

## REPORT OF THE 6th WORKSHOP on MSE of IOTC WPM Scientists

**Bangkok, Thailand, 1-4 April 2017**

The 6th workshop on Management Strategy Evaluation (MSE) of the Working Party on Methods (WPM) of IOTC was held at “Chairman’s room” of Shangri-la Hotel, Bangkok, from 1-4 April 2017. The list of participants is given in **Annex A**. The Group is composed of members of WPM actively involved on the development of MSE simulations for IOTC stocks.

### **1. Introductory items**

#### *1.1 Opening remarks*

Kitakado welcomed the participants to the workshop and to Bangkok. He noted that the main objectives of the meeting were:

1. To review recent progress and the current status of the development of MSE (OMs, MPs and simulations) for ALB, SKJ, YFT and BET, and discuss initializing the work for SWO
2. To agree on how best to present MSE results to IOTC Scientific Committee (SC), Technical Committee on Management Procedures (TCMP), and Commission (COM).
3. To review the plan for the upcoming TCMP
4. To develop a possible roadmap for the next 4 years of MSE work to guide MP developers.

The agreed agenda is given as **Annex B**. The list of documents and presentations is given as **Annex C**.

#### *1.2 Appointment of chair and rapporteurs*

Kitakado served as Chairman. Rapporteur(s) for each agenda item are shown in brackets in **Annex B**.

### **2. Review of current state of affairs**

#### *2.1 UPDATE on WPM07 and SC19 in 2016*

The group recalled that the 7th Session of the WPM was held in Victoria Seychelles, 11-13 November 2016. The consolidated list of recommendations to the SC19 is shown in the appendix to the report.

## *2.2 UPDATE on MPD03 and COM(S20) in 2016*

The group recalled the 3rd Session of the Indian Ocean Tuna Commission Management Procedures Dialogue (MPD03) was held in La Reunion, France, on 21st May 2016. The MPD is mandated under IOTC Resolution 14/03 on enhancing the dialogue between fisheries scientists and managers.

The Commission meeting was held on 23-27 May 2016. A total of 12 Conservation and Management Measures (CMMs) adopted at the 20th Session of the Commission (consisting of 12 Resolutions and 0 Recommendations). The Resolutions relevant to MSE are as follows:

- Resolution 16/01 On an interim plan for rebuilding the Indian Ocean yellowfin tuna stock
- Resolution 16/02 On harvest control rules for skipjack tuna in the IOTC area of competence
- Resolution 16/09 On establishing a technical committee on management procedures dialogue

Issues relevant to Resolutions 16/01 and Resolution 16/02 are discussed in the Group this time (see Items 4, 5 and 7)

## *2.3 PROCESS of MSE development, discussion and adoption at IOTC*

The Group noted that the SC concluded that the Workplan for MSE identified in Res 15/10 is unlikely to be achieved since adequate and timely resources for conducting the required work have not been available. The Scientific Committee provided an updated workplan for the MSE in its most recent report. The Group noted that TCMP could take on the task of refining the Workplan to clarify the process schedule needed for the eventual adoption of Management Procedures within the Commission. The Group discussed a possible schedule that might serve as a general guideline for this after consideration by the SC (Annex C).

### **3. REVIEW of status of work on Albacore OMs and MPs**

#### *3.1 Review of status, current issues and possible solutions*

The albacore OM is currently undergoing a substantial revision, including reconditioning with new CPUE series provided by the joint CPUE analyses working group (and other new data from the 2015 assessment).

Additional uncertainty in selectivity is being introduced by admitting the possibility of dome-shaped selectivity for the northern longline fleets. A large number of these new models estimate extremely high biomass (in which fishery exploitation rates are negligible and CPUE trends are explained by recruitment variability rather than fishery depletion). These results need to be filtered from the OM based on carrying capacity arguments, as employed in previous iterations. The group suggested that it would be worth checking the quality of fit to the dome-shaped selectivity and considering whether it may be preferable to allow the double-normal selectivity function to estimate the descending limb of the dome-shape, rather than fixing the decline at 50% of the peak.

