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

Busan, Republic of Korea, 20–22 September 2011

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–WPTmT03 2011. Report of the Third Session of the IOTC Working Party on Temperate Tunas. Busan, Republic of Korea, 20–22 September 2011. *IOTC–2011–WPTmT03–R[E]: 34 pp.*

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 Third Session of the Indian Ocean Tuna Commission (IOTC) WPTmT was held in Busan, Republic of Korea, from 20 to 22 September 2011. The meeting was attended by 16 individuals, including one invited expert, Dr. Simon Hoyle, from the Secretariat of the Pacific Community (SPC) – Oceanic Fisheries Program.

The following are a subset of the complete recommendations from the WPTmT03 to the Scientific Committee, which are provided at Appendix IV.

***Albacore*: 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 (para. 78).

Stock status. Trends in the Taiwan,China CPUE series suggest that the longline vulnerable biomass has declined to about 39% of the level observed in 1980. There were 20 years of moderate fishing before 1980, and the catch has more than doubled since 1980. Catches have increased substantially since the previous albacore assessment when there was considered to be a risk that $SB<SB_{MSY}$, so the risk will have increased further. It is considered likely that recent catches have been above MSY, recent fishing mortality exceeds F_{MSY} ($F_{2010}/F_{MSY} > 1$). There is a moderate risk that total biomass is below B_{MSY} ($B_{2010}/B_{MSY} \approx 1$).

Outlook. Maintaining or increasing effort will probably result in further declines in 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.

The WPTmT recommended that the Scientific Committee consider the following (para. 79):

- 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.
- Current catches (average ~41,000 t over the last five years, ~44,000 t in 2010) likely exceed MSY (29,900 t, range: 21,500–33,100 t). Maintaining or increasing effort will probably 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 (Table 3). However, a number of inconsistencies between the model and data were noted for future investigation.

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

The WPTmT recommended that the Scientific Committee note the draft resource stock status summary for albacore (*Thunnus alalunga*) – Appendix VI (para. 85).

The WPTmT agreed that there was an urgent need to carry out revised stock assessments for the albacore resource in the Indian Ocean in 2012, and recommended that the Scientific Committee consider recommending that the Commission consider approving funds for this purpose (para. 90).

1. ELECTION OF A CHAIR AND VICE-CHAIR

1. The Secretariat notified participants that, as there was no current Chair or Vice-Chair for the Working Party on Temperate Tunas (WPTmT), they would need to consider electing an acting-Chair for the duration of the meeting. Dr. Dae Yeon Moon from the Republic of Korea was nominated and elected as acting-Chair of the Third Session of the WPTmT.

2. OPENING OF THE MEETING

2. The Third Session of the Indian Ocean Tuna Commission's (IOTC) WPTmT was held in Busan, Republic of Korea, from 20 to 22 September 2011. A total of 16 participants attended the Session. The list of participants is provided at Appendix I.

3. The meeting was opened on 20 September, 2011 by the acting-Chair, Dr. Dae Yeon Moon, who subsequently welcomed participants to the Republic of Korea. Participants were informed that a Chair and Vice-Chair for the next biennium would need to be elected prior to the close of the meeting.

3. ADOPTION OF THE AGENDA

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

4. OUTCOMES OF THE THIRTEENTH SESSION OF THE SCIENTIFIC COMMITTEE

5. The WPTmT **NOTED** paper IOTC–2011–WPTmT03–03 which outlined the main outcomes of the Thirteenth Session of the Scientific Committee, specifically related to the work of the WPTmT.

6. The WPTmT **NOTED** the recommendations of the Thirteenth 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.

5. OUTCOMES OF THE FIFTEENTH SESSION OF THE COMMISSION

7. The WPTmT **NOTED** paper IOTC–2011–WPTmT03–04 which outlined the main outcomes of the Fifteenth Session of the Commission, specifically related to the work of the WPTmT.

8. The WPTmT **NOTED** the Commission's request that a Kobe II strategy matrix be provided for all stock assessments by the species Working Parties, and for these to be included in the report of the Scientific Committee in 2011 and all future reports.

9. The WPTmT **NOTED** the outcomes of the Fifteenth Session of the Commission, and agreed to consider how best to provide the Scientific Committee with the information it needs, in order to satisfy the Commission's requests, throughout the course of the meeting.

6. PROGRESS ON THE RECOMMENDATIONS OF WPTMT02

10. The WPTmT **NOTED** paper IOTC–2011–WPTmT03–05 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.

11. 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 Scientific Committee.

7. REVIEW OF THE DATA AVAILABLE FOR TEMPERATE TUNA SPECIES

12. The WPTmT **NOTED** paper IOTC–2011–WPTmT03–06 which summarised the standing of a range of information received by the 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. Statistics for 2010 represent preliminary catch information.

