Report of the Fourth Session of the IOTC Working Party on Temperate Tunas

Shanghai, China, 20–22 August 2012

DISTRIBUTION:

Participants in the Session
Members of the Commission
Other interested Nations and International Organizations
FAO Fisheries Department
FAO Regional Fishery Officers

BIBLIOGRAPHIC ENTRY

IOTC–WPTmT04 2012. Report of the Fourth Session of the IOTC Working Party on Temperate Tunas. Shanghai, China, 20–22 August 2012. *IOTC–2012–WPTmT04–R[E]: 43 pp.*

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

Contact details:

Indian Ocean Tuna Commission
Le Chantier Mall
PO Box 1011
Victoria, Mahé, Seychelles
Ph: +248 4225 494
Fax: +248 4224 364
Email: secretariat@iotc.org
Website: http://www.iotc.org

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The Fourth Session of the Indian Ocean Tuna Commission (IOTC) WPTmT was held in Shanghai, China, from 20 to 22 August 2012. A total of 26 participants attended the Session.

The following are a subset of the complete recommendations from the WPTmT04 to the Scientific Committee, which are provided at Appendix IV.

Indonesian longline fishery for albacore

Noting that Indonesian catches represent more than 40% of the total albacore catches in the Indian Ocean, determined from the revised catch history developed by the IOTC Secretariat, the WPTmT **RECOMMENDED** that Indonesia further strengthen sampling efforts on its coastal and off-shore fisheries in early 2013, where required, and liaise with the IOTC Secretariat in order to better determine the catches of albacore by the Indonesian longline fleet. (para. 42)

Effect of piracy on temperate tuna catches

The WPTmT **RECOMMENDED** that given the potential impacts of piracy on the albacore fishery through the relocation of longliners into traditional albacore fishing grounds, specific analysis should be carried out and presented at the next WPTmT meeting by the CPCs most affected by these activities, including Japan, Rep. of Korea and Taiwan,China. (para. 55)

CPUE discussion summary

NOTING that a set of 'core areas' which are likely to be robust to frequent fluctuations of external factors, may be more informative than using all of the data available, especially when other species were being targeted, the WPTmT **RECOMMENDED** that 'core areas' be identified and agreed to by the WPTmT so as to facilitate and monitor population abundance trends across all fleets. This should be carried out intersessionally and presented at the Scientific Committee's proposed longline CPUE workshop, to be held in the second quarter of 2013. The authors of the three CPUE papers presented during the WPTmT agreed to lead this work, in collaboration with the IOTC Secretariat. (para. 71)

Selection of Stock Status indicators

In deciding upon the most appropriate way to present the integrated stock assessment results to the Scientific Committee, the WPTmT **AGREED** that the output of the ASPM model were most likely to numerically and graphically represent the current status of albacore in the Indian Ocean. However, the WPTmT **RECOMMENDED** that the Scientific Committee note that this does not represent an endorsement of the ASPM model over the other models used in 2012, as there are still substantial problems with the ASPM model, and the WPTmT considers all of the models to be equally informative of stock status. (para. 102)

Parameters for future analyses: CPUE standardization and stock assessments

Noting that the areas used in the various CPUE standardisations undertaken in 2012 were very different from one analysis to another, the WPTmT **AGREED** that there is a need to define core area(s) for the CPUE standardisation of albacore and **RECOMMENDED** that scientists from CPCs with longline fisheries for albacore, work together to explore their data and defined such core areas, well in advance of the next WPTmT meeting in 2013. (para. 104)

It was noted that the current time frames for data exchange do not allow enough time to conduct thorough stock assessment analyses properly, and this could have a detrimental effect on the quality of advice provided by the WPTmT. Thus, the WPTmT **RECOMMENDED** that data exchanges should be made as early as possible, but no later than 45 days prior to a working party meeting, so that CPUE analysis can be provided to the IOTC Secretariat no later than 30 days before a working party meeting. (para. 106)

Indian Ocean albacore management advice

The WPTmT **RECOMMENDED** that the Scientific Committee note the management advice developed for albacore, as provided in the draft resource stock status summary (Appendix VII). (para. 108)

CPUE standardisation

The WPTmT also **ENCOURAGED** data to be used in stock assessments, including CPUE standardisations, be made available not less than three months before each meeting by CPCs and where possible, data summaries no later than two months prior to each meeting, from the IOTC Secretariat; and **RECOMMENDED** that data to be used in stock assessments, including CPUE standardisations be made available not less than 30 days before each meeting by CPCs. (para. 111)

1. Opening of the Meeting

1. The Fourth Session of the Indian Ocean Tuna Commission's (IOTC) WPTmT was held in Shanghai, China, from 20 to 22 August 2012. A total of 26 participants attended the Session. The list of participants is provided at Appendix I.

2. The meeting was opened on 20 August, 2012 by the Chair, Dr. Zang Geun Kim, who welcomed participants to Shanghai, China. Participants were informed that a Vice-Chair for the next biennium would need to be elected prior to the close of the meeting. The participants were also welcomed to Shanghai by Prof. Lixiong Xu of the College of Marine Sciences, Shanghai Ocean University, China.

2. Adoption of the Agenda and Arrangements for the Session

3. The WPTmT **ADOPTED** the Agenda provided at Appendix II. The documents presented to the WPTmT04 are listed in Appendix III.

4. **NOTING** that several key working papers were provided either immediately prior to, or on the morning of the meeting, thereby making it difficult or impossible for all participants to thoroughly review and therefore be able to comment and contribute to discussions during the meeting, the WPTmT **URGED** all authors to ensure that they comply with the recommendation from the Scientific Committee (SC) that all working party papers need to be submitted to the IOTC Secretariat no later than 15 days prior to the relevant meeting.

3. Outcomes of the Fourteenth Session of the Scientific Committee

5. The WPTmT **NOTED** paper IOTC–2012–WPTmT04–03 which outlined the main outcomes of the Fourteenth Session of the Scientific Committee, specifically related to the work of the WPTmT.

Indonesian catch estimates

6. The WPTmT **NOTED** the following two key comments from the SC in 2011, directed at the albacore catch estimates obtained from the Indonesian fresh tuna longline fishery:

   "*The SC **NOTED** that the catches of albacore estimated for the fresh tuna longline fishery of Indonesia in recent years are thought to be uncertain, as they cannot be verified using data collected through port sampling, and that to date, the IOTC Secretariat has not received catch-and-effort data for this fishery. The SC was also informed that misidentification between yellowfin tuna and albacore might occur in the Indonesian catches which may contribute to the rise of declared albacore catches in recent years. However, the catch levels estimated by the IOTC Secretariat also account for other sources such as the export declarations from Bali and canning factories receiving the products abroad. Finally, the SC urged Indonesia to undertake a thorough examination of the sampling procedure at landing sites as soon as possible. Indonesia requested that the IOTC Secretariat to bridge the gap of catch data of albacore recorded by Indonesian authorities by providing a list of vessels directly exporting albacore to the canning factories abroad.*" (para. 28 of the SC14 report)

   "*The SC **NOTED** the difficulties faced by Indonesian scientists and managers in terms of commercial catches being transhipped at sea, as well as catches directly exported abroad contributing to IUU fishing. The SC **HIGHLIGHTED** the need for logbooks to be utilised on all commercial fishing vessels, noting that this is already a mandatory requirement for IOTC CPCs. Indonesia encouraged collaboration among CPCs to exchange necessary information related to vessels landing their catch to their countries.*" (para. 29 of the SC14 report)

7. The WPTmT **URGED** Indonesia to provide catch-and-effort data and size data for albacore, in particular for its fresh tuna and deep-freezing longline fleets, as soon as possible, noting that this is already a mandatory reporting requirement (IOTC Resolution 10/02). Reporting should include data from all vessels, including those based in ports of other CPCs.

Stock structure

8. The WPTmT **NOTED** that a new research program, to be carried out by Ifremer in La Reunion, is aimed at determining the level of genetic connectivity for albacore in the south-west Indian Ocean and the Atlantic Ocean. It was indicated that preliminary findings of the study will be presented at the next sessions of the SC and the WPTmT. The program was developed to meet a recommendation made by the WPTmT in 2011 and agreed to by the SC, which stated:

"*Noting that at present very little is known about the population structure and migratory range of albacore in the Indian Ocean, other than the possible connectivity with the southern Atlantic, the SC RECOMMENDED that a research project addressing the albacore stock structure, migratory range and movement rates in the Indian Ocean be considered at its 2012 annual meeting as this project is assigned a high priority." (Recommendation SC14-72)*

9. The WPTmT **NOTED** the recommendations of the Fourteenth Session of the Scientific Committee on data and research related to temperate tunas 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 Sixteenth Session of the Commission

10. The WPTmT **NOTED** paper IOTC–2012–WPTmT04–04 which outlined the main outcomes of the Sixteenth Session of the Commission, specifically related to the work of the WPTmT.

11. The WPTmT **NOTED** the 15 Conservation and Management Measures (CMMs) adopted at the 16th Session of the Commission (consisting of 13 Resolutions and 2 Recommendations), and in particular the following three Resolutions which have a direct impact on the work of the WPTmT: Resolution 12/01 *On the Implementation of the Precautionary Approach*; Resolution 12/03 *On Catch and Effort Recordings by Fishing Vessels in the IOTC Area of Competence*; and Resolution 12/11 *On the implementation of a limitation of fishing capacity of Contracting Parties and Cooperating non-Contracting Parties*.

Kobe II Strategy Matrix

12. The WPTmT **NOTED** the Commission's recognition that the Kobe II strategy matrix is a useful and necessary tool for management, and requested that such a matrix shall be provided for all stock assessments by the species Working Parties, and for these to be included in the report of the SC in 2012 and all future reports.

13. The WPTmT **NOTED** the outcomes of the Sixteenth Session of the Commission, 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.

4.2 Review of Conservation and Management Measures (CMMs) relating to temperate tunas

14. The WPTmT **NOTED** paper IOTC–2012–WPTmT04–05 which aimed to encourage the WPTmT to review the existing CMMs relating to albacore, 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.

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

5. PROGRESS ON THE RECOMMENDATIONS OF WPTMT03

16. The WPTmT **NOTED** paper IOTC–2012–WPTmT04–06 which provided an update on the progress made in implementing the recommendations from previous WPTmT meetings, and also provided alternative recommendations for the consideration and potential endorsement by participants.

17. The WPTmT **AGREED** to a set of revised recommendations, that are provided throughout this report and in the consolidated list of recommendations (Appendix IV), for the consideration of the SC.

6. REVIEW OF THE DATA AVAILABLE AT THE SECRETARIAT FOR TEMPERATE TUNA SPECIES

18. The WPTmT **NOTED** paper IOTC–2012–WPTmT04–07 which summarised the standing of a range of data and statistics received by the IOTC Secretariat for albacore, in accordance with IOTC Resolution 10/02 *Mandatory statistical requirements for IOTC Members and Cooperating non-Contracting Parties (CPC's)*, for the period 1950–2010. The paper also provided a range of fishery indicators, including catch and effort trends, for fisheries catching albacore in the IOTC area of competence. A summary of the supporting information for the WPTmT is provided in Appendix V.

19. The WPTmT **NOTED** the main albacore 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 **RECOMMENDED** that the CPCs listed in the Appendix, make efforts to remedy the data issues identified and to report back to the WPTmT at its next meeting.

20. The WPTmT **AGREED** that the main fleets catching albacore (Japan, Taiwan,China and Indonesia) should continue to improve their sampling programs to collect biological information on albacore caught in their fisheries, preferably through observer programmes, and to continue to provide this information (including the raw data) to the IOTC Secretariat.

21. The WPTmT **NOTED** that in recent years many foreign vessels have been unloading catches of albacore in Mauritius, representing around 60% of the total catch, and that Mauritius is making efforts to monitor albacore for catch and length data. The WPTmT **RECOGNIZED** the value of the biological information collected in Mauritius and **RECOMMENDED** that the IOTC-OFCF Project considers supporting Mauritius to collect this information.

22. The WPTmT **NOTED** that sampling the frozen component of the Indonesian catch is difficult as it is unloaded directly into trucks and freezers, and the frozen fish are not accessible to the samplers, and **REQUESTED** Indonesia to continue its efforts to increase the sampling of the frozen component of the catches in port and through observers, as well as the collection and reporting of catch-and-effort data collected through logbooks.

23. The WPTmT **NOTED** Japan and Taiwan,China efforts to analyse the size samples collected from their longline fisheries for albacore in order to verify if the length frequencies derived from such samples are representative of their fisheries, and **ENCOURAGED** them to continue to work with the IOTC Secretariat on this issue and **REQUESTED** that the results of this work be presented at the next WPTmT meeting.

24. The WPTmT **RECALLED** that Resolution 10/02 *on mandatory statistical requirement for IOTC Members and Cooperating Non-contracting Parties (CPCs)*, requires sampling coverage for size data to be set to one fish measured by ton caught, by species and type of fishery, with samples being representative of all the periods and areas fished. Alternatively, size data for longline fleets may be provided as part of the Regional Observer Scheme where such fleets have at least 5% coverage of all fishing operations.

7. New Information on Biology, Ecology, Fisheries and Environmental Data Relating to Temperate Tunas

7.1 Review new information on the biology, stock structure, their fisheries and associated environmental data

Japanese longline fishery for albacore

25. The WPTmT **NOTED** paper IOTC–2012–WPTmT04–09 which provided an overview of the Japanese longline fishery and its albacore catch in the Indian Ocean, including the following abstract provided by the author:

> "*Status of effort, albacore catch, CPUE and body size was summarized for Japanese longline fishery operating in the Indian Ocean including recent trends. Japanese longline vessels were targeting albacore since late 1960s, albacore became non-target after that, but it has become one of target species in recent years. Fishing effort fluctuated and it is sharply decreasing in recent years probably due to the effects of pirates. Albacore catch was high in 1960s, sharply decreased in 1970s, and then gradually increased with fluctuation. In the early period, the effort was deployed mainly in the tropical area, and then expanded to the south. Fishing effort in the northwestern part (around Somalia) sharply decreased after 2009 due to pirates. During 1960s albacore was main component of the catch in the western part between 10°S and 35°S, and is also main component in the southern part including west off Australia. Size data of albacore has been almost constantly collected from on-board measurement, observer program and so on. Changes in fish size by season and area were observed.*"

26. The WPTmT **NOTED** the uneven time-area and generally low sampling coverage by scientific observers which is highest in the southern Indian Ocean below 30 degrees south, reflecting the observer program for southern bluefin tuna. It was **AGREED** that Japan should expand its scientific

observer program to ensure a representative sampling program of all areas fished is undertaken. Progress should be reported to the next WPTmT meeting.

27. The WPTmT **NOTED** the clear pattern of catch and effort moving out of the area in the north-west Indian Ocean by the Japanese longline fleet, which is considered to be a direct result of the impacts of piracy activities in this region.

28. The WPTmT **NOTED** that size data for albacore from the Japanese longline fleet are still very limited, however, the WPTmT was informed that with the deployment of observers since July 2010, more size data will continue to be reported to the IOTC Secretariat in 2012 and 2013.

Observer data from China

29. The WPTmT **NOTED** paper IOTC–2012–WPTmT04–16 Rev_1 which provided an overview of a new study on the growth of albacore based on Chinese observer data, including the following abstract provided by the authors:

"*The age and growth of fish are essential biological parameters for the assessment of fishery resources. Albacore tuna age and growth was studied by examining growth rings on the cross sections of the first dorsal fin spines based on 106 samples collected by Chinese scientific observers in the southern and central Indian Ocean from September 2008 to April 2009. The fork length (FL) of the Albacore tuna samples ranged from 97 to 120 cm, with the dominant FL class at 103-112 cm (85%). A comparison with Akaike information criterion (AIC) suggested that among power regression, linear regression, and exponential regression, linear regression equation was most suitable for describing the relationship between fork length and spine radius (AIC=754.30). The mean back-calculated FL was estimated by Fraser-Lee's method, and von Bertalanffy growth equation was* $L_t = 113.7\ [1–e^{-0.194(t + 8.39)}]$."

30. The WPTmT **THANKED** the scientists from China for providing a further update on research carried out as part of its national observer program, noting that this was a direct request of the previous WPTmT. The information gathered would provide useful comparative information for the draft albacore executive summary and for potential use in future stock assessments.

31. **NOTING** that the range of lengths used in the study was limited and may have an impact on the results presented, the WPTmT **REQUESTS** that China expands the study by collecting smaller albacore, and to present the findings at the next WPTmT meeting.

32. The WPTmT **ENCOURAGED** China and other CPCs to provide similar research reports on albacore biology, including through the use of fish otolith studies, either from data collected through observer programs or other research programs, at the next WPTmT meeting.

