Report of the Fifteenth Session of the IOTC Working Party on Tropical Tunas

San Sebastian, Spain, 23–28 October 2013

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ACRONYMS

aFAD	anchored Fish aggregating device
ASPM	Age-Structured Production Model
B	Biomass (total)
BET	Bigeye tuna
B_{MSY}	Biomass which produces MSY
CE	Catch and effort
CI	Confidence Interval
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.
DWLL	Distant water longline (vessel)
EEZ	Exclusive Economic Zone
ENSO	El Niño–Southern Oscillation
EU	European Union
F	Fishing mortality; F_{2011} is the fishing mortality estimated in the year 2011
FAD	Fish aggregating device
F_{MSY}	Fishing mortality at MSY
GLM	Generalised linear model
HBF	Hooks between floats
IO	Indian Ocean
IOTC	Indian Ocean Tuna Commission
K2SM	Kobe II Strategy Matrix
LL	Longline
M	Natural Mortality
MSC	Marine Stewardship Council
MSE	Management Strategy Evaluation
MSY	Maximum sustainable yield
n.a.	Not applicable
PS	Purse seine
q	Catchability
ROS	Regional Observer Scheme
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})
SKJ	Skipjack tuna
SS3	Stock Synthesis III
Taiwan,China	Taiwan, Province of China
VB	Von Bertalanffy (growth)
WPTT	Working Party on Tropical Tunas of the IOTC
YFT	Yellowfin tuna

HOW TO INTERPRET TERMINOLOGY CONTAINED IN THIS REPORT

Level 1: **RECOMMENDED, RECOMMENDATION**: Any conclusion from a subsidiary body of the Commission 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). The intention is that the higher body will consider the recommended action for endorsement.

Level 2: **REQUESTED**: A request from an IOTC body to a particular CPC, the IOTC Secretariat, or other body (not the Commission) to carry out a specified task. Ideally this should be highly specific and contain a timeframe for the completion of the task.

Level 3: **AGREED**: Any point of discussion from a meeting which the IOTC body considers to be an agreed course of action for the IOTC body, or a general point of agreement among participants of the meeting.

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 perpetuity.

Any other term: Any other term may be used in addition to the above key terms to highlight to the reader the importance of the relevant paragraph in a report. However, other terms used are considered for explanatory/informational purposes only and have no rating within the reporting terminology hierarchy described above (e.g. **CONSIDERED**; **URGED**; **ACKNOWLEDGED**).

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EXECUTIVE SUMMARY

The Fifteenth Session of the Indian Ocean Tuna Commission's (IOTC) Working Party on Tropical Tunas (WPTT) was held in San Sebastian, Spain, from 23 to 28 October 2013. The meeting was opened on 23 October 2013 by the Chair, Dr Hilario Murua (EU-Spain), who welcomed participants to San Sebastian, Spain. A total of 46 participants attended the Session (47 in 2012), including one invited expert, Dr. Andrew Cooper, from Simon Fraser University, Canada. The following are a subset of the complete recommendations from the WPTT15 to the Scientific Committee, which are provided at Appendix XII.

Japan data collection and processing systems

The WPTT **THANKED** Japan for addressing some of the concerns raised by the WPTT in 2012, and **RECOMMENDED** that Japan and the IOTC Secretariat continue joint work, in cooperation with other countries having longline fisheries, to address other issues identified by the WPTT, as the lack of specimens of small size from the samples and discrepancies in the average weights estimated using the available catch-and-effort and length frequency data. (para. 62)

Taiwan,China data collection and processing systems

NOTING that in recent years fishers from the Taiwan,China longline fleet have been collecting both length and weight measurements for the same specimens, the WPTT **RECOMMENDED** that the measured lengths and lengths derived from weight measurements are compared in order to validate the reliability of this dataset (para. 67)

Length Frequency inter-sessional meeting guidelines

NOTING the size data issues (discrepancies in catch, effort and notably size data (low sampling rate, uneven distribution of sampling in regard to the spatial extent of the fishery) in the Japanese and Taiwan,China tropical tuna data sets) identified by the WPTT in 2012 and 2013 and the Scientific Committee in 2012, the WPTT **RECOMMENDED** that an inter-sessional meeting attached to the WPDCS and WPM on *data collection and processing systems for size data from the main longline fleets in the Indian Ocean*, be carried out in early 2014, under the guidelines contained in Appendix IV. (para. 74)

The WPTT **NOTED** that the data collection and processing systems used for distant-water longline fisheries tend to apply to all oceans **AGREEING** that it is likely that the issues identified for the Indian Ocean also apply to other areas. In this regard, the WPTT **RECOMMENDED** that the IOTC Secretariat informs other tuna-RFMO Secretariats about the issues identified and facilitates participation of their staff to the WPDCS, where required. (para. 75)

India fisheries

NOTING the potential utility of the longline CPUEs derived from the research surveys conducted by the "Fishery Survey of India", the WPTT **RECOMMENDED** that as a high priority, India undertake a standardisation of the CPUE series, with the support of the IOTC Secretariat, and for this to be presented at the next WPTT meeting. (para. 92)

Analysis of the Time-Area Closures (including Resolution 12/13)

NOTING that the objective of Resolution 12/13 is to decrease the overall pressure on the main targeted stocks in the Indian Ocean, in particular yellowfin tuna and bigeye tuna, and also to evaluate the impact of the current time/area closure and any alternative scenarios on tropical tuna population, the WPTT reiterated its previous **RECOMMENDATION** that the SC request that the Commission specify the level of reduction or the long term management objectives to be achieved with the current or alternative time area closures, as these are not contained within Resolution 12/13. (para. 245)

Review of the draft, and adoption of the Report of the Fifteenth Session of the WPTT

The WPTT **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPTT15, provided at Appendix XII, as well as the management advice provided in the draft resource stock status summary for each of the tropical tuna species under the IOTC mandate: (para. 271)

- Bigeye tuna (*Thunnus obesus*) – Appendix VII
- Skipjack tuna (*Katsuwonus pelamis*) – Appendix VIII
- Yellowfin tuna (*Thunnus albacares*) – Appendix IX

A summary of the stock status for tropical tuna species under the IOTC mandate is provided in Table 1.

Table 1. Status summary for species of tropical tuna under the IOTC mandate.

Stock	Indicators	2008	2009	2010	2011	2012	2013	Advice to Commission
Bigeye tuna *Thunnus obesus*	Catch 2012: 115,793 t Average catch 2008–2012: 107,603 t MSY (1000 t): 132 (98.5–207) F_{2012}/F_{MSY}: 0.42 (0.21–0.80) SB_{2012}/SB_{MSY}: 1.44 (0.87–2.22) $SB_{2012}SB_0$: 0.40 (0.27–0.54)	Green	Green	Green	Green	Green	Green	A new stock assessment was carried out in 2013. The stock is above a biomass level that would produce MSY in the long term (i.e. $SB_{2012}/SB_{MSY} > 1$) and current fishing mortality is below the MSY-based reference level (i.e. $F_{2012}/F_{MSY} < 1$). Current spawning stock biomass was estimated to be 40% of the unfished levels. Catches in 2012 (≈115,800 t) remain lower than the estimated MSY values from the 2013 stock assessment. The average catch over the previous five years (2008–12; ≈107,600 t) also remains below the estimated MSY. In 2012 catch levels of bigeye tuna increased markedly (~24% over values in 2011), especially longline catches. On the weight of stock status evidence available, the bigeye tuna stock is therefore **not overfished**, and is **not subject to overfishing**. <Click here for full stock status summary>
Skipjack tuna *Katsuwonus pelamis*	Catch 2012: 314,537 t Average catch 2008–2012: 400,980 t MSY (1000 t): 478 (359–598) F_{2011}/F_{MSY}: 0.80 (0.68–0.92) SB_{2011}/SB_{MSY}: 1.20 (1.01–1.40) SB_{2011}/SB_0: 0.45 (0.25–0.65)	Grey	Grey	Grey	Green	Green	Green	No new stock assessment was carried out for skipjack tuna in 2013. Previous results suggest that the stock is not overfished ($B>B_{MSY}$) and that overfishing is not occurring ($C<MSY$ and $F<F_{MSY}$). Spawning stock biomass was estimated to have declined by approximately 45 % in 2011 from unfished levels. Total catch has continued to decline with 314,537 t landed in 2012, in comparison to 384,537 t in 2011. Based on the stock assessment carried out in 2012, the stock was considered to be **not overfished** and **not subject to overfishing**. <Click here for full stock status summary>
Yellowfin tuna *Thunnus albacares*	Catch 2012: 368,663 t Average catch 2008–2012: 317,505 t MSY (1000 t): 344 (290–453) F_{2010}/F_{MSY}: 0.69 (0.59–0.90) SB_{2010}/SB_{MSY}: 1.24 (0.91–1.40) SB_{2010}/SB_0: 0.38 (0.28–0.38)	Red	Red	Yellow	Green	Green	Green	No new stock assessment was carried out for yellowfin tuna in 2013. The stock assessment model used in 2012 suggests that the stock is currently **not overfished** ($SB_{2010}>SB_{MSY}$) and **not subject to overfishing** ($F_{2010}<F_{MSY}$). Total catch has continued to increase with 368,663 t landed in 2012, a value over previous MSY estimates (344,000 t), in comparison to 327,490 t in 2011 and 300,000 t in 2010. However, catch rates have improved in the purse seine fishery while remaining stable for the Japanese longline fleet. Therefore it is difficult to know whether the stock is moving towards a state of being subject to overfishing. <Click here for full stock status summary>

Colour key	Stock overfished($SB_{year}/SB_{MSY} < 1$)	Stock not overfished ($SB_{year}/SB_{MSY} \geq 1$)
Stock subject to overfishing($F_{year}/F_{MSY} > 1$)	Red	Orange
Stock not subject to overfishing ($F_{year}/F_{MSY} \leq 1$)	Yellow	Green
Not assessed/Uncertain	Grey	

1. Opening of the Meeting

1. The Fifteenth Session of the Indian Ocean Tuna Commission's (IOTC) Working Party on Tropical Tunas (WPTT) was held in San Sebastian, Spain, from 23 to 28 October 2013. The meeting was opened on 23 October 2013 by the Chair, Dr Hilario Murua (EU-Spain), who welcomed participants to San Sebastian, Spain. A total of 46 participants attended the Session (47 in 2012), including one invited expert, Dr. Andrew Cooper, from Simon Fraser University, Canada. The list of participants is provided at Appendix I.

Meeting participation fund

2. **NOTING** that the IOTC Meeting Participation Fund (MPF), adopted by the Commission in 2010 (Resolution 10/05 *On the establishment of a Meeting Participation Fund for developing IOTC Members and non-Contracting Cooperating Parties*), was used to fund the participation of 10 national scientists to the WPTT15 meeting (8 in 2012), all of which were required to submit and present a working paper at the meeting, the WPTT **RECOMMENDED** that this fund be maintained into the future.

2. Adoption of the Agenda and Arrangements for the Session

3. The WPTT **ADOPTED** the Agenda provided at Appendix II. The documents presented to the WPTT15 are listed in Appendix III.

3. Outcomes of the Fifteenth Session of the Scientific Committee

4. The WPTT **NOTED** paper IOTC–2013–WPTT15–03 which outlined the main outcomes of the Fifteenth Session of the Scientific Committee (SC15), specifically related to the work of the WPTT.

5. The WPTT **NOTED** the recommendations of the SC15 on data and research, and **AGREED** to consider how best to progress these issues at the present meeting.

4. Outcomes of Sessions of the Commission

4.1 Outcomes of the Seventeenth Session of the Commission

6. The WPTT **NOTED** paper IOTC–2013–WPTT15–04 which outlined the main outcomes of the Seventeenth Session of the Commission, specifically related to the work of the WPTT and **AGREED** to consider how best to provide the SC with the information it needs, in order to satisfy the Commission's requests, throughout the course of the meeting.

7. The WPTT **NOTED** the 11 Conservation and Management Measures (CMMs) adopted at the Seventeenth Session of the Commission (consisting of 11 Resolutions and 0 Recommendations), and in particular the following Resolutions which have a direct impact on the work of the WPTT:
   - Resolution 13/03 *On the recording of catch and effort data by fishing vessels in the IOTC area of competence* (not applicable to India due a formal objection received)
   - Resolution 13/08 *Procedures on a fish aggregating devices (FADs) management plan, including more detailed specification of catch reporting from FAD sets, and the development of improved FAD designs to reduce the incidence of entanglement of non-target species*
   - Resolution 13/10 *On interim target and limit reference points and a decision framework*
   - Resolution 13/11 *On a ban on discards of bigeye tuna, skipjack tuna, yellowfin tuna and a recommendation for non-targeted species caught by purse seine vessels in the IOTC area of competence*

Impacts of catching bigeye tuna and yellowfin tuna juveniles and spawners

8. The WPTT **NOTED** that at the 16th Session of the Commission, it adopted Resolution 12/13 *for the conservation and management of tropical tunas stocks in the IOTC area of competence*, which superseded Resolution 10/01. Contained within Resolution 12/13 is a requirement that the SC will develop at its 2012 and 2013 sessions, the following:

c) an evaluation of the impact on yellowfin and bigeye tuna stocks by catching juveniles and spawners taken by all fisheries. The Scientific Committee shall also recommend measures to mitigate the impacts on juvenile and spawners. (para. 15 of the S16 report)

9. The WPTT **NOTED** however, that the fishery statistics available for many fleets, in particular for coastal fisheries, are not accurate enough for a comprehensive analysis as has been repeatedly noted in previous WPTT and SC reports. As a result, the Commission **REQUESTED** that the countries engaged in those fisheries take immediate actions to improve fishery statistics reporting to the IOTC Secretariat. (para. 16 of the S17 report)

Kobe II Strategy Matrix

10. The WPTT **NOTED** the Commission's request that a Kobe II strategy matrix be provided for all stock assessments by the species Working Parties, and for these to be included in the report of the SC in 2013 and all future reports. The Commission considered the strategy matrix to be a useful and necessary tool for management. (para. 31 of the S17 report)

On data

11. The WPTT **NOTED** the Commission's request that all CPCs improve their data collection and reporting to the IOTC, especially taking into account that the Commission has initiated the consultation process on developing criteria for a quota allocation system (para. 34 of the S17 report). This was despite the minor improvements in the quantity of fisheries statistics available to the SC and its Working Parties in 2012.

IOTC species identification cards

12. The WPTT **NOTED** that the Commission allocated funds in its 2013 budget to develop and print sets of identification cards for the three tropical tunas, two temperate tuna, and six neritic tunas and seerfish species under the IOTC mandate. A consultant had been hired and the identification cards are expected to be completed by the end of the year.

4.2 Review of Conservation and Management Measures relating to tropical tunas

13. The WPTT **NOTED** paper IOTC–2013–WPTT15–05 which aimed to encourage the WPTT to review the existing Conservation and Management Measures (CMMs) relevant to tropical tunas, and as necessary to 1) provide recommendations to the SC on whether modifications may be required; and 2) recommend whether other CMMs may be required.

14. The WPTT **AGREED** that it would consider proposing modifications for improvement to the existing CMMs following discussions held throughout the current WPTT meeting.

5. PROGRESS ON THE RECOMMENDATIONS OF WPTT14

15. The WPTT **NOTED** paper IOTC–2013–WPTT15–06 which provided an update on the progress made in implementing the recommendations from the previous WPTT, which were endorsed by the SC, and to provide alternative recommendations for those yet to be completed.

16. The WPTT **NOTED** that any recommendations developed during a Session, must be carefully constructed so that each contains the following elements:
    - a specific action to be undertaken (deliverable);
    - clear responsibility for the action to be undertaken (i.e. a specific CPC of the IOTC, the Secretariat, another subsidiary body of the Commission or the Commission itself);
    - a desired time from for delivery of the action (i.e. by the next working party meeting, or other date).

17. The WPTT **REQUESTED** that the IOTC Secretariat continue to annually prepare a paper on the progress of the recommendations arising from the previous WPTT, incorporating the final recommendations adopted by the Scientific Committee and endorsed by the Commission.

6. NEW INFORMATION ON FISHERIES AND ASSOCIATED ENVIRONMENTAL DATA RELATING TO TROPICAL TUNAS

Climate and oceanographic conditions

18. The WPTT **NOTED** paper IOTC–2013–WPTT15–09 which provided an outline of climate and oceanographic conditions in the Indian Ocean in the recent years, with an update to August 2013, including the following abstract provided by the author:

    "*In this paper, we provide an update on the trends of climate and oceanographic conditions in the Indian Ocean and in sub-regions (Somali basin, East and West Equatorial areas, Mozambique Channel and*

Maldives). The ENSO cycle has been largely fluctuating between ENSO-neutral and Niña conditions during the past 4 years. Positive sea surface temperature (SST) anomalies have prevailed since the early 2000 over the West Indian Ocean (WIO). Substantial deepening of the thermocline occurs in the WIO in relation with intense El Niño events, but the opposite response (shoaling) during La Niña events is not clear on the long term. Since 2008, SOI has shown predominantly positive values (Niña) and thermocline has shoaled without major disruption along this trend until April 2011. Chlorophyll (SSC) has shown a declining trend over 2006-2010, followed by a slight increase from October 2010 to May 2011 in association with a Niña event, then continued to decline until March 2013. Then, the trend reversed and positive anomalies developed from May 2013 onwards – see paper for full abstract."

19. The WPTT **NOTED** the return to neutral ENSO conditions in 2012–13 after a strong 2010–11 Niña event. In the western Indian Ocean there has been a progressive return to normal conditions of the thermocline depth (after several years of shallow thermocline) and the return to normal conditions in sea surface chlorophyll (SSC) early 2013 after an overall decreasing trend over more than 6 years.

20. The WPTT **NOTED** the significant increase of SSC (+40%) in the Somali basin in 2013, due to a more active Somali upwelling compared to the previous 7 years when the SSC fluctuated between 8 and 25% below the mean. In other regions, SSC increased at a lower rate from rates of 20 to 11% below the mean (2011–12) to values about the mean in 2013.

21. The WPTT **NOTED** the impact of Niño and Niña conditions on the thermocline depth (respectively causing a deeper and shallower mixed layer), especially in the west equatorial region, and on SSC conditions in the east equatorial region, causing more (less) SSC during Niña (Niño) events.

22. The WPTT **NOTED** the combined effect of surface currents, SSC content and SST gradients in the spatial distribution of catch and CPUEs on associated schools (by the purse seine fishery) in the Greater Somali Basin during the 3rd quarter of the year. For example, the catch rate of skipjack tuna in the Somali basin were related to the chlorophyll concentration which has shown lower levels during recent years which may partly explain the reduction of skipjack tuna productivity. This area is a retention area where biological production supplied by the coastal upwelling is trapped for several weeks, leading to the development of good foraging conditions for top predators.

23. The WPTT **NOTED** the potential of environmental data series to understand inter-annual fluctuations and trends in CPUE series.

24. The WPTT **AGREED** that new approaches should be developed in order to better understand the role of ecological processes on CPUE variability. One key approach is to select sub-areas being in agreement with the spatial structure of the variability pattern of environmental covariates, where GLMs could be performed. GLMs should include the environmental covariates potentially leading catchability (e.g. thermocline depth) and exclude those potentially driving changes in abundance (e.g. SSC, as a proxy of prey enrichment). Then, common statistical methods could be applied to study linkages and potential time lags between partially-standardised CPUE series and series of other abundance-related environmental proxies.

Dipole mode and El-Nino events

25. The WPTT **NOTED** paper IOTC–2013–WPTT15–10 which provided an overview of the impact of dipole mode and El-Nino events on catches of yellowfin tuna in the Eastern Indian Ocean off west Java, including the following abstract provided by the authors:

"*The impact of Indian Ocean Dipole Mode (IOD) and El Niño-Southern Oscillation (ENSO) events on catches of yellowfin tuna (Thunnus albacares) (YFT) in the Eastern Indian Ocean (EIO) off Java was analyzed through the use of remotely sensed environmental data (sea surface temperature/ SST and chlorophyll-a concentration/ SSC) and yellowfin tuna catch data. Analyses were conducted for the period of 2003–2012, which included the strong positive dipole mode event in association with weak ENSO in 2006. Yellowfin tuna catch data were based from the report of Palabuhanratu fishing port and remotely sensed environmental data were based from MODIS-Aqua_NOAA. IOD has a significant effect on the catch composition and proportion of YFT. In the strong positive dipole mode event in 2006 and weak ENSO events in 2011 and 2012 the catch of YFT was higher than normal period. An increasing Catch Per Unit Effort (CPUE) of YFT started from May-June and reached the peak on September-October was noted, this might be due to upwelling evident before the increasing trend observed* – see paper for full abstract."

26. The WPTT **NOTED** the impact of ENSO cycle on yellowfin tuna longline CPUE series in the eastern Indian Ocean, with high CPUEs (and enhanced chlorophyll content) during positive Dipole mode (equivalent to Niño event) compared to Niña events when CPUE are lower than average. The positive dipole situation triggers a

coastal upwelling and significant biological enrichment off Southern Java, which is reflected in yellowfin tuna CPUE series.

27. THE WPTT **NOTED** that the analysis presented did not include time lags between the onset of the upwelling and the CPUE series. Similarly, only real values, instead of anomalies, were considered.

28. The WPTT **ENCOURAGED** Indonesia to pursue the monitoring of environmental conditions in this region of the Indian Ocean and to perform analyses exploring time lags between environmental factors and CPUE series.

Mauritius – Tropical tuna abundance around anchored FADs

29. The WPTT **NOTED** paper IOTC–2013–WPTT15–11 which provided an overview of the seasonal abundance of the tropical tunas around fish aggregating devices anchored off the coast of Mauritius (2010–2012), including the following abstract provided by the authors:

 "*Catch rates of the pelagic species around the Fish Aggregating Devices (aFADs) anchored off the Western coast of Mauritius show that the seasonal variation of the sea surface temperature (SST) has a significant influence on the abundance of the tropical tuna. The results of the study carried out over the period 2010 to 2012 suggest that the season of relative abundance for the skipjack tuna (Katsuwonus pelamis) is more pronounced during the summer months when SST is higher. The study on the other hand indicates that the yellow fin tuna (Thunnus albacares) prefers the cooler waters which prevail both at start of winter and at the outset of the summer season. The broad annual migration of the yellow fin and skipjack tunas around the anchored FADs is noticeably associated with the annual SST cycle. The results also indicated a marked scarcity in the presence of the big eye tuna (Thunnus obesus) in the landings of the artisanal FAD fishery* – see paper for full abstract."

30. The WPTT **NOTED** that access to the artisanal FAD fishery in Mauritius is open to all the community of domestic fishers (registered professional and amateur/recreational/sports). However only catch and/or effort from the registered professional fishers are available at the prescribed fish landing stations and are considered reliable. The network of aFADs is maintained by the national fisheries authorities but fishers contribute by monitoring the status of aFADs at sea and by retrieving and bringing back drifting, damaged or lost FADs to the land station for repairs by the authorities.

31. **NOTING** that catch statistics are collected at landing sites, the WPTT **ENCOURAGED** Mauritius to compile size samples on the artisanal FAD fishery and report findings at the next WPTT meeting.

New method to estimate tuna abundance

32. The WPTT **NOTED** paper IOTC–2013–WPTT15–12 which outline a new fisheries independent method to estimate abundances of tropical tunas, including the following abstract provided by the authors:

 "*Estimating animal abundance is a challenging task, particularly for those species that occupy vast and remote areas. Despite the development of satellite, archival and acoustic tagging techniques that allow the tracking of animals in their natural environments, these technologies have so far been underutilized in developing abundance estimation of animal populations, both for marine and terrestrial species. We developed a new sampling theory for estimating species abundance that employs these technologies and that can be applied to any species that aggregate at well-defined sites. Based on a behavioral model describing the associative behavior of animals, we relate the time that individuals spend associated at a particular aggregative site and out of it to their abundance. Taking the case study of tropical tuna associated with floating objects (which constitute aggregation points for several pelagic fish species), we implemented our approach using a data set obtained through acoustic tagging. Our method provides a new path, which is fisheries independent, for direct estimation of populations of tropical tuna* – see paper for full abstract."

33. The WPTT **NOTED** that the same approach can be applied to obtain population assessments for any marine and terrestrial species that display associative behaviour and from which behavioural data have been acquired using acoustic, archival, or satellite tags or even visual observations where individual animals can be recognised.

34. The WPTT **RECOGNISED** the great value of developing fisheries-independent methods to assess stock abundance. However, a substantial amount of observations (residence and absence times at and from FADs estimated by electronic tagging, number of floating objects per area and season) need to be collected to be able to implement this method, and this should be seen as a potential alternative for the future.

35. The WPTT **NOTED** that several challenges have to be addressed before absolute abundance estimates may be produced, such as the difficulty to discriminate species from echosounder recordings by buoys, and accounting for removal of fish from FADs due to fishing.

Spatial assessment and management of tuna populations

36. The WPTT **NOTED** paper IOTC–2013–WPTT15–13 which provided a discussion paper on whether Indian Ocean tuna populations are being assessed and managed at the appropriate spatial scale, including the following abstract provided by the authors:

"*Tuna species managed under the auspices of the Indian Ocean Tuna Commission have generally been assumed (explicitly or implicitly) to be highly mobile and consist of a single panmictic spawning population for the purposes of stock assessment and management. In this paper, we: i) briefly review evidence that questions this assumption (largely based on recent population genetics and tagging studies), ii) qualitatively discuss the implications of violating this assumption, and iii) outline some elements of a collaborative research plan to resolve these issues and mitigate the consequences of getting this assumption wrong. This paper is intended to stimulate discussion within the IOTC scientific community about the potential importance of population structure within the Indian Ocean and extent to which it should be considered a research and management priority* – see paper for full abstract."

37. The WPTT **RECOMMENDED** the necessity to perform additional research on population structure to challenge the current paradigm of a single panmictic spawning population throughout the entire Indian Ocean, which has strong implications for management. Applying genetics, otolith microchemistry, parasitology and analysis of the IOTC tag-recovery dataset is likely to provide the information required to determine if stocks are being managed at the appropriate scales.

38. **NOTING** that several projects are currently collecting samples from the three tropical tunas in the Indian Ocean for genetic purposes (including CSIRO, RCMFC, AZTI, MRC and a joint collaboration between IRD, the University of Bologna and SFA), the WPTT **ENCOURAGED** the research teams involved to work collaboratively to establish priorities and reduce the chance of effort duplication.

39. The WPTT **ACKNOWLEDGED** the participation of several countries (e.g. Maldives, Indonesia) in providing samples for the pilot study and **AGREED** that more collaborators from CPCs cooperate in those projects by providing samples and assistance in identifying potential funding sources for analysis.

EU-Spain purse seine fleet statistics

40. The WPTT **NOTED** paper IOTC–2013–WPTT15–14 which outlined the statistics of the purse seine Spanish fleet in the Indian Ocean (1990–2012), including the following abstract provided by the authors:

"*This document presents summary statistics of the purse seiner Spanish fleet fishing in the Indian Ocean from 1990 to 2012. Data include catch and effort statistics as well as some fishery index by species and fishing mode. Information about the sampling scheme and the coverage of sampling, together with maps and diagrams representing the fishing pattern of this fleet by time and area strata is also included.*"

Sri Lanka fisheries catch statistics

41. The WPTT **NOTED** paper IOTC–2013–WPTT15–15 Rev_1 which provided an analysis of catch assessment in offshore and coastal tuna fisheries in Sri Lanka, including the following abstract provided by the authors:

"*Tuna fisheries in Sri Lanka are developing rapidly with the expansion of offshore and deep sea /high seas fishing. Over 4,000 boats are currently engaged in tuna fishing, out of which around 700 boats in length between 5.5 and 9.8 m are categorized as single day and operated in the coastal areas where as about 3,300 vessels between 8.8 to 18.3 m are operated offshore and high seas adjacent to the EEZ. The estimated total large pelagic fishery production in 2012 was 105,240 Mt and the majority of large pelagic catch, consists of tunas 66,840 Mt (63%) followed by billfish 8,730 Mt (8.5%), sharks 3180 Mt (3.0%) and Seer 620 Mt (0.5%). Among the different fishing gears used for catching large pelagic fish, large-mesh gillnet (GN) or long line (GN/LL) as secondary gear, were the widely used fishing gears in tuna fisheries. Gillnet with longline combination contributes to more than 75% of the total tuna fishing effort in the country* – see paper for full abstract."

42. **NOTING** that the size measurements were taken as round length (using a tape measurement), which is not considered best practice, the WPTT **REQUESTED** that Sri Lanka measure fish using a straight length (i.e. using callipers), either fork length or predorsal length (between snout and 1st dorsal fin), for yellowfin tuna and bigeye tuna, as reliable conversion tables exist now and are available on the IOTC web site.

43. **NOTING** that logbooks have been developed but are not yet properly in use throughout the fleets, the WPTT **URGED** Sri Lanka to take actions to improve data collection and reporting of these logbooks by the fishers as soon as possible in order to provide catch and effort statistics, as required in IOTC Resolution 10/02.

44. **NOTING** that tuna statistics in Sri Lanka are collected by a governmental institution and a research agency, the WPTT **REQUESTED** that both institutions cooperate to ensure the best possible information is shared and submitted to the IOTC, thereby ensuring the best possible quality of catch and effort statistics.

Sri Lanka fisheries and length-weight relationships

45. The WPTT **NOTED** paper IOTC–2013–WPTT15–16 which provided a review of the tuna fishery in Sri Lanka and an estimation of the length-weight relationships for yellowfin tuna and bigeye tuna, including the following abstract provided by the authors:

    "There are three dominant oceanic tuna species frequently found in Sri Lankan waters namely yellowfin tuna (Thunnus albacares), bigeye tuna (Thunnus obesus) and skipjack tuna (Katsuwonus pelamis). This paper reviews the trends of oceanic tuna landings in Sri Lanka. Also, attempt was made to estimate the length weight relationships of two major species: yellowfin tuna (Thunnus albacares) and big eye tuna (Thunnus obesus). The annual production of oceanic tuna has increased rapidly over the period 1950-2010 and the highest production was reported in 2004. Skipjack tuna was the major contributor throughout the period followed by yellowfin tuna. Oceanic tuna resources are frequently targeted by offshore fishing crafts of three categories: UN3A (9.8 - 12.2 m in length), UN3B (12.2-15.2m) and UN4 (15.2-18.3m). Gillnet has effectively been contributing for catching oceanic tuna. The estimated length - weight relationships for yellowfin tuna (T. albacares) and bigeye tuna (T. obesus) were W= 0.033L 2.848 and W=0.011L 3.08 respectively."

I.R. Iran fisheries

46. The WPTT **NOTED** paper IOTC–2013–WPTT15–17 which provided an overview of the I.R. Iran tropical tuna fisheries, including the following abstract provided by the authors:

    "*A brief description of fishing status in I.R. Iran with the emphasis on tropical tuna. Average catch of tropical tuna in Indian Ocean operated by Iranian fishing fleet during recent 5 years (2008 to 2012) was equivalent to 51,678 tonnes where average 5 years catch for skipjack was 24,026 tonnes, yellowfin tuna: 27,298 tonnes and bigeye tuna 354 tonnes. Comparing the catch of 10 countries which are the main exploiter of tropical tuna in Indian Ocean. 10 countries in Indian Ocean with more than 89% are the main exploiter of these species, To sum up, mentioned information indicates that purse seine-LS which allocated around 80% of Purse Seine catch to itself has more negative impact on fish stocks than other fishing methods and catch small size tropical tuna species and need special attention. Actions carried out concerning improvements of 14th working party approvals for tropical tuna in Iran.*"

47. The WPTT **NOTED** that only a fraction of the Iranian gillnet fleet (~2000 out of 6000) target tropical tuna and tuna-like species in the western tropical Indian Ocean, as the development of piracy in the waters off Somalia has led to a contraction of the gillnet fleets operations, and hence increased effort, in the Arabian Sea and inshore waters of I.R. Iran, where neritic tunas are more abundant.

48. The WPTT **NOTED** that data on bigeye tuna in the Iranian fishery (along with the correct identification of this species in the catch) started in 2012, which will allow to cross-verify catch estimates for previous years, and correct them, where necessary. Any future spatial stratification corrections will need to take into account the fact that bigeye tuna are rare from 8°N to 12°N and virtually absent north of 12°N.

49. The WPTT **ENCOURAGED** the I.R. Iran to continue improving reporting from their purse seine fleet, and to report progress to the WPTT at its next meeting.

Madagascar fisheries

50. The WPTT **NOTED** paper IOTC–2013–WPTT15–18 which provided an overview of tropical tuna catches by the malagasy longliners in 2012, including the following abstract provided by the authors:

    "*The longline fishing is one of a recent fishery practiced by Malagasy fishing fleets. Partial analyzes were made on their activities during the year 2012. VMS Positions, logbooks and observer data sampling were used for these analyzes. Mapping of VMS positions shows that national longliners fishing zones focus in the North East of the EEZ. For the year 2012, a slight decrease of the total catch was observed compared to the previous two years (From 490 tons in 2010 to 388 in 2013 tons). The description of the species composition of catches show the predominance of tropical tuna catch rate (45%) compared to other pelagic species such as billfishes, sharks. In the Tropical tunas, the catch rate in Bigeye predominates (44%) followed by albacore (29%) and Yellowfin tuna (26%). The catch rate in Skipjack is very low (less than 1%). The samples made by observers on board were used to calculate the average size of individual catches. Bigeye, Yellowfin, Albacore and Skipjack have respectively an average size of 116.51, 127.55, 105.82 and 63.08cm*."

51. **NOTING** that while a number of longliners flagged to Madagascar have operated in the Indian Ocean in recent years, and that only nominal catch data has been reported officially to the IOTC Secretariat, the WPTT **URGED** Madagascar to report catch-and-effort and size data as soon as possible, and ensure that data collected in future years is also provided to the IOTC Secretariat, noting that it is already a mandatory reporting requirement (Resolution 10/02).

Thailand – tuna unloading by foreign vessels

52. The WPTT **NOTED** paper IOTC–20 13–WPTT15–19 which provided an overview of foreign tuna fleets unloading in Phuket, Thailand during 1995–2012, including the following abstract provided by the authors:
“*Both of unloaded tuna from longline and purse seine fisheries are examined in term of effort, catch and value, species composition, landing production categorized by flag countries, size of fish as well as the relevance information and activity of port sampling and sampling size. The objective of this study is to follow up the data on tuna fisheries in the Indian Ocean, thus the available data at first from the beginning of tuna longliners unloading in Phuket until the year of 2012 and the data of tuna purse seiners unloading in Phuket during 2003 to 2012 are described in this paper. Besides the conclusion with the progression on improvement of the port sampling and monitoring currently in place, the encounter problems and recommendation are included.*”

53. The WPTT **NOTED** a drop in the bigeye tuna catch by foreign longliners since 2003 which resulted in a larger proportion of yellowfin tuna in the catch. The author explained this was not due to an rapid shift in targeting of the fleets, but to the departure of longliners from China, that were targeting bigeye.

Thailand – domestic longline fishery

54. The WPTT **NOTED** paper IOTC–2013–WPTT15–43 which provided an overview of the tuna longline fishery in the Indian Ocean by the Thailand fleet during 2010–2012, including the following abstract provided by the authors:
“*Thai tuna longline fishery were operated in the Indian Ocean during 2010–2012 composed of 2 tuna longliners. The main fishing ground was located in the western part of the Indian Ocean. In 2010-2011 fishing ground was located cover the central and the western part of the ocean whereas in 2012 the fishing ground was located mostly in the central part of the Western Indian Ocean. The data of tuna fishery was collected from Thai longliner logbooks. The fishing operations targeted on tropical tuna species, bigeye tuna and yellowfin tuna. During 2010-2012, the fishing operation amount 1,232 days or 3,449,600 hooks were recorded. The highest catch of these species was in 2012, followed by 2011 and 2010, respectively. A total of bigeye tuna and yellowfin tuna composition during 2010-2012 was 61.33% by number and 71.01% by weight of total catch. The highest CPUE of total catch was found in 2012, followed by 2011 and 2010, respectively.*”

55. The WPTT **THANKED** Thailand for providing a detailed catch and effort dataset for its two longliners, **NOTING** these data were made available at a spatial resolution of 1° square.

Indonesia fisheries

56. The WPTT **NOTED** paper IOTC–2013–WPTT15–20 which provided an overview of Indonesia’s tropical tuna fisheries in the Indian Ocean, including the following abstract provided by the authors:
“*Indonesia lays between two large continents i.e. Asia and Australia as well as two main oceans i.e. the Indian Ocean and Pacific Ocean with a wide coverage of marine waters within its jurisdiction. This strategic location provides various advantages for Indonesia, among those particularly in the tuna fishery is the abundances of tropical tunas surrounding its marine waters. The species of tropical tuna that are commonly found in the area are yellowfin tuna (YFT), bigeye tuna (BET) and skipjack tuna (SKJ). These species are targeted by various fishing gears such as tuna longline (LL), purse seine (PS), pole and line (PL), hand line (HL), and gill net (GN). Among those, long line and purse seine are gears type that mainly contribute a significant catch from the total catch of tuna. In the recent years, hand line also contributes significant catch following the former gears as consequences FADs use in hand line fishery –* see paper for full abstract.”

57. The WPTT **NOTED** the discrepancies between sizes of yellowfin tuna and bigeye tuna measured by enumerators at landing sites and observers at sea. Fish less than 20 kg, which are unsuitable for the sashimi market, do not appear in the landing statistics. The smaller size fish are thought to be either discarded or used to supply local markets. The WPTT **NOTED** with concern that this size range can represent a large amount of fish which are not currently reported and therefore included in the IOTC database for assessment purposes.

58. **RECOGNISING** that this problem is not specific to Indonesia, but exists in all the longline fleets exporting for the sashimi market, the WPTT **EMPHASIZED** the need to collect size measurements by observers to reconstitute the actual size range harvested by the longline fleets.

59. The WPTT **NOTED** with interest the research activities implemented by Indonesia to study stock structure using genetic techniques, based on sampling made in 9 sites across the archipelago and 2 outlier sites (Maldives and Salomon Islands); and to better understand the distribution in depth of the various tuna species using instrumented longlines, which can contribute to the development of habitat models.

60. **NOTING** that the catches of tuna longliners flagged to Indonesia and landing in foreign ports are not being reported, the WPTT **REMINDED** Indonesia that it is a mandatory IOTC requirement that it monitors its fleets on the high seas and reports catch and effort data to the IOTC Secretariat, in accordance with IOTC Resolution 13/03 and 10/02.

Japan data collection and processing systems

61. The WPTT **NOTED** paper IOTC–2013–WPTT15–22 which provided a comparison of length frequency data collected onboard deep-sea longliners flagged in Japan, by scientific observers or fishermen on commercial vessels, and scientists on research and training vessels, including the following abstract provided by the author:

“*A comparison of fish size by different sampling methods (commercial and training vessels and scientific observer) for Japanese longline fishery operating in the Indian Ocean was conducted to examine representativeness of size data and to consider how to apply to stock assessment models. Size data by training vessels, which operated mainly between 1960s and 1980s in the tropical area of eastern Indian Ocean, were main component during this period. Size data measured by scientific observers have been main component since mid-2000s especially for bigeye tuna. Length frequencies of the fish in the same area-quarter strata were usually similar among sampling methods if sufficient number of fish were measured, although some differences were observed. In several strata a mode of smaller fish was observed only as for the fish measured by training vessels and/or scientific observers. Difference of average weight of the fish between based on catch and effort data and size data was observed by about 10 kg or more for a part of period. Some considerations and examinations will be necessary to decide how to apply size data to stock assessment models*.”

62. The WPTT **THANKED** Japan for addressing some of the concerns raised by the WPTT in 2012, and **RECOMMENDED** that Japan and the IOTC Secretariat continue joint work, in cooperation with other countries having longline fisheries, to address other issues identified by the WPTT, as the lack of specimens of small size from the samples and discrepancies in the average weights estimated using the available catch-and-effort and length frequency data.

Taiwan,China data collection and processing systems

63. The WPTT **NOTED** paper IOTC–2013–WPTT15–40 which provided an overview of the data collection and processing system of statistics for the Taiwan,China deep-sea longline fishery (Overseas Fisheries Development Council, Taiwan,China), including the following abstract provided by the authors:

“*A comprehensive data collection and processing system regarding the statistical data of Taiwan,China deep-sea tuna longline fisheries has been gradually established since the Overseas Fisheries Development Council (OFDC) took over the duty of data management in 1994. The historical data of Atlantic Ocean is the first part that had been further reviewed and revised. In 1996, the paper "Current status of Taiwan,China longline fisheries in the Atlantic Ocean (ICCAT-SCRS/1996/155)"was presented in the ICCAT-SCRS meeting as the provisional result of such review. Since any alteration in the fisheries statistics system will possibly have a significant influence on the stock assessment, in 1997, Dr. Peter Miyake, the ICCAT Assistant Executive Secretary, was sent to Taiwan,China and had cooperated with Taiwan,China scientists to conduct an overall survey of Taiwan,China fisheries statistics system and longline fisheries data of Atlantic Ocean. And, the Commission subsequently produced an official document (ICCAT-SCRS/1997/17) in the 1997 ICCAT-SCRS meeting and provided useful advice for the improvement of our statistics system* – see paper for full abstract.”

64. The WPTT **CONGRATULATED** the Overseas Fisheries Development Council for the efforts put towards increasing logbook and length frequency sampling coverage, and results achieved, in particular the very high coverage rate for logbooks and very large numbers of specimens measured attained in recent years.

65. **NOTING** that the majority of the samples were collected by fishers on board commercial longliners, and bearing in mind the issues that the WPTT had identified in the past concerning this dataset, the WPTT expressed **CONCERN** about the lack of independent data that would allow for this information to be validated.

66. **NOTING** that in recent years scientific observers have collected length frequency data, the WPTT **REQUESTED** that OFCD explores the use of these data to validate the data collected by fishers.

67. **NOTING** that in recent years fishers from the Taiwan,China longline fleet have been collecting both length and weight measurements for the same specimens, the WPTT **RECOMMENDED** that the measured lengths and lengths derived from weight measurements are compared in order to validate the reliability of this dataset.

Taiwan,China length frequency data review

68. The WPTT **NOTED** paper IOTC–2013–WPTT15–41 which provided a review of length frequency data of the Taiwan,China distant water longline fleet, including the following abstract provided by the authors:

"*Taiwan,China has collected one of the longest and most extensive sets of size frequency data of longline fleets operating in the Indian Ocean. According to the Overseas Fisheries Development Council of Taiwan,China (OFDC), since 1980 over 10.6 million tuna specimens have been recorded for lengths by the Taiwan,China distant water longline fleet; between 2003 and 2005 alone, size data was collected for over 3.2 million samples. For almost 20 years the fleet has accounted for between 80%-100% of size frequency samples of BET, YFT and ALB from longline fleets published by the IOTC Secretariat. The size data reported by Taiwan,China are also one of the main inputs of the stock assessment of tuna species in the Indian Ocean, in an area where longliners have contributed over 75% of the total catch of BET, 85% of ALB, and 35% of YFT since the 1950s. Ensuring the size data is of the highest quality, as well understanding the implications of any changes to the collection and processing of the data, is of critical importance*."

69. The WPTT **EXPRESSED CONCERN** on the effects that the issues identified in paper IOTC–2013–WPTT15–41 may have on stock assessments that use length samples or other datasets derived using this information.

70. The WPTT **NOTED** the length distribution of samples recorded by the Taiwan,China longline fleet since 1980 for bigeye tuna and yellowfin tuna (Fig. 1). The sampling coverage is also shown alongside each year, expressed as number of fish per tonne of catch (denoted by the size of the green proportional circle; the larger the circle the higher the sampling coverage).