13. The WPTmT **NOTED** the main albacore data issues that are considered to negatively affect the quality of the statistics available at the IOTC, by type of dataset and fishery, which are provided in

Appendix V, 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.

Albacore – catch trends

14. The WPTmT **NOTED** that albacore are currently caught almost exclusively using drifting longlines (98%), and between 20°S and 40°S, with remaining catches recorded using purse seines and other gears (Fig. 1). Between 1983 and 1992, the majority of albacore catches were taken by the Taiwan,China fleet using drifting gillnets which targeted juvenile albacore in the southern Indian Ocean (30°S to 40°S) (Fig. 1). In 1992 the United Nations worldwide ban on the use of drifting gillnets effectively closed this gillnet fishery.

15. The WPTmT **NOTED** that the 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, with total catches in excess of 30,000 t. Following the removal of the gillnet fleet, catches dropped to less than 20,000 t by 1993. However, catches more than doubled over the period from 1993 (less than 20,000 t) to 2001 (44,000 t). Record catches of albacore were reported in 2007, at around 45,000 t, and again in 2008, at 48,000 t. Catches for 2009 are estimated to be approximately 40,000 t, while preliminary catches for 2010 amount to 43,711 t.

16. The WPTmT **NOTED** that the catches of albacore in recent years have come almost exclusively from vessels flagged in 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 40% of the total catches of albacore in the Indian Ocean.

17. The WPTmT **NOTED** that longliners from Japan and Taiwan,China have been operating in the Indian Ocean since the early 1950s (Fig. 2). While 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.

18. The WPTmT **NOTED** that 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 on the increase 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 (68% of the total catches for 2008–2010) as opposed to deep-freezing longliners.

19. The WPTmT **NOTED** that while most of the catches of albacore have traditionally come from the western Indian Ocean, in recent years a larger proportion of the catch has come from the eastern Indian Ocean (Fig. 3). 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 (Indonesia not represented in Fig. 3 as spatial catch-and-effort data is not available or highly uncertain for these fleets). In the western Indian Ocean, the catches of albacore mostly result from the activities of deep-freezing longliners and purse seiners.

20. The WPTmT **NOTED** that 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.

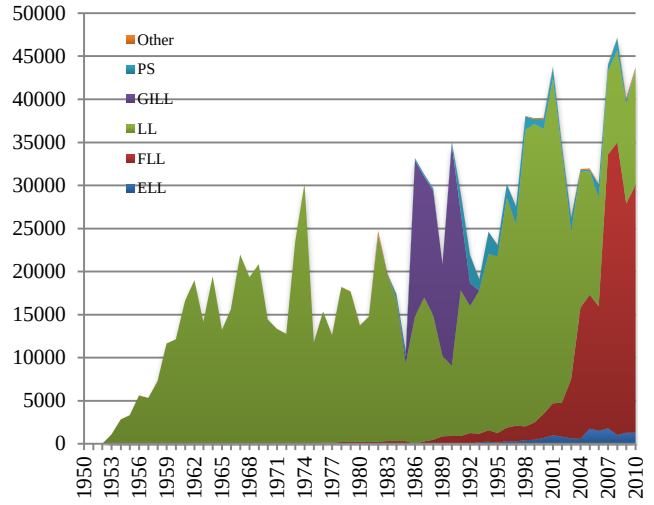


Fig. 1. Annual catches of albacore by gear recorded in the IOTC Database (1961–2010) (Data as of August 2011).

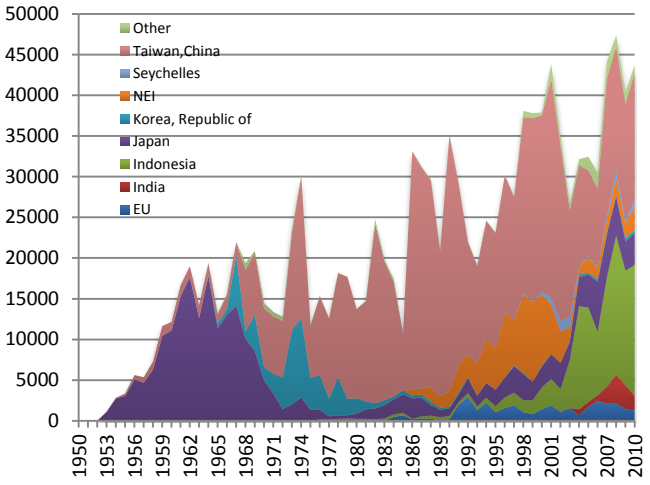


Fig. 2. Annual catches of albacore by fleet recorded in the IOTC Database (1961–2010) (Data as of August 2011).