Mauritian catch and effort data for albacore

33. The WPTmT **NOTED** paper IOTC–2012–WPTmT04–12 which provided an overview of the catch and effort of vessels landing catch in Mauritius, including the following abstract provided by the authors:

"*Albacore tuna (Thunnus alalunga) caught in the Indian Ocean is a commercially valuable species in the tuna longline fishery, especially since 2008, when it was targeted by longliners. Based on logbook data collected and sampling of albacore landed in Mauritius by licensed foreign longliners from 2007 to 2011, the catch/ effort and length-frequency data of albacore has been compiled. As albacore tuna is also caught by local fishing boats, catch/ effort estimates based on samples collected at fish landing stations and final unloading data obtained from the local swordfish fishing operators are also compiled. Catch of albacore tuna by foreign licensed longliners landed in Mauritius has nearly doubled from 1 997 tons in 2007 to 3 580 tons in 2011, with a peak of 4 532 tons in 2010. A decline in fishing activity of the local swordfish fishing fleet was noted which brought along a decline in landings of albacore tuna from 74.4 tons in 2007 to 15.8 tons in 2011. Moreover, some 177 tonnes of albacore tuna are caught annually by the artisanal fishermen operating around anchored Fish Aggregating Devices (AFADs) on boats less than 12 m. During the period under review, a total of 14 472 specimens of albacore were sampled for length frequency. Fork length ranged from 68 cm to 133 cm, with nearly all fish (94%) in the 80-116 cm range, and the mean was 100.1 cm. From 2007 to 2011, more than 50% of the species transhipped in Mauritius consisted of albacore tuna, increasing from 12 182 tons in 2007 to around 20 765 tons in 2011.*"

34. The WPTmT **ENCOURAGED** Mauritius to make further progress in improving the monitoring of landings of albacore in Mauritius. This could include increased length frequency of port samples of

foreign vessels and to conduct additional length frequency analysis with respect to the local FAD fishery, biological sampling including gonads to determine sex and other morphometric measurements.

35. **NOTING** that there are a substantial number of vessels flagged to Malaysia and Indonesia which are calling at Mauritius for unloading, CPCs for which statistics are not fully reported, the WPTmT **ENCOURAGED** Mauritius to continue the collection of information on these fleets (see para. 21).

36. The WPTmT **AGREED** that Mauritius should make efforts to compare the information collected (i.e. catch, catch and effort and size frequency) with the information contained in logbooks (i.e. fishing area and period), in order to identify time-area strata for the length frequency data.

Indonesian longline fishery for albacore

37. The WPTmT **NOTED** paper IOTC–2012–WPTmT04–13 which provided catch and effort information for albacore by Indonesia's Indian Ocean tuna longline fishery based at Benoa fishing port, including the following abstract provided by the authors:

"*This paper presents the current information on catch and size distribution of Albacore (Thunnus alalunga) caught in the Eastern Indian Ocean based Benoa through catch monitoring and scientific observer program from 2011 – 2012 (up to June). The catch estimation of ALB landed at Benoa port in 2011 about 384.3 tons lower compared to ATLI (Indonesia Tuna Longline Assosiation) which up to 2,303 tons. These differences caused by most of ALB landed were frozen and in some processing plant this catch could not be covered due to accessibility. Length frequency measurements of ALB caught distributed from 36 – 128 cm (FL) and dominated by size 90 – 115 cm (FL). Information on fishing ground, hook rate, and length – weight relationship based on observer records were also presented.*"

38. The WPTmT **NOTED** the continued difficulties which Indonesia faces in adequately sampling albacore unloaded frozen at Benoa port due to accessibility problems.

39. The WPTmT **NOTED** the difficulties faced by Indonesian scientists and managers in terms of commercial catches being transhipped at sea and highlighted the need for logbooks to be utilised on all commercial fishing vessels, noting that this is already a mandatory requirement for IOTC CPCs.

40. The WPTmT **NOTED** the ongoing review of catches of albacore carried out by the IOTC Secretariat in consultation with the DGCF of Indonesia. The WPTmT was informed that the current catch estimates of albacore for Indonesia were derived from reports of albacore imports into canning factories cooperating with the ISSF, and **RECOMMENDED** that the IOTC Secretariat and Indonesia continue cooperation to finalize the review and report final estimates of catches of albacore to the next meeting of the WPTmT.

41. The WPTmT **RECALLED** that size frequency should be taken to the lowest centimeter, while it appears that some of the data from Indonesian observers, presented in paper IOTC–2012–WPTmT04–13, seems to indicate that some of the fish are measured in five centimeter classes. The author of the paper indicated that this was not the case and agreed to provide the raw data.

42. Noting that Indonesian catches represent more than 40% of the total albacore catches in the Indian Ocean, determined from the revised catch history developed by the IOTC Secretariat, the WPTmT **RECOMMENDED** that Indonesia further strengthen sampling efforts on its coastal and off-shore fisheries in early 2013, where required, and liaise with the IOTC Secretariat in order to better determine the catches of albacore by the Indonesian longline fleet.

Thailand longline fishery for albacore

43. The WPTmT **NOTED** paper IOTC–2012–WPTmT04–14 which provided an overview of the catch and effort by the Thailand flagged fleet, including the following abstract provided by the authors:

"*Three Thai tuna longliners were operated in the Indian Ocean since 2007, but there were only two longliners operated during 2008-2011. The main fishing ground was the central and southern part of the Indian Ocean. This report was based on the data extracted from fishing logsheets which were delivered to Department of Fisheries, Thailand. During 2007-2011, fishing operations in the Indian Ocean were recorded 2,276 fishing days. The highest total catch was in 2010 with 607.69 tonnes followed by 2007, 2011, 2009 and 2008, respectively (461.75, 370.39, 295.23 and 265.57 tonnes). The highest CPUE was found in 2010 with 13.62 fish/1000 hooks followed by 2007 and 2011, respectively (10.20 and 9.36 fish/1,000 hooks). In 2011, albacore tuna was the lowest catch by weight and number (11.44 tonnes and 353 fish), and its CPUE reduced to 0.34 fish/1,000 hooks. Moreover, the average composition by number of this species* *decreased from 32.8% (2007-2010) to 3.7% in 2011. The composition of albacore tuna by zone was the highest catch in the 3rd zone (3.74 tonnes and 119 fish). It was the lowest catch in the 4th zone (1.96 tonnes and 53 fish); however this zone was the highest CPUE of albacore tuna (0.59 fish/1,000 hooks).*"

44. The WPTmT **NOTED** that the decrease of albacore CPUE in 2011 was probably due to a change in targeting with the fishing vessels operating more in the equatorial area this year.

45. The WPTmT **REQUESTED** that Thailand present their catch and effort data by area and year at the next WPTmT meeting so as to enable participants to better understand the spatial and temporal nature of the fleet.

Korean longline fishery for albacore

46. The WPTmT **NOTED** paper IOTC–2012–WPTmT04–15 which provided an overview of the catch and effort by the Korean flagged fleet, including the following abstract provided by the authors:
"*To provide the information for assessing albacore stock status, the catch and effort for albacore tuna by Korean longline fishery in the Indian Ocean, 1965-2011, was reviewed using fisheries statistics from the IOTC data base and logbook data compiled from fishing vessels. The number of active fishing vessels showed the highest in the mid-1970s, and then have sharply decreased and reduced up to 7 vessels in 2011. The total catch trend by Korean tuna longline fishery generally followed that of the number of vessels engaged in fishing. The albacore tuna catch peaked at 9,206 mt in 1974 and decreased sharply thereafter, and it has started to increase since the mid-2000s. The CPUE of albacore tuna showed a steady trend from 1977 to 2002, and an increasing trend in recent years. The fishing ground of albacore tuna by Korean longline fishery distributed between 20°N and 20°S of the EIO and 20°N and 40°S of the WIO. It has moved gradually to the southern of the Indian Ocean and, in recent years, distributed mainly between 20°S and 40°S of the eastern and western Indian Ocean. This transition is supposed due to the pirate activities off the coast of Somalia and Korean southern bluefin tuna fishery*."

47. The WPTmT **NOTED** the clear pattern of catch and effort moving out of the area in the north-west Indian Ocean by the Rep. of Korea's longline fleet, which is considered to be a direct result of the impacts of piracy activities in this region.

48. The WPTmT **NOTED** that the reported increase in the catches of albacore, which have been combined with a decrease in the catches of bigeye tuna in recent years by the Rep. of Korea's longline fleet, was most likely related to the Rep. of Korea's southern bluefin tuna fishery pattern, and due to the increasing piracy activity in the western Indian Ocean which result in the displacement of longline vessels towards the southern Indian Ocean which are now targeting albacore.

49. The WPTmT **NOTED** the Rep. of Korea's efforts to review the historical data series and **REQUESTS** that this review be finalized and results reported to the IOTC Secretariat as soon as possible so that the statistics held in the IOTC database can be updated.

Other new information and general discussion

50. The WPTmT **NOTED** that, in recent years, the catches of albacore reported for longliners flagged to China in the Indian Ocean have increased markedly, and as this may originate from a change in targeting by some vessels, it was **RECOMMENDED** that China explore the reasons for this shift and report back to the next meeting of the WPTmT.

51. The WPTmT **RECOMMENDED** that as a matter of priority, India, Indonesia and Japan increase sampling coverage to attain at least the coverage levels recommended by the Commission, including:
    - catches sampled or observed for at least 5% of the vessel activities, including collection of catch, effort and size data for IOTC species and main bycatch species;
    - implementation of logbook systems for offshore fisheries.

    The information collected through the above activities should allow India, Indonesia and Japan to estimate catches by gear and species.

52. The WPTmT **NOTED** the information paper on albacore biology from the Pacific Ocean, IOTC–2012–WPTmT04–INF02.

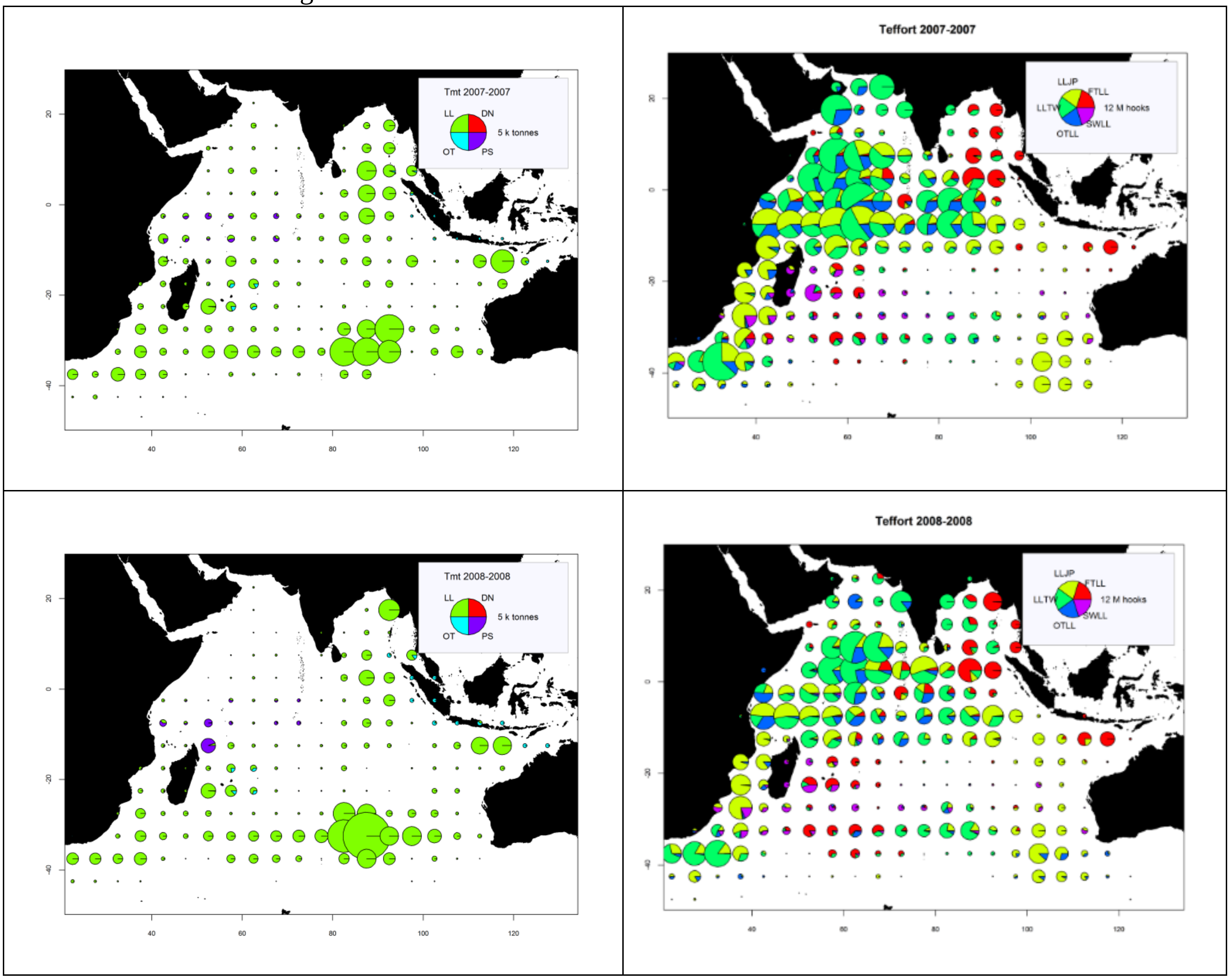
7.2 Effect of piracy on temperate tuna catches

53. The WPTmT **NOTED** that, although no specific analysis of the impacts of piracy on fisheries in the Indian Ocean were presented at this meeting, paper IOTC–2012–WPTmT04–09 and 15 indicated that there has been a substantial displacement of effort into traditional albacore fishing areas, thereby increasing fishing pressure on this species. In recent years, the proportion of fishing effort of the Japanese longline fleet sharply decreased in the north-western Indian Ocean (off the Somalia coastline), while fishing effort increased in the area south of 25°S, especially off western Australia, where catch rates of albacore are higher (Fig. 1).

54. The WPTmT **NOTED** that the number of active vessels from the Rep. of Korea has decreased from 26 in 2006 to 7 in 2011 (73% reduction). Since 2007, the Rep. of Korea tuna longline fleet has moved fishing grounds to south of 20°S in the Indian Ocean, especially to the waters off the western Australian coastline, where some targeting of albacore has occurred since 2010. This has resulted in an increase in catch despite an overall reduction of fishing effort (Fig. 1).

55. The WPTmT **RECOMMENDED** that given the potential impacts of piracy on the albacore fishery through the relocation of longliners into traditional albacore fishing grounds, specific analysis should be carried out and presented at the next WPTmT meeting by the CPCs most affected by these activities, including Japan, Rep. of Korea and Taiwan,China.

56. The WPTmT **NOTED** reports from Thailand, China and Taiwan,China that longline vessels from some fleets appear to be moving back towards the central Indian Ocean in 2012, as a direct result of increased CPUE being recorded in these areas. The WPTmT **AGREED** that this movement back into the area vacated due to piracy activities should be closely monitored and reported at the SC and the next WPTmT meeting.



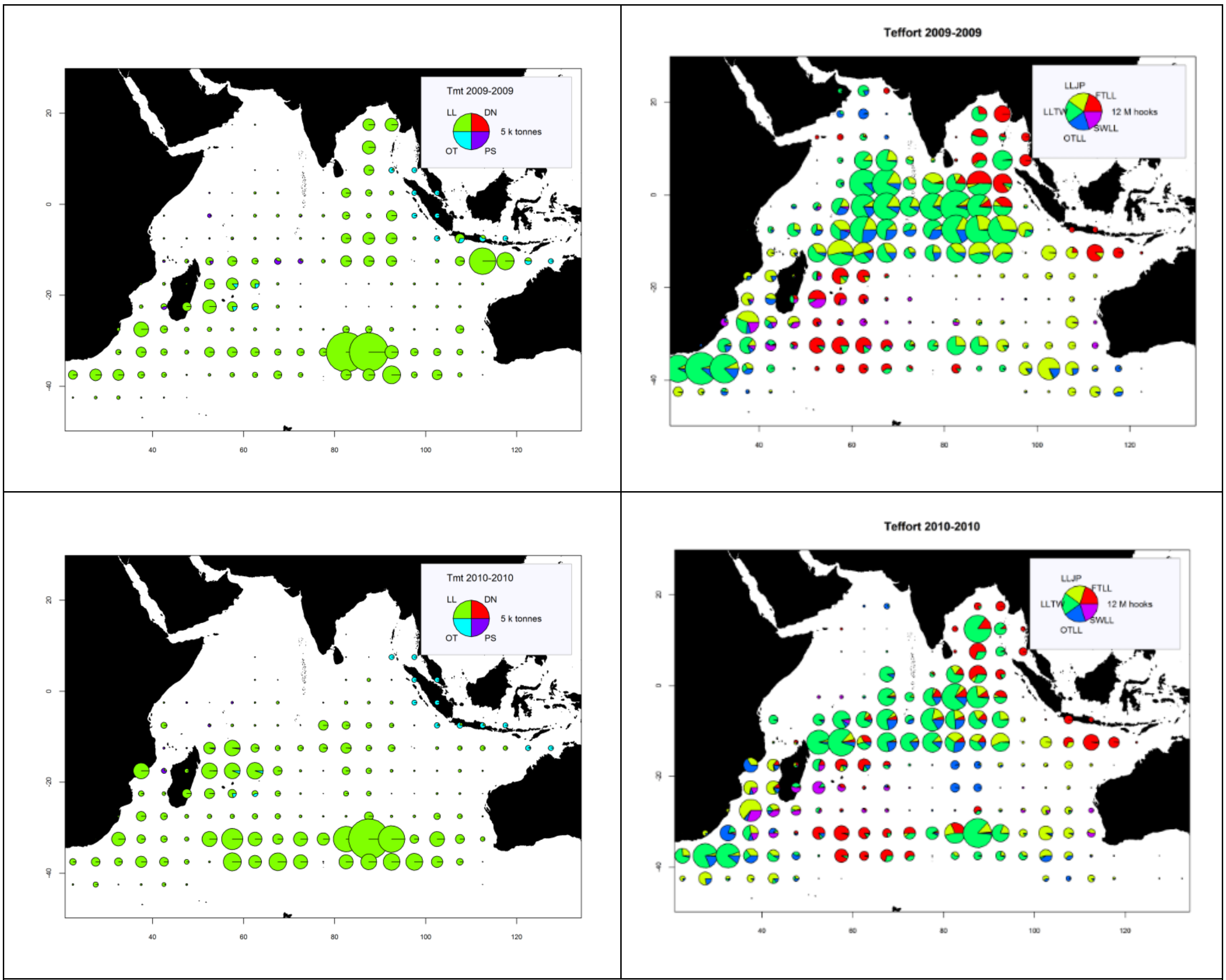


Fig. 1. The geographical distributions of catches by gear (tonnes; left column) and effort by the main longline fleets (millions of hooks; right column) for albacore caught in the IOTC area of competence, 2007–10.