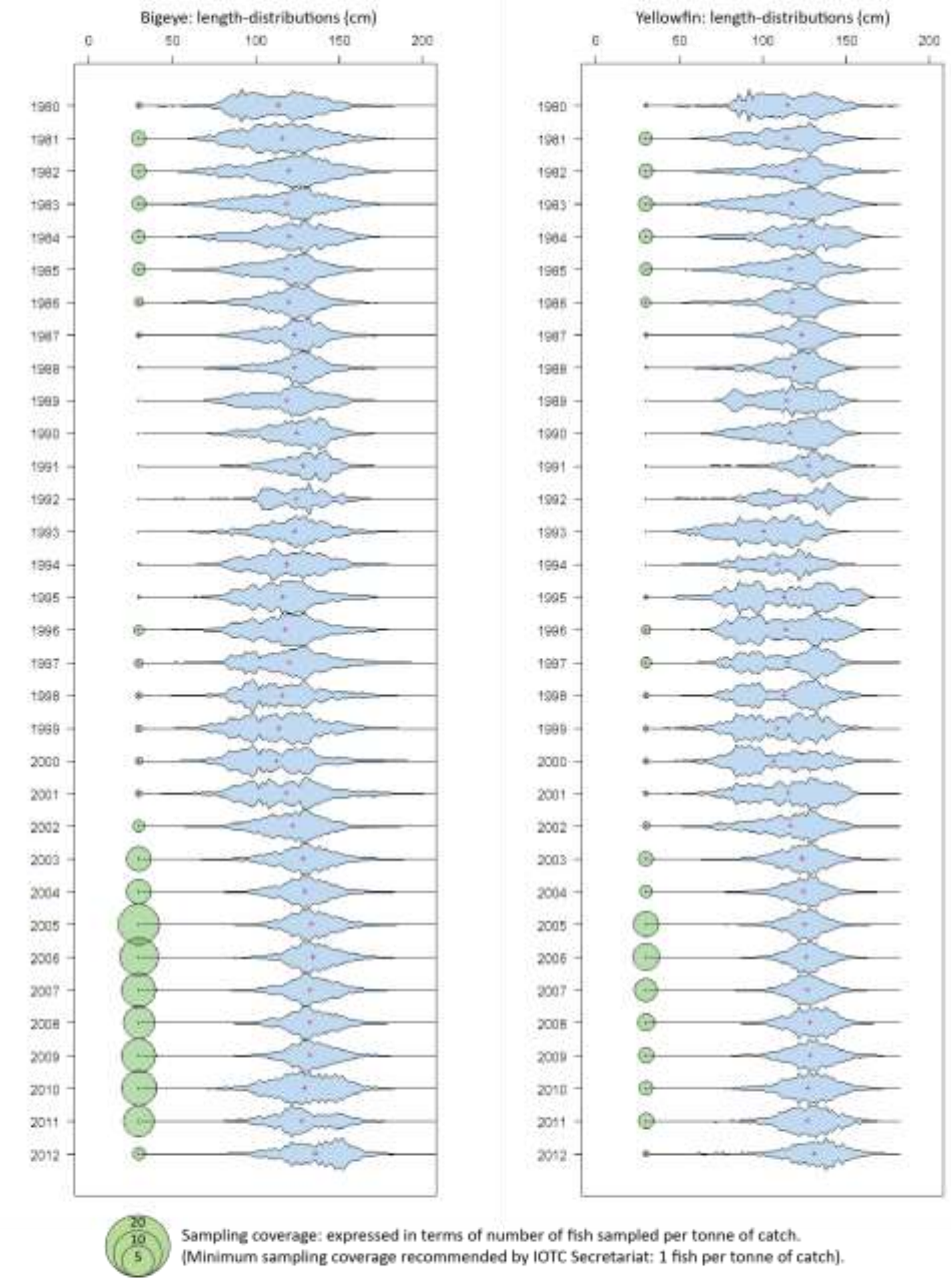


Fig. 1. Distribution of lengths and sampling coverage of bigeye tuna (left plot) and yellowfin tuna (right plot) size data available from Taiwan,China distant water longline (DWLL vessels). Red cross-hairs indicate the mean length in each year; the proportional circles the sampling coverage (number fish sampled per tonne of catch).

71. The WPTT **NOTED** that, since the early 2000's, the numbers of small specimens in the samples of tropical tunas for longliners flagged in Taiwan,China have dropped markedly, across all areas and seasons, and the fact that these size categories were never present in the samples collected on longline vessels flagged to Japan. In this regard, scientists from Taiwan,China informed the WPTT that new regulations implemented by their government, extending requirements for the reporting of catch, effort, and length frequency data and limiting catches for longline vessels flagged in Taiwan,China, may have affected the quality of reports from some vessels since that time, in particular as regards to length frequency data.

72. The WPTT **AGREED** on the need for the IOTC Secretariat, and scientists from Japan, Taiwan,China, and other important longline fisheries to explore further the issues identified in the document, in particular in-depth evaluation of data collection and processing procedures for each fleet and procedures implemented by the IOTC Secretariat to prepare datasets for the assessments that use length frequency data or estimates derived from them.

Length Frequency inter-sessional meeting guidelines

73. The WPTT **NOTED** that an inter-sessional meeting combined with the WPDCS and possibly the WPM is required to address the accuracy and precision of the longline length frequency data, among Taiwan,China, Japan and the IOTC Secretariat.

74. **NOTING** the size data issues (discrepancies in catch, effort and notably size data [low sampling rate, uneven distribution of sampling in regard to the spatial extent of the fishery] in the Japanese and Taiwan,China tropical tuna data sets) identified by the WPTT in 2012 and 2013 and the Scientific Committee in 2012, the WPTT **RECOMMENDED** that an inter-sessional meeting attached to the WPDCS and WPM on *data collection and processing systems for size data from the main longline fleets in the Indian Ocean*, be carried out in early 2014, under the guidelines contained in Appendix IV.

75. The WPTT **NOTED** that the data collection and processing systems used for distant-water longline fisheries tend to be applied to all oceans **AGREEING** that it is likely that the issues identified for the Indian Ocean also apply to other areas. In this regard, the WPTT **RECOMMENDED** that the IOTC Secretariat informs other tuna-RFMO Secretariats about the issues identified and facilitates participation of their staff to the WPDCS, where required.

Maldives pole-and-line fishery challenges

76. The WPTT **NOTED** paper IOTC–2013–WPTT15–42 which outlined the challenges to the pole-and-line tuna fishery in the Maldives, including the following abstract provided by the authors:

> "*Maldivians have been catching tuna for nearly 1000 years from the coastal waters, free swimming schools and around drifting objects in the Indian Ocean. Tuna catches in the Maldives reached its peak in 2006 with a reported catch of 166,000t (138,000t of skipjack and 23,000t of yellowfin tuna). The pole-and-line fishery contributes 75-80% of all tuna landings in the country. The remaining is caught by handline, troll line and longline. In the past the tuna fishery had some difficulty in attracting young people to work on the vessels. But with the increasing price of tuna in the world markets the youth are keener to engage in the tuna fishery. Although there is no shortage of fishermen to work on the vessels the fishery is now facing a number of challenges. The increasing oil price and the declining catches have resulted in several fishers seeking alternative livelihoods. The boom in the tuna fishery in the middle of the last decade resulted in fishers building larger vessels and install bigger engines* – see paper for full abstract."

77. The WPTT **NOTED** that the decline of tuna catches in the Maldives since 2006 and the increase in fuel costs, may have affected the economic viability of tuna fishing for a number of fishers. This has resulted in changes in fishing practices, such as combining handline and pole-and-line fishing during a same trip.

78. The WPTT **NOTED** that such changes in fishing strategies had negative consequences on the quality of catch statistics, as it makes it difficult to discriminate between catches of both gears when fish are sampled at the landing site.

79. **NOTING** the improved data collection systems being implemented by the Maldives, which includes in particular the identification of bigeye tuna in catches, the WPTT **ENCOURAGED** Maldives to continue the development of its program.

80. **NOTING** that the Maldivian skipjack tuna catch is not separated by association type, i.e. aFAD and free schools, and therefore the proportion of skipjack tuna caught under the aFADs around the Maldives is unknown, the WPTT **REQUESTED** that the Maldivian data collection system is further improved in order to account for the association of the reported catch, as this could improve the standardisation of the pole-and-line CPUE.

81. **NOTING** that bigeye tuna in the Maldives have previously been recorded as yellowfin tuna by samplers and in logbooks, the WPTT **URGED** the Maldives to make every possible effort to collect length frequency samples by species, as well as to assess the likely bias introduced in the length frequency distributions available for yellowfin tuna, derived from length samples where specimens of both yellowfin tuna and bigeye tuna had previously been recorded as yellowfin tuna.

European Union fishery statistics

82. The WPTT **NOTED** paper IOTC–2013–WPTT15–44 which provided an overview of the statistics of the European Union and associated flags purse seine fishing fleet targeting tropical tunas in the Indian Ocean 1981-2012, including the following abstract provided by the authors:

"*In 2012, the European Union and associated flags purse seine fishing fleet of the Indian Ocean was composed of 37 vessels of individual carrying capacity >800 t, which all represented a total carrying capacity of more than 45,000 t. The total cumulated nominal effort was about 9,500 and 7,800 fishing and searching days, respectively. The total number of fishing sets was about 9,000, with about 5,600 realised on FAD-associated schools (i.e. >60%). Overall, the capacity and nominal effort of the fleet have remained stable during the recent years while the total catches have significantly dropped from more than 260,000 t during 2009-2011 to less than 230,000 t in 2012. The decline in catch is mainly explained by a combination of a major decrease in the number of sets per day and catch rates of skipjack on FAD-associated schools, the catch of skipjack per positive set being the lowest observed since 1984, i.e. 15 t set*$^{-1}$ – see paper for full abstract."

83. The WPTT **NOTED** with concern that catches of skipjack tuna from free schools have almost disappeared in 2012. Simultaneously, the proportion of bigeye tuna catches by purse seine from free schools has increased. Bigeye tuna forming free schools are adult fish with a size range similar to that found in longline catches. Moreover, skipjack tuna catches dramatically declined (35%) from 2011 to 2012, as a consequence of the overall decline of FAD catches.

84. The WPTT **NOTED** that there has been a substantial decrease in the mean weight of skipjack tuna, from around 2.8 kg in the period 1982 to 2006, to approximately 2.2 kg in 2012.

85. The WPTT **REQUESTED** that further research be undertaken to better understand the decline of catch rates of skipjack tuna on FADS. It is not clear whether this is due to reduced tuna aggregations around FADs, a lesser number of active FADs, a shift in targeting to free schools, or a combination of all these factors.

86. The WPTT **NOTED** that the replacement of traditional FADs with ecological FADs (i.e. FADs reducing the incidence of entanglement of non-target species) has been implemented for the EU fleet. However the proportion of ecological FADs in comparison to other FADs used by the European Union purse seine fleets is still unknown.

87. The WPTT **NOTED** the results of an analysis based on FAD trajectories, which shows that a proportion of FADs drifting outside of the areas usually covered by the purse seine fleets, are not retrieved by purse seine vessels, and effort to produce estimates of the total number of drifting FADs is required.

88. The WPTT **NOTED** the ongoing implementation of DFAD logbooks aboard purse seine vessels according to IOTC Resolution 13/08 that will provide better information on FADs in the forthcoming years.

89. The WPTT **NOTED** errors in the procedure used to correct the species composition of the European Union purse seine catches on free-swimming schools. This error resulted in an over-representation (20–30%) of bigeye tuna in the statistics provided to the IOTC Secretariat, compared to the composition produced by the species sampling. Recalling the need for the European Union to submit corrected catches by species to the IOTC, the WPTT **RECOMMENDED** that EU scientists document all estimation procedures and the changes in species composition arising from them and report this information at the next session of the WPTT, in 2014.

90. The WPTT **NOTED** that logbook data of the European Union purse seine fleet has confirmed the change in the fleet strategy identified at the previous WPTT meeting, with a reduction in catch on the free swimming schools to FAD-associated schools. In 2012, the ratio of total catch being taken in association with FADs, in comparison to free school, is closer to the average values for the period 2004–09 (~65%).

India fisheries

91. The WPTT **NOTED** paper IOTC–2013–WPTT15–45 which provided a comparison of changes in the exploration and exploitation of oceanic tuna resources in the Indian EEZ in 1970–2012, including the following abstract provided by the authors:

"*The Indian EEZ is about 2.8% of the surface area of the Indian Ocean. As per IOTC, from the Indian Ocean in the year 1970 harvested 41,813 tons of Yellowfin tuna whereas from the Indian seas only 600* *tons of Yellowfin tuna. During 70's Tuna is one of the least exploited resources of Indian Seas, the average catch of Yellowfin tuna for 1970-79 period being 1,768 tons and skipjack tuna 1,191tons. The peak production of Yellowfin tuna of 3720 tons and skipjack 2396 tons was reordered in 1979. Exploration and exploitation of the oceanic tuna resources in the areas over the past four decades have shown that the tuna resources in the area consists of Yellowfin tuna (Thunnus albacares), the Bigeye tuna (Thunnus obesus) and Skipjack tuna (Kastuwonus pelamis).In Lakshadweep islands, Skipjack tuna and a small fraction of juvenile Yellowfin tuna which enters the surface water are caught by pole and lines and troll lines* – see paper for full abstract."

92. **NOTING** the potential utility of the longline CPUEs derived from the research surveys conducted by the "Fishery Survey of India", the WPTT **RECOMMENDED** that as a high priority, India undertake a standardisation of the CPUE series, with the support of the IOTC Secretariat, and for this to be presented at the next WPTT meeting.

93. The WPTT **REITERATED** its concern on the lack or poor quality of tuna catch and effort statistics for the Indian longline fleet, and **REMINDED** India that it is a mandatory requirement (Resolution 10/02) to report catch and effort data to the IOTC at the appropriate resolution, and that this information should cover the entire area of operation of the fleet.

94. The WPTT **NOTED** that the majority of the vessels registered in India were originally flagged in Taiwan,China and the fact that some or the totality of this fleet may also be monitored by Taiwan,China. In this regard, the WPTT **REQUESTED** that India and Taiwan,China work together in order to increase the amount and quality of the data for this fleet component and India to present a new dataset, where required, and a document covering the findings of this work to the next meeting of the WPTT, in 2014.

Information papers

95. The WPTT **NOTED** the other information papers provided to the meeting, as detailed in IOTC–2013–WPTT15–02 and thanked the contributors for the information.

Tuna tagging papers

96. The WPTT **NOTED** that the journal *Fishery Research* will publish in 2014, its special issue containing various selected scientific papers that have been prepared by IOTC scientists following the IOTTP tagging symposium in 2012. However, this issue will only contain selected papers submitted to the journal according to its publication standards and timelines.

97. The WPTT **NOTED** that other research presented during the tagging conference, but not submitted/accepted by the journal, will remain unpublished unless it is added to the grey literature.

98. **NOTING** that the new IOTC website, due to come online in 2014, will contain a section for tuna tagging research and associated publications, the WPTT **AGREED** that research papers, submitted to the symposium, WPTT or SC, but which was not published in the special issue of the journal *Fisheries Research*, should be added to the IOTC webpages. To ensure the quality of these papers, they should first be submitted to the WPTT for consideration at its next meeting in 2014. The Chair of the WPTT, lead editor for the special edition, shall request such papers for submission to the next WPTT meeting.

Catch at size data

99. The WPTT **NOTED** the importance of presenting the information of catch at size when reviewing the fishery statistics of each species. Fig. 2 shows the plot of catch at size for bigeye tuna by gear from 1970 to 2012.

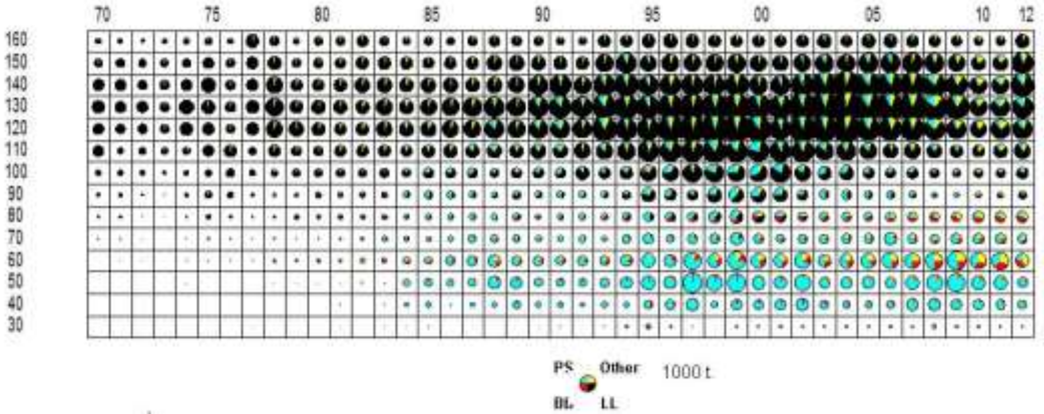


Fig. 2. Bigeye tuna: Catch at size by gear. Left axis is length in 10 cm size classes. Top axis years from 1970 to 2011.

7. BIGEYE TUNA – REVIEW OF NEW INFORMATION ON STOCK STATUS

7.1 Review of the statistical data available for bigeye tuna

100. The WPTT **NOTED** paper IOTC–2013–WPTT15–07 Rev_1 which summarised the standing of a range of data and statistics received by the IOTC Secretariat for bigeye tuna, in accordance with IOTC Resolution 10/02 *Mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties (CPC's)*, for the period 1950–2011. The paper also provided a range of fishery indicators, including catch and effort trends, for fisheries catching bigeye tuna in the IOTC area of competence. It covers data on nominal catches, catch-and-effort, size-frequency and other data, in particular release and recapture (tagging) data. A summary of the supporting information for the WPTT is provided in Appendix V.

101. The WPTT **NOTED** the main tropical tuna data issues that are considered to negatively affect the quality of the statistics available at the IOTC Secretariat, by type of dataset and fishery, which are provided in Appendix VI, and **REQUESTED** that the CPCs listed in the Appendix, make efforts to remedy the data issues identified and to report back to the WPTT at its next meeting.

102. The WPTT **NOTED** issues on the accuracy of total catch estimates related to the capture of juvenile bigeye tuna. In particular, the substantial changes in the catches of bigeye tuna for some countries, fleets, and periods, and the coastal fisheries of Indonesia and Sri Lanka, which usually do not report catches of bigeye tuna by species. The new catch estimates were determined by a review carried out by a consultant hired by the IOTC.

103. The WPTT **AGREED** that the new catches estimated are likely to be more accurate than those previously used, however, in order to validate the new information, it was **REQUESTED** that, Indonesia and Sri Lanka make every possible effort to improve species identification in the future. In this regard, Indonesia informed participants that it is making efforts to improve species identification, in particular through better monitoring of fisheries around anchored FADs and that more accurate catches of bigeye tuna will be reported in the future.

104. **NOTING** that in the case of the Maldives and other coastal fisheries, juveniles of bigeye tuna often account for a substantial proportion of the total catch but are either not reported or assigned to an 'Other' species category, making it necessary for the WPTT to use alternative estimates prepared by the IOTC Secretariat, the WPTT **REQUESTED** CPCs catching large numbers of juvenile bigeye tuna to improve the enumeration and classification of this species. In this regard, the Maldives informed the WPTT that it has compiled data that will make it possible to correct the catch series of yellowfin tuna and bigeye tuna for its pole-and-line fishery and will report this information to the IOTC Secretariat prior to the next meeting of the WPTT.

105. The WPTT **NOTED** that Sri Lanka received support in 2012 from the IOTC-OFCF Project and 2013 from the BOBLME and IOTC to strengthen its data collection and processing systems and expects to improve data collection, processing and reporting for its fisheries in the near future.

7.2 Review new information on the biology, ecology, stock structure, their fisheries and associated environmental data for bigeye tuna

Indonesia bigeye population biology

106. The WPTT **NOTED** paper IOTC–2013–WPTT15–21 which provided an overview of population structure and reproduction of bigeye tuna (*Thunnus obesus*) in Indian Ocean at western part of Sumatra and southern part of Java and Nusa Tenggara, including the following abstract provided by the authors:

   "*This research was conducted to identify population structure and reproduction aspect of bigeye tuna (Thunnus obesus) in west off Sumatra and south off Java and Nusa Tenggara of Indian Ocean. The sample of fish was collected from catch landed by fishermen. The fish was caught from the Indian Ocean during 2010. Analysis of population structure was done by using of histology technique of fish genetic and reproduction. Result showed that population structure of the bigeye tuna in Indian Ocean consisted of two different sub populations namely sub population in west off Sumatra and another one is sub population in south of Java and Nusa Tenggara waters. The most of bigeye tuna catch (about 39%) was categorized as immature fish with Gonad Somatic Index stage I. The immature fish was mostly found in west off Sumatra waters. While the catch in south off Java and Nusa Tenggara waters was mostly categorized as mature fish. It was indicated that south off Java and Nusa Tenggara waters was as spawning ground of the big eye tuna.*"

107. The WPTT **NOTED** that the separation of the potential sub-populations was surprising because there is usually more of a gradient, and perhaps additional samples in the intermediate areas would show such a pattern.

108. The WPTT **AGREED** that it would be useful to share this information with other sampling programs throughout the Indian Ocean, particularly as some of the bigeye tuna could be migrants from the Pacific Ocean.

Bigeye tag dispersal - a simple spatially structured model

109. The WPTT **NOTED** an impromptu presentation on a spatially resolved model to investigate the dispersal of bigeye tuna tags from the main release site off the eastern African coast. The purpose of the analysis was to formulate recommendations for the treatment of the tagging data within the stock assessment model, specifically the spatial extent of mixing following release. The model was configured to predict the monthly distribution of tag recoveries (by 2x2 lat,long spatial scale) of smaller bigeye tuna from the purse seine fishery. A range of environmental parameters were investigated to redistribute the monthly tag populations with the preferred model option utilising NCEP current vector data. The resulting model provided a reasonable approximation to the spatio-temporal distribution of tag recoveries although some marked discrepancies were noted (particularly for tag recoveries in the Mozambique Channel). The final model indicated that there was likely to be a persistent retention of tagged bigeye tuna within the western equatorial region with the occasional transfer of tagged fish eastwards along the equator.

110. The WPTT **NOTED** that the model suggested that tagged bigeye tuna may not be adequately mixed within the entire eastern equatorial region (region 1) during the first 12–18 months following release. However, the modelling results should be considered preliminary and further development of the approach, or more sophisticated modelling approaches, is considered very important to improve the utilisation of the tagging data in the stock assessment. The conclusions may also be of relevance to yellowfin tuna and skipjack tuna, specifically for the younger fish.

111. **NOTING** that most tags were only at liberty for 18 months – 2 years, the WPTT **AGREED** that the model was adequately parameterised to limit the analysis to the juvenile component of the stock. It was considered reasonable to assume that the movement of this component of the stock was likely to be strongly influenced by prevailing oceanographic conditions.

112. The WPTT **NOTED** that the current data was at a relatively coarse spatial scale and on a monthly time-step, and that currents in the Mozambique Channel are highly variable at small spatial scales, which could explain why the model could not move tuna south into the channel. It might be possible to get finer-scale current data from the FADs, but this additional work would require resources.

113. The WPTT **NOTED** that for the stock assessment Region 1 could be subdivided to a scale where the assumption of rapid mixing is valid, but doing so would add additional parameters, which might be even more problematic.

7.3 Data for input into stock assessments

European Union – Catch-per-unit-of-effort (CPUE)

114. The WPTT **NOTED** paper IOTC–2013–WPTT15–23 which provided a standardised CPUE for juvenile bigeye tuna and yellowfin tuna and skipjack tuna and from the European purse seine fleet in the Indian Ocean from 1981 to 2011 , including the following abstract provided by the authors:

    "*In this document three abundance indices are obtained for the juveniles of tropical tunas (yellowfin (≤10Kg), skipjack and bigeye (≤10Kg) of European purse seine fishery in the Indian ocean from 1981 to 2011 using generalized linear models. Catch and effort data come from detailed daily logbooks. Catch rates are modelled using the delta lognormal model. The method estimates a combined CPUE of the three species from aggregated catches, and the proportion of catches for each species, so the final individual abundance indices are calculated multiplying both estimators for each species. Explanatory factors used in the analysis are: year, zone, quarter, holding capacity, country and starting date of the vessel. Year is the most explanatory factor of variability in CPUE and, depending on the species, the fishing area and the quarter are significant. Vessel characteristics have a significant explanatory effect in observed aggregated catch rates.*"

115. The WPTT **NOTED** that this work is based on catch-per-set, which measures the size of the school and that there is a need to investigate other alternatives to fishing-days for FADs. The main goal of the CPUE indicator was to assess the variability of year class strength on bigeye tuna and yellowfin tuna.

116. **NOTING** the difficulties to standardise the purse seine CPUE and its representativeness as an abundance index, the WPTT **AGREED** that comparisons of the index to the estimate of the recruitment from the stock assessment model, which did not use the information contained in the index, coincide to a certain degree.

117. The WPTT **NOTED** that the trends in CPUE series for all three tropical tuna species seem to follow similar patterns to each other, and the environmental indices discussed in paper IOTC–2013–WPTT15–09, and perhaps more advanced multi-species modelling, possibly as a multinomial, might be more appropriate.

118. The WPTT **NOTED** that the relative contribution of the free school fishery compared to the FAD fishery needs to be accounted for in the standardisation, as for some years the fleet is likely to be targeting larger yellowfin tuna in free swimming schools.

119. The WPTT **REQUESTED** that the standardised CPUE index for skipjack tuna and juvenile bigeye tuna and yellowfin tuna caught by the EU purse seiner fleets, be updated and submitted to the next WPTT meeting.

120. The WPTT **NOTED** the CPUE series presented at the meeting for purse seine series for the whole Indian Ocean (Fig. 3).

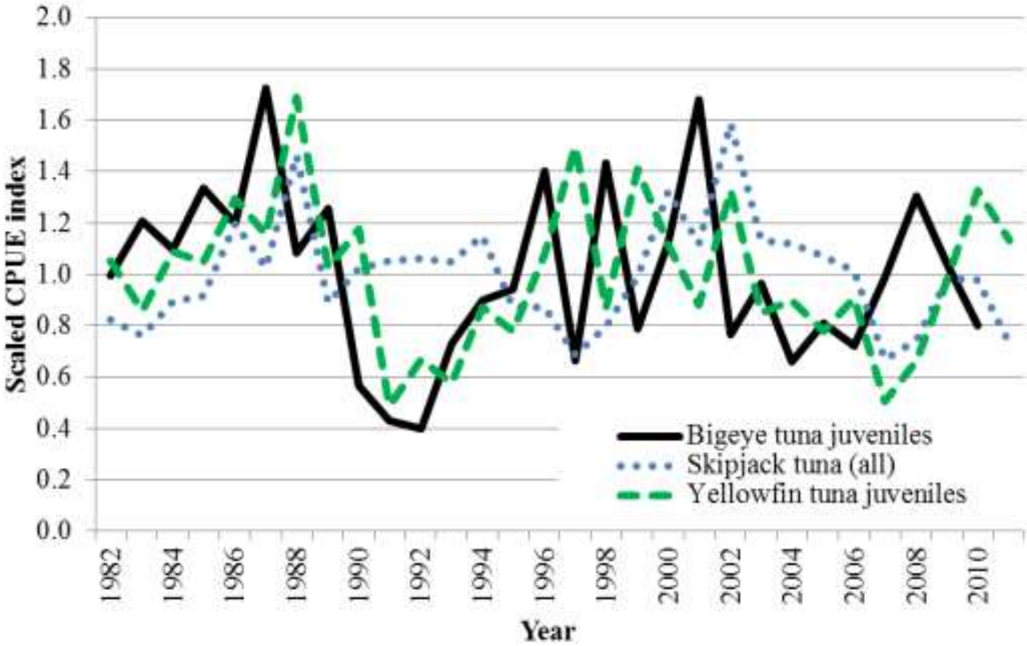


Fig. 3. Juvenile bigeye tuna and yellowfin tuna; skipjack tuna (all): Comparison of the three standardised purse seine CPUE series for the European Union. Series have been rescaled relative to their respective means from 1982–2011.

Republic of Korea – Catch-per-unit-of-effort (CPUE)

121. The WPTT **NOTED** paper IOTC–2013–WPTT15–24 which provided a CPUE standardisation for bigeye tuna caught by Korean tuna longline fisheries in the Indian Ocean from 1977 to 2012, including the following abstract provided by the authors:

> "*In this study, bigeye tuna CPUE (catch per unit effort) standardization of Korean longline fisheries in the Indian Ocean was conducted by Generalized Linear Model (GLM) using operational data and aggregated data (1977–2012) to assess the proxy of the abundance index. The data used for GLM were catch (in number), effort (number of hooks) and number of hooks between floats (HBF) by year, month and area. In addition, we explored the core area where Korean tuna longline vessels have been fishing for bigeye tuna. Bigeye tuna CPUE was standardized for the whole area using operational data and aggregated data and for the core area. All the CPUEs had decreased until the early of 2000s except a jump in the mid-1990s, and then showed a steady trend with a level of 2–3 in recent years.*"

122. The WPTT **NOTED** that the number of hooks between floats has decreased due to targeting of southern bluefin tuna in recent years.

123. The WPTT **NOTED** the similar trend between the CPUE series from the Rep. of Korea longline fleet (Fig. 4) and those from the Japan longline fleet (Fig. 5) and **ENCOURAGED** further investigation and use of CPUE data from the Rep. of Korea in the future.

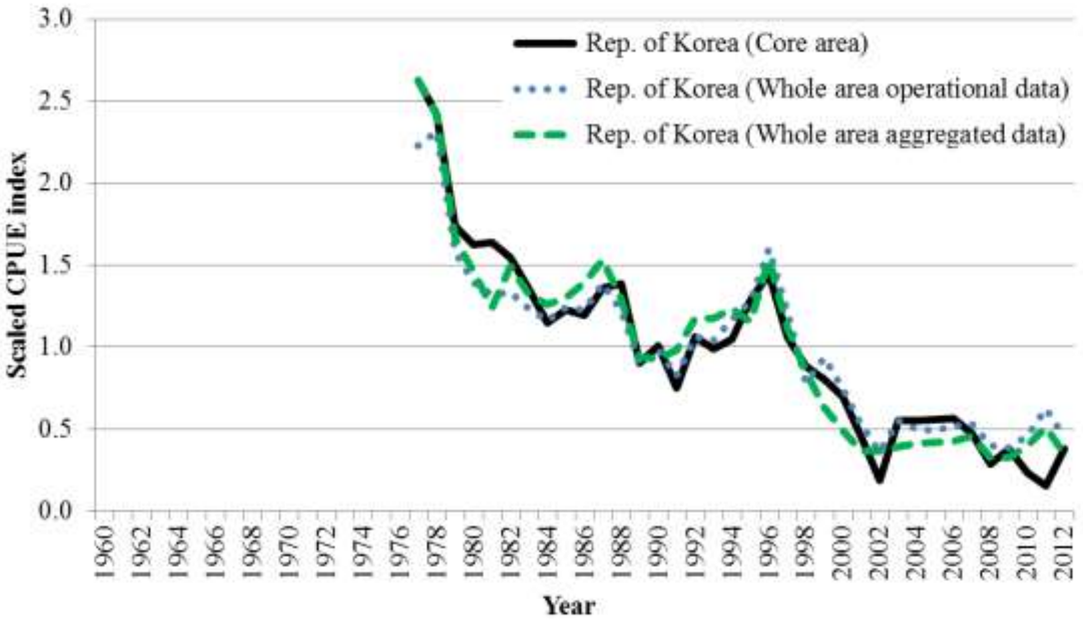


Fig. 4. Bigeye tuna: Comparison of the three standardised longline CPUE series for the Rep. of Korea. Series have been rescaled relative to their respective means from 1977–2012.

Japan – Catch-per-unit-of-effort (CPUE)

124. The WPTT **NOTED** paper IOTC–2013–WPTT15–25 which provided a Japanese longline CPUE for bigeye tuna in the Indian Ocean standardized by GLM from 1960 to 2012, including the following abstract provided by the authors:

> "*Standardization of Japanese longline CPUE for bigeye tuna was conducted for 1960-2012 by using GLM (generalized linear model, log normal error structured). Methods of standardization are the same as or similar to those used at IOTC WPTT in 2012. The effects of season (month or quarter), subarea or LT5LN5 (five degree latitude-longitude block), SST (sea surface temperature), NHF (number of hooks between floats) and material of main line, and several interactions between them were used for standardization. The trend of CPUE slightly differed by area, but high jump in 1977 and 1978, slight decrease after that, and increasing trend in the recent few years are seen as for each area. Change in fishing gear (material of main line and NHF) was seen especially after 1990s, which may have caused the difference between nominal and standardized CPUE.*"

125. The WPTT **NOTED** that the standardised CPUE of the previous assessment in 2011 and in this study (Fig. 5) were almost identical in the tropical, the south region and the whole Indian Ocean areas.

126. The WPTT **NOTED** that during the period 1970–1980 the use of deep longlines targeting bigeye tuna became the standard for the Japanese fleet. Thus, the sharp increase in CPUE in 1977 is most likely to correspond to the change in increased catchability rather than a rapid increase of the biomass of the population.

127. The WPTT **AGREED** that as the Japanese longline CPUE series was the longest series available for any bigeye tuna fleet operating in the Indian Ocean, it was likely to provide the most useful information for stock assessment purposes. However, due to the recent retraction in the areas fished, partially as a result of piracy, the utility of the series to determine abundance trends may be reduced for the most recent years.

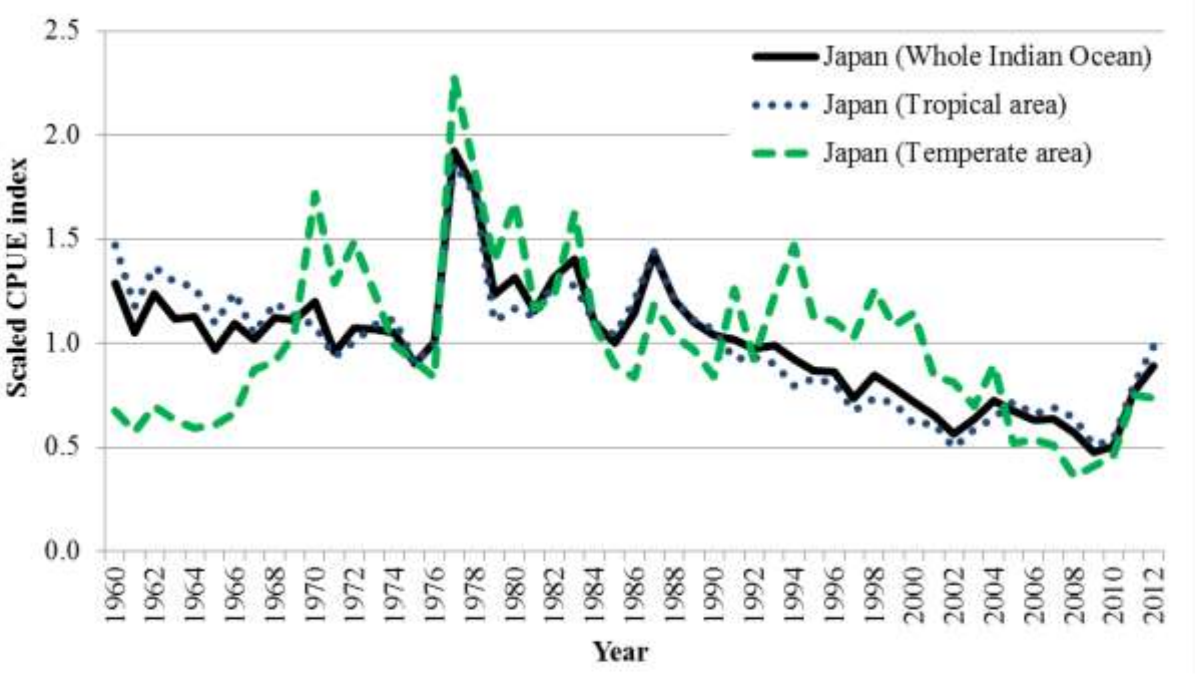


Fig. 5. Bigeye tuna: Comparison of the three standardised longline CPUE series for Japan. Series have been rescaled relative to their respective means from 1960–2012.

Taiwan,China – Catch-per-unit-of-effort (CPUE)

128. The WPTT **NOTED** paper IOTC–2013–WPTT15–26 which provided a CPUE standardisations for bigeye tuna caught by Taiwan,China longline fishery in the Indian Ocean using generalised linear model from 1980 to 2012, including the following abstract provided by the authors:

> "*Quarterly and annual Taiwan,China longline CPUEs for bigeye tuna in the south, tropical and whole Indian Ocean were standardized up to 2012 by GLM. The trend of standardized CPUE for whole Indian Ocean was similar to that of the tropical Indian Ocean. Standardized CPUE series showed a relatively stable trend over the period from 1980 to 2012. However, CPUE value reached a peak in 2012 due to fishing effort was more aggregated in the western equatorial region with relative high catch rate. Besides, the trend of standardized CPUE for south Indian Ocean showed a fluctuation in the mid-1990s, reaching a peak in 2003 and then decreasing steadily to 2009 and followed a slight recover in recent year. Quarterly and annual Taiwan,China longline CPUEs for yellowfin tuna in the tropical and whole Indian Ocean were standardized up to 2012 by GLM. The trend of standardized CPUE for whole Indian Ocean was similar to that of the tropical Indian Ocean* – see paper for full abstract"

129. The WPTT **NOTED** that the standardised CPUE series showed a relatively stable trend from 1979 to 2004. After that, the CPUE continuously decreased to the historical low level in 2009, and then started to increase in recent two years (Fig. 6). After that, the nominal CPUE continually dropped to the historical lowest CPUE of 1 fish/1000 hooks. And then came back to the level of 2 fish/1000 hooks in 2012. As for the standardised CPUE series, they showed very similar trend with the nominal CPUE except before 1986. There is no updated information for the Area 1 since few fishing activities occurred in this area for 2011 and 2012.

130. The WPTT **NOTED** that the spatial distribution of the fleet has been decreasing, and that this is problematic from the perspective of developing reliable indices of abundance (standardised CPUE series).

131. The WPTT **AGREED** that it can be problematic to use species composition as an index of targeting because it may also be related to the abundance over time, and as such, dampen the annual signal. It would be better to use different criteria, such as operational data (such as hooks between floats) when it is available.

132. The WPTT **NOTED** the need for clarification in the data filtering process. One of the filtering rules is to exclude a data point when there is zero catch of all of the four main species (bigeye tuna, yellowfin tuna, albacore and swordfish), and this does not imply that zeros catches are being removed when zero catches occur for only one of the main species. When there was zero catch for all the four main species, the vessel was likely targeting southern bluefin tuna.

133. The WPTT **NOTED** that the CPUE series for the Taiwan,China longline fleet conflicts with the declining trends of the Japanese and Rep. of Korea series, except for the most recent years. It was **AGREED** that the recent decline in the Taiwan,China CPUE series and the divergence between nominal and standardised series was thought to be due to changes in targeting and in the spatial distribution of effort, likely related to piracy activities in the northwest Indian Ocean.

134. The WPTT **NOTED** that the standardised CPUE series for bigeye tuna caught by the Taiwan,China longline fleet in the temperate region of the Indian Ocean may provide important information regarding stock status for bigeye tuna. The bigeye tuna catch by the Taiwan,China longline fishery is relatively high compared with other fisheries. It was suggested that the standardised CPUE series for the Taiwan,China bigeye tuna longline fishery in the temperate region of the Indian Ocean could be considered in future analysis of bigeye tuna (Fig. 6).

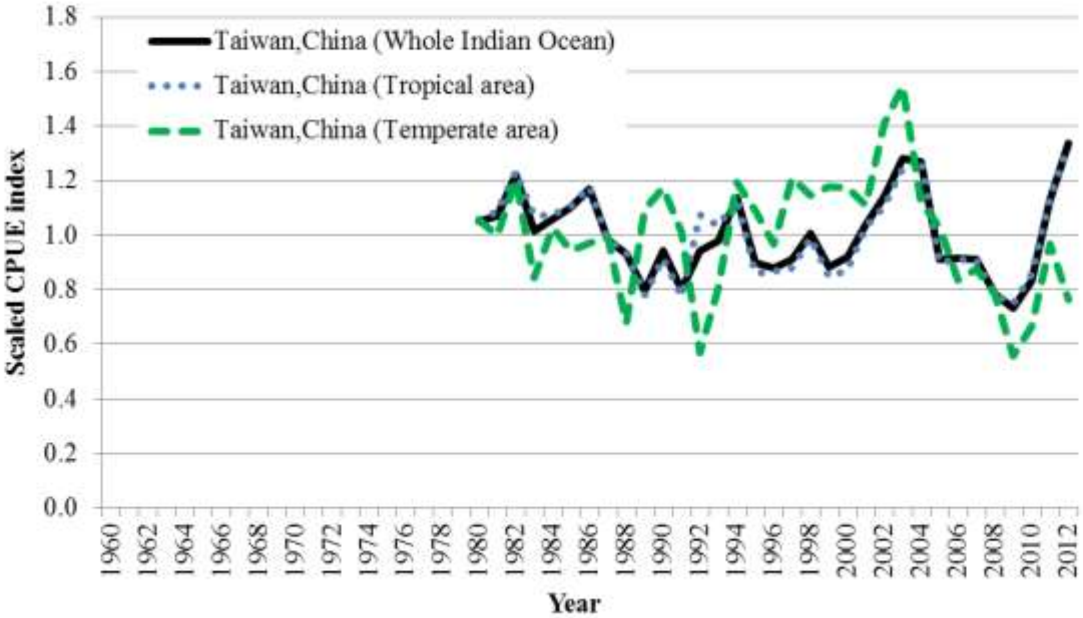


Fig. 6. Bigeye tuna: Comparison of the three standardised longline CPUE series for Taiwan,China. Series have been rescaled relative to their respective means from 1980–2012.

Bigeye tuna CPUE discussion summary

135. The WPTT **AGREED** that were was a great deal of concern about the reliability of the standardised CPUE indices given the contrasting trends observed and the impacts of piracy on longline fleet operations since 2007. Changing spatial distribution of the Japanese longline fleet, particularly in recent years, and the potential for changes in efficiency, may lead to increased uncertainty and confidence in the reliability of the Japanese longline CPUE series.

136. The WPTT **NOTED** that in the bigeye tuna equatorial areas 1 and 2, there is an unexplained differential pattern of steadily declining Japanese bigeye tuna CPUEs and stable bigeye tuna CPUE for the Taiwan,China fleet (both nominal and standardised CPUE showing very similar trend). This result may be due to the peculiar multispecies nature of the longline fisheries and to the changes in target species that are not well incorporated into CPUE standardisations.

137. The WPTT **AGREED** that of the CPUE series presented at the meeting, listed below and shown in Figs. 4, 5, and 6 only the Japanese longline CPUE index (quarterly) for the whole Indian Ocean (1960–2012) (Fig. 7) should be utilised for the final stock assessment model runs to be used in the development of management advice in 2013, noting that the Japanese series from the tropical areas and the Indian Ocean as a whole, showed very similar trends (Fig. 7).

- Rep. of Korea data (1977–2012): Series (core area and whole Indian Ocean) from document IOTC–2013–WPTT15–24 (Fig. 4).
- Japan data (1960–2012): Series (whole Indian Ocean, tropical area, temperate area) from document IOTC–2013–WPTT15–25 (Fig. 5).
- Taiwan,China data (1980–2012): Series (whole Indian Ocean, tropical area, temperate area) from document IOTC–2013–WPTT15–26 (Fig. 6).

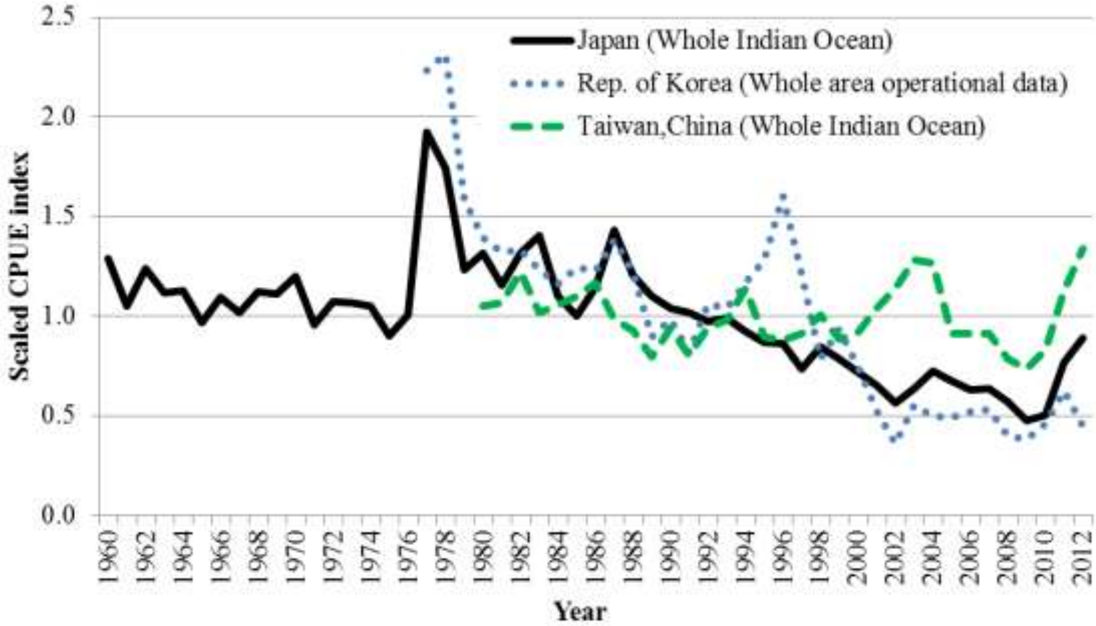


Fig. 7. Bigeye tuna: Standardised CPUE series for the longline fleets of Japan, Rep. of Korea and Taiwan,China for the whole Indian Ocean (1960–2012). The quarterly series for the Japanese longline fleet was used in the final 2013 stock assessment runs used for management advice.

