REVISED: GUIDELINES FOR THE PRESENTATION OF CPUE STANDARDISATIONS AND STOCK ASSESSMENT MODELS

PREPARED BY: IOTC SECRETARIAT, 23 NOVEMBER 2014

PURPOSE

To request that the Scientific Committee (SC) revise the current '*Guidelines for the presentation of CPUE standardisations and stock assessment models'* (Appendix I), noting that the Commission adopted **Recommendation 14/07** ***To standardise the presentation of scientific information in the annual Scientific Committee report and in Working Party reports***, at its 18th Session in 2014.

BACKGROUND

At the 18th Session, the Commission **CONSIDERED** and **ADOPTED** a proposal for a new Conservation and Management Measure which would require the modification of the current *Guidelines for the presentation of CPUE standardisations and stock assessment models',* as detailed below:

- Recommendation 14/07 *To standardise the presentation of scientific information in the annual Scientific Committee report and in Working Party reports* (Appendix II)

The Commission **ADOPTED** Recommendation 14/07 *To standardise the presentation of scientific information in the annual Scientific Committee report and in Working Party report.* The Recommendation builds upon the excellent work to date by the Scientific Committee, its working parties and the IOTC Secretariat to standardise the presentation of scientific information in their annual reports, including via the *'Executive Summaries'* for each stock. In this context and in order to support scientific advice made available by the IOTC Scientific Committee, the executive summaries of the annual IOTC Scientific Committee report which present the stock assessment results may include, when possible as defined in this proposal, clearly: Stock status; Model outlooks; Data quality and limitations of the assessment models; Alternative approach (data poor stocks). (S18 Report, para. 128)

DISCUSSION

Relevant experts present at the SC17 should consider the newly adopted Recommendation 14/07 and in a small working group, revise the current guidelines for the consideration and adoption by the SC17.

RECOMMENDATION/S

That the Scientific Committee:

1) **NOTE** paper IOTC–2014–SC17–06 which requested that the Scientific Committee (SC) revise the current '*Guidelines for the presentation of CPUE standardisations and stock assessment models'*, noting that the Commission adopted Recommendation 14/07 *To standardise the presentation of scientific information in the annual Scientific Committee report and in Working Party reports*, at its 18th Session in 2014.
2) **ADOPTED** revised '*Guidelines for the presentation of CPUE standardisations and stock assessment models'* for use by its working parties in 2015 and future years.

APPENDICES

Appendix I: 2012: Guidelines for the presentation of stock assessment models

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

APPENDIX I

GUIDELINES FOR THE PRESENTATION OF STOCK ASSESSMENT MODELS

Extract from the Fifteenth Session of the Scientific Committee
(IOTC–2012–SC15–R; pages 270–274; Appendix XXXVII)

These guidelines attempt to ensure greater transparency and facilitate peer-review of models employed in the provision of advice on the status of the stocks. Scientists presenting stock assessment model runs should provide to the IOTC Secretariat a copy of all input and output files, for all runs presented, and of the executable file or files used within 10 days of the end of each meeting. These will be archived for future testing and replication. Scientists are encouraged to freely share the source code of the methods used. The IOTC scientists/Stock Assessment Expert will support CPC's in meeting these guidelines.

While this is not an all encompassing list, these documents should describe:

1) The available catch data and mention, if necessary, data sources or observations not included in the analysis.
2) Available indices of abundance used.
3) Available tag data used
4) Assumptions made on parameter values used as constants.
5) Parameters estimated and priors specified if used in parameter estimation.
6) Population trajectories and dynamics with respect to reference points.
7) Residual diagnostics on both CPUE derived indices (e.g. qq plots, observed versus fitted values, fitted versus residuals scatter plots).
8) Residual plots of model versus observed CPUE, and observed versus actual catch compositions should be presented.
9) When referring to datasets provided by the Secretariat, the date, coverage and precise database should be mentioned.
10) Data sources not previously seen by a Working Party may need a separate document presenting them. This includes standardized CPUE series or other data sources processed prior to use.
11) The population dynamics that are modelled and the techniques used should be clearly presented including a description of the partition, annual cycle, and other relevant population processes.
12) Alternative scenarios and retrospective analyses should ideally be carried and, if included, a description of the motivation for the selection of base and alternative cases should be added, giving detail of how the alternative case assumptions differ from those of the base case.
13) The description of any retrospective analyses should cover the assumptions involved and results obtained.
14) Projections should be similarly documented as detailed below

Documentation requirement and guidelines

While these guidelines are basic good practices to include in the assessments and background data that go into the assessments (including CPUEs), they are not meant to preclude CPC's from presenting data or assessment models.