Catch: Longline (LL, green), Driftnet (DN, red), Purse seine (PS, purple), Other fleets (OT, blue).

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).

8. Review of New Information on the Status of Albacore Tuna

8.1 Data for input into stock assessments (stock status indicators for albacore)

CPUE Standardisations

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

57. The WPTmT **NOTED** paper IOTC–2012–WPTmT04–17 which provided a standardized CPUE for albacore based on the Rep. of Korea's longline catch and effort statistics from 1986 to 2010, including the following abstract provided by the authors:

    "*CPUE standardization for albacore of Korean longline fisheries in the Indian Ocean was conducted by GLM using fisheries data (1986-2010), i.e., catch (number), effort (number of hooks) and number of hooks between floats (HBF) by year, month and 5°× 5° (Lat. and Long.) area. Albacore standardized CPUE showed the declining trend from the mid-1980s to the beginning of 2000s, and started to increase thereafter. Albacore standardized CPUE between Korea and Japan was similar, while Korean standardized CPUE showed a large increasing in 2010.*"

58. The WPTmT **AGREED** that operational level catch and effort data, which is likely to more accurately reflect the actual catch of albacore, should be used for the CPUE standardization of the Rep. of Korea

longline fishery data. Using catch and effort data which is aggregated to 5 x 5 degrees, is likely to miss key signals that may be present in the data.

59. The WPTmT **NOTED** that the large increase in the Rep. of Korea's longline CPUE from 2010, is a direct result of the targeting of albacore in the south-eastern Indian Ocean, a combined result of displaced effort from the western Indian Ocean and the Rep. of Korea's SBT fishing pattern.

60. The WPTmT **NOTED** a range of other matters regarding this paper which are relevant to the other papers presented on CPUE standardisation, as provided in the CPUE discussion summary, below.

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

61. The WPTmT **NOTED** paper IOTC–2012–WPTmT04–18 which provided a standardized CPUE for albacore based on Taiwan,China longline catch and effort statistics from 1980 to 2011, including the following abstract provided by the authors:

"*Standardized abundance indices of Indian albacore, dating from 1980 to 2011, based on Taiwanese longline catch and effort statistics by using Generalized Liner Model (GLM) procedure were carried out in present study. Subareas, subdivided by nominal CPUE composition stemmed from area-time catch specifications, as well as factors of year, quarter, bycatch effects of bigeye tuna, yellowfin tuna, and swordfish were used to construct the GLM for obtaining the standardized yearly CPUE trend from 1980 to 2011. Standardized quarterly CPUE series from the 1st quarter of 1980 to the 4th quarter of 2011 were also performed by using quarter-series, subareas, bycatch effects of bigeye tuna, yellowfin tuna, and swordfish as factors of concern.*

The factor of subareas, which may have an indication of habitat specification, always showed the major explanatory factor to the total variance. Thus a better aggregation on those unit statistical blocks, which may have similar habitat specification, is essential for obtaining a better abundance index. In present study, the nominal CPUE of three main species and "other fishes" in 5 degree statistical blocks were used to process the hierarchical cluster analysis and resulted in a dendrogram of 4 clusters of fishing block.

Yearly CPUE trend of Indian albacore thus obtained indicated that it appeared a decline trend from early 1980s to early 1990s, and leveled off since early 1990s up to early 2000s, then decreased till mid 2000s, and leveled off since mid 2000s up to 2011. Quarterly CPUE trend showed a similar trend as those of yearly fluctuations. Incidentally, a periodic up and down in CPUE series was also notified as a cycle of about ten years."

62. The WPTmT **AGREED** that the CPUE standardization could be improved by using different north/south boundaries to test the robustness/sensitivity of the analysis to the spatial assumptions used.

63. The WPTmT **NOTED** that the current analysis does not consider any interactions, and therefore, further examination of interactions such as area/quarter should be carried out. This is required as the Taiwanese CPUE appears to be the most stable of those available for use in stock assessments and as a result, there needs to be confidence that the series is representative of variations in stock abundance.

64. The WPTmT **NOTED** a range of other matters regarding this paper which are relevant to the other papers on CPUE standardisation, as provided in the CPUE discussion summary, below.

Japanese – Catch-per-unit-effort analysis (CPUE)

65. The WPTmT **NOTED** paper IOTC–2012–WPTmT04–10 Rev_1 which provided a standardized CPUE series for albacore based on Japanese longline catch and effort statistics from 1966 to 2011, including the following abstract provided by the authors:

"*Standardization of albacore CPUE by Japanese longline fishery in the Indian Ocean during 1966-2011 was conducted using the General Linear Model (GLM) with log-normal (LN model) and negative binomial (NB model) error structures. Original (operational level) catch and effort data were used for standardization. Based on the distributions of standardized residuals, LN model was considered to be better. CPUE declined during 1966-1979, was comparatively stable until mid-1990s and increased after that until the latest year. CPUE in 2011 was similar level to that in in the late 1960s. CPUE for both LN and NB models indicated similar trend. Quarterly CPUE indicated strong seasonality and was usually higher in the second and third quarter. Based on targeting strategy for Japanese longline fishery, it may be better to truncate CPUE in the early period (for example until 1960s) for using in the stock assessment models.*"

66. The WPTmT **NOTED** that the analysis intentionally used coarse area definitions to assess the impact of the size of area used in the analysis, and to replicate the analysis for the Rep. of Korea and Taiwan,China longline fishery data.

67. The WPTmT **NOTED** that the use of negative binomial distributions is a possible way to deal with so-called "0-data", but the amount of observed 0-data might exceed the level of the amount which can be expected in the negative binomial distributions. Instead, a kind of zero-inflated discrete distribution or a delta-lognormal distribution are worth using to remedy this problem.

68. The WPTmT **NOTED** a range of other matters regarding this paper which are relevant to the other papers on CPUE standardisation, as provided in the CPUE discussion summary, below.

CPUE information papers

69. The WPTmT **NOTED** information papers IOTC–2012–WPTmT04–INF04, 05 and 06, related to the CPUE standardisations discussed above. The core elements from each paper have been incorporated into the CPUE discussion summary below, for working papers IOTC–2012–WPTmT04–17, 18 and 10 Rev_1.

CPUE discussion summary

70. The WPTmT **AGREED** that the spatial structure used in the CPUE analysis in 2012, may not be consistent with the biology and fisheries for albacore. It was considered that a separation based on a consistent element such as the biology of the fish, which is likely to be more consistent than fleet dynamics which change over time, should be used to define the spatial nature of the fishery. In this case the data should be examined to determine the latitude and/or longitude at which spatial changes in average size are most apparent. The selected area separation could also be used for CPUE standardisation.

71. **NOTING** that a set of ‘core areas’ which are likely to be robust to frequent fluctuations of external factors, may be more informative than using all of the data available, especially when other species were being targeted, the WPTmT **RECOMMENDED** that ‘core areas’ be identified and agreed to by the WPTmT so as to facilitate and monitor population abundance trends across all fleets. This should be carried out intersessionally and presented at the Scientific Committee’s proposed longline CPUE workshop, to be held in the second quarter of 2013. The authors of the three CPUE papers presented during the WPTmT agreed to lead this work, in collaboration with the IOTC Secretariat.

72. The WPTmT **AGREED** that the following matters shall be taken into account when undertaking CPUE standardisation analysis in 2013:

- The WPTmT **AGREED** that changes in species targeting is the most important issue to address in CPUE standardisations, and that the following points should be taken into consideration:
  - i. While hooks between floats (HBF) provides some indication of setting depth, it is generally considered not to be a sufficient indicator of species targeting. HBF is just one aspect of the setting technique, which can vary by species, area, set-time, and other factors.
  - ii. Highly aggregated (e.g. 5x5 degrees) data can make it difficult to observe the factors driving CPUE in a fishery, in particular the targeting effects. Operational data provides additional information that may allow effort to be classified according to fishing strategy (e.g. using cluster analyses or regression trees to estimate species targeting as a function of spatial areas, bait type, catch species composition, set-time, vessel-identity, skipper, etc.). Operational data also permits vessel effects to be included in analyses.
  - iii. The inclusion of other species as factors in a Generalized Linear Model (GLM) standardization may be misleading, because the abundance of all species changes over time. Including these factors may also fail to resolve problems due to changes in targeting, particularly when modeling aggregated data. However, comparing models with and without the other species factors can be useful to identify whether there is likely to be a targeting problem.

- The WPTmT **AGREED** that appropriate spatial structure needs to be considered carefully as fish density (and targeting practices) can be highly variable on a fine spatial scale, and it can be misleading to assume that large areas are homogenous when there are large shifts in the spatial distribution of effort. The following points should also be taken into consideration:
  - i. Addition of finer scale (e.g. 5x5 degrees) fixed spatial effects in the model can help to account for heterogeneity within sub-regions.

ii. Efforts should be made to identify spatial units that are relatively homogeneous in terms of the population and fishery to the extent possible (e.g. uniform catch size composition and targeting practices).
iii. There may be advantages in conducting separate analyses for different sub-regions. The error distribution may differ by sub-region (e.g. proportion of zero sets), and there may be very different interactions among explanatory variables.
iv. If the selectivity differs among regions (e.g. due to spatial variability in the age composition of the population, it may not be appropriate to pool sub-regional indices into a regional index (e.g. albacore populations seem to be partitioned with spawners caught predominantly in the equatorial/tropical regions and juveniles caught predominantly in the temperate waters, and the two age categories could have somewhat different CPUE trends).
v. The possibility of defining a representative 'space-time' window: if this leads to the identification of a fishery with homogeneous targeting practices, it is probably worthwhile. However, it may not be possible to identify an appropriate window, or the window may be so small that it is not representative of the larger population (or has a high variance).

- The WPTmT **AGREED** that if there are many observations with positive effort and zero catch, it is worth considering models which explicitly model the processes that lead to the zero observations (e.g. negative binomial, zero-inflated or delta-lognormal models). Adding a small constant to the lognormal model may be fine if there are few zero's, but may not be appropriate for areas with many zero catches (e.g. north of 10^{o}S). Sensitivity to the choice of constant should be tested.

- The WPTmT **NOTED** that the appropriate inclusion of environmental variables in CPUE standardization is an ongoing research topic. Often these variables do not have as much explanatory power as, or may be confounded with, fixed spatial effects. This may indicate that model-derived environmental fields are not accurate enough at this time, or there may need to be careful consideration of the mechanisms of interaction to include the variable in the most informative way.

- The WPTmT **AGREED** that it is difficult to prescribe analyses in advance, and model building should be undertaken as an iterative process to investigate the processes in the fishery that affect the relationship between CPUE and abundance. Specifically:
  i. Model building should proceed with a stepwise introduction of explanatory terms, in which the net effect of each level of complexity is presented. Parameter estimates should be presented and examined to see if the mechanism makes sense and the contribution has a practical influence.
  ii. Simulations have shown that model selection using Akaike Information Criterion (AIC) tends to recommend over-parameterized models.

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

74. The WPTmT **AGREED** that there was merit in exploring the option of using all data from the three main fleets (Taiwan,China, Japan and Rep. of Korea) together in a combined CPUE analysis with a common area definition, to avoid missing combinations (area/quarter/other factors), by incorporating a "fleet effect". This may lead to a single standardised CPUE series which would avoid the need for CPUE series weighting.

75. The WPTmT **NOTED** that of the CPUE series available for assessment purposes, listed below, the Taiwan,China series or a combined CPUE (weighted average of Japan and Taiwan,China) were used in the stock assessment models for 2012, for the reasons discussed above (shown in Fig. 2).
   - Rep. of Korea data (1986–2010): Series from document IOTC–2012–WPTmT04–17 Rev_1
   - Taiwan,China data (1980–2011): Series from document IOTC–2012–WPTmT04–18
   - Japan data (1966–2011): Series from document IOTC–2012–WPTmT04–10 Rev_1
   - Weighted average by catch (1980–2011): Taiwan,China and Japan series from above.

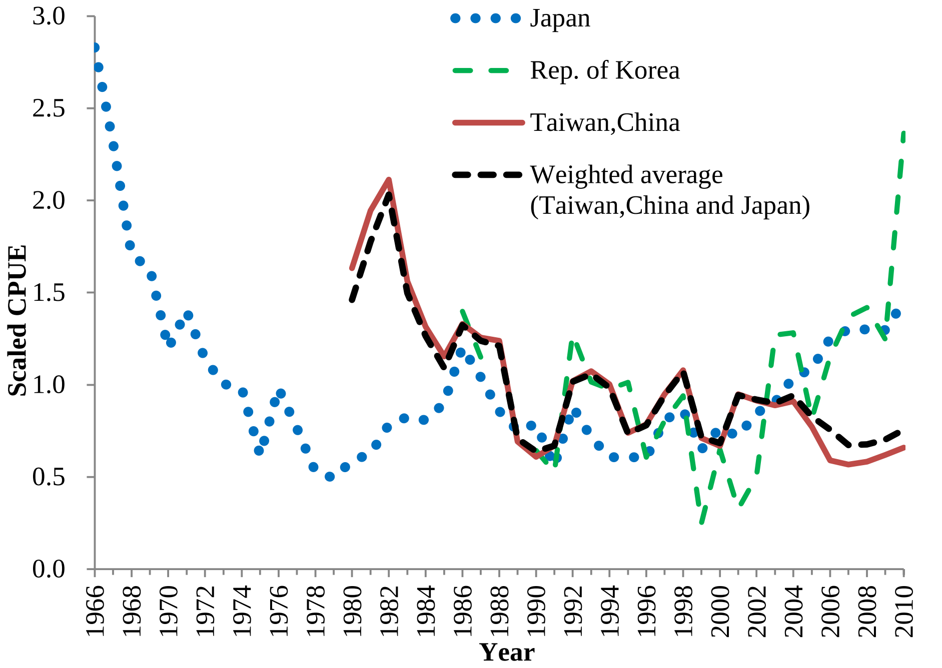


Fig. 2. Comparison of the three CPUE series for longline fleets fishing for albacore in the IOTC area of competence, as well as the weight average of the Taiwan,China and Japan series. Series have been rescaled relative to their respective means from 1966–2010.

8.2 Stock assessments

76. The WPTmT **NOTED** that a range of quantitative modelling methods (ASPIC, ASPM and SS3) were applied to the albacore assessment in 2012, ranging from the highly aggregated ASPIC surplus production model to the age-, sex- and spatially-structured SS3 analysis. The different assessments were presented to the WPTmT in documents IOTC–2012–WPTmT04–19, 20 Rev_2, 21 Rev_3 and 11 Rev_2. Each model is summarized in the sections below.

Summary of stock assessment models in 2012: albacore

77. The WPTmT **NOTED** Table 1 which provides an overview of the key features of each of the four stock assessments presented in 2012 (3 model types) and Table 2, which provides a summary of the assessment results.

Table 1. Summary of final stock assessment model features as applied to the Indian Ocean albacore resource in 2012.

Model feature	**ASPIC (Doc #20 Rev_2)**	**ASPM 1 (Doc #19)**	**ASPM 2 (Doc# 21 Rev_4)**	**SS3 (Doc# 11 Rev_2)**
Software availability	NMFS toolbox	A. Punt	Rademeyer & Nishida	NMFS toolbox
Population spatial structure / areas	1	1	1	1
Number CPUE Series	1 (combined)	2	1 (combined)	1 (TWN,CHN); 1 (combined)
Uses Catch-at-length/age	No	Yes	Yes	Yes
Age-structured	No	Yes	Yes	Yes
Sex-structured	No	No	No	Yes
Number of Fleets	2	1	2	5
Stochastic Recruitment	No	Yes	Yes	Yes

78. The WPTmT **AGREED** that there is value in undertaking a number of different modelling approaches to facilitate comparison, and **RECOMMENDED** that spatially structured integrated models, which are capable of more detailed representation of complicated population and fishery dynamics, and integrate several sources of data and biological research that cannot be considered in the simpler production models, be carried out for the next WPTmT, as data and resources permit.

Table 2. Summary of final model features for 2012, along with the results of the assessment from 2011 for the Indian Ocean albacore resource.