7.4 Stock assessment updates

Bigeye tuna: Summary of stock assessment models in 2013

138. The WPTT **NOTED** that a range of quantitative modelling methods (ASAP, ASPM and SS3) were applied to bigeye tuna in 2013. Table 2 provides an overview of the key features of each of the three stock assessments for bigeye tuna, while Table 3 provides a summary of the assessment results.

139. The WPTT **NOTED** the value of comparing different modelling approaches evaluating alternative hypothesis about the quality of the data used. Evaluating and validating the data is integral in the assessment, as fitting to alternative CPUE indices and assuming different model structures can have a large influence on the assessments.

Table 2. Bigeye tuna: Summary of final stock assessment model features as applied in 2013.

Model feature	**ASAP**	**ASPM**	**SS3**
Software availability	NMFS toolbox	*	NMFS toolbox
Population spatial structure / areas	1	1	1
Number CPUE Series	2	1	1
Uses Catch-at-length/age	Yes (CAA)	Yes (CAA)	Yes
Uses tagging data	No	No	No
Age-structured	Yes	Yes	Yes
Sex-structured	No	No	No
Number of Fleets	7	5	12
Stochastic Recruitment	Yes	Yes	Yes

* http://ocean-info.ddo.jp/kobeaspm/aspm/aspm.zip

Table 3. Bigeye tuna: Summary of model results for 2013.

Management quantity	ASAP	ASPM	SS3
Most recent catch estimate (t) (2012)		115,793	
Mean catch over last 5 years (t) (2008–2012)		107,603	
MSY (t) (80% CI) [plausible range]	96,893 [89,242-105,761]	125,500 (90,700–150,300)	132,000 [98,000–207,000]
Data period (catch)	1978–2012	1952–2012	1952–2012
CPUE series	Longline (Japanese+ Taiwan,China)	Japan (whole area)	Japan, Longline, quarterly whole Indian Ocean
CPUE period	1978–2012	1960–2012	1960–2012
F_{2012}/F_{MSY} (80% CI) [plausible range]	0.74 [0.60–0.91]	0.42 (0.27–0.56)	0.42 [0.21–0.80]
B_{2012}/B_{MSY} (80% CI)	n.a.	n.a.	n.a.
SB_{2012}/SB_{MSY} (80% CI) [plausible range]	1.41 [1.19–1.66]	1.10 (0.88–1.32)	1.44 [0.87–2.22]
B_{2012}/B_0 (80% CI)	n.a.	(n.a.)	n.a.
SB_{2012}/SB_0 (80% CI) [plausible range]	n.a.	0.38 (n.a)	0.40 [0.27–0.54]
$B_{2012}/B_{2012,\ F=0}$	n.a.	n.a.	n.a.
$SB_{2012}/SB_{2012,\ F=0}$	n.a.	n.a.	0.40 [0.27–0.54]

n.a. not available
ASAP plausible range derived from all the runs used from base case and sensitivity runs.
ASPM 80% CI derived from a single model run and bootstrap estimates of uncertainty.
SS3 plausible range derived from a range of Maximum Posterior Density (MPD) estimates.

Age Structured Assessment Program (ASAP)

140. The WPTT **NOTED** paper IOTC–2013–WPTT15–28 which provided a stock assessment of bigeye tuna (*Thunnus obesus*) in the Indian Ocean using ASAP, including the following abstract provided by the authors:
“*This paper presented a stock assessment for Indian Ocean bigeye tuna (Thunnus obesus) using Age Structured Assessment Program (ASAP), based on fishery-specific annual catch and catch-at-age data. Biological parameters (e.g., growth, natural mortality) were assumed as in previous assessments by other models. The assessment considered that the bigeye tuna stock were subject to 7 fisheries, i.e., Deep longline fishery (LL), Purse seine fishery of free-school (PSFS), Purse seine fishery of associated-school (PSLS), Pole-and-line and small seine fisheries (BB), Fresh longline fishery (FL), Line fishery (LINE), and Other fishery (OTHER). The stock was modeled on yearly basis from 1978 to 2012. Standardized catch-per-unit-effort (CPUE) derived from longline fisheries of Japan and Taiwan,China were used as abundance indices for tuning the model. Key sources of uncertainty were considered to come from steepness (ranging at 0.7, 0.8, and 0.9) of Beverton-Holt stock-recruitment relationship and weighting schemes for alternative abundance indices and age-composition data. Therefore, sensitivity analyses were run considering various combinations of these uncertainties* – see paper for full abstract.”

141. The WPTT **CONGRATULATED** the authors for their comprehensive work and **NOTED** that the ASAP results generally estimate current stock status to be similar to that estimated from SS3 and ASPM, although the model structure applied different assumptions and used different inputs (mainly catch at age, external to the model).

142. The WPTT **REQUESTED** that the modelling framework and assumptions be aligned to those applied in the SS3 assessment (see below) for the next assessment, as much as possible, to enhance comparability between model outcomes.

143. The WPTT **NOTED** that the ASAP modelling framework makes use of catch at age determined externally to the model process which may prevent propagation of statistical uncertainty in that process into the model outcomes. It was also noted, however, that the system allows for variability in the catch at age matrix and, as a result in this particular application, yielded estimates of catch at age in the most recent year that equated to catch lower than reported. This feature can have impact on estimates of productivity of the stock and in this case may be the reason for lower estimates of MSY when compared with the results from the SS3 model application, which cause some concerns on the result reliability of this particular model approach.

144. The WPTT **NOTED** Table 3 which provides an overview of the key features of the stock assessment model used in 2013.

145. The WPTT **NOTED** the key assessment results for the ASAP model as shown below for the one area assessment (Table 4; Fig. 8).

Table 4. Key management quantities from the ASAP assessment, for the aggregate Indian Ocean.

Management Quantity	Aggregate Indian Ocean
2012 catch estimate	115,793
Mean catch from 2008–2012	107,603
MSY [plausible range]	96,893 (89,242–105,761)
Data period used in assessment	1978–2012
F_{2012}/F_{MSY} [plausible range]	0.74 [0.60–0.91]
B_{2012}/B_{MSY}	n.a.
SB_{2012}/SB_{MSY} [plausible range]	1.41 [1.19–1.66]
B_{2012}/B_0	n.a.
SB_{2012}/SB_0	n.a.
$B_{2012}/B_{2012,\ F=0}$	n.a.
$SB_{2012}/SB_{2012,\ F=0}$	n.a.

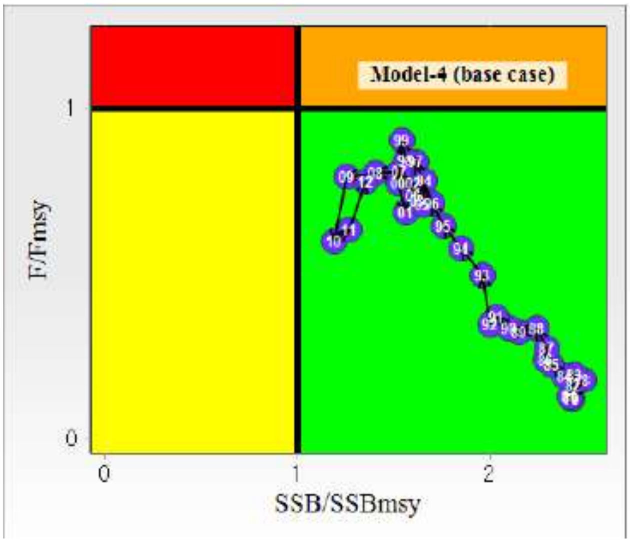


Fig. 8. Bigeye tuna: ASAP Indian Ocean assessment Kobe plot (Base case evaluation). Circles indicate the trajectory of the point estimates for the SB/SB_{MSY} ratio and F/F_{MSY} ratio for each year 1978–2012.

146. The WPTT **NOTED** that projections for this assessment method over a 10 year period may not be appropriate bearing in mind the large uncertainties in the outputs from the stock assessment model.

147. The WPTT **NOTED** that considering the uncertainties, the updated stock assessment carried out in 2013 was similar to the results gathered in 2010 which give consistency to the general perception of the stock status. The

noticeable feature in the current assessment is the population response to large reductions in catch, which in general improved stock condition compared to the prior assessment.

Stock Synthesis III (SS3)

148. The WPTT **NOTED** paper IOTC–2013–WPTT15–30 which provided a stock assessment of bigeye tuna in the Indian Ocean for 2012 using SS3, including the following abstract provided by the authors:

“*A stock assessment of Indian Ocean bigeye tuna was conducted using Stock Synthesis. The assessment was structured to include 12 fisheries defined by fishing method and IO sub-region (eastern equatorial, western equatorial and southern). The key data sets included in the model were fishery specific catches and size frequency data, Japanese longline CPUE indices (from 1960) and tag release/recovery data from the IO RTTP. The model assumed that the stock was in unexploited, equilibrium conditions in 1952 - the first year of the available catch data. Preliminary modelling investigated a wide range of structural assumptions and examined the influence of key data sets. The results of the preliminary modelling are documented in IOTC–2013–WPTT15–30. These results revealed that the data were inadequate to support a regionally structured (three region) assessment model. The results also highlighted a strong conflict between the CPUE indices and the fishery-specific length frequency data, particularly the data from the longline fishery. There is considerable concern regarding the reliability of these data, particularly the recent data from the TW longline fishery (see IOTC–2013–WPTT15–41) and on that basis the longline length frequency data were substantially down-weighted in the final assessment models. By comparison, the length frequency data from the main purse-seine fisheries are considered to be reliable.*”

149. The WPTT **CONGRATULATED** the authors for their comprehensive work. Following discussion, it was **AGREED** that the single area model was likely to yield a more robust representation of the current status of the stock given the limitations of and uncertainty associated with the underlying data. Although there are questions related to the representativeness of the longline size frequency data which warrants down weighting them in the analysis, the same cannot be said for the purse seine size frequency, which is considered accurate and representative.

150. **NOTING** that unfortunately, the modelling structure implemented to date is not able to accommodate the tagging data for the bigeye tuna assessment since the model assumptions necessary for their inclusion do not yet match the realities of the data, the WPTT **AGREED** that more work be undertaken on modelling frameworks that can adequately account for the rates of mixing observed in the tagging data.

151. **NOTING** the extensive discussion of the preliminary results and subsequent sensitivity trials conducted at the meeting, the WPTT **AGREED** to a grid of assumptions to characterise the uncertainty in the SS3 assessment.

152. The WPTT **AGREED** to final assessment models which included a single region structure (spatially aggregated), while maintaining the spatial definitions of the individual fisheries. The models included the Japanese longline quarterly CPUE indices derived for the whole Indian Ocean, linked to the (logistic) selectivity of the longline fishery within the western equatorial region. The purse seine size frequency data were assigned a moderate weighting (effective sample size 100), while all other length frequency data were down-weighted (ESS 10). Analyses of tag recovery data indicated that sufficient mixing of tags did not occur over the basin-scale during a reasonable time period (at least 2 years). Consequently, the inclusion of the tagging data in the assessment model may introduce a substantial bias in the estimation of stock biomass from the basin scale model. For this reason, the tagging data were excluded from the final, preferred model options, although for comparative purposes a model option is presented that included the tag data.

153. The WPTT **NOTED** the key uncertainties in the assessment model identified during the meeting and a range of plausible scenarios that were formulated, specifically the level of natural mortality for the older age classes (two options), the steepness of the stock-recruitment relationship (0.7, 0.8 or 0.9) and the catchability of the longline fishery (static or increasing 1% p.a.). The 12 combinations of these three parameters are considered to encompass the main uncertainties of the stock assessment and individual model options were configured accordingly.

154. The WPTT **AGREED** that all model options estimated a strong increase in fishing mortality during the 1990s with a peak in fishing mortality from the late 1990s to late 2000s coinciding with the peak in catches. For most model options, fishing mortality did not exceed F_{MSY} during that period, with the exception of two model options with an increase in longline catchability, lower M and lower steepness (0.7 and 0.8). For all model options, fishing mortality levels declined rapidly in the late 2000s following the decline in the total catch from the fishery. In 2012, fishing mortality was estimated to be well below the F_{MSY} for all model options.

155. The WPTT **NOTED** that the spawning biomass was estimated to decline steadily from 1980 to 2010 and for the two conservative model options declined below the SB_{MSY} by 2010. Stock biomass is estimated to have increased during the last 2-3 years of the model, due to lower catches and an increase in recent recruitment. For

2012, most model options estimate the stock to be above, or well above, the SB_{MSY} level, with the exception of the two conservative model options. These models predict biomass levels will exceed the reference point over the short-term (1–2 years). Estimates of MSY for the stock range from 98,000 t to 207,000 t with most model options estimating yields in excess of the current (2012) catch of 116,000 t. However, most estimates of MSY are less than the peak in the annual catches of about 150,000 t during 1997–2002.

156. The WPTT **NOTED** the presentation for comparative purposes that the model option that included the tagging data (with a 4 quarter mixing period), which resulted in estimates of stock biomass that were considerably lower than the corresponding base model (steepness 0.8, no catchability increase and higher M). Nonetheless, the resulting estimates of fishing mortality were considerably lower than F_{MSY} (F/F_{MSY} = 0.39) and biomass was considerably higher than SB_{MSY} (SB/SB_{MSY} = 1.74) while MSY was estimated at 138,000 t.

157. The WPTT **NOTED** that the key assessment results for the stock synthesis model (SS3) (range of outputs from this grid), while characterising a relatively wide range of uncertainty, largely indicated that the stock was neither overfished nor undergoing overfishing in 2012 (Tables 5, 6, 7; Fig. 9). The point estimate of MSY is the median of the 12 plausible runs which are given equal weighting.

Table 5. Bigeye tuna: Key management quantities from the SS3 assessment, for the aggregate Indian Ocean.

Management Quantity	Aggregate Indian Ocean
2012 catch estimate	115,793 t
Mean catch from 2008–2012	107,603 t
MSY [plausible range]	132,000 [98,000–207,000]
Data period used in assessment	1952–2012
F_{2012}/F_{MSY} [plausible range]	0.42 [0.21–0.80]
B_{2012}/B_{MSY}	n.a.
SB_{2012}/SB_{MSY} [plausible range]	1.44 [0.87–2.22]
B_{2012}/B_{1952}	n.a.
SB_{2012}/SB_{1952} [plausible range]	0.40 [0.27–0.54]
$B_{2012}/B_{2012,\ F=0}$	n.a.
$SB_{2012}/SB_{2012,\ F=0}$	0.40 [0.27–0.54]

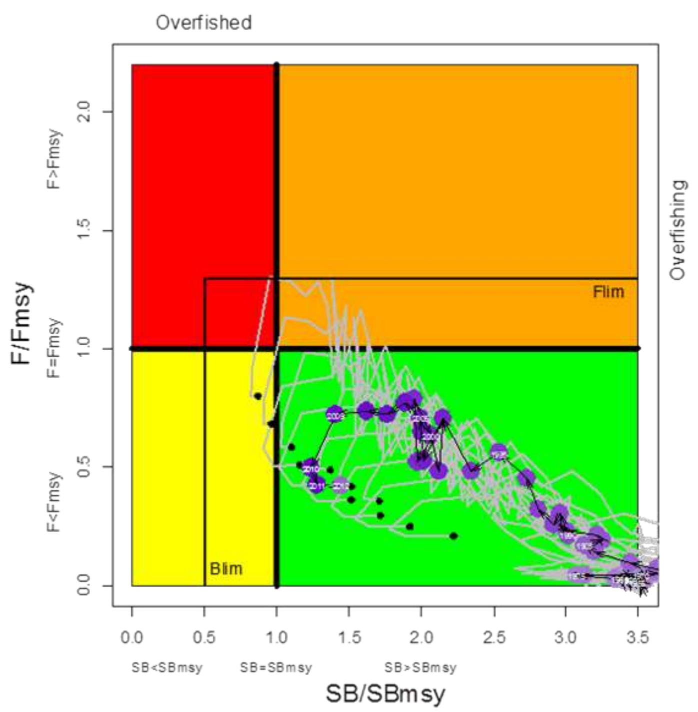


Fig. 9. Bigeye tuna: SS3 Aggregated Indian Ocean assessment Kobe plot. The Kobe plot presents the trajectories for the range of 12 plausible model options included in the formulation of the final management advice (grey lines with the black point representing the terminal year of 2012). The trajectory of the median of the 12 plausible model options (purple points) is also presented. The interim biomass (B_{lim}) and fishing mortality limit (F_{lim}) reference points are also shown.

Table 6. A comparison of the MSY based reference points from the individual plausible SS3 model options that excluded the tagging data with different levels of steepness of the stock recruitment relationship (SSR), alternative assumptions regarding natural mortality (M1, higher M; M2, lower M) and treatment of the Japanese longline CPUE indices (q0, no increase in catchability; q1, 1% p.a. increase in catchability). A comparable model run including tag data is also presented.

Tag	**Steepness**	**LLq**	**M**	**SB0**	**SB_{MSY}**	**MSY**	**SB_{2012}/SB_{MSY}**	**F_{2012}/F_{MSY}**
No	0.8	q0	M1	1,674,570	464,949	187,596	1.924	0.248
No	0.8	q1	M1	1,230,490	344,059	143,632	1.309	0.430
No	0.8	q0	M2	2,068,550	597,346	122,541	1.513	0.418
No	0.8	q1	M2	1,669,190	482,316	105,543	0.967	0.683
No	0.7	q0	M1	1,703,280	526,637	169,410	1.715	0.295
No	0.7	q1	M1	1,264,770	392,389	131,920	1.161	0.508
No	0.7	q0	M2	2,125,490	676,530	112,232	1.369	0.486
No	0.7	q1	M2	1,738,530	553,032	97,842	0.869	0.800
No	0.9	q0	M1	1,661,680	401,872	206,976	2.222	0.209
No	0.9	q1	M1	1,203,630	295,291	155,743	1.513	0.361
No	0.9	q0	M2	2,026,550	519,441	132,555	1.710	0.359
No	0.9	q1	M2	1,618,690	416,289	113,100	1.097	0.583
Yes	0.8	q0	M1	1,174,990	326,141	137,587	1.742	0.386

158. The WPTT **NOTED** that projections for this stock over a 10 year period may not be appropriate bearing in mind the large uncertainties in the outputs from the stock assessment model and the likelihood of increased catch and effort from areas in the northwest Indian Ocean in the near future.

159. The WPTT **NOTED** that considering the uncertainties, the updated stock assessment carried out in 2013 was similar to the results gathered in 2010 which give consistency to the general perception of the stock status. The noticeable feature in the current assessment is the population response to large reductions in catch, which general improved stock condition compared to the prior assessment.

Table 7. Bigeye tuna: 2013 SS3 Aggregated Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of 12 plausible models violating the MSY-based reference points for five constant catch projections (2012 catch level, + 10%, + 20%, + 30% and + 40%) projected for 3 and 10 years. Note: from the 2013 stock assessment using catch estimates at that time.

Reference point and projection timeframe	**Alternative catch projections (relative to 2012) and weighted probability (%) scenarios that violate reference point**				
	100% (115,800 t)	**110%** (127,400 t)	**120%** (139,000 t)	**130%** (150,500 t)	**140%** (162,100 t)
$SB_{2015} < SB_{MSY}$	0	0	0	0	0
$F_{2015} > MSY$	0	0	0	8	17
$SB_{2022} < SB_{MSY}$	0	0	8	17	25
$F_{2022} > MSY$	0	0	8	17	25

Age Structured Production Model (ASPM)

160. The WPTT **NOTED** paper IOTC–2013–WPTT15–31 Rev_1 which provided a stock and risk assessment of bigeye tuna (*Thunnus obesus*) in the Indian Ocean by Age-Structured Production Model (ASPM), including the following abstract provided by the authors:

> "*We applied an Age-Structured Production Model (ASPM) to assess the status of the bigeye tuna stock (Thunnus obesus) in the Indian Ocean using 61 years of data (1952-2012). The assessment results suggested that MSY=120,500 tons (catch in 2012=99,899 tons) and the SSB ratio (2012) is near the MSY level (1.10), while F ratio (2012) is much lower than the MSY level (0.42). The results suggested that the bigeye stock is in the healthy condition and the projection based on the current catch level (99,899 tons) suggest that the current level can increase the stock from 2013 and after.*"

161. The WPTT **CONGRATULATED** the authors for their comprehensive work, and **NOTED** that the ASPM results generally estimate current stock status to be similar to that estimated from SS3 and ASAP, although the model structure applied different assumptions and used different inputs (mainly catch at age, external to the model).

162. The WPTT **REQUESTED** the model structure and sensitivity grid for ASPM be made as similar to that agreed for SS3 in order to enhance comparison between model outcomes.

163. The WPTT **NOTED** that like with ASAP, the model is structured to allow for variability in catch at age, and hence in annual catch. It was further noted that like with ASAP, this feature can result in deviations from the reported catch, and thus influence estimates of MSY.

164. The WPTT **NOTED** the sensitivity of the model outcomes to the grid of assumptions requested, but noted the results were generally consistent with the other modelling efforts in terms of current stock status, although the historical patterns in F and SB were somewhat more variable.

165. The WPTT **NOTED** Table 8 and Fig. 10 which provide the key assessment results for the ASPM model.

Table 8. Key management quantities from the ASPM assessment, for the aggregate Indian Ocean.

Management Quantity	Aggregate Indian Ocean
2012 catch estimate	115,793 t
Mean catch from 2008–2012	107,603 t
MSY (80% CI)	120,500 (90,700–150,300)
Data period used in assessment	1952–2012
F_{2012}/F_{MSY} (80% CI)	0.42 (0.27–0.56)
B_{2012}/B_{MSY}	n.a.
SB_{2012}/SB_{MSY} (80% CI)	1.10 (0.88–1.32)
B_{2012}/B_{1952}	0.38 (n.a.)
SB_{2012}/SB_{1952} (80% CI)	n.a.
$B_{2012}/B_{2012, F=0}$	n.a.
$SB_{2012}/SB_{2012, F=0}$ (80% CI)	n.a.

ASPM 80% CI derived from a single model run and bootstrap estimates of uncertainty.

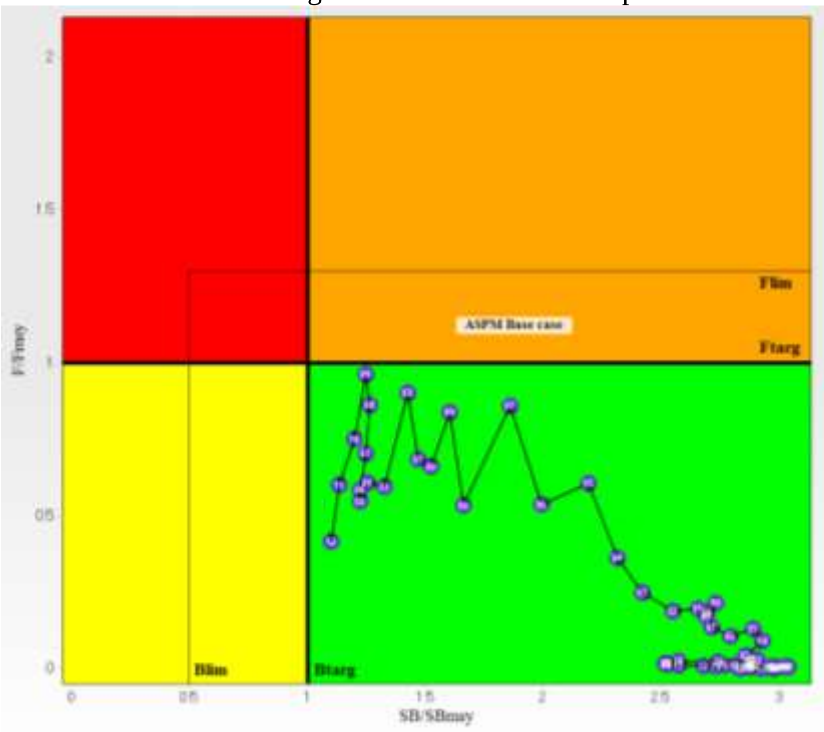


Fig. 10. Bigeye tuna: ASPM Indian Ocean assessment Kobe plot (preferred model outcome used in the 2013 analysis in 2012). Circles indicate the trajectory of the point estimates for the SSB/SSB_{MSY} ratio and F/F_{MSY} ratio for each year 1950–2012.

166. The WPTT **NOTED** that projections for this stock over a 10 year period, may not be appropriate bearing in mind the large uncertainties in the outputs from the stock assessment model and the likelihood of increased catch and effort from areas near the Somali coast in the near future.

167. The WPTT **NOTED** that the results of the updated stock assessment carried out in 2013 using this model application were similar to the results gathered in 2011 (and 2006) which give consistency to the general perception of the stock status.

Parameters for future analyses: Bigeye tuna CPUE standardisation and stock assessments

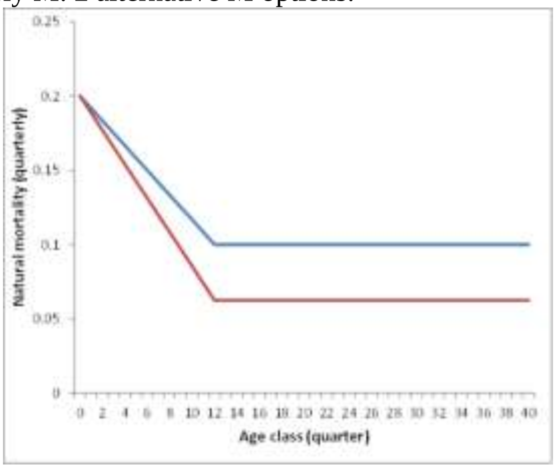
168. The WPTT **AGREED** that in order to obtain comparable CPUE standardisations, the analyses shall be conducted with similar parameters and resolutions when the stock is next assessed. Table 9 provides a set of parameters that shall give guidelines, if available, for the standardisation of CPUE to be used as indices of abundance for the stock assessments.

Table 9. Tentative set of parameters for the standardisation of CPUE series in the future.

CPUE standardisation parameters	Value for future CPUE standardisation
Area	1 region
CE Resolution	Operational data
GLM Factors	Year, area, SST (as appropriate) and gear effects (no vessel effect)
Model	Lognormal

169. The WPTT **NOTED** that the model parameters contained in Table 10 could be considered appropriate for future bigeye tuna stock assessments preliminary base case analysis, with appropriate sensitivity runs.

Table 10. Bigeye tuna: Model parameters for use in future base case and sensitivity stock assessment runs.

Biological parameters	Value for assessments
Sex ratio	1:1
Age (longevity)	15 years
Natural mortality	Age specific, quarterly M. 2 alternative M options.
	
Growth formula	VB log K 2-stanza growth (Eveson et al. 2012 IOTC–2012–WPTT14–23)
Weight-length allometry	W=aL^b with a= 3.661^{-05} and b=2.901 common to sex
Maturity	Length-specific (50% mature at length 110 cm)
Fecundity	Proportional to the spawning biomass
Stock-recruitment	B&H, h=0.8 (plus sensitivity e.g. 0.7 and 0.9), sigma_R=0.6
Other parameters	
Fisheries	12 (Longline (5); Baitboat; Purse seine free school (2); Purse seine log school (2); Other (2))
Abundance indices	Japan longline whole Indian Ocean (alternative option with 1% p.a. increase in catchability)
Selectivity	Age based, fishery specific

7.5 Selection of Stock Status indicators

170. The WPTT **AGREED** that management advice for bigeye tuna should be based on the range of results from the SS3 models. The SS3 results were preferred to the other assessment platforms (ASPM and ASAP) because a more comprehensive range of model options were investigated and a range of diagnostics indicated that the

models represented a reasonable fit to the main datasets. The range of plausible SS3 model options was considered to adequately represent the range of uncertainty in the assessment. Integrating across all outcomes, the 2013 stock assessment model results did not differ substantively from the previous (2010 and 2011) assessments or amongst the models applied, although, the final overall estimates of stock status differ somewhat due to the revision of the catch history, new information, and updated standardised CPUE indices.

171. The WPTT **NOTED** that all the runs (except 2 extremes) carried out in 2013 indicate that the stock is above a biomass level that would produce MSY in the long term (i.e. $SB_{2012}/SB_{MSY} > 1$) and in all runs that current fishing mortality is below the MSY-based reference level (i.e. $F_{2012}/F_{MSY} < 1$). This is illustrated in Fig. 11, which shows the time trajectories in F/F_{MSY} and B/B_{MSY} across the range of model results applied to characterize uncertainty in stock status.

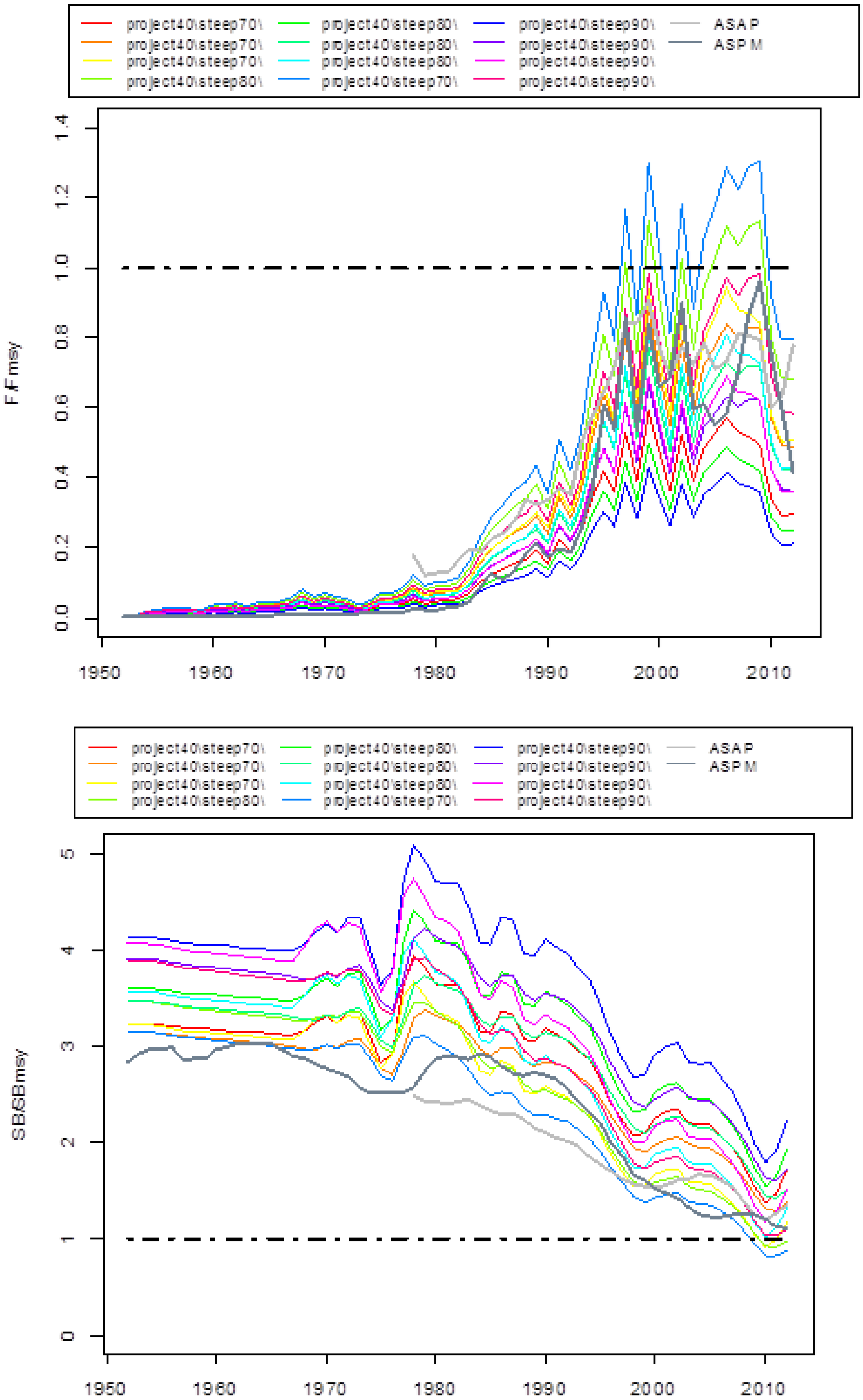


Fig. 11. Bigeye tuna: Ranges of F/F_{MSY} (top) and B/B_{MSY} (bottom) over time, indicating the range of uncertainty in stock assessment outcomes from the stock assessment models used in 2013 (SS3). ASAP and ASPM base cases are presented for comparative purposes.

7.6 Development of technical advice on the status of bigeye tuna

172. The WPTT **ADOPTED** the management advice developed for bigeye tuna as provided in the draft resource stock status summary: Bigeye tuna (*Thunnus obesus*) – Appendix VII.

173. The WPTT **REQUESTED** that the IOTC Secretariat update the draft stock status summary for the bigeye tuna with the latest 2012 catch data, and for the summary to be provided to the SC as part of the draft Executive Summary, for its consideration.

8. SKIPJACK TUNA – REVIEW OF NEW INFORMATION ON STOCK STATUS

8.1 Review of the statistical data available for skipjack tuna

174. The WPTT **NOTED** paper IOTC–2013–WPTT15–07 Rev_1 which summarised the standing of a range of data and statistics received by the IOTC Secretariat for skipjack tuna, in accordance with IOTC Resolution 10/02 *Mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties (CPC's)*, for the period 1950–2011. The paper also provided a range of fishery indicators, including catch and effort trends, for fisheries catching skipjack tuna in the IOTC area of competence. It covers data on nominal catches, catch-and-effort, size-frequency and other data, in particular release and recapture (tagging) data. A summary of the supporting information for the WPTT is provided in Appendix V.

175. The WPTT **EXPRESSED** concern about substantial drops in total catch, catch rates, and average catch reported by the purse seine, pole-and-line, and gillnet fisheries in the western Indian Ocean in recent years, as well as a large drop in the contribution of skipjack tuna from free-schools to total catches of skipjack tuna reported by purse seine vessels flagged to the European Union. Although part of the decrease in catch could be explained by the presence of piracy activities, the nature of the drop warrant further investigation and it was stressed that there was a need to closely monitor the fisheries involved in the future.

8.2 Review new information on the biology, ecology, stock structure, their fisheries and associated environmental data for skipjack tuna

176. No items were discussed under this item in 2013, although these issues were covered in the general revision of information of agenda item 6.

8.3 Data for input into stock assessments

Maldives – Catch-per-unit-of-effort (CPUE)

177. The WPTT **NOTED** paper IOTC–2013–WPTT15–32 which provided the Maldives skipjack pole-and-line fishery catch rate standardization 2004–2011: reconstructing historic CPUE till 1985, including the following abstract provided by the authors:

> "*A qualitative description and GLM-based standardization of the Maldivian skipjack (Katsuwonus pelamis, SKJ) pole and line fishery catch rate data are presented for the period 2004-2011. The raw data consists of around 124000 records of catch (numbers) and effort (fishing days) by month, atoll and vessel; vessel characteristics were added to the CPUE dataset based on information from the registry of vessels. A subset of 56,698 records were extracted from the dataset, identified as records of fishing activity targeting skipjack. In the process, the paper discusses several data quality issues with the CPUE dataset, notably records with zero skipjack catch with a directed PL fishery and which were eventually discounted from the final analysis. FAD data was also incorporated into the analysis using the number of active FADS associated with the nearest atoll that the landing data is collected from. In order to do this, the distribution of FADs was split into three regions incorporating the North Atolls, Middle Atoll and South Atolls* – see paper for full abstract."

178. The WPTT **NOTED** the importance of having a standardised CPUE series for the Maldives pole-and-line fishery for input to the skipjack tuna stock assessment, as this fishery has the longest time series of catch and effort data for skipjack tuna in the Indian Ocean. At the same time, how representative the Maldives pole-and-line CPUE is of stock abundance remains uncertain.

179. **NOTING** that the standardised Maldivian CPUE series (2004–11) has declined from the peak in 2006, the WPTT **AGREED** that further work is required to improve the standardisation of this series before the next stock assessment.

180. The WPTT **NOTED** that the data currently available for CPUE standardisation include: improved vessel logbook data; new live bait fishery logbook data; and anchored FAD (aFAD) data that are potentially informative about "hyperstability" conditions that may be caused by fishing on aFADs.

181. The WPTT **WELCOMED** the work undertaken during this intersessional period for the Maldives skipjack pole-and-line fishery CPUE standardisation.

182. The WPTT **NOTED** the following points:

- The vessel effect could be examined to assess if the single day effect is primarily for certain vessels that could be excluded from the dataset;
- The fuel price could affect the catch rates if it excludes vessels from reaching high skipjack tuna density fishing grounds;

183. The WPTT **NOTED** that the targeted effort for skipjack tuna should be specifically determined to obtain information on the proportion of the days that boats switch targeting between handline and pole-and-line in any given trip.

184. The WPTT **NOTED** that the other factors that may affect the CPUE is the availability of bait that may influence the catch rate, and the distance the vessels are going over time to catch skipjack.

185. The WPTT **AGREED** that the following indices (Fig. 12), with updates for 2013, should be used in the scheduled 2014 stock assessment for skipjack tuna.

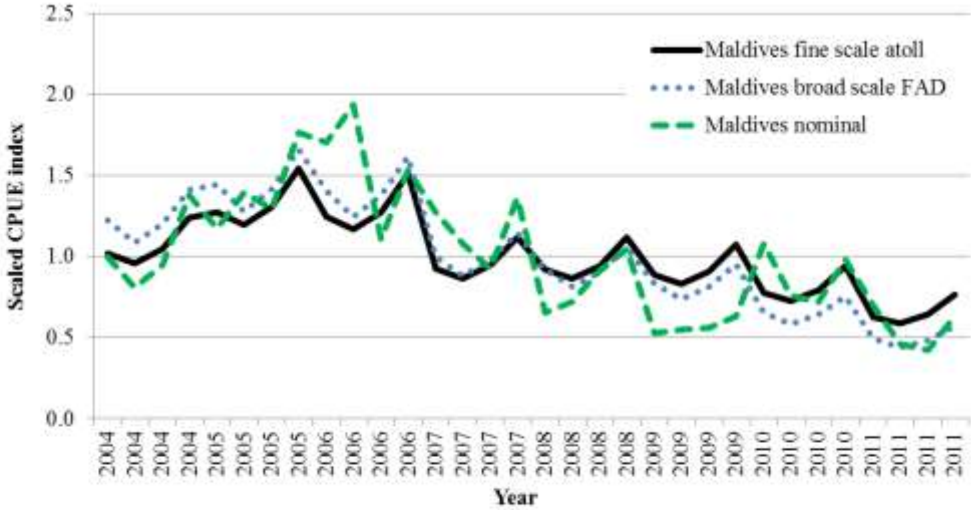


Fig. 12. Maldives quarterly pole-and-line CPUE series for skipjack tuna from 2004–11, using fine scale atoll data, broad scale FAD data, as well as the nominal CPUE series for comparison.

186. The WPTT **REQUESTED** further investigation of the existing data to produce an improved standardised CPUE series for the aFAD-associated school skipjack tuna fishery in the Indian Ocean, and for information on these matters to be presented to the next meeting of the WPTT.

Skipjack tuna management strategy evaluation

187. The WPTT **NOTED** paper IOTC–2013–WPTT15–33 which provided an update on the progress and arrangement for management strategy evaluation of Indian Ocean skipjack tuna, including the following abstract provided by the authors:

> "*One of the conditions of MSC Certification of Maldives pole-and-line skipjack fishery was that limit and target reference points for the stock are appropriate and there is a well-defined and effective harvest control rule in place. Maldives Seafood Producers and Exporters Association (MSPEA) as the MSC Certification Client has agreed to implement the MSC Client Action Plan (CAP) where these objectives have to be achieved for the Indian Ocean skipjack within the first five- year cycle of the Certificate. Formal recognition of reference points and harvest controls are now mandatory in the IOTC following the adoption of the Resolution to implement the Precautionary Approach for managing tuna species in the Indian Ocean. In order to achieve the overall objective of establishing reference points and harvest control measures for major Indian Ocean tuna species the Working Party on Methods has formulated a work programme for undertaking Management Strategy Evaluations (MSE)* – see paper for full abstract."

188. The WPTT **NOTED** that the MSE Work Programme focuses initially on albacore, the most heavily exploited stock in the IOTC area. Maldives, as part of their commitment in implementing the MSC client action plan (CAP) has taken the initiative to conduct MSE work on skipjack side by side with the IOTC-supported albacore work.

189. The WPTT **NOTED** that consultation workshops are planned to share progress and update the skipjack tuna MSE work for scientists and industry. Progress of the work will be presented at relevant gatherings of

opportunity and communicated to the IOTC Secretariat and the Group by electronic means. The process will benefit from the active engagement of the WPTT, WPM and Scientific Committee.

190. The WPTT **WELCOMED** the initiative undertaken by the Maldives in support of MSE for skipjack tuna fisheries. The work was considered to being undertaken in a transparent way and fits well within the workplan for MSE that the Scientific Committee and Commission have endorsed. The work of MSE initiated by the Maldives should be carried out in close collaboration with the WPTT and WPM, with results being provided to the WPTT at its annual meeting.

191. The WPTT **RECALLED** Resolution 12/01 *on the implementation of the precautionary approach*, which addressed the necessity of development of MSE to improve the advice from the Scientific Committee to the Commission.

192. The WPTT **NOTED** that limit reference points (LRP) set boundaries which are intended to constrain harvesting within safe biological limits within which the stocks can produce maximum sustainable yield (MSY). Precautionary reference points should be stock-specific to account for the reproductive capacity, the resilience of each stock and the characteristics of the fisheries exploiting the stock, as well as other sources of mortality and major sources of uncertainty.

193. The WPTT **AGREED** that any fishery management strategies developed as part of the MSE process, should ensure that the risk of exceeding limit reference points (LRPs) is very low. If a stock falls below a LRP or is at risk of falling below such a reference point, conservation and management measures would need to be rapidly initiated to facilitate stock recovery.

194. The WPTT **AGREED** that the allowable risk of breaching a LRP may be applied on a species-specific basis.

195. The WPTT **AGREED** that as part of the MSE process, consideration of the quality and robustness of the interim reference points outlined in IOTC Recommendation 12/14, or any subsequent revision, should be undertaken.

196. The WPTT **NOTED** that target reference points (TRP) indicate the desired system state and are what a harvest control rule (HCR) would aim to achieve with high probability. Effectively, a stock that is below the target should be harvested at a lower rate than one above the target.

197. The WPTT **NOTED** that the proposed reference points should be viewed as interim performance objectives, that set minimum risk standards to get the MSE process started. The expectation is that the Harvest Control Rule development will be an iterative process. Feedback during the stakeholder consultations may result in more appropriate target objectives with better trade-offs among conflicting management measures (e.g. economically viable catch rates may require biomass levels that are substantially higher than the proposed target and limit reference points).

198. The WPTT **NOTED** that at a recent informational session held at the UN, FAO has indicated that its GEF-funded ABNJ tuna project, in which the IOTC is a partner, is expected to come on-line soon. Within that project, there are funds intended to help accelerate the MSE process amongst the tuna RFMOs, including the IOTC. Participants welcomed this news and expressed the view that these funds could help support science-policy dialogue on evaluation of limit and target reference points developing Harvest Control Rules responsive to the Commission's needs while considering the guidance provided in Resolution 13/10 *on interim target and limit reference points and a decision framework*.

Parameters for future analyses: Skipjack tuna CPUE standardisation and stock assessments

199. The WPTT **RECALLED** its previous agreement that in order to obtain comparable CPUE standardisations, the analyses shall be conducted with similar parameters and resolutions in 2014. Table 11 provides a set of parameters, discussed during the WPTT that shall give guidelines, if available, for the standardisation of CPUE in 2014 to be used as indices of abundance for the scheduled 2014 stock assessment of skipjack tuna.

Table 11. Skipjack tuna: A set of parameters for the standardisation of CPUE series in 2014.

CPUE standardisation parameters	Value for 2014 CPUE standardisation
Area	*To be defined (possible eastern and western Indian Ocean.* Explore core area(s)
CE Resolution	Operational data
GLM Factors	Year, Quarter, Area, HBF, vessel, environmental + interactions
Model	negative binomial, zero-inflated or delta-lognormal models

200. The WPTT **RECALLED** the need for CPUE standardisations of skipjack tuna for the next stock assessment scheduled for 2014, and **REQUESTED** that scientists from CPCs with pole-and-line and purse seine fisheries for skipjack tuna, work together to explore their data well in advance of the next WPTT meeting in 2014.

201. The WPTT **RECALLED** that in the absence of alternative improved information the model parameters contained in Table 12 should be considered appropriate for future skipjack tuna stock assessments preliminary base case analysis, with appropriate sensitivity runs.

202. The WPTT **NOTED** that as a matter of priority the available data from the RTTP-IO shall be further analysed to assess the validity of the parameters presented in Table 12 (and Tuna Tagging Symposium journal publications) and improved methods for integrating the tags into assessment models (as detailed in Appendix X).