Software inspection and archival

- Input and output files of all alternative runs or scenarios presented should be made available during the meeting for inspection by interested members and for later archiving by the Secretariat. Ideally, these should be stored together with a copy of the software used in the analysis. When this is not possible due to licensing issues, a complete reference of the versions of both software and operating system employed should be made. Similarly, confidential inputs need not be provided but they should be documented and identified.
- Software used should ideally be open sourced using an appropriate license, or at least be made available to interested parties for inspection under a limited license. If closed source software is used, this should be clearly justified and sufficient tests as to its validity and reliability, under similar circumstances as those under which it will be used in IOTC-related work, should be carried out and its results made available. Even if the software is not available/open sourced, an executable should be part of the documentation so anyone could run the model.
- Comprehensive testing, including testing of the influence of various assumptions, is greatly encouraged in all cases.

Observations

- Describe the available data and mention, if necessary, data sources or observations not included in the analysis. When referring to datasets provided by the Secretariat, indicate the date, coverage (years, fleets, areas), and precise database (*e.g.* Nominal Catch, Catch and Effort).
- Data sources not previously seen by a Working Party might need their own document presenting them. This includes standardized CPUE series or other data sources processed prior to use.

Standardised CPUE indices of abundance

- Description of data pre-processing (*e.g.* treatment of outliers, selection of core areas if applicable)
- Efforts should be made to describe temporal and spatial patterns in the data, identifying gaps or sudden operational changes that that lead to an unbalanced design.
- Software and specific function calls
- Standard diagnostic plots (e.g. residuals, leverage plots, qq plots, observed versus fitted values, fitted versus residuals scatter plots)
- Parameter values, including error estimates for the final model used.
- For complicated models, a stepwise progression from simpler models should be documented to help identify confounding, and a distinction between statistical significance and practical significance.
- Efforts should be made to circulate these analyses well in advance of the relevant working party to allow discussion, and timely implementation in the stock assessment analyses.

Population dynamics

- Describe the population dynamics that are modelled and the techniques used including a description of the partition (age/length/sex groups, maturity, spatial structure, movement dynamics, if necessary), annual cycle (time steps, growth assumptions, natural and fishing mortality functions, recruitment, and sequence of those), and relevant population processes. Fixed parameters should be identified and documented. Emphasis should be placed in describing the formal statistical methods applied, including modelling methods, and form, limits and assumptions of both free and derived parameters.

Statistical methods

- Describe of the formal statistical methods, including
    1. Software name, version number, bibliographic references and source
    2. Maximum likelihood or objective function
    3. Bootstrap assumptions and MCMC algorithm, if used.
- Describe the free parameters used by the model, including
    1. Name and description of the parameter
    2. Details of the estimation bounds/functional relationships with other parameters
    3. Details of the prior assumed (if any), and source of the prior
    4. Weightings for likelihood terms
    5. Adjustment of variance by scaling/adding process error
    6. Penalties
- Describe the derived parameters used by the model, including
    1. Name, description and definitions of derived parameters (be precise with those that have alternative definitions, e.g., B0, MSY, BMSY)
    2. Details of any bounds/functional relationships with other parameters.
    3. Details of any priors assumed (including source).

Scenarios and retrospective analyses

- Alternative scenarios and retrospective analyses should be carried when possible and, if included, a description of the motivation for the selection of base and alternative cases should be added, giving detail of how the alternative case assumptions differ from those of the base case. Description of any retrospective analyses, should cover the assumptions involved and results obtained. Projections should be similarly documented.