Management quantity	ASPIC	ASPM (base case)	SS3 (four preferred/ plausible scenarios: median & range)	ASPIC (2011)
Most recent catch estimate (t) (2010)	42,968			43,714
Mean catch over last 5 years (t) (2006–2010)	39,833			41,076
h (steepness)	n.a	0.7 (fixed)	0.7 or 0.8 (fixed)	n.a.
MSY (1,000 t) (80% CI) [plausible range of values]	35.9 (31.3–39.1)	33.3 (31.1–35.6)	27.6 [25.3–30.3]	29.9 (21.5–33.1)
Data period (catch)	1950–2010	1950–2010	1950–2010	1950–2010
CPUE series	JPN+TWN LL (weighted by catch) (annual)	TWN LL (annual)	TWN LL (quarterly) or JPN+TWN LL (weighted by catch)	TWN LL (annual)
CPUE period	1980–2010	1980–2010	1980–2010	1980–2010
$F_{current}/F_{MSY}$ (80% CI) [plausible range of values]	1.00 (0.75–1.24)	1.33 (0.90–1.76)	1.60 [1.24–2.11]	1.61 (1.19–2.22)
$B_{current}/B_{MSY}$ (80% CI) [plausible range of values]	1.16 (0.96–1.49)	n.a.	n.a.	0.89 (0.65–1.12)
SB_{2010}/SB_{MSY} (80% CI) [plausible range of values]	n.a.	1.05 (0.54–1.56)	0.92 [0.67–1.27]	n.a.
SB_{2010}/SB_{MSY} (80% CI) [plausible range of values]	n.a.	n.a.	n.a.	n.a.
B_{2010}/B_{1950} (80% CI)	0.44 (n.a.)	n.a.	n.a.	0.39 (n.a.)
SB_{2010}/SB_{1950} (80% CI) [plausible range of values]	n.a.	0.29 (n.a.)	0.23 [0.18–0.28]	n.a.
$SB_{2010}/SB_{current,\ F=0}$	n.a.	n.a.	n.a.	n.a.

A Stock-Production Model Incorporating Covariates (ASPIC)

79. The WPTmT **NOTED** paper IOTC–2012–WPTmT04–20 Rev_2 which provided a stock assessment for albacore in the Indian Ocean by A Stock-Production Model Incorporating Covariates (ASPIC) which incorporates some of the improvements agreed at last years' WPTmT meeting, including the following abstract provided by the authors:

"Assessment of albacore stock in the Indian Ocean based on ASPIC was conducted using latest data. Catch (Japanese and Taiwanese longline including similar longline fisheries, and other fisheries, 1950-2010) and standardized CPUE (Japanese and Taiwanese longline) were incorporated. Catch and CPUE for Japanese and Taiwanese longline were incorporated separately or as a combined index (weighted average by catch as for CPUE). Convergence and reasonable results were obtained for the scenarios with combined longline catch and CPUE, and fixed B1/K (0.9 or 0.8). Taiwanese STD CPUE vs. catch in 1980-2010 is reasonably reflected, however, Japanese STD CPUE and catch are not well reflected, and probably that is why convergences were not obtained in the ASPIC analyses with Japanese STD CPUE except for combined index. As a result, MSY was estimated to be 35,900 tons, and TB (total biomass) ratio and F ratio (ratio of 2010 level to MSY level) was 1.16 and 1.00, respectively. The recent catch level is about 40,000 tons, which is about 4,000 tons higher than the MSY level. Hence the albacore stock is considered to be slightly overfishing. The Kobe plot 1 shows large confidential surfaces which imply that ASPIC analyses include large uncertainties. According to KOBE II (risk assessments), if current catch level will be maintained, then TB will exceed TB (MSY) in

74% of the probability and F(MSY) in 82% in 2020 (10 years later). Under such circumstances, both catch and F should be kept below current levels until the risk probability decreases. The results in the present study were a bit more optimistic than those for last assessment."

80. The WPTmT **NOTED** the key assessment results for A Stock-Production Model Incorporating Covariates (ASPIC) as shown below (Tables 3 and 4; Fig. 3).

Table 3. Key management quantities from the ASPIC assessment, for the Indian Ocean.

Management Quantity	Indian Ocean
2010 catch estimate	42,968
Mean catch from 2006–2010	39,833
MSY (1000 t) (80% CI)	35.9 (31.3–39.1)
Data period used in assessment	1950–2010
F_{2010}/F_{MSY} (80% CI)	1.00 (0.75–1.24)
B_{2010}/B_{MSY} (80% CI)	1.16 (0.96–1.49)
SB_{2010}/SB_{MSY}	–
B_{2010}/B_{1950} (80% CI)	0.44 (n.a.)
SB_{2010}/SB_{1950}	–
$B_{2010}/B_{1950, F=0}$	–
$SB_{2010}/SB_{1950, F=0}$	–

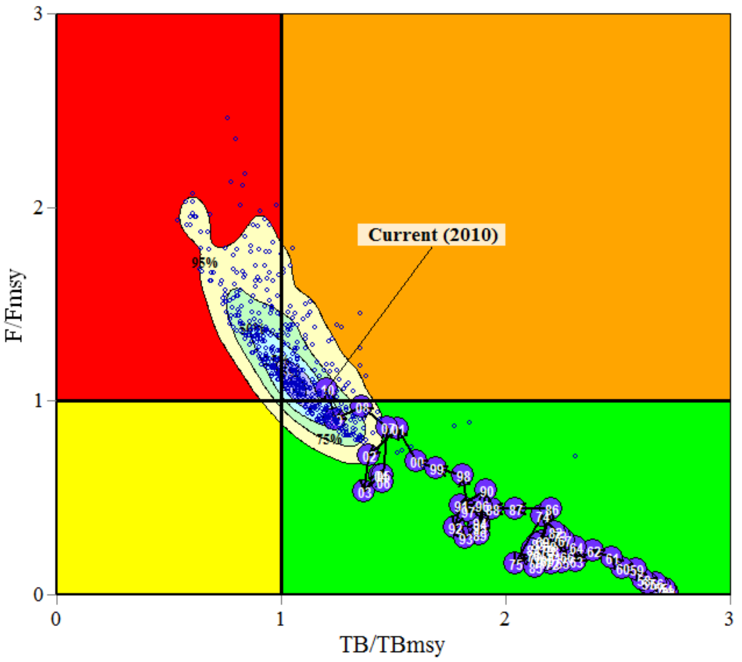


Fig. 3. ASPIC Aggregated Indian Ocean assessment Kobe plot (95% bootstrap confidence surfaces shown around 2010 estimate). Fixed B(1950)/K=0.9. Blue circles indicate the trajectory of the point estimates for the TB ratio and F ratio for each year 1950–2010.

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

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

81. The WPTmT **NOTED** the following with respect to the modelling approach present at the meeting:
    - That the Taiwan,China CPUE standardisation should be used over the Japanese CPUE series because the Japanese CPUE demonstrates strong targeting shifts away from albacore (1960s) and toward albacore in recent years (as a consequence of piracy in the western Indian Ocean), that was not accounted for in the standardization analysis.
    - The Fox model had problems converging to a sensible solution when the Japanese CPUE were given substantial weight, and/or when the initial biomass was constrained to be less than or equal to the carrying capacity.

82. The WPTmT **NOTED** that there was some incompatibility among the CPUE series, catch data and the Fox model. The structural rigidity of the Fox model limits the number of ways in which the error processes can be examined, and it was felt that this limited the scope of the analysis. Attempts to resolve the limitations are encouraged, as is the use of alternative models.

83. The WPTmT **NOTED** that the general population trends and MSY parameters estimated by the Fox model appeared to be plausibly consistent with the general perception of the fishery and the data. However, these results are considered to be highly uncertain because of i) uncertainty in the catch rate standardization, ii) uncertainty in recent catches, and iii) limited ability to explore alternative interpretations of the data due to software constraints.

84. The WPTmT **AGREED** that noting the uncertainties described above, the results of the assessment indicate that the stock biomass is approaching the MSY level, and that current fishing effort is at or above MSY levels.

85. The WPTmT **NOTED** that ASPIC is a simple model which uses few biological parameters and that a logistic model was not used because of biases based on the model.

86. The WPTmT **NOTED** that the model has at most only three paramters (mostly only two parameters: r and K), but convergence was not reached in the optimization of likelihood function. As exploitation began in 1950, it seems reasonable to assume B1/K to be 1. However, this scenario resulted in "non-convergence" and therefore the authors conclude that B1/K=0.9 should be used in the assessment. To evaluate the impact of assumption of B1/K on the stock indicators, an assessment based on a Bayesian production mode was undertaken to avoid failure of optimization of likelihood (there is no need of optimization in Bayesian analysis). The result showed that the assumption of B1/K was not influential to B/B_{MSY} and F/F_{MSY} although the values were slightly different, and therefore the authors' conclusion based on B1/K is not considered problematic, but further investigation and analyses are required including the use of the Pella-Tomlison model.

Age-structured production model (ASPM – 1)

87. The WPTmT **NOTED** paper IOTC–2012–WPTmT04–19 which provided a stock assessment for albacore in the Indian Ocean by an Age-Structured Production Model (ASPM), including the following abstract provided by the authors:

    "*Mainly based on 1967-2011 Taiwanese longline and historic Japanese longline catch & effort data and annual Indian albacore catch compiled by IOTC, an age-structured production model algorithm was adopted and exercised for assessing the stock surplus potentials of Indian albacore. Further assumed that (1) official VBGE parameters of South Atlantic albacore and (2) selectivity patterns of Taiwanese & Japanese longline fisheries operating in the South Atlantic Ocean were adequate to transfer to Indian albacore resource as a first trial for this study.*

    Results thus obtained indicated that (1) estimates of B/K appeared to decline from 1968 to 1979, then rose slightly in the early 1980s and appeared leveled off in 2011; (2) current exploitable biomass is estimated to be 98 % of that in 1950 (the beginning of albacore longline fishery in the Indian is assumed); (3) ratio of B2011/K appeared to be larger than 0.2, which deemed as a threshold of "something bad" when the biomass falling below this level (Francis, 1992); (3) ratio of is larger than 1.0 from 1950 to 2011; (4) ratio of is currently equal to 2.03; (5) fishing mortality F2011 is estimated as 53.5% of FMSY; and (5) although MSY level estimated by the data to be about 44,000 mt per year, projecting results for various TACs indicate that the 42,000 mt level will introduce about 40% risk endurance whereas 40,000 mt level will exert about 30% risk endurance if taking precautions measures into consideration."

88. The WPTmT **NOTED** that this assessment was preliminary in nature and as such, the authors presented it for general information purposes only, while the model is further developed. The

preliminary results were acknowledged as being consistent with the second ASPM paper provided to the meeting (IOTC–2012–WPTmT04–21 Rev_4). As such, no detailed results are presented.

89. The WPTmT **AGREED** that as the assessment incorporates autocorrelation in the recruitment deviations, it would be beneficial for a revised version of the assessment to produce times series of recruitment deviations as well as the usual scatter plot for estimated spawner-recruitment relationship.

90. The WPTmT **NOTED** that the assessment attempted to incorporate the autocorrelation in the recruitment deviations, so it was suggested to produce a times series of recruitment deviations as well as the normal scatter plot for estimating the spawner-recruitment relationship. It was not clear which value of steepness was used, and using several options for that unknown parameter was desirable. Natural mortality of 0.3 was used, although the authors were encourage to use alternatives in sensitivity runs for presentation at the next WPTmT meeting. The authors were question on how the age-selectivity curve was developed, and the author explained that it was derived from the stock assessment for Atlantic albacore, and not estimated in the model by using catch-at-age data.

91. The WPTmT **REQUESTED** that any future revision to the assessment should include projections to meet the Commission's request for a Kobe 2 management strategy matrix to be presented for each assessment.

Age-structured production model (ASPM – 2)

92. The WPTmT **NOTED** paper IOTC–2012–WPTmT04–21 Rev_4 which provided a stock assessment for albacore in the Indian Ocean by an 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 albacore tuna stock (Thunnus alalunga) in the Indian Ocean using 61 years of data (1950-2010). The results suggested that the fishing effort (2010) is the above MSY level (F/Fmsy=1.33), while the spawning stock biomass (SB) is around at the MSY level (SB/SBmsy=1.05). This means that the current status of the albacore stock is the overfishing and its population is now reaching to its MSY level. The risk assessments suggested that current catch in 2010 (43,000 t) should be reduced to at least 20% (i.e., 34,000t, close to the MSY level: 33,000 t) to keep lower risks to violate Fmsy and SBmsy levels.*"

93. The WPTmT **NOTED** the key assessment results for the age-structured production model (ASPM) as shown below (Tables 5 and 6; Fig. 4).

Table 5. Key management quantities from the ASPM assessment, for the aggregate Indian Ocean.

Management Quantity	Aggregate Indian Ocean (TWN,CHN CPUE only) (base case)	Aggregate Indian Ocean (TWN,CHN and JPN CPUE weighted by catch) (sensitivity run2)
2010 catch estimate	42,968	42,968
Mean catch from 2006–2010	39,833	39,833
MSY (1000 t) (80% CI)	33,300 (31,100–35,600)	33,300 (31,100–35,600)
Data period used in assessment	1950–2010	1950–2010
F_{2010}/F_{MSY} (80% CI)	1.33 (0.90–1.76)	1.21 (0.45–1.98)
B_{2010}/B_{MSY} (80% CI)	–	–
SB_{2010}/SB_{MSY} (80% CI)	1.05 (0.54–1.56)	1.15 (0.64–1.66)
B_{2010}/B_{1950} (80% CI)	–	–
SB_{2010}/SB_{1950}	0.29 (n.a.)	0.32 (n.a.)
$B_{2010}/B_{1950,\ F=0}$	–	–
$SB_{2010}/SB_{1950,\ F=0}$	–	–

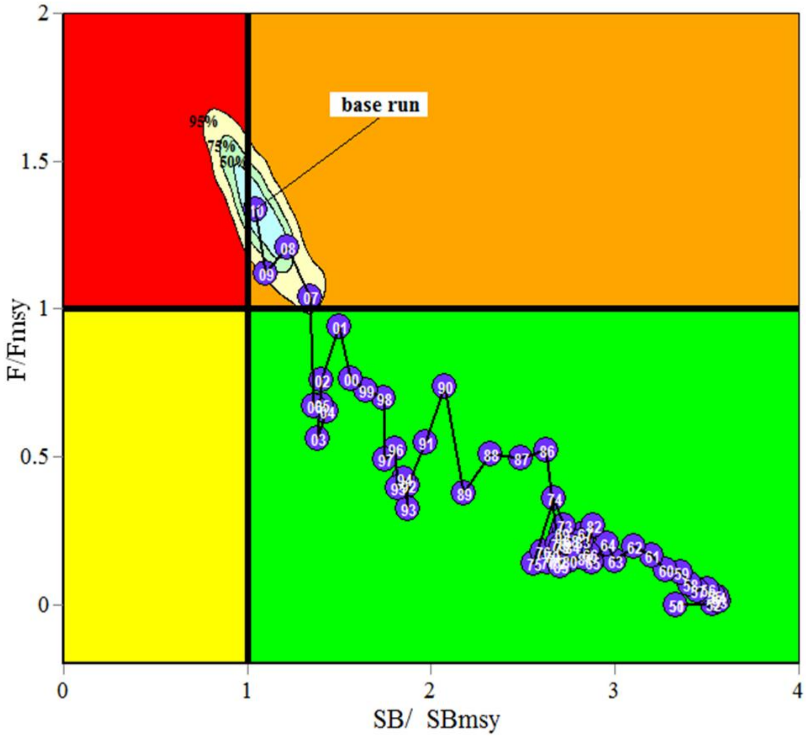


Fig. 4. ASPM Aggregated Indian Ocean assessment Kobe plot (95%, 75% and 50% MCMC confidence surfaces shown around 2010 estimate). Blue circles indicate the trajectory of the point estimates for the SB ratio and F ratio for each year 1950–2010.

Table 6. ASPM Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of violating the MSY-based reference points for five constant catch projections (2010 catch level, ± 10% ± 20%, ± 30% and ± 40%) projected for 3 and 10 years.

Reference point and projection timeframe	Alternative catch projections (relative to 2010) and probability (%) of violating MSY reference points								
	60%	**70%**	**80%**	**90%**	**100%**	**110%**	**120%**	**130%**	**140%**
$SB_{2013} < SB_{MSY}$	<1	1	8	15	23	35	46	55	65
$F_{2013} > F_{MSY}$	<1	2	18	47	74	91	98	>99	>99
$SB_{2020} < SB_{MSY}$	<1	<1	12	40	69	90	>99	>99	>99
$F_{2020} > F_{MSY}$	<1	<1	20	67	94	>99	>99	>99	>99

94. The WPTmT **NOTED** the following with respect to the modelling approach present at the meeting:
- The positive correlation between catch and CPUE in recent years for the Japanese and Korean CPUE is unusual, and questioned why this would be the case. Albacore have recently been more heavily targeted mainly in the eastern Indian Ocean as a result of displaced effort in the western Indian Ocean. As a result, areas which have not been heavily fished for many years are now producing high catches of albacore.
- Natural mortality (M) used in the analysis is derived from Lee and Liu (1992), which was estimated based on the samples caught by the gillnet fishery which is dominated by small fish. As a consequence, sensitivity analyses using different M was suggested for further analysis.
- Although most participants felt that it would be better to divide the input data into five instead of two, the author explained that such scenarios were attempted, but didn’t converge.
- It was suggested that the size data for “other” fisheries (other than longline) is not sufficient and urged the authors to combine these fisheries for future analysis.
- The age-selectivity curve for the “other” fishery seemed erroneous, and is most likely a function of the combination of several fisheries in this category.