Table 12. Skipjack tuna: Tentative model parameters for use in future base case stock assessment runs.

Biological parameters	Value for assessments
Sex ratio	1:1
Age (longevity)	8+ years
Natural mortality	M=0.8 (/year) constant over ages (or estimated within the model to be 1.48 age 0-1,1.13 age 1-2, 1.13 age 2-3, 0.83 for 3-4 and older)
Growth formula	VB log K 2-stanza growth (IOTC–2012–WPTT–23 Rev_1)
Weight-length allometry	$W=aL^b$ with $a= 5.32*10^{-6}$ and $b=3.34958$ common to sex
Maturity	Length-specific (50% mature at length 38 cm, fully mature at 44 cm)
Fecundity	Proportional to the spawning biomass
Stock-recruitment	B&H, h=0.8 (plus sensitivity e.g. 0.7 and 0.9), sigma_R=0.6
Other parameters	
Fisheries	4 (Maldives PL, Purse Seine FS, Purse Seine LS, Other)
Abundance indices	PSFS/PSLS combined, Maldives PL
Selectivity	Fishery specific. Cubic splines

8.4 Selection of Stock Status indicators

203. The WPTT **AGREED** that as no new stock assessment was carried out in 2013, the advice on the status of skipjack tuna in 2013 would be based on the models using an integrated statistical assessment method from 2012 (see IOTC–2012–WPTT14–R) and current catch and effort trends presented at the current meeting.

8.5 Development of technical advice on the status of skipjack tuna

204. The WPTT **ADOPTED** the management advice developed for skipjack tuna as provided in the draft resource stock status summary: Skipjack tuna (*Katsuwonus pelamis*) – Appendix VIII.

205. The WPTT **REQUESTED** that the IOTC Secretariat update the draft stock status summary for the skipjack tuna with the latest 2012 catch data, and for the summary to be provided to the SC as part of the draft Executive Summary, for its consideration.

9. YELLOWFIN TUNA – REVIEW OF NEW INFORMATION ON STOCK STATUS

9.1 Review of the statistical data available for yellowfin tuna

206. The WPTT **NOTED** paper IOTC–2013–WPTT15–07 Rev_1 which summarised the standing of a range of data and statistics received by the IOTC Secretariat for yellowfin tuna, in accordance with IOTC Resolution 10/02 *Mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties (CPC's)*, for the period 1950–2012. The paper also provided a range of fishery indicators, including catch and effort trends, for fisheries catching yellowfin tuna in the IOTC area of competence. It covers data on nominal catches, catch-and-effort, size-frequency and other data, in particular release and recapture (tagging) data. A summary of the supporting information for the WPTT is provided in Appendix V.

207. The WPTT **NOTED** that according to the information within the IOTC database, some longline fleets, in particular the Taiwan,China longline fleet, have resumed fishing in the western central tropical area since January 2012. However, longliners flagged to Japan have not fished in the area since July 2009.

208. **NOTING** that drops in total effort and area coverage may reduce the ability of the WPTT to produce accurate CPUE estimates for some fleets and/or years, the WPTT **AGREED** that the movement of fleets back into the area vacated due to piracy activities should be closely monitored and reported at the SC and the next WPTT meeting.

9.2 Review new information on the biology, ecology, stock structure, their fisheries and associated environmental data for yellowfin tuna

Kenya yellowfin tuna population dynamics

209. The WPTT **NOTED** paper IOTC–2013–WPTT15–34 which provided an overview of the seasonality, morphometrics and feeding behaviour of yellowfin tuna (*Thunnus albacares*) caught by sports fishers in the Kenyan waters, including the following abstract provided by the authors:

> "*Yellowfin tuna (Thunnus albacares) are among the major target species caught by sports fishers in Kenyan waters. The study on the feeding habits of the tuna was conducted between November 2012 and January 2013 which is the peak season for yellowfin tuna in the Kenyan waters. For seasonality data, a 19 year daily catch data from 1987 to 2011 was used. The yellowfin tuna were most abundant in the coastal waters during the months of October and November. There were two distinct size classes caught during this study. The smaller ones had an average weight 7.2 ± 1.0 kgs and had an average fork length of 73.4 ±5.6 cm. The larger ones had an average weight 26.1 ± 4.4 kgs and had an average fork length of 110.8 ±7.0 cm. The major food contents in the fish stomachs were crabs (Charybdis smithii), Sepia spp., anchovies (Stolephorus commersonii) and Kawakawa (Euthynus affinis)* – see paper for full abstract."

210. The WPTT **NOTED** that the stomach content analysis, which identified differences in diets of juveniles and adult yellowfin tuna, and in particular the amount of cuttle fish in the stomachs of juvenile yellowfin tuna, was unusual. These may be due to the distribution of adults and juveniles, as the adults are more off-shore versus juveniles inhabiting inshore habitats.

India small scale yellowfin tuna fisheries

211. The WPTT **NOTED** paper IOTC–2013–WPTT15–35 which provided an overview of traditional small scale fishing for yellowfin tuna *Thunnus albacares* in Andhra Pradesh along east coast of India, including the following abstract provided by the authors:

> "*The yellowfin tunas form one of the major components of oceanic tuna catch along the Indian coast. They are fished both along the mainland as well as the Island systems with the total annual catch from the mainland varying from 10,307 t to 19,163 t during 2010-2012. Commercial fishing is mainly by small mechanized wooden crafts and non-mechanized traditional crafts. Mechanized crafts operated pole and line, long line and gillnets and non-mechanized crafts operated hand lines and troll lines. Highly skilled fishermen of Andhra Pradesh State situated along the east coast of India use traditional catamarans fitted with sails to catch yellowfin tunas from deep waters by operating either the hand lines or the troll lines. Around 1500 such units operated along the coast with an average annual landings of 4,300 t during 2010-2012. Fishing is carried out for a day as the crafts do not have any storage facility* – see paper for full abstract."

Yellowfin tuna nursery grounds

212. The WPTT **NOTED** paper IOTC–2013–WPTT15–36 which provided a discrimination of yellowfin tuna from the putative nurseries of the Western Indian Ocean, including the following abstract provided by the authors:

> "*Stable carbon and oxygen isotope ratios (δ13C and δ18O) were measured in otoliths of young of the year yellowfin tuna (Thunnus albacares) collected from different nursery areas in the western Indian Ocean. Samples were obtained from February 2009 to May 2010 from three regions that include a variety of physical characteristics and habitat types: Somali waters in the northwestern Indian Ocean (0-10ºN), surrounding waters of the Seychelles Islands (0-10ºS) and northern Mozambique Channel (13-16ºS). Somalia and Seychelles region did no show a significant difference in otolith isotopic signature and thus, fish collected in these regions were pooled together and compared with those collected in Mozambique Channel. Significant differences existed in δ18O values among the two nurseries, with more depleted values in fish collected in Mozambique Channel compared with those collected in Seychelles-Somalia region. Cross-validated classification success, based on quadratic discriminant analysis, was relatively high, with 70% of the fish correctly classified to their respective nursery areas* – see paper for full abstract."

213. **NOTING** that the work was based on few samples, the WPTT **AGREED** that the results are in line with what would be expected from the oceanographic conditions of the Indian Ocean and, thus, that the results from otolith stable isotope analysis may provide some preliminary insights into yellowfin tuna stock structure and connectivity between possible subpopulations in the western Indian Ocean.

214. The WPTT **NOTED** that the results are in some extent different from the results of the IOTC Regional Tuna Tagging Programme, where a high and quick rate of mixing is evidenced across the Western Indian Ocean, and thus a more comprehensive study about otolith microchemistry is required to discriminate among possible different nursery areas of the Indian Ocean.

215. **NOTING** that other projects are also seeking to understand the connectivity and stock structure of the three tropical tuna species using otolith microchemistry as well as genetic methods (see paper IOTC–2013–WPTT15–13), the WPTT **ENCOURAGED** the research teams involved to work collaboratively to establish priorities and reduce the chance of effort duplication.

9.3 Data for input into stock assessments

Japan – Catch-per-unit-of-effort (CPUE)

216. The WPTT **NOTED** paper IOTC–2013–WPTT15–37 which provided the Japanese longline CPUE for yellowfin tuna in the Indian Ocean up to 2012 standardised by general linear model, including the following abstract provided by the authors:

"*Japanese longline CPUE for yellowfin tuna was standardized by GLM with lognormal error structure. Number of hooks between float (NHF) and material of main and branch lines were applied in the model for the effect of fishing gear. Generally, CPUE indices indicated declining trend, but were comparatively constant for the last five years. The trend of CPUE for whole Indian Ocean was similar to that in the main fishing ground. Trend of CPUEs with and without Area 2 (off Somalia) were similar. Trends of CPUEs were relatively similar among areas. Applying LT5LN5 factor (five degree block) in the model showed relatively large effect on the CPUE trend for Area 3 and 4 in which the declining trend until around 1990 was steeper in the model without LT5LN5*"

217. The WPTT **NOTED** that the change in gear appears to have had the effect of increasing the catch ratio of yellowfin tuna in the Japanese longline catch when compared to bigeye tuna.

218. The WPTT **NOTED** the decrease in effort by the Japanese fleet since 2009. For example, the majority of the yellowfin tuna catches by the Japanese longline fleet (64% of their total 2011 catches; 80% of their total 2012 catches) were caught in two 5º squares of Region 3 (south west of Madagascar), and Region 4. However, effort is slowly moving back to Region 2. There has been a major decline in the total yellowfin tuna catches by Japanese longliners in other areas. As a consequence, concerns were raised about the representativeness of the Japanese CPUE abundance index for yellowfin tuna in recent years (Fig. 13). However, it was noted that standardised CPUE with and without Area 2, which is one of main fishing ground, gave a similar trend.

219. The WPTT **AGREED** that an examination of whether the areas are representative and how they are weighted in the analysis needs to be examined because the size of areas does not always correspond to sample size. This is particularly a concern when the samples in a given area keep declining. Examining alternative hypothesis should be made in future years. The primary ones to be examined are whether the fisheries and stocks are spatially and temporally dynamic processes and how these are accounted for within the standardisation procedures.

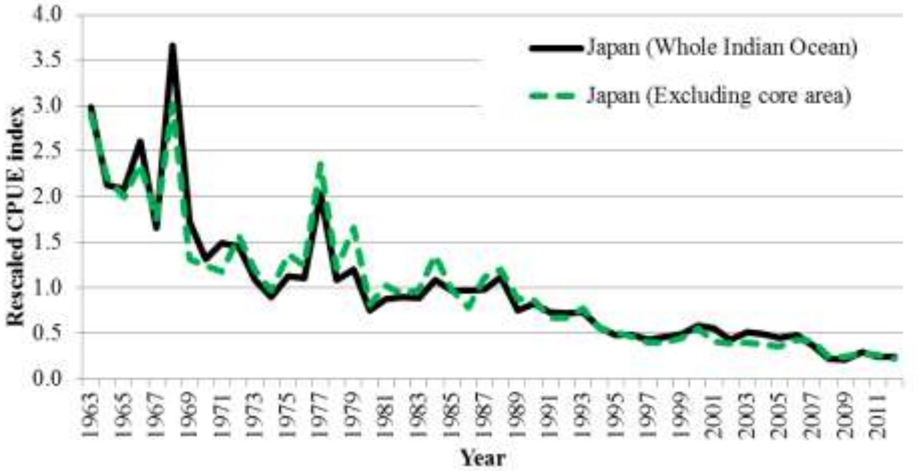


Fig. 13. Yellowfin tuna: Comparison of the two standardised longline CPUE series (with and without Region 2) for Japan. Series have been rescaled relative to their respective means from 1963–2012.

Taiwan,China– Catch-per-unit-of-effort (CPUE)

220. The WPTT **NOTED** paper IOTC–2013–WPTT15–38 which provided a CPUE standardisation for yellowfin tuna caught by the Taiwan,China longline fishery in the Indian Ocean using generalized linear model, including the following abstract provided by the authors:

"*Quarterly and annual Taiwan,China longline CPUEs for yellowfin tuna in the tropical and whole Indian Ocean were standardized up to 2012 by GLM. The trend of standardized CPUE for whole Indian Ocean was similar to that of the tropical Indian Ocean. Standardized CPUE series showed a relatively stable trend before 2003. After that, the CPUE decreased steadily to the historical low level in 2009, and then* *started to increase in recent years. There is no updated information for the Area 1 since few fishing activities occurred in this area for 2011 and 2012.*"

221. The WPTT **NOTED** that the CPUE series is relatively stable for the entire series (Fig. 14) and the main reason for this may be the main species targeted was bigeye tuna, while yellowfin tuna was an incidental catch. Another possible reason for this difference may be the spatial stratification of the effort between the two fleets.

222. The WPTT **NOTED** that the nominal and standardised CPUE series were similar, and showed a flat trend until 2004 and a recent increase after a rapid decline during 2005–09 for the whole Indian Ocean.

223. **NOTING** that data from Taiwan,China vessels flagged to India was not used in the analysis, the WPTT **REQUESTED** that OFDC scientists from Taiwan,China work with the IOTC Secretariat to gain a better estimate of catch data from the Bay of Bengal.

224. The WPTT **NOTED** that targeting in this paper was handled by using the catch composition of the target species as a proxy for targeting, as opposed to the use of hooks per basket in the Japanese longline CPUE series. It was suggested that the effect of these two different proxies should be investigated.

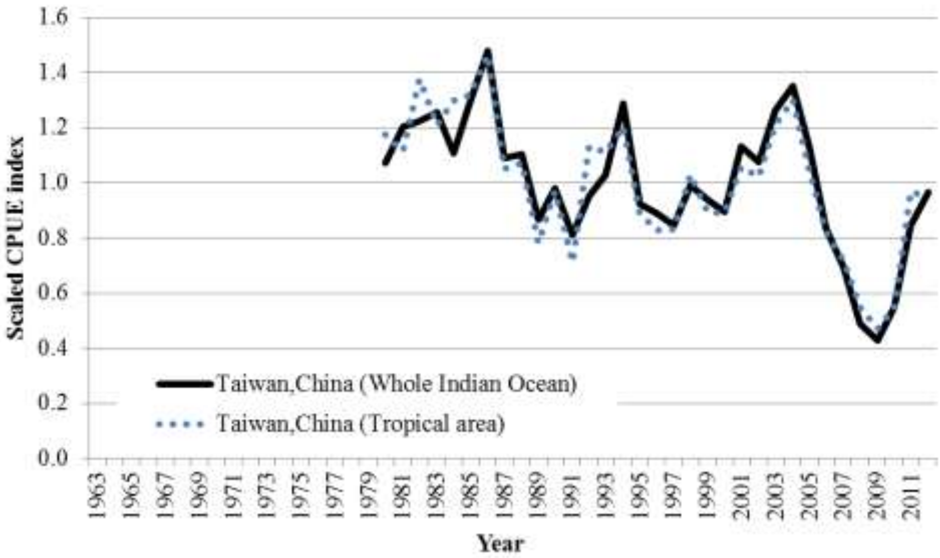


Fig. 14. Yellowfin tuna: Comparison of the two standardised longline CPUE series for Taiwan,China. Series have been rescaled relative to their respective means from 1963–2012.

CPUE discussion summary

225. The WPTT **NOTED** that the standardised CPUE trend estimated for the Taiwan,China longline fleet (Fig. 14) is in contrast to the consistent negative trend displayed by the Japanese series (Fig. 13). The difference in the series between Taiwan,China and the Japan/Rep. of Korea standardised CPUE series, were questioned as it would seem intuitive that the trend should have decreased when catches increased significantly at the advent of the purse seine fishery. The WPTT **AGREED** that scientists from these fleets resolve this by meeting inter-sessionally to assess why this may be occurring.

226. The WPTT **NOTED** that the use of hooks between floats as a proxy for targeting should be further explored. Currently, most papers break HBF into fixed, discrete categories, but they do not test the sensitivity of their results to changes in these categories (e.g., 2-3, 4-5, 6-8 vs. 2-4, 5-6, 7-8). Another way to investigate this would be to treat HBF as a non-linear continuous term, possibly in a GAM.

227. The WPTT **NOTED** that in general, researchers will be better off not aggregating their data and instead tracking CPUE by individual vessel which will allow for the inclusion of vessel effects, temporal correlation, and possibly even accounting for similar performance of vessels owned by the same company.

228. The WPTT **NOTED** that all the models currently assume that there have been zero changes in efficiency. The reality is that efficiency has increased over time, and ignoring that will bias the result. The uncertainty lies in how much has efficiency changed. Researchers should include variables that might account for such changes in efficiency. This could be done using fleet-level variables (e.g. the approximate percentage of the fleet that has adopted each type of technological improvement) or maybe even at the vessel level if such information is available. Such preliminary analysis has been done for bigeye tuna and the Japanese fleet and possibly could be repeated with yellowfin tuna for both Taiwan,China and Japan. The WPTT **REQUESTED** that future analysis use the fleet effect model to examine efficiency for fleets in both Taiwan,China and Japan in 2014.

229. The WPTT **AGREED** that the main source of information on abundance trends for stock assessment purposes is the index of abundance derived from the Japan and Taiwan,China longline CPUE series. Concerns were raised on the ability of this standardised CPUE series to represent the yellowfin tuna stock abundance in the Indian Ocean. These indices have shown steep declining trends in the Western tropical area, where most of the catches occur, over the last five years. Moreover, the decrease and almost disappearance of effort of the Taiwan,China and Japan longline vessels in the north-western part of the Indian Ocean during recent years due to the piracy, raise a concern about the utility and representativeness of these indices for stock assessment during recent years. There is substantial difficulty in fully understanding and quantifying changes in the fishery that would help interpreting the patterns observed in the index of abundance.

230. The WPTT **NOTED** that for the longline fisheries (LL fisheries in regions 1–5; Fig. 15, CPUE indices were derived using generalised linear models (GLM) from the Japanese longline fleet (LL regions 2–5) and for the Taiwan,China longline fleet (LL region 1) to be used in the stock assessment in subsequent years for the stock assessment.

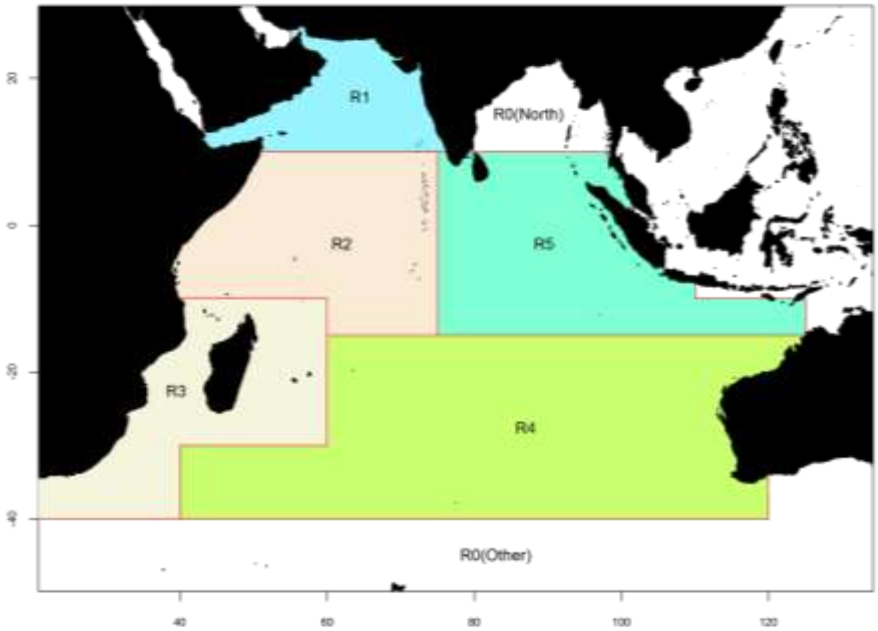


Fig. 15. Spatial stratification of the Indian Ocean for the MFCL assessment model carried out in 2012.

9.4 Stock assessments

231. The WPTT **NOTED** paper IOTC–2013–WPTT15–39 Rev_1 which provided a Stock assessment on yellowfin tuna in the Indian Ocean by A Stock-Production Model Incorporating Covariates (ASPIC), including the following abstract provided by the authors:

> " *In this study, ASPIC (A Stock-Production Model Incorporating Covariates) was applied to assess the stock status of yellowfin tuna in the Indian Ocean using the nominal catch by fleet and the standardized CPUE of JPN LL and TWN LL updated up to recently (1972-2012). The objective of this study is not to provide any management advices on this species but to compare ASPIC results with those of MFCL and ASPM which were conducted in 2012. As a result (Kobe plot I; stock trajectory), it suggested that ASPIC and ASPM showed the similar pattern.*"

232. The WPTT **NOTED** that one or the other series should be used, as they give contradictory signals. It would be better to run the CPUE series separately.

233. The WPTT **NOTED** that in order to compare with latest stock assessments, this analysis should be carried out using similar inputs (i.e. CPUE series) as the ones used in MULTIFAN-CL.

234. The WPTT **NOTED** that ICCAT resolves differences by using either one or two indices, or using a catch rate which was uniform across all fleets. More work needs to be done to assess these differences. How this is quantified and propagated into management advice is an important issue.

Parameters for future analyses: Yellowfin tuna CPUE standardisation and stock assessments

235. The WPTT **AGREED** that in order to obtain comparable assessments, the CPUE standardisations should be conducted with similar parameters and resolutions. Table 13 provides a set of parameters, discussed during WPTT meetings that shall give guidelines, if available, for the standardisation of CPUE in 2014 to be used as indices of abundance for future stock assessments (currently scheduled for 2015).

Table 13. Yellowfin tuna: A set of parameters for the standardisation of CPUE series in 2014.

CPUE standardisation parameters	Value for 2014 CPUE standardisation
Area	*To be defined.* Explore core area(s)
CE Resolution	Operational data
GLM Factors	Year, Quarter, Area, HBF, vessel, environmental + interactions
Model	negative binomial, zero-inflated or delta-lognormal models

236. **NOTING** that the areas used in the various CPUE standardisations undertaken in 2012 were very different from one analysis to another, the WPTT **AGREED** that there is a need to define core area(s) for the CPUE standardisation of yellowfin tuna and **REQUESTED** that scientists from CPCs with longline and purse seine fisheries for yellowfin tuna, work together to explore their data and define such core areas, well in advance of the next WPTT meeting in 2014.

9.5 Selection of Stock Status indicators

237. The WPTT **RECALLED** that a range of quantitative modelling methods were applied to the yellowfin tuna assessment in 2012, ranging from the non-spatial, age-structured production model (ASPM) to the age and spatially-structured MULTIFAN-CL and SS3 analysis. The different assessments were presented to the WPTT in documents IOTC–2012–WPTT14–38, 39 and 40 Rev_2.

238. **NOTING** that no formal stock assessment was carried out in 2013, the WPTT **AGREED** that management advice for yellowfin tuna should be based on the 2012 MFCL stock assessment (based upon the base case analysis with short term recruitment with alternative steepness of the stock-recruitment relationship of 0.7, 0.8 and 0.9), the ASPM based case using steepness of 0.9, and current catch and effort trends presented at the current meeting. A major limitation of the ASPM model is that it is not spatially structured and thus does not allow the internal incorporation of tagging data, although it does externally by using the improved catch-at-age table and natural mortality estimates based on tagging data.

9.6 Development of technical advice on the status of yellowfin tuna

239. The WPTT **ADOPTED** the management advice developed for yellowfin tuna as provided in the draft resource stock status summary: Yellowfin tuna (*Thunnus albacares*) – Appendix IX.

240. The WPTT **REQUESTED** that the IOTC Secretariat update the draft stock status summary for the yellowfin tuna with the latest 2012 catch data, and for the summary to be provided to the SC as part of the draft Executive Summary, for its consideration.

10. Analysis of the Time-Area Closures (including Resolution 12/13)

241. The WPTT **NOTED** IOTC Resolution 12/13 *for the conservation and management of tropical tunas stocks in the IOTC area of competence*, which instructed the Scientific Committee to provide at its 2012 Session the following:
    - *a) an evaluation of the closure area* [see Fig. 16], *specifying in its advice if a modification is necessary, its basic scientific rationale with an assessment of the impact of such a closure on the tropical tuna stocks, notably yellowfin and bigeye tuna.*
    - *b) an evaluation of the closure time periods, specifying in its advice if a modification is necessary, its basic scientific rationale with an assessment of the impact of such a closure on the tropical tuna stocks, notably yellowfin and bigeye tuna.*
    - *c) an evaluation of the impact on yellowfin and bigeye tuna stocks by catching juveniles and spawners taken by all fisheries. The Scientific Committee shall also recommend measures to mitigate the impacts on juvenile and spawners.*

242. The WPTT **RECALLED** the work carried out by the Chair and others between the WPTT meeting and SC in 2011, which included the presentation of a paper to the SC (see IOTC–2011–SC14–39). The paper presented to the SC in 2011 provided an evaluation of the IOTC time-area closure by estimating what the maximum potential loss of catches would be under different scenarios of time-area closure, as estimated from the catch statistics of the IOTC. The impacts of piracy and the closed area (February for longline, November for purse seine) are likely to have confounding effects and therefore it is difficult for the WPTT to provide advice at this time. The longline effort had already been entirely redistributed to other areas and the purse seine data for November were not yet available when the paper was prepared, nor at the date of the SC.

243. The WPTT **NOTED** that the results obtained from the study were similar to the analysis carried out for the SC in 2010, which emphasised that catch reduction expected from the current time-area closure were negligible.

244. The WPTT **RECALLED** the advice provided by the SC in 2012 to the Commission that the current closure defined in Resolution 12/13 is likely to be ineffective, as fishing effort will be redirected to other fishing grounds in the Indian Ocean. The positive impacts of the moratorium within the closed area would likely be offset by effort reallocation.

245. **NOTING** that the objective of Resolution 12/13 is to decrease the overall pressure on the main targeted stocks in the Indian Ocean, in particular yellowfin tuna and bigeye tuna, and also to evaluate the impact of the current time/area closure and any alternative scenarios on tropical tuna population, the WPTT reiterated its previous **RECOMMENDATION** that the SC request that the Commission specify the level of reduction or the long term management objectives to be achieved with the current or alternative time area closures, as these are not contained within Resolution 12/13.

Fig. 16. IOTC closure area as detailed in Resolution 12/13.

11. Effect of Piracy on Tropical Tuna Catches

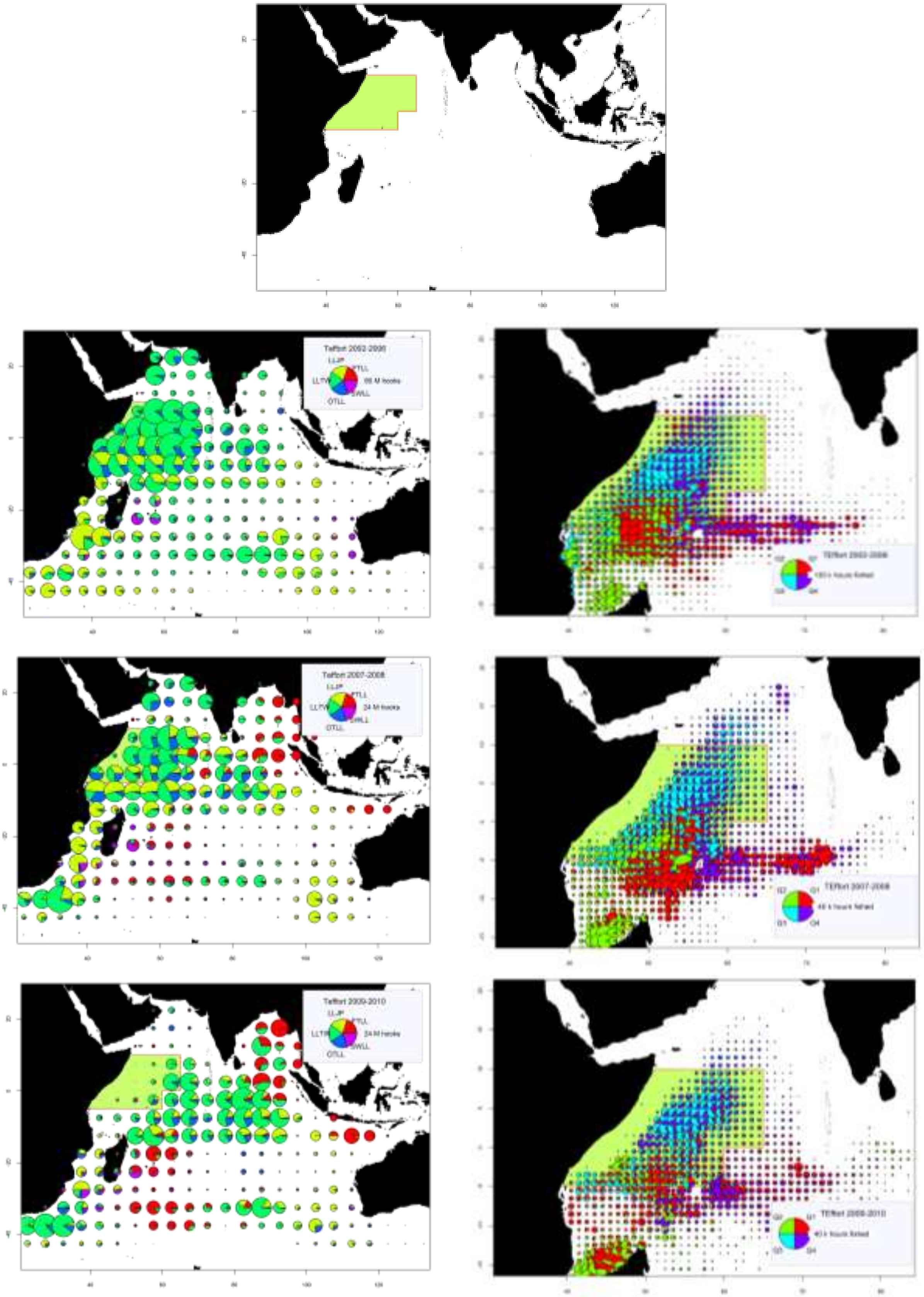
246. The WPTT **NOTED** that, although no specific analysis of the impacts of piracy on fisheries in the Indian Ocean were presented at this meeting, many papers presented demonstrated clear impacts of piracy on fishing operations in the western Indian Ocean (Somali basin) and other areas as a result of relocated fishing effort, including papers IOTC–2013–WPTT15–07 Rev_1 which indicated that there has been a substantial displacement of effort eastward (Fig. 17).

247. The WPTT **NOTED** that the relative number of active longline vessels in the IOTC area of competence declined substantially from 2008 until 2011 (Fig. 18a, b), as did the purse seine fleets (Fig. 18c).The decline was likely due to the impact of piracy activities in the western Indian Ocean. The fishing effort by the purse seine fleets shifted east by at least 100 miles during 2008–11 compared to the historic distribution of effort (Fig. 17) although vessels remained in the area impacted by piracy due to the presence of onboard military personnel.

248. The WPTT **NOTED** that since 2011, there has been an increase in the number of active longline vessels in the Indian Ocean for Japan (68 in 2011 to 98 in 2012), China (10 in 2011 to 32 in 2012), Taiwan,China (132 in 2011 to 138 in 2012) and the Philippines (2 in 2011 to 14 in 2012) (Fig. 18a). Similarly, there has been an overall increase in the number of active purse seine vessels in the Indian Ocean for the European Union and assimilated fleets (34 in 2011 to 36 in 2012) and for all other purse seine fleets combined (23 in 2011 to 35 in 2012) (Fig. 18c).

249. The WPTT **RECALLED** that in the first half of 2011, 11 longline vessels from Taiwan,China, moved to the Atlantic Ocean and 2 to the Pacific Ocean. However, in the second half of 2011, 5 longline vessels returned from the Atlantic Ocean, and 1 longline vessel returned from the Pacific Ocean. The departure of the vessels from the Indian Ocean is reflected in the total effort deployed throughout not only the western Indian Ocean impacted by piracy, but also the entire Indian Ocean (Fig. 19a for longline and Fig. 19b for purse seine). In 2012, the trend was reversed, with a total of 15 longline vessels being transferred from the Atlantic Ocean back to the Indian Ocean, resulting in an overall increase in longline effort, particularly in the western Indian Ocean (Fig. 19a). Similarly, 6 longline vessels from Taiwan,China have been transferred from the Pacific Ocean back to the Indian Ocean in 2012. Although total levels of effort for the Taiwan,China longline fleet in the Indian Ocean remained low in 2012, effort levels in waters off Somalia increased markedly (Figs. 17 and 19a).

250. The WPTT **AGREED** that given the reports that both longline and purse seine vessels from some fleets appear to be moving back towards the western Indian Ocean in 2012, this should be closely monitored and reported at the SC and the working party meetings in 2014.



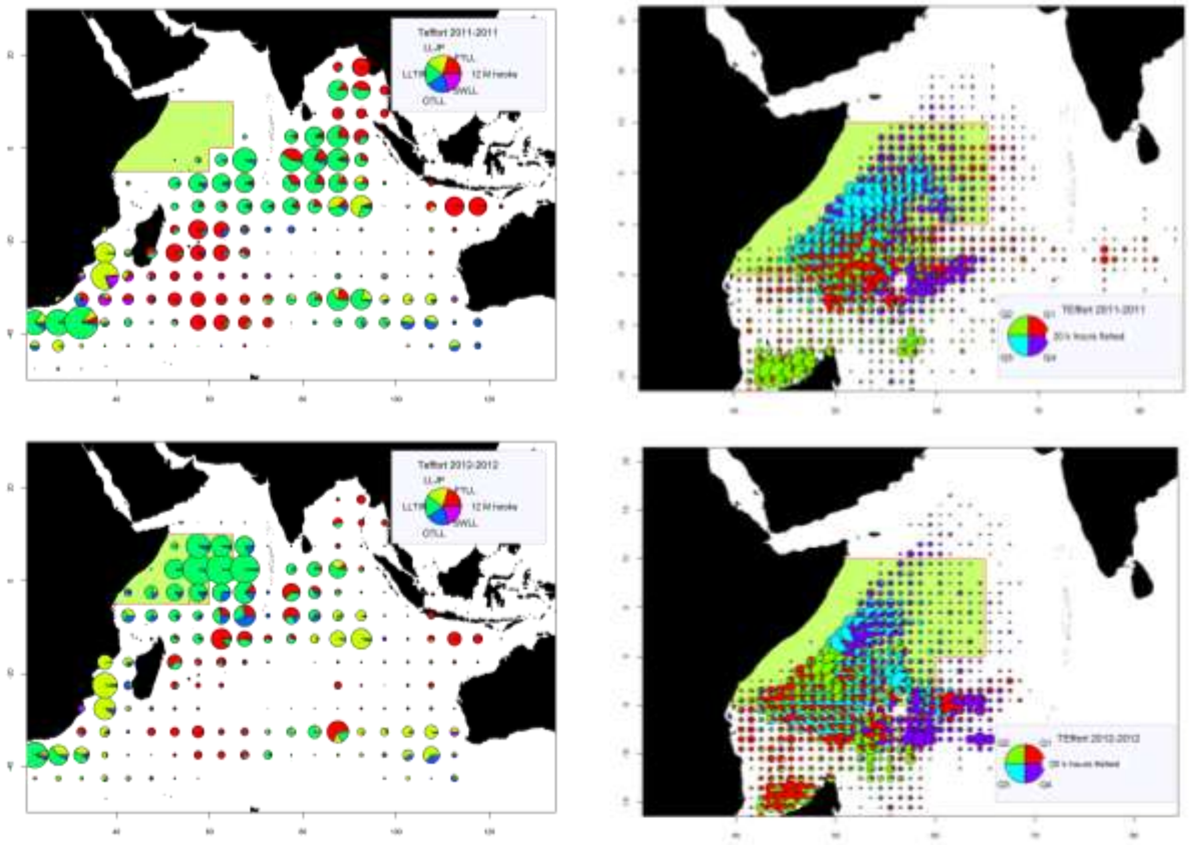


Fig. 17. The geographical distribution of fishing effort for longline (5 x 5 degrees; millions of hooks – left column) as reported for the longline fleets of Japan (LLJP), Taiwan,China (LLTW), fresh-tuna longline (FTLL), other longline (OTLL), and longline directed at swordfish (SWLL), and for purse seine (1 x 1 degrees; hours fished – right column) in the IOTC area of competence (Data as of September 2013), for 2002–06, 2007–08, 2009–10, 2011 and 2012. The area shaded in green is where piracy activities are considered highest. Longline effort: LLJP (light green): deep-freezing longliners from Japan; LLTW (dark green): deep-freezing longliners from Taiwan,China; SWLL (turquoise): swordfish longliners (Australia, EU, Mauritius, Seychelles and other fleets); FTLL (red): fresh-tuna longliners (China, Taiwan,China and other fleets; OTLL (blue): Longliners from other fleets (includes Belize, China, Philippines, Seychelles, South Africa, South Korea and various other fleets).

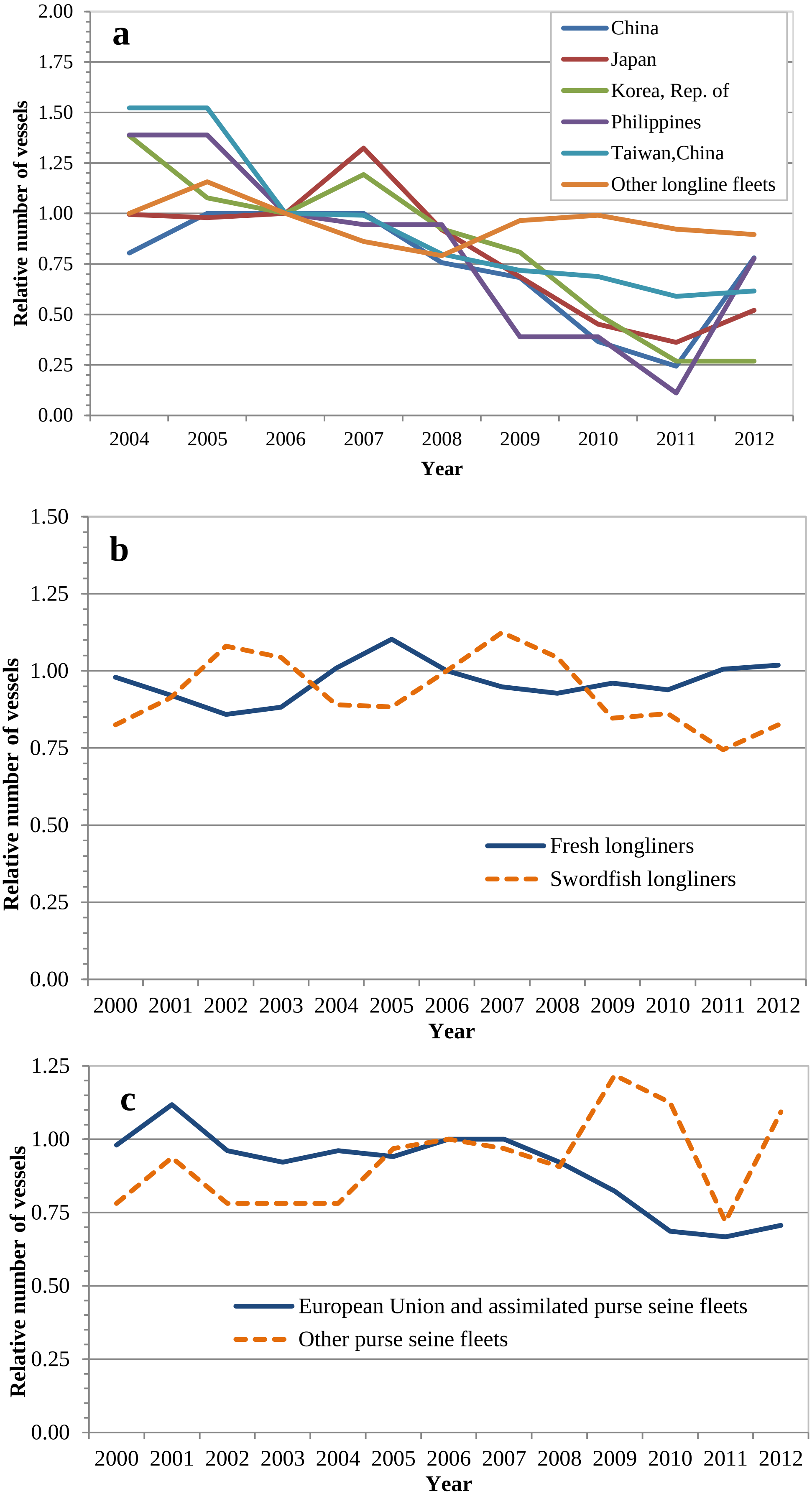
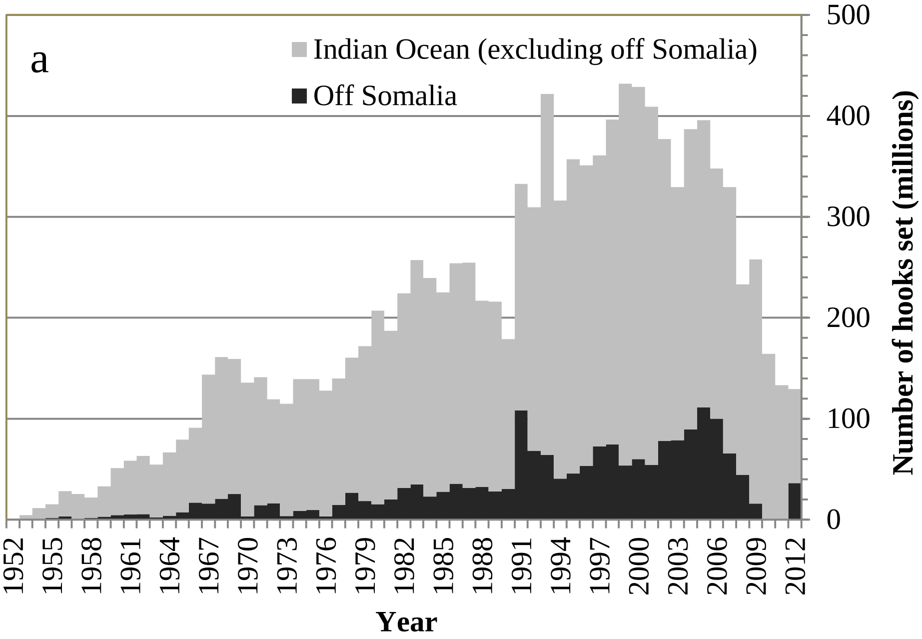


Fig. 18. The change in the relative number of some active a) deep freezing longline (numbers have been scaled to the number of active vessels in 2006), b) other longline and c) purse seine fleets since 2000 in the Indian Ocean.



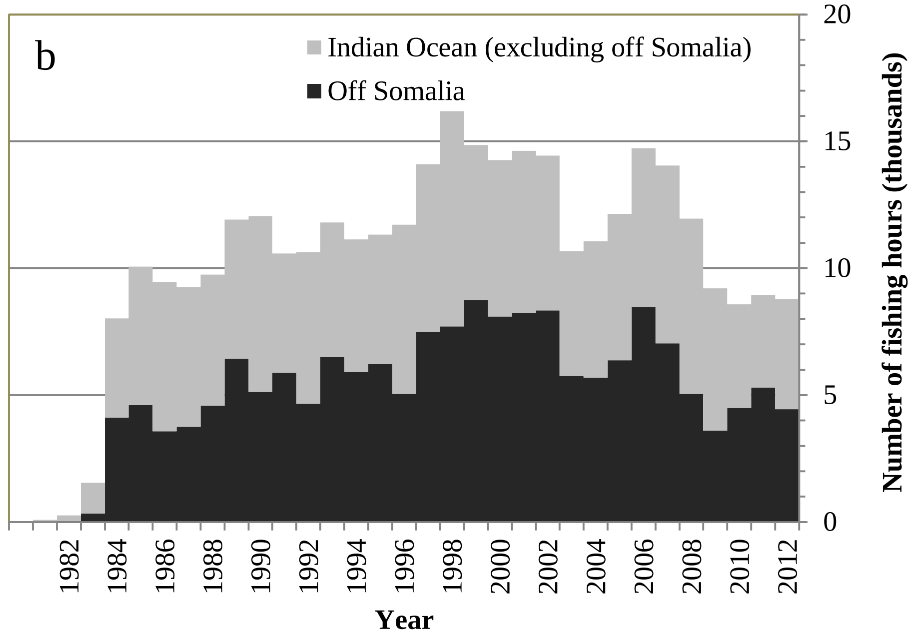


Fig. 19. Changes in total effort for a) longline (number of hooks set in millions), and b) purse seine (number of hours fished in thousands) vessels by year and geographical area: off the Somalia coastline (area shown in the insert of Fig. 17) and for the rest of the Indian Ocean.

