighting assumptions and the need to ensure that MP performance against pessimistic scenarios is explicitly considered (whether in reference or robustness scenarios).*

The TCMP identified two initial MP tuning criteria for YFT:

- *Pr(mean(B(2019:2039))/BMSY >= 1.0) = 0.5*
- *Pr(mean(B(2024))/BMSY >= 1.0) = 0.5*

Initial testing of candidate MPs suggest that the generally high productivity of OM-ref might result in counter-intuitive performance at these tuning levels. However, MP results should not be taken seriously until confidence in the reference OM is increased. These results are presented for feedback and/or endorsement by the WPTT and WPM, noting that the Commission MSE workplan expects MSE results to be presented to the TCMP for consideration in 2018".

47. The WPM **NOTED** that the second phase of the project began in September 2017 and the software is openly available for downloading, installing and running (https://github.com/pjumppanen/MSE-IO-BET-YFT).

48. The WPM **NOTED** the delays in funding and **THANKED** the authors for conducting some parts of the work while out of contract.

49. Due to the project funding delays, the WPM **NOTED** that there will be no opportunity for scientific review of the BET MSE work before the SC20 takes place in November 2017 so the informal technical MSE workshop represents the only review opportunity before the TCMP02 in 2018. Therefore the WPM **RECOMMENDED** the SC schedule the next informal technical MSE workshop to take place between March-April 2018 to facilitate review ahead of the TCMP02.

50. The WPM further **NOTED** that both the YFT and BET MSE can also be reviewed by the WPTT and WPM in 2018, before the Commission is likely to make any MP selection (2019 at the earliest), however, the phase 2 contract concludes in December 2018.

51. The WPM **AGREED** on the general specification of the reference case OM, but **RECOGNISED** the need for further work to identify and eliminate implausible models (notably the very high MSY scenarios). The "habitat approach" (Arrizabalaga et al) was proposed as one option.

52. The WPM **NOTED** there were similar issues with some extremely high MSY values estimated in the skipjack assessment. This was also influenced by the tagging data and was overcome by excluding some of the data from the small-scale tagging programmes. The yellowfin tuna assessment only included the RTTP tagging data, however, if enough data exist for the species from the small-scale tagging programmes then this might also be investigated.

53. The WPM **DISCUSSED** the use of alternative catch history scenarios for a robustness OM, however, no specific proposals were made.

7. SWORDFISH MSE: UPDATE

7.1 Stock Assessment

54. The WPM **NOTED** a presentation covering the structure, assumptions and results of the Indian Ocean swordfish stock assessment, carried out by WPB in 2017 (IOTC-2017-WPB15-R). Problematic issues in the SS3 stock assessment identified by the WPB, and of relevance to the work on building an operating model for this stock, were highlighted. The WPM **DISCUSSED** which of those issues should be included in the model grid defined for the swordfish operating model.

55. The WPM **NOTED** the large number of independent CPUE indices, and **AGREED** that it would be useful to bring the datasets together and undertake a joint analysis as a joint CPUE series based on operational data should increase spatio-temporal coverage, as well as better handle changes in targeting. The WPM therefore **RECOMMENDED** that future stock assessments of swordfish are based on a joint standardised CPUE series.

56. The WPM **RECOMMENDED** that stock assessment results should include both MSY and depletion-based indicators. The WPM **NOTED** that the current stock assessment of swordfish shows a stock in the green area of the Kobe plot, given the current value of B/B_{MSY} ratio, while the stock is estimated to be at around 30% of virgin biomass. This latter value would be generally considered to indicate a stock is likely to be overexploited.

7.2 Swordfish MSE

57. The WPM **DISCUSSED** the current status of development of MSE simulations for Indian Ocean swordfish.

58. The WPM **NOTED** that no work has been carried out so far on the development on an MSE for swordfish, given that no specific funding has yet been made available. Nevertheless, some WPM scientists have agreed to start work on a first version of the swordfish OM over the next few weeks, and will update the SC on progress achieved in the short interim period. The WPM **THANKED** the scientists involved.

59. Following the discussion on the swordfish stock assessment, the WPM **AGREED** that the following table is used by the scientists involved in the development of the operating model as a first possible grid of variables and alternative values to be considered.

Table 1: Proposed structure of the uncertainty grid for generating an Operating Model for Indian Ocean swordfish based on a set of SS3 model runs.

Variable	**Values**			**No.**
Selectivity	Double Normal	Logistic		2
Steepness	0.6	0.75	0.9	3
Growth + maturity	Slow growth, late maturity	Fast growth, early maturity		2
M	Low	High		2
ESS	2	20		2
CPUE scaling schemes	area effect * surface	Catch	Biomass	3
CPUEs	JAP late + PT	JAP late	TWN + PT	3
Catchability increase	0%	1% / year		2
SigmaR	0.2	0.4/0.6		2
			Total	1,728

60. The WPM **NOTED** that it is often useful to have different variance specifications in the conditioning and projections associated with an individual model specification. This intentional inconsistency can be uncomfortable from a theoretical statistics perspective, but it is useful from a pragmatic perspective, because the conditioning and projections serve different purposes. For model fitting, it may be desirable to provide a low CV on CPUE indices to ensure that the model is consistent with the most informative data in the assessment (this might be considered a shortcut for down-weighting other variance assumptions). However, the projections are used to evaluate MP performance, and one would not want to provide unrealistically informative relative abundance indices (i.e. assuming a commercial CPUE CV of <0.2 would seem unreasonably optimistic). Similarly, constraining recruitment deviations (for some or all of the time series) may be useful in model fitting to get convergence to sensible results when size/age composition data are incomplete/uninformative. However, retaining the low recruitment CV in projections would reduce the challenge that the real MP will have to confront.

61. [new para] The group **AGREED** that the swordfish projections should never have a CV (CPUE) < 0.2, or CV (recruitment) < 0.4.

62. The WPM **SUGGESTED** that approaches based on sampling theory, such as partially confounded designs, should be applied here to increase efficiency by decrease the computational requirements while allowing for further exploration of different model options.

8. PRESENTATION AND EVALUATION OF MSE RESULTS

8.1 Visualisation of MSE results

63. The WPM **NOTED** the suggested improvements to the standard methods of presenting MSE results requested by the TCMP01. The following modifications were proposed, which are illustrated in the revised standardised presentation of MSE results in Appendix IV.

- The number of years in which the stock falls into the red zone ($B<B_{MSY}$ and $F>F_{MSY}$) of the Kobe plot is presented in a new figure, which shows the proportion of runs in each quadrant of the Kobe plot (red, green, yellow and orange) in each projection year.

- Three individual realisations were already included in the time series plots. The WPM **AGREED** that additional individual realisations would not provide much additional information, and would over-complicate the existing figures. Therefore, no changes were made to these figures.

- Uncertainty ranges (25^{th}-75^{th} percentiles) for SB/SB_{MSY} and catch have been added to Table 1 (of Appendix IV). The WPM **AGREED** that uncertainty ranges for the other performance measures would not be informative.

- The WPM **AGREED** that the inclusion of trigger reference points for each MP in the Kobe plot is only applicable to a certain class of HCR, and cannot be consistently applied. Therefore, trigger reference points have not been included on the Kobe plots.

- An additional time series plot has been included that illustrates the historic and projected catches for each of the MPs. Similar to the time series plots for B and F, the median catch for each MP and the 25^{th}-75^{th} and 10^{th}-90^{th} percentiles are illustrated, along with three individual realizations.

- The summary of all performance indicators for all MPs across four different time periods in Table 2 has been separated into 4 sub-tables.

64. The WPM **NOTED** that an upcoming workshop on MSE communication and presentation, involving scientists and managers from various tuna RFMOs, will take place next year. A document will be presented on the history and experience of the Management Procedure Dialogues and TCMP sessions that have taken place so far at IOTC.

65. The WPM **RECOMMENDED** the proposed revisions to the standardised methods for the presentation of MSE results (Appendix IV) are submitted to the SC20 for discussion, revision and endorsement, as appropriate. This should still be considered a living document that will benefit from revision based upon ongoing feedback received from the SC and the TCMP.

8.2 Performance indicators

66. The WPM **AGREED** that no changes to the existing performance indicators are needed.

9 CPUE STANDARDISATION

9.1 Update on the status of the joint CPUE indices (yellowfin tuna, bigeye tuna & albacore)

67. The WPM **NOTED** the report of the 2017 joint CPUE workshop which was held in Busan, Republic of Korea, from 3-7 July 2017 (IOTC–2017–WPM08–INF04) presented by the Chairperson of the WPM08.

68. The WPM **NOTED** that the workshop developed joint standardised CPUE indices for bigeye and yellowfin tuna through the application of cluster analyses to derive targeting strategies for each fleet. The WPM further **NOTED**

that there have been no fundamental changes to the general methodology used this year but that the focus has been on the capacity building aspects of the work in terms of the training provided to national scientists in data preparation and the development of standardised indices for individual fleets.

69. The WPM **NOTED** paper IOTC–2017–WPM08–18 which described the collaborative study of tropical tuna CPUE from multiple Indian Ocean longline fleets in 2016 including the following summary provided by the authors:

"*We describe a collaborative study between national scientists with expertise in Japanese, Korean, Seychelles, and Taiwanese longline fleets, an independent scientist, and an IOTC scientist. Terms of Reference covered issues related to bigeye and yellowfin tuna CPUE indices in the Indian Ocean. A series of workshops in June and July 2017 developed joint indices of abundance for bigeye and yellowfin tunas, provided support and training to national scientists in their analyses of catch and effort data, and further developed CPUE analysis methods. National indices and results of data preparation and cluster analysis are provided in related papers, while this paper IOTC-2017-WPM08-18 reports detailed methods and joint indices. New developments covered in this paper include addition of data from the Seychelles, splitting the western tropical areas into northern and southern sub-regions for both species, and testing the inclusion of time-area interactions in the model. Figures and tables are provided for each set of indices, including both quarterly and annual indices. Diagnostic plots are also presented*".

70. The WPM **THANKED** the authors for the comprehensive analysis undertaken.

71. The WPM **NOTED** that standardised CPUE indices were developed for the combined dataset as well as separately for each individual fleet.

72. The WPM **NOTED** that effort-based area weighting was applied to the standardisation, which could reduce potential bias in the presence of shifting fishing effort over time.

73. The WPM **NOTED** that vessel ID is not available for the Japanese longline dataset before 1979. The WPM **AGREED** that the recommended time period for splitting the CPUE series for use in the stock assessment are: 1952-79 without vessel ID and 1979-Present with vessel ID.

74. The WPM **NOTED** the spike in standardized indices in 2012 corresponding to the period when fleets returned to the fishing ground in the western Indian Ocean with the reduced threat of piracy. The WPM **NOTED** the prominence of this spike for bigeye and **ENCOURAGED** investigation into the cause of this using other available data sources (e.g. size data).

75. The WPM **WELCOMED** the review of the Seychelles longline data that have been used for the first time in the joint analysis. The WPM also **NOTED** that hooks between floats (hbf) are not available in the Seychelles longline dataset for years prior to 2015, limiting its potential use in the joint standardisation.

76. The WPM **NOTED** that changes in line material were not considered in the standardisations as studies from the Pacific have indicated that the recording of the line type (mainline as well as branchlines) is not particularly reliable and information on line material is also not available for other fleets involved in the joint analysis.

77. Nevertheless, the WPM **NOTED** that the changes in line material used by the Japanese fleet mean that hbf is not a consistent covariate throughout the model so **AGREED** that a further improvement would be to develop categories of deep, mid- or shallow sets rather than using raw hbf data. However, this would not be a trivial task given the differential effect of hook depth on species caught at different latitudes due to variation in environmental factors (e.g. current shear). While environmental factors (e.g. current shear) have been shown to influence longline catch rates, the trend in environment factors can be confounded with abundance indices, and the inclusion of the 5x5 grid square in the standardisation can explain most of variability associated with environmental factors.

78. The WPM **NOTED** that Vessel ID could also be included as a random effect, however, this assumes that the vessel effects are normally distributed and sampled from a large population of vessels, whereas the majority of vessels fishing are actually already included in the model. Nevertheless, the WPM **AGREED** that it may be useful to explore a hierarchical model structure by nesting vessel.clusters within clusters (assuming these have more similar fishing strategies) in the next iteration of this study.