Stock Synthesis III (SS3)

95. The WPTmT **NOTED** paper IOTC–2012–WPTmT04–11 Rev_2 which provided a stock assessment for albacore in the Indian Ocean by Stock Synthesis III (SS3) model, including the following abstract provided by the authors:

"*Stock assessment for the Indian Ocean albacore tuna based on the Stock Synthesis III (SS3) was attempted with consideration of available information on catch, abundance indices and length frequency up to 2010. A total of five fisheries were defined. Three independent CPUE series (Japan, Taiwan and Korea) were available for tuning indices. Quarterly length compositions from the different fisheries contributed to the likelihood in addition to the populations indices. The Several biological and ecological parameters such as the growth curves, length-weight relationship, natural mortality and steepness were assumed to be known (see main text of this paper) when optimizing the likelihood. Results based on the three independent incompatible CPUE series produced unreasonable results. Therefore, a CPUE series for Taiwanese longline fishery, in which fishing operation and fishing ground have been stable and its catch accounts for a large extent of total catch in the Indian Ocean, was employed in the base case scenario. Also, the weighted average of Japanese and Taiwanese CPUEs was also used in sensitivity tests.*

In a base case scenario (here natural mortality=0.2207, steepness=0.8 and SD of recruitment deviation=0.2), the current F/F_{MSY} and SB/SB_{MSY} were estimated as 1.657 and 0.844, respectively. A current SB(2010)/SB(1950) ratio was at 0.186, and the level of MSY was assessed as 28,093 (t). The figures become more optimistic when the abundance index was replaced with the averaged one; the current F/F_{MSY} and SB/SB_{MSY} were respectively 1.242 and 1.268 and MSY was 30,296 (t). The estimated stock indices were sensitive to changes in the value of steepness, natural mortality, the extent of recruitment deviation and abundance indices, but the outcome of this exercise provides some implications to the interpretation of the albacore stock, in which some of key biological parameters are unknown and have uncertainty, because other stock assessment methods failed to provide comprehensive sensitivity tests due to lack of convergence in optimization.

Run	CPUE	Natural Mortality (M)	Steepness (h)	Recruitment deviation (σR)	F_{2010}/F_{MSY}	SSB_{2010}/SSB_{MSY}	SSB_{2010}/SSB_{1950}	MSY
1	Taiwanese CPUE only	0.2207	0.6	0.2	2.614	0.563	0.171	23,135 t
2	Taiwanese CPUE only	0.2207	0.7	0.2	2.113	0.667	0.176	25,291 t
3 (base)	Taiwanese CPUE only	0.2207	0.8	0.2	1.657	0.844	0.186	28,093 t
4	Taiwanese CPUE only	0.2207	0.9	0.2	1.234	1.209	0.204	32,125 t
5	Taiwanese CPUE only	0.4	0.8	0.2	0.997	1.349	0.264	36,444 t
6	Taiwanese CPUE only	0.2207	0.8	0	0.469	2.994	0.612	59,074 t
7	Taiwanese CPUE only	0.2207	0.8	0.4	1.477	0.913	0.201	30,533 t
8	Weighted average of JPN and TWN CPUEs	0.2207	0.7	0.2	1.546	1.011	0.267	27,162 t
9	Weighted average of JPN and TWN CPUEs	0.2207	0.8	0.2	1.242	1.268	0.281	30,296 t

The work would be a possible kick-off for future improvement toward management advice and also a basis of developing operating models (OMs) in the management strategy evaluations (MSEs)."

96. The WPTmT **NOTED** the key assessment results for the Stock Synthesis III model (SS3) as shown below (Table 7; Fig. 5).

Table 7. Key management quantities from the SS3 assessment for the Indian Ocean. Median value and range of four plausible runs 2, 3, 8 and 9 (in brackets).

Management Quantity	Aggregate Indian Ocean
2010 catch estimate	42,968
Mean catch from 2006–2010	39,833
MSY (1000 t)	27.6 (25.3–30.3)
Data period used in assessment	1950–2010
F_{2010}/F_{MSY}	1.60 (1.24–2.11)
B_{2010}/B_{MSY}	n.a.
SB_{2010}/SB_{MSY}	0.92 (0.67–1.27)
B_{2010}/B_{1950}	–
SB_{2010}/SB_{1950}	0.23 (0.18 – 0.28)
$B_{2010}/B_{1950, F=0}$	–
$SB_{2010}/SB_{1950, F=0}$	–

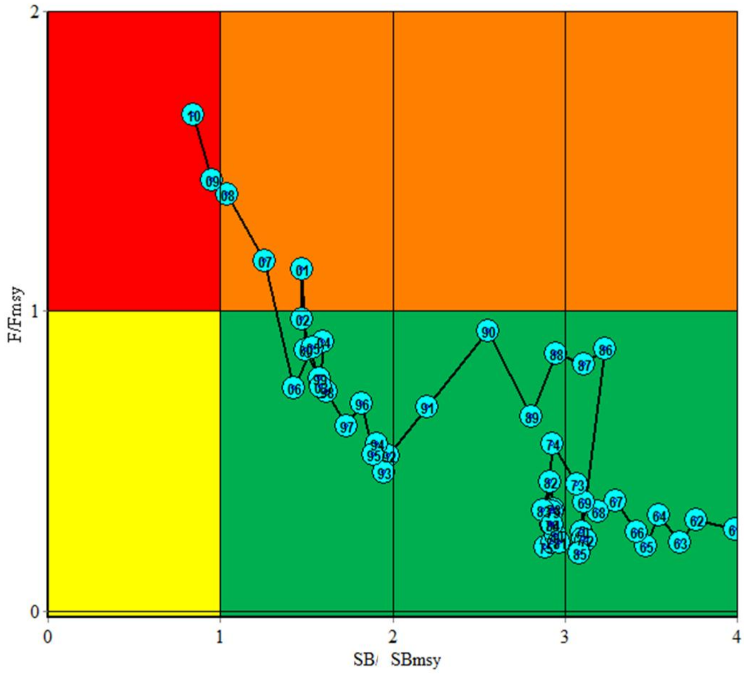


Fig. 5. SS3 Aggregated Indian Ocean assessment Kobe plot for the median values of four preferred scenarios. Blue circles indicate the trajectory of the point estimates for the SB ratio and F ratio for each year 1950–2010.

97. The WPTmT **NOTED** the following with respect to the modelling approach present at the meeting:
    - Using an average CPUE and fitting the model to the series is not a suitable approach, especially as the two series show different trends. A better approach would be to use a single series which is considered the most plausible, in this case the Taiwanese longline CPUE series.
    - Steepness should be set at 0.7 based on the known biology of this species, although sensitive analysis on values of 0.6 and 0.8 are suggested.
    - Using a single core area for CPUE standardisation instead of dividing areas would be desirable to monitor changes in abundance. This would be more robust to changes in fleet dynamics, which is evident in the albacore fishery.

8.3 Selection of Stock Status indicators

98. The WPTmT **NOTED** the following with respect to the various modelling approaches used in 2012:
    - There was more confidence in the abundance indices this year due to the additional CPUE analyses from Japan and Taiwan,China, and the exploration of the Rep. of Korea catch and effort data. This has led to improved confidence in the overall assessments.

- The Taiwan,China CPUE is more likely to closely represent albacore abundance at this time, because a substantial part of the Taiwanese fleet has always targeted albacore.
- Conversely, the Japanese CPUE seems to demonstrate very strong targeting shifts away from albacore (1960s) and back towards albacore in recent years (as a consequence of piracy in the western Indian Ocean). Similar trends are seen in the Rep. of Korea CPUE series.
- CPUE series should not be average across series with different trends as this is likely to result in spurious trends. Thus, only series which are considered to be most representative of abundance, in this case the Taiwan,China series, should be used in stock assessments while further work is carried out on the Japanese and Korean longline series.
- Albacore stock status should be determined by qualitatively integrating the results of the various stock assessments undertaken in 2012. The WPTmT treated all analyses as equally informative, and focussed on the features common to all of the results.
- It was recognised that the deterministic production models were only able to explore a limited number of modelling options. The structural rigidity of these simple models causes numerical problems when fit to long time series for some cases.

99. The WPTmT **NOTED** the value of comparing different modelling approaches. The structured models are capable of a more detailed representation of complicated population and fishery dynamics, and integrate several sources of data and biological research that cannot be considered in the simple production models. However, there are a lot of uncertainties in basic albacore biology (e.g. growth rates, M, stock recruitment relationship), and it is difficult to represent all of these uncertainties. In contrast, the production models often provide robust estimates regardless of uncertainties in basic biological characteristics. However, sometimes the ASPIC model can have difficulty fitting long time series, and production models in general cannot represent some important dynamics (e.g. arising from complicated recruitment variability).

100. The WPTmT **NOTED** that the stock structure of the Indian Ocean albacore resource is under investigation, but currently uncertain. The south-west region was identified as an area of interest, as it is likely that there is stock connectivity with the southern Atlantic albacore population.

101. The WPTmT **AGREED** that albacore stock status should be determined by qualitatively integrating the results of the various stock assessments undertaken in 2012. The WPTmT treated all analyses as equally informative, and focussed on the features common to all of the results.

102. In deciding upon the most appropriate way to present the integrated stock assessment results to the Scientific Committee, the WPTmT **AGREED** that the output of the ASPM model were most likely to numerically and graphically represent the current status of albacore in the Indian Ocean. However, the WPTmT **RECOMMENDED** that the Scientific Committee note that this does not represent an endorsement of the ASPM model over the other models used in 2012, as there are still substantial problems with the ASPM model, and the WPTmT considers all of the models to be equally informative of stock status.

8.4 Parameters for future analyses: CPUE standardization and stock assessments

103. The WPTmT **AGREED** that in order to obtain comparable CPUE standardisations, the analyses shall be conducted with similar parameters and resolutions. Table 8 provide a set of parameters, discussed during the WPTmT, that shall give guidelines, if available, for the standardisation of CPUE in 2013 to be used as indices of abundance for the stock assessments.

Table 8. A set of parameters for the standardisation of CPUE series in 2013.

CPUE standardisation parameters	Value for 2013 CPUE standardization
Area	*To be defined.* Explore core area(s)
CE Resolution	Operational data
GLM Factors	Year, Quarter, Area, HBF, vessel + interactions
All fleet	*Combine data for all fleets with the above effects + fleet*

104. Noting that the areas used in the various CPUE standardisations undertaken in 2012 were very different from one analysis to another, the WPTmT **AGREED** that there is a need to define core area(s) for the CPUE standardisation of albacore and **RECOMMENDED** that scientists from CPCs with longline fisheries for albacore, work together to explore their data and defined such core areas, well in advance of the next WPTmT meeting in 2013.

105. The WPTmT **AGREED** that a global CPUE standardisation could be undertaken by pooling all the data available for the main longline fleets in one analyses.

106. It was noted that the current time frames for data exchange do not allow enough time to conduct thorough stock assessment analyses properly, and this could have a detrimental effect on the quality of advice provided by the WPTmT. Thus, the WPTmT **RECOMMENDED** that data exchanges should be made as early as possible, but no later than 45 days prior to a working party meeting, so that CPUE analysis can be provided to the IOTC Secretariat no later than 30 days before a working party meeting.

107. The WPTmT **AGREED** that the model parameters contained in Table 9 should be used for applicable stock assessments in 2013, with appropriate sensitivity runs, unless modifications to the parameters are agreed to by the WPTmT participants following intersessional work to be undertaken under the guidance of Dr. Toshihide Kitakado.

Table 9. Model parameters agreed to by the WPTmT for use in base case stock assessment runs in 2013.

Biological parameters	**Value for 2013 assessments**
Sex ratio	1:1
Age (longevity)	10+ years
Natural mortality	M=0.2207 (/year) constant over ages[1]
Growth formula	L=147.5(1-exp(-0.126(t+1.89))) common to sex[2]
Weight-length allometry	$W = aL^b$ with $a = 5.691\times10^{-5}$, $b = 2.7514$. common to sex[3]
Maturity	Age-specific (0 for Age <=3, 0.25 for Age=4, 0.5 for Age=5, 0.75 for Age=6 and 1 for Age>=7)
Fecundity	Proportional to the spawning biomass
Stock-recruitment	B&H, h=0.7, sigma_R=0.2
Other parameters	
Fisheries	5 (Jpn LL, Twn LL, DN, PS, Other)
Abundance indices	Jpn, Twn, Kor (combined if available)
Selectivity	Fishery specific. Dome-shaped double-normal

[1] Lee and Liu 1992; [2] Lee and Yeh 2007; [3] Lee and Kuo 1988

9. Development of Technical Advice on the Status of the Albacore Tuna Stock

9.1 Indian Ocean albacore management advice

108. The WPTmT **RECOMMENDED** that the Scientific Committee note the management advice developed for albacore, as provided in the draft resource stock status summary (Appendix VII).

9.2 Update of species Executive Summaries for the consideration of the Scientific Committee

109. The WPTmT **REQUESTED** that the IOTC Secretariat update the draft stock status summary for albacore with the latest 2011 catch data, and for the summary to be provided to the Scientific Committee as part of the draft Executive Summary, for its consideration.

10. Research Recommendations and Priorities

10.1 Revision of the WPTmT work plan

CPUE standardisation

110. The WPTmT **AGREED** that there was an urgent need to investigate the CPUE issues as outlined in paragraph 72 and for this to be a high priority research activity for the albacore resource in the Indian Ocean in 2013.

111. The WPTmT also **ENCOURAGED** data to be used in stock assessments, including CPUE standardisations, be made available not less than three months before each meeting by CPCs and where possible, data summaries no later than two months prior to each meeting, from the IOTC Secretariat; and **RECOMMENDED** that data to be used in stock assessments, including CPUE standardisations be made available not less than 30 days before each meeting by CPCs.

Stock assessment

112. The WPTmT **AGREED** that there was an urgent need to carry out revised stock assessments for the albacore resource in the Indian Ocean in 2013.

113. **NOTING** that with the exception of the SS3 stock assessment paper, all others stock assessment papers for albacore were made available by the authors immediately prior to the WPTmT04 meeting, which did not allow the other participants of the meeting to adequately review the methodology, the WPTmT **REMINDED** working party participants of the 2010 Scientific Committee recommendation that stock assessment papers need to be provided to the Secretariat for posting to the IOTC website **<u>no later than 15 days before</u>** the commencement of the relevant meeting.

114. The WPTmT **AGREED** that future projections for stock assessments should firstly examine scenarios under constant catch projections of +/-20% and +/-40%, and then refine the catch projects to finer l scale levels depending on the initial outcomes, noting that the aim to develop useful projections for the development of management advice.

Stock structure

115. Noting that at present very little is known about the population structure and migratory range of albacore in the Indian Ocean, other than the possible connectivity with the southern Atlantic, the WPTmT **RECOMMENDED** that research aimed at determining albacore stock structure, migratory range and movement rates in the Indian Ocean be considered a high priority research project by the Scientific Committee in 2013.

Spawning

116. Noting that there are difficulties faced by some CPCs in collecting gonad samples from albacore, as a result of fish generally being frozen whole after being gutted, the WPTmT **RECOMMENDED** that CPCs collect gonad samples from albacore to confirm the spawning time and location of the spawning area that are presently hypothesized for albacore, over the coming year and to report findings at the next WPTmT in 2013.

Additional core topics for research

117. The WPTmT **ENCOURAGED** China and other CPCs to provide further research reports on albacore biology, including using through the use of fish otolith studies, either from data collected through observer programs or other research programs, at the next WPTmT meeting in 2013.

118. The WPTmT **RECOMMENDED** that the Scientific Committee add the following core topic areas as priorities for research over the coming year:
    - Size data analyses
    - Growth rates and ageing studies
    - Stock status indicators – exploration of indicators from available data
    - Collaborate with SPC-OFP to examine their current simulation approach to determine priority research areas.

11. OTHER BUSINESS

11.1 Southern Bluefin tuna

119. The WPTmT **NOTED** that a summary report on the biology, stock status and management of southern bluefin tuna would be provided to the IOTC Secretariat following the CCSBT scientific working group which is due to meet at the end of August, 2012.

11.2 Date and place of the Fifth Session of the WPTmT

120. The WPTmT participants were unanimous in thanking China for hosting the Fourth Session of the WPTmT and commended China on the warm welcome, the excellent facilities and assistance provided to the IOTC Secretariat in the organisation and running of the Session.

121. Following a discussion on who would host the Fifth Session of the WPTmT, the WPTmT **AGREED** that the IOTC Secretariat should liaise with CPCs to determine where it would be feasible to hold the next meeting of the WPTmT, noting that Indonesia, Japan and Mauritius had expressed a level of interest. It was also **AGREED** that if this was not possible, then the IOTC Secretariat should discuss

other options with Members, or alternatively to consider holding the next meeting in conjunction with the equivalent ICCAT meeting in September or October 2013.

122. The WPTmT **AGREED** that the next meeting should be held late in 2013, preferably in October, so that data from 2012, which is due to be submitted to the IOTC Secretariat by the end of June 2013, is available for use in stock assessments. 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 2012.

11.3 Development of priorities for an Invited Expert at the next WPTmT meeting

123. The WPTmT **RECOMMENDED** the following core areas of expertise and priority areas for contribution that need to be enhanced for the next meeting of the WPTmT in 2013, should an Invited Expert be necessary:
    - Expertise: experience with CPUE analysis and standardisation for albacore.
    - Priority areas for contribution: stock assessment for albacore.

11.4 Election of a Vice-Chairperson of the WPTmT for the Next Biennium

124. The WPTmT **CONSIDERED** candidates for the position of Vice-Chair of the WPTmT for the next biennium. Mr. Takayuki Matsumoto (from the National Research Institute of Far Seas Fisheries – Japan) was nominated and elected as Vice-Chair of the WPTmT for the next *biennium*.

125. The WPTmT **RECOMMENDED** that the Scientific Committee note the new Vice-Chair (Mr. Takayuki Matsumoto) of the WPTmT for the next *biennium*.

11.5 Review of the draft, and adoption of the Report of the Fourth Session of the WPTmT

126. The WPTmT **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPTmT04, provided at Appendix IV.

127. The report of the Fourth Session of the Working Party on Temperate Tunas (IOTC–2012–WPTmT04–R) was **ADOPTED** on the 6 September 2012.