Several changes to the implementation of the CPUE in the OM were made. These data are now used as the historical inputs to the MPs. The method of simulating CPUE observations in the projections was discussed, and it was suggested that the new approach should attempt to account for i) differential selectivity by fleet, and ii) consistency between the historical and projected observation error. Auto-correlation based on the historical residuals may be useful for forward projections if there is evidence of systematic lack of fit (and should be used to smooth the transition from the last historical year to the first projection year if auto-correlation is high and the most recent residual is large). Simulated CPUE series are generated separately for northern and southern fleets. Both series will be used for the biomass dynamics model MPs, while only the southern one will be used for the CPUE-based MPs.

The MP testing to date used the same stochastic time series of recruitment deviations for all projections. The group recognized that this would understate the recruitment uncertainty and suggested that recruitment variability should be independent for each stochastic realization (though the same random number sequence should be used when comparing different MPs). It was also suggested that projected recruitment variability could follow the same principles as CPUE variability in terms of consistency in the CV between historical and projection periods and auto-correlation.

It was recognized that the full suite of XXX reference case OM specifications may be an unwieldy and unnecessary number of models to retain for MP testing. Clustering algorithms were used to classify the stock status estimates into similar groups, which one could subset and still retain the diversity of the full ensemble. Some of the juvenile M options were identified as not contributing substantially to the uncertainty envelope. However, it was also noted that similar stock status estimates might not correspond to similar MP performance, such that the clustering might instead be applied to the MSE results.

Two scenarios were flagged for future consideration: i) robustness scenarios associated with historical catch misreporting associated with the Indonesian longline fleet, and ii) TAC implementation error.

### *3.2 Workplan*

The following development priorities before the TCMP meeting were identified:

- Finalize selection of OM conditioning runs based on limits of the relationship between  $K \sim$  area, and on a sufficient number of runs from each of the main clusters identified. Final runs should include all OM iterations to better assess how each factor in the OM affects MP performance.
- Ensure internal consistency of OM and MP runs with regards to the error structure (SD, autocorrelation) of the CPUE observations and variability in future recruitments.
- Carry out runs of two MPs with tuning according to the agreed objectives;  
 $\Pr(\text{green Kobe}) = 75\%$  &  $\Pr(B = B_{\text{target}}) = 50\%$ .

## **4. Review of status on work on Skipjack OMs and MPs**

### *4.1 Review of status, current issues and possible solutions*

There has been no progress on skipjack MP evaluation since the adoption of the skipjack HCR in 2016 (resolution 16-02). The group noted that the TCMP and Commission need to understand the implementation process and timeline for the HCR. The process for the HCR calculation needs to be defined. It needs to be clarified whether the quota arising from the HCR can take effect on 1 Jan of the year immediately following

endorsement by the SC, with or without intersessional approval by the Commission, or whether the Commission will expect to endorse the quota, delaying the application until the following calendar year.

The group noted that if the Commission adopts a different implementation lag than was assumed in the MP evaluations, this may affect the MP performance.

#### *4.2 Workplan*

The group noted that Resolution 15/10 identifies the expectation for further work on skipjack MP evaluation in the years ahead. The group felt that it was premature to define this work until after the first HCR iteration.

### **5. REVIEW of status of work on Yellowfin and Bigeye OMs and MPs**

The Group reviewed the current status of the work on yellowfin and bigeye MSE simulations.

The phase 1 development on the OMs and initial test of MPs for yellowfin and bigeye was completed in July 2016. The software and initial results are publicly available through github. There has been no work conducted since. The phase 2 project is expected to be active from July 2017-December 2018.

The priorities for Phase 2 were discussed, which included (1) update of the OMs and Reference Set, (2) spatial dynamics, (3) MPs and (4) tuning.

With regards to the OMs, they will be updated in relation to new assessments (particularly revised CPUE indices, and new spatial structure for BET). Details on the OM Reference set defined by 2016 WPM for BET and YFT were reviewed and Robustness scenarios were clarified by the group, including the selectivity changes that would be explored by admitting temporal variability in the OM conditioning. A specific proposal for pre-1979 CPUE series is still required.