79. WPM **RECOGNISED** the importance of normalizing these procedures and approaches into the various Working Party stock assessments making use of longline catch rate indices and **RECOMMENDED** that the SC endorse such joint analyses and **REQUESTED** these continue into the future as a normal course of business. It was **NOTED** that additional time for more detailed analysis is still needed and WPM **SUGGESTED** that methods to increase analysis time, such as the use of secure, cloud-based data exchange and increased use of electronic communication between analysts be investigated.

80. **NOTING** the ongoing confidentiality issues with some of the datasets, the WPM **REQUESTED** that the authors and the Secretariat explore possibilities for independent data holders to facilitate the process. However, the WPM further **NOTED** that while there is a need for an agreement and an agreed process to provide access to confidential data, once in place, this may not necessitate face-to-face meetings and could instead become a remote process.

81. The WPM **NOTED** paper IOTC–2017–WPM08–19 which described the possible causes of discontinuities in the Japanese longline CPUE series including the following summary provided by the authors:

"The Indian Ocean Tuna Commission's 7th Working Party on Methods (IOTC-2016-WPM07-R) noted concern about a step change in the Japanese CPUE in the late 1970s, which affects the joint indices and therefore the assessments. The WPM recommended work to improve the understanding of the fishery, including the factors that created the discontinuity in the bigeye (and to a lesser extent yellowfin) CPUE 1976-80, and the associated size data. We explored the characteristics of the 1977 discontinuity, and found that it occurred in all datasets examined, which included Japanese data for all oceans, and Taiwanese and Korean data for the Indian Ocean. It occurred for both bigeye and yellowfin to differing degrees, and in multiple regions in each ocean. We also analysed Japanese size data, and found no contemporary changes in that dataset. We discuss some possible explanations, and suggest that changes to the population or catchability (oceanography, introduction of deep setting) are unlikely. Explanations associated with catch reporting appear more plausible, partly due to elimination of alternatives, but we have not identified any evidence of such effects. We suggest some options for further exploring the issue."

82. The WPM **NOTED** that the commercial size data are not available for the Indian Ocean during the period of the discontinuity, and that the research and training vessel size data are relatively sparse and may not adequately reflect changes in commercial fishing strategies. The WPM **NOTED** that it would be useful to explore size data from other oceans which may have more size data, including commercial size data, for this period.

83. The WPM **NOTED** the importance of this issue for CPUE indices, and the need for further work to identify causes and their implications for standardisation methods.

84. The WPM **NOTED** paper IOTC–2017–WPM08–20 which described selectivity changes and spatial size patterns of bigeye and yellowfin tuna in the early years of the Japanese longline fishery including the following summary provided by the authors:

"*Stock assessment requires an understanding of the fisheries that provide the data, and the biology and ecology of the species assessed. We standardized the size data to reveal spatial and temporal patterns. There were significant changes in mean sizes through time, with a substantial decline during the 1950s, consistent with the juvenilisation hypothesis. The decline was too rapid to represent change in the population size structure due to fishing, which is reflected in the inability of the yellowfin stock assessment to fit the early size data. Spatial size variation is common in tunas but has not previously been reported for Indian Ocean bigeye and yellowfin tuna. We found significant spatial variation in both yellowfin and bigeye tunas, across datasets collected in different ways. The Japanese spatial patterns contrast with the Taiwanese length frequency data, which show relatively little spatial size variation. It would be useful to review the spatial location information associated with the Taiwanese size data. We recommend further analyses that include bigeye size data starting in 1952. It would also be useful to compare early size changes across oceans and fleets, and for other species such as billfish; and to investigate size changes after the resumption of fishing in the piracy area near Somalia.*

85. The WPM **NOTED** the suggestion to examine the size data collected from the western Indian Ocean before and after the piracy period to test the juvenilisation hypothesis.

86. The WPM **THANKED** the authors for the investigation selectivity changes and spatial size patterns of bigeye and yellowfin tuna in the early years of the Japanese longline fishery and **AGREED** that this work is important in terms of improving understanding of the trends in CPUE. **NOTING** that various issues have been identified that could be explored further, the WPM **RECOMMENDED** that this work is continued.

87. The WPM **NOTED** paper IOTC–2017–WPM08–21 exploring Japanese size data and historical changes in data management including the following summary provided by the authors:

"*The 2016 IOTC Working Party on Methods recommended work to improve understanding of the size data used in tuna assessments. The Japanese longline fishery provides the longest and most valuable size dataset for the bigeye and yellowfin tuna assessments. We explored this dataset in order to describe and characterise the types and sources of size data, so that analysts can understand the patterns in the data; and to check the validity of assumptions used in preparing the data for assessments. We provide figures showing the types of data available (spatial resolution, commercial vs research & training, measurement unit, and sampling type), for each species and by time period and location. We also describe a previously unsuspected change in 1970*

from rounding up to rounding down. The current practice is to round up, so there must have been a further change after 1988. Further investigation is recommended to determine when the later change occurred. We recommend exploring the implications of these changes for other size datasets used by IOTC and other RFMOs. We further recommend exploring how size data biases noted by Satoh et al (2016) in the Eastern Pacific may affect Indian Ocean data."

88. The WPM **NOTED** the change in rounding practices of collected size data over time: before 1970 bins occurred at even number (spikes at 6 and 0); after 1970 bins occurred at odd number (spikes at 5 and 9). The WPM **SUGGESTED** simulation testing may be used to evaluate the potential effect of the changes in rounding practice on the stock assessment results.

89. The WPM **REQUESTED** that the Secretariat adjusts Japanese size data to a consistent rounding direction, assuming that all the size data are similarly affected unless there is reason to believe there are exceptions.

90. The WPM **NOTED** paper IOTC–2017–WPM08–22 describing regional scaling factors for Indian Ocean stock assessments including the following summary provided by the authors:

"In stock assessments with multiple regions it is important to determine the relative abundances among the regions. Relative abundances can be estimated using CPUE data, using the relative catch rates among regions as a proxy for density, and also allowing for the size of each region. The method has been used for Indian Ocean yellowfin assessments since 2005, and is similar to the method used in WCPO bigeye and yellowfin assessments. This paper describe several modifications to the approach and compares the results. First, I use standardized catch rates rather than mean values. Second, I use the period 1980-2000 rather than 1963-1975 as the base period. Finally, in all analyses I use Japanese and Korean aggregated data, rather than Japanese data only. Both changing the time period and using standardized CPUE had moderate impacts on the regional scaling parameters. Further development using operational data is recommended, so as to allow for the effects of targeting on catch rates. We also suggest exploring other datasets to allow for far northern areas not sampled by Japanese and Korean effort."

91. The WPM **NOTED** that there are some areas for which data are missing and so in these cases it was assumed that catch rates were very low as no fishing was taking place there, however, it was also **NOTED** that for a species such as swordfish, which is subject to mixed targeting with other species, then a different assumption would have to be made.

9.2 Priorities for future development of the joint CPUE indices

92. The WPM **NOTED** that a substantial amount of work has already been completed for the tropical tunas and that it may be more worthwhile to focus on some other species for which this approach would be useful. The WPM therefore **RECOMMENDED** that a similar joint analysis approach is explored for key IOTC billfish and shark species.

10 OTHER MATTERS

10.1 Other matters

93. The WPM **NOTED** paper IOTC–2017–WPM08–INF03 providing updates on the improved data sharing processes that are currently being developed by the IOTC Secretariat including the following summary provided by the authors:

"Access to all public data managed by the IOTC Secretariat has historically been mediated by the Secretariat staff, that routinely prepares standard datasets and disseminates these through the IOTC website. While this approach has been widely accepted by the scientific community, recent changes in the internal data management processes in place at the IOTC Secretariat have also paved the ground to an improvement in the data sharing processes, that could now be made available to scientists in an asynchronous and fully customizable way by means of remote services using standard data format and fully accessible over the Internet."

94. The WPM **THANKED** the Secretariat for the work undertaken to improve the access and flexibility of access to the IOTC datasets, further **NOTING** that it should be completed by the end of 2018.

95. The WPM **NOTED** that the IOTC Secretariat currently holds a number of records that are marked as "confidential" by the original data providers (CPCs) and **ACKNOWLEDGED** that for external users to get access to this information through the described remote services, explicit permission from the data providers is still needed. The

WPM further **NOTED** that individual users will be provided with a set of credentials which will be required to be access the data and son specific confidentiality rules can be established on a user-by-user basis.

96. The WPM **ACKNOWLEDGED** that this approach could also be extended to other types of information sets (e.g. stock assessment inputs and outputs) for their easier dissemination to interested scientists, as well as to other RFMOs and national fisheries management organizations as a whole.

Distribution of Kawakawa in the Andaman Sea Coast of Thailand

97. The WPM **NOTED** paper IOTC–2017–WPM08–08 which described the fishing grounds and distribution of abundance of kawakawa, including the following summary:

"The fishing ground of purse sein which operated in the Andaman Sea Coast of Thailand was distributed typically in the area, and all of them was set the net outside the artisanal coastal area. The most of the fishing ground has a depth in the range of 40-80 meter, and it usually closed to their home or fishing port. Moreover, there was specifics area for FADs purse seine where in the west of Ranong, Phang-nga and Satun province. Kawakawa has an overall CPUE 111.06 kg/day. There were not different on abundance in each area although the highest CPUE occurred in area 3 as 120.05 kg/day which followed by an area of 2, 4 and 1 as 112.97, 111.84 and 94.76 kg/day respectively. However, it was cleared that CPUE during the North-East monsoon)October – May(was higher than the South-West monsoon".

98. The WPM **NOTED** that this paper is more relevant to the WPNT and **ENCOURAGED** the authors to submit any future updates to WPNT.

99. The WPM **NOTED t**hat this paper described fishing on anchored FADs by the Thai purse seine fishery.

Bigeye tuna in Benoa Port, Indonesia

100. The WPM **NOTED** paper IOTC–2017–WPM08–09 which described bigeye tuna in Benoa Port, Bali, Indonesia. The following summary was provided by the authors:

"Bigeye tuna (Thunnus obesus) is one of the most important commercial species in Indian Ocean including Indonesia. The catch of bigeye tuna has been monitored since 2002 from Benoa Port, Bali, Indonesia. The objectives of this study is to investigate the method that is used to estimate the production of bigeye tuna from Benoa Port using enumeration data. The data were obtained from enumeration activity from January 2012 to December 2016. The estimation of the total production was calculated from sampled data multiplied by the proportion of total vessels and sampled vessels."

101. The WPM **NOTED** these are from fresh and frozen tuna longliners and so fish are identified to species level.

Iranian gillnetting

102. The WPM **NOTED** paper IOTC–2017–WPM08–10 which described gillnetting by the Iranian fleet, including the following summary:

"This working paper describes the landings in Iran from 2010 to 2106 and the changing nature of the fishing fleet. In 2016 251,000 t of large pelagics were landed in Iran. Almost 94% of this catch was harvested by gillnet (reduced from 97% in 2010). The number of gillnet Dhows (more than 3 Mt) has reduced from 2476 in 2010 to 1103 (51% reduction) in 2016. The change resulted from some replacement of gillnet effort with longline and trolling vessels. This report also pointed out some of the problems in the fishing community and management practices by IFO".

103. The WPM **NOTED** the size data reported from the Iranian gillnet fisheries that was excluded from the 2017 skipjack assessment because they were rounded to 3cm size bins which does not conform to IOTC data reporting standards. As these data represented some very large sized fish they may be influential for the assessment.

104. The WPM **NOTED** the planned support mission planned by the Secretariat to Iran with the aim of assisting the IFO with improving data reporting to IOTC where possible, including size data submissions.

105. The WPM further **NOTED** the possibility of fitting kernel density distributions to the size data to enable the re-binning into smaller size classes to facilitate use in assessments.

JABBA: Just Another Bayesian Biomass Assessment

106. The WPM **NOTED** paper IOTC–2017–WPM08–11 which described an assessment model, JABBA, including the following summary provided by the authors:

"This working paper presents applications of the generalized Bayesian State-Space Surplus Production Model framework JABBA (Just Another Bayesian Biomass Assessment) using the recent 2017 IOTC assessments for Indian Ocean blue shark and swordfish as working examples. The assessment input data comprised multiple, partially conflicting, fisheries-depend abundance indices over varying time spans, as commonly encountered in assessments of large pelagic fish. We therefore focus on inbuilt JABBA features for evaluating, identifying and potentially improving poor model fits, which may arise from fitting of multiple standardized CPUE time series with conflicting trends to the available catch time series."