Standards for assessment outputs:

Management quantities:

As **AGREED** by the IOTC Scientific Committee, assessments shall be presented with the minimum set of management quantities, where possible. Examples (Example 1) indicating the derived management quantities with uncertainty are shown below.

EXAMPLE 1: Species stock status summary

Management Quantity	Aggregate Indian Ocean
2011 catch estimate	38,946 t
Mean catch from 2007–2011	41,609 t
MSY (80% CI)	33,300 (31,100–35,600)
Data period used in assessment	1950–2010
$F_{current}/F_{MSY}$ (80% CI)	1.33 (0.90–1.76)
$B_{current}/B_{MSY}$ (80% CI)	–
$SB_{current}/SB_{MSY}$ (80% CI)	1.05 (0.54–1.56)
$B_{current}/B_0$ (80% CI)	–
$SB_{current}/SB_0$	0.29 (n.a.)
$B_{current}/B_{0,\ F=0}$	–
$SB_{current}/SB_{0,\ F=0}$	–

Kobe II Strategy Matrix

The Commission has requested that Kobe II management strategy matrices be provided for all stock assessments by the species Working Parties, and for these to be included in the report of the SC:

S16: "*The Commission **NOTED** the provision by the SC of the Kobe II strategy matrix for bigeye tuna, skipjack tuna, yellowfin tuna and swordfish (IO and SWIO) and recognized that it is a useful and necessary tool for management. The Commission **REQUESTS** that such matrices shall be provided for all stock assessments by the species Working Parties, and for these to be included in the report of the SC in 2012 and all future reports.*" (para. 33 of the S16 report).

Initial projections should be at a coarse level, i.e. current catch levels, ± 20% and ± 40% (see example 2 below). However, once these initial projections have been run, finer scale projections (e.g. ± 5, 10 and 15%) should be undertaken and included in the assessment paper (see example 3 below) that are related to possible management actions being investigated.

EXAMPLE 2: Swordfish: Aggregated Indian Ocean assessment - Kobe 2 Strategy Matrix, indicating a range of probabilities across four assessment approaches. Probability (percentage) of violating the MSY-based reference points for five constant catch projections (2009 catch level, ± 20% and ± 40%) projected for 3 and 10 years.

Reference point and projection timeframe	Alternative catch projections (relative to 2009) and probability (%) of violating reference point				
	60%	**80%**	**100%**	**120%**	**140%**
$B_{2012} < B_{MSY}$	0–4	0–8	0–11	2–12	4–16
$F_{2012} > F_{MSY}$	0–1	0–2	0–9	0–16	6–27
$B_{2019} < B_{MSY}$	0–4	0–8	0–11	0–13	6–26
$F_{2019} > F_{MSY}$	0–1	0–2	0–9	0–23	7–31

EXAMPLE 3: ASPIC Aggregated Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of violating the target MSY-based reference points for eight constant catch projections (2010 catch level, ± 10%, ± 20%, ± 40% and -15%) projected for 3 and 10 years.

Target Reference point and projection timeframe	Alternative catch projections (relative to 2010) and probability (%) of violating MSY reference points							
	60% (catch t)	**80%** (catch t)	**85%** (catch t)	**90%** (catch t)	**100%** (catch t)	**110%** (catch t)	**120%** (catch t)	**140%** (catch t)
$B_{2013} < B_{MSY}$	45	48	50	53	57	62	67	81
$F_{2013} > F_{MSY}$	11	47	54	58	66	71	76	82
$B_{2020} < B_{MSY}$	18	51	59	66	74	82	87	91
$F_{2020} > F_{MSY}$	<1	49	61	70	82	89	91	96

EXAMPLE 4: ASPIC Aggregated Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of violating the limit MSY-based reference points for eight constant catch projections (2010 catch level, ± 10%, ± 20%, ± 40% and -15%) projected for 3 and 10 years.