With regards to spatial dynamics uncertainty. The assessments and OMs suggest limited mixing and differential spatial depletion, which may not be realistic, and could adversely affect MP behaviour (i.e. fleets are assigned to areas, and may not be able to reach their quota in the assigned area even though fish may be abundant elsewhere).

With regards to MPs, they should be harmonized across albacore and bigeye/yellowfin, at least until there is a demonstration that species-specific MPs are useful. For tuning the MPs for bigeye and yellowfin, a series of criteria are proposed in section 7 of this report.

## **6. Work on Swordfish Oms**

### *6.1 Review stock assessment results*

The Group recalled the most recent assessment of the Indian Ocean stock status from 2014. An updated assessment using catch and effort data through 2015 will be conducted in 2017, which should form the basis for development of Operating Models for the swordfish MSE.

### *6.2 PLAN toward WPB, WPM08 and SC20 (Timelines, responsibilities)*

The workplan identified by the Commission under Res 15/10, calls for MSE on swordfish to be completed by 2017 and presented to the Commission meeting in 2018. While the SC has identified this work as having high priority, necessary resources for the work have not yet been identified. As a result, no progress on this topic has yet been achieved. The Group noted that with the recent availability of enhanced research support funds from the European Community, this work could be initiated in the near future, but it remains unlikely that the workplan identified in Res 15/10 can be realized.

## **7. Generic issues on MP Evaluation**

### *7.1 MP Tuning*

The group discussed the merit of "tuning" MPs to help guide the Commission in the MP selection process. Tuning (as used extensively in the IWC and CCSBT) consists of adjusting the control parameters of candidate MPs to obtain a specific single-dimension management objective (ideally the highest priority) from the simulation results (e.g. from resolution 16/01 preamble - "...recover the stocks to levels above the interim target reference points with 50% probability by 2024"). When different candidate MPs have identical performance with respect to the tuning objective, it is much easier to rank their performance with respect to secondary and tertiary objectives such as mean catch over the study period and/or stability in catches etc.... This removes the need to evaluate MPs

across a broad range of the performance indicator trade-off space as the main management objective (eg maintaining the stock in the green quadrant of the kobe plot with a particular probability) will narrow down the MPs to be evaluated. Moreover, this simplifies the communication of results to managers. This also allows MP developers to focus effort on improving performance within a narrow range of the trade-off space, which may result in improvements that might not be generically achievable across the whole trade-off space.

Tuning is technically easy, but requires the Commission to agree to (ideally) one specific objective, among many potential candidates. However, this should be done iteratively, as it is unlikely that Commissioners would articulate a tuning objective at the beginning of the process without being familiar with the technicalities of the MP process. However, in the CCSBT and IWC, tuning objectives were identified relatively easily, through an iterative process guided by the scientists. It is proposed that the scientists will initially present MP results on the basis of 2 tuning objectives proposed through a pragmatic interpretation of Commission objectives and to demonstrate the performance contrast associated with different tuning objectives. This provides the Commissioners with a sense of the possible trade-offs and uncertainties, at which point they will be encouraged to articulate their preferred tuning objectives for the next iteration, if desired.

The tuning objectives may differ according to the circumstances of the individual species. The group proposes that the first iteration of MP results should present results for each of the example tuning objectives as outlined in Table 1.

While the group recognized that tuning has important advantages, it may be a difficult concept to communicate to commissioners. They may request many additional tuning levels, which may undermine some of the benefits of tuning. The group should work on a communication strategy for the TCMP which emphasizes that i) commissioners are responsible for articulating management objectives, and should work with scientists to provide concise quantitative performance objectives preferably during the TCMP meeting, ii) the tuning objectives will be key drivers of the management performance statistics trade-offs, and iii) if managers can agree on specific management objectives, scientists may be able to develop MPs which provide better performance in terms of higher precision with respect to achieving primary objectives, greater robustness, and better performance with respect to secondary objectives.