107. The WPM **THANKED** the developer for the comprehensive assessment tool presented, **NOTING** the utility of being able to adapt the model and run multiple simulations within a relatively short period of time and the advantages for collaborative assessments performed during tRFMO working groups.

108. The WPM **WELCOMED** the advances made in the modelling structure embodied in JABBA and **ENCOURAGED** Working Parties to also utilise this model framework in conducting stock assessments.

Online tool for stock assessment models

109. The WPM **NOTED** paper IOTC–2017–WPM08–12 Rev_1 which described an online tool to easily run stock assessment models, using SS3 and YFT as an example. The following summary was provided by the authors:

"Stock assessment software are complex and advanced technical skills are required to develop the models. Producing output becomes time-intensive and even more complex as thousands of simulations must be run on super-computers in order to include the multiple sources of uncertainty in assessment results. As few stock assessment participants have the specific technical skills required to reproduce these outputs, our aim has been to develop a Virtual Research Environment (VRE) that enables any user to easily parameterize, execute and edit online various steps of the stock assessment work flow using SS3 (a widely-used statistical catch-at-age model), with standardized data outputs. Here, we illustrate the stock assessment work flow through the VRE, using the last stock assessment of yellowfin, provided by the IOTC, as an example."

110. The WPM **WELCOMED** the online approach for running stock assessment models presented by the authors and, NOTING that these projects often have short time frames, **ENCOURAGED** the team to make plans for how this will be maintained and updated after 2018 when the funding for personnel ends with the BlueBridge project, and after 2020 when the availability of the infrastructure will depend on alternative funding.

Revision of species supporting information for IOTC Executive Summaries

111. The WPM **NOTED** paper IOTC–2017–WPM08–16 Rev_1 which proposed some amendments to the current supporting information for the IOTC species Executive Summaries for tropical tunas.

112. The WPM **NOTED** that the inclusion of stochastic projections in support of the Kobe II strategy matrix would make the IOTC species Executive Summaries more consistent with other tRFMOs. The WPM further **AGREED** that trajectories of SSB and F should be included in the supporting information for the Executive Summaries, with uncertainty bounds. The WPM **REQUESTED** the authors include these proposals in the revised document to be presented to WPTT.

10.2 Future considerations for WPM: methods to investigate management advice across multiple model structures for assessing stock status

113. The WPM **NOTED** the request from the WPTT in 2016:

"The WPTT NOTED that there were results from several assessment models presented, and it was not clear whether or how to synthesize all of the results. Some of the analyses were much more detailed than others and used more of the available data. Additionally, some of the models were very similar and did not seem to provide new insight. The WPTT REQUESTED the WPM to provide guidance on the most appropriate models to use in the future, and how to provide advice when multiple models are presented" [IOTC-2016-WPTT18-R, para. 91]

114. The WPM **NOTED** that this was added to the WPM programme of work, however, due to lack of funding and no intersessional work no progress has yet been made.

115. The WPM **NOTED** that paper IOTC–2017–WPM08–15 provided an overview of one potential method that may be used to assess the appropriateness of different models, however, the WPM **ACKONWLEDGED** that work will need to be carried out inter-sessionally to explore the issues properly, and this will require some level of preparation and planning. The WPM therefore **AGREED** to increase the priority of this project in the Programme of Work from 7 to 6.

11 WPM PROGRAM OF WORK

11.1 Revision of the WPM Program of work (2018–2022)

116. The WPM **NOTED** paper IOTC–2017–WPM08–07 presenting the draft WPM Programme of Work (2018–2022).

117. 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)

118. 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 (2018–2022) that are yet to be funded, for circulation to potential funding bodies.

119. The WPM **RECOMMENDED** that the Scientific Committee consider and endorse the WPM Programme of Work (2018–2022), as provided in Appendix V.

12 OTHER BUSINESS

12.1 Presentation of stock status advice for data limited stocks

120. The WPM **NOTED** the request from the SC to investigate alternative stock assessment methods to be used in data-limited situations and for an evaluation of alternative methods of presenting advice from data-limited assessments to managers:

> *"The SC **NOTED** the importance of exploring alternative data poor stock assessment methods and **RECOMMENDED** that the Commission allocates funding for work to explore methods based on different data sources, such as catch curve estimation of mortality from length-frequency data. A range of data sources should be explored, including data from observer programmes, the sport fisheries project, and non-state actor (e.g. WWF) projects for suitability". (SC19, Para. 32)*

> *"The SC **RECALLED** the recommendation of the WPNT05 for the SC to request the Working Party on Methods evaluate a proposed alternative methodology for presenting management advice for data poor methods in 2016. The SC **REQUESTED** that the WPM evaluate the possibility of using different colours to distinguish between stocks which have not been assessed (e.g., white) and stocks which have been assessed but the status is considered to be uncertain (e.g., grey)". (SC19, Para. 33)*

121. The WPM **AGREED** that work on the presentation of stock status advice for data limited stocks will need to be carried out inter-sessionally, and that this will require some level of preparation and planning. The WPM **REQUESTED** the Chairperson liaise with the Chairs of the species WPs (WPNT and WPB) in order to draft a study proposal on this issue and **RECOMMENDED** the SC allocate funding to this project.

12.2 Joint tRFMO Management Strategy Evaluation working group

122. The WPM **NOTED** that while no joint tRFMO MSE meeting took place in 2017 the joint tRFMO MSE initiative is continuing with a new Chairperson due to be elected shortly. The WPM further **REQUESTED** the WPM Chairperson to provide an update on any progress made by the joint technical working group at the next meeting of the WPM in 2018.

12.3 Date and place of the 9th and 10th sessions of the WPM

123. The WPM **REQUESTED** that the IOTC Secretariat liaise with CPCs intersessionally to determine if they would be willing to host the 9th and 10th sessions of the WPM in conjunction with the WPTT (Table 2.).

Table 2. Draft meeting schedule for the WPM (2018 and 2019)

	2018			2019		
Meeting	**No.**	**Date**	**Location**	**No.**	**Date**	**Location**
Working Party on **Methods** (WPM)	9th	Third week in October (3 d) (with WPTT)	TBD	10th	Third week in October (3 d) (with WPTT)	TBD

124. The WPM also **NOTED** the informal MSE technical working group meeting to be held in March/April 2018 (para.49).

12.4 Election of a Chairperson and Vice-Chairperson for the next biennium

125. The WPM **THANKED** Dr Toshihide Kitakado and Dr Iago Mosqueira for their excellent Chairmanship and vice-Chairmanship over the past two years.

126. The WPM **NOTED** that the first term of the current Chairperson, Dr Toshihide Kitakado 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.

127. NOTING the Rules of Procedure (2014), the WPM **CALLED** for nominations for the position of Chairperson of the IOTC WPM for the next biennium. Dr Toshihide Kitakado was nominated, seconded and re-elected/elected as Chairperson of the WPM for the next biennium.

128. The WPEB **NOTED** that the first term of the current Vice-Chairperson, Dr Iago Mosqueira is due to expire at the closing of the current WPM meeting and as per the IOTC Rules of Procedure (2014), participants are required to elected a new Vice-Chairperson/s for the next biennium.

129. **NOTING** the Rules of Procedure (2014), the WPM **CALLED** for nominations for the position/s of the Vice Chairperson of the IOTC WPM for the next biennium. Dr Iago Mosqueira was nominated, seconded and re-elected/elected as Vice-Chairperson of the WPM for the next biennium.

130. The WPM **RECOMMENDED** that the SC note the Chairperson, Dr Toshihide Kitakado and Vice-Chairperson, Dr Iago Mosqueira, of the WPM for the next biennium.

12.5 Development of priorities for Invited Expert(s) at the next WPM meeting

131. The WPM **THANKED** the invited expert, Dr Rishi Sharma, for his excellent contributions to the meeting.

132. Given the importance of external peer review, the WPM **RECOMMENDED** that the Commission continues to allocate sufficient budget for a regular invited expert to be invited to meetings of the WPM.

133. The WPM **AGREED** to the following core areas of expertise and priority areas for contribution that need to be enhanced for the next meeting of the WPM in 2018, by an Invited Expert(s):

- **Expertise**: Management Strategy Evaluation.
- **Priority areas for contribution**: Data limited stock assessments, evaluation of management procedures, communication of fisheries advice.

12.6 Review of the draft, and adoption of the Report of the 8th Session of the WPM

134. The WPM **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPM08, provided in Appendix VII.

135. 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.

136. The Chair **THANKED** the all the participants for their dedicated discussion during the session. He also expressed his sincere appreciation to the coordinating rapporteur, Martin, assisted by Fiorellato, Fu, Kolody, Merino, Mosqueira, Scott, Sharma, Sullivan and Williams, for their excellent work.

137. The report of the 8th Session of the Working Party on Methods (IOTC–2017–WPM08–R) was **ADOPTED** on 15 October 2017.

APPENDIX I
LIST OF PARTICIPANTS

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APPENDIX II
AGENDA FOR THE 8TH WORKING PARTY ON METHODS

Date: 13-15 October 2017
Location: Seychelles
Venue: Savoy Hotel, Beau Vallon
Time: 09:00 – 17:00 daily
Chairperson: Dr. Toshihide Kitakado; **Vice-Chairperson**: Dr. Iago Mosqueira

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 19th Session of the Scientific Committee (IOTC Secretariat)
   - 3.2 Outcomes of the 21st Session of the Commission (IOTC Secretariat)
   - 3.3 Review of Conservation and Management Measures relevant to the WPM (IOTC Secretariat)
   - 3.4 Progress on the recommendations of WPM07 (IOTC Secretariat and Chairperson)
   - 3.5 Review of intersessional meetings related to the IOTC MSE process (Chairperson)
4. **ALBACORE MSE: UPDATE** (Vice-Chairperson)
   - 4.1 Conditioning of operating models
   - 4.2 Simulation platform
   - 4.3 Tentative Harvest Control Rules
5. **SKIPJACK TUNA MSE: UPDATE** (Chairperson)
6. **BIGEYE TUNA AND YELLOWFIN TUNA MSE: UPDATE** (Chairperson and Consultant)
7. **SWORDFISH MSE: UPDATE** (Vice-Chairperson)
8. **PRESENTATION AND EVALUATION OF MSE RESULTS** (Chairperson and Vice-Chairperson)
   - 7.1 Visualisation of MSE results
   - 7.2 Performance indicators
9. **CPUE STANDARDISATION** (Chairperson and Consultant)
   - 9.1 Update on the status of the joint CPUE indices (yellowfin tuna, bigeye tuna & albacore).
   - 9.2 Priorities for future development of the joint CPUE indices.
10. **OTHER MATTERS (**Chairperson)
    - 10.1 Other matters
    - 10.2 Future considerations for WPM: methods to investigate management advice across multiple model structures for assessing stock status
11. **WPM PROGRAM OF WORK** (Chairperson and IOTC Secretariat)
    - 11.1 Revision of the WPM Program of Work (2018–2022)
12. **OTHER BUSINESS**
    - 12.1 Presentation of stock status advice for data limited stocks (Chairperson)
    - 12.2 Meeting of the Joint t-RFMO Management Strategy Evaluation working group (Chairperson)
    - 12.3 Date and place of the 9th and 10th Sessions of the WPM (Chairperson and IOTC Secretariat)
    - 12.4 Election of a Chairperson and Vice-Chairperson for the next biennium
    - 12.5 Development of priorities for Invited Expert(s) at the next WPM meeting (Chairperson)
    - 12.6 Review of the draft, and adoption of the Report of the 8th Session of the WPM (Chairperson)

