TERMS OF REFERENCE FOR THE PROVISION OF SCIENTIFIC SERVICES TO THE IOTC
YELLOWFIN TUNA (*THUNNUS ALBACARES*) STOCK ASSESSMENT USING STOCK SYNTHESIS III (SS3)

Scientific Services to be provided:
Following the assessments of the Indian Ocean yellowfin tuna (*Thunnus albacares*) stock undertaken in 2008, 2009, 2011 and 2012 using the integrated model MultiFan-CL, the IOTC requires a short term consultancy for the following activities:

YELLOWFIN TUNA STOCK ASSESSMENT

1. To undertake an assessment using the Stock Synthesis III (SS3) platform, and draft a working paper to be presented at the WPTT17 (23–28 October 2015).
2. The assessment will be expected to consider data submitted before the data submission deadline of 60 days before the meeting (24 August 2015), data received after this will not necessarily be considered by the consultant, and will not be considered if received after 23 September 2015 (less than 30 days before the meeting).
3. The new assessment shall incorporate the 2012 assessment discussions/comments of the WPTT and the SC, and use updated and additional data available (i.e. fisheries, tagging and biological data). The assessment shall incorporate projections for 10 years and include Kobe II Management Strategy Matrices, as required by the Commission and detailed in the IOTC *Guidelines for the presentation of CPUE standardisations and stock assessment models*, adopted by the IOTC Scientific Committee in 2014.
4. To conduct, to the extent possible in the available time, sensitivity runs with alternative parameters (e.g. natural mortality, growth, selectivity, steepness, aggregate vs. disaggregated spatial structure, etc.) including the following:
    - ***Review the spatial stratification:***
        - The previous yellowfin tuna assessment structure included 5 regions defined by fishery operations, catch-at-size distributions and Longhurst biogeographical areas. There are limited tag recoveries and no reporting rate estimates outside of the core purse seine fishery region (region 2). This induces limitations for the model to estimate movement rates between areas, for which the current results appear to be unrealistic.
        - If movement among all regions cannot be estimated, there may be insufficient justification to retain this structure in the model and management advice, and should be reconsidered. If current movement estimates are to be believed it may be necessary to treat the stock as two separate populations (West IO and East IO), or as a single Indian Ocean stock. Some examination of this hypothesis should be examined and documented by the consultant.
        - Consider if further partitioning the core purse seine area would be useful, into smaller sub-regions from which it may be possible to estimate movement. In addition the examination of the new tagging data, and a possibly simpler two area model in the West IO could be examined as the purse seine fleets are mostly operational in these areas.
    - ***Integration of all (including small-scale and recent recoveries) tagging data***
    - ***Explore alternative M values.*** The different tuna-RFMOs use very different M estimates/assumptions in their tropical tuna stock assessments, but it is not clear that there is compelling evidence for real biological differences.
        - Range of values accepted in other RFMOs
        - Values estimated using independent Brownie/Brownie Peterson (B/BP) estimators
        - Internal estimates from the integrated model
- ***Movement estimates are doubtful when inferred in the absence of tag recoveries. For any spatial structure that includes such estimates, effort should be made to describe the movement uncertainty:***
        - How do the other parameter estimates and stock status inferences change when alternative

fixed migration rates are imposed for the areas and ages with few recoveries and unknown reporting?
  - If B/BP movement estimates can be used as fixed input, how do they affect the model dynamics? Do they provide compelling evidence for variability in movement by age/season or year that cannot be adequately described in the integrated models?
  - How do the movement rates vary in relation to the variance-related assumptions for CPUE and size composition data?
  - In the previous yellowfin tuna assessment, there appeared to be sensitivity to stationary purse seine selectivity assumptions (likely change around the 2004-2006 peak catch years). Alternative options of temporal variability in selectivity should be explored, especially in relation to the independent F estimates derived from the B/BP analyses.
  - All tuna stock assessments are also sensitive to longline selectivity assumptions (logistic vs. dome-shaped). This question should be investigated in relation to alternative M options.
- ***Examine conflicts among different sources of data and assumptions.*** In addition to the explorations above, interactions/conflicts among the tagging, CPUE and size frequency should be quantified by down-weighting the different data sources. This could also be done in context of a structural uncertainty grid, where other assumptions on selectivity, natural mortality and steepness could be examined.

The above explorations should be summarised to describe which of the plausible assumptions have important implications for management advice. The interactions among the most important assumptions should be recognised in the stock status advice.

- ***Estimates of uncertainty*** need to be provided in relation to all of the important structural assumptions and parameter estimation errors that are of interest for management. This could either be done with MCMC or with an uncertainty grid that covers many of the structural uncertainties described above.

5. To document the assessment in accordance with the IOTC "*Guidelines for the presentation of CPUE standardisations and stock assessment models*", adopted by the IOTC Scientific Committee in 2014; and to provide a draft report to the IOTC Secretariat no later than 30 days prior to meeting of the WPTT, i.e. 23rd September 2015, and the final report no later than 15 days prior to the meeting of the WPTT, i.e. 8th October 2015.
6. To present the results of the work undertaken to the WPTT to be held in Montpellier, France from the 23–28 October 2015.
7. To undertake any additional analyses deemed relevant by the WPTT or the IOTC Secretariat up to 60 days after the start date of the contract.
8. To provide an updated stock assessment report no later than 15 days after the meeting of the WPTT17, i.e. 12th November 2015, which will be updated using the model run(s) agreed to during the WPTT17 meeting, and the subsequent projections, management quantities and Kobe II Management Strategy Matrices.

Conditions and payment:
In total this Service will require 60 days of work and will include a mission to Montpellier, France to attend the 17th Session of the IOTC Working Party on Tropical Tunas (WPTT17).

The IOTC Secretariat will also pay the cost of a return airfare from the contractor's home to the WPTT17 meeting in Montpellier, France. A Daily Subsistence Allowance will be paid in accordance with FAO procedures for attendance at the Working Party meeting.

Expected Outputs:
- To provide a draft report of the yellowfin tuna stock assessment to the IOTC Secretariat no later than 30 days prior to meeting of the WPTT, i.e. 23rd September 2015, and the final report no later than 15 days prior to the meeting of the WPTT, i.e. 8th October 2015.
- To present the results of the work undertaken to the WPTT17 to be held in Montpellier, France from the 22–28 October 2015.
- To provide the final report of the yellowfin tuna stock assessment no later than 15 days after the

meeting of the WPTT17, i.e. 12th November 2015.

Expressions of Interest:
Deadline for Submission: Monday 2 March 2015 - Please refer to the attached Terms of Reference and email application/CV to Secretariat@iotc.org with heading: **YELLOWFIN TUNA ASSESSMENT**