Limit Reference point and projection timeframe	Alternative catch projections (relative to 2010) and probability (%) of violating MSY reference points							
	60% (catch t)	**80%** (catch t)	**85%** (catch t)	**90%** (catch t)	**100%** (catch t)	**110%** (catch t)	**120%** (catch t)	**140%** (catch t)
$B_{2013} < B_{MSY}$	0	0	0	0	10	10	15	17
$F_{2013} > F_{MSY}$	0	0	0	0	9	12	12	12
$B_{2020} < B_{MSY}$	0	0	0	0	7		7	7
$F_{2020} > F_{MSY}$	0	0	0	0	5	5	5	5

KOBE Plots

1) A KOBE plot must be provided with each stock assessment paper as requested by the Commission
Some description describing the axes used (derived quantity, B_{MSY}, SB_{MSY}, F_{MSY}, C_{MSY}, etc). The plot trajectory should be described in recent years (example 4).
2) Interim target and limit reference points should be plotted as well.

As requested by the Commission and detailed in IOTC Recommendation 12/14 (para. 1):

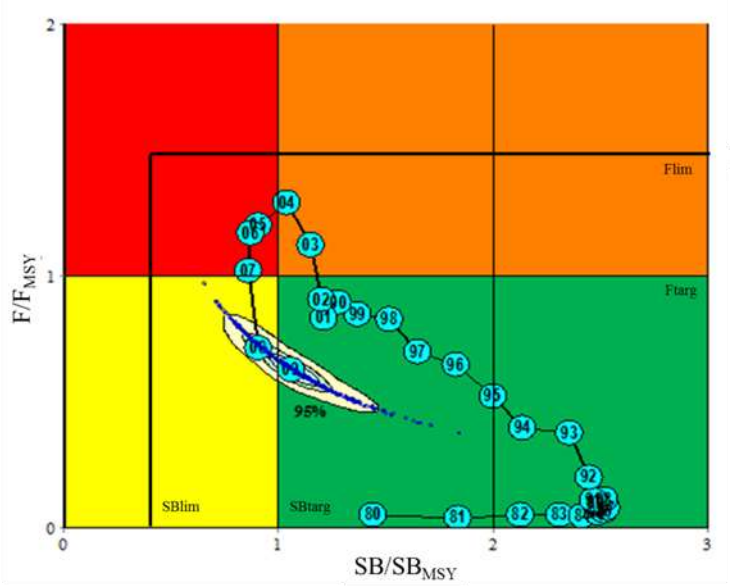
Para 1: *When assessing stock status and providing recommendations to the Commission, the Scientific Committee should apply the following interim target and limit reference points for the species of tuna and tuna-like species listed in* ***Table 1****. B_{MSY} refers to the biomass level for the stock that would produce the Maximum Sustainable Yield; F_{MSY} refers to the level of fishing mortality that produces the Maximum Sustainable Yield.*

Table 1. Interim target and limit reference points.

Stock	Target Reference Point	Limit Reference Point
Albacore tuna	B_{MSY}; F_{MSY}	40% of B_{MSY}; 40% above F_{MSY}
Bigeye tuna	B_{MSY}; F_{MSY}	50% of B_{MSY}; 30% above F_{MSY}
Skipjack tuna	B_{MSY}; F_{MSY}	40% of B_{MSY}; 50% above F_{MSY}
Yellowfin tuna	B_{MSY}; F_{MSY}	40% of B_{MSY}; 40% above F_{MSY}
Swordfish	B_{MSY}; F_{MSY}	40% of B_{MSY}; 40% above F_{MSY}

If a stock assessment is undertaken for a species other than those listed in IOTC Recommendation 12/14 (shown above) then the following default interim target and limit reference points shall be shown on the Kobe plot:

Stock	Target Reference Point	Limit Reference Point
Other IOTC species	B_{MSY}; F_{MSY}	50% of B_{MSY}; 20% above F_{MSY}



EXAMPLE 4: Swordfish: ASPIC Aggregated Indian Ocean assessment Kobe plot (95% Confidence surfaces shown around 2009 estimate). Blue circles indicate the trajectory of the point estimates for the SB ratio and F ratio for each year 1950–2010. Target (Ftarg and SBtarg) and limit (Flim and SBlim) reference points are shown to be 0.4 and 1.4 of SB_{MSY} and F_{MSY} respectively.