Appendix I
List of participants

Chairperson
Dr. Zang Geun **Kim**
National Fisheries Research and Development Institute
Repr. Of Korea
E-mail: zgkim@nfrdi.go.kr

Other participants
Mr. Jintao **Chen**
Shanghai Ocean University
China
E-mail: jtchen@shou.edu.cn

Mr. Watcharapong **Chumchuen**
Department of Fisheries
Thailand
E-mail: W.Chumchuen@gmail.com

Dr. Xiaojie **Dai**
Shanghai Ocean University
China
E-mail: xjdai@shou.edu.cn

Ms. Zahirah **Dhurmeea**
Ministry of Fisheries
Mauritius
E-mail: zdhurmeea@mail.gov.mu

Mr. Long **Geng**
Shanghai Ocean University
China
E-mail: 119934918@99.com

Dr. Wejiang **Guan**
Shanghai Ocean University
China
E-mail: wjguan@shou.edu.cn

Mr. Miguel **Herrera**
Indian Ocean Tuna Commission
E-mail: mh@iotc.org

Mr. Tang **Hao**
Shanghai Ocean University
China
E-mail: tanghao812@126.com

Dr. Toshihide **Kitakado**
Tokyo University of Marine Science and Technology
Japan
E-mail: kitakado@kaiyodai.ac.jp

Ms. Mi Kyung **Lee**
National Fisheries Research and Development Institute
Rep. of Korea
E-mail: mklee@nfrdi.go.kr

Dr. Sung Il **Lee**
National Fisheries Research and Development Institute
Rep. of Korea
E-mail: silee@nfrdi.go.kr

Mr. Takayuki **Matsumoto**
National Research Institute of Far Seas Fisherieso
E-mail: matumot@affrc.go.jp

Mr. Julien **Million**
Indian Ocean Tuna Commission
E-mail: jm@iotc.org

Dr. Tom **Nishida**
National Research Institute of Far Seas Fisheries
Japan
E-mail: tnishida@affrc.go.jp

Ms. Sampan **Panjarat**
Department of Fisheries
Thailand
E-mail: spanjarat@yahoo.com

Mr. Bram **Setyadji**
Research Institute For Tuna Fisheries, Indonesia
E-mail: bram.setyadji@gmail.com

Dr. Siquan **Tian**
Shanghai Ocean University
China
E-mail: sqtian@shou.edu.cn

Dr. David **Wilson**
Indian Ocean Tuna Commission
E-mail: david.wilson@iotc.org

Mr. Feng **Wu**
Shanghai Ocean University
China
E-mail: wufeng2576@126.com

Dr. Wang **Xuefang**
Shanghai Ocean University
China
E-mail: txpwxf@163.com

Mr. Liuxiong **Xu**
Shanghai Ocean University
China
E-mail: lxxu@shou.edu.cn

Dr. Shean-Ya **Yeh**
National Taiwan University
Taiwan,China
E-mail: sheanya@ntu.edu.tw

Mr. Xiaochun **Zheng**
Shanghai Ocean University
China
E-mail: zhengxiaoc1986@sina.com

Mr. Cheng **Zhou**
Shanghai Ocean University
China
E-mail: zhoucheng286@126.com

Dr. Jiangfeng **Zhu**
Shanghai Ocean University
China
E-mail: jfzhu@shou.edu.cn

APPENDIX II
AGENDA FOR THE FOURTH WORKING PARTY ON TEMPERATE TUNAS

Date: 20–22 August 2012
Location: Old campus of Shanghai Ocean University, Shanghai, China
2nd Meeting Room, Distant-water Fishery Training Centre
Time: 09:00 – 17:00 daily
Chair: Dr. Zang Geun Kim; **Vice-Chair**: Vacant

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

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

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

4. **OUTCOMES OF SESSIONS OF THE COMMISSION** (Secretariat)

5. **PROGRESS ON THE RECOMMENDATIONS OF WPTmT03** (Chair and Secretariat)

6. **REVIEW OF THE DATA AVAILABLE AT THE SECRETARIAT FOR TEMPERATE TUNA SPECIES** (Secretariat)

7. **NEW INFORMATION ON BIOLOGY, ECOLOGY, FISHERIES AND ENVIRONMENAL DATA RELATING TO TEMPERATE TUNAS** (Chair)
   - 7.1 Review new information on the biology, stock structure, their fisheries and associated environmental data
     - Catch and effort
     - Catch at size
     - Growth curves and age–length key
     - Catch at age
   - 7.2 Effect of piracy on temperate tuna catches

8. **REVIEW OF NEW INFORMATION ON THE STATUS OF ALBACORE TUNA**
   - 8.1 Nominal and standardised CPUE indices
   - 8.2 Stock assessments
   - 8.3 Selection of Stock Status indicators

9. **DEVELOPMENT OF TECHNICAL ADVICE ON THE STATUS OF THE ALBACORE TUNA STOCK**
   - 9.1 Indian Ocean albacore management advice
   - 9.2 Update of species Executive Summaries for the consideration of the Scientific Committee (Chair)

10. **RESEARCH RECOMMENDATIONS AND PRIORITIES**
    - 10.1 Revision of the WPTmT work plan (Chair)

11. **OTHER BUSINESS**
    - 11.1 Southern bluefin tuna (Secretariat)
    - 11.2 Date and place of the Fifth Session of the WPTmT (Chair and Secretariat)
    - 11.3 Development of priorities for an Invited Expert at the next WPTmT meeting (Chair)
    - 11.4 Election of a Vice-Chairperson of the WPTmT for the next biennium (Chair)
    - 11.5 Review of the draft, and adoption of the Report of the Fourth Session of the WPTmT (Chair)

APPENDIX III
LIST OF DOCUMENTS

Document	Title	Availability
IOTC–2012–WPTmT04–01a	Draft Agenda of the Fourth Working Party on Temperate Tunas	✓(20 May 2012)
IOTC–2012–WPTmT04–01b	Draft Annotated agenda of the Fourth Working Party on Temperate Tunas	✓(14 Aug 2012)
IOTC–2012–WPTmT04–02	Draft List of documents	✓(16 July 2012)
IOTC–2012–WPTmT04–03	Outcomes of the Fourteenth Session of the Scientific Committee (Secretariat)	✓(15 June 2012)
IOTC–2012–WPTmT04–04	Outcomes of the Sixteenth Session of the Commission (Secretariat)	✓(22 June 2012)
IOTC–2012–WPTmT04–05	Review of Conservation and Management Measures relating to temperate tuna (Secretariat)	✓(25 June 2012)
IOTC–2012–WPTmT04–06	Progress made on the recommendations of WPTmT03 (Secretariat and Chair)	✓(16 July 2012)
IOTC–2012–WPTmT04–07	Review of the statistical data and fishery trends for albacore (Secretariat)	✓(2 July 2012)
IOTC–2012–WPTmT04–08	Status of the Indian Ocean albacore resource (*Thunnus alalunga*) (Secretariat)	✓(16 July 2012)
IOTC–2012–WPTmT04–09	Review of Japanese longline fishery and its albacore catch in the Indian Ocean (T. Matsumoto)	✓(8 August 2012)
IOTC–2012–WPTmT04–10 Rev_1	Standardization of albacore CPUE by Japanese longline fishery in the Indian Ocean (T. Matsumoto, T. Kitakado and H. Okamoto)	✓(8 August 2012) ✓(15 August 2012)
IOTC–2012–WPTmT04–11 Rev_2	First attempt of stock assessment using Stock Synthesis III (SS3) for the Indian Ocean albacore tuna (*Thunnus alalunga*) (T. Kitakado, E. Takashima, T. Matsumoto, T. Ijima and T. Nishida)	✓(4 August 2012) ✓(17 August 2012) ✓(21 August 2012)
IOTC–2012–WPTmT04–12	Catch/ effort and length-frequency data collected on albacore tuna landed in Mauritius (Z. Dhurmeea, S.P. Beeharry and T. Sooklall)	✓(3 August 2012)
IOTC–2012–WPTmT04–13	Catch and size distribution of albacores (*Thunnus alalunga*) in the Eastern Indian Ocean (B. Setyadji, D. Novianto, B. Nugraha and L. Sadiyah)	✓(10 August 2012)
IOTC–2012–WPTmT04–14	Albacore Tuna Fishery in the Indian Ocean by Thai Longliners during 2007–2011 (W. Chumchuen)	✓(9 August 2012)
IOTC–2012–WPTmT04–15	Review of catch and effort for albacore tuna by Korean longline fishery in the Indian Ocean (Z.G. Kim, S.I. Lee, S.C. Yoon, M.K. Lee, J.E. Ku and D.W. Lee)	✓(12 August 2012)
IOTC–2012–WPTmT04–16 Rev_1	Age and growth of albacore tuna (*Thunnus alalunga*) in the southern and central Indian Ocean based on Chinese observer data (C. Zhou, F. Li, H. Tang, L. Xu and S. Tian)	✓(19 August 2012) ✓(20 August 2012)
IOTC–2012–WPTmT04–17 Rev_1	Standardization of albacore catch rates of Korean tuna longline fisheries in the Indian Ocean (1986–2010) (S.I. Lee, Z.G. Kim, T. Nishida, M.K. Lee)	✓(12 August 2012) ✓(19 August 2012)
IOTC–2012–WPTmT04–18	Standardized CPUE of Indian albacore (*Thunnus alalunga*) based on Taiwanese longline catch and effort statistics dating from 1980 to 2011 (L.-K. Lee, F.-C. Chang, C.-Y. Chen, W.-J. Wang and S.-Y. Yeh)	✓(20 August 2012)
IOTC–2012–WPTmT04–19	Assessment on Indian albacore stock based mainly on Taiwanese longline data (F.-C. Chang, C.-Y. Chen, L.-K. Lee, and S.-Y. Yeh)	✓(20 August 2012)
IOTC–2012–WPTmT04–20 Rev_2	Stock and risk assessments of albacore in the Indian Ocean based on ASPIC (T. Matsumoto, T. Nishida and T. Kitakado)	✓(15 August 2012) ✓(16 August 2012) ✓(22 August 2012)
IOTC–2012–WPTmT04–21 Rev_4	Stock and risk assessments on albacore (*Thunnus alalunga*) in the Indian Ocean based on AD Model Builder implemented Age-Structured Production Model (ASPM) (T. Nishida and R. Rademeyer)	✓(16 August 2012) ✓(17 August 2012) ✓(19 August 2012) ✓(22 August 2012)
Information papers		

Document	**Title**	**Availability**
IOTC–2012–WPTmT04–INF01	IOTC SC – Guidelines for the Presentation of Stock Assessment Models	✓(21 May 2012)
IOTC–2012–WPTmT04–INF02	WCPFC SC – Population biology of albacore tuna in the Australian region (J.H. Farley, A.J. Williams, C.R. Davies, N.P. Clear, J.P. Eveson, S.D. Hoyle and S.J. Nicol)	✓(20 July 2012)
IOTC–2012–WPTmT04–INF03	WCPFC SC – Stock assessment of albacore tuna in the south Pacific Ocean (S. Hoyle, J. Hampton and N. Davies)	✓(29 July 2012)
IOTC–2012–WPTmT04–INF04	Review: CPUE Standardizations for Japan for the Albacore Assessment (R. Sharma – Secretariat)	✓(20 August 2012)
IOTC–2012–WPTmT04–INF05	Review: CPUE Standardizations for Korea for the Albacore Assessment (R. Sharma – Secretariat)	✓(20 August 2012)
IOTC–2012–WPTmT04–INF06	Review: CPUE Standardizations for Taiwan,China for the Albacore Assessment (R. Sharma – Secretariat)	✓(20 August 2012)
IOTC–2012–WPTmT04–INF07	Review: ASPIC stock assessment for ALB (R. Sharma – Secretariat)	✓(20 August 2012)
IOTC–2012–WPTmT04–INF08	Review: ASPM stock assessment for ALB Assessment (R. Sharma – Secretariat)	✓(20 August 2012)
IOTC–2012–WPTmT04–INF09	Review: SS3 stock assessment for ALB (R. Sharma – Secretariat)	✓(20 August 2012)

APPENDIX IV
CONSOLIDATED RECOMMENDATIONS OF THE FOURTH SESSION OF THE WORKING PARTY ON TEMPERATE TUNAS

Note: Appendix references refer to the Report of the Fourth Session of the Working Party on Temperate Tunas (IOTC–2012–WPTmT04–R)

Review of the Data Available at the Secretariat for Temperate Tuna Species

WPTmT04.01 (para. 19): The WPTmT **NOTED** the main albacore 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 **RECOMMENDED** that the CPCs listed in the Appendix, make efforts to remedy the data issues identified and to report back to the WPTmT at its next meeting.

WPTmT04.02 (para. 21): The WPTmT **NOTED** that in recent years many foreign vessels have been unloading catches of albacore in Mauritius, representing around 60% of the total catch, and that Mauritius is making efforts to monitor albacore for catch and length data. The WPTmT **RECOGNIZED** the value of the biological information collected in Mauritius and **RECOMMENDED** that the IOTC-OFCF Project considers supporting Mauritius to collect this information.

New Information on Biology, Ecology, Fisheries and Environmental Data Relating to Temperate Tunas

Indonesian longline fishery for albacore

WPTmT04.03 (para. 40): The WPTmT **NOTED** the ongoing review of catches of albacore carried out by the IOTC Secretariat in consultation with the DGCF of Indonesia. The WPTmT was informed that the current catch estimates of albacore for Indonesia were derived from reports of albacore imports into canning factories cooperating with the ISSF, and **RECOMMENDED** that the IOTC Secretariat and Indonesia continue cooperation to finalize the review and report final estimates of catches of albacore to the next meeting of the WPTmT.

WPTmT04.04 (para. 42): Noting that Indonesian catches represent more than 40% of the total albacore catches in the Indian Ocean, determined from the revised catch history developed by the IOTC Secretariat, the WPTmT **RECOMMENDED** that Indonesia further strengthen sampling efforts on its coastal and off-shore fisheries in early 2013, where required, and liaise with the IOTC Secretariat in order to better determine the catches of albacore by the Indonesian longline fleet.

Other new information and general discussion

WPTmT04.05 (para. 50): The WPTmT **NOTED** that, in recent years, the catches of albacore reported for longliners flagged to China in the Indian Ocean have increased markedly, and as this may originate from a change in targeting by some vessels, it was **RECOMMENDED** that China explore the reasons for this shift and report back to the next meeting of the WPTmT.

WPTmT04.06 (para. 51): The WPTmT **RECOMMENDED** that as a matter of priority, India, Indonesia and Japan increase sampling coverage to attain at least the coverage levels recommended by the Commission, including:

- catches sampled or observed for at least 5% of the vessel activities, including collection of catch, effort and size data for IOTC species and main bycatch species;
- implementation of logbook systems for offshore fisheries.

The information collected through the above activities should allow India, Indonesia and Japan to estimate catches by gear and species.

Effect of piracy on temperate tuna catches

WPTmT04.07 (para. 55): The WPTmT **RECOMMENDED** that given the potential impacts of piracy on the albacore fishery through the relocation of longliners into traditional albacore fishing grounds, specific analysis should be carried out and presented at the next WPTmT meeting by the CPCs most affected by these activities, including Japan, Rep. of Korea and Taiwan,China.

Review of New Information on the Status of Albacore tuna

CPUE discussion summary

WPTmT04.08 (para. 71): **NOTING** that a set of 'core areas' which are likely to be robust to frequent fluctuations of external factors, may be more informative than using all of the data available, especially when other species were being targeted, the WPTmT **RECOMMENDED** that 'core areas' be identified and agreed to by the WPTmT so as to facilitate and monitor population abundance trends across all fleets. This should be carried out intersessionally and presented at the Scientific Committee's proposed longline CPUE workshop, to be held in the second quarter of 2013. The authors of the three CPUE papers presented during the WPTmT agreed to lead this work, in collaboration with the IOTC Secretariat.

Stock assessments

WPTmT04.09 (para. 78): The WPTmT **AGREED** that there is value in undertaking a number of different modelling approaches to facilitate comparison, and **RECOMMENDED** that spatially structured integrated models, which are capable of more detailed representation of complicated population and fishery dynamics, and integrate several sources of data and biological research that cannot be considered in the simpler production models, be carried out for the next WPTmT, as data and resources permit.

Selection of Stock Status indicators

WPTmT04.10 (para. 102): In deciding upon the most appropriate way to present the integrated stock assessment results to the Scientific Committee, the WPTmT **AGREED** that the output of the ASPM model were most likely to numerically and graphically represent the current status of albacore in the Indian Ocean. However, the WPTmT **RECOMMENDED** that the Scientific Committee note that this does not represent an endorsement of the ASPM model over the other models used in 2012, as there are still substantial problems with the ASPM model, and the WPTmT considers all of the models to be equally informative of stock status.

Parameters for future analyses: CPUE standardization and stock assessments

WPTmT04.11 (para. 104): Noting that the areas used in the various CPUE standardisations undertaken in 2012 were very different from one analysis to another, the WPTmT **AGREED** that there is a need to define core area(s) for the CPUE standardisation of albacore and **RECOMMENDED** that scientists from CPCs with longline fisheries for albacore, work together to explore their data and defined such core areas, well in advance of the next WPTmT meeting in 2013.