APPENDIX III
LIST OF DOCUMENTS

Document	Title	Availability
IOTC–2017–WPM08–01a	Agenda of the 8th Working Party on Methods	✓ 10 August
IOTC–2017–WPM08–01b	Annotated agenda of the 8th Working Party on Methods	✓ 6 October
IOTC–2017–WPM08–02	List of documents of the 8th Working Party on Methods	✓ 26 September
IOTC–2017–WPM08–03	Outcomes of the 19th Session of the Scientific Committee (IOTC Secretariat)	✓ 27 September
IOTC–2017–WPM08–04	Outcomes of the 21st Session of the Commission (IOTC Secretariat)	✓ 27 September
IOTC–2017–WPM08–05	Review of Conservation and Management Measures relating to methods (IOTC Secretariat)	✓ 27 September
IOTC–2017–WPM08–06	Progress made on the recommendations and requests of WPM07 and SC19 (IOTC Secretariat)	✓ 27 September
IOTC–2017–WPM08–07	Revision of the WPM Program of Work (2018–2022) (IOTC Secretariat & Chairpersons)	✓ 27 September
IOTC–2017–WPM08–08	Fishing Ground and Abundance Distribution of Kawakawa (*Euthynnus affinis*) by Purse Seine Fisheries along the Andaman Sea Coast of Thailand, 2016 (S. Hoimuk)	✓ 13 October
IOTC–2017–WPM08–09	Catch Methods to Estimate The Production of Bigeye Tuna (Thunnus obesus) From Benoa Port, Bali, Indonesia (P.A.R.P.Tampubolon, I.Jatmiko1, B.Setyadji1, Z. Fahmi)	✓ 28 September
IOTC–2017–WPM08–10	Analysis of status of tuna gillnetting in Iran (G.Moradi)	✓ 11 October
IOTC–2017–WPM08–11 Rev_1	JABBA: Just Another Bayesian Biomass Assessment (H. Winker , F. Carvalho and M. Kapur)	✓ 9 October ✓ 13 October
IOTC–2017–WPM08–12 Rev_1	An online tool to easily run stock assessment models, using SS3 and YFT as an example (A.Nieblas, S.Bonhommeau, T.Imzilen, D.Fu, F.Fiorellato, J.Barde)	✓ 28 September ✓ 9 October
IOTC–2017–WPM08–13	Management Strategy Evaluation for the Indian Ocean Tuna Albacore Stock (I. Mosqueira)	✓ 4 October
IOTC–2017–WPM08–14	Methods employed to examine which interactions were important in the grid structure developed for ALB OM in the Indian Ocean & BFT in the Eastern Atlantic Ocean (R. Sharma, I. Mosqueira and L. Kell)	✓ 26 September
IOTC–2017–WPM08–15	Examining Jack-knifes for Diagnostics on Indian Ocean Albacore and East Atlantic Bluefin Assessments (R.Sharma, I.Mosqueira and L.Kell)	✓ 26 September
IOTC–2017–WPM08–16 Rev_2	Revision of Supporting information for IOTC species Executive Summaries (F. Marsac)	✓ 26 September ✓ 10 October
IOTC–2017–WPM08–17	Update on Yellowfin Tuna Management Procedure Evaluation Oct 2017 (D. Kolody and P. Jumppanen)	✓ 2 October
IOTC–2017–WPM08–18	Collaborative study of tropical tuna CPUE from multiple Indian Ocean longline fleets in 2017 (S.D. Hoyle, C. Assan, S. Chang, D. Fu, R. Govinden, D.N. Kim, T. Kitakado, S.I. Lee, J. Lucas, T. Matsumoto and Y.M. Yeh)	✓ 29 September
IOTC–2017–WPM08–19 Rev_1	Exploring possible causes of historical discontinuities in Japanese longline CPUE (S. Hoyle, K. Satoh and T. Matsumoto)	✓ 29 September ✓ 13 October
IOTC–2017–WPM08–20	Selectivity changes and spatial size patterns of bigeye and yellowfin tuna in the early years of the Japanese longline fishery (S. Hoyle, K. Satoh and T. Matsumoto)	✓ 29 September
IOTC–2017–WPM08–21	Exploration of Japanese size data and historical changes in data management (S. Hoyle, K. Satoh and T. Matsumoto)	✓ 29 September
IOTC–2017–WPM08–22	Regional scaling factors for Indian Ocean stock assessments (S. Hoyle)	✓ 2 October
Information Documents		
IOTC-2017-WPM08-INF01	Report of the 6th workshop on MSE of IOTC WPM Scientists	✓ 27 September
IOTC-2017-WPM08-INF02	Report of the IOTC TCMP	✓ 27 September

Document	Title	Availability
IOTC-2017-WPM08-INF03	Data as resources: how to enhance data sharing capabilities between the Secretariat and the scientific community (IOTC Secretariat)	✓ 27 September
IOTC-2017-WPM08-INF04	Report of the Fourth IOTC CPUE Workshop on Longline Fisheries	✓ 4 October
IOTC-2017-WPM08-INF05	ABNJ workshop summary report: Indian Ocean tuna harvest strategies capacity building	✓ 6 October

APPENDIX IV
PROPOSED REVISIONS TO THE STANDARDISED METHODS FOR THE PRESENTATION OF MSE RESULTS

Introduction

The Indian Ocean Tuna Commission (IOTC) management strategy evaluation (MSE) work program was initiated following adoption of the proposal to implement the precautionary approach for managing IOTC species in 2012 (Resolution 12/01). From this Resolution, the IOTC Scientific Committee (SC) was instructed to assess the performance of candidate management procedures (MP) through MSE, and provide the Commission with advice on their performance against Commission objectives. The IOTC Working Party on Methods (WPM) leads the technical development of MSEs for key IOTC species.

Effective and consistent communication of MSE results is important to ensure that decision makers are clearly informed about the likely consequences of implementing different MPs or harvest control rules (HCR). The use of standardised terminology and presentation formats for MSE results would facilitate a better understanding and maximise the engagement of all partners in the MP dialogue. This proposal outlines some guidelines for standardising the communication of MSE results to the Technical Committee on Management Procedures (TCMP) and Commission.

Proposal for presenting MSE results

It is important that decision makers are presented with a selection of candidate MPs (or HCRs) from which to evaluate the relative performance against the Commission objectives. However, consideration needs to be given to limit the number of MPs (or HCRs) and performance measures that are presented to avoid saturation and confusion. As a guide, a maximum of 6 candidate MPs (or HCRs) and 6 performance measures would seem to allow sufficient coverage of the range of potential MPs of interest whilst limiting the amount of information to communicate.

The key elements of the presentation material are as follows:

1. **Illustrate the MPs** that have been evaluated in a figure and/or briefly define them in text.
2. Present the results for the performance of each MP in:
    a. **Boxplots** for a representative subset of performance measures
    b. **A summary table** that ranks the performance of each MP against a subset of performance measures
    c. **Trade-off plots** for a representative subset of performance measures
    d. **A Kobe plot** for the B/B_{MSY} and F/F_{MSY} performance measures
    e. **A stacked bar plot** indicating the proportion of runs in each of the Kobe quadrants in each year
    f. **Time series plots** for stock size, ~~and~~ fishing intensity and catch performance measures.

~~4.~~3. Provide a clear and **succinct summary** of the performance of each MP.
~~5.~~4. Provide the numerical results for each MP across all 16 performance measures endorsed by the SC in a table in an appendix.

1. Illustrate the Management Procedures

It will be important that decision makers have a clear understanding of the MPs (or HCRs) that have been evaluated. To achieve this, a clear description of each MP (or HCR) should be presented prior to the MSE results, along with an explanation of the relevant decision steps involved. Example figures are illustrated in Figures 1 and 2.

2. Performance of Management Procedures

a. Boxplots

The key plots for communicating MSE results should clearly indicate the relative performance of each MP (or HCR) against a representative subset of performance measures from the categories of status, safety, yield, abundance and stability. These plots should clearly indicate the uncertainties in the MSE using error bars to represent percentiles. Example boxplots are illustrated in Figure 3. The summary period(s) which were used to generate the results should be clearly indicated.

b. Summary table

A summary table that ranks the performance of each MP against the key performance measures is shown in Table 1. The numbers in the table indicate the performance of each MP while the colours represent the relative ranking.

c. Trade-off plots

Trade-off plots provide useful information for evaluating the trade-off between different performance measures, particularly between yield (catch) and other performance measures. Example trade-off plots are illustrated in Figure 4. The summary period(s) which were used to generate the results should be clearly indicated.

d. Kobe plot

An example Kobe plot indicating the performance of MPs is illustrated in Figure 5. Consistent with the adopted guidelines for presenting stock assessment results, the Kobe plot indicates target and limit reference points. The summary period(s) which were used to generate the results should be clearly indicated.

e. Stacked bar plots

An example stacked bar plot in Figure 6 illustrates the proportion of individual projection runs for each of the MPs that were in each of the four Kobe quadrants in each year of the projections.

f. Time series plots

Example time series plots are illustrated for the stock size (~~in~~ Figure ~~6~~ 7) ~~for the stock size performance measure, and in Figure 7 for the~~ fishing intensity (Figure 8), and catch (Figure 9) performance measures. Time series plots for additional performance measures may also be relevant. The key elements depicted in these figures are the median of all runs and the 25^{th}-75^{th} and 10^{th}-90^{th} percentiles and the target and limit reference points. A sample of individual realizations should be included in the projections to illustrate the typically erratic nature of individual trajectories.

3. Summary performance of Management Procedures and management advice

To assist with decisions on adopting candidate MPs, the Commission will require some guidance on the performance of each candidate MP, in addition to the figures and tables provided. A clear and succinct summary statement comparing the relative performance of each MP against the performance measures would allow the Commission to evaluate the trade-offs among alternative MPs when making such decisions.

The following statement provides an example summary of the performance for a hypothetical MP.

- MP1 achieved the second highest catches, and second lowest level of catch variability. There was a 5% chance that MP1 would be at or above the biomass target reference point and 2% chance it would be at or below the fishing mortality target reference point. There is a 25% risk that MP1 will cause the spawning biomass to fall below the limit reference point and a 50% risk that MP1 will cause the fishing mortality to exceed the limit reference point over the next 20 years.

4. Full set of results for each Management Procedure

While the main presentation of MSE results should focus on a selection of key performance measures summarised for a single time period, it is possible that the Commission will have interest in seeing the results for other performance measures or the same performance measures for a different summary time period. Therefore, the numerical results for each MP across all 16 performance measures and for the different time periods evaluated should be provided for reference in a table in an appendix, but not reported or presented in the main results. Table 2 provides an example table of MSE outputs comparing the performance of 6 MPs against all IOTC performance measures for 4 time periods (1, 5, 10, and 20 years). Additional information, such as percentiles ranges, could be added in parentheses for each value.

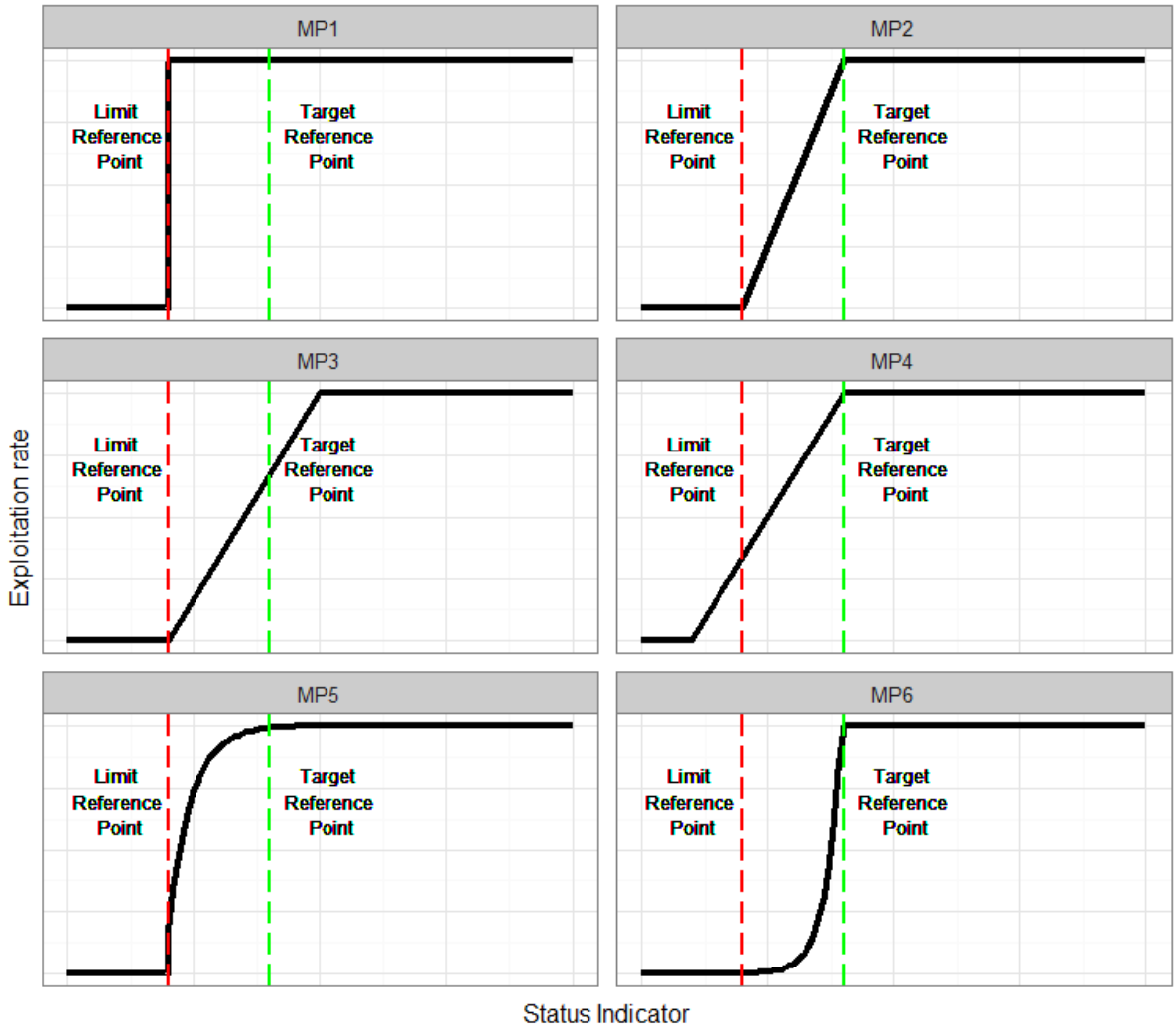

Figure 1. Illustration of six hypothetical example management procedures (MPs) relating the recommended exploitation rate to status indicator. The limit and target reference points are indicated by red and green dashed lines respectively.

