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Proposed workshop on Indian Ocean longline CPUE standardization methods

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Summary

Commercial Catch Per Unit Effort (CPUE) is a critical input to all of the model-based stock assessments conducted by the IOTC. CPUE needs to be standardized to account for changes in catchability over time, so that it can be interpreted as a relative abundance index, and used to make inferences about the impact of the fishery on the population. The working parties have noted concerns about all of the standardized CPUE series and the timeframe for exchange (e.g. see Working Party Report extracts in attachment 1). A dedicated CPUE workshop has been proposed to help improve the CPUE analyses. It is suggested that the Working Party on Methods might develop the Terms of Reference for such a workshop, noting the following:

1. Many of the data and CPUE issues are the same for the different species, but different analysts use different methods of standardization, different data resolution, etc., for reasons that are not clear.

2. The different CPUE analysts should meet, along with invited experts with relevant experience from other oceans, to compare and further develop methods for standardizing the longline CPUE series for the different species.

3. The analyses recommended by the WPTmT 2011 (attached) provide an initial list of topics for consideration.

4. Holding the workshop well in advance of the 2012 working parties would ensure that data exchange guidelines would be met for 2012, and would allow the analysts sufficient time to incorporate results into the assessment models.

5. Concerns about the standardization for pole and line and purse seine CPUE for skipjack tuna assessment are also an important concern. However the issues are very different from the longline fisheries and might be best addressed in a different forum.

Attachment 1: CPUE-related comments from the WPTmT 2011, WPB 2011 and WPTT 2010

CPUE-related extracts from 2011 WPTmT Final Report:

ALB(longline)

CPUE discussion summary

61. The WPTmT **RECOMMENDED** that the following matters be taken into account when undertaking CPUE standardisation analysis:

- The WPTmT **AGREED** that changes in species targeting is the most important issue to address in CPUE standardisations, and that the following points should be taken into consideration:

  i. While hooks between floats (HBF) provides some indication of setting depth, it is generally considered not to be a sufficient indicator of species targeting. HBF is just one aspect of the setting technique, which can vary by species, area, set-time, and other factors.

  ii. Highly aggregated (e.g. 5x5 degree) data can make it difficult to observe the factors driving CPUE in a fishery, in particular the targeting effects. Operational data provides additional information that may allow effort to be classified according to fishing strategy (e.g. using cluster analyses or regression trees to estimate species targeting as a function of spatial areas, bait type, catch species composition, set-time, vessel-identity, skipper, etc.). Operational data also permits vessel effects to be included in analyses.

  iii. The inclusion of other species as factors in a GLM standardization may be misleading, because the abundance of all species changes over time. Including these factors may also fail to resolve problems due to changes in targeting, particularly when modeling aggregated data. However, comparing models with and without the other species factors can be useful to identify whether there is likely to be a targeting problem.

- The WPTmT **AGREED** that appropriate spatial structure needs to be considered carefully as fish density (and targeting practices) can be highly variable on a fine spatial scale, and it can be misleading to assume that large areas are homogenous when there are large shifts in the spatial distribution of effort. The following points should also be taken into consideration:
  i. Addition of finer scale (e.g. 5x5 degree) fixed spatial effects in the model can help to account for heterogeneity within sub-regions.
  ii. Efforts should be made to identify spatial units that are relatively homogeneous in terms of the population and fishery to the extent possible (e.g. uniform catch size composition and targeting practices).
  iii. There may be advantages in conducting separate analyses for different sub-regions. The error distribution may differ by sub-region (e.g. proportion of zero sets), and there may be very different interactions among explanatory variables.
  iv. If the selectivity differs among regions (e.g. due to spatial variability in the age composition of the population, it may not be appropriate to pool sub-regional indices into a regional index (e.g. albacore populations seem to be partitioned with spawners caught predominantly in the equatorial/tropical regions and juveniles caught predominantly in the temperate waters and the two age categories could have somewhat different CPUE trends).
  v. The possibility of defining a representative 'space-time' window: if this leads to the identification of a fishery with homogeneous targeting practices, it is probably worthwhile. However, it may not be possible to identify an appropriate window, or the

window may be so small that it is not representative of the larger population (or has a high variance).

- The WPTmT **AGREED** that if there are many observations with positive effort and zero catch, it is worth considering models which explicitly model the processes that lead to the zero observations (e.g. negative binomial, zero-inflated or delta models). Adding a small constant to the lognormal model may be okay if there are few zeroes, but may not be appropriate for areas with many zero catches (e.g. north of 10^0S). Sensitivity to the choice of constant should be tested.
- The WPTmT **NOTED** that the appropriate inclusion of environmental variables in CPUE standardization is an ongoing research topic. The WPTmT **AGREED** that often these variables do not have as much explanatory power as, or may be confounded with, fixed spatial effects. This may indicate that model-derived environmental fields are not accurate enough at this time, or there may need to be careful consideration of the mechanisms of interaction to include the variable in the most informative way.
- The WPTmT **AGREED** that it is difficult to prescribe analyses in advance, and model building should be undertaken as an iterative process to investigate the processes in the fishery that affect the relationship between CPUE and abundance. Specifically:
  i. Model building should proceed with a stepwise introduction of explanatory terms, in which the net effect of each level of complexity is presented. Parameter estimates should be presented and examined to see if the mechanism makes sense and the contribution has a practical influence.
  ii. Simulations have shown that model selection using Akaike Information Criterion (AIC) tends to recommend over-parameterized models.