WPTmT04.12 (para. 106): It was noted that the current time frames for data exchange do not allow enough time to conduct thorough stock assessment analyses properly, and this could have a detrimental effect on the quality of advice provided by the WPTmT. Thus, the WPTmT **RECOMMENDED** that data exchanges should be made as early as possible, but no later than 45 days prior to a working party meeting, so that CPUE analysis can be provided to the IOTC Secretariat no later than 30 days before a working party meeting.

Development of Technical Advice on the Status of the Albacore Tuna Stock

Indian Ocean albacore management advice

WPTmT04.13 (para. 108): The WPTmT **RECOMMENDED** that the Scientific Committee note the management advice developed for albacore, as provided in the draft resource stock status summary (Appendix VII).

Research Recommendations and Priorities

CPUE standardisation

WPTmT04.14 (para. 111): The WPTmT also **ENCOURAGED** data to be used in stock assessments, including CPUE standardisations, be made available not less than three months before each meeting by CPCs and where possible, data summaries no later than two months prior to each meeting, from the IOTC Secretariat; and **RECOMMENDED** that data to be used in stock assessments, including CPUE standardisations be made available not less than 30 days before each meeting by CPCs.

Stock structure

WPTmT04.15 (para. 115): Noting that at present very little is known about the population structure and migratory range of albacore in the Indian Ocean, other than the possible connectivity with the southern Atlantic, the WPTmT **RECOMMENDED** that research aimed at determining albacore stock structure, migratory range and movement rates in the Indian Ocean be considered a high priority research project by the Scientific Committee in 2013.

Spawning

WPTmT04.16 (para. 116): Noting that there are difficulties faced by some CPCs in collecting gonad samples from albacore, as a result of fish generally being frozen whole after being gutted, the WPTmT **RECOMMENDED** that CPCs collect gonad samples from albacore to confirm the spawning time and location of the spawning area that are presently hypothesized for albacore, over the coming year and to report findings at the next WPTmT in 2013.

Additional core topics for research

WPTmT04.17 (para. 118): The WPTmT **RECOMMENDED** that the Scientific Committee add the following core topic areas as priorities for research over the coming year:

- Size data analyses
- Growth rates and ageing studies
- Stock status indicators – exploration of indicators from available data
- Collaborate with SPC-OFP to examine their current simulation approach to determine priority research areas.

Other Business

Development of priorities for an Invited Expert at the next WPTmT meeting

WPTmT04.18 (para. 123): The WPTmT **RECOMMENDED** the following core areas of expertise and priority areas for contribution that need to be enhanced for the next meeting of the WPTmT in 2013, should an Invited Expert be necessary:

- Expertise: experience with CPUE analysis and standardisation for albacore.
- Priority areas for contribution: stock assessment for albacore.

Election of a Vice-Chairperson of the WPTmT for the next Biennium

WPTmT04.19 (para. 125): The WPTmT **RECOMMENDED** that the Scientific Committee note the new Vice-Chair (Mr. Takayuki Matsumoto) of the WPTmT for the next *biennium*.

Review of the draft, and adoption of the Report of the Fourth Session of the WPTmT

WPTmT04.20 (para. 126): The WPTmT **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPTmT04, provided at Appendix IV.

APPENDIX V
SUMMARY OF DATA AVAILABLE AT THE IOTC SECRETARIAT

Extracts from IOTC–2012–WPTmT04–07

Albacore

Albacore – Catch trends

Albacore are currently caught almost exclusively using drifting longlines (98%) (Figs. 1, 2, 3; Table 1), South of 10°S (Table 2), with remaining catches recorded using purse seines and other gears (Fig. 1). Catches of albacore were relatively stable until the mid-1980s, except for high catches recorded in 1973 and 1974 (Fig. 1). The catches increased markedly during the mid-1980's due to the use of drifting gillnets by Taiwan,China (Fig. 2), with total catches in excess of 30,000 t. The drifting gillnet fleet targeted juvenile albacore in the southern Indian Ocean (30°S to 40°S). In 1992 the United Nations worldwide ban on the use of drifting gillnets effectively closed this gillnet fishery.

Following the removal of the drifting gillnet fleet, catches dropped to less than 20,000 t by 1993 (Figs. 1, 2). However, catches more than doubled over the period from 1993 (less than 20,000 t) to 2001 (44,000 t). Since 2001, catches have been almost exclusively taken by drifting longlines (Figs. 1, 2, 3). Record catches of albacore were reported in 2007, at around 43,000 t, and again in 2008, at 44,000 t. Catches for 2009 are estimated to be approximately 39,000 t, while preliminary catches for 2010 amount to 42,968 t (Table 1).

Catches of albacore in recent years have come almost exclusively from vessels from Indonesia and Taiwan,China, although the catches of albacore reported for the fresh tuna longline fishery of Indonesia have increased considerably since 2003 to around 17,000 t (Fig. 2), which represents approximately 32% of the total catches of albacore in the Indian Ocean.

Longliners from Japan and Taiwan,China have been operating in the Indian Ocean since the early 1950s (Fig. 2). Although the Japanese albacore catch ranged from 8,000 t to 18,000 t in the period 1959 to 1969, in 1972, catches rapidly decreased to around 1,000 t, due to a change in the target species, mainly to southern bluefin tuna and bigeye tuna. Albacore became a bycatch species for the Japanese fleet with catches between 200 t and 2,500 t. In recent years the Japanese albacore catch has been around 2,000 to 6,000 t (Fig. 2).

In contrast to the Japanese longliners, catches by Taiwan,China longliners increased steadily from the 1950's to average around 10,000 t by the mid-1970s. Between 1998 and 2002 catches ranged between 21,500 t to 26,900 t, equating to just over 60% of the total Indian Ocean albacore catch. Between 2003 and 2010 the albacore catches by Taiwan,China longliners have been between 10,000 and 18,000 t, with catches appearing to be increasing in recent years. There has been a shift in the proportion of catches of albacore by deep-freezing and fresh-tuna longliners in recent years, with increasing catches of fresh-tuna (72% of the total catches for 2008–10) as opposed to deep-freezing longliners (Fig. 1; Table 1).

While most of the catches of albacore have traditionally come from the southwest Indian Ocean, in recent years a larger proportion of the catch has come from the southern and eastern Indian Ocean (Fig. 2; Table 2). The relative increase in catches in the eastern Indian Ocean since the early 2000's is mostly due to increased activity of fresh-tuna longliners from Taiwan,China and Indonesia. In the western Indian Ocean, the catches of albacore mostly result from the activities of deep-freezing longliners and purse seiners. One consequence of Somali maritime piracy in the western tropical Indian Ocean in recent years has been the movement of part of the deep-freezing longline fleets out of this area, where the target species were tropical tunas or swordfish, to operate in southern waters of the Indian Ocean. This led to increased catches of albacore by some longline fleets, in particular vessels from China, Taiwan,China and Japan.

Fleets of oceanic gillnet vessels from Iran and Pakistan and gillnet and longline vessels from Sri Lanka have extended their area of operation in recent years, to operate on the high seas closer to the equator. The lack of catch-and-effort data from these fleets makes it impossible to assess whether they are operating in areas where catches of juvenile albacore are likely to occur.

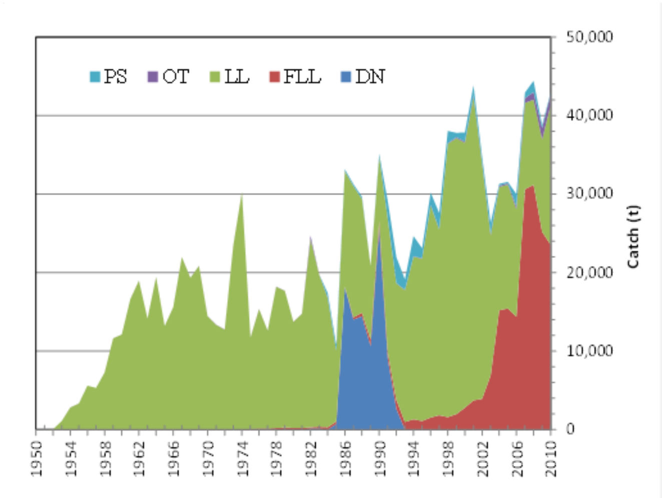


Fig. 1. Annual catches of albacore by gear recorded in the IOTC Database (1950–2010) (Data as of June 2012). Freezing-longline (LL); Fresh-tuna longline (FLL); Purse seine (PS); Other gears NEI (OT).

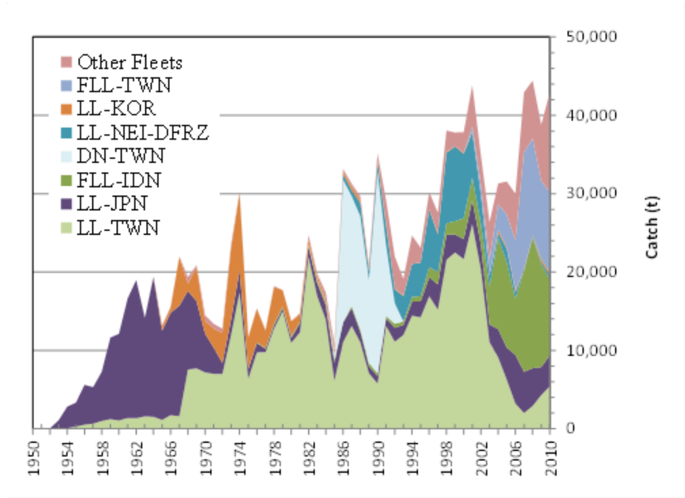


Fig. 2. Annual catches of albacore by fleet recorded in the IOTC Database (1950–2010) (Data as of June 2012). Freezing Longlines of Taiwan,China (LL-TWN), Japan (LL-JPN), Rep. of Korea (LL-KOR), and other nei fleets (LL-NEI-DFRZ); Fresh-tuna longlines of Indonesia (FLL-IDN), and Taiwan,China (FLL-TWN); Driftnets of Taiwan,China (DN-TWN); all other fleets combined (Other Fleets).

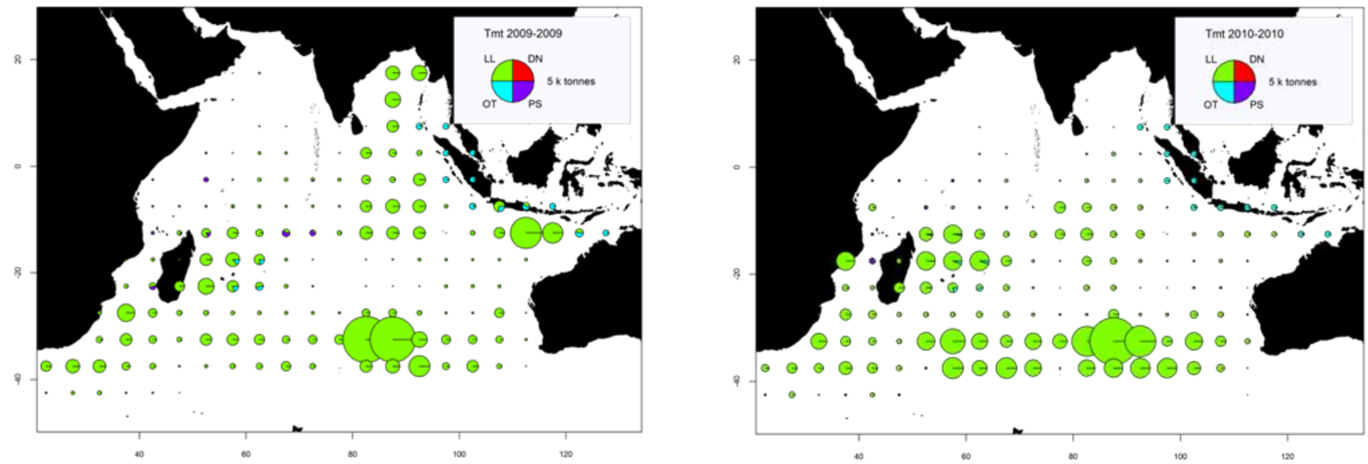


Fig. 3a–b. Time-area catches (total combined in tonnes) of albacore estimated for 2009 (left) and 2010 (right) by type of gear: Longline (LL, green), Driftnet (DFRT, red), Purse seine (PS, purple), Other fleets (OT, blue). Time-area catches are not available for all fleets; catches for those were assigned by 5x5 square and month using information from other fleets. Catches of fresh-tuna longliners are not represented (Data as of June 2012).

TABLE 1. Best scientific estimates of the catches of albacore (*Thunnus alalunga*) by gear and main fleets [or type of fishery] by decade (1950–2000) and year (2001–2010), in tonnes. Data as of June 2012. Catches by decade represent the average annual catch, noting that some gears were not used for all years (refer to Fig. 2).

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
DN				5,823	3,735											
LL	3,715	17,233	16,903	15,214	21,876	19,901	38,664	29,999	17,819	15,721	15,774	13,696	11,001	10,837	11,749	17,834
FLL			80	314	1,328	14,940	3,724	3,918	6,908	15,201	15,454	14,383	30,616	31,194	25,206	23,538
PS				203	1,683	920	1,281	772	1,496	232	164	1,548	725	1,424	392	207
OT	6	9	26	68	63	441	186	152	144	163	176	381	599	989	1457	1389
Total	**3,721**	**17,242**	**17,009**	**21,622**	**28,685**	**36,202**	**43,855**	**34,841**	**26,367**	**31,317**	**31,568**	**30,008**	**42,941**	**44,444**	**38,804**	**42,968**

Fisheries: Driftnet (**DN**; Taiwan,China); Freezing-longline (**LL**); Fresh-tuna longline (**FLL**); Purse seine (**PS**); Other gears nei (**OT**).

TABLE 2. Best scientific estimates of the catches of albacore (*Thunnus alalunga*) by fishing area for the period 1950–2010 (in metric tons). Data as of June 2012.

Area	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
N	69	135	207	55	549	2,229	700	821	742	1,151	1,589	2,452	6,870	4,636	3,237	471
S	3,652	17,107	16,803	21,567	28,135	33,972	43,155	34,021	25,625	30,167	29,979	27,556	36,071	39,809	35,567	42,496
Total	**3,721**	**17,242**	**17,010**	**21,622**	**28,684**	**36,201**	**43,855**	**34,842**	**26,367**	**31,318**	**31,568**	**30,008**	**42,941**	**44,445**	**38,804**	**42,967**

Areas: North of 10ºS (**N**); South of 10ºS (**S**)

Albacore – Uncertainty of catches

While retained catches were fairly well known until the early-1990s (Fig. 4), the quality of catch estimates since that time has been compromised due to poor catch reports from some fleets, in particular:

- Longliners of Indonesia and Malaysia: to date, Indonesia and Malaysia have reported incomplete catches of albacore for their longline fleets, as they do not monitor activities of longliners under their flags based outside of their ports (e.g. Mauritius, Sri Lanka, and Thailand). In addition, in recent years Indonesia has reported catches of albacore for fresh-tuna longliners under its flag that are in contradiction with the amounts of albacore recorded from alternative sources, including data on exports of albacore from Bali, and data from canning factories under the ISSF scheme. The new catches of albacore estimated by the IOTC Secretariat using the above sources are around 14,000 t (average 2006–10), well above those reported by the flag country (8,000 t).
- Fleets using gillnets on the high seas, in particular Iran, Pakistan and Sri Lanka: Catches are likely to be less than 1,000 t.
- Non-reporting industrial longliners (NEI): Refers to catches from longliners operating under flags of non-reporting countries. While the catches were moderately high during the 1990s, they have not exceeded 2,000 t in recent years.

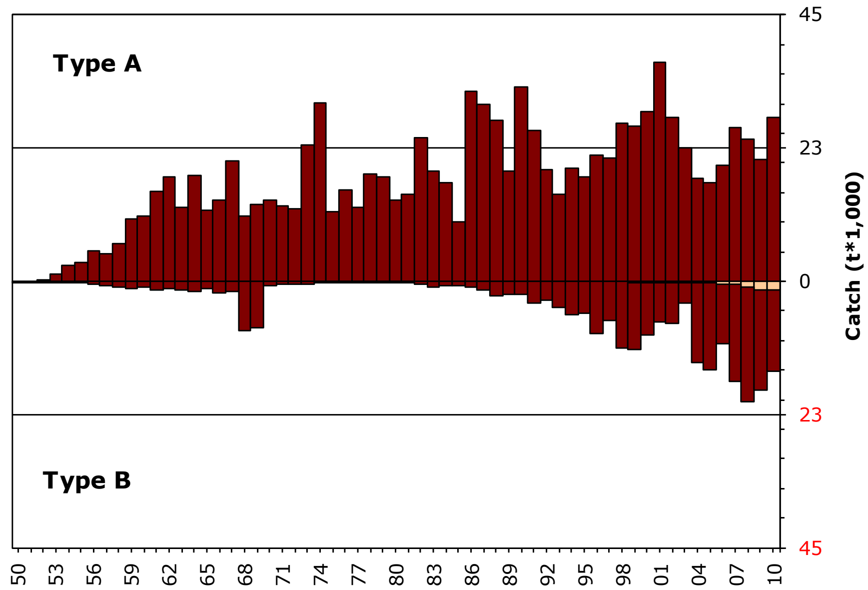


Fig. 4. Albacore: Uncertainty of annual catch estimates for albacore (1950–2010) (Data as of June 2012).