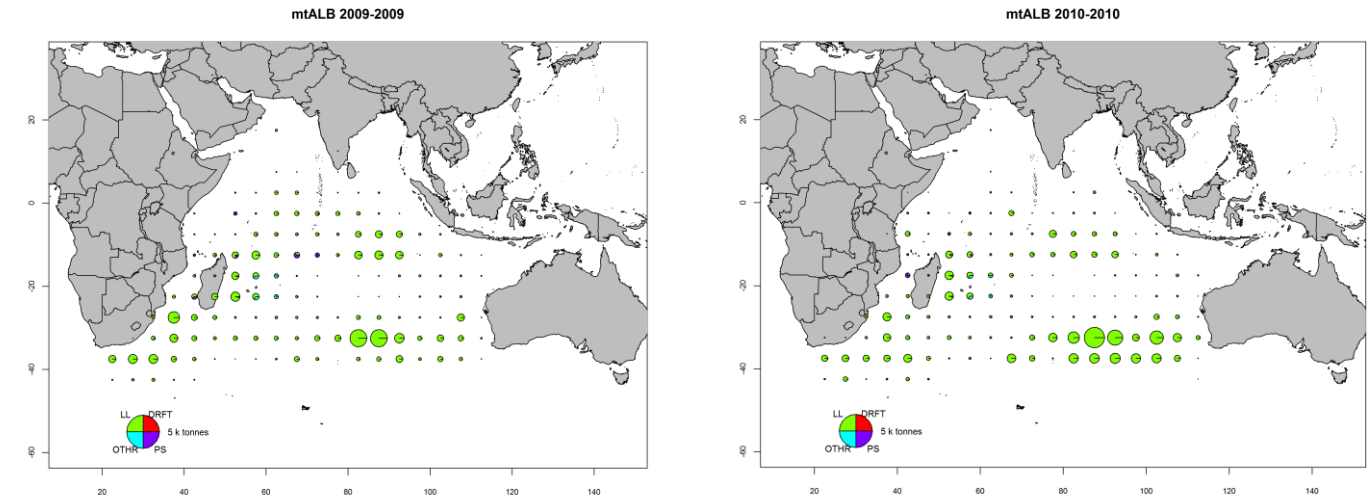


Fig. 3a–b. Time-area catches (total combined in tonnes) of albacore estimated for 2009 and 2010 by type of gear: Longline (LL, green), Driftnet (DFRT, red), Purse seine (PS, purple), Other fleets (OTHER, blue). Time-area catches are not available for all fleets; catches for those were assigned by 5x5 square and month using information from other fleets. Catches of fresh-tuna longliners are not represented (Data as of August 2011).

Albacore – uncertainty of catches

21. The WPTmT **NOTED** that retained catches are fairly well known (Fig. 4); however catches are uncertain for:
    - Longliners of Indonesia, India and Malaysia operating in Southern waters: To date, Indonesian, Indian and Malaysian longline vessels operating in Southern waters have not reported catches of albacore, noting that the Secretariat has estimated these catches at around 3000 t annually.
    - Fleets using gillnets on the high seas, in particular Iran, Pakistan and Sri Lanka: Catches are likely to be less than 1000 t.
    - Non-reporting industrial longliners (NEI): Refers to catches from longliners operating under flags of non-reporting countries. Historically high catches, however thought to be between 1000 and 2000 t in recent years.

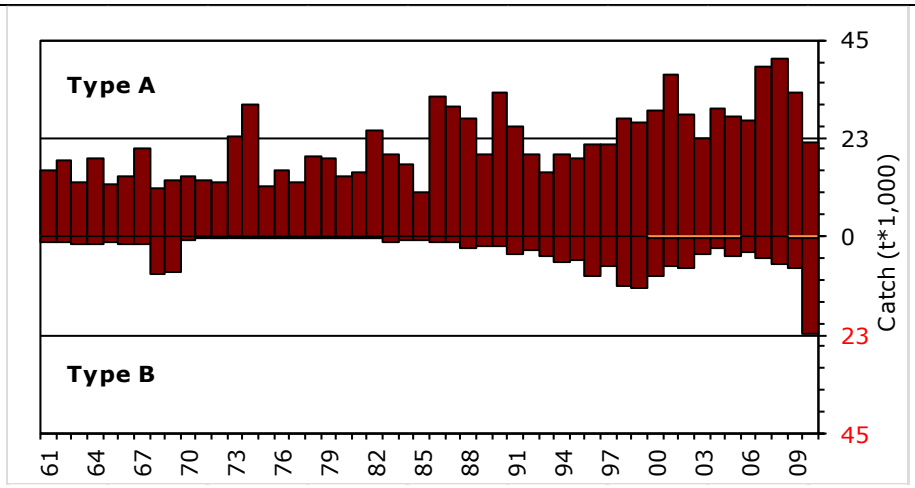


Fig. 4. Uncertainty of annual catch estimates for albacore (1950–2010) (Data as of August 2011).