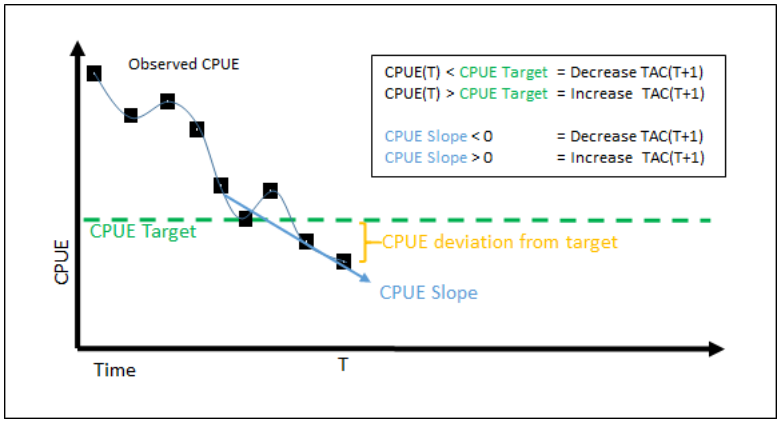

Figure 2. Illustration of an example catch per unit effort (CPUE) management procedure (MP) relating changes in the recommended TAC to changes in the CPUE over time. The target CPUE reference point is indicated by the green dashed line.

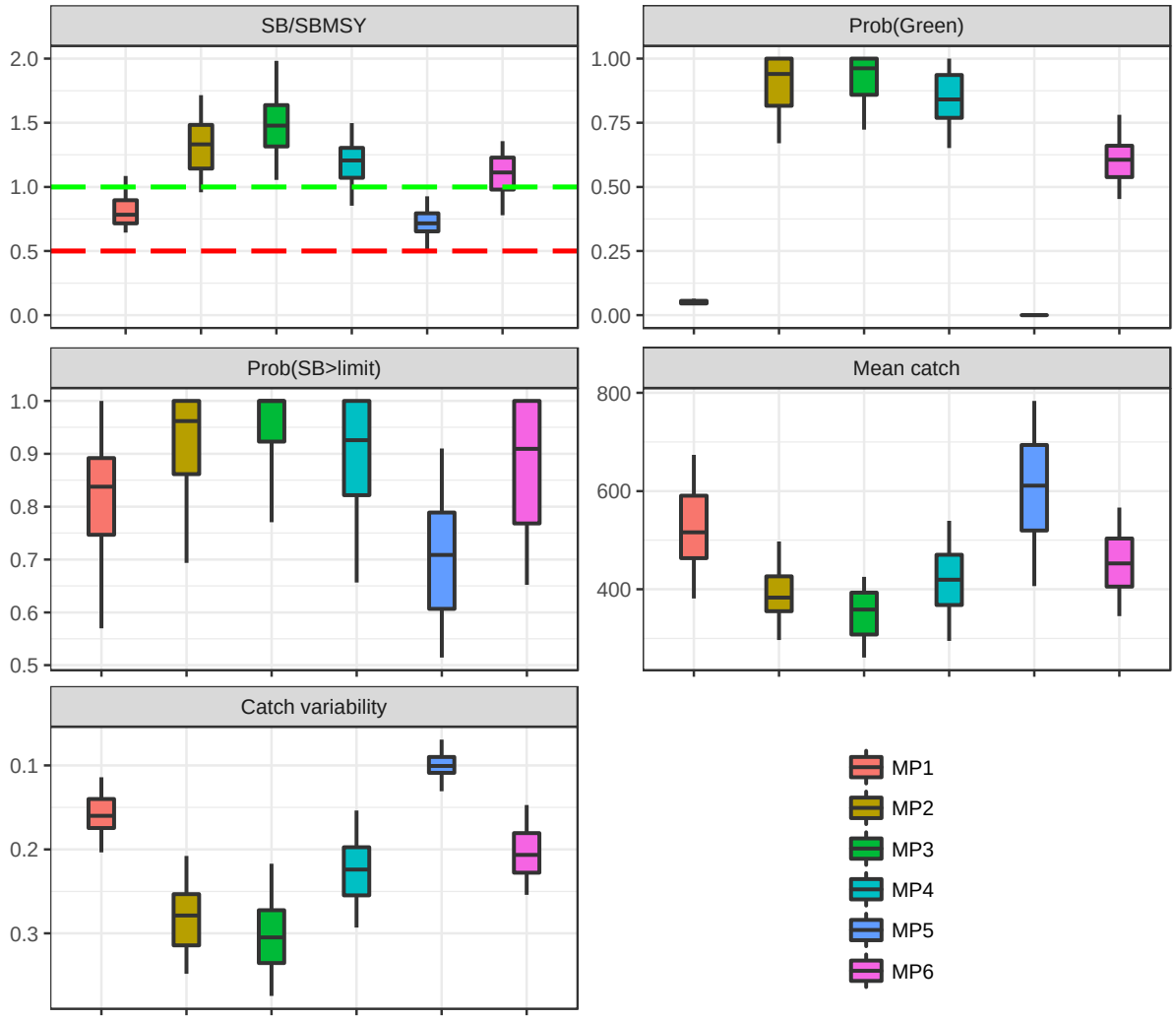

Figure 3. Example of MSE outputs comparing the performance of 6 management procedures (MPs) against 5 performance measures. Each data point represents the median over 20 years of simulation in the projection period as the horizontal line, 25th -75th percentiles as coloured bars, and 10th -90th percentiles as thin lines. Limit and target reference points for the biomass performance measure are indicated by red and green dashed lines respectively. Note the y-axis for catchability is reversed.

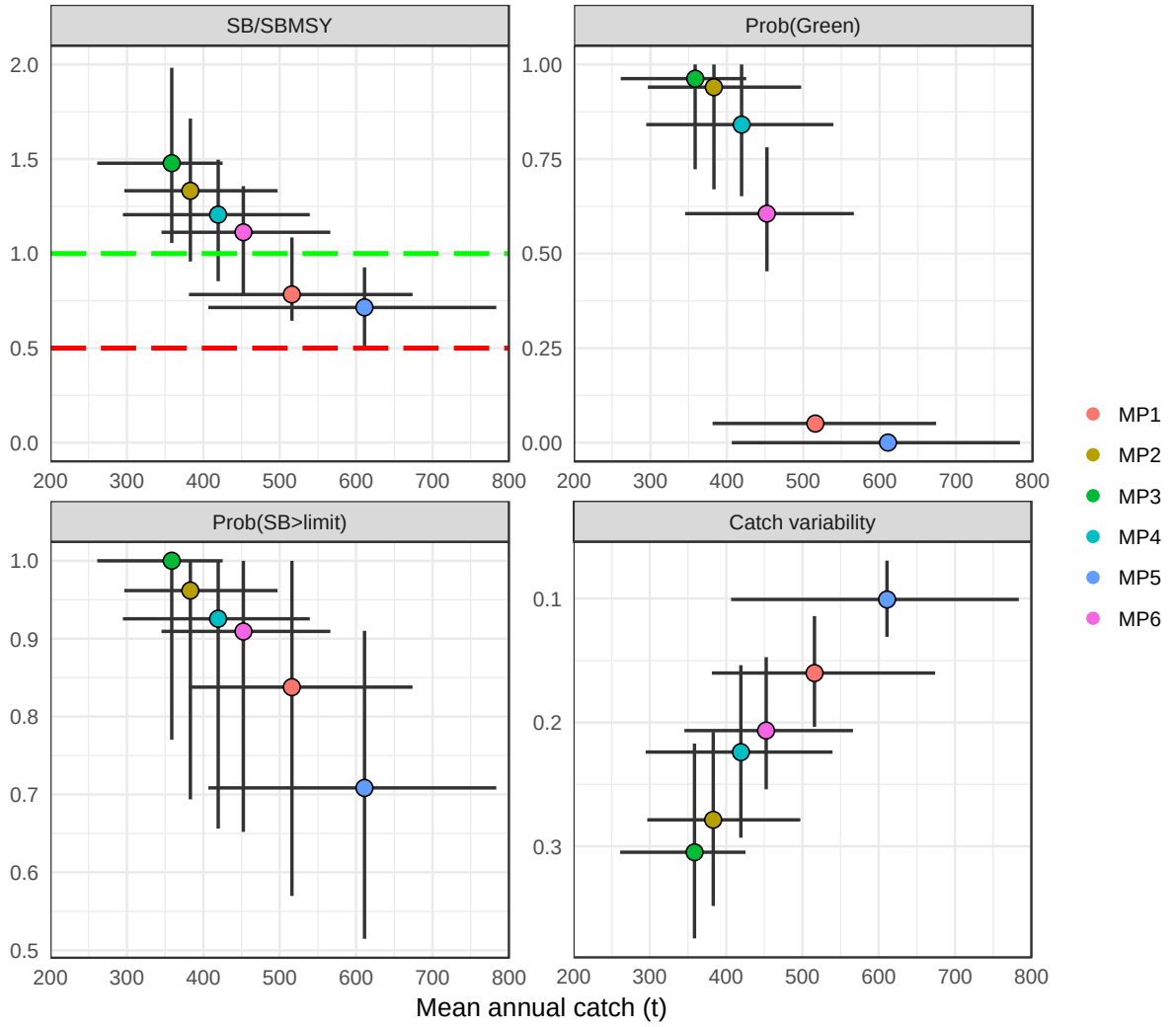

Figure 4. Example trade-off plots indicating the trade-offs in performance of 6 management procedures (MPs) between yield (catch) and 4 performance measures. Each data point represents the median over 20 years of simulation in the projection period and the errors bars represent the 25th -75th percentiles as thick lines, and 10th -90th percentiles as thin lines. Note the y-axis for catchability is reversed.

Table 1. Performance of six hypothetical example MPs against five key performance measures averaged over 20 years of simulation in the projection period. Shading indicates the relative performance for each MP (dark = better, light = worse). The 25th - 75th percentiles for SB/SB_{MSY} and catch are shown in parentheses. See Figures 2 and 3 for more detail on performance of each MP.