12. RESEARCH RECOMMENDATIONS AND PRIORITIES

12.1 Revision of the WPTT work plan

251. The WPTT **NOTED** paper IOTC–2013–WPTT15–08 which aimed to ensure that participants at the WPTT15 consider, revise and develop a detailed work plan for the WPTT for the coming years, for provision and potential endorsement by the Scientific Committee.

252. The WPTT **NOTED** the range of research projects on tropical tunas, currently underway, or in development within the IOTC area of competence, and reminded participants to ensure that the projects described are included in their National Reports to the SC, which are due on the 17th of November 2013.

CPUE Standardisation inter-sessional work

253. The WPTT **NOTED** that the trends in CPUE series are substantially different between the major longline CPC's in the Indian Ocean for tropical tuna. This trend is even apparent in other species (albacore and swordfish) in the

Indian Ocean. Spatial and temporal complexity of the fleet and the species should be analysed using operational data in the Indian Ocean to resolve these differences, and provide a more accurate index over the Indian Ocean.

254. **NOTING** these CPUE issues identified by the WPTT in 2010, 2011, 2012 and 2013 and the Scientific Committee in 2012, the WPTT **RECOMMENDED** that further inter-sessional work be carried out in conjunction with the IOTC Secretariat on the major longline CPC's in the Indian Ocean in early 2014 using the operation data to address issues identified in the CPUE Workshop Report.

Consultants

255. The WPTT **NOTED** the excellent work done by IOTC consultants in 2013 on a range of projects from Management Strategy Evaluation to the bigeye tuna SS3 stock assessment, and **RECOMMENDED** that their engagement be renewed for the coming year to supplement the skill set available within IOTC CPCs. An indicative budget is provided at Table 14 for the consideration of the Scientific Committee.

TABLE 14. Estimated budget for IOTC consultants to be engaged on tropical tunas in 2014

Description	Unit price	Units required	Total
Tropical tuna Management Strategy Evaluation (fees)	US$450	35	15,750
Tropical tuna Management Strategy Evaluation (travel)	US$8,000	1	8,000
Tropical tuna Stock Assessment (fees)	US$450	35	15,750
Tropical tuna Stock Assessment (travel)	US$8,000	1	8,000
Total estimate (US$)			**47,500**

256. The WPTT **RECOMMENDED** that the SC consider and endorse the workplan and assessment schedule for the WPTT for 2014, and tentatively for future years, as provided at Appendix X and Appendix XI, respectively.

12.2 Development of priorities for an Invited Expert at the next WPTT meeting

257. The WPTT **NOTED** with thanks, the outstanding contributions of the invited expert for the meeting, Dr. Andrew Cooper from Simon Fraser University, Canada, both prior to and during the WPTT meeting which contributed greatly to the group's understanding of tropical tuna data and assessment methods.

258. The WPTT **ENCOURAGED** Dr. Andrew Cooper to maintain links with IOTC scientists to aid in the improvement of stock assessment approaches for IOTC stocks.

259. The WPTT **AGREED** to the following core areas of expertise and priority areas for contribution that need to be enhanced for the next meeting of the WPTT in 2014, by an Invited Expert:
   - **Expertise**: Stock assessment; including from regions other than the Indian Ocean; data poor analysis; tagging analysis and CPUE standardisation.
   - **Priority areas for contribution**: Refining the information base, historical data series and indicators for tropical tuna species for stock assessment purposes (species focus: skipjack tuna).

13. Other Business

260. The WPTT **NOTED** with thanks to all authors, that for the second year in a row, every working paper submitted to the WPTT was provided prior to the commencement of the Session, with most being submitted 15 days in advance of the meeting. The advanced submission of working papers enables all participants sufficient time to thoroughly review meeting papers and therefore be able to comment and contribute to discussions during the Session.

261. The WPTT **URGED** all authors to continue ensure that they make every effort to comply with the recommendation from the SC that all working party papers need to be submitted to the IOTC Secretariat no later than 15 days prior to the relevant meeting.

262. The WPTT **NOTED** the capacity building activities that the IOTC Secretariat was carrying out in several developing coastal states in the IOTC Area, in particular activities with the support of the OFCF, the BOBLME, and COI-SmartFish. The WPTT **THANKED** these institutions for the support provided and **REQUESTED** that they consider extending such activities in the future, where possible.

13.1 Election of a Vice-Chairperson of the WPTT for the next biennium

263. The WPTT **NOTED** that the first term of the current Vice-Chairperson, Dr. M. Shiham Adam (Maldives) is due to expire at the closing of the current WPTT meeting and as such, participants either need to re-elected Dr. Adam for a second and final term, or a new Vice-Chairperson needs to be elected.

264. Noting the rules of procedure of the IOTC: Rule X.6: The Scientific Committee [*and its Working Parties*] shall elect, preferably by consensus, a Chairperson and a Vice-Chairperson from among its members for two years,

the WPTT **CALLED** for nominations for the newly vacated position of Vice-Chairperson for the next biennium. Dr. M. Shiham Adam (Maldives) was nominated for a second term and unanimously re-elected as Vice-Chairperson of the WPTT for the next *biennium*.

265. The WPTT **RECOMMENDED** that the SC note that Dr. M. Shiham Adam (Maldives) was re-elected as Vice-Chairperson of the WPTT for the next *biennium*.

13.2 Date and place of the Sixteenth Session of the WPTT

266. The WPTT participants were unanimous in thanking EU-Spain, and in particular AZTI, for hosting the Fifteenth Session of the WPTT and commended EU-Spain and AZTI on the warm welcome, the excellent facilities and assistance provided to the IOTC Secretariat in the organisation and running of the Session.

267. Following a discussion on who would host the 16th Session of the WPTT in 2014, the WPTT **REQUESTED** that the IOTC Secretariat liaise with CPCs to determine if they would be able to host the 16th Session in 2014.

268. The WPTT **AGREED** that the next meeting be held at the end of October 2014. The exact dates and meeting location will be confirmed and communicated by the IOTC Secretariat to the SC for its consideration at its next session to be held in December 2013, noting that the length of the meeting should remain at 6 days.

269. Following a discussion on who would host the 17th Session of the WPTT in 2015, the WPTT **REQUESTED** that the IOTC Secretariat liaise with CPCs to determine if they would be able to host the 17th Session in 2015. The tentative dates and meeting location will be communicated by the IOTC Secretariat to the SC for its consideration.

270. The WPTT **NOTED** the importance of having a degree of stability in the participation of CPCs to each of the working party meetings and **ENCOURAGED** participants to regularly attend each meeting to ensure as much continuity as possible.

13.3 Review of the draft, and adoption of the Report of the Fifteenth Session of the WPTT

271. The WPTT **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPTT15, provided at Appendix XII, as well as the management advice provided in the draft resource stock status summary for each of the tropical tuna species under the IOTC mandate:
    - Bigeye tuna (*Thunnus obesus*) – Appendix VII
    - Skipjack tuna (*Katsuwonus pelamis*) – Appendix VIII
    - Yellowfin tuna (*Thunnus albacares*) – Appendix IX

272. The report of the Fifteenth Session of the Working Party on Tropical Tunas (IOTC–2013–WPTT15–R) was **ADOPTED** on the 28 October 2013.

APPENDIX I
LIST OF PARTICIPANTS

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APPENDIX II
AGENDA FOR THE FIFTEENTH WORKING PARTY ON TROPICAL TUNAS

Date: 23–28 October 2013
Location: Hotel NH Aranzazu
San Sebastián, Spain.
Time: 09:00 – 17:00 daily
Chair: Dr. Hilario Murua; **Vice-Chair**: Dr. Shiham Adam

1. **OPENING OF THE MEETING** (Chair)

2. **ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION** (Chair)

3. **OUTCOMES OF THE FIFTEENTH SESSION OF THE SCIENTIFIC COMMITTEE** (Secretariat)

4. **OUTCOMES OF SESSIONS OF THE COMMISSION** (Secretariat)
   - 4.1 Outcomes of the Seventeenth Session of the Commission (Secretariat)
   - 4.2 Review of Conservation and Management Measures relevant to tropical tunas (Secretariat)

5. **PROGRESS ON THE RECOMMENDATIONS OF WPTT14** (Chair and Secretariat)

6. **NEW INFORMATION ON FISHERIES AND ASSOCIATED ENVIRONMENTAL DATA RELATING TO TROPICAL TUNAS**
   - 6.1 Review new information on fisheries and associated environmental data (CPC papers)

7. **BIGEYE TUNA – REVIEW OF NEW INFORMATION ON STOCK STATUS**
   - 7.1 Review of the statistical data available for bigeye tuna (Secretariat)
   - 7.2 Review new information on the biology, ecology, stock structure, their fisheries and associated environmental data for bigeye tuna (CPC papers)
   - 7.3 Data for input into stock assessments (indcators):
     - o Catch and effort
     - o Catch at size
     - o Growth curves and age-length key
     - o Catch at age
     - o CPUE indices and standardised CPUE indices
     - o Tagging data
   - 7.4 Stock assessment updates
   - 7.5 Selection of Stock Status indicators
   - 7.6 Development of technical advice on the status of bigeye tuna

8. **SKIPJACK TUNA – REVIEW OF NEW INFORMATION ON STOCK STATUS**
   - 8.1 Review of the statistical data available for skipjack tuna (Secretariat)
   - 8.2 Review new information on the biology, ecology, stock structure, their fisheries and associated environmental data for skipjack tuna (CPC papers)
   - 8.3 Data for input into stock assessments (indicators):
     - o Catch and effort
     - o Catch at size
     - o Growth curves and age-length key
     - o Catch at age
     - o CPUE indices and standardised CPUE indices
     - o Tagging data
   - 8.4 Selection of Stock Status indicators
   - 8.5 Development of technical advice on the status of skipjack tuna

9. **YELLOWFIN TUNA – REVIEW OF NEW INFORMATION ON STOCK STATUS**
   - 9.1 Review of the statistical data available for yellowfin tuna (Secretariat)
   - 9.2 Review new information on the biology, ecology, stock structure, their fisheries and associated environmental data for yellowfin tuna (CPC papers)

9.3 Data for input into stock assessments (indicators):

- Catch and effort
- Catch at size
- Growth curves and age-length key
- Catch at age
- CPUE indices and standardised CPUE indices
- Tagging data

9.4 Selection of Stock Status indicators

9.5 Development of technical advice on the status of yellowfin tuna

10. ANALYSIS OF THE TIME-AREA CLOSURES (Noting Resolution 12/13)

11. EFFECT OF PIRACY ON TROPICAL TUNA CATCHES

12. RESEARCH RECOMMENDATIONS AND PRIORITIES

12.1 Revision of the WPTT work plan

12.2 Development of priorities for an Invited Expert at the next WPTT meeting

13. OTHER BUSINESS

13.1 Election of a Vice-Chairperson of the WPTT for the next biennium

13.2 Date and place of the Sixteenth Session of the WPTT

13.3 Review of the draft, and adoption of the Report of the Fifteenth Session of the WPTT

APPENDIX III
LIST OF DOCUMENTS

Document	Title	Availability
IOTC–2013–WPTT15–01a	Agenda of the Fifteenth Working Party on Tropical Tunas	✓(25 July 2013) ✓(23 October 2013)
IOTC–2013–WPTT15–01b	Draft annotated agenda of the Fifteenth Working Party on Tropical Tunas	✓(7 October 2013)
IOTC–2013–WPTT15–02	Draft list of documents for the Fifteenth Working Party on Tropical Tunas	✓(3 October 2013)
IOTC–2013–WPTT15–03	Outcomes of the Fifteenth Session of the Scientific Committee (Secretariat)	✓(30 September 2013)
IOTC–2013–WPTT15–04	Outcomes of the Seventeenth Session of the Commission (Secretariat)	✓(2 October 2013)
IOTC–2013–WPTT15–05	Review of Conservation and Management Measures relevant to tropical tunas (Secretariat)	✓(3 October 2013)
IOTC–2013–WPTT15–06	Progress made on the recommendations of WPTT14 (Secretariat)	✓(7 October 2013)
IOTC–2013–WPTT15–07 Rev_1	Review of the statistical data and fishery trends for tropical tunas (Secretariat)	✓(7 October 2013) ✓(22 October 2013)
IOTC–2013–WPTT15–08	Revision of the WPTT work plan (Secretariat)	✓(3 October 2013)
Multi-species/General		
IOTC–2013–WPTT15–09	Outline of climate and oceanographic conditions in the Indian Ocean in the recent years: an update to August 2013 (F. Marsac)	✓(14 October 2013)
IOTC–2013–WPTT15–10	Impact of dipole mode and El-Nino events on catches of yellowfin tuna (*Thunnus albacares*) in the Eastern Indian Ocean off west Java (K. Amri, A. Suman, H.E. Irianto & Wudianto)	✓(8 October 2013)
IOTC–2013–WPTT15–11	Seasonal abundance of the tropical tunas around fish aggregating devices anchored off the coast of Mauritius (2010–2012) (V.M. Chooramun & V. Senedhun)	✓(7 October 2013)
IOTC–2013–WPTT15–12	A new fisheries independent method to estimate abundances of tropical tunas (M. Capello, J-L. Deneubourg, M. Robert, K. Holland, K. Schaefer, L. Dagorn)	✓(11 October 2013)
IOTC–2013–WPTT15–13	Are Indian Ocean tuna populations assessed and managed at the appropriate spatial scale? Brief review of the evidence and implications (D. Kolody, P. Grewe, C. Davies & C. Proctor)	✓(17 October 2013)
IOTC–2013–WPTT15–14	Statistics of the purse seine Spanish fleet in the Indian Ocean (1990–2012) (A. Delgado de Molina, J. Ariz & J.J. Areso)	✓(21 August 2013)
IOTC–2013–WPTT15–15 Rev_1	Analysis of catch assessment in offshore and coastal tuna fisheries in Sri Lanka (J.A.D.B. Jayasooriya & H.M.U. Bandara)	✓(21 September 2013) ✓(27 October 2013)
IOTC–2013–WPTT15–16	A review on oceanic tuna fishery in Sri Lanka and estimation of the length-weight relationships for yellowfin tuna and bigeye tuna (H.A.C.C. Perera, S.S.K. Haputhanthri & K.H.K. Bandaranayake)	✓(7 October 2013)
IOTC–2013–WPTT15–17	Trends of tropical tuna in Iran (M. Akhondi)	✓(15 October 2013)
IOTC–2013–WPTT15–18	Tropical tunas caught by the malagasy longliners in 2012 (R. Fanazava)	✓(18 October 2013)
IOTC–2013–WPTT15–19	Foreign Tuna Fleets Unloading in Phuket, Thailand During 1995–2012 (P. Nootmorn, S. Rodpradit, T. Chaiyen & S. Panjarat)	✓(2 September 2013)
IOTC–2013–WPTT15–20	Tropical tuna fisheries in the Indian Ocean of Indonesia (H.E. Irianto, Wudianto, F. Satria & B. Nugraha)	✓(8 October 2013)
Bigeye tuna		
IOTC–2013–WPTT15–21	Population structure and reproduction of bigeye tuna (*Thunnus obesus*) in Indian Ocean at western part of Sumatra and southern part of Java and Nusa Tenggara (A. Suman, H.E. Irianto, K. Amri & B. Nugraha)	✓(8 October 2013)
IOTC–2013–WPTT15–22	Comparison of size data for bigeye and yellowfin tuna based on different sampling methods caught by Japanese longline in the Indian Ocean (T. Matsumoto)	✓(16 October 2013)
IOTC–2013–WPTT15–23	Standarized CPUE for juveniles yellowfin, skipjack and bigeye tuna from the European purse seine fleet in the Indian Ocean from 1981 to 2011 (M. Soto, A. Delgado de Molina & E. Chassot)	✓(9 October 2013)
IOTC–2013–WPTT15–24	CPUE standardization for bigeye tuna caught by Korean tuna longline fisheries in the Indian Ocean (S. Il Lee, Z.G. Kim, M.K. Lee, D-W. Lee & T. Nishida)	✓(11 October 2013)

Document	Title	Availability
IOTC–2013–WPTT15–25	Japanese longline CPUE for bigeye tuna in the Indian Ocean standardized by GLM (T. Matsumoto, K. Satoh and H. Okamoto)	✓(9 October 2013)
IOTC–2013–WPTT15–26	CPUE standardizations for bigeye tuna caught by Taiwan,China longline fishery in the Indian Ocean using generalized linear model (Y.-M. Yeh & S.-T. Chang)	✓(14 October 2013)
IOTC–2013–WPTT15–27	Withdrawn	Withdrawn
IOTC–2013–WPTT15–28 Rev_1	Stock assessment of bigeye tuna (*Thunnus obesus*) in the Indian Ocean using ASAP (J. Zhu, W. Guan, S. Tian, X. Dai & L. Xu)	✓(15 October 2013) ✓(23 October 2013)
IOTC–2013–WPTT15–29	Withdrawn	Withdrawn
IOTC–2013–WPTT15–30	Stock assessment of bigeye tuna in the Indian Ocean for 2012 (A. Langley, M. Herrera & R. Sharma)	✓(6 August 2013)
IOTC–2013–WPTT15–31 Rev_1	Stock and risk assessment of bigeye tuna (*Thunnus obesus*) in the Indian Ocean by Age-Structured Production Model (ASPM) (T. Nishida & K. Iwasaki)	✓(19 October 2013) ✓(27 October 2013)
Skipjack tuna		
IOTC–2013–WPTT15–32	Maldives skipjack pole and line fishery catch rate standardization 2004–2011: reconstructing historic CPUE till 1985 (R. Sharma, J. Geehan & M.S. Adam)	✓(7 October 2013)
IOTC–2013–WPTT15–33 Rev_1	Process and arrangement for management strategy evaluation of Indian Ocean skipjack tuna (M.S. Adam, R. Sharma & N. Bentley)	✓(7 October 2013) ✓(16 October 2013)
Yellowfin tuna		
IOTC–2013–WPTT15–34	Seasonality, morphometrics and feeding behaviour of yellowfin tuna (*Thunnus albacares*) caught by sports fishers in the Kenyan waters (S. Ndegwa)	✓(7 October 2013)
IOTC–2013–WPTT15–35	Traditional small scale fishing for yellowfin tuna *Thunnus albacares* in Andhra Pradesh along east coast of India (P. Rohit)	✓(23 September 2013)
IOTC–2013–WPTT15–36	Discrimination of yellowfin tuna from the putative nurseries of the Western Indian Ocean (I. Fraile, H. Murua, I. Zudaire, H. Arrizabalaga & J. Rooker)	✓(11 October 2013)
IOTC–2013–WPTT15–37	Japanese longline CPUE for yellowfin tuna in the Indian Ocean up to 2012 standardized by generalized linear model (T. Matsumoto, H. Okamoto & T. Kitakado)	✓(9 October 2013)
IOTC–2013–WPTT15–38	CPUE standardizations for yellowfin tuna caught by Taiwan,China longline fishery in the Indian Ocean using generalized linear model (Y.-M. Yeh & S.-T.Chang)	✓(14 October 2013)
IOTC–2013–WPTT15–39 Rev_1	Stock assessment on yellowfin tuna in the Indian Ocean by A Stock-Production Model Incorporating Covariates (ASPIC) (S. Il Lee, Z.G. Kim, M.K. Lee, D-W. Lee & T. Nishida)	✓(11 October 2013)
Other papers/ Late titles		
IOTC–2013–WPTT15–40 Rev_1	Data collection and processing system of statistics for the Taiwan,China deep-sea longline fishery (Overseas Fisheries Development Council, Taiwan,China)	✓(14 October 2013) ✓(23 October 2013)
IOTC–2013–WPTT15–41 Rev_1	Review of length frequency data of the Taiwan,China distant water longline fleet (J. Geehan & S. Hoyle)	✓(7 October 2013) ✓(22 October 2013)
IOTC–2013–WPTT15–42	Challenges to the pole-and-line tuna fishery in the Maldives (A.R Jauharee)	✓(19 October 2013)
IOTC–2013–WPTT15–43	Tuna Longline Fishery in the Indian Ocean by Thai Fleet during 2010–2012 (N. Darumas, A. Wongkeaw & W. Chumchuen)	✓(22 October 2013)
IOTC–2013–WPTT15–44	Statistics of the European Union and associated flags purse seine fishing fleet targeting tropical tunas in the Indian Ocean 1981-2012 (E. Chassot, A. Delgado de Molina, C. Assan, P. Dewals, P. Cauquil, J.J. Areso, D.M. Rahombanjanaharyk & L. Floch)	✓(12 October 2013)
IOTC–2013–WPTT15–45	A comparison of changes in the exploration and exploitation of oceanic tuna resources in the Indian EEZ in 1970–2012 (A. Anrose, C. Babu & M.K. Sinha)	✓(10 October 2013)
Information papers		
IOTC–2013–WPTT15–INF01	IOTC SC – Guidelines for the Presentation of Stock Assessment Models	✓(13 August 2013)
IOTC–2013–WPTT15–INF02	WCPFC: Evaluation of tag mixing assumptions for skipjack, yellowfin and bigeye tuna stock assessments in the western Pacific and Indian Oceans. 2013. WCPFC–SC9–2013/SA–IP–11 (D.S. Kolody, S. Hoyle)	✓(23 September 2013)

Document	Title	Availability
IOTC–2013–WPTT15–INF03	How much do Fish Aggregating Devices (FADs) modify the floating object environment in the ocean? (L. Dagorn, N. Bez, T. Fauvel & E. Walker) 2013. Fisheries Oceanography, 22(3): 147–153)	✓(2 October 2013)
IOTC–2013–WPTT15–INF04	Is it good or bad to fish with FADs? What are the real impacts of the use of drifting FADs on pelagic marine ecosystems? (L. Dagorn, K. Holland, V. Restrepo & G. Moreno) 2013. Fish and Fisheries, 14: 391-415 (DOI: 10.1111/j.1467-2979.2012.00478.x.)	✓(2 October 2013)
IOTC–2013–WPTT15–INF05	Does social behavior influence the dynamics of aggregations formed by tropical tunas around floating objects? An experimental approach (M. Robert, L. Dagorn, J. Lopez, G. Moreno & J-L Deneubourg) 2013. Journal of Experimental Marine Biology and Ecology, 440: 238–243	✓(2 October 2013)
IOTC–2013–WPTT15–INF06	Movement behaviour of skipjack (*Katsuwonus pelamis*) and yellowfin (*Thunnus albacares*) tuna at anchored fish aggregating devices (FADs) in the Maldives investigated using acoustic telemetry (R. Govinden, R. Jauhary, J.D. Filmalter, F. Forget, M. Soria, M.S. Adam & L. Dagorn) 2012. Aquatic Living Resources, 26: 69–77	✓(2 October 2013)
IOTC–2013–WPTT15–INF07	First announcement and call for papers – Sixth international symposium On GIS/spatial analyses in fishery and aquatic sciences (Tampa, Florida, USA, August 25– 29, 2014)	✓(23 September 2013)
IOTC–2013–WPTT15–INF08	Investigating the influence of length-frequency data on the stock assessment of Indian Ocean bigeye tuna (R. Sharma, A. Langley, M. Herrera & J. Geehan)	✓(7 October 2013)
IOTC–2013–WPTT15–INF09	The reproductive biology, condition and feeding ecology of the skipjack, *Katsuwonus pelamis*, in the western Indian Ocean (M.G. Mendizabal)	✓(7 October 2013)
IOTC–2013–WPTT15–INF10	Fecundity regulation strategy of the yellowfin tuna (*Thunnus albacares*) in the Western Indian Ocean (I. Zudairea, H. Murua, M. Grandea, M. Korta, H. Arrizabalaga, J.J. Areso, A. Delgado-Molinac)	✓(11 October 2013)
IOTC–2013–WPTT15–INF11	Reproductive potential of yellowfin tuna (*Thunnus albacares*) in the western Indian Ocean (I. Zudaire, H. Murua, M. Grande, N. Bodin)	✓(11 October 2013)
IOTC–2013–WPTT15–INF12	Evaluating harvest control rules for bigeye tuna (*Thunnus obesus)* and yellowfin tuna (*Thunnus albacares*) fisheries in the Indian Ocean (Y. Zhang, Y. Chen, J. Zhu, S. Tian & X. Chen)	✓(15 October 2013)
IOTC–2013–WPTT15–INF13	Comparison of daily- and annual- increment counts in otoliths of bigeye (*Thunnus obesus*), yellowfin (*T. albacares*), southern bluefin (*T. maccoyii*) and albacore (*T. alalunga*) tuna (A.J. Williams, B.M. Leroy, S.J. Nicol, J.H. Farley, N.P. Clear, K. Krusic-Golub & C.R. Davies)	✓(15 October 2013)
IOTC–2013–WPTT15–INF14 Rev_1	Statistics of the purse seine fleets of France’s overseas territories targeting tropical tunas in the Indian Ocean (2001–2012)	✓(12 October 2013) ✓(28 October 2013)
IOTC–2013–WPTT15–INF15 Rev_1	Statistics of French purse seine fishing fleet targeting tropical tunas in the Indian Ocean (1981–2012)	✓(12 October 2013) ✓(28 October 2013)

APPENDIX IV
GUIDELINES FOR A REVIEW OF DATA COLLECTION AND PROCESSING SYSTEMS FOR SIZE DATA FROM MAIN LONGLINE FLEETS IN THE INDIAN OCEAN

Background

Each year, the IOTC Secretariat prepares input tables for the assessments of IOTC stocks, including catches in number and weight for tropical tunas, albacore and swordfish, by fishery, species, length class, year, quarter and fishing area, as defined by the IOTC working parties. Total numbers of tunas and billfish are derived from the available nominal catch, catch-and-effort and size frequency datasets, as provided by IOTC CPCs[1] or other Parties.

For a number of years the IOTC Scientific Committee has expressed concern about the poor coverage of length frequency samples for some important longline fleets, as the Japanese, Indonesian, and Indian longline fleets; and the difficulty to reconcile the catch-and-effort and size frequency datasets available for the Taiwan,China longline fleet. For the latter, in particular the fact that average weights derived from each dataset for the same area and time-period are highly conflicting, especially during the last decade when sampling coverage increased to values close to total enumeration.

In light of the above and additional information presented at the meeting of the WPTT15 in 2013 (IOTC–2013–WPTT15–41), the WPTT agreed on the need to extend the duration of the WPDCS to address the issues identified, with the participation of the IOTC Secretariat, invited experts, and scientists from Indonesia, Taiwan,China, Japan and other parties having important longline fisheries in the Indian Ocean. In addition, the WPTT agreed on the value to invite other tuna-RFMO Secretariats to attend the next WPDCS meeting, noting that some of the issues identified for longline fisheries may also affect other oceans.

Proposed work

1) Review the procedures used by the IOTC Secretariat to prepare input files for the assessments of IOTC species, in particular tropical tunas, albacore, swordfish and marlins.
2) Review the procedures used for the collection and processing of size data from large-scale tuna longline fisheries in the Indian Ocean, over the entire size frequency data series, in particular:
    a) Types of size data collected, data sources, and data validation and processing (e.g. stratification, procedures used to convert sizes into fork length, etc., where required)
    b) Other uses of size frequency data, where applicable (e.g. estimation of catches in weight from numbers recorded in logbooks, or contribution of size data to the estimation of nominal catches for the fishery)
3) Address the concerns raised by the IOTC Working Parties concerning the quality of size data available for longline fleets, in particular:
    a) Likely effects that changes in sampling coverage and contribution of length frequency data from longline fleets have on the assessments of IOTC species, in particular tropical tunas, albacore, swordfish and marlins.
    b) Likely effects that the use of length frequency data from different sources (e.g. scientific observers, fishers, training and research boats) have on the assessments of IOTC species, in particular tropical tunas, albacore, swordfish and marlins.
    c) Further explore the reasons behind the sudden changes in the shape of length frequency distributions recorded during some periods for the Taiwan,China longline fleet, in particular the marked decrease in the amount of small fish in the samples recorded for the last decade.
    d) Further explore the reasons for average weights derived from the catch and effort and size frequency datasets to be conflicting over the entire time-series.
4) Where required, identify areas of future work and propose a road-map for these activities to be carried out, for consideration and endorsement by the IOTC Scientific Committee in 2014.

Initially, the WPDCS should report results to the meeting of the WPTT and IOTC Scientific Committee in 2014, in particular:

a) Fully document size frequency data collection and processing procedures used by Taiwan,China, Japan and other important longline fisheries over the entire history of the fishery.

[1] IOTC Contracting and Cooperating Non-Contracting Parties

b) Where necessary, recommend changes to the data collection and/or processing systems for longline fleets, and propose a roadmap for the implementation of the activities recommended by the institutions concerned.
c) Provide guidance on the best use of the available length frequency data for the assessments of IOTC species, including the type of fisheries to be considered and the procedures that are recommended for the preparation of the different datasets.

APPENDIX V
STATISTICS FOR TROPICAL TUNAS

Extracts from IOTC–2013–WPTT15–07 Rev_1

The contribution of tropical tunas (bigeye tuna, skipjack tuna and yellowfin tuna) to the total catches of IOTC species in the Indian Ocean has changed over the years (Fig. 1a,b), in particular following the arrival of industrial purse seine fleets to the Indian Ocean, in the early-1980s (increase), and after the onset of piracy, in recent years (decrease). Hence, in recent years (2010–12), the catches of tropical tunas in the Indian Ocean have accounted for 53% of the combined catches of all IOTC species (60% over the period 1950–2012). Among the tropical tuna species skipjack tuna dominate by volume, with catches that account for 47% of the total tropical tuna catches in recent years (2010–12; Fig. 1c). While the catch levels of yellowfin tuna were also high during the same period (41%), the catches of bigeye tuna were at lower levels (12%).

Tropical tunas are caught by coastal countries and distant water fishing nations in the Indian Ocean (Fig. 2). In recent years the coastal fisheries of five countries (Indonesia, Sri Lanka, Maldives, I.R. Iran, and India) have reported as much as 54% of the of the total catches of tropical tuna species from all countries and species combined, while the industrial purse seine vessels and longliners flagged to EU,Spain and Seychelles reported around 24% of the total catches of these species (2010–12; Fig. 2).

The majority of the catches of tropical tuna species are sold to international markets, including the sashimi market in Japan (large specimens of yellowfin tuna and bigeye tuna in fresh or deep-frozen condition), and processing plants in the Indian Ocean region or abroad (small specimens of skipjack tuna and, to a lesser extent, yellowfin tuna and bigeye tuna). A component of the catches of tropical tunas, in particular skipjack tuna caught by some coastal countries in the region, is sold in local markets or retained by the fishers for personal consumption. Tropical tunas are mainly caught by purse seine vessels (38% of the total catches of tropical tunas for 2010–12), with large catches also reported by gillnets (19%), several types of handlines and trolling (16%), longlines (15%), and pole-and-lines (11%), in both coastal waters and the high seas. Tropical tunas are the target of many fisheries although they are also caught incidentally by fisheries targeting other tunas, small pelagic species, or other non-tuna species (e.g. sharks).

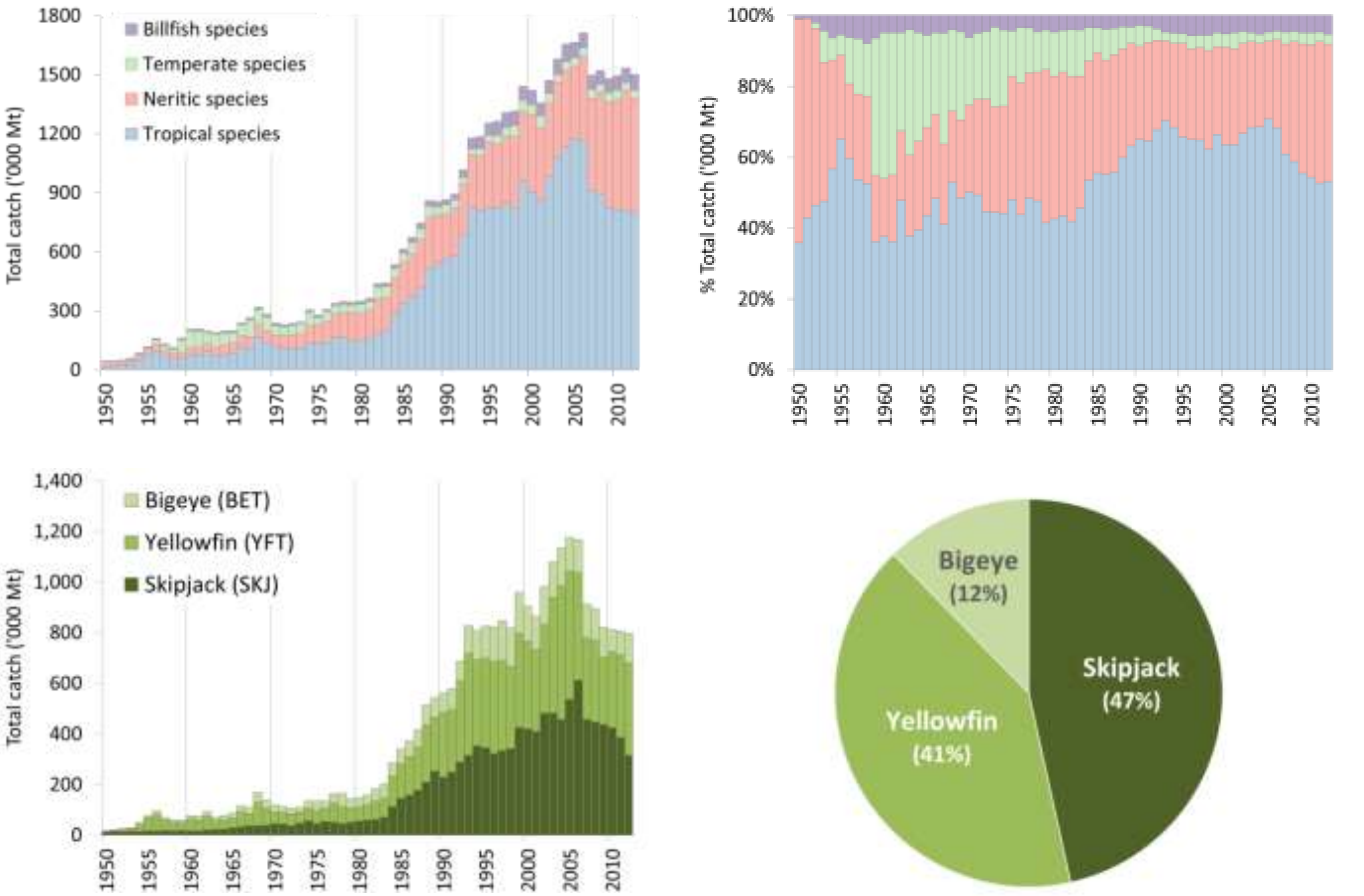


Fig. 1a–d. Tropical tunas: Top: Contribution of the three tropical tuna species under the IOTC mandate to the total catches of IOTC species in the Indian Ocean, over the period 1950–2012 (a. Top left: total catch; b. Top right: percentage, same colour key as Fig. 1a) (Data as of September 2013); **Bottom:** Contribution of each tropical tuna species to the total combined catches of tropical tunas (c. Bottom left: nominal catch of each species, 1950–2012; d. Bottom right: share of tropical tuna catch by species, 2009–12).

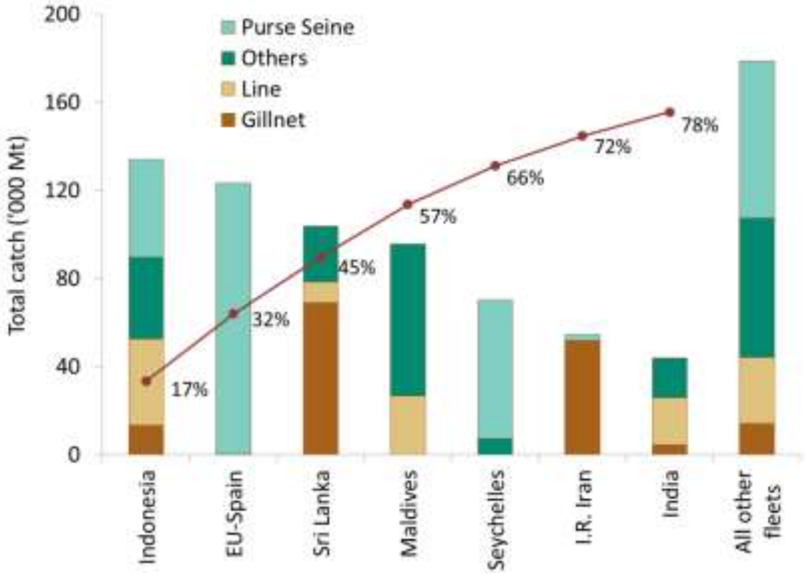


Fig. 2. Tropical tunas: Average catches in the Indian Ocean over the period 2009–12, by country (Data as of September 2013). Countries are ordered from left to right, according to the magnitude of catches of tropical tunas reported. The red line indicates the (cumulative) proportion of catches of tropical tunas for the countries concerned, over the total combined catches of species reported from all countries and fisheries.

Effort trends

The total effort by five degree square grid, for longline, purse seine and pole-and-line vessel is provided in Figs. 3, 4 and 5, respectively for 2011 and 2012.

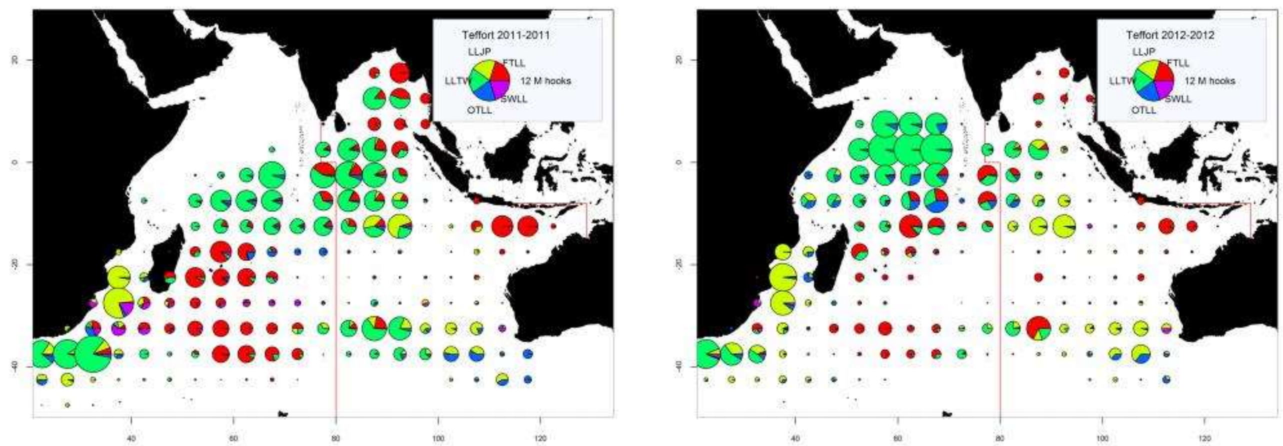


Fig. 3. Number of hooks set (millions) from longline vessels by five degree square grid and main fleets, for the years 2011 and 2012 (Data as of September 2013).

LLJP (light green): deep-freezing longliners from Japan
LLTW (dark green): deep-freezing longliners from Taiwan,China
SWLL (turquoise): swordfish longliners (Australia, EU, Mauritius, Seychelles and other fleets)
FTLL (red) : fresh-tuna longliners (China, Taiwan,China and other fleets)
OTLL (blue): Longliners from other fleets (includes Belize, China, Philippines, Seychelles, South Africa, Rep. of Korea and various other fleets)

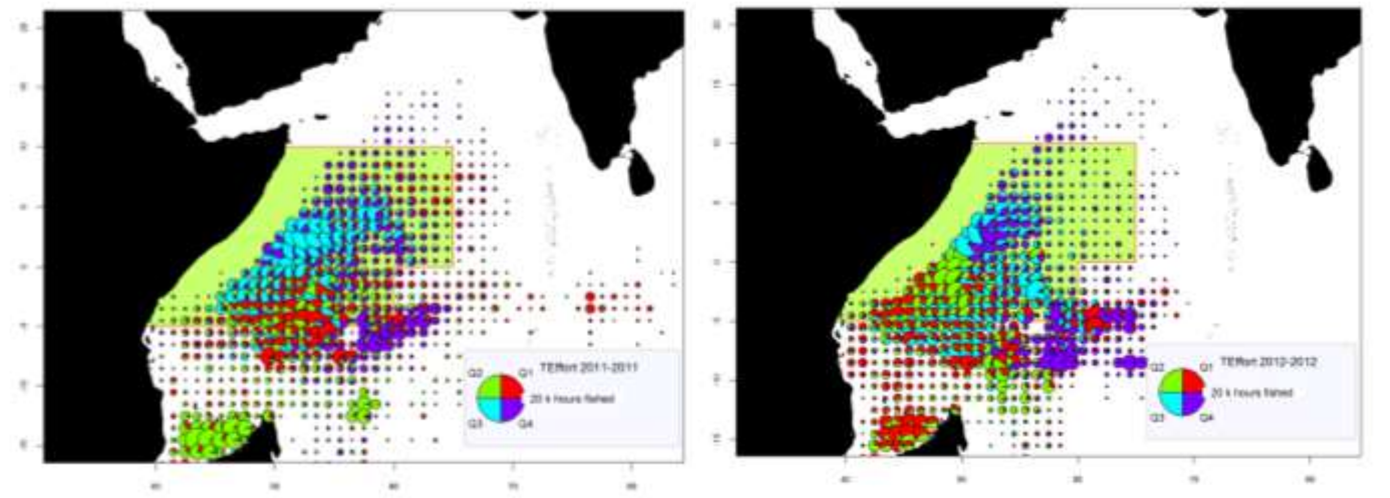


Fig. 4. Purse seine effort by quarter expressed as the number of hours of fishing (Fhours) in thousands (k), by 1 degree square grid in the western Indian Ocean, for the years 2011 and 2012 (Data as of September 2013). The area shaded in green is where piracy activities are considered highest.

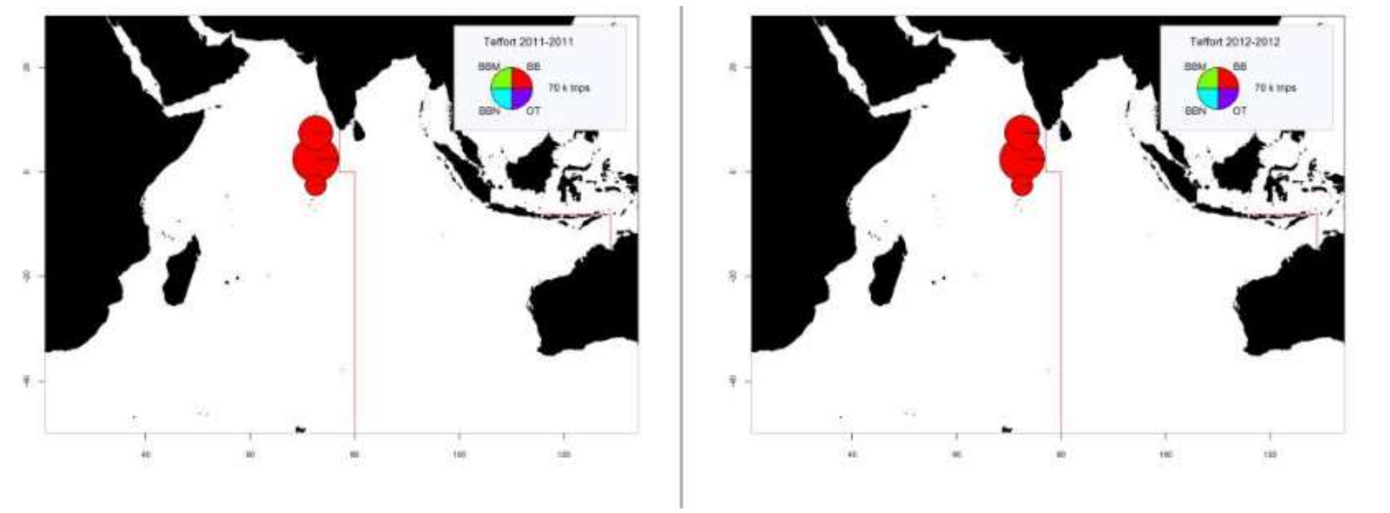


Fig. 5. Number of trips (equivalent to fishing days) in thousands (k), from pole-and-line vessels by 5 degree square grid and main fleets, for the years 2011 and 2012 (Data as of September 2013).

BBM (green): Pole-and-line (mechanized baitboats)
BBN (blue): Pole-and-line (non-mechanized baitboats)
BB (red): Pole-and-line (all baitboats, especially mechanized)
OT (purple): Pole-and-line and other gears unidentified

Bigeye tuna (*Thunnus obesus*)

Extracts from IOTC–2013–WPTT15–07 Rev_1

Bigeye tuna – Fisheries and catch trends

Bigeye tuna is mainly caught by industrial longline (70% in 2012) and purse seine (19% in 2012) fisheries, with the remaining 11% of the catch taken by other fisheries (Table 1). However, in recent years the catches of bigeye tuna by gillnet fisheries are likely to be higher, due to the major changes experienced in some of these fleets, notably changes in boat size, fishing techniques and fishing grounds, with vessels using deeper gillnets on the high seas, in areas where catches of bigeye tuna by other fisheries are important.