*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.*

22. The WPTmT further **NOTED** that:

- The catch series for albacore in recent years has changed substantially, especially since 2003. This change was due to a review of the data series for Indonesian longliners (Fig. 5).
- Levels of discards are believed to be low although they are unknown for industrial fisheries other than European (EU) purse seiners.
- 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 and Philippines.
    - non-reporting by industrial purse seiners and longliners (NEI).
- 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, for the fleets referred to above.
- 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 paucity of catch by area data available for some industrial fleets (Taiwan,China, NEI, India and Indonesia).

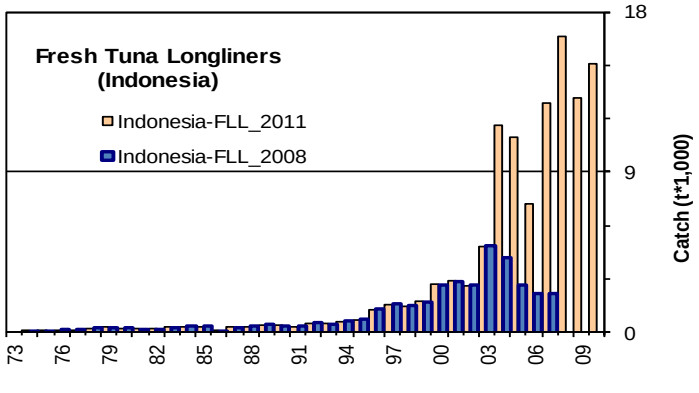


Fig. 5. Catches of fresh-tuna longline vessels based in Indonesia (domestic and foreign) estimated in 2011 (1973–2010) versus catches estimated in 2008 (1973–2006). The revised Indonesian nominal catch series data was estimated by the IOTC Secretariat.

Logbook coverage

23. The WPTmT **RECOMMENDED** that the WPDCS monitor that CPCs ensure that logbooks used for their fleets are compliant with the minimum data requirements contained in Resolutions 08/04 *concerning the recording of catch by longline fishing vessels in the IOTC area* and 10/03 *concerning the recording of catch by fishing vessels in the IOTC area* of the Commission (noting Recommendation 11/06 *concerning the recording of catch and effort by fishing vessels in the IOTC area of competence*), and to ensure that logbook coverage is appropriate to produce acceptable levels of precision (CV to be initially set at less than 20%) in their catch and effort statistics for temperate tuna species.

24. The WPTmT **RECOMMENDED** that the main fleets catching albacore (Japan, Taiwan,China and Indonesia) collect biological information on albacore caught in their fisheries, preferably through observer programmes, and provide this information (including the raw data) to the Secretariat in 2012.

Catch-and-effort and Size data

25. The WPTmT **RECOMMENDED** that as a matter of priority, India provide catch-and-effort data and size data for temperate tuna, in particular from its commercial longline fleet, as soon as possible, noting that this is already a mandatory reporting requirement.

26. The WPTmT **NOTED** that when the IOTC-OFCF sampling project commended in Indonesia in 2002, landings of albacore appeared to be fairly small and the sampling protocol was implemented in order to separate fresh and frozen fish. The WPTmT also **NOTED** that sampling the frozen component of the catch is difficult as it is unloaded directly into trucks and freezers, and the frozen fish are not accessible to the samplers.

27. The WPTmT **RECOMMENDED** that as a matter of priority, Indonesia and Malaysia provide catch-and-effort data and size data for temperate tuna, in particular for their fresh tuna and/or deep-freezing longline fleets, as soon as possible, noting that this is already a mandatory reporting requirement. Reporting should also include data from their vessels operating from other CPCs.

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 be reported to the IOTC Secretariat in 2012.

29. The WPTmT **RECOMMENDED** that size data for albacore from the Japanese longline fleet are collected and reported to the IOTC Secretariat in 2012, with a summary to be provided to the WPTmT.

30. The WPTmT **RECOMMENDED** that Japan and Taiwan,China 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. In particular Japan to compare length frequency distributions derived from samples collected:
    - by fishermen on commercial vessels
    - by observers on commercial vessels
    - by scientists on research and training vessels.

31. The WPTmT **RECOMMENDED** that as a matter of priority, the Philippines provide size data for temperate tuna, noting that this is already a mandatory reporting requirement.

32. 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 for 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.