Management Procedure	**Performance Measure**				
	SB/SB_{MSY}	Prob(Green)	Prob(SB>limit)	Mean Catch	Catch variability
MP1	0.78 (0.64-1.09)	0.05	0.84	516 (463-590)	0.16
MP2	1.33 (0.96-1.71)	0.94	0.96	383 (355-426)	0.28
MP3	1.48 (1.06-1.98)	0.96	1	358 (308-393)	0.3
MP4	1.21 (0.85-1.50)	0.84	0.93	419 (368-470)	0.22
MP5	0.72 (0.51-0.93)	0	0.71	611 (520-694)	0.1
MP6	1.11 (0.78-1.36)	0.61	0.91	452 (405-503)	0.21

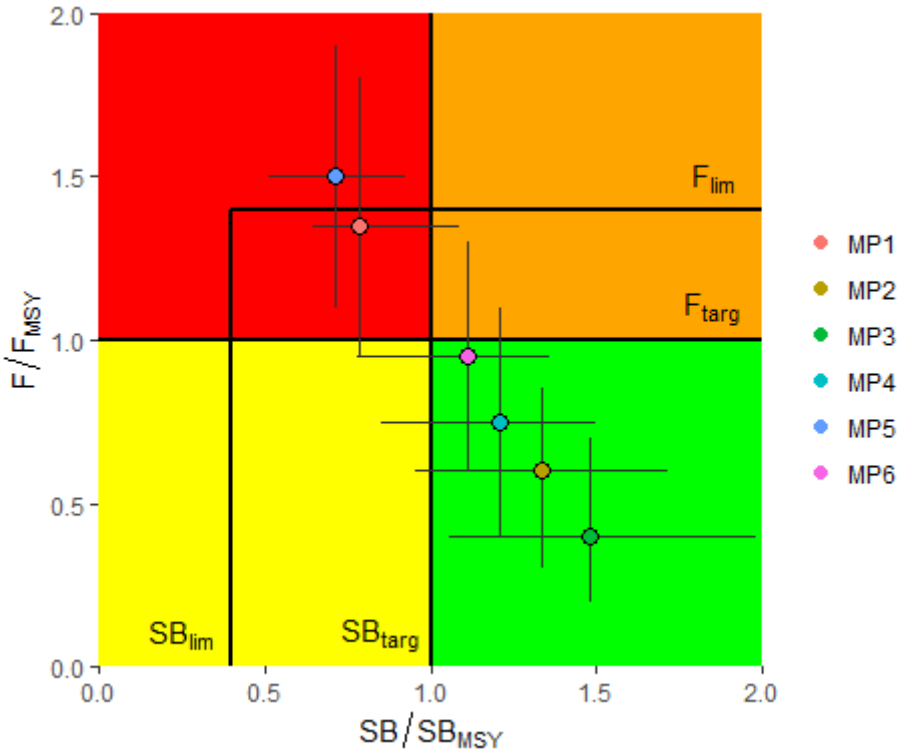

Figure 5. Kobe plot for hypothetical example of MSE outputs comparing 6 management procedures (MPs) against performance measures for SB/SB_{MSY} and F/F_{MSY}. Each data point represents the median in the final year of the projection period and the error bars represent the 90th percentiles. Target (SB_{targ} and F_{targ}) and limit (SB_{lim} and F_{lim}) reference points are indicated by black lines.

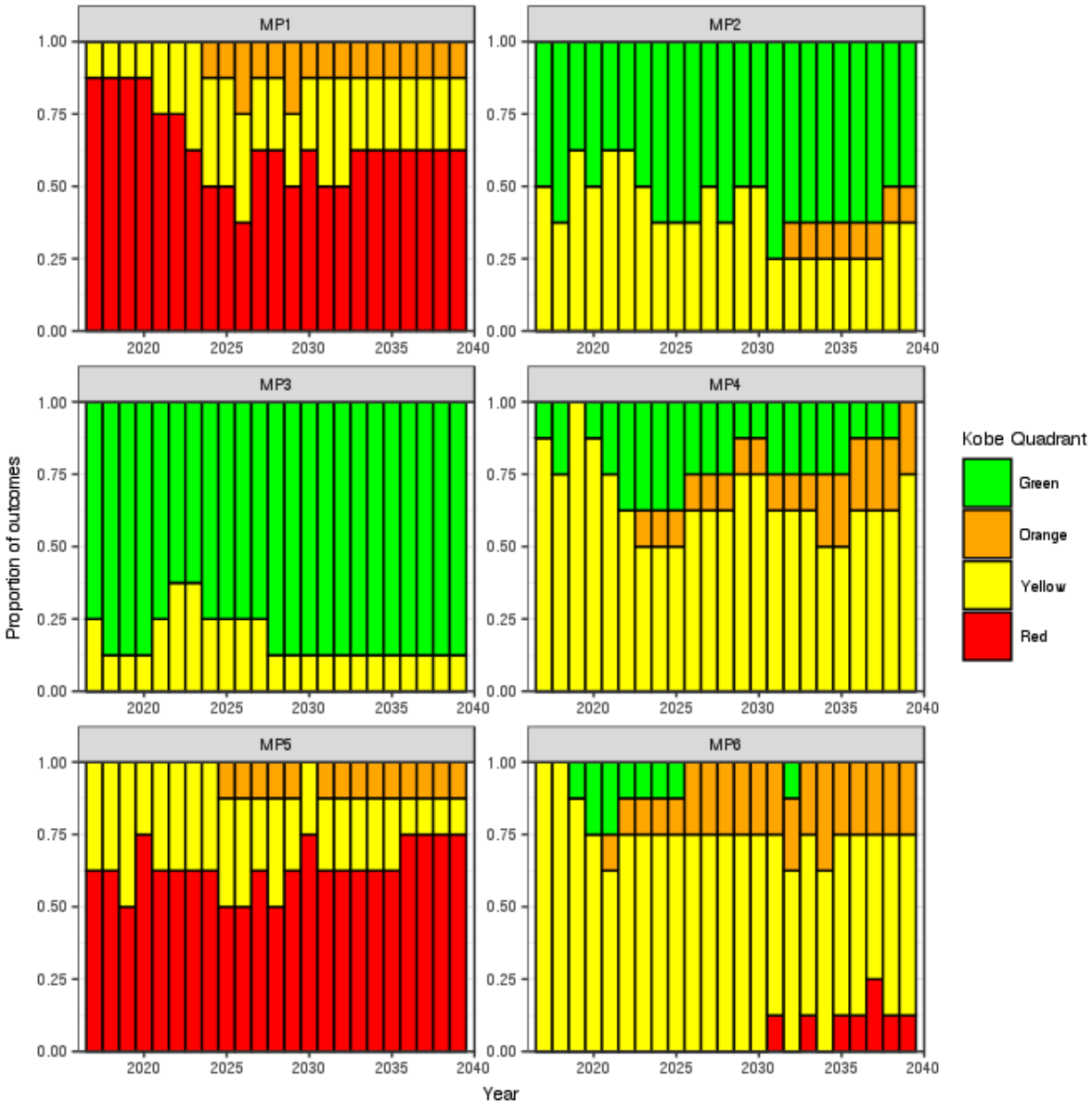

Figure 6. Proportion of runs in each of the Kobe quadrants (green, orange, yellow and red) in each projection year for a hypothetical example of MSE outputs comparing 6 management procedures (MPs).

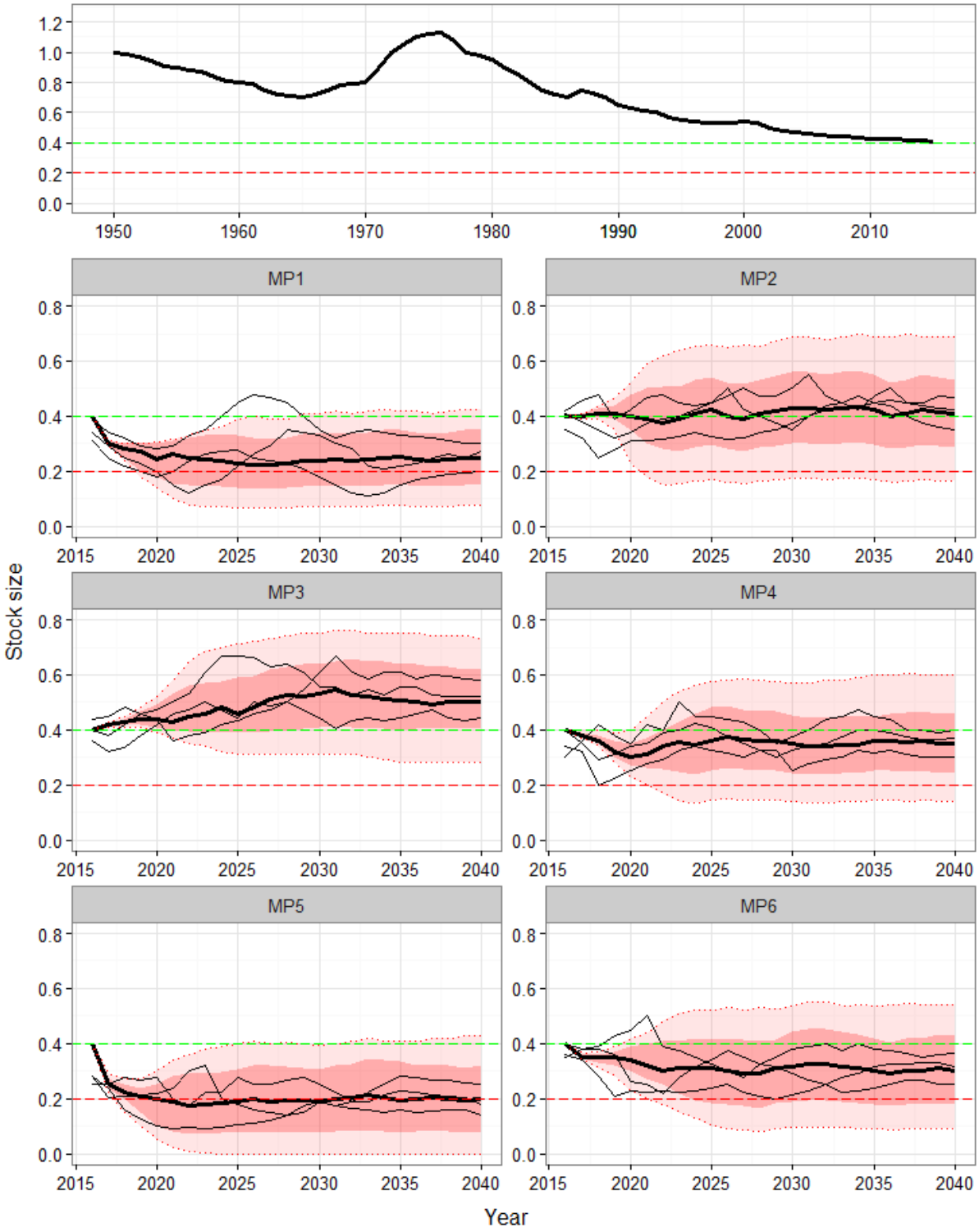

Figure 7. Time series plots for a hypothetical example of the performance of 6 MPs against the stock size performance measure. The top panel represents the historical period (1950-2015) and the bottom 6 panels represent the projection years (2016-2040). The median for each MP is represented by the bold black lines, a dark ribbon shades the 25th-75th percentile region and a light ribbon shades the 10th-90th percentile region. Three additional thin black lines show individual realizations. Horizontal lines indicate depletion-based target (green) and limit (red) reference points.