62. The WPTmT **NOTED** that there were concerns about both the Taiwan,China and Japanese CPUE series for albacore that warranted further investigation. It was expected that the Taiwan,China CPUE would be more closely related to albacore abundance at this time, because a substantial part of the Taiwanese fleet has always targeted albacore. Conversely, the Japanese CPUE seems to demonstrate very strong targeting shifts away from albacore (1960s) and back towards albacore in recent years (as a consequence of piracy in the western Indian Ocean).

64. The WPTmT 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.

65. The WPTmT **RECOMMENDED** that a dedicated workshop on CPUE standardization, including issues of interest for other IOTC species should be carried out before the next round of stock assessments in 2012, possibly coordinated under the IOTC Working Party on Methods, and that where possible it should include a range of invited experts, including those working on CPUE standardisation in other ocean/RFMOs.

CPUE-related extracts from 2011 WPB Final Report:

SWO (longline)

112. The WPB **AGREED** that further progress might be made in a dedicated CPUE workshop, possibly coordinated under the IOTC Methods Working Group, as the same issues are relevant for most of the main species.

118. The WPB **RECOMMENDED** that a dedicated workshop on CPUE standardization, including issues of interest for other IOTC species should be carried out before the next round of stock IOTC–2011–WPB09–R[E] assessments in 2012, and that where possible it should include a range of invited experts (as agreed in para. 112).

119. The WPB **NOTED** that CPUE standardisation and stock assessments should be carried out well in advance of working party meetings in future years (see para. 153).

153. The WPB **ENCOURAGED** data to be used in billfish stock assessments, including standardised CPUE, be made available not less than three months before each meeting by CPCs and where possible, data summaries no later than one month prior to each meeting, from the IOTC Secretariat.

Marlins and Sailfish (longline)

108. The WPB **RECOMMENDED** that marlins and sailfish undergo CPUE analysis in 2012, with striped marlin taking priority over other species.

109. The WPB **RECOMMENDED** that as a matter of priority, striped marlin be the subject of CPUE analysis in 2011, and that CPUE series be compared among fleets where possible.

112. The WPB **AGREED** that further progress might be made in a dedicated CPUE workshop, possibly coordinated under the IOTC Methods Working Group, as the same issues are relevant for most of the main species.

118. The WPB **RECOMMENDED** that a dedicated workshop on CPUE standardization, including issues of interest for other IOTC species should be carried out before the next round of stock assessments in 2012, and that where possible it should include a range of invited experts (as agreed in para. 112).

CPUE-related extracts from 2010 WPTT Final Report:

YFT (longline)

157. The main source of information on abundance trends for stock assessment purposes is the index of abundance derived from the Japanese longline CPUE series. Concerns have been raised on the ability of this standardized CPUE series to represent the yellowfin stock abundance in the Indian Ocean. This index has shown steep declining trends in the Western tropical area, where most of the catches occur, over the last five years. The WPTT acknowledges the difficulty of fully understanding and quantifying changes in the fishery that would help interpreting the patterns observed in the index of abundance.

BET (longline)

193. The standardized Japanese longline CPUE index, together with the catch data, represents the most important input in the stock assessment on the abundance of the stock. There have clearly been

large temporal changes in the gear configurations and spatial distributions of effort in this fishery, and it remains unclear how well the standardization can account for these effects.

SKJ (pole and line; purse seine)

200. Some issues were raised by the group about the number of vessels derived from the vessel registry as the separation between handline and pole-and-line vessels were not made. The WPTT noted that the 10-fold increase in the SKJ catches from about 50,000 t in the 1950s should have resulted in a strong decline in the catch rates of the fishery well before 2005. The WG recognized that there were strong similarities between the Maldivian pole-and-line and the European purse-seine fisheries in the difficulties associated with estimating fishing effort, *i.e.* the definition of a unit of fishing effort for tuna schools associated with FADs and the monitoring of changes in fishing technology and power over time. Although vessel size might be a good proxy of variables such as engine power, it does not allow represent modifications of electronic equipment used to improve the detection of schools. In the western Pacific Ocean, information collected about the introduction of electronic components (*e.g.* sonar, *etc.*) available from the logbooks of the Japanese pole and line fishery revealed significant positive effects of such technology for locating tuna schools. It was also noted that the importance of FADs steadily increased in the last two decades and that they play a major role in increasing the catchability of tunas. The use of a FAD-deployment database available in the Maldives was encouraged in future approaches to improve the time series of CPUE by including the number of FADs in the catch rates standardization process.

201. Aside from the difficulties of practically capturing the technological developments in the fishery, it was noted that availability of livebait will always be an issue when one considers estimating the CPUE indices from baitboat data. Unless very fine scale data, such as vessel track plots that may be used to partition the times for baiting, searching and fishing, are available, reliable estimation of CPUE indices will be an issues.

202. The CPUE series of skipjack for the European purse-seine fleet is presented in Figure 41. The nominal CPUE has remained fairly stable, despite the long history of intense fishing on this stock. Although attempts have been made at standardizing this CPUE series to account for changes in efficiency, no reliable index of abundance is currently available.

203. Acknowledging the usefulness of standardizing CPUE for skipjack, the WPTT recommended that the work is pursued and that progress are presented at the next Session.