Fishery trends for albacore

33. The WPTmT **NOTED** paper IOTC–2011–WPTmT03–07 which provided a range of fishery indicators to aid the WPTmT in developing its advice to the Scientific Committee, including total effort from longline vessels flagged to Japan, Taiwan,China and EU,Spain by five degree square grid from 2007 to 2010 (Fig. 6), and total effort from purse seine vessles 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 (Fig. 7).

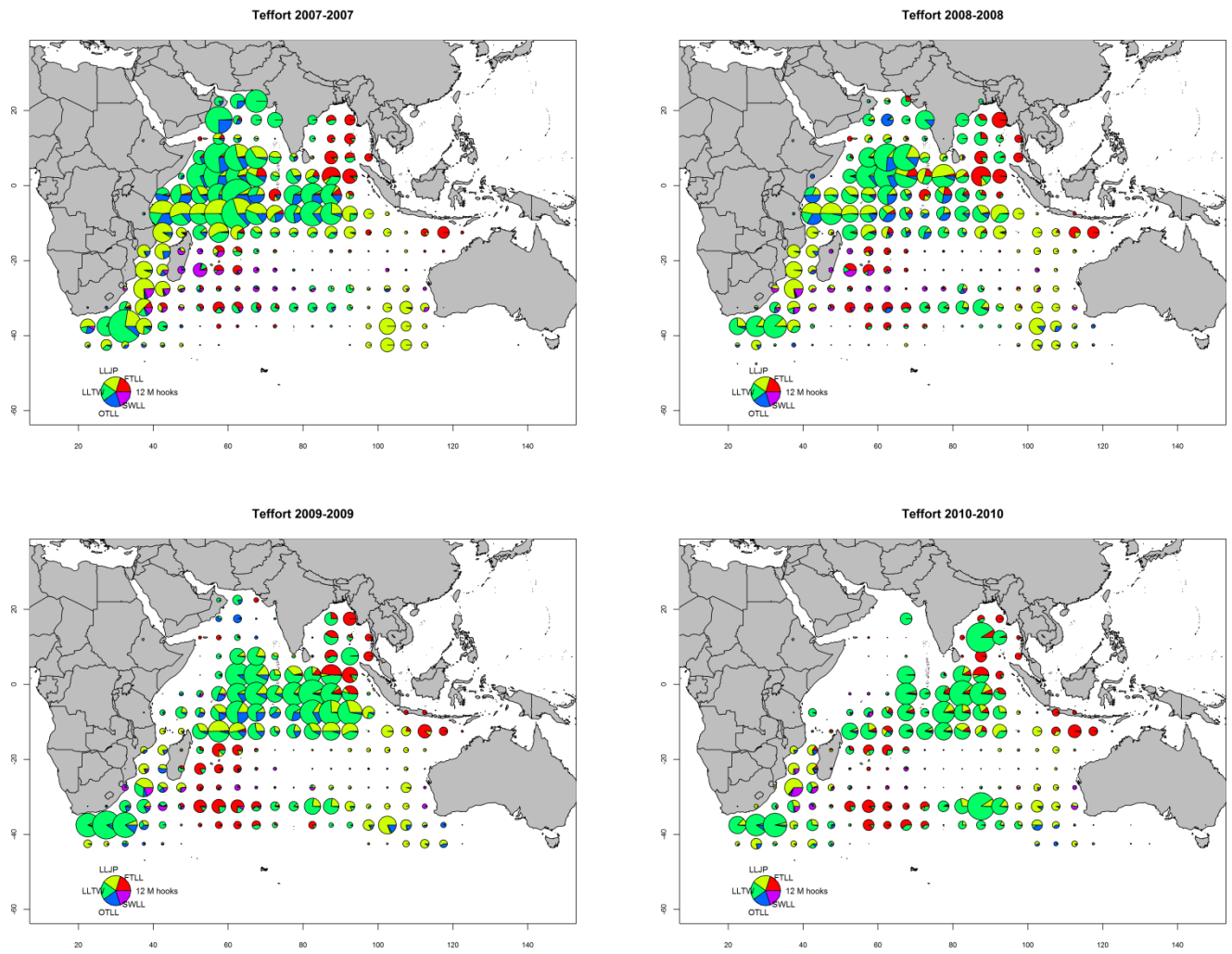
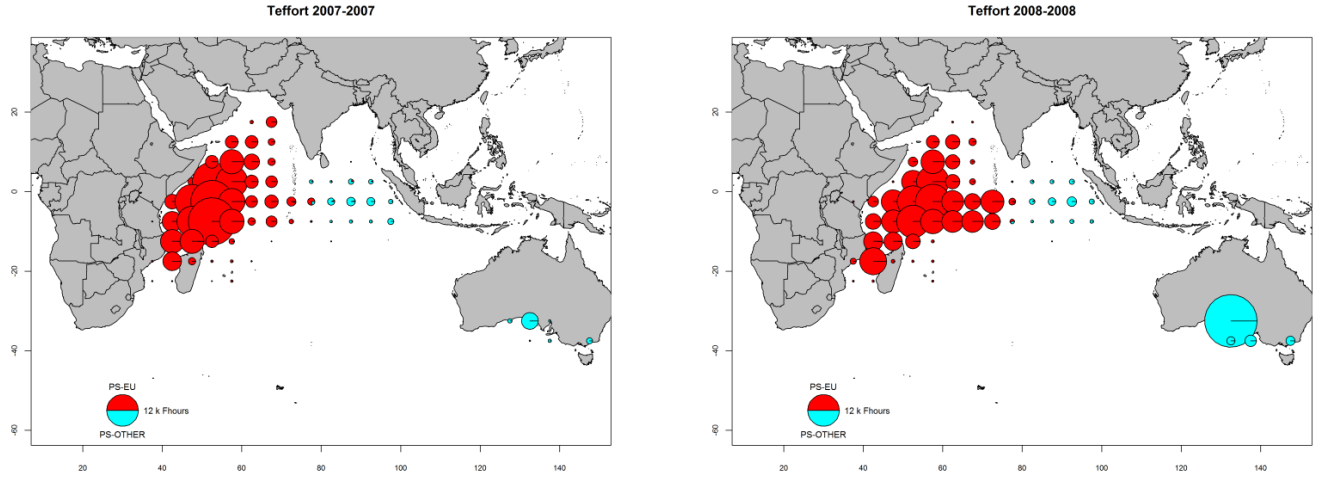