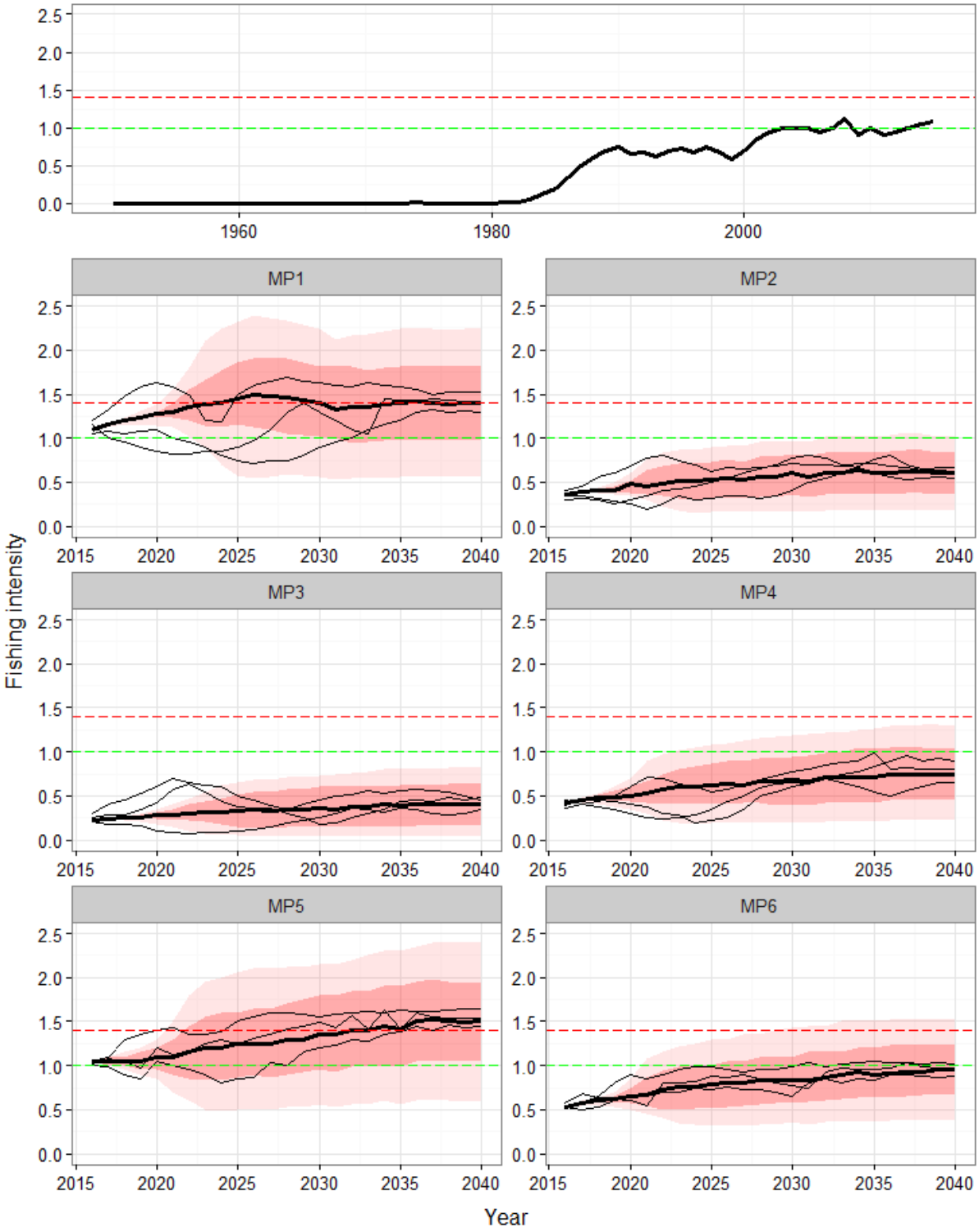

Figure 8. Time series plots for a hypothetical example of the performance of 6 MPs against the fishing intensity performance measure. The top panel represents the historical period (1950-2015) and the bottom 6 panels represent the projection years (2016-2040). The median for each MP is represented by the bold black lines, a dark ribbon shades the 25th-75th percentile region and a light ribbon shades the 10th-90th percentile region. Three additional thin black lines show individual realizations. Horizontal lines indicate depletion-based target (green) and limit (red) reference points.

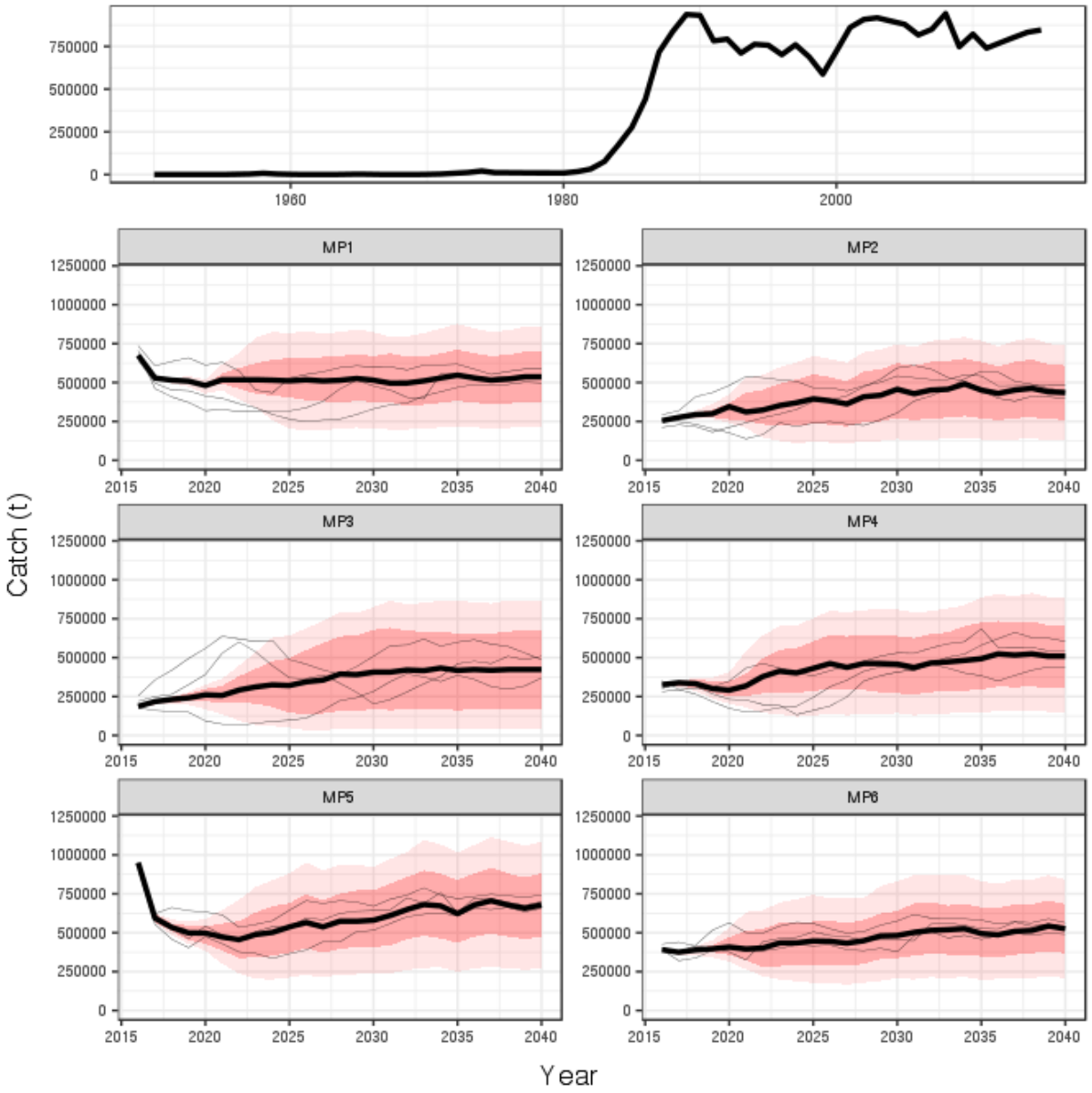

Figure 9. Time series plots for a hypothetical example of the performance of 6 MPs against the catch performance measure. The top panel represents the historical period (1950-2015) and the bottom 6 panels represent the projection years (2016-2040). The median for each MP is represented by the bold black lines, a dark ribbon shades the 25th-75th percentile region and a light ribbon shades the 10th-90th percentile region. Three additional thin black lines show individual realizations.

Table 2a. Hypothetical example of MSE outputs comparing the performance of 6 management procedures (MPs) against all IOTC performance measures for in the first projection year.

Status : maximize stock status		1 year					
		MP1	MP2	MP3	MP4	MP5	MP6
1. Mean spawner biomass relative to pristine	SB/SB_0	0.5	0.8	0.9	0.7	0.4	0.6
2. Minimum spawner biomass relative to pristine	SB/SB_0	0.3	0.6	0.6	0.5	0.2	0.4
3. Mean spawner biomass relative to SB_{MSY}	SB/SB_{MSY}	0.8	1.3	1.4	1.2	0.7	1.1
4. Mean fishing mortality relative to target	F/F_{tar}	1.4	0.6	0.4	0.8	1.5	0.9
5. Mean fishing mortality relative to F_{MSY}	F/F_{MSY}	1.4	0.6	0.4	0.8	1.5	0.9
6. Probability of being in Kobe green quadrant	SB,F	0.5	0.9	1	0.8	0.3	0.7
7. Probability of being in Kobe red quadrant	SB,F	0.3	0.1	0	0.1	0.5	0.2
Safety : maximize the probability of remaining above low stock status (i.e. minimize risk)							
8. Probability of spawner biomass being above 20% of SB_0	SB	0.8	0.9	0.9	0.8	0.7	0.8
9. Probability of spawner biomass being above B_{Lim}	SB	0.8	1.0	1.0	0.9	0.7	0.9
Yield : maximize catches across regions and gears							
10. Mean catch (1'000 t)	C	520	390	350	430	600	460
11. Mean catch by region and/or gear (1'000 t)	C	250	200	180	210	310	220
12. Mean catch relative to MSY	C/MSY	1.1	0.7	0.6	0.8	1.2	0.9
Abundance: maximize catch rates to enhance fishery profitability							
13. Mean catch rates (by region and gear) (for fisheries with meaningful catch-effort relationship)	I	3.2	3.8	3.9	2.7	2.5	2.6
Stability: maximize stability in catches to reduce commercial uncertainty							
14. Mean absolute proportional change in catch	C	0.2	0.3	0.3	0.2	0.1	0.2
15. % Catch co-efficient of variation	C	20	25	24	18	12	21
16. Probability of shutdown	C	0.01	0.01	0.01	0.01	0.01	0.01

Table 2b. Hypothetical example of MSE outputs comparing the performance of 6 management procedures (MPs) against all IOTC performance measures for a 5-year projection period.

Status : maximize stock status		5 years					
		MP1	MP2	MP3	MP4	MP5	MP6
1. Mean spawner biomass relative to pristine	SB/SB_0	0.5	0.8	1.0	0.7	0.4	0.6
2. Minimum spawner biomass relative to pristine	SB/SB_0	0.3	0.5	0.6	0.5	0.2	0.4
3. Mean spawner biomass relative to SB_{MSY}	SB/SB_{MSY}	0.9	1.2	1.3	1.1	0.7	1.2
4. Mean fishing mortality relative to target	F/F_{tar}	1.4	0.6	0.4	0.8	1.5	0.9
5. Mean fishing mortality relative to F_{MSY}	F/F_{MSY}	1.5	0.5	0.4	0.8	1.6	0.9
6. Probability of being in Kobe green quadrant	*SB,F*	0.5	0.9	0.9	0.8	0.3	0.7
7. Probability of being in Kobe red quadrant	*SB,F*	0.3	0.1	0.0	0.1	0.5	0.2
Safety : maximize the probability of remaining above low stock status (i.e. minimize risk)							
8. Probability of spawner biomass being above 20% of SB_0	*SB*	0.8	0.8	0.9	0.8	0.7	0.8
9. Probability of spawner biomass being above B_{Lim}	*SB*	0.8	1.0	1.0	0.9	0.7	0.8
Yield : maximize catches across regions and gears							
10. Mean catch (1'000 t)	*C*	551	417	378	434	600	460
11. Mean catch by region and/or gear (1'000 t)	*C*	248	194	176	229	335	218
12. Mean catch relative to MSY	*C/MSY*	1.2	0.6	0.6	0.8	1.3	1.0
Abundance: maximize catch rates to enhance fishery profitability							
13. Mean catch rates (by region and gear) (for fisheries with meaningful catch-effort relationship)	*I*	3.0	3.8	4.0	2.6	2.3	2.8
Stability: maximize stability in catches to reduce commercial uncertainty							
14. Mean absolute proportional change in catch	*C*	0.2	0.3	0.3	0.2	0.1	0.2
15. % Catch co-efficient of variation	*C*	19.4	27.3	26.2	17.6	11.5	21.0
16. Probability of shutdown	*C*	0.01	0.01	0.01	0.01	0.01	0.01

Table 2c. Hypothetical example of MSE outputs comparing the performance of 6 management procedures (MPs) against all IOTC performance measures for a 10-year projection period.