Total annual catches have increased steadily since the start of the fishery, reaching the 100,000 t level in 1993 and peaking at over 160,000 t in 1999 (Fig. 1). Catches dropped since then to values between 130,000–150,000 t (2000–07), further dropping in recent years, to values under 90,000 t in recent years (2010–11), and increasing in 2012 to over 115,000 t. The Scientific Committee believes that the recent drop in catches could be related, at least in part, with the expansion of piracy in the northwest Indian Ocean (Area R1, Table 2), which led to a marked drop in the levels of longline effort in the core fishing area of these species in 2010–11 (Table 2).

TABLE 1. Bigeye tuna: Best scientific estimates of the catches of bigeye tuna (*Thunnus obesus*) by gear and main fleets [or type of fishery] by decade (1950–2009) and year (2003–2012), in tonnes (Data as of September 2013). Catches by decade represent the average annual catch, noting that some gears were not used since the beginning of the fishery (refer to Fig. 1).

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
BB	21	50	266	1,536	2,968	4,864	4,103	4,519	4,119	4,822	5,274	6,731	6,770	6,782	6,963	5,217
FS	0	0	0	2,341	4,823	6,216	7,915	4,097	8,484	6,406	5,672	9,646	5,301	3,792	6,222	7,180
LS	0	0	0	4,855	18,317	20,253	15,918	19,295	17,557	18,521	18,104	19,876	24,708	18,486	16,386	10,434
LL	6,488	21,979	30,270	42,887	62,311	71,273	85,203	90,621	75,863	72,932	74,170	51,591	51,553	32,252	35,794	65,655
FL	0	0	218	3,066	26,307	23,471	19,431	22,366	19,637	18,788	22,451	23,323	15,810	12,759	14,667	15,774
LI	43	294	658	2,384	4,278	5,560	5,037	5,595	4,735	5,372	5,898	7,323	7,231	7,796	7,692	5,583
OT	38	63	164	859	1,407	3,725	2,768	3,136	3,098	4,581	4,203	5,121	6,294	5,368	5,985	5,950
Total	**6,589**	**22,387**	**31,577**	**57,930**	**120,411**	**135,362**	**140,377**	**149,629**	**133,493**	**131,422**	**135,772**	**123,611**	**117,667**	**87,235**	**93,709**	**115,793**

Gears: Pole-and-Line (**BB**); Purse seine free-school (**FS**); Purse seine associated school (**LS**); Deep-freezing longline (**LL**); Fresh-tuna longline (**FL**); Line (handline, small longlines, gillnet & longline combine) (**LI**); Other gears nei (gillnet, trolling & other minor artisanal gears)(**OT**).

TABLE 2. Bigeye tuna: Best scientific estimates of the catches of bigeye tuna (*Thunnus obesus*) by area [as used for stock assessment in 2013] by decade (1950–2009) and year (2003–2012), in tonnes (Data as of September 2013). Catches by decade represent the average annual catch. The areas are presented in Fig. 3a.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
A1	2,436	11,824	17,359	34,731	57,127	76,920	88,763	91,531	85,659	80,428	79,588	65,565	56,210	38,626	39,411	68,721
A2	3,586	6,872	9,844	18,071	43,292	42,178	31,162	40,377	33,543	40,150	48,055	48,918	53,948	41,316	47,113	38,540
A3	199	2,614	2,876	2,679	15,033	12,040	16,318	13,298	10,100	5,533	4,007	4,570	3,716	4,447	4,711	4,967
A0	368	1,077	1,499	2,448	4,960	4,224	4,134	4,423	4,189	5,311	4,121	4,559	3,794	2,846	2,473	3,565
Total	**2,436**	**11,824**	**17,359**	**34,731**	**57,127**	**76,920**	**140,377**	**149,629**	**133,493**	**131,422**	**135,772**	**123,611**	**117,667**	**87,235**	**93,709**	**115,793**

Areas: West Indian Ocean (**A1**); East Indian Ocean (**A2**); Southwest and Southeast Indian Ocean(**A3**); Other Areas(A0)

Bigeye tuna have been caught by industrial longline fleets since the early 1950's, but before 1970 they only represented an incidental catch. After 1970, the introduction of fishing practices that improved catchability of the bigeye tuna resource, combined with the emergence of a sashimi market, resulted in bigeye tuna becoming a primary target species for the main industrial longline fleets. Total catch of bigeye tuna by longliners in the Indian Ocean increased steadily from the 1970's attaining values over 90,000 t between 1996 and 2007, and dropping markedly thereafter (Fig. 1). With the exception of 2012, bigeye tuna catches in recent years have been low, representing less than half the catches of bigeye tuna recorded before the onset of piracy in the Indian Ocean. Since the late 1980’s Taiwan,China has been the major longline fleet fishing for bigeye tuna in the Indian Ocean, taking as much as 40% of the total longline catch in the Indian Ocean (Fig. 2). However, the catches of longliners from Taiwan,China between 2007 and 2011 decreased markedly (≈20,000 t), to values three times lower than those in 2003. Catches in 2012 are higher though still far from those in 2003. Large bigeye tuna (averaging just above 40 kg) are primarily caught by longlines, in particular deep longline vessels.

Since the late 1970’s, bigeye tuna has been caught by purse seine vessels fishing on tunas aggregated on floating objects and, to a lesser extent, associated to free swimming schools (Fig. 1) of skipjack tuna and yellowfin tuna. The highest catch of bigeye tuna by purse seiners in the Indian Ocean was recorded in 1999 (≈40,000 t). Catches since 2000 have been between 20,000 and 30,000 t. Purse seiners flagged to EU countries and the Seychelles take the majority of purse seine caught bigeye tuna in the Indian Ocean (Fig. 2). Purse seine vessels mainly take small juvenile bigeye tuna (averaging around 5 kg) whereas longliner vessels catch much larger and heavier fish; and while purse seiner vessels take lower tonnages of bigeye tuna compared to longline vessels, they take larger numbers of individual fish.

By contrast with yellowfin tuna and skipjack tuna, for which the major catches are taken in the western Indian Ocean, bigeye tuna is also exploited in the eastern Indian Ocean (A2 in Fig. 3 and Table 2). The relative increase in catches in the eastern Indian Ocean in the late 1990's was mostly due to increased activity of small longliners fishing tuna to be marketed as fresh product. This fleet started its operation in the mid 1970's. However, the catches of bigeye tuna in the eastern Indian Ocean have shown a decreasing trend in recent years, as some of the vessels moved south to target albacore (Figs. 3, 4).

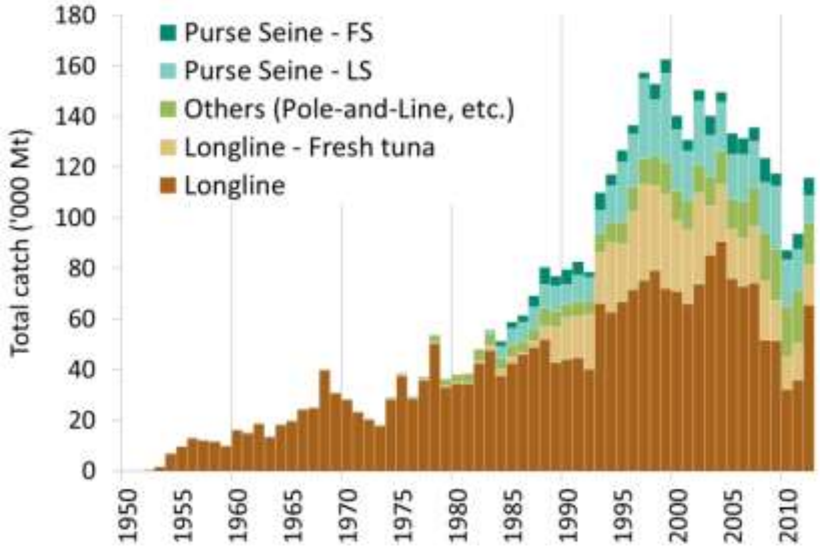


Fig. 1. Bigeye tuna: Annual catches of bigeye tuna by gear (1950–2012) (Data as of September 2013). Gears: Purse seine free-school (FS); Purse seine associated school (LS); Deep-freezing longline (LL); Fresh-tuna longline (FL); Other gears nei (Pole-and-Line, handline, small longlines, gillnet, trolling & other minor artisanal gears) (OT).

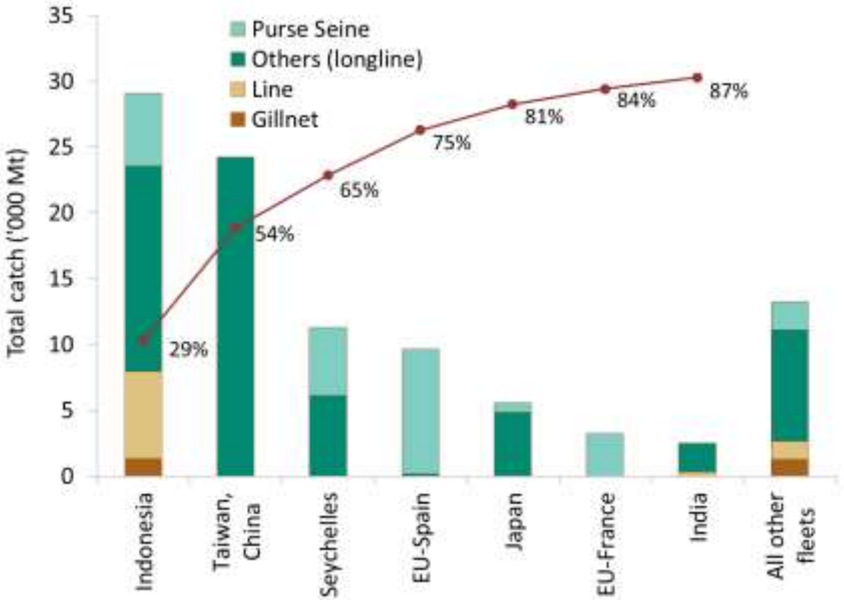


Fig. 2. Bigeye tuna: average catches in the Indian Ocean over the period 2009–12, by country (Data as of September 2013). Countries are ordered from left to right, according to the magnitude of catches of bigeye tuna reported. The red line indicates the (cumulative) proportion of catches of bigeye tuna for the countries concerned, over the total combined catches of this species reported from all countries and fisheries.

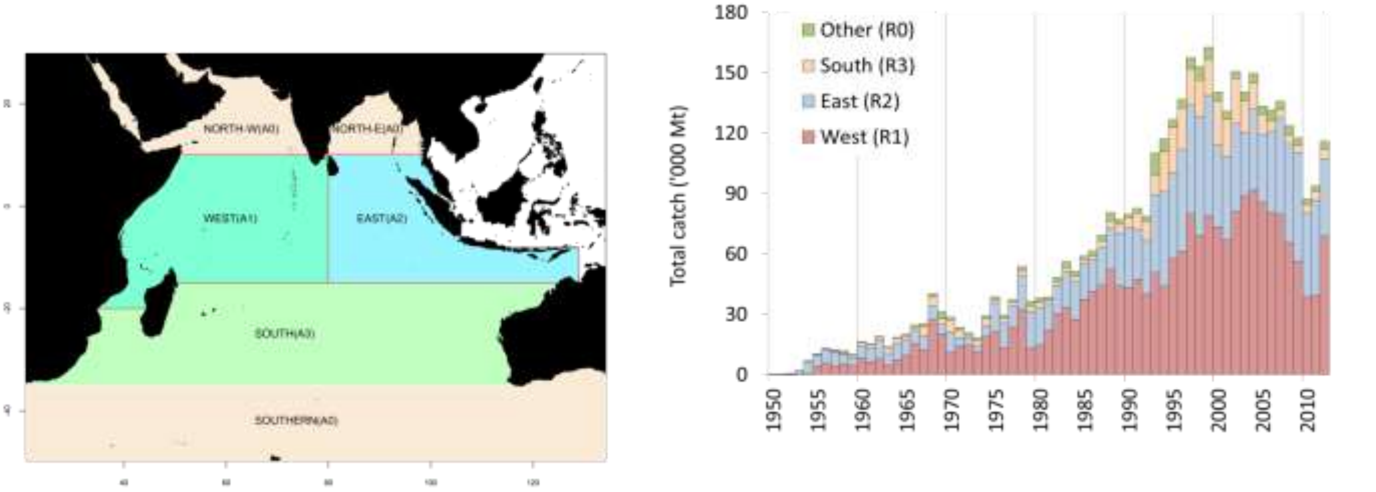


Fig. 3a–b. Bigeye tuna: Catches of bigeye tuna by area by year estimated for the WPTT (1950–2012) (Data as of September 2013). Catches outside the areas presented in the Map were assigned to the closest neighbouring area for the assessment. Areas: West Indian Ocean (A1); East Indian Ocean (A2); Southwest and Southeast Indian Ocean (A3); Other Areas (A0).

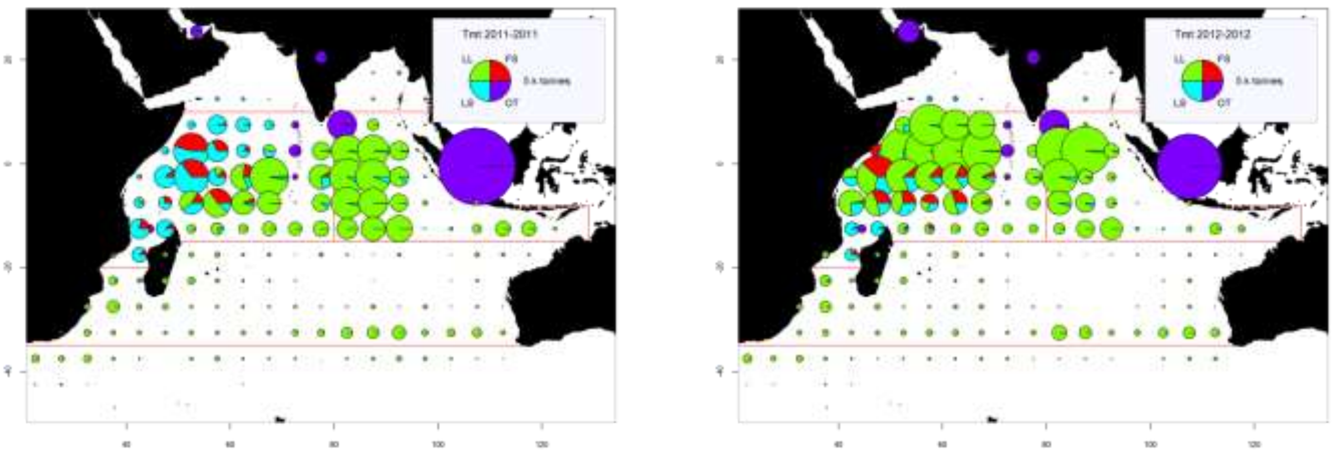


Fig. 4. Bigeye tuna: Time-area catches (total combined in tonnes) of bigeye tuna estimated for 2011 (left) and 2012 (right) by gear. Longline (**LL**), Purse seine free-schools (**FS**), Purse seine associated-schools (**LS**), and other fleets (**OT**), including pole-and-line, drifting gillnets, and various coastal fisheries. Data as of September 2013. The catches of fleets for which the flag countries do not report detailed time and area data to the IOTC are recorded within the area of the countries concerned, in particular driftnets from Iran, gillnet and longline fishery of Sri Lanka, and coastal fisheries of Indonesia.

Bigeye tuna – uncertainty of catches

Retained catches: Thought to be well known for the major fleets (Fig. 5); but are less certain for non-reporting industrial purse seiners and longliners (NEI) and for other industrial fisheries (e.g. longliners of India). Catches are also uncertain for some artisanal fisheries including the pole-and-line fishery in the Maldives, the gillnet fisheries of Iran (before 2012) and Pakistan, the gillnet and longline combination fishery in Sri Lanka and the artisanal fisheries in Indonesia, Comoros (before 2011) and Madagascar.

Discard levels: Believed to be low although they are unknown for most industrial fisheries, excluding industrial purse seiners flagged in EU countries for the period 2003–07.

Changes to the catch series: The catch history for bigeye tuna changed following reviews of the catches of Indonesia, Sri Lanka, and, to a lesser extent, other fisheries (EU,France, India, Pakistan). Overall, the best estimates of catch for the bigeye tuna are higher in 2013 than those used for the WPTT in 2012, with marked increases to the catches since the early 1990s. More details about the reviews are provided in paper IOTC–2013–WPTT15–07 Rev_1.

CPUE Series: Catch-and-effort data are generally available from the major industrial fisheries. However, these data are not available from some fisheries or they are considered to be of poor quality, especially throughout the 1990s and in recent years (Fig. 5), for the following reasons:

- non-reporting by industrial purse seiners and longliners (NEI)
- no data are available for the fresh-tuna longline fishery of Indonesia, over the entire time series, and data for the fresh-tuna longline fishery of Taiwan,China are only available since 2006
- uncertain data from significant fleets of industrial purse seiners from Iran and longliners from India, Indonesia, Malaysia, Oman, and Philippines.
- incomplete data for the driftnet fisheries of Iran and Pakistan and the gillnet/longline fishery of Sri Lanka, especially in recent years.

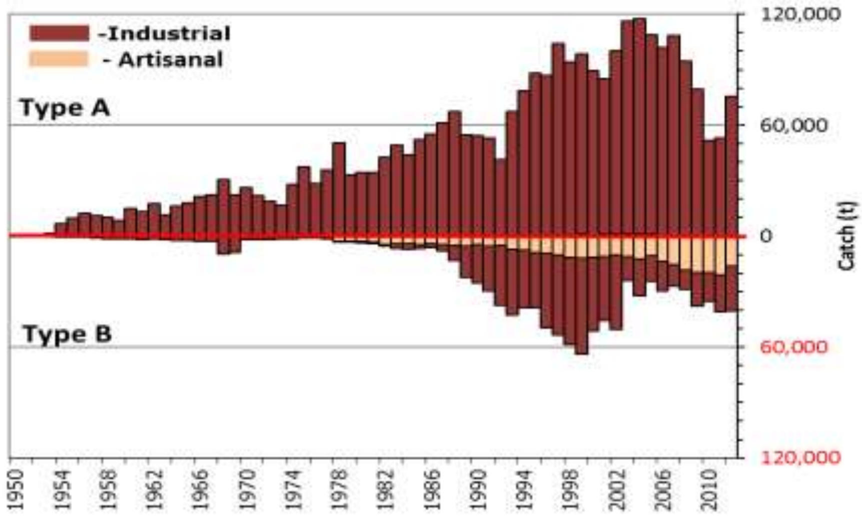


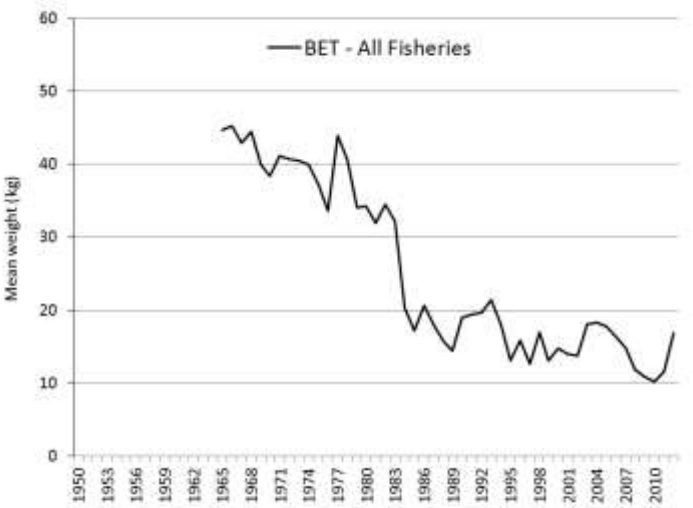
Fig. 5. Bigeye tuna: Uncertainty of annual catch estimates for bigeye tuna (Data as of September 2013). Catches below the zero-line (**Type B**) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by the IOTC Secretariat). Catches over the zero-line (**Type A**) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets.

Bigeye tuna: Fish size or age trends (e.g. by length, weight, sex and/or maturity)

Trends in average weight: Can be assessed for several industrial fisheries although they are incomplete or of poor quality for most fisheries before the mid-1980s and for some fleets in recent years (e.g. Japan and Taiwan,China longline) (Fig. 6).

Catch-at-Size table: This is available but the estimates are more uncertain for some years and some fisheries due to**):**

- the paucity of size data available from industrial longliners before the mid-60s, from the early-1970s up to the mid-1980s and in recent years (Japan and Taiwan,China)
- the paucity of catch by area data available for some industrial fleets (NEI, India, Indonesia, Iran, Sri Lanka)



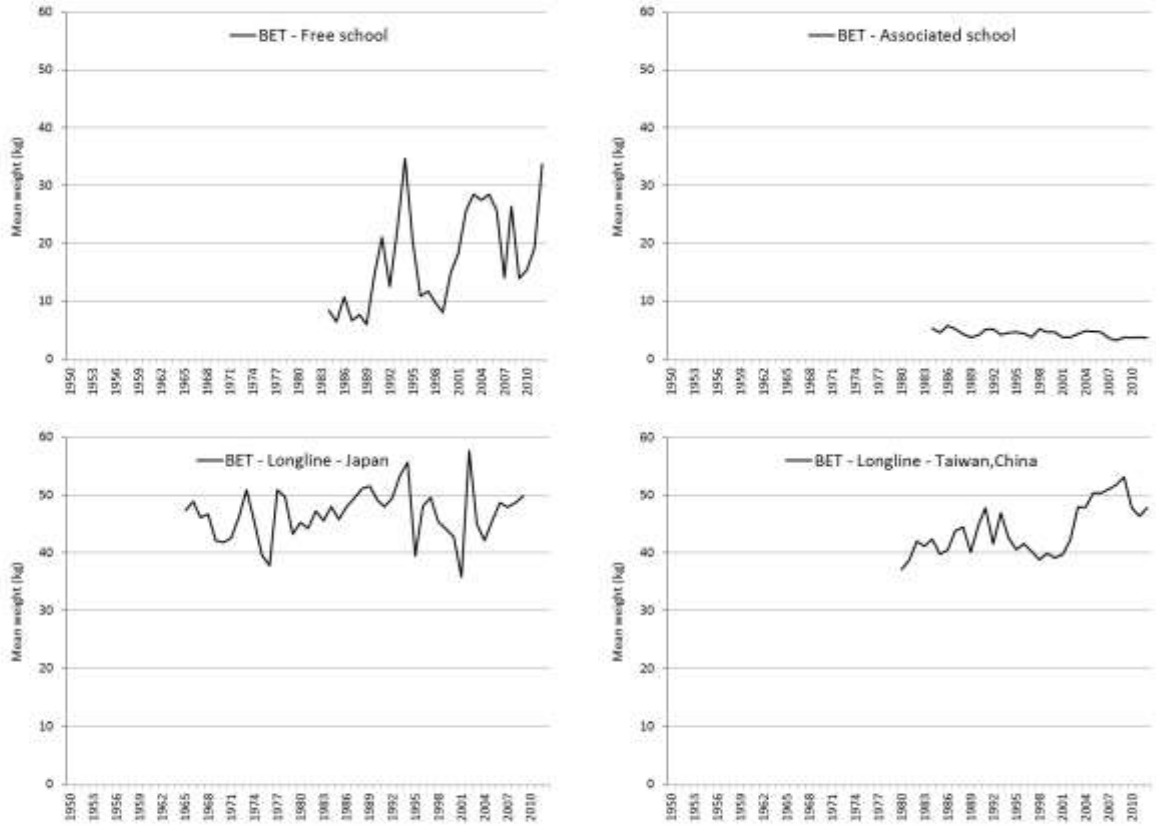


Fig. 6. Bigeye tuna: Changes in average weight (kg) of bigeye tuna from 1950 to 2012 – all fisheries combined (top) and by main fleet (Data as of September 2013).

Bigeye tuna – tagging data

A total of 35,997 bigeye tuna (17.9%) were tagged during the Indian Ocean Tuna Tagging Programme (IOTTP). Most of them (96.0%) were tagged during the main Regional Tuna Tagging Project-Indian Ocean (RTTP-IO) and released off the coast of Tanzania in the western Indian Ocean, between May 2005 and September 2007 (Fig. 7). The remaining were tagged during small-scale projects, and by other institutions with the support of the IOTC Secretariat, in the Maldives, India, and in the south west and the eastern Indian Ocean. To date, 5,789 specimens (16.1%) have been recovered and reported to the IOTC Secretariat. These tags were mainly reported from the purse seine fleets operating in the Indian Ocean (90.9%), while 5.2% were recovered from longline vessels.

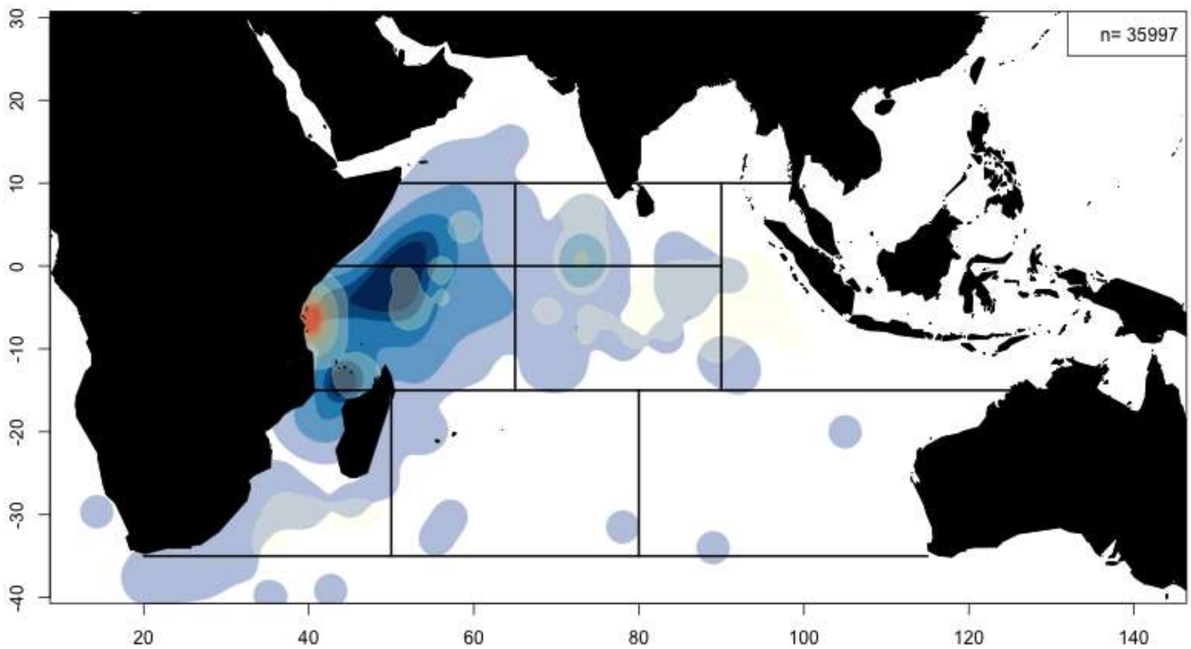


Fig. 7. Bigeye tuna: Densities of releases (in red) and recoveries (in blue) (Data as of September 2012).

Skipjack tuna (*Katsuwonus pelamis*)

Extracts from IOTC–2013–WPTT15–07 Rev_1

Skipjack tuna: Fisheries and catch trends

Catches of skipjack tuna increased slowly from the 1950s, reaching around 50,000 t during the mid-1970s, mainly due to the activities of fleets using pole-and-lines and gillnets (Table 1; Fig. 1). The catches increased rapidly with the arrival of purse seine vessels in the early 1980s, and skipjack tuna became one of the most important commercial tuna species in the Indian Ocean. Annual catches peaked at over 600,000 t in 2006 (Table 1; Fig. 1). Though preliminary, the catch levels estimated for 2012, at around 315,000 t, represent the lowest catches recorded since 1998.

The increase in skipjack tuna catches by purse seine vessels (Fig. 1) is due to the development of a fishery in association with Fish Aggregating Devices (FADs) (Table 1). In recent years, over 90% of the skipjack tuna caught by purse seine vessels is taken from around FADs (Table 1; Fig. 1). Catches by purse seine vessels increased steadily since 1984 with the highest catches recorded in 2002 and 2006 (>240,000 t). The catches dropped in the years 2003 and 2004, probably as a consequence of high purse seine catch rates on free schools of yellowfin tuna during those years. In 2007 purse seine catches declined by around 100,000 t, from those taken in 2006. The constant increase in catches and catch rates by purse seine vessels until 2006 are believed to be associated with increases in fishing power and in the number of FADs (and the technology associated with them) used in the fishery. The sharp decline in purse seine catches since 2007 coincided with a similar decline in the catches by Maldivian baitboats (pole-and-line).

Table 1. Skipjack tuna: Best scientific estimates of the catches of skipjack tuna (*Katsuwonus pelamis*) by gear and main fleets [or type of fishery] by decade (1950–2009) and year (2003–2012), in tonnes (Data as of September 2013). Catches by decade represent the average annual catch, noting that some gears were not used since the beginning of the fishery (refer to Fig. 1).

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
BB	10,007	15,148	24,684	41,705	77,079	109,081	114,060	111,833	138,652	147,428	106,605	98,923	75,199	82,971	68,886	67,573
FS	0	0	41	15,253	30,598	25,868	30,975	18,516	43,166	34,930	24,199	16,274	10,433	8,774	9,000	2,984
LS	0	0	125	34,472	124,032	163,656	179,930	137,282	168,018	211,509	120,951	128,448	148,135	144,097	123,056	80,989
OT	4,999	11,712	21,952	38,281	87,731	174,498	155,952	187,840	185,989	217,275	203,428	202,986	201,415	188,172	183,594	162,990
Total	**15,006**	**26,860**	**46,801**	**129,712**	**319,440**	**473,102**	**480,916**	**455,470**	**535,825**	**611,143**	**455,183**	**446,631**	**435,182**	**424,013**	**384,537**	**314,537**

Gears: Pole-and-Line (**BB**); Purse seine free-school (**FS**); Purse seine associated school (**LS**); Other gears nei (**OT**).

Table 2. Skipjack tuna: Best scientific estimates of the catches of skipjack tuna (*Katsuwonus pelamis*) by area [as used for the assessment] by decade (1950–2009) and year (2003–2012), in tonnes (Data as of September 2013). Catches by decade represent the average annual catch. The areas are present in Fig. 3a.

Areas/ Regions	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
R1	4,524	9,951	19,291	34,587	80,757	115,572	110,103	119,042	94,897	104,270	127,329	148,270	150,091	154,588	155,333	124,950
R2	10,483	16,910	27,511	95,126	238,683	357,530	370,814	336,428	440,928	506,873	327,853	298,361	285,091	269,426	229,205	189,586
Total	**15,006**	**26,860**	**46,801**	**129,712**	**319,440**	**473,102**	**480,916**	**455,470**	**535,825**	**611,143**	**455,183**	**446,631**	**435,182**	**424,013**	**384,537**	**314,537**

Areas: East Indian Ocean plus Maldives (**R1**); West Indian Ocean excluding Maldives (**R2**)

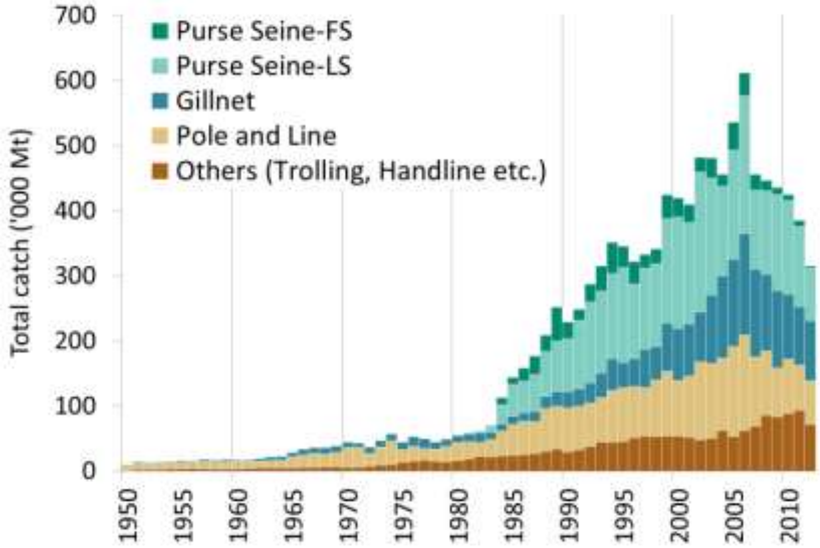


Fig. 1. Skipjack tuna: Annual catches of skipjack tuna by gear (1950–2012) (Data as of September 2013).

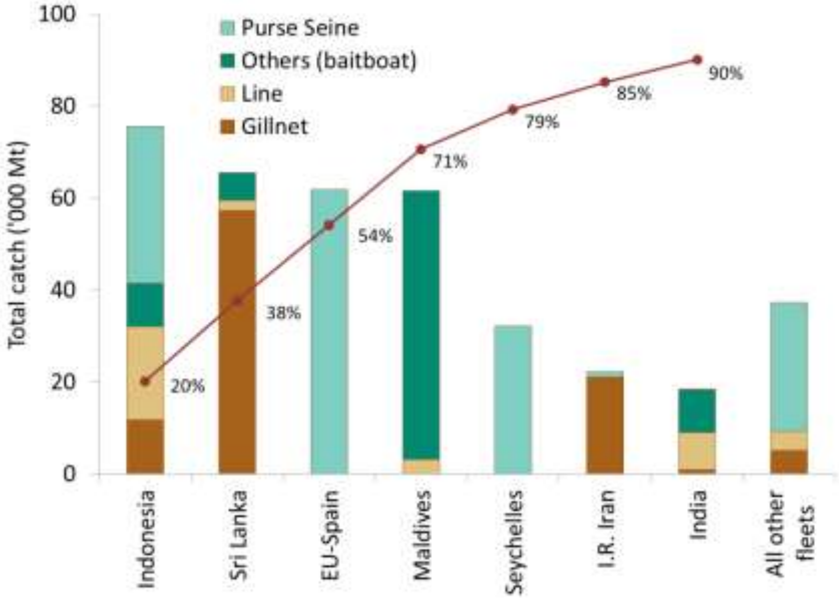


Fig. 2. Skipjack tuna: average catches in the Indian Ocean over the period 2009–12, by country (Data as of September 2013). Countries are ordered from left to right, according to the importance of catches of skipjack reported. The red line indicates the (cumulative) proportion of catches of skipjack for the countries concerned, over the total combined catches of this species reported from all countries and fisheries.

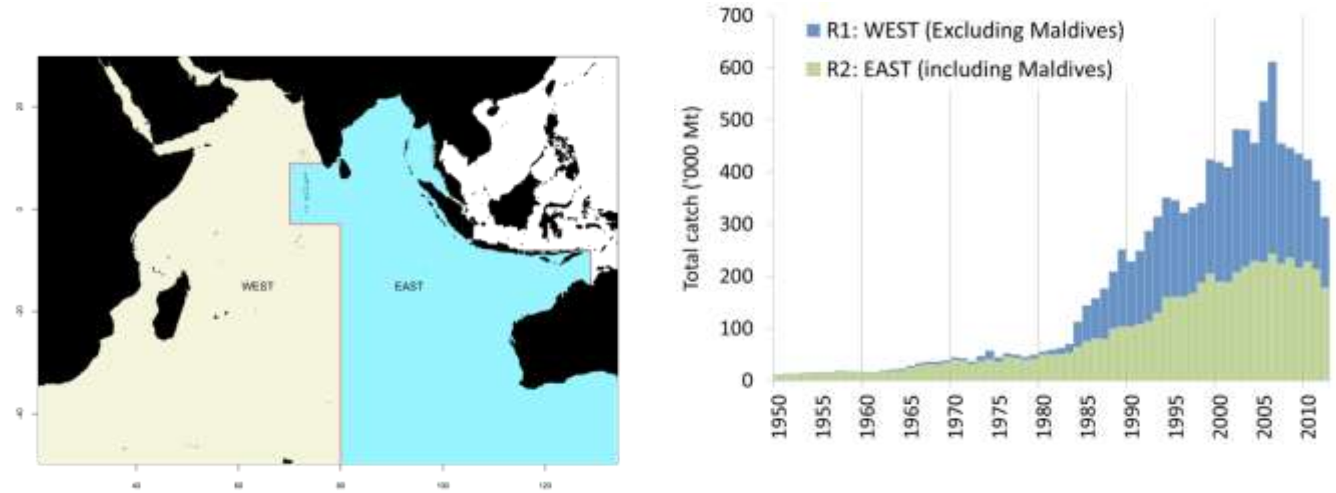


Fig. 3a–b. Skipjack tuna: Catches of skipjack tuna by area by year estimated for the WPTT (1950–2012) (Data as of September 2013). Areas: East Indian Ocean plus Maldives (R1); West Indian Ocean excluding Maldives (R2).

The Maldivian fishery has effectively increased its fishing effort with the mechanisation of its pole-and-line fleet since 1974, including an increase in boat size and power and the use of anchored FADs since 1981. Skipjack tuna represents some 80% of its total catch, and catch rates regularly increased between 1980 and 2006, the year in which the maximum catch was recorded for this fishery (≈140,000 t). The catches of skipjack tuna have declined since, with catches in recent years estimated to be at around 55,000 t, representing less than half the catches taken in 2006 and just 58% of the total catches of tropical tunas. In 2011 and 2012 Maldives reported high catches of yellowfin tuna following the development of handline fisheries for yellowfin tuna in the Maldives (Fig. 2).

Several fisheries using gillnets have reported large catches of skipjack tuna in the Indian Ocean (Fig. 2), including the gillnet/longline fishery of Sri Lanka, driftnet fisheries of I.R. Iran and Pakistan, and gillnet fisheries of India and Indonesia. In recent years gillnet catches have represented as much as 20 to 30 % of the total catches of skipjack tuna in the Indian Ocean. Although it is known that vessels from I.R. Iran and Sri Lanka (Figs. 3, 4) have been using gillnets on the high seas in recent years, reaching as far as the Mozambique Channel, the activities of these fleets are poorly understood, as no time-area catch-and-effort series have been made available for those fleets to date.

The majority of the catches of skipjack tuna originate from the western Indian Ocean (Table 2, Figs. 3b, 4). Since 2007 (Table 2) the catches of skipjack tuna in the western Indian Ocean have dropped considerably, especially in areas off Somalia, Kenya, Tanzania and around the Maldives. The drop in catches are considered by the SC to be partially explained by the drop in catch rates and fishing effort by some fisheries due to the effects of piracy in the western Indian Ocean region, including all industrial purse seine fleets, as well as those using driftnets from I.R. Iran (**Figs. 3, 4**) and Pakistan; and the drop in the catches of skipjack tuna by Maldives baitboats following the introduction of handlines to target large specimens of yellowfin tuna.

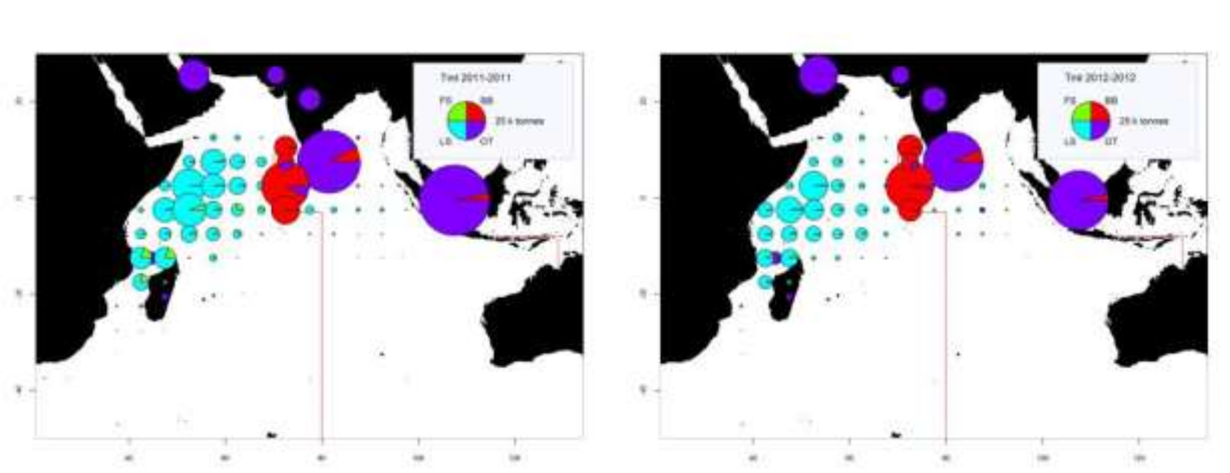


Fig. 4. Skipjack tuna: Time-area catches (total combined in tonnes) of skipjack tuna estimated for 2011 (left) and 2012 (right) by gear (Data as of September 2013). Purse seine free-schools (**FS**), Purse seine associated-schools (**LS**), pole-and-line (BB), and other fleets (**OT**), including longline, drifting gillnets, and various coastal fisheries. The catches of fleets for which the flag countries do not report detailed time and area data to the IOTC are recorded within the area of the countries concerned, in particular driftnets from Iran and Pakistan, gillnet and longline fishery of Sri Lanka, and coastal fisheries of Comoros, Indonesia and India.

Skipjack tuna – uncertainty of catches

Retained catches are generally well known for the industrial fisheries but are less certain for many artisanal fisheries (**Fig. 5**), notably because:

- catches are not being reported by species
- there is uncertainty about the catches from some significant fleets including the coastal fisheries of Sri Lanka, Comoros and Madagascar.

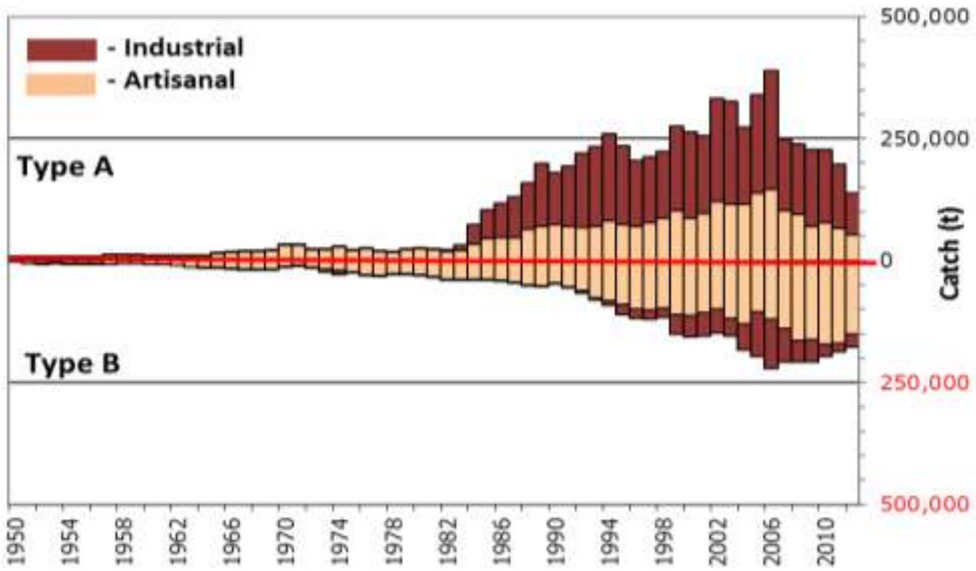


Fig. 5. Skipjack tuna: Uncertainty of annual catch estimates for skipjack tuna (Data as of September 2013). Catches below the zero-line (Type B) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document. Catches over the zero-line (Type A) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets.

Discard levels are believed to be low although they are unknown for most industrial fisheries, excluding industrial purse seine vessels flagged to EU countries for the period 2003–07.

Changes to the catch series: There have been no major changes to the catches of skipjack tuna, as a whole, since the WPTT in 2012. However, the IOTC Secretariat used new information compiled during 2012–13 to rebuild the catch series for the coastal fisheries operated in some countries, in particular Indonesia and India. In general, the new catches of skipjack tuna estimated by the IOTC Secretariat are lower than those used in the past by the WPTT. More details about these reviews can be found in paper IOTC–2013–WPTT15–07 Rev_1.

CPUE Series: Catch and effort data are available from various industrial and artisanal fisheries. However, these data are not available from some important fisheries or they are considered to be of poor quality for the following reasons:

- insufficient data available for the gillnet fisheries of I.R. Iran and Pakistan
- the poor quality effort data for the gillnet/longline fishery of Sri Lanka
- no data are available from important coastal fisheries using hand and/or troll lines, in particular Indonesia, India and Madagascar.