Fig. 6. Number of hooks set (millions) from longline vessels by five degree square grid and main fleets, for the years 2007 to 2010 (Data as of August 2011).

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, South Korea and various other fleets)



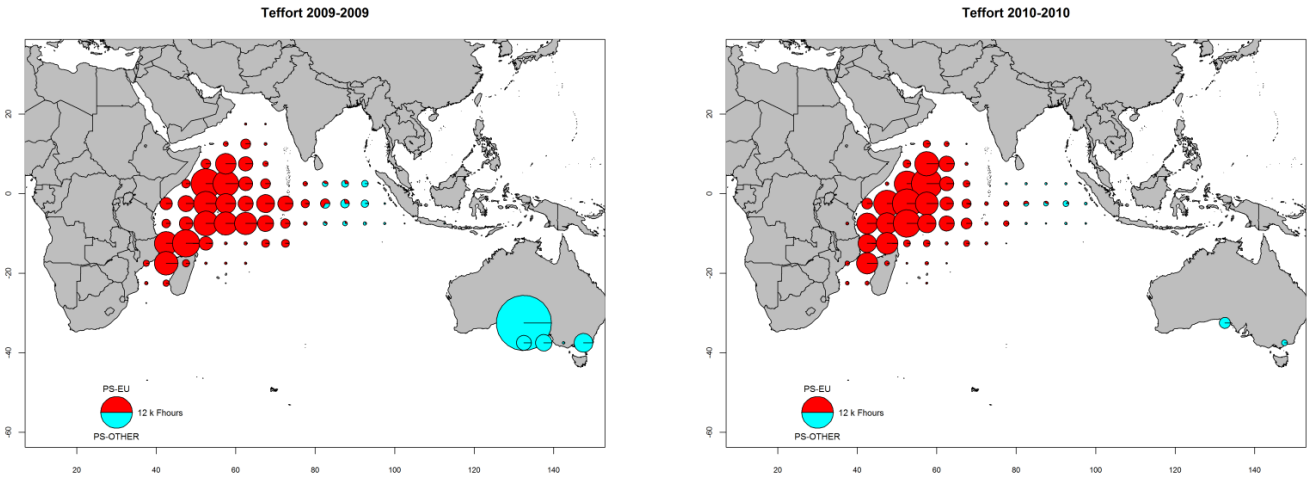


Fig. 7. Number of hours of fishing(Fhours) from purse seine vessels by 5 degree square grid and main fleets, for the years 2007 to 2010 (Data as of August 2011).