Status : maximize stock status		10 years					
		MP1	MP2	MP3	MP4	MP5	MP6
1. Mean spawner biomass relative to pristine	SB/SB_0	0.5	0.8	0.9	0.7	0.4	0.6
2. Minimum spawner biomass relative to pristine	SB/SB_0	0.3	0.6	0.6	0.5	0.2	0.4
3. Mean spawner biomass relative to SB_{MSY}	SB/SB_{MSY}	0.8	1.3	1.4	1.2	0.7	1.1
4. Mean fishing mortality relative to target	F/F_{tar}	1.4	0.6	0.4	0.8	1.5	0.9
5. Mean fishing mortality relative to F_{MSY}	F/F_{MSY}	1.4	0.6	0.4	0.8	1.5	0.9
6. Probability of being in Kobe green quadrant	SB,F	0.5	0.9	1	0.8	0.3	0.7
7. Probability of being in Kobe red quadrant	SB,F	0.3	0.1	0	0.1	0.5	0.2
Safety : maximize the probability of remaining above low stock status (i.e. minimize risk)							
8. Probability of spawner biomass being above 20% of SB_0	SB	0.8	0.9	0.9	0.8	0.7	0.8
9. Probability of spawner biomass being above B_{Lim}	SB	0.8	1.0	1.0	0.9	0.7	0.9
Yield : maximize catches across regions and gears							
10. Mean catch (1'000 t)	C	520	390	350	430	600	460
11. Mean catch by region and/or gear (1'000 t)	C	250	200	180	210	310	220
12. Mean catch relative to MSY	C/MSY	1.1	0.7	0.6	0.8	1.2	0.9
Abundance: maximize catch rates to enhance fishery profitability							
13. Mean catch rates (by region and gear) (for fisheries with meaningful catch-effort relationship)	I	3.2	3.8	3.9	2.7	2.5	2.6
Stability: maximize stability in catches to reduce commercial uncertainty							
14. Mean absolute proportional change in catch	C	0.2	0.3	0.3	0.2	0.1	0.2
15. % Catch co-efficient of variation	C	20	25	24	18	12	21
16. Probability of shutdown	C	0.01	0.01	0.01	0.01	0.01	0.01

Table 2d. Hypothetical example of MSE outputs comparing the performance of 6 management procedures (MPs) against all IOTC performance measures for a 20-year projection period.

Status : maximize stock status		20 years					
		MP1	MP2	MP3	MP4	MP5	MP6
1. Mean spawner biomass relative to pristine	SB/SB_0	0.5	0.8	1.0	0.7	0.4	0.6
2. Minimum spawner biomass relative to pristine	SB/SB_0	0.3	0.5	0.6	0.5	0.2	0.4
3. Mean spawner biomass relative to SB_{MSY}	SB/SB_{MSY}	0.9	1.2	1.3	1.1	0.7	1.2
4. Mean fishing mortality relative to target	F/F_{tar}	1.4	0.6	0.4	0.8	1.5	0.9
5. Mean fishing mortality relative to F_{MSY}	F/F_{MSY}	1.5	0.5	0.4	0.8	1.6	0.9
6. Probability of being in Kobe green quadrant	SB,F	0.5	0.9	0.9	0.8	0.3	0.7
7. Probability of being in Kobe red quadrant	SB,F	0.3	0.1	0.0	0.1	0.5	0.2
Safety : maximize the probability of remaining above low stock status (i.e. minimize risk)							
8. Probability of spawner biomass being above 20% of SB_0	SB	0.8	0.8	0.9	0.8	0.7	0.8
9. Probability of spawner biomass being above B_{Lim}	SB	0.8	1.0	1.0	0.9	0.7	0.8
Yield : maximize catches across regions and gears							
10. Mean catch (1'000 t)	C	551	417	378	434	600	460
11. Mean catch by region and/or gear (1'000 t)	C	248	194	176	229	335	218
12. Mean catch relative to MSY	C/MSY	1.2	0.6	0.6	0.8	1.3	1.0
Abundance: maximize catch rates to enhance fishery profitability							
13. Mean catch rates (by region and gear) (for fisheries with meaningful catch-effort relationship)	I	3.0	3.8	4.0	2.6	2.3	2.8
Stability: maximize stability in catches to reduce commercial uncertainty							
14. Mean absolute proportional change in catch	C	0.2	0.3	0.3	0.2	0.1	0.2
15. % Catch co-efficient of variation	C	19.4	27.3	26.2	17.6	11.5	21.0
16. Probability of shutdown	C	0.01	0.01	0.01	0.01	0.01	0.01

APPENDIX V
WORKING PARTY ON METHODS PROGRAM OF WORK (2018–2022)

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	Research Priority	Funding Priority	Lead	Est. budget (potential source)	Timing				
						2018	2019	2020	2021	2022
1. Management Strategy Evaluation	1.1 Albacore	High	5	EU (JRC)	Funded (EC JRC)					
	1.1.1 Revision of Operating Models based on WPM and SC feedback, including possible robustness tests									
	1.1.2 Implementation of initial set of simulation runs and results									
	1.1.3 Revision of Management Procedures and Indicators after presentation of initial set to TCMP and Commission									
	1.1.4 External peer review (2018 or date TBD)				US$15,000					
	1.1.5 Evaluation of new set of Management Procedures (if required)									
	1.2 Skipjack tuna	High	2	Maldives						
	1.2.1 Review of model implementation and participation in MSE process				$?? (TBD)					
	1.3 Bigeye tuna	High	4							
	1.3.1 Update OM & present preliminary MP results to TCMP, WPTT/WPM review of new OM			Australia (CSIRO)	$75,000 (ABNJ/CSIRO)					

	1.3.2 External peer review (2018 or date TBC)				US$15,000					
	1.3.3 Present revised MP results to TCMP with target adoption date of 2019				$30,000 (Jan - Jun 2018)					
	1.3.4 Additional iterations if required				(TBD)					
	1.4 Yellowfin tuna	High	3							
	1.4.1 Update OM & present preliminary MP results to TCMP, WPTT/WPM review of new OM			Australia (CSIRO)	Funded to Dec 2018 (ABNJ/CSIRO)					
	1.4.2 External peer review (2018 or date TBD)				US$15,000					
	1.4.3 Present revised MP results to TCMP with target adoption date of 2018; iteratively update development if required)				US$30,000 (Jan-Jun 2018)					
	1.4.4 additional iterations if required				(TBD)					
	1.5 Swordfish	High	1	TBD	$?? (TBD)					
	1.5.1 Initial OM									
	1.5.2 Conditioning and OM set up									
	1.5.3 Generic MP tests									
	1.5.4 Final Model with MPs									
	1.5.5 External peer review				US$15,000					
2. Presentation of stock status advice for data limited stocks	2.1 Explore potential methods of presenting stock status advice to managers from a range of data limited scenarios, e.g. through the development of a 'Tier' approach for providing stock status advice, based on the type of indictors used to determine stock status (e.g. CPUE series, stock assessment model)	Medium	7	Consult.	US$10,000 (TBD)					

3. Multiple stock status derived from different model structures	3.1 Develop specific guidance for the most appropriate models to be used or how to synthesize the results when multiple stock assessment models are presented. (*see IOTC-2016-WPTT18-R, para.91*)	Medium	6	$?? (TBD)					

APPENDIX VI
CONSOLIDATED RECOMMENDATIONS OF THE 8TH SESSION OF THE WORKING PARTY ON METHODS

Note: Appendix references refer to the Report of the 7th Session of the Working Party on Methods (IOTC–2017–WPM08–R)

Outcomes of the 21st Session of the Commission

WPM08.01: **NOTING** that the Commission considers the development of an MSE for swordfish to be a high priority activity, the WPM **RECOMMENDED** that this is reflected in the 2019 budget of the Commission (para. 10).

Skipjack tuna MSE: Update

WPM080.2: The WPM **NOTED** some ambiguity in the interpretation of the approach for deriving median values for the stock status statistics used to calculate the TAC. To provide some clarity, the WPM **RECOMMENDED** that the SC apply the median value of the distribution of B_{curr}/B_0 outcomes from the stock assessment with associated characterised uncertainty for specifying the I value for use in TAC setting. Likewise, median values of estimates of B_{curr} and E_{targ} with associated characterised uncertainty should also be used in calculations of TAC (i.e. I x E_{targ} x B_{curr}) (para. 44).

WPM08.03: Further, **NOTING** that the simulations used in testing robustness of the agreed HCR in Res 16/02 projected forward applying a first year catch level of 425,000 t (as documented in https://github.com/iotcwpm/SKJ/blob/master/procedures.hpp#L303), representing the recent reported catch, C_{recent} used in the simulations used for testing the HCR), and considering para 9.d in Res 16/02, the WPM **RECOMMENDED** that the SC consider that, in the event $B_{curr}/B_0 > 0.4$ (i.e. $> B_{thresh}$), the TAC for 2018-2020 should not exceed 1.3x C_{recent} or, in the event that $0.1 < B_{curr}/B_0 < 0.4$, the TAC for 2018-2020 should not be less than $0.7C_{recent}$. The WPM also noted that using C_{recent} values different to those used in the simulation trials could result in unexpected performance of the HCR (para. 45).

Bigeye and yellowfin tuna MSE

WPM08.04: Due to the project funding delays, the WPM **NOTED** that there will be no opportunity for scientific review of the BET MSE work before the SC20 takes place in November 2017 so the informal technical MSE workshop represents the only review opportunity before the TCMP02 in 2018. Therefore the WPM **RECOMMENDED** the SC schedule the next informal technical MSE workshop to take place between March-April 2018 to facilitate review ahead of the TCMP02 (para. 49).

Swordfish MSE: update

WPM08.05: The WPM **NOTED** the large number of independent CPUE indices, and **AGREED** that it would be useful to bring the datasets together and undertake a joint analysis as a joint CPUE series based on operational data should increase spatio-temporal coverage, as well as better handle changes in targeting. The WPM therefore **RECOMMENDED** that future stock assessments of swordfish are based on a joint standardised CPUE series (para. 55).

WPM08.06: The WPM **RECOMMENDED** that stock assessment results should include both MSY and depletion-based indicators. The WPM **NOTED** that the current stock assessment of swordfish shows a stock in the green area of the Kobe plot, given the current value of B/B_{MSY} ratio, while the stock is estimated to be at around 30% of virgin biomass. This latter value would be generally considered to indicate a stock is likely to be overexploited (para. 56).

Visualisation of MSE results

WPM08.07: The WPM **RECOMMENDED** the proposed revisions to the standardised methods for the presentation of MSE results (Appendix IV) are submitted to the SC20 for discussion, revision and endorsement, as appropriate. This should still be considered a living document that will benefit from revision based upon ongoing feedback received from the SC and the TCMP (para. 65).

Update on the status of the joint CPUE indices (yellowfin tuna, bigeye tuna & albacore)

WPM08.08: WPM **RECOGNISED** the importance of normalizing these procedures and approaches into the various Working Party stock assessments making use of longline catch rate indices and **RECOMMENDED** that the SC endorse such joint analyses and **REQUESTED** these continue into the future as a normal course of business. It was **NOTED** that additional time for more detailed analysis is still needed and WPM **SUGGESTED** that methods to increase analysis time, such as the use of secure, cloud-based data exchange and increased use of electronic communication between analysts be investigated (para. 79).

WPM08.09: The WPM **THANKED** the authors for the investigation selectivity changes and spatial size patterns of bigeye and yellowfin tuna in the early years of the Japanese longline fishery and **AGREED** that this work is important in terms of improving understanding of the trends in CPUE. **NOTING** that various issues have been identified that could be explored further, the WPM **RECOMMENDED** that this work is continued (para.86).

Priorities for future development of the joint CPUE indices

WPM08.10: The WPM **NOTED** that a substantial amount of work has already been completed for the tropical tunas and that it may be more worthwhile to focus on some other species for which this approach would be useful. The WPM therefore **RECOMMENDED** that a similar joint analysis approach is explored for key IOTC billfish and shark species (para. 92).

Revision of the WPM Program of work (2018–2022)

WPM08.11: The WPM **RECOMMENDED** that the Scientific Committee consider and endorse the WPM Programme of Work (2018–2022), as provided in Appendix V (para. 119).

Presentation of stock status advice for data limited stocks

WPM08.12: The WPM **AGREED** that work on the presentation of stock status advice for data limited stocks will need to be carried out inter-sessionally, and that this will require some level of preparation and planning. The WPM **REQUESTED** the Chairperson liaise with the Chairs of the species WPs (WPNT and WPB) in order to draft a study proposal on this issue and **RECOMMENDED** the SC allocate funding to this project (para.121).

Election of a Chairperson and Vice-Chairperson for the next biennium

WPM08.13: The WPM **RECOMMENDED** that the SC note the Chairperson, Dr Toshihide Kitakado and Vice-Chairperson, Dr Iago Mosqueira, of the WPM for the next biennium (para. 130).

Development of priorities for Invited Expert(s) at the next WPM meeting

WPM08.14: Given the importance of external peer review, the WPM **RECOMMENDED** that the Commission continues to allocate sufficient budget for a regular invited expert to be invited to meetings of the WPM (para. 132).

Review of the draft, and adoption of the Report of the 8th Session of the WPM

WPM08.15: The WPM **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPM08, provided in Appendix VII.