Deadlines for availability of data for stock assessments need to be adhered to:

As **AGREED** by the Scientific Committee in 2011:

1) The SC also **ENCOURAGED** data to be used in stock assessments, including CPUE standardisations, be made available not less than three months before each meeting by CPCs and where possible, data summaries no later than two months prior to each meeting, from the IOTC Secretariat; and **RECOMMENDED** that data to be used in stock assessments, including CPUE standardisations be made available not less than 30 days before each meeting by CPCs.
2) Stock assessment papers need to be provided to the Secretariat for posting to the IOTC website no later than 15 days before the commencement of the relevant meeting.

APPENDIX II

RECOMMENDATION 14/07
TO STANDARDISE THE PRESENTATION OF SCIENTIFIC INFORMATION IN THE ANNUAL SCIENTIFIC COMMITTEE REPORT AND IN WORKING PARTY REPORTS

The Indian Ocean Tuna Commission (IOTC),

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

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

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

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

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

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

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

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

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

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

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

   Stock status

   a) A Kobe plot/chart showing:

      i. Any Target and Limit Reference Points adopted by the Commission, e.g. F_{MSY} and F_{LIM}, SB_{MSY} and SB_{LIM} or B_{MSY} and B_{LIM}, depending on the assessment models used by the Scientific Committee, or proxies where available;

      ii. The stock estimates, expressed in reference to Target Reference Points adopted by the Commission, e.g. as $F_{CURRENT}$ on F_{MSY} and as $SB_{CURRENT}$ on SB_{MSY} or as $B_{CURRENT}$ on B_{MSY};

      iii. The estimated uncertainty around estimates, provided that statistical methods to do so have been agreed upon the Scientific Committee and that sufficient data exist;

      iv. The stock status trajectory.

b) A graphical representation showing the proportion of model outputs of the years used for advice from the last stock assessment that are within the green quadrant of the Kobe plot/chart (not overfished, not subject to overfishing), the yellow and orange quadrants (overfished or subject to overfishing) and the red quadrant (overfished and subject to overfishing).

Model outlooks

c) Two Kobe II strategy matrices:

i. A first one indicating the probability of complying with the Target Reference Points adopted by the Commission, e.g. the probability of either $SB>SB_{MSY}$ or $B>B_{MSY}$ and of $F<F_{MSY}$ for different levels of catch across multiple years;

ii. A second one indicating the probability of being inside safe biological limits expressed through Limit Reference Points adopted by the Commission, e.g. the probability of either $SB>SB_{LIM}$ or $B>B_{LIM}$ and of $F<F_{LIM}$ for different levels of catch across multiple years;

iii. When the Commission agrees on acceptable probability levels associated with the target and limit reference points on a stock by stock basis, the Scientific Committee could prepare and include, in the annual report, the Kobe II strategy matrices using colour coding corresponding to these thresholds.

Data quality and limitations of the assessment models

d) A statement qualifying the quality, the reliability and where relevant the representativeness of input data to stock assessments, such as, but not limited to:

i. Fisheries statistics and fisheries indicators (e.g. catch and effort, catch-at size and catch at age matrices by sex and, when applicable, fisheries dependent indices of abundance);

ii. Biological information (e.g. growth parameters, natural mortality, maturity and fecundity, migration patterns and stock structure, fisheries independent indices of abundance);

iii. Complementary information (e.g. consistencies among available abundance indices, influence of the environmental factors on the dynamic of the stock, changes in fishing effort distribution, selectivity and fishing power, changes in target species).

e) A statement qualifying the limits of the assessment model with respect to the type and the quality of the input data and expressing the possible biases in the assessment results associated with uncertainties of the input data;

f) A statement concerning the reliability of the projections carried out over the long term.

Alternative approach (data poor stocks)

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

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

3. The Commission encourages the IOTC Scientific Committee to include either in its annual report or in the detailed reports, where possible and if considered as relevant and useful, any other tables and/or graphics supporting scientific advice and management recommendations. In particular, the IOTC Scientific Committee will include, where possible, information on the recruitment trajectories, on the stock-recruitment relationship and some ratio such as yield per recruit or biomass per recruit.

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