*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.*

- The catch series for albacore has not changed substantially since the WPTmT in 2011.
- Levels of discards are believed to be low although they are unknown for industrial fisheries other than European (EU) purse seiners (2003–07).
- Catch-and-effort series are available from various industrial fisheries. Nevertheless, catch-and-effort are not available from some fisheries or they are considered to be of poor quality, especially during the last decade, for the following reasons:
    - uncertain data from significant fleets of longliners, including India, Indonesia, Malaysia, Oman, and Philippines;
    - no data for fresh-tuna longliners flagged in Taiwan,China during 1990–2006 and poor coverage the following years (2007–10);
    - non-reporting by industrial purse seiners and longliners (NEI).

Albacore – Effort trends

Total effort from longline vessels flagged to Japan, Taiwan,China and EU,Spain by five degree square grid from 2007 to 2010 are provided in Fig. 5, and total effort from purse seine vessels flagged to the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags), and others, by five degree square grid and main fleets, for the years 2007 to 2010 are provided in Fig. 6.

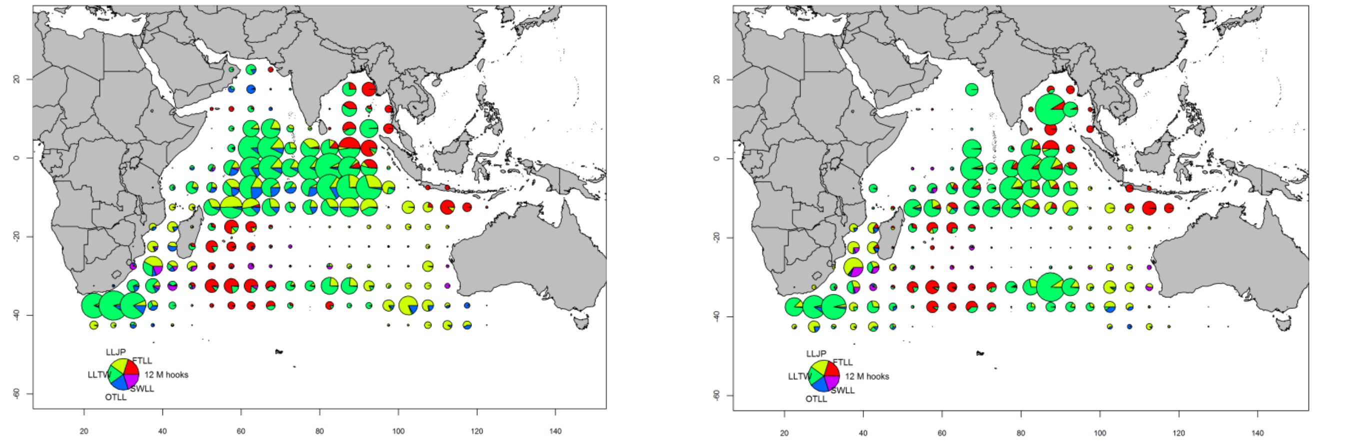


Fig. 5. Number of hooks set (millions) from longline vessels by five degree square grid and main fleets, for the years 2009 (left) and 2010 (right) (Data as of August 2011).
LLJP (light green): deep-freezing longliners from Japan
LLTW (dark green): deep-freezing longliners from Taiwan,China
SWLL (turquoise): 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)

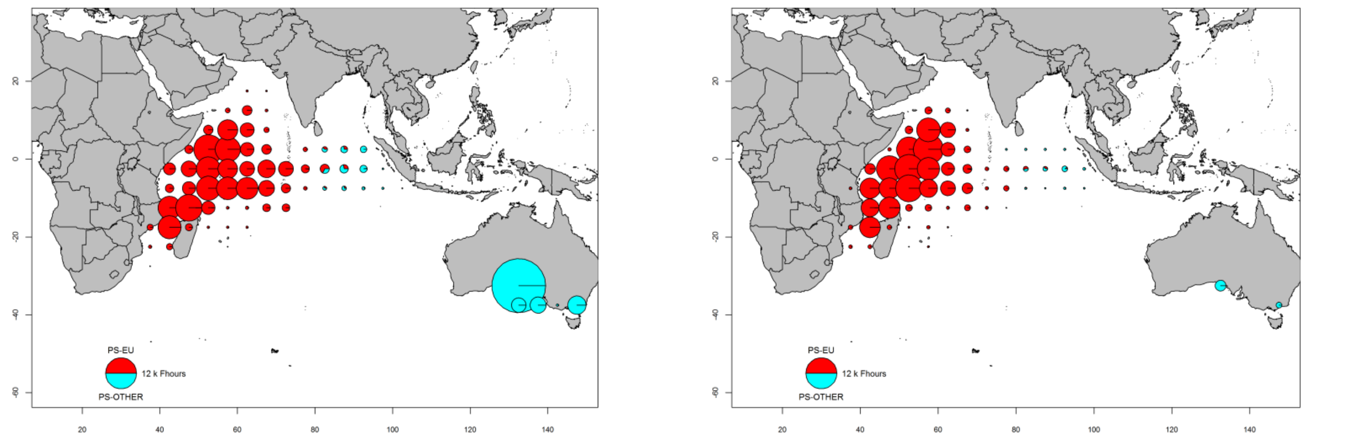


Fig. 6. Number of hours of fishing(Fhours) from purse seine vessels by 5 degree square grid and main fleets, for the years 2009 (left) and 2010 (right) (Data as of August 2011).
PS-EU (red): Industrial purse seiners monitored by the EU and Seychelles (operating under flags of EU countries, Seychelles and other flags)
PS-OTHER (green): Industrial purse seiners from other fleets (includes Japan, Mauritius and purse seiners of Soviet origin) (excludes effort data for purse seiners of Iran and Thailand)

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

The size frequency data for the deep-freezing longline fishery from Taiwan,China for the period 1980–2009 is available. In general, the amount of catch for which size data for the species are available before 1980 is still very low. The data for the Japanese longline fleets is available; however, the number of specimens measured per stratum has been decreasing in recent years. Few data are available for the other fleets.

- Trends in average weight can be assessed for several industrial fisheries although they are incomplete or of poor quality for most fisheries before 1980, between 1986 and 1991, and in recent years, due to the lack of length samples for the fleets referred to above (Fig. 7).
- Catch-at-Size/Age tables are available but the estimates are highly uncertain for some periods and fisheries including:
    - all industrial longline fleets before the mid-60s, from the early-1970s up to the early-1980s and most fleets in recent years, in particular fresh-tuna longliners

- the complete lack of size samples from the driftnet fishery of Taiwan,China over the entire fishing period (1982–92)
- the paucity of catch by area data available for some industrial fleets (Taiwan,China, NEI, India and Indonesia)

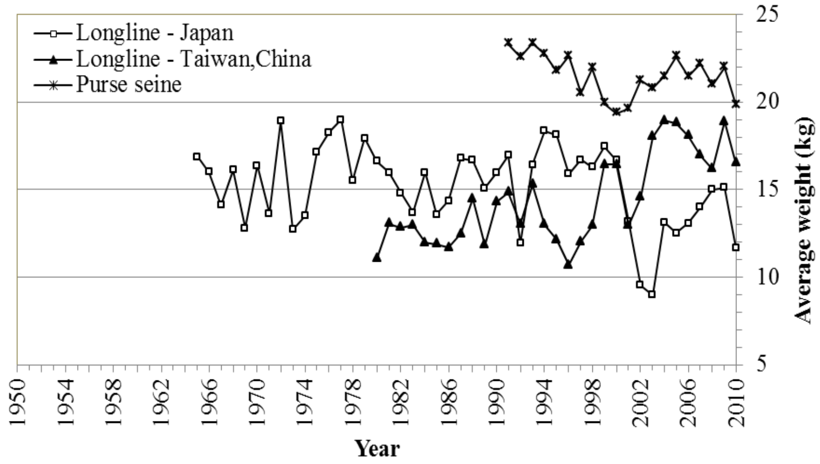


Fig. 7. Average weight in kg of the catches of all fleets (blue), gillnet (red), LL-JPN (dark green), LL-TWN (black), Purse seine (green) and other gears (grey) from 1950 to 2010.

APPENDIX VI
MAIN ISSUES IDENTIFIED RELATING TO THE STATISTICS OF ALBACORE

Extract from IOTC–2012–WPTmT04–07

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

1. **Catch-and-Effort data from Industrial Fisheries:**

- **Longline** fishery of **Indonesia**: The catches of albacore estimated for the longline fishery of Indonesia account for 32% of the total catches of albacore in the Indian Ocean in recent years (average catch 2006–10). While Indonesia has reported total catches of albacore around 7,700 t in recent years (average 2005–09), the catches available from alternative sources are markedly higher, and were used to derive the IOTC estimates, amounting to around 13,300 t for the same period. To date, the Secretariat has not received catch-and-effort data for this fishery.
- **Fresh-tuna longline** fishery of **Taiwan,China**: The catches of albacore estimated for the fresh-tuna longline fishery of Taiwan,China account for 27% of the total catches of albacore in the Indian Ocean in recent years (average catch 2006–10). Although the Secretariat has received catch-and-effort data for this fishery in recent years, time-area coverage is still very low.
- **Longline** fisheries of **India**, **Malaysia, Oman,** and **Philippines:** The catches of albacore estimated for the longline fisheries of India, Malaysia, Oman, and Philippines are uncertain, with current estimates accounting for 2% of the total catches of albacore in the Indian Ocean in recent years (average catch 2006–10). None of these countries are reporting catch-and-effort data as per the IOTC standards.
- **Drifting gillnet** fisheries of **Iran** and **Pakistan**: Both Iran and Pakistan have reported nil catches of albacore for their fisheries. To date, the Secretariat has not received catch-and-effort data for these fisheries which compromises the ability of the IOTC Secretariat to assess the amount of gillnet effort exerted by these fisheries in areas where catches of albacore may occur.

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

- Driftnet of Taiwan,China: No size data available over the entire period of activity of the fishery (1982–92).
- **Longline** fishery of **Indonesia**: Indonesia has reported size frequency data for its fresh-tuna longline fishery in recent years. However, the samples cannot be fully disaggregated by month and fishing area (5x5 grid) and refer mostly to the component of the catch that is unloaded fresh. The quality of the samples in the IOTC database is for this reason uncertain.
- **Fresh-tuna longline** fishery of **Taiwan,China**: Taiwan,China provided length frequency data of albacore only for three months in 2010, and therefore coverage remains low.
- **Longline** fishery of **Japan:** The number of samples reported and total number of fish sampled for the longline fishery of Japan since 2000 has been very low.
- Longline fisheries of **India**, **Malaysia**, Oman, and **Philippines:** To date, none of these countries has reported size frequency data of albacore.

3. **Biological data:**

- Industrial **longline** fisheries, in particular **Taiwan,China**, **Indonesia**, **and Japan**: The IOTC Secretariat had to use length-age keys, length-weight keys, and processed weight-live weight keys for albacore from other oceans due to the general paucity of biological data available from the fisheries indicated.

APPENDIX VII
DRAFT RESOURCE STOCK STATUS SUMMARY – ALBACORE

DRAFT: STATUS OF THE INDIAN OCEAN ALBACORE (*THUNNUS ALALUNGA*) RESOURCE

TABLE 1. Status of albacore (*Thunnus alalunga*) in the Indian Ocean.

Area[1]	Indicators – 2012 assessment		2012 stock status determination 2010[2]
Indian Ocean	Catch 2010:	42,968 t	(orange)
	Average catch 2006–2010:	39,833 t	
	MSY (80% CI)):	33 300 t (31,100–35,600)	
	F_{2010}/F_{MSY} (80% CI):	1.33 (0.9–1.76)	
	SB_{2010}/SB_{MSY} (80% CI):	1.05 (0.54–1.56)	
	SB_{2010}/SB_{1950} (80% CI):	0.29 (n.a.)	

[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 for the assessment.

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

The WPTmT **RECOMMENDED** the following management advice for albacore in the Indian Ocean, for the consideration of the Scientific Committee, noting that there remains considerable uncertainty about the relationship between abundance and the standardized CPUE series, and about the total catches over the past decade.

Stock status. Trends in the Taiwan,China CPUE series suggest that the longline vulnerable biomass has declined to about 29% of the level observed in 1950. There were 20 years of moderate fishing before 1980, and the catch has more than doubled since 1980. Catches have increased substantially since 2007, attributed to the Indonesian fishery although there is substantial uncertainty remaining on the catch estimates. It is considered that recent catches have been well above the MSY level, recent fishing mortality exceeds F_{MSY} (F_{2010}/F_{MSY} =1.33). Spawning biomass is considered to be at or very near to the SB_{MSY} level (SB_{2010}/SB_{MSY} =1.05) (Table 1, Fig. 1). Fishing mortality needs to be reduced by at least 20% to ensure that spawning biomass is maintained at MSY levels (Table 2).

Outlook. Maintaining or increasing effort in the core albacore fishing grounds is likely to result in further declines in albacore biomass, productivity and CPUE. The impacts of piracy in the western Indian Ocean has resulted in the displacement of a substantial portion of longline fishing effort into the traditional albacore fishing areas in the southern and eastern Indian Ocean. It is therefore unlikely that catch and effort on albacore will decline in the near future unless management action is taken.

The WPTmT **RECOMMENDED** that the Scientific Committee consider the following:

- The available evidence indicates considerable risk to the stock status at current effort levels.
- The two primary sources of data that drive the assessment, total catches and CPUE are highly uncertain and should be investigated further as a priority.
- The lack of consistency in the data inputs to the analysis and the impacts of using different areas for each fleet on the CPUE standardisations, makes interpretation of the results difficult.
- The use of fine-scale versus aggregated data in the CPUE standardisations by fleet introduces substantial uncertainty.
- Current catches (average 39,833 t over the last five years, 42,968 t in 2010) exceed the MSY level (33,300 t, range: 31,100–35,600 t). Maintaining or increasing effort will result in further declines in biomass, productivity and CPUE.
- A Kobe 2 Strategy matrix was calculated to quantify the risk of different future catch scenarios, using the projections from the ASPM model (Table 2). The projections indicated that a

minimum reduction in fishing mortality of 20% would be required to ensure that the stock does not move to an overfished state by 2020 (i.e. below SB_{MSY}) (Table 2).

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

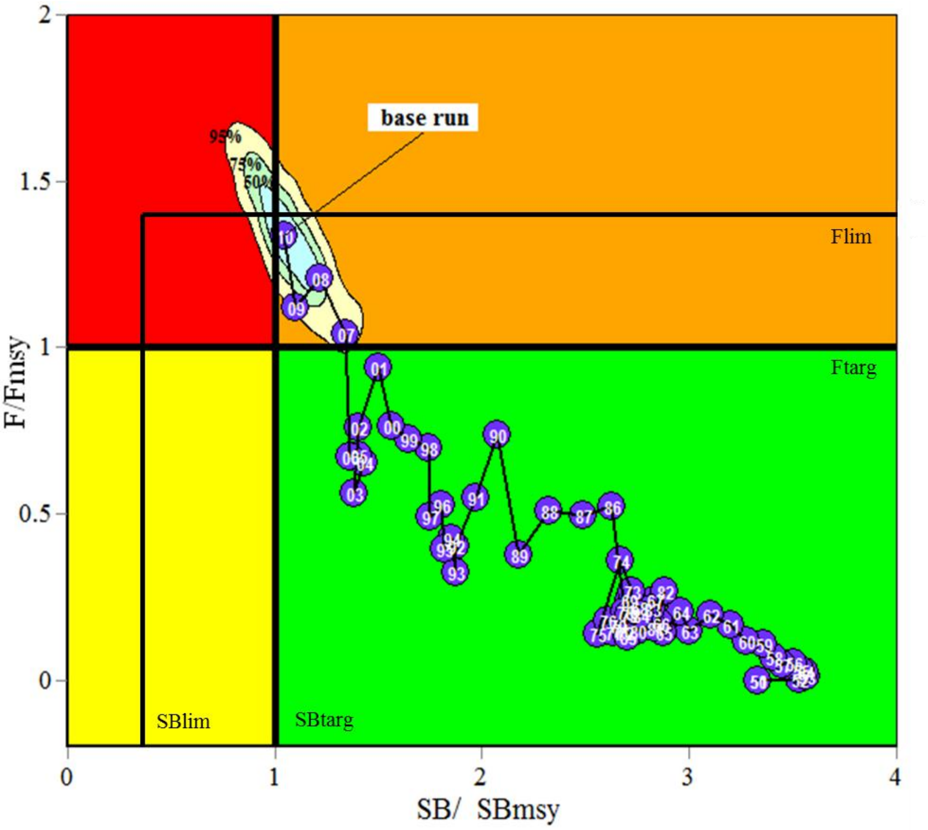


Fig. 1. ASPM Aggregated Indian Ocean assessment Kobe plot (95% bootstrap confidence surfaces shown around 2010 estimate). Blue circles indicate the trajectory of the point estimates for the SB ratio and F ratio for each year 1950–2010. Target (Ftarg and SBtarg) and limit (Flim and SBlim) reference points are shown.

TABLE 2. ASPM Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of violating the MSY-based reference points for five constant catch projections (2010 catch level, ± 10% ± 20%, ± 30% and ± 40%) projected for 3 and 10 years.

Reference point and projection timeframe	Alternative catch projections (relative to 2010) and probability (%) of violating MSY reference points								
	60%	**70%**	**80%**	**90%**	**100%**	**110%**	**120%**	**130%**	**140%**
$SB_{2013} < SB_{MSY}$	<1	1	8	15	23	35	46	55	65
$F_{2013} > F_{MSY}$	<1	2	18	47	74	91	98	>99	>99
$SB_{2020} < SB_{MSY}$	<1	<1	12	40	69	90	>99	>99	>99
$F_{2020} > F_{MSY}$	<1	<1	20	67	94	>99	>99	>99	>99