Table 1. Initial tuning criteria proposed for candidate MPs. These are identified as

possible interpretations of existing IOTC resolutions, but other interpretations are possible.

| Species            | MP Tuning criterion                            | Rationale                                                                                                                                                                                      |
|--------------------|------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ALB,<br>BET<br>YFT | $\Pr(B > B_{\text{targ}}) = 0.5$<br>(20y mean) | CMM 15/10 (annex 1) - "...achieve target reference points on average"                                                                                                                          |
| ALB,<br>BET        | $\Pr(\text{green Kobe}) = 0.75$<br>(20y mean)  | CMM 15/10 - maintain stock within green Kobe quadrant with a "high probability" where high probability is consistent with the ICCAT and IOTC MSE capacity building workshop survey respondents |
| YFT only           | $\Pr(B(2024) > B_{\text{targ}}) = 0.5$         | CMM 16/01 preamble - "...recover the stocks to levels above the interim target reference points with 50% probability by 2024"                                                                  |

## 7.2 Reference and Robustness set OMs

The group discussed the distinction between reference set and robustness set OMs in MP evaluation. The reference set is generally recognized as the core set of models, each of which is considered to have a reasonable probability of representing reality, and together encompass the main uncertainties about current stock status and future dynamics. The robustness set of OMs is more difficult to define. These scenarios are often described as being unlikely, but potentially risky (e.g. recruitment failures, IUU catch, CPUE hyperstability), and may have a useful role to help select among MPs that otherwise have similar performance. The robustness set may also be a dynamic "holding tank", e.g. for untested scenarios that may later be discarded if the situation does not prove to be troubling for the MP, or for managing uncertainty scenarios which are not agreed to be likely by consensus.

At this time, there are a small number of robustness scenarios proposed for albacore, yellowfin and bigeye, which have not been tested. These scenarios were proposed in the spirit of curiosity, with neither strong support nor opposition, so the group did not consider it a priority to communicate these scenarios to the TCMP in this round.

## 8. PRESENTATION of MSE



The standardised figures and tables for presentation of MSE results that were agreed at WPM07 and SC19 in 2016 were reviewed. Some minor revisions were suggested by the group to improve the clarity of some figures and tables. The revised figures and tables are presented in the updated guidelines (Annex D). The specific revisions included the following:

Higher values are considered better than lower values for most performance measures. Catch variability and fishing mortality are two exceptions. To maintain consistency, and avoid confusion, the group agreed that it would be desirable to present results where higher points in figures (not necessarily values) of performance measures were always better. To achieve this, it was necessary to reverse the y-axis for catch variability in the box plot and trade-off figures. The group agreed it would not be desirable to reverse the y-axis for fishing mortality on the Kobe plot as this format of presenting outputs is very familiar with managers, and there are no other performance measures presented with the Kobe plot to create inconsistencies.

The group considered that the colour used to shade the relative performance of management procedures in the summary table was unnecessary and potentially misleading. The group agreed to use a neutral grey shading to indicate relative performance (darker=better).

The group agreed that the error bars in the Kobe plot should be consistent with the box plots and indicate the 25th and 75th percentiles as boxes, in addition to the 5th and 95th percentiles, however, these were found to be visually confusing

The group agreed that the summary text used to explain the overall performance of each management procedure should be objective and not misleading. Terms such as “performed well” were considered too subjective. The example summary text has been revised to articulate the results more objectively.

## **9. Strategy for TCMP**

The Group discussed the technical material to be used in the forthcoming Technical Committee on Management Procedures to be held on 20<sup>th</sup> of May in Yogyakarta. Considering that the TCMP meeting is only for one day, the Group underlined that it is very important to discuss the scientific message that needs to be conveyed to receive feedback from managers to allow the MP developers to proceed (eg specific management

objectives/timeframes). The Group also agreed that the technical material should be organized as follows for presentation to the TCMP:

1. General introduction of the management framework of IOTC and MSE process in the IOTC, including resolution 15/10 and 16/02,
2. Capacity building exercise to describe the concepts of MP/MSE, including the figures and tables agreed by Scientific Committee to present the results of the MSE,
3. Species specific results of MP/MSE using the standard figures adopted by SC but focusing on questions that need an answer from managers to progress with the process (eg objectives, etc...),
4. Particularly for Skipjack, the discussion should also focus on the process of application of Resolution 16/02,
5. The Process, workplan, timeframe and resources needed to progress on the IOTC MSE development based on the SC workplan

The group agreed to prepare a joint presentation for the general introduction of the capacity building with regards to MSE as well as the species specific presentations using the standard figures to show the results. These species specific presentations should be clear and concise and highlighting clearly what is needed from managers to continue with the process. The group also agreed to prepare handouts with the figures and concept to be used to convey the results of the MSE work to be distributed one week before the TCMP. The group also discussed the need for a facilitator.

## **10. TRAINING and capacity building on MSE at IOTC**

The Group noted that at its 15th Session in 2011, the Commission agreed to further support capacity building activities among its Members by implementing adequate capacity building and support programs. As a result, the IOTC Secretariat has developed a work program that included science capacity building workshops. The aims of the workshops were to a) improve the level of comprehension among IOTC Members on how the scientific process informs the management of IOTC species and ecosystems and increase the awareness of IOTC Members to their obligations, as stipulated in the Commissions' Conservation and Management Measures, relevant to the IOTC Science Process. A series of workshops had taken place and which covered a number of topics. Some of these have been on the topic of MSE, including workshops supported by the GEF/FAO ABNJ Tuna project. The Group suggested that, to the degree that funds

allow, these capacity building and training workshops continue into the future. However, it was also considered that future training workshops be better coordinated through the Scientific Committee.

The Group noted that there has been a capacity building workshop held in Sri Lanka and sponsored by the GEF/FAO ABNJ Tuna project in March of this year. The Group was also informed of an upcoming training session on the use of data limited stock assessment methods for IOTC scientists in early May of this year (see Agenda 11.2).

## **11. Other ISSUES for WPM08**

### *11.1 Tier approach.*

The Group noted the prior advice offered by WPM on the Tier approach and did not carry on exhaustive discussion of the topic at the current meeting. In many ways the tier approach relates to methods for provision of management advice for data limited circumstances. The Group did note that the Secretariat has organized training for IOTC Scientists on the so-called DLMToolkit (<http://www.datalimitedtoolkit.org>), which is being organized for May and November 2017 (see agenda 10.1).

### *11.2 Stock assessment methods for data limited stocks*

The Group was informed of the upcoming training courses in data-limited stock assessment methods being organized for IOTC CPC scientists by the Secretariat. The Group noted this positive initiative and also responsive to one of the recommendations in the recent performance review of the IOTC Science Enterprise, although it was suggested that in the future, better coordination with the WPM and Scientific Committee is needed. After reviewing the proposed curriculum, the Group raised some concern that the workshop may be too advanced for a majority of the IOTC scientists that are hoping to attend. For this reason, the Group considered that multiple trainings at a slower pace than envisioned in the curriculum proposal may be required to assure that the methods developed could be regularly incorporated into the analyses the Working Parties undertake.

### *11.3 MSE for North Atlantic albacore*

The group was informed of the developments of the HCR evaluations for North Atlantic albacore. The presentation was mostly focused on a series of preliminary results in the format requested by ICCAT's

Panel 2. It was noted that in this case, the MSE had a specific objective: To facilitate ICCAT's adoption of a HCR for the assessment of this stock.

## **12. ADOPTION of report**

The meeting closed at 13:00 on 4 April 2017 after reviewing the draft reports. Kitakado thanked the participants for their cooperative and constructive discussion. He also appreciated the rapporteurs. The meeting thanked the Chair, and it also thanked Shiham Adam for arranging an efficient working environment, and ABNJ and ISSF for providing financial support.