Skipjack tuna: Fish size or age trends (e.g. by length, weight, sex and/or maturity)

Trends in average weight cannot be assessed before the mid-1980s (Fig. 6) and are incomplete for most artisanal fisheries thereinafter, namely hand lines, troll lines and many gillnet fisheries (Indonesia).

Catch-at-Size table: CAS are available but the estimates are uncertain for some years and fisheries due to:

- the lack of size data before the mid-1980s
- the paucity of size data available for some artisanal fisheries, notably most hand lines and troll lines (Madagascar, Comoros) and many gillnet fisheries (Indonesia, Sri Lanka).

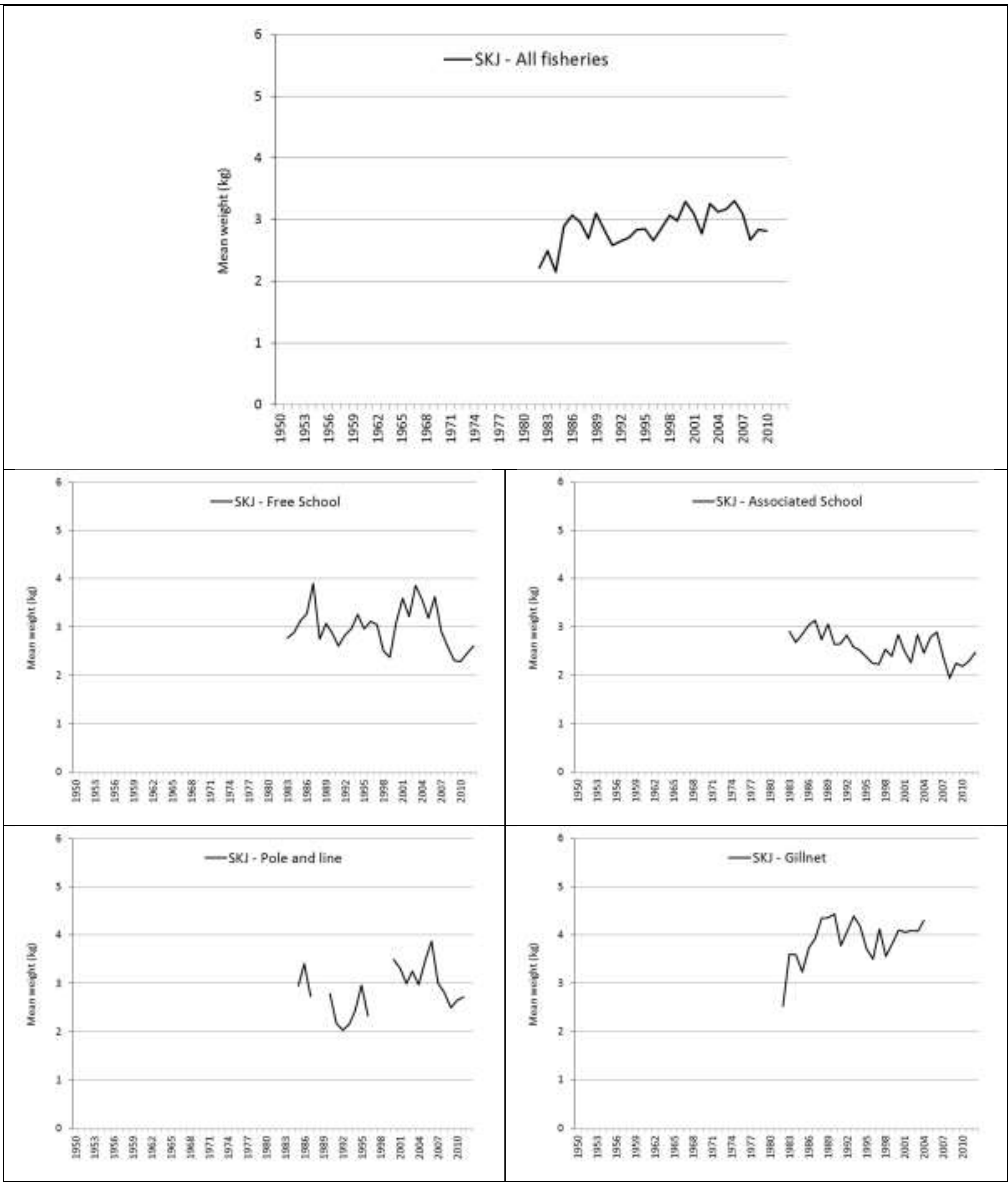


Fig. 6. Skipjack tuna: Changes in average weight (kg) of skipjack tuna from 1950 to 2012 – all fisheries combined (top) and by main fleet (Data as of September 2013).

Skipjack tuna – Tagging data

A total of 101,212 skipjack tuna (representing 50.2% of the total number of fish tagged) were tagged during the Indian Ocean Tuna Tagging Programme (IOTTP). Most of them, 77.4%, were released during the main Regional Tuna Tagging Project-Indian Ocean (RTTP-IO) and were released around Seychelles, in the Mozambique Channel and off the coast of Tanzania, between May 2005 and September 2007 (Fig. 7). The remaining were tagged during small-scale tagging projects, and by other institutions with the support of IOTC, around the Maldives, India, and in the south west and the eastern Indian Ocean. To date, 17,688 specimens (17.5%), have been recovered and reported to the IOTC Secretariat. Around 69.5% of the recoveries were from the purse seine fleets operating from the Seychelles, and around 28.9% by the pole-and-line vessels mainly operating from the Maldives. The addition of the data from the past projects in the Maldives (in 1990s) added 14,506 tagged skipjack tuna to the databases, or which 1,960 were recovered mainly in the Maldives.

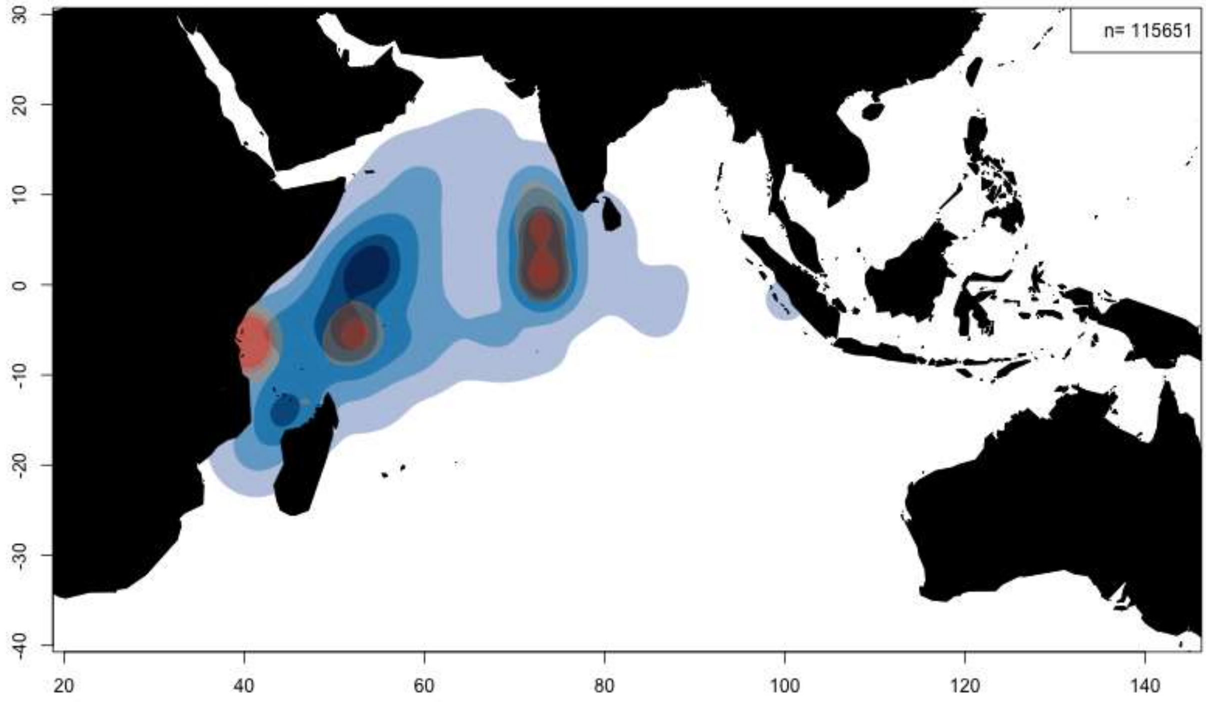


Fig. 7. Skipjack tuna: Densities of releases (in red) and recoveries (in blue) (Data as of September 2012).

Yellowfin tuna *(Thunnus albacares)*

Yellowfin tuna – Fisheries and catch trends

Catches by gear, area, country and year from 1950 to 2012 are shown in Tables 1, 2; Figs. 1, 2, 3 and 4. Contrary to the situation in other oceans, the artisanal fishery component in the Indian Ocean is substantial, taking 20–30% of the total catch. Catches of yellowfin tuna (Table 1; Fig. 1) remained more or less stable between the mid-1950s and the early-1980s, ranging between 30,000 and 70,000 t, owing to the activities of longline vessels and, to a lesser extent, gillnet vessels. The catches increased rapidly with the arrival of the purse seiners in the early 1980s and increased activity of longliners and other fleets, reaching over 400,000 t in 1993. Catches of yellowfin tuna between 1994 and 2002 remained stable, between 330,000 and 350,000 t. Yellowfin tuna catches during 2003, 2004, 2005 and 2006 were much higher than in previous years with the highest catches ever recorded in 2004 (over 525,000 t) and average annual catch for the period at around 480,000 t. Yellowfin tuna catches dropped markedly after 2006, with the lowest catches recorded in 2009. Catch levels in 2012 are estimated to be at around 370,000 t, although they represent preliminary figures.

TABLE 1. Yellowfin tuna: Best scientific estimates of the catches of yellowfin tuna (*Thunnus albacares*) by gear and main fleets [or type of fishery] by decade (1950–2009) and year (2003–2012), in tonnes (Data as of September 2013). Catches by decade represent the average annual catch, noting that some gears were not used since the beginning of the fishery (refer to Fig. 1).

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
FS	-	-	18	31,561	64,974	89,377	136,881	168,392	123,998	85,044	53,526	74,985	36,049	32,135	36,453	64,593
LS	-	-	17	17,610	56,275	61,719	87,015	59,655	69,878	74,612	43,778	41,546	51,351	73,383	76,659	66,166
LL	21,990	41,250	29,493	34,090	71,557	70,227	70,225	99,768	130,993	88,365	65,490	39,354	36,552	37,073	33,957	40,756
LF	-	-	615	4,286	47,571	34,150	31,162	32,938	35,949	31,752	33,302	34,342	23,125	21,501	21,267	23,366
BB	2,111	2,318	5,810	8,295	12,805	16,061	17,277	15,876	16,734	18,017	16,268	18,326	16,819	14,105	14,016	15,386
GI	1,572	4,116	7,838	11,899	39,421	49,388	53,769	74,160	61,257	62,601	43,412	48,011	42,822	50,772	50,448	59,902
HD	728	1,779	4,772	11,488	26,073	42,737	43,768	52,447	47,288	40,898	40,961	41,163	37,160	43,398	66,347	70,797
TR	1,102	1,981	4,335	6,946	11,628	16,124	12,979	20,929	16,793	18,235	19,715	18,814	16,822	19,968	20,424	21,444

OT	80	193	453	1,844	3,318	5,055	4,012	4,631	4,220	5,294	5,897	7,060	7,071	7,665	7,919	6,253
Total	**27,583**	**51,637**	**53,351**	**128,019**	**333,622**	**384,838**	**457,089**	**528,797**	**507,111**	**424,819**	**322,349**	**323,602**	**267,771**	**300,000**	**327,490**	**368,663**

Gears: Purse seine free-school (**FS**); Purse seine associated school (**LS**); Deep-freezing longline (**LL**); Fresh-tuna longline (**FL**); Pole-and-Line (**BB**); Gillnet (**GI**); Hand line (**HD**); Trolling (**TR**); Other gears nei (**OT**).

TABLE 2. Yellowfin tuna: Best scientific estimates of the catches of yellowfin tuna (*Thunnus albacares*) by area by decade (1950–2009) and year (2003–2012), in tonnes (Data as of September 2013). Catches by decade represent the average annual catch. The areas are presented in Fig. 3a.

Area / Region	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
R1	2,146	4,715	6,951	16,783	74,549	86,730	82,305	125,641	129,465	108,572	80,564	74,481	59,642	65,334	77,905	89,020
R2	11,226	23,066	21,208	71,695	138,278	180,825	262,313	271,608	248,766	199,399	128,041	137,320	104,423	124,456	146,643	178,394
R3	844	7,516	5,892	9,592	23,974	24,750	22,968	27,389	25,591	24,770	24,617	21,297	20,063	19,565	20,159	19,365
R4	917	1,785	1,415	1,257	8,298	6,244	10,032	9,079	7,121	4,485	1,682	1,755	1,438	1,981	1,123	3,087
R5	11,253	13,226	16,074	22,606	67,947	61,369	54,882	69,154	65,387	67,863	62,446	57,492	66,764	62,458	57,007	57,978
R0 (North)	1,195	1,305	1,796	6,053	20,533	24,896	24,554	25,898	30,730	19,726	24,996	31,253	15,433	26,196	24,639	20,817
R0 (Other)	1	24	15	32	43	24	34	29	51	5	2	5	7	10	13	2
Total	**27,583**	**51,637**	**53,351**	**128,019**	**333,622**	**384,838**	**457,089**	**528,797**	**507,111**	**424,819**	**322,349**	**323,602**	**267,771**	**300,000**	**327,490**	**368,663**

Areas: Arabian Sea (**R1**); Off Somalia (**R2**); Mozambique Channel (**R3**); South Indian Ocean (**R4**); East Indian Ocean (**R5**); Bay of Bengal (**R0(North)**); Other Area (**R0(Other)**)

Although some Japanese purse seine vessels have fished in the Indian Ocean since 1977, the purse seine (Fig. 1) fishery developed rapidly with the arrival of European vessels between 1982 and 1984. Since then, there has been an increasing number of yellowfin tuna caught, with a larger proportion of the catches made of adult fish, as opposed to bigeye tuna catches, of which the majority refers to juvenile fish. Purse seine vessels typically take fish ranging from 40 to 140 cm fork length (FL) and smaller fish are more common in the catches taken north of the equator. Catches of yellowfin tuna increased rapidly to around 130,000 t in 1993, and subsequently they fluctuated around that level, until 2003–05 when they were substantially higher (over or close to 200,000 t). The amount of effort exerted by the EU purse seine vessels (fishing for yellowfin tuna and other tunas) varies seasonally and from year to year.

The purse seine fishery is characterised by the use of two different fishing modes (Table 1; Figs. 1, 2 and 4). The fishery on floating objects (FADs), catches large numbers of small yellowfin tuna in association with skipjack tuna and juvenile bigeye tuna, and a fishery on free swimming schools, catches larger yellowfin tuna on multi-specific or mono-specific sets. Between 1995 and 2003, the FAD component of the purse seine fishery represented 48–66% of the sets undertaken (60–80% of the positive sets) and accounted for 36–63% of the yellowfin tuna catch by weight (59–76% of the total catch). The proportion of yellowfin tuna caught (in weight) on free-schools during 2003–06 (64%) was much higher than in previous or following years (at around 50%).

The longline fishery (Table 1; Fig. 1) started in the early 1950’s and expanded rapidly over throughout the Indian Ocean. Longline vessels mainly catch large fish, from 80 to 160 cm FL, although smaller fish in the size range 60 cm – 100 cm (FL) have been taken by longliners from Taiwan,China since 1989 in the Arabian Sea. The longline fishery targets several tuna species in different parts of the Indian Ocean, with yellowfin tuna and bigeye tuna being the main target species in tropical waters. The longline fishery can be subdivided into a deep-freezing longline component (large scale deep-freezing longliners operating on the high seas from Japan, Korea and Taiwan,China) and a fresh-tuna longline component (small to medium scale fresh tuna longliners from Indonesia and Taiwan,China). The total longline catch of yellowfin tuna reached a maximum in 1993 (≈200,000 t). Catches between 1994 and 2004 fluctuated between 85,000 t and 130,000 t. The second highest catches of yellowfin tuna by longline vessels were recorded in 2005 (≈165,000 t). As was the case for the purse seine fleets, since 2005 longline catches have declined with current catches estimated to be at around 60,000 t, representing a two-fold decrease from the catches taken in 2005. The Scientific Committee believes that the recent drop in longline catches could be related, at least in part, with the expansion of piracy in the northwest Indian Ocean, which led to a marked drop in the levels of longline effort in one of the core fishing areas of the species (Fig. 4).

Catches by other gears, namely pole-and-line, gillnet, troll, hand line and other minor gears, have increased steadily since the 1980s (Table 1; Figs. 1). In recent years the total artisanal yellowfin tuna catch has been around 140,000–160,000 t, with the catch by gillnets (the dominant artisanal gear) at around 50,000 t. During the years 2004 and then in 2012 the catches by artisanal gears attained its maximum over the time series, peaking at 165,000 t and 170,000 t, respectively.

Yellowfin tuna catches in the Indian Ocean during 2003, 2004, 2005 and 2006 were much higher than in previous years (Fig. 1), while bigeye tuna catches remained at their average levels. Purse seine vessels currently take the bulk of the yellowfin tuna catch, mostly from the western Indian Ocean, around Seychelles (Tables 1, 2; Fig. 4; Off Somalia (R2) and Mozambique Channel (R3) (Figs. 3, 4). In 2003 and 2004, total catches by purse seine vessels in this area were around 225,000 t — about 50% more than the previous largest purse seine catch, which was recorded in 1995. Similarly, artisanal yellowfin tuna catches have been near their highest levels and longline vessels have reported higher than normal catches in the tropical western Indian Ocean during this period.

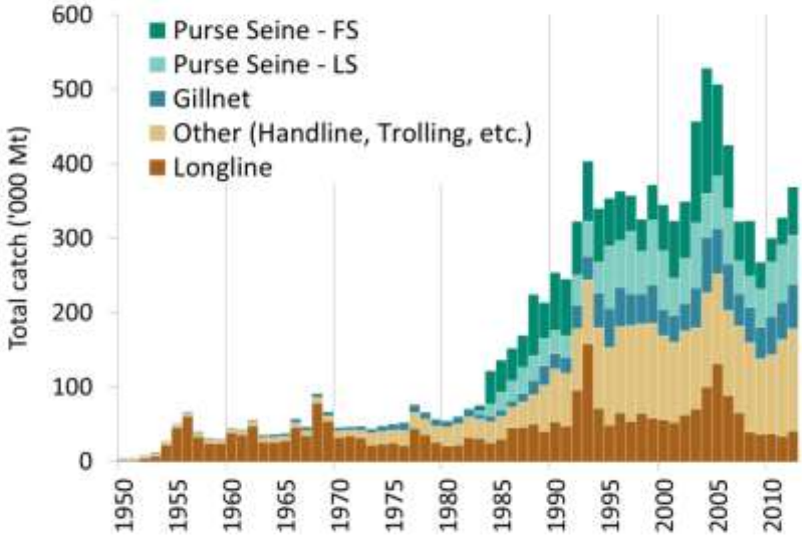


Fig. 1. Yellowfin tuna: Catches of yellowfin tuna by gear by year estimated for the WPTT (1950–2012) (Data as of September 2013). Purse seine free-school (FS); Purse seine associated school (LS).

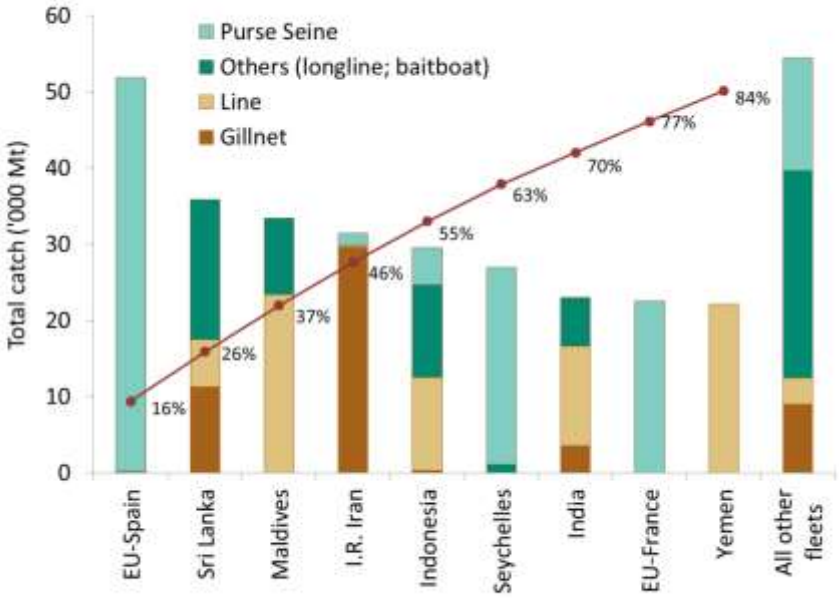


Fig. 2. Yellowfin tuna: average catches in the Indian Ocean over the period 2009–12, by country (Data as of September 2013). Countries are ordered from left to right, according to the importance of catches of yellowfin reported. The red line indicates the (cumulative) proportion of catches of yellowfin for the countries concerned, over the total combined catches of this species reported from all countries and fisheries.

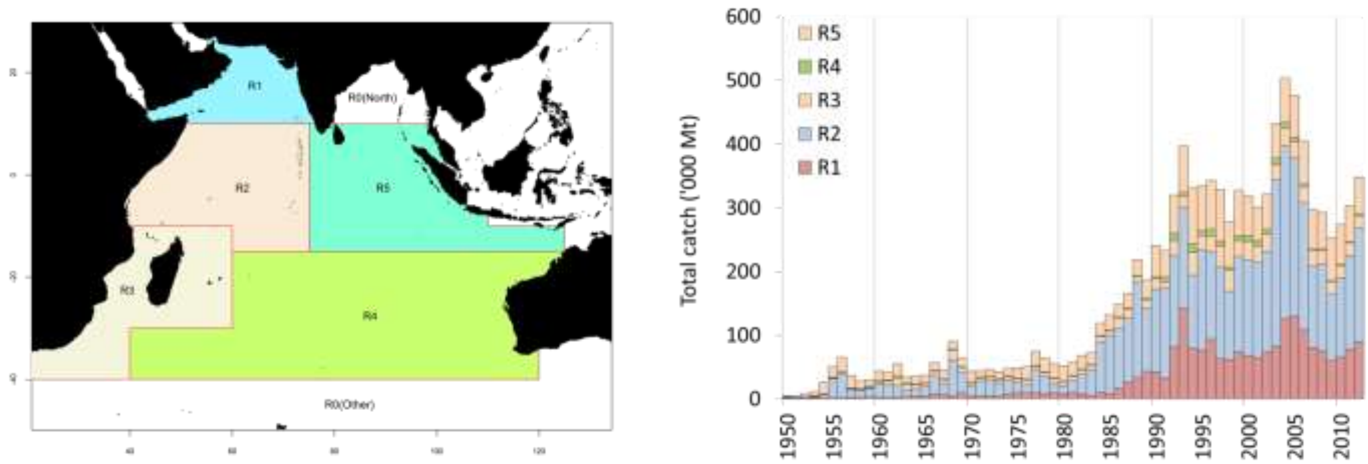


Fig. 3a–b. Yellowfin tuna: Catches of yellowfin tuna by area by year estimated for the WPTT (1950–2012) (Data as of September 2013). Catches in areas R0 were assigned to the closest neighbouring area for the assessment. Areas: Arabian Sea (R1); Off Somalia (R2); Mozambique Channel (R3); South Indian Ocean (R4); East Indian Ocean (R5); Bay of Bengal (R0(North)); Other Area (R0(Other)).

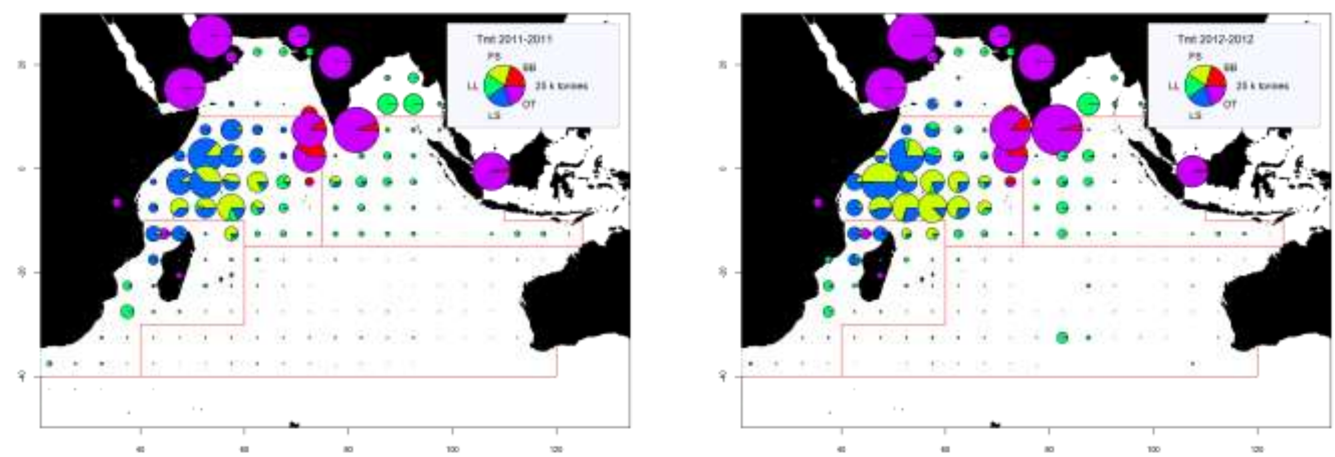


Fig. 4a–b. Yellowfin tuna: Time-area catches (total combined in tonnes) of yellowfin tuna estimated for 2011 and 2012, by type of gear (Data as of September 2013). Longline (LL), Purse seine free-schools (FS), Purse seine associated-schools (LS), pole-and-line (BB), and other fleets (OT), including drifting gillnets, and various coastal fisheries. The catches of fleets for which the flag countries do not report detailed time and area data to the IOTC are recorded within the area of the countries concerned, in particular driftnets from Iran and Pakistan, gillnet and longline fishery of Sri Lanka, and coastal fisheries of Yemen, Oman, Comoros, Indonesia and India.

In recent years the catches of yellowfin tuna in the western Indian Ocean have dropped considerably, especially in areas off Somalia, Kenya and Tanzania and in particular between 2007 and 2011 (**Figs. 3, 4**). The drop in catches is the consequence of a drop in fishing effort due to the effect of piracy in the western Indian Ocean region. Even though the activities of purse seiners have been affected by piracy in the Indian Ocean, the effects have not been as marked as with longliners, for which current levels of effort are close to nil in the area impacted by piracy. The main reason for this is the presence of security personnel onboard purse seine vessels of the EU and Seychelles, which has made it possible for purse seiners under these flags to continue operating in the northwest Indian Ocean. Longline effort levels in the western tropical area have increased in 2012, as a consequence of increased security in the region.

Yellowfin tuna – uncertainty of catches

Retained catches are generally well known (Fig. 5); however, catches are less certain for:

- many coastal fisheries, notably those from Indonesia, Sri Lanka, Yemen, and Madagascar
- the gillnet fishery of Pakistan
- non-reporting industrial purse seiners and longliners (NEI), and longliners of India.

Discard levels are believed to be low although they are unknown for most industrial fisheries, excluding industrial purse seiners flagged in EU countries for the period 2003–2007.

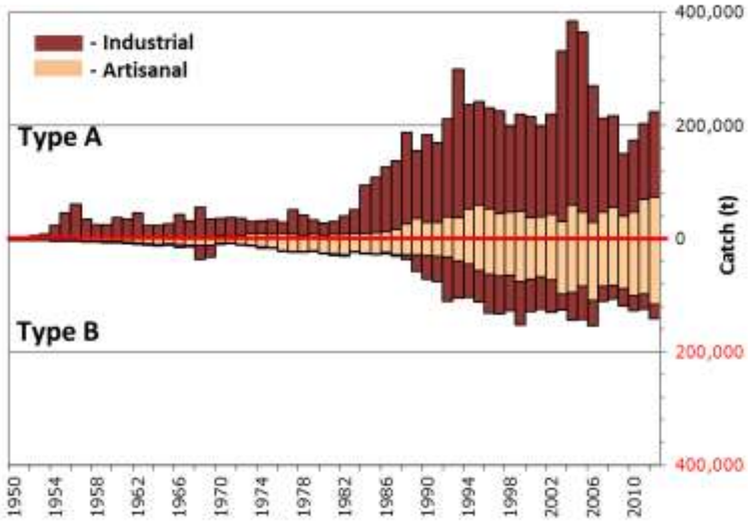


Fig. 5. Yellowfin tuna: Uncertainty of annual catch estimates for yellowfin tuna (Data as of September 2013). Catches below the zero-line (**Type B**) refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat), do not report catch data by gear and/or species (broken by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document. Catches over the zero-line (**Type A**) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets.

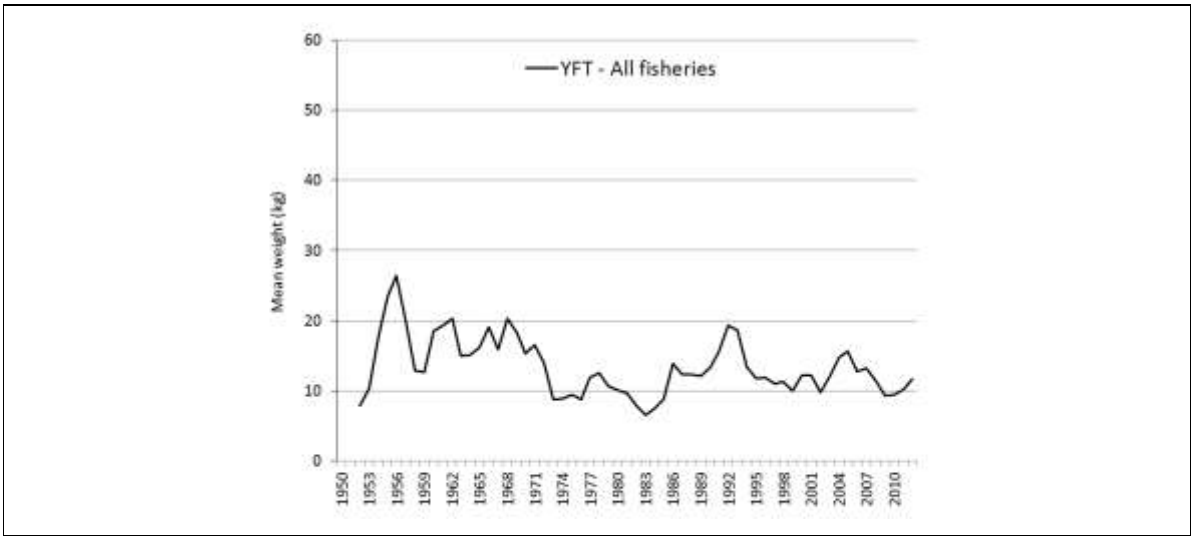
Changes to the catch series: There have not been significant changes to the total catches of yellowfin tuna since the WPTT in 2011. However, the IOTC Secretariat used new information compiled during 2012–13 to rebuild the catch series for the coastal fisheries operated in some countries, in particular Pakistan, Indonesia, Sri Lanka, and India. In general, the new catches of yellowfin tuna estimated by the IOTC Secretariat are slightly higher than those used in the past by the WPTT. More details about these reviews can be found in paper IOTC–2013–WPTT15–07 Rev_1.

CPUE Series: Catch-and-effort data are available from the major industrial and artisanal fisheries. However, these data are not available for some important fisheries or they are considered to be of poor quality for the following reasons:

- no data are available for the fresh-tuna longline fishery of Indonesia, over the entire time series, and data for the fresh-tuna longline fishery of Taiwan,China are only available since 2006
- insufficient data for the gillnet fisheries of Iran and Pakistan
- the poor quality effort data for the significant gillnet/longline fishery of Sri Lanka
- no data are available from important coastal fisheries using hand and/or troll lines, in particular Yemen, Indonesia, and Madagascar.

Yellowfin tuna – Fish size or age trends (e.g. by length, weight, sex and/or maturity)

Trends in average weight can be assessed for several industrial fisheries (Fig. 6) but they are very incomplete or of poor quality for some fisheries, namely hand lines (Yemen, Comoros, Madagascar), troll lines (Indonesia) and many gillnet fisheries.



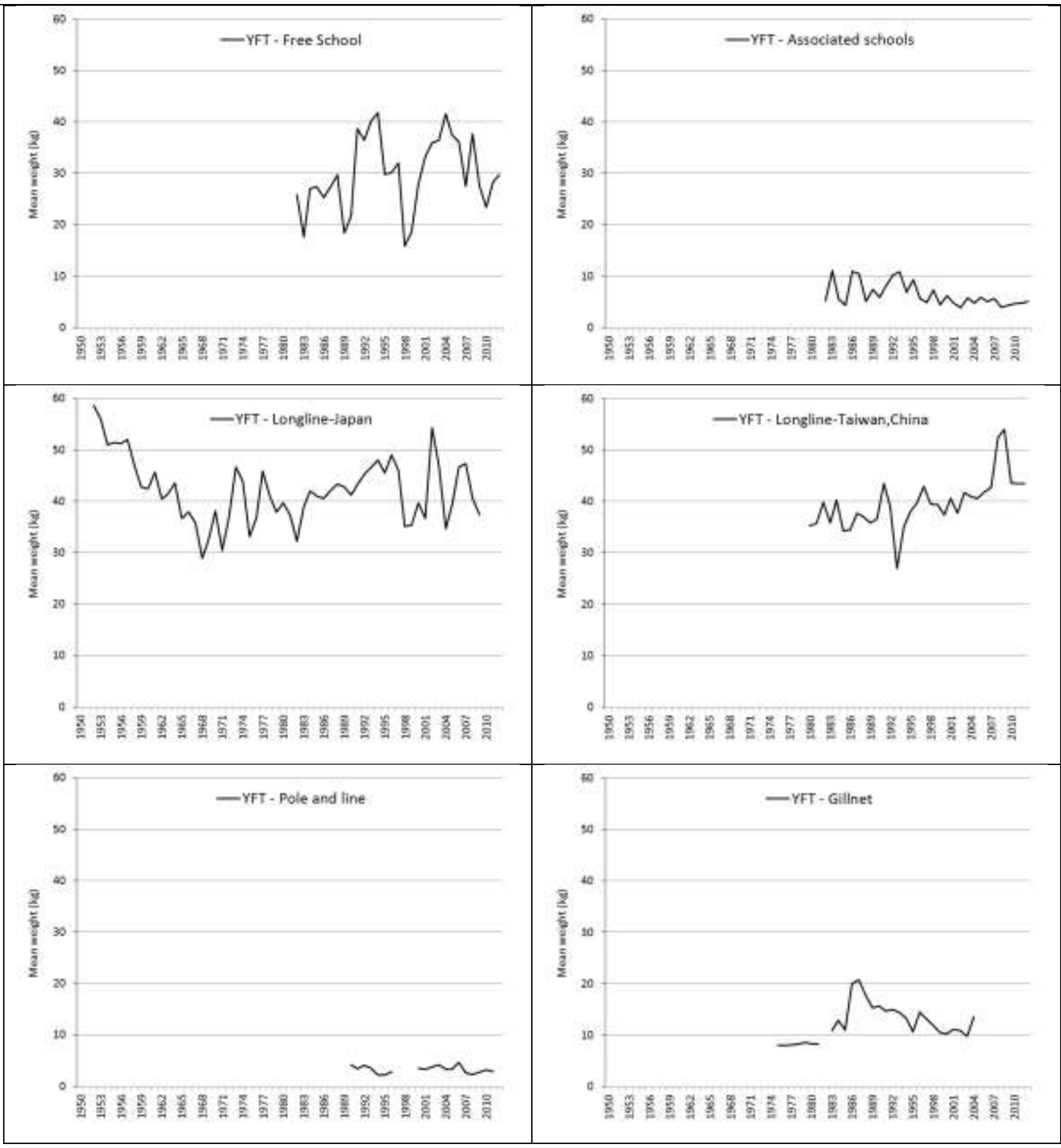


Fig. 6. Yellowfin tuna: Changes in average weight (kg) of yellowfin tuna from 1950 to 2012 – all fisheries combined (top) and by main fleet (Data as of September 2013).

Catch-at-Size table: This is available although the estimates are more uncertain in some years and some fisheries due to:

- size data not being available from important fisheries, notably Yemen, Pakistan, Sri Lanka and Indonesia (lines and gillnets) and Comoros and Madagascar (lines)
- the paucity of size data available from industrial longliners from the late-1960s up to the mid-1980s, and in recent years (Japan and Taiwan,China)
- the paucity of catch by area data available for some industrial fleets (NEI, Iran, India, Indonesia, Malaysia).

Yellowfin tuna – tagging data

A total of 63,328 yellowfin tuna (representing 31.4% of the total number of specimens tagged) were tagged during the Indian Ocean Tuna Tagging Programme (IOTTP). Most of them (86.4%) were released during the main Regional Tuna Tagging Project-Indian Ocean (RTTP-IO) and were released around Seychelles, in the Mozambique Channel, along the coast of Oman and off the coast of Tanzania, between May 2005 and September 2007 (Fig. 7). The remaining were tagged during small-scale tagging projects, and by other institutions with the support of IOTC Secretariat, in Maldives, India, and in the south west and the eastern Indian Ocean. To date, 10,834 specimens (17.1%), have been recovered and reported to the IOTC Secretariat. More than 85.9% of these recoveries we made by the purse seine fleets operating in the Indian Ocean, while around 9.1% were made by pole-and-line and less than 1% by longline vessels. The addition of the data from the past projects in the Maldives (in 1990s) added 3,211 tagged yellowfin tuna to the databases, or which 151 were recovered, mainly from the Maldives.

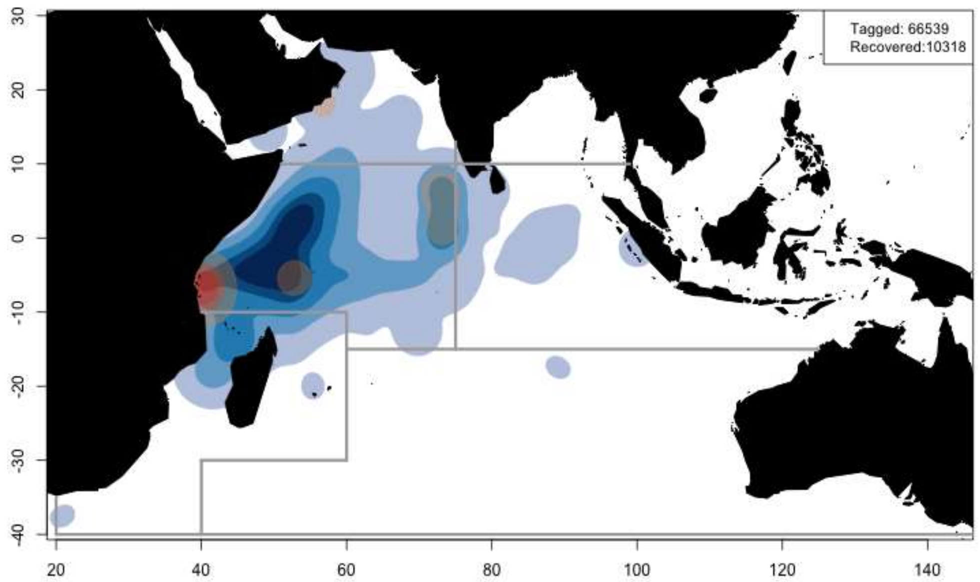


Fig. 7. Yellowfin tuna: Densities of releases (in red) and recoveries (in blue). The red line represents the stock assessment areas (Data as of September 2012).

APPENDIX VI

MAIN ISSUES IDENTIFIED RELATING TO THE STATISTICS OF TROPICAL TUNAS

Extract from IOTC–2013–WPTT15–07 Rev_1

The following list is provided by the IOTC Secretariat for the consideration of the WPTT. The list covers the main issues which the Secretariat considers affect the quality of the statistics available at the IOTC, by type of dataset and type of fishery.

1. Catch-and-Effort data from Coastal Fisheries:

- **Drifting gillnet** fishery of **Iran**: In 2013 I.R. Iran reported catches of bigeye tuna for its drifting gillnet fishery for the first time, for the year 2012. Although I.R. Iran has reported catches of yellowfin tuna and skipjack tuna (average catches at around 60,000 t during 2008–12) it has not reported catch-and-effort data as per the IOTC standards, in particular for those vessels that operate outside of its EEZ. The IOTC Secretariat estimated caches of bigeye tuna for Iran for years before 2012, assuming various levels of activity of vessels using driftnets on the high seas, depending on the year, and catch ratios bigeye tuna:yellowfin tuna recorded for industrial purse seiners on free-swimming tuna schools in the northwest Indian Ocean. Catches of bigeye tuna were estimated for the period 2005–11, with average catches estimated at around 700 t per year.
- **Drifting gillnet** fishery of **Pakistan**: To date, Pakistan have not reported catches of bigeye tuna for its gillnet fishery, although a component of the fleet is known to operate on the high seas, where catches of bigeye tuna are reported by other fleets operating the same area. In addition, Pakistan has not reported catch-and-effort data for its drifting gillnet fishery, in particular for those vessels that operate outside its EEZ. The IOTC Secretariat did not estimate catches of bigeye tuna for Pakistan. Pakistan reported catches of yellowfin tuna and skipjack tuna at around 9,000 t per year during 2008–12.
- **Gillnet/longline** fishery of **Sri Lanka**: Although Sri Lanka has reported catches of bigeye tuna for its gillnet/longline fishery the catches are considered to be too low (average catches at around 560 t during 2008–12). This is probably due to the mislabelling of catches of bigeye tuna as yellowfin tuna. The IOTC Secretariat estimated caches of bigeye tuna for Sri Lanka in 2012 with recent catches estimated at around 2,100 t per year. In addition, Sri Lanka has not reported catch-and-effort data as per the IOTC standards, including separate catch-and-effort data for longline and gillnet and catch-and-effort data for those vessels that operate outside its EEZ.
- **Pole-and-line** fishery of **Maldives**: Although the pole-and-line fishery of Maldives does catch bigeye tuna, both yellowfin tuna and bigeye tuna are reported aggregated, as yellowfin tuna. The IOTC Secretariat used the proportion of bigeye tuna in samples collected in the Maldives in the past to break the catches of yellowfin tuna, which in fact represent the combined catches of the two species, into yellowfin tuna and bigeye tuna, per year, with average catches of bigeye tuna estimated at around 850 t per year. Maldives has not reported catch-and-effort data by gear type and geographic area for 2002–03[2].
- **Coastal** fisheries of **Indonesia, Madagascar, Sri Lanka[3]** (other than gillnet/longline) and **Yemen**: The catches of tropical tunas for these fisheries have been estimated by the IOTC Secretariat in recent years (total average catches of tropical tunas for the period 2008-12 amount to over 140,000 t per year, especially skipjack tuna). The quality of the estimates is thought to be very poor due to the paucity of the information available about the fisheries operating in these countries.
- **Coastal** fisheries of **Comoros:** In 2011-12 the IOTC and the OFCF provided support to the strengthening of data collection for the fisheries of Comoros, including a Census of fishing boats and the implementation of sampling to monitor the catches unloaded by the fisheries in selected locations over the coast. The IOTC Secretariat and the *Centre National de resources Halieutiques* of Comoros derived estimates of catch using the data collected and the new catches estimated are at around half the values reported in the past by Comoros (around 5,000 t per year instead of 9,000 t). The IOTC Secretariat revised estimates of catch for the period 1995-2010 using the new estimates.

[2] It is important to note that Maldives has used the available catch-and-effort data to derive CPUE indices for its pole-and-line fishery, and have undertaken preliminary assessments of skipjack tuna in cooperation with the IOTC Secretariat, presented at the WPTT in 2011. In addition, in October 2012 Maldives provided catch-and-effort data for its pole-and-line fishery for the period 2004–11.

[3] In 2012–13 the Ministry of Fisheries and Aquatic Resources Development of Sri Lanka received support from IOTC, the OFCF and BOBLME to strengthen its data collection and processing system, which will make it possible to derive estimates of catch for the coastal fisheries of Sri Lanka for 2012 and following years.