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)

8. NEW INFORMATION ON BIOLOGY, ECOLOGY, FISHERIES AND ENVIRONMENTAL DATA RELATING TO TEMPERATE TUNAS

8.1 Review new information on the biology, stock structure, their fisheries and associated environmental data: albacore

Longline fleet of Thailand

34. The WPTmT **NOTED** paper IOTC–2011–WPTmT03–08 which provided an overview of the recent activities of the longline fleet from Thailand catching albacore, including the following abstract provided by the authors:

> "*Three Thai tuna longliners operated in the Indian Ocean in 2007 but there were only two longliners operating during 2008–2010. The main fishing ground was in the southern part of the Indian Ocean (around the east and south coast of Madagascar). Information in this report based on the data extracted from logsheets which were delivered to the Department of Fisheries, Thailand. From the year 2007 to 2010, one thousand nine hundred and four days fishing operations in the Indian Ocean were recorded. The total catch was highest in 2010 for 607.69 tonnes followed by 461.75, 295.23 and 265.57 tonnes in 2007, 2009 and 2008, respectively. The highest CPUE was found in 2010 (13.62 fish/1000 hooks) followed by year 2007, 2008 and 2009 (10.20, 5.88 and 5.16 fish/1000 hooks, respectively). Albacore was the highest composition by weight and number in 2010 (263.41 tonnes and 11,456 fish) with CPUE 8.65 fish/1,000 hooks. It was the lowest composition by weight and number in 2008 (22.84 tonnes and 1,066 fish) with CPUE 0.91 fish/1,000 hooks. In 2010, albacore tuna catch and CPUE were highest in zone 3 with 244.60 tonnes and 12.10 fish/1,000 hooks following by zone 4, zone 2 and zone 5.*"

35. The WPTmT **NOTED** that the large reported increase in CPUE for 2010 by the Thai longline fleet was most likely a result of a change in targeting to albacore, as a direct result of the increased market value for the Japanese sashimi market, and of the piracy activities in the western Indian Ocean, which has resulted in the displacement of longline vessels towards the southern Indian Ocean which are now catching a larger proportion of albacore.

Observer data from China

36. The WPTmT **NOTED** paper IOTC–2011–WPTmT03–11 which provided an overview of the fisheries biology for albacore based on Chinese observer data, including the following abstract provided by the authors:

> "*China developed its distant-water tuna fishery in the late 1980s. Longlining fishing is the only fishing method applied by Chinese fleets for tuna and tuna-like species in the IOTC water. Bigeye*

tuna and yellowfin tuna are the main target species, and albacore is only one bycatch for Chinese fleets. The tuna technical working group of Shanghai Ocean University (SOU) is in charge of the national tuna observer program under authorization by the Bureau of fisheries, Ministry of Agriculture, China. Two or three observers who are graduate students majoring in marine fisheries science & technology of SOU have been dispatched each year in IOTC water since 2003. In this paper, we studied the fisheries biology of albacore using the data collected by one observer who was dispatched on board deep frozen longliner in the IOTC water in 2009."

37. Noting that the current information available on albacore biology from the Indian Ocean is limited, the WPTmT **RECOMMENDED** that China provide further updates on research carried out as part of its national observer program, at the next session of the WPTmT and **ENCOURAGED** other CPCs to provide similar research reports on albacore biology, either from data collected through observer programs or other research programs, at the next WPTmT meeting.

38. Noting that there are difficulties faced by some CPCs in collecting gonad samples from albacore – albacore is generally frozen whole and not gutted, the WPTmT **RECOMMENDED** that CPCs, in particular Japan, 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.

Korean catch and effort for albacore

39. The WPTmT **NOTED** paper IOTC–2011–WPTmT03–12 which provided an overview of the catch and effort by the Korean flagged fleet, including the following abstract provided by the authors:

"*Korean tuna longline fishery begun with an experimental fishing in the Indian Ocean in the mid-1950s. The target species were yellowfin tuna, bigeye tuna and albacore. Its catch statistics are available from the early 1960s on and the logbook data from the mid-1970s on. The size data have been obtained from the recent scientific observation program. The fishing effort (1000 hooks) was the highest of 65,334 in 1978 but gradually decreased in a stepwise pattern until 1998 and then stagnant at 12,000-5000 from 1999 to 2010. The albacore catch was also the highest with 158 thousands fishes in 1978 but it considerably decreased by 10 thousand fishes until 1990s. In recent years, it was slightly increasing by 30 thousand fishes. The nominal CPUE (fishes/1000hooks) of albacore was 2.5 during 1975-1978 and then decreased by 0.3 until 2002, while it increased by 2.5 in 2009 and by 5.4 in 2010. When Korean longline catch was high, the fishing efforts were deployed throughout the areas between 20°N and 20°S of the eastern and western Indian Ocean, including the western Indian Ocean between 20°N and 40°S. With the efforts decreasing throughout areas, the albacore catch became a minor. However, in the 2000s, though the fishing effort was stable at the lowest level and even further decreased, the albacore catch was increasing to the level as was in the 1980s but yellowfin tuna and bigeye tuna were decreasing. It was supposed that the recent increase of albacore catch was attributable to the relative increase of fishing effort in the south-western Indian Ocean and the decrease of yellowfin and bigeye tuna catch was influenced by the decrease of fishing effort in the north-western Indian Ocean. The length frequency distributions of albacore ranged from 90 to 116 cm with a mode at 103 cm in the western Indian Ocean between 5°N and 25°S, while it ranged 59-117 cm in the south-western Indian Ocean between 25°S and 45°S.*"