## **Annex A**

### **LIST OF PARTICIPANTS**

|                    |                                                          |
|--------------------|----------------------------------------------------------|
| Toshihide Kitakado | Tokyo University of Marine Science and Technology, Japan |
| Dale Kolody        | CSIRO, Australia                                         |
| Gorka Merino       | AZTI, Spain, EU                                          |
| Iago Mosqueira     | Joint Research Centre, European Commission               |
| Hilario Murua      | AZTI, Spain, EU                                          |
| Gerald Scott       | International Seafood Sustainability Foundation, USA     |
| Ashley Williams    | Department of Agriculture and Water Resources, Australia |

## **Annex B**

### **AGENDA**

#### **1. Introductory items [Kitakado]**

- 1.1 Opening remarks
- 1.2 Appointment of chair and rapporteurs

#### **2. REVIEW of current state of affairs [Kitakado, Scott]**

- 2.1 UPDATE on WPM07 and SC19 in 2016
- 2.2 UPDATE on MPD03 and COM(S20) in 2016
- 2.3 PROCESS of MSE development, discussion and adoption at IOTC

#### **3. REVIEW of status of work on Albacore OMs and MPs [Kolody]**

- 3.1 REVIEW status, current issues and possible solutions
- 3.2 Workplan

#### **4. REVIEW of status of work on Skipjack OMs and MPs [Kolody]**

- 4.1 REVIEW status, current issues and possible solutions
- 4.2 Workplan

#### **5. REVIEW of status of work on Yellowfin and Bigeye OMs and MPs [Merino]**

#### **6. Work on Swordfish OMs [Scott]**

- 6.1 Review stock assessment results
- 6.2 PLAN toward WPB, WPM08 and SC20 (Timelines, responsibilities)

#### **7. General issues arisen on evaluation of MPs [Kolody]**

- 7.1 Tuning of MP
- 7.2 Reference and robustness set of OMs

#### **8. PRESENTATION of MSE [Murua and Williams]**

#### **9. Strategy for TCMP [Murua]**

#### **10. TRAINING and capacity building on MSE at IOTC [Scott]**

## **11. Other ISSUES for WPM08 [Scott]**

11.1 Tier approach

11.2 Stock assessment methods for data limited stocks

11.3 MSE for North Atlantic albacore

## **12. ADOPTION of report**

## Annex C

### Possible schedule of MSE development plan interpreted by the Group from SC documents to assist MP technical developers

|                 | ALB                                                   | SKJ                                                 | YFT                                                   | BET                                                   | SWO                                            |
|-----------------|-------------------------------------------------------|-----------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------|------------------------------------------------|
| - WPs 2017      | Technical evaluation of MPs finalized                 |                                                     | OM/MP updated and reviewed                            | OM/MP updated and reviewed                            | Framework/platform agreed                      |
| - SC 2017       | MPs reviewed and forward to COM for its consideration | Application of HCR using 2017 SA results to set TAC | MPs reviewed and forward to COM for its consideration | MPs reviewed and forward to COM for its consideration | Seek funding for developers; Approach endorsed |
| - TCMP/COM 2018 | MPs presented for consideration                       | Endorse three years' TAC                            | MPs presented for consideration                       | Preliminary MPs presented for feedback                |                                                |
| - WPs 2018      | OM/MP updated and reviewed                            | Review implementation (reconditioning considered? ) | OM/MP updated and reviewed                            | OM/MP updated and reviewed                            | Initial OM conditioned, generic MP applied     |
| - SC 2018       |                                                       |                                                     | MPs revised if necessary for consideration            | Ps revised if necessary for consideration             |                                                |
| - TCMP/COM 2019 | Target adoption of MP                                 |                                                     | Target adoption of MP                                 | Target adoption of MP                                 |                                                |
| - WPs 2019      | Possible application of MP to set TAC                 |                                                     |                                                       |                                                       | OM/MP reviewed                                 |
| - SC 2019       |                                                       |                                                     | MPs revised if necessary for consideration            | Ps revised if necessary for consideration             |                                                |
| - TCMP/COM 2020 |                                                       |                                                     | MP presented and approved                             | MP presented and approved                             |                                                |
| - WPs 2020      |                                                       |                                                     |                                                       |                                                       | MP agreed?                                     |
| - SC 2020       |                                                       |                                                     |                                                       |                                                       |                                                |