2. **Catch-and-Effort data from Surface and Longline Fisheries:**

- **Longline** fishery of **India**: India has reported catches and catch-and-effort data for its commercial longline fishery for activities inside of the EEZ of India. However, India has not reported catches of tropical tunas or other species for vessels under its flag, which the IOTC Secretariat had to estimate, with total catches of tropical tunas at around 4,000 t per year (2008-12).
- **Longline** fisheries of **Indonesia** and **Malaysia**: Indonesia and Malaysia have not reported catches for longliners under their flag that are not based in their ports. In addition Indonesia has not reported catch-and-effort data for its longline fishery to date.
- **Industrial tuna purse seine** fishery of **Iran**: Although Iran has reported catch-and-effort data for its purse seine fishery in recent years, data are not as per the IOTC standards.
- **Discard levels for all fisheries**: The total amount of tropical tunas discarded at sea remains unknown for most fisheries and time periods. Discards of tropical tunas are thought to be significant during some periods on industrial purse seine fisheries using fish aggregating devices (FADs) and may also be high due to depredation of catches of longline fisheries, by sharks or marine mammals, in tropical areas.

3. **Size data from All Fisheries:**

- **Longline** fisheries of **Japan** and **Taiwan,China:** In 2010, the IOTC Scientific Committee identified several issues concerning the size frequency statistics available for Japan and Taiwan,China, which remain unresolved. In addition, the number of specimens sampled for length onboard longliners flagged in Japan in recent years remains under the minimum recommended by the IOTC, which is at least 1 fish per metric ton of catch measured for length (0.06 fish per metric ton of catch for all tropical tuna species combined).
- **Gillnet** fisheries of **Iran** and **Pakistan:** Even though both countries have reported size frequency data for their gillnet fisheries in recent years, data are not reported by geographic area and the numbers measured are under the minimum sample size recommended by the IOTC (0.16 fish measured per metric ton of catch for Iran and 0.02 for Pakistan).
- **Longline** fisheries of **India, Oman** and the **Philippines:** To date, these countries have not reported size frequency data for their longline fisheries.
- **Gillnet/longline** fishery of **Sri Lanka:** Although Sri Lanka has reported length frequency data for tropical tunas in recent years, sampling coverage is below recommended levels (0.17 fish measured per metric ton of catch) and lengths are not available by gear type or fishing area[4].
- **Longline** fisheries of **Indonesia** and **Malaysia**: Indonesia and Malaysia have reported some size frequency data for its fresh-tuna longline fishery in recent years. However, the samples cannot be fully broken by month and fishing area (5x5 grid) and they refer exclusively to longliners based in ports in those countries.
- **Coastal** fisheries of **India, Indonesia** and **Yemen**: To date, these countries have not reported size frequency data for their coastal fisheries.

4. **Biological data for all tropical tuna species:**

- Surface and longline fisheries, in particular **Taiwan,China**, **Indonesia**, **Japan**, and **China**: The IOTC database does not contain enough data to allow for the estimation of statistically robust length-weight or non-standard size to standard length keys for tropical tuna species due to the general paucity of biological data available from the Indian Ocean.

[4] In 2012-13 the Ministry of Fisheries and Aquatic Resources Development of Sri Lanka received support from IOTC, the OFCF and BOBLME to strengthen its data collection and processing system, including collection of more length frequency data from the fisheries.

APPENDIX VII
DRAFT RESOURCE STOCK STATUS SUMMARY – BIGEYE TUNA

Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien
iotc ctoi

Status of the Indian Ocean bigeye tuna (BET: *Thunnus obesus*) resource

TABLE 1. Bigeye tuna: Status of bigeye tuna (*Thunnus obesus*) in the Indian Ocean

Area[1]	**Indicators**		**2013 stock status**[2] **determination**
Indian Ocean	Catch in 2012: Average catch 2008–2012:	115,793 t 107,603 t	(green)
	MSY (1000 t): F_{2012}/F_{MSY}: SB_{2012}/SB_{MSY} : SB_{2012}/SB_0:	132 t (98.5–207 t)[3] 0.42 (0.21–0.80)[3] 1.44 (0.87–2.22)[3] 0.40 (0.27–0.54)[3]	

[1]Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2]The stock status refers to the most recent years' data used in the assessment.
[3]The point estimate is the median of the plausible models investigated in the 2013 SS3 assessment

Colour key	Stock overfished($SB_{year}/SB_{MSY}< 1$)	Stock not overfished ($SB_{year}/SB_{MSY}\geq 1$)
Stock subject to overfishing($F_{year}/F_{MSY}> 1$)	(red)	(orange)
Stock not subject to overfishing ($F_{year}/F_{MSY}\leq 1$)	(yellow)	(green)

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. A new stock assessment was carried out in 2013. The 2013 stock assessment model results did not differ substantively from the previous (2010 and 2011) assessments; however, the final overall estimates of stock status differ somewhat due to the revision of the catch history and updated standardised CPUE indices. All the runs (except 2 extremes) carried out in 2013 indicate the stock is above a biomass level that would produce MSY in the long term (i.e. $SB_{2012}/SB_{MSY} > 1$) and in all runs that current fishing mortality is below the MSY-based reference level (i.e. $F_{2012}/F_{MSY} < 1$) (Table 1 and Fig. 1). The median value of MSY from the model runs investigated was 132,000 t with a range between 98,000 and 207,000 t. Current spawning stock biomass was estimated to be 40% (Table 1) of the unfished levels. Catches in 2012 (≈115,800 t) remain lower than the estimated MSY values from the 2013 stock assessments (Table 1). The average catch over the previous five years (2008–12; ≈107,600 t) also remains below the estimated MSY. In 2012 catch levels of bigeye tuna increased markedly (~24% over values in 2011), especially longline catches. On the weight of stock status evidence available, the bigeye tuna stock is therefore **not overfished**, and is **not subject to overfishing**.

Outlook. Declines in longline effort since 2007, particularly from the Japanese, Taiwan,China and Republic of Korea longline fleets, as well as purse seine effort have lowered the pressure on the Indian Ocean bigeye tuna stock, indicating that current fishing mortality would not reduce the population to an overfished state in the near future.

The Kobe strategy matrix based on all plausible model runs from SS3 in 2013 illustrates the levels of risk associated with varying catch levels over time and could be used to inform future management actions (Table 2).

The SS3 projections from the 2013 assessment show that there is a low risk of exceeding MSY-based reference points by 2015 and 2022 if catches are maintained at the current levels of 115,800 t (0% risk that $B_{2022}<B_{MSY}$ and 0% risk that $F_{2022}>F_{MSY}$) (Table 2). The following key points should be noted:

- The median value of Maximum Sustainable Yield (MSY) from the model runs investigated was 132,000 t with a range between 98,000 and 207,000 t (range expressed as the different runs of SS3 done in 2013 using steepness values of 0.7, 0.8 and 0.9; different natural mortality values; and catchability increase for longline CPUE) (see Table 1 for further description)). Current stock size is above SB_{MSY} and predicted to increase on the short term. Catches at the level of 132,000 t have a low probability of reducing the stock below SB_{MSY} in the short term (3–5 years) and medium term (10 years). Therefore, the annual catches of bigeye tuna should not exceed the median value of MSY. However, for lower productivity model options, catches at the median MSY level will reduce stock biomass over the long-term (10–15 years).

- If catch remains below the estimated MSY levels, then immediate management measures are not required. However, continued monitoring and improvement in data collection, reporting and analysis is required to reduce the uncertainty in assessments.
- provisional reference points: Noting that the Commission in 2012 agreed to Recommendation 12/14 *on interim target and limit reference points*, the following should be noted:
  - **Fishing mortality**: Current fishing mortality is considered to be below the provisional target reference point of F_{MSY}, and therefore below the provisional limit reference point of $1.4*F_{MSY}$ (Fig. 1).
  - **Biomass**: Current spawning biomass is considered to be above the target reference point of SB_{MSY}, and therefore above the limit reference point of $0.4*SB_{MSY}$ (Fig. 1).

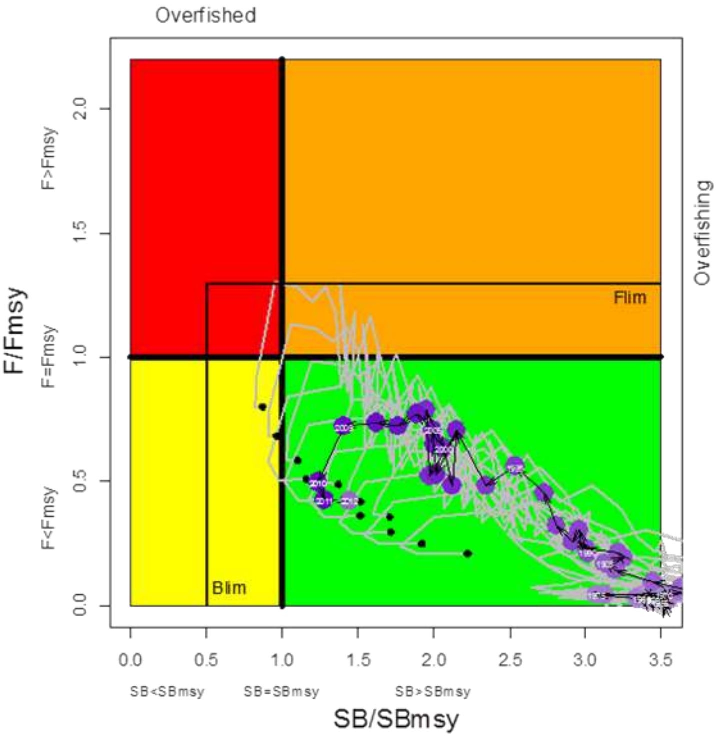


Fig. 1. Bigeye tuna: SS3 Aggregated Indian Ocean assessment Kobe plot. The Kobe plot presents the trajectories for the range of 12 plausible model options included in the formulation of the final management advice (grey lines with the black point representing the terminal year of 2012). The trajectory of the median of the 12 plausible model options (purple points) is also presented. The biomass (B_{lim}) and fishing mortality limit (F_{lim}) reference points are also presented.

Table 2. Bigeye tuna: 2013 SS3 Aggregated Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of weighted distribution of models violating the MSY-based reference points for five constant catch projections (2012 catch level, ± 10%, ± 20%, ± 30% and ± 40%) projected for 3 and 10 years. Note: from the 2013 stock assessment using catch estimates at that time.

Reference point and projection timeframe	**Alternative catch projections (relative to 2012) and weighted probability (%) scenarios that violate reference point**				
	100% (115,800 t)	**110%** (127,400 t)	**120%** (139,000 t)	**130%** (150,500 t)	**140%** (162,100 t)
$SB_{2015} < SB_{MSY}$	0	0	0	0	0
$F_{2015} > MSY$	0	0	0	8	17
$SB_{2022} < SB_{MSY}$	0	0	8	17	25
$F_{2022} > MSY$	0	0	8	17	25

APPENDIX VIII
DRAFT RESOURCE STOCK STATUS SUMMARY – SKIPJACK TUNA

Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien
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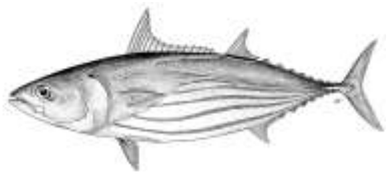

Status of the Indian Ocean skipjack tuna (SKJ: *Katsuwonus pelamis*) resource

TABLE 1. Status of skipjack tuna (*Katsuwonus pelamis*) in the Indian Ocean

Area[1]	Indicators		2013 stock status determination
Indian Ocean	Catch 2012: Average catch 2008–2012:	314,537 t 400,980 t	
	MSY (1000 t): F_{2011}/F_{MSY}: SB_{2011}/SB_{MSY}: SB_{2011}/SB_0:	478 t (359–598 t) 0.80 (0.68–0.92) 1.20 (1.01–1.40) 0.45 (0.25–0.65)	

[1]Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.

Colour key	Stock overfished($SB_{year}/SB_{MSY}< 1$)	Stock not overfished ($SB_{year}/SB_{MSY}\geq 1$)
Stock subject to overfishing(C_{year}/MSY> 1)		
Stock not subject to overfishing (C_{year}/MSY≤ 1)		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. No new stock assessment was carried out for skipjack tuna in 2013. Previous results suggest that the stock is not overfished ($B>B_{MSY}$) and that overfishing is not occurring (C<MSY and $F<F_{MSY}$) (Table 1 and Fig. 1). Spawning stock biomass was estimated to have declined by approximately 45 % in 2011 from unfished levels (Table 1). Total catch has continued to decline with 314,537 t landed in 2012, in comparison to 384,537 t in 2011. Based on the stock assessment carried out in 2012, the stock was considered to be **not overfished** and **not subject to overfishing** (Table 1).

Outlook. The recent declines in catches are thought to be caused by a recent decrease in purse seine effort as well as a decline in CPUE of large skipjack tuna in the surface fisheries. There remains considerable uncertainty in the assessment, and the range of runs analysed illustrate a range of stock status to be between 0.73–4.31 of SB_{2011}/SB_{MSY} based on all runs examined. The WPTT does not fully understand the recent declines of pole-and-line and purse seine catch and CPUE, which may be due to the combined effects of the fishery and environmental factors affecting recruitment or catchability. Catches in 2010 (424,013 t), 2011 (384,537 t) and 2012 (314,537 t) as well as the average level of catches of 2008–2012 (400,980 t) are below MSY targets though may have exceeded them in 2005 and 2006.

The Kobe strategy matrix illustrates the levels of risk associated with varying catch levels over time and could be used to inform management actions. Based on the SS3 assessment conducted in 2011, there is a low risk of exceeding MSY-based reference points by 2020 if catches are maintained at the current levels (< 20 % risk that $B_{2019} < B_{MSY}$ and 30 % risk that C_{2019}>MSY as proxy of $F > F_{MSY}$) and even if catches are maintained below the 2005–2010 average (500,000 t) based on the analysis done in 2011 (the 2012 reference point indicates that 500,000 t levels maybe too high for the Indian Ocean skipjack tuna stock). The following key points should be noted:

- The mean estimates of the Maximum Sustainable Yield for the skipjack tuna Indian Ocean stock is 478,190 t (Table 1) and considering the average catch level from 2008–2012 was 400,980 t, the stock appears to be in no immediate threat of breaching target and limit reference points.
- If the recent declines in effort continue, and catch remains substantially below the estimated MSY, then urgent management measures are not required. However, recent trends in some fisheries, such as Maldivian pole-and-line and purse seine fishery, suggest that the situation of the stock should be closely monitored with a new stock assessment to be carried out in 2014.
- The Kobe strategy matrix (Table 2: from the 2011 assessment) illustrates the levels of risk associated with varying catch levels over time and could be used to inform management actions.
- Provisional reference points: Noting that the Commission in 2012 agreed to Recommendation 12/14 *on interim target and limit reference points*, the following should be noted:

- **Fishing mortality**: Current fishing mortality is considered to be below the provisional target reference point of F_{MSY}, and therefore below the provisional limit reference point of $1.5*F_{MSY}$ (Fig. 1). Based on the current assessment there is a very low probability that the limit reference points of $1.5*F_{MSY}$ at the current catch levels will be exceeded in 3 or 10 years.
- **Biomass**: Current spawning biomass is considered to be above the target reference point of SB_{MSY}, and therefore above the limit reference point of $0.4*SB_{MSY}$ (Fig. 1). Based on the current assessment, there is a low probability that the spawning stock biomass, at the current catch levels, will be below the limit reference point of $0.4*SB_{MSY}$ in 3 or 10 years.

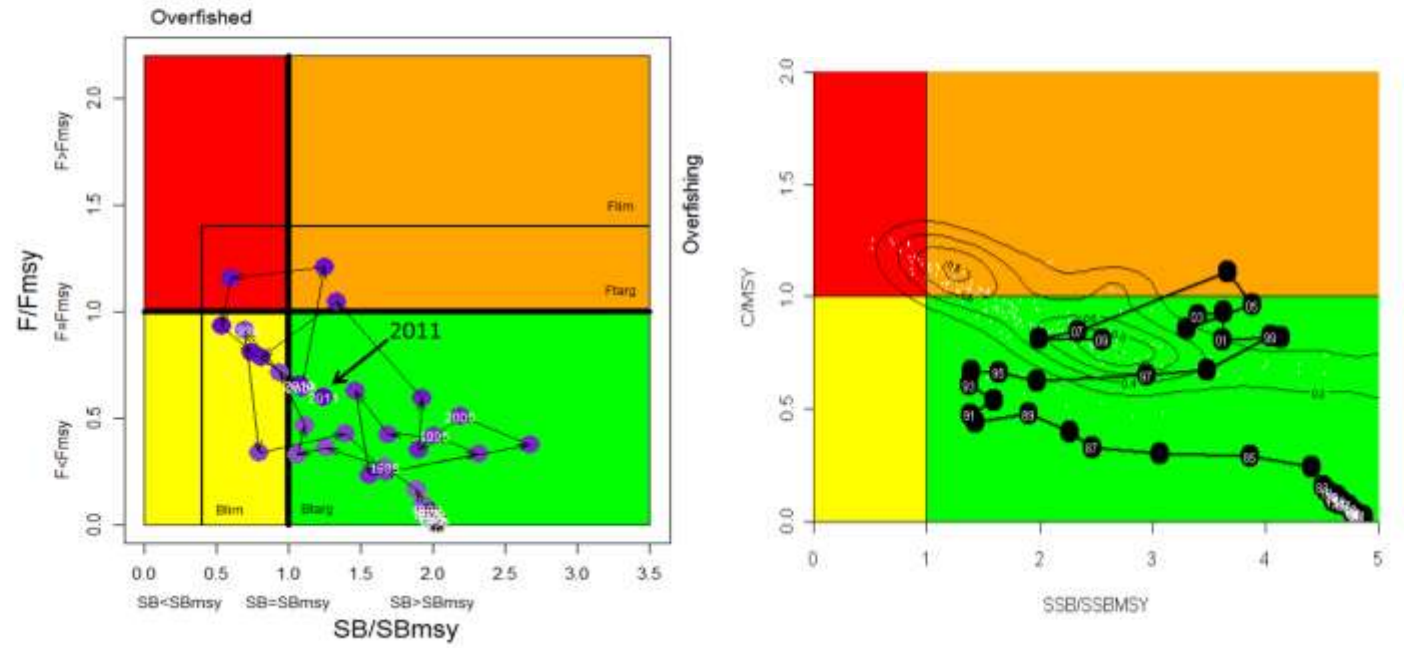

Fig. 1. Skipjack tuna: 2012 SS3 Indian Ocean assessment Kobe plot (left; mean values of the weighted models used in the analysis in 2012). Circles indicate the trajectory of the point estimates for the SB ratio and F/F_{MSY} ratio for each year 1950–2011. 2011 SS3 Aggregated Indian Ocean assessment Kobe plot (right). Black circles indicate the trajectory of the weighted median of point estimates for the SB ratio and C/MSY ratio for each year 1950–2009. Probability distribution contours are provided only as a rough visual guide of the uncertainty (e.g. the multiple modes are an artifact of the coarse grid of assumption options). Due to numerical problems in the F_{MSY} calculations for this population, the proxy reference point C/MSY is reported instead of F/F_{MSY}, which should be interpreted with caution for the reasons given under Table 1 above.

TABLE 2. Skipjack tuna: 2011 SS3 Aggregated Indian Ocean assessment Kobe II Strategy Matrix. Weighted 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. Note: from the 2011 stock assessment using catch estimates at that time.

Reference point and projection timeframe	**Alternative catch projections (relative to 2009) and weighted probability (%) scenarios that violate reference point**				
	60% (274,000 t)	**80%** (365,000 t)	**100%** (456,000 t)	**120%** (547,000 t)	**140%** (638,000 t)
$SB_{2013} < SB_{MSY}$	<1	5	5	10	18
$C_{2013} > MSY$ (proxy for F_{2009}/F_{MSY})	<1	<1	31	45	72
$SB_{2020} < SB_{MSY}$	<1	5	19	31	56
$C_{2020} > MSY$ (proxy for F_{2009}/F_{MSY})	<1	<1	31	45	72

APPENDIX IX
DRAFT RESOURCE STOCK STATUS SUMMARY – YELLOWFIN TUNA

Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien
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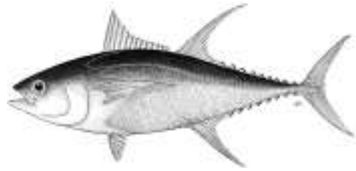

Status of the Indian Ocean yellowfin tuna (YFT: *Thunnus albacares*) resource

TABLE 1. Yellowfin tuna: Status of yellowfin tuna (*Thunnus albacares*) in the Indian Ocean

Area[1]	**Indicators**			**2013 stock status determination**
Indian Ocean	Catch 2012: Average catch 2008–2012:	368,663 t 317,505 t		(green)
	 MSY (1000 t): F_{2010}/F_{MSY}: SB_{2010}/SB_{MSY}: SB_{2010}/SB_0:	Multifan 344 t (290–453 t) 0.69 (0.59–0.90) 1.24 (0.91–1.40) 0.38 (0.28–0.38)	ASPM 320 (283–358 t) 0.61 (0.31–0.91) 1.35 (0.96–1.74) -	

[1]Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.

Colour key	Stock overfished(SB_{year}/SB_{MSY}< 1)	Stock not overfished (SB_{year}/SB_{MSY}≥ 1)
Stock subject to overfishing(F_{year}/F_{MSY}> 1)	(red)	(orange)
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)	(yellow)	(green)

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. No new stock assessment was carried out for yellowfin tuna in 2013. Previous stock assessment model results (2012) did not differ substantively from the previous (2011) assessment; however, the final overall estimates of stock status differ somewhat due to the refinement in the selection of the range of model options due to increased understanding of key biological parameters (primarily natural mortality). The stock assessment model used in 2012 suggests that the stock is currently **not overfished** (SB_{2010}>SB_{MSY}) and **not subject to overfishing** (F_{2010}<F_{MSY}) (Table 1 and Fig. 1). Two trajectories are presented that compare the Kobe plots obtained from the MFCL and ASPM assessments. While the MFCL assessment indicates that fishing mortality is below the limit and target reference points during the whole time series, the ASPM model run indicates that the target reference points may have been exceeded during the period of high catches in the mid 2000's (2003–2006). However, estimates of total and spawning stock biomass show a marked decrease from 2004 to 2009 in both cases, corresponding to the very high catches of 2003–2006. Recent reductions in effort and, hence, catches resulted in a slight improvement in stock status in 2010. Spawning stock biomass in 2010 was estimated to be 38% (31–38%) (from Table 1) of the unfished levels. Total catch has continued to increase with 368,663 t landed in 2012, a value over previous MSY estimates (344,000 t; Table 1), in comparison to 327,490 t in 2011 and 300,000 t in 2010. However, catch rates have improved in the purse seine fishery while remaining stable for the Japanese longline fleet. Therefore it is difficult to know whether the stock is moving towards a state of being subject to overfishing. If the provisional catch estimate for 2013 confirms the increasing trend, it may be necessary to carry out a new stock assessment in 2014.

The following key points should be noted:

- The Maximum Sustainable Yield estimate for the whole Indian Ocean is 344,000 t with a range between 290,000–453,000 t for MFCL; 320,000 t with a range between 283,000 and 358,000 t for ASPM (Table 1). The management advice in 2012 indicated that annual catches of yellowfin tuna should not exceed the lower range of MSY (300,000 t) in order to ensure that stock biomass levels could sustain catches at the MSY level in the long term. Catches have exceeded this level in 2011 and 2012.
- Recent recruitment estimated by MFCL is estimated to be considerably lower than the whole time series average. If recruitment continues to be lower than average, catches below MSY would be needed to maintain stock levels. However, although recent recruitment estimated by ASPM is similar to MFCL estimates, the ASPM recruitment trend is estimated to be at a lower level without any declining trend.
- Provisional reference points: Noting that the Commission in 2012 agreed to Recommendation 12/14 *on interim target and limit reference points*, the following should be noted:

- **Fishing mortality**: Current fishing mortality is considered to be below the provisional target reference point of F_{MSY}, and therefore below the provisional limit reference point of $1.4*F_{MSY}$ (Fig. 1).
- **Biomass**: Current spawning biomass is considered to be above the target reference point of SB_{MSY}, and therefore above the limit reference point of $0.4*SB_{MSY}$ (Fig. 1).

Outlook (Based on MultifanCL). The potential yields from the fishery have also declined over the last five years as an increased proportion of the catch is comprised of smaller fish, primarily from the purse seine FAD fishery. The main mechanism that appears to be behind the very high catches in the 2003–2006 period is an increase in catchability by surface and longline fleets due to a high level of concentration across a reduced area and depth range. This was likely linked to the oceanographic conditions at the time generating high concentrations of suitable prey items that yellowfin tuna exploited. A possible increase in recruitment in previous years, and thus in abundance, cannot be completely ruled out, but no signal of it is apparent in either data or model results. This means that those catches probably resulted in considerable stock depletion.

In an attempt to provide management advice independent of the MSY construct, the recent levels of absolute fishing mortality estimated from region 2 were compared to the natural mortality level. It is considered that the tagging data provides a reasonable estimate to fishing mortality for the main tag recovery period (2007–09). The estimates of fishing mortality for the main age classes harvested by the purse-seine fishery are considerably lower than the corresponding levels of natural mortality and on that basis, recent fishing mortality levels are not considered to be excessive.

The decrease in longline and purse seiner effort in recent years has substantially lowered the pressure on the Indian Ocean stock as a whole, indicating that current fishing mortality has not exceeded the MSY-related levels in recent years. If the security situation in the western Indian Ocean were to improve, a rapid reversal in fleet activity in this region may lead to an increase in effort which the stock might not be able to sustain, as catches would then be likely to exceed MSY levels. Catches in 2010 (300,000 t) are within the lower range of MSY values The current assessment indicates that catches of about the 2010 level are sustainable, at least in the short term. However, the stock is unlikely to support substantively higher yields based on the estimated levels of recruitment from over the last 15 years.

In 2011, the WPTT undertook projections of yellowfin tuna stock status under a range of management scenarios for the first time, following the recommendation of both the Kobe process and the Commission, to harmonise technical advice to managers across RFMOs by producing Kobe II management strategy matrices. The purpose of the table is to quantify the future outcomes from a range of management options (Table 2). The table describes the presently estimated probability of the population being outside biological reference points at some point in the future, where "outside" was assigned the default definitions of $F>F_{MSY}$ or $SB<SB_{MSY}$. The timeframes represent 3 and 10 year projections (from the last data in the model), which corresponds to predictions for 2013 and 2020. The management options represent three different levels of constant catch projection: catches 20% less than 2010, equal to 2010 and 20% greater than 2010.

The projections were carried out using 12 different scenarios based on similar scenarios used in the assessment for the combination of those different MFCL runs: LL selectivity flat top vs. dome shape; steepness values of 0.7, 0.8 and 0.9; and computing the recruitment as an average of the whole time series vs. 15 recent years (12 scenarios). The probabilities in the matrices were computed as the percentage of the 12 scenarios being $SB>SB_{MSY}$ and $F<F_{MSY}$ in each year. In that sense, there are not producing the uncertainty related to any specific scenario but the uncertainty associated to different scenarios.

There was considerable discussion on the ability of the WPTT to carry out the projections with MFCL for yellowfin tuna. For example, it was not clear how the projection redistributed the recruitment among regions as recent distribution of recruitment differs from historic; which was assumed in the projections. The WPTT agreed that the true uncertainty is unknown and that the current characterization is not complete; however, the WPTT feels that the projections may provide a relative ranking of different scenarios outcomes. The WPTT recognised at this time that the matrices do not represent the full range of uncertainty from the assessments. Therefore, the inclusion of the K2SM at this time is primarily intended to familiarise the Commission with the format and method of presenting management advice.

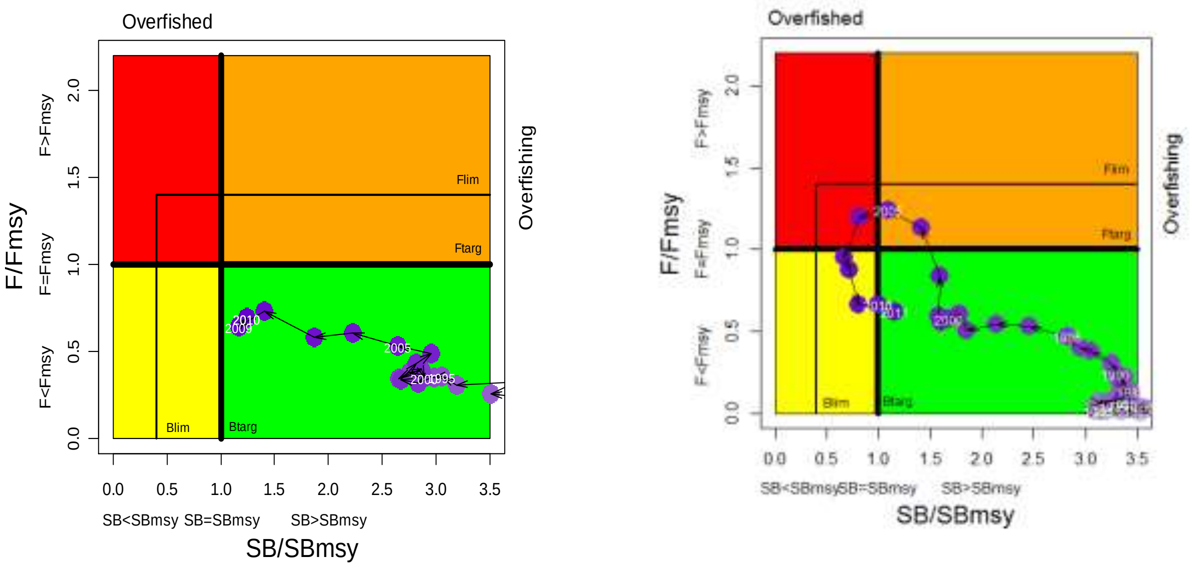

Fig. 1. Yellowfin tuna: MULTIFAN-CL Indian Ocean yellowfin tuna stock assessment Kobe plot. Blue circles indicate the trajectory of the point estimates for the SB ratio and F ratio for each year 1972–2010 for a steepness value of 0.8. The left panel is output obtained from the base case run in MFCL. The right panel is obtained from the ASPM base case model run with steepness value of 0.9.

TABLE 2. Yellowfin tuna: 2011 MULTIFAN-CL Indian Ocean yellowfin tuna stock assessment Kobe II Strategy Matrix. Percentage probability of violating the MSY-based reference points for five constant catch projections (2010 catch level, ± 20% and ± 40%) projected for 3 and 10 years. In the projection, however, 12 scenarios were investigated: the six scenarios investigated above as well as the same scenarios but with a lower mean recruitment assumed for the projected period. Note: from the 2011 stock assessment using catch estimates at that time.

Reference point and projection timeframe	**Alternative catch projections (relative to 2010) and probability (%) of violating reference point**				
	60% (165,600 t)	**80%** (220,800 t)	**100%** (276,000 t)	**120%** (331,200 t)	**140%** (386,400 t)
$SB_{2013} < SB_{MSY}$	<1	<1	<1	<1	<1
$F_{2013} > F_{MSY}$	<1	<1	58.3	83.3	100
$SB_{2020} < SB_{MSY}$	<1	<1	8.3	41.7	91.7
$F_{2020} > F_{MSY}$	<1	41.7	83.3	100	100

APPENDIX X
WORK PLAN FOR THE WORKING PARTY ON TROPICAL TUNAS

Requests from the Commission

At Sessions of the Commission, Conservation and Management Measures adopted contained elements which call on the Scientific Committee, via the WPTT, to undertake specific tasks.

Resolution 13/08 Procedures on a fish aggregating devices (FADs) management plan, including more detailed specification of catch reporting from FAD sets, and the development of improved FAD designs to reduce the incidence of entanglement of non-target species

(para. 7) The IOTC Scientific Committee will analyse the information, when available, and provide scientific advice on additional FAD management options for consideration by the Commission in 2016, including recommendations on the use of biodegradable materials in new and improved FADs and the phasing out of FAD designs that do not prevent the entanglement of sharks, marine turtles and other species. When assessing the impact of FADs on the dynamic and distribution of targeted fish stocks and associated species and on the ecosystem, the IOTC Scientific Committee will, where relevant, use all available data on abandoned FADs (i.e. FADs without a beacon).

Resolution 13/11 On a ban on discards of bigeye tuna, skipjack tuna, yellowfin tuna, and a recommendation for non-targeted species caught by purse seine vessels in the IOTC area of competence

(para. 4) The IOTC Scientific Committee, the IOTC Working Party on Tropical Tunas, and the IOTC Working Party on Ecosystems and Bycatch shall annually:

a) review the information available on bycatch (retained and discarded) by purse seine vessels; and
b) provide advice to the Commission on options to sustainably manage discards in purse seine fisheries.

Resolution 12/13 For the conservation and management of tropical tunas stocks in the IOTC area of competence

(para. 10) The IOTC Scientific Committee will provide at its 2011, 2012 and 2013 Plenary sessions:

a) an evaluation of the closure area, specifying in its advice if a modification is necessary, its basic scientific rationale with an assessment of the impact of such a closure on the tropical tuna stocks, notably yellowfin tuna and bigeye tuna;
b) an evaluation of the closure time periods, specifying in its advice if a modification is necessary, its basic scientific rationale with an assessment of the impact of such a closure on the tropical tuna stocks, notably yellowfin tuna and bigeye tuna;
c) an evaluation of the impact on yellowfin tuna and bigeye tuna stocks by catching juveniles and spawners taken by all fisheries. The IOTC Scientific Committee shall also recommend measures to mitigate the impacts on juvenile and spawners;
d) any other advice on possible different management measures based on the Kobe II matrix, on the main targeted species under the IOTC competence.

Resolution 05/01 *On Conservation and Management Measures for bigeye tuna*

(para. 7) The IOTC Scientific Committee be tasked to provide advice, including advice on;

- the effects of different levels of catch on the SSB (in relation to MSY or other appropriate reference point);
- the impact of misreported and illegal catch of bigeye tuna on the stock assessment and required levels of catch reduction; and
- evaluation of the impact of different levels of catch reduction by main gear types.

Priority species for 2014: *Skipjack tuna*

High priority projects 2014–2015

- ***Stock status analyses (development of abundance indices)***
    i. Develop/improve accurate standardised CPUE indices for all three tropical tuna species, for the Indian Ocean as a whole or by sub-region as appropriate.
    ii. Investigate the source of inconsistencies in the longline length frequency data, as identified by the WPTT.
    iii. Develop methods to estimate historical catch series by gear.
    iv. Develop life history and biological patterns for the species (namely migration patterns and distribution patterns).
- ***Tagging data analysis***
    i. Information and results arising from the RTTP-IO tagging program should be fully utilised and summarised for the 2014 WPTT skipjack tuna stock assessment. Additional analyses are recommended, including, inter alia:
        1. Analysis of the existing tagging data sets.
            - Skipjack tuna movements (taking into account the reporting rates of tags now estimated) using ad hoc models
            - Skipjack tuna growth: VB or others
            - Skipjack tuna total mortality rates based on temporal trends of recoveries
            - Skipjack natural mortality and longevity
            - Analysis of potential interactions between purse seine and pole-and-line fisheries
            - Review of FAD catches and their association to FADs: movements, growth, etc.

    This work should be conducted as soon as possible as all the data needed for this study (on fisheries and tags/recoveries) are now fully available and this work should also make use of the results from the tagging symposium research.

Stock assessment

- ***Skipjack tuna***

Medium priority project:

- ***Tagging data***
    i. Improved approaches for integrating tagging data into stock assessments.

    The recent RTTP-IO (and similar large-scale tagging programmes in the Pacific Ocean) have provided a wealth of data on tropical tuna population dynamics. However, recent analyses have demonstrated that movement dynamics are not compatible with standard tag-based population estimators for movement and natural/fishing mortality. In attempting to integrate the tagging data within stock assessments, the following problems are encountered:
        1. Tag reporting rates are thought to be low for all fleets except for the purse seine fleet landing in the Seychelles. If reporting rates by longline and artisanal fisheries are low, then this may introduce greater uncertainties in the recovery results.
        2. Tag displacements are relatively low on average (for instance in the Indian Ocean showing a full mixing only within 500 nautical mile radius) and full mixing of the tagged and untagged population is demonstrably limited at the basin scale.
        3. Tag release designs are unbalanced in the west and negligible in the east.
        4. Tagging results show various other complexities that are still difficult to incorporate in current assessments (for instance differential growth and mortality by sex).
        5. Assessments are often sensitive to the inclusion of tagging data, and it is currently not clear that recent Indian Ocean assessments are improved by including tag dynamics, or whether large biases for movement and mortality are being introduced.

    There is not a simple solution for these problems, but there are directions to explore:
        1. Increasing the spatial resolution of the tagging model (for instance with full mixing boxes of ~500 mile radius) will reduce the impact of the tag mixing problem (but this comes at a cost of increased model complexity and over-parameterisation).
        2. There is potential value in attempting to use environmental and physical oceanographic information to make inferences about population dynamics in data-poor regions.
        3. Simulation studies can help to understand the biases, potentially develop bias correction methods, and improve the quantification of uncertainty introduced by constraining assumptions.

Estimated budget for IOTC consultants to be engaged on skipjack tuna analysis

Description	**Unit price**	**Units required**	**Total**
Improved approaches for integrating tagging data into stock assessments (fees)	US$400	75	30,000
Data preparation for skipjack tuna stock assessment	US$400	50	20,000
Total estimate (US$)			**50,000**

- ***Stock structure***
  i. genetic research to determine the connectivity of species throughout their distributions: such studies should be developed at the sub-regional level.
  ii. Additional tagging research to better understand and estimate exploitation rates, the movement dynamics, possible spawning locations, natural mortality, fishing mortality and post-release mortality of stocks from various fisheries in the Indian Ocean.
- ***Biological information***
  i. Quantitative biological studies are necessary throughout the species range to determine key biological parameters including age-at-maturity and fecundity-at-age/length relationships, age-length keys, age and growth, which will be fed into future stock assessments.

APPENDIX XI
ASSESSMENT SCHEDULE FOR THE WORKING PARTY ON TROPICAL TUNAS

Table 1. Schedule of stock assessments for tropical tuna species in 2014 and tentatively for 2015–2018.

Species	**2014**	**2015**	**2016**	**2017**	**2018**
Working Party on Tropical Tunas					
Bigeye tuna	Indicators	Indicators	**Full assessment**	Indicators	Indicators
Skipjack tuna	**Full assessment**	Indicators	Indicators	**Full assessment**	Indicators
Yellowfin tuna	Indicators	**Full assessment**	Indicators	Indicators	**Full assessment**

Note: the assessment schedule may be changed dependant on the annual review of fishery indicators, or SC and Commission requests.

APPENDIX XII
CONSOLIDATED RECOMMENDATIONS OF THE FIFTEENTH SESSION OF THE WORKING PARTY ON TROPICAL TUNAS

Note: Appendix references refer to the Report of the Fifteenth Session of the Working Party on Tropical Tunas (IOTC–2013–WPTT15–R)

Meeting participation fund

WPTT15.01 (para. 2): **NOTING** that the IOTC Meeting Participation Fund (MPF), adopted by the Commission in 2010 (Resolution 10/05 *On the establishment of a Meeting Participation Fund for developing IOTC Members and non-Contracting Cooperating Parties*), was used to fund the participation of 10 national scientists to the WPTT15 meeting (8 in 2012), all of which were required to submit and present a working paper at the meeting, the WPTT **RECOMMENDED** that this fund be maintained into the future.

Spatial assessment and management of tuna populations

WPTT15.02 (para. 37): The WPTT **RECOMMENDED** the necessity to perform additional research on population structure to challenge the current paradigm of a single panmictic spawning population throughout the entire Indian Ocean, which has strong implications for management. Applying genetics, otolith microchemistry, parasitology and analysis of the IOTC tag-recovery dataset is likely to provide the information required to determine if stocks are being managed at the appropriate scales.

Japan data collection and processing systems

WPTT15.03 (para. 62): The WPTT **THANKED** Japan for addressing some of the concerns raised by the WPTT in 2012, and **RECOMMENDED** that Japan and the IOTC Secretariat continue joint work, in cooperation with other countries having longline fisheries, to address other issues identified by the WPTT, as the lack of specimens of small size from the samples and discrepancies in the average weights estimated using the available catch-and-effort and length frequency data.

Taiwan,China data collection and processing systems

WPTT15.04 (para. 67): **NOTING** that in recent years fishers from the Taiwan,China longline fleet have been collecting both length and weight measurements for the same specimens, the WPTT **RECOMMENDED** that the measured lengths and lengths derived from weight measurements are compared in order to validate the reliability of this dataset.

Length Frequency inter-sessional meeting guidelines

WPTT15.05 (para. 74): **NOTING** the size data issues (discrepancies in catch, effort and notably size data (low sampling rate, uneven distribution of sampling in regard to the spatial extent of the fishery) in the Japanese and Taiwan,China tropical tuna data sets) identified by the WPTT in 2012 and 2013 and the Scientific Committee in 2012, the WPTT **RECOMMENDED** that an inter-sessional meeting attached to the WPDCS and WPM on *data collection and processing systems for size data from the main longline fleets in the Indian Ocean*, be carried out in early 2014, under the guidelines contained in Appendix IV.

WPTT15.06 (para. 75): The WPTT **NOTED** that the data collection and processing systems used for distant-water longline fisheries tend to apply to all oceans **AGREEING** that it is likely that the issues identified for the Indian Ocean also apply to other areas. In this regard, the WPTT **RECOMMENDED** that the IOTC Secretariat informs other tuna-RFMO Secretariats about the issues identified and facilitates participation of their staff to the WPDCS, where required.

European Union fishery statistics

WPTT15.07 (para. 89): The WPTT **NOTED** errors in the procedure used to correct the species composition of the European Union purse seine catches on free-swimming schools. This error resulted in an over-representation (20–30%) of bigeye tuna in the statistics provided to the IOTC Secretariat, compared to the composition produced by the species sampling. Recalling the need for the European Union to submit corrected catches by species to the IOTC, the WPTT

RECOMMENDED that EU scientists document all estimation procedures and the changes in species composition arising from them and report this information at the next session of the WPTT, in 2014.

India fisheries

WPTT15.08 (para. 92): **NOTING** the potential utility of the longline CPUEs derived from the research surveys conducted by the "Fishery Survey of India", the WPTT **RECOMMENDED** that as a high priority, India undertake a standardisation of the CPUE series, with the support of the IOTC Secretariat, and for this to be presented at the next WPTT meeting.

Analysis of the Time-Area Closures (including Resolution 12/13)

WPTT15.09 (para. 245): **NOTING** that the objective of Resolution 12/13 is to decrease the overall pressure on the main targeted stocks in the Indian Ocean, in particular yellowfin tuna and bigeye tuna, and also to evaluate the impact of the current time/area closure and any alternative scenarios on tropical tuna population, the WPTT reiterated its previous **RECOMMENDATION** that the SC request that the Commission specify the level of reduction or the long term management objectives to be achieved with the current or alternative time area closures, as these are not contained within Resolution 12/13.

Research Recommendations and Priorities

CPUE Standardisation inter-sessional work

WPTT15.10 (para. 254): **NOTING** these CPUE issues identified by the WPTT in 2010, 2011, 2012 and 2013 and the Scientific Committee in 2012, the WPTT **RECOMMENDED** that further inter-sessional work be carried out in conjunction with the IOTC Secretariat on the major longline CPC's in the Indian Ocean in early 2014 using the operation data to address issues identified in the CPUE Workshop Report.

Consultants

WPTT15.11 (para. 255): The WPTT **NOTED** the excellent work done by IOTC consultants in 2013 on a range of projects from Management Strategy Evaluation to the bigeye tuna SS3 stock assessment, and **RECOMMENDED** that their engagement be renewed for the coming year to supplement the skill set available within IOTC CPCs. An indicative budget is provided at Table 14 for the consideration of the Scientific Committee.

TABLE 14. Estimated budget for IOTC consultants to be engaged on tropical tunas in 2014

Description	Unit price	Units required	Total
Tropical tuna Management Strategy Evaluation (fees)	US$450	35	15,750
Tropical tuna Management Strategy Evaluation (travel)	US$8,000	1	8,000
Tropical tuna Stock Assessment (fees)	US$450	35	15,750
Tropical tuna Stock Assessment (travel)	US$8,000	1	8,000
Total estimate (US$)			**47,500**

WPTT15.12 (para. 256): The WPTT **RECOMMENDED** that the SC consider and endorse the workplan and assessment schedule for the WPTT for 2014, and tentatively for future years, as provided at Appendix X and Appendix XI, respectively.

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

WPTT15.13 (para. 265): The WPTT **RECOMMENDED** that the SC note that Dr. M. Shiham Adam (Maldives) was re-elected as Vice-Chairperson of the WPTT for the next *biennium*.

Review of the draft, and adoption of the Report of the Fifteenth Session of the WPTT

WPTT15.14 (para. 271): The WPTT **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPTT15, provided at Appendix XII, as well as the management advice provided in the draft resource stock status summary for each of the tropical tuna species under the IOTC mandate:

- Bigeye tuna (*Thunnus obesus*) – Appendix VII
- Skipjack tuna (*Katsuwonus pelamis*) – Appendix VIII
- Yellowfin tuna (*Thunnus albacares*) – Appendix IX