40. The WPTmT **NOTED** that the reported increase in catches of albacore, which have been combined with a decrease in the catches of bigeye tuna in recent years by the Republic of Korea longline fleet was most likely related to the Republic of Korea 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 catching a larger proportion of albacore.

41. Noting that the nominal catch (NC) data provided at the WPTmT03 meeting was found to conflict with the NC data history provided by the Republic of Korea for all years prior to 1994, and for catch-and-effort data for most of the history of the longline fleet, the WPTmT **RECOMMENDED** that the Rep. of Korea liaise with the Secretariat to provide a fully justified revised catch history which will replace the data currently held by the Secretariat before the end of 2011.

Japanese longline fishery for albacore

42. The WPTmT **NOTED** paper IOTC–2011–WPTmT03–13 which provided a review of the Japanese longline fishery and its albacore catch in the Indian Ocean, including the following abstract provided by the authors:

"*There are two kinds of Japanese tuna fishery in the Indian Ocean, i.e. longline and purse seine fisheries. In those fisheries only the longline fishery has caught albacore. The longline fishery commenced in 1952 in the eastern equatorial waters in the Indian Ocean. The fishing effort of the longline first expanded westward, and then southward. In the late 1960s, the effort covered entire fishing ground of the longline in the Indian Ocean. The annual amount of the effort has changed since the late 1960s. And also annual albacore catch have considerably changed, ranging from 400 t to 18,000 t, as well as catches of other tunas. Those changes were mainly due to the change of targeting as seen in the other Oceans. In this document, historical and spatial changes of albacore catch and the fishing effort were described in conjunction with the catches of the other tunas and tuna-like species. In addition, the size data of albacore caught by the longline are shown to see general information of fish size and to seek the possibility of the application of the age-structured stock assessment for Indian albacore stock."*

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

44. The WPTmT **AGREED** that the latitudinal separation of 30 degrees, used to describe the spatial nature of the Japanese longline fishery, may not be consistent with the biology and fisheries for albacore. It was considered that a separation based on a consistent element such as 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 at which spatial changes in average size are most apparent. The selected latitudinal separation could also be used for CPUE standardisation.

Indonesian longline fishery

45. The WPTmT **NOTED** paper IOTC–2011–WPTmT03–14 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 information on ALB catch by Benoa-based longline vessels collected by the Benoa Port-based Catch Monitoring Program and Observer Program. The ALB catch landed at the Benoa Fishing Port in 2010 was estimated by RITF to be about 983,14 tons, whereas based on ATLI, ALB catch landed at Benoa Fishing Port in 2010 amounted of 2715,42 tons. This discrepancy was due to sampling for frozen catch (including ALB) could not be conducted in some companies and also there was one company that sell their catch direct to the collector. The observed longline sets were concentrated within the area between 10° - 20°S and 105° - 120°E. Since 2008, the observed setting positions have never extended to south of 20°S. ALB had higher catch rates in area south of 15°S.*"

46. The WPTmT **NOTED** that the data provided in paper IOTC–2011–WPTmT03–14 was substantially lower than that held by the Secretariat. In was noted that, as albacore is mainly unloaded frozen, this may be a function of the lack of these frozen fish being sampled at Benoa port due to accessibility problems.

47. 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.

48. The WPTmT **NOTED** that the IOTC Secretariat had undertaken a review of historical Indonesian nominal catch series data that resulted in substantial revisions to the series. Prior to 2008, export data from Indonesia were aggregated for all species. The Secretariat only received the export data by species for 2008 and 2009, and the ISSF import data for 2009. Considering that the effort on albacore is likely to have started to increase in 2003, estimates for 2003–2007 were calculated with the proportion of albacore in the catch considering an increase in longline activities in the south.

49. 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 Secretariat, the WPTmT **RECOMMENDED** that Indonesia further strengthen sampling efforts on its coastal and off-shore fisheries in early 2012, where required, and liaise with the Secretariat in order to better determine the catches of albacore by the Indonesian longline fleet.

50. 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.

Piracy in the Indian Ocean

51. The WPTmT **NOTED** that the impacts of piracy in the eastern Indian Ocean appears to have resulted in the relocation of longliners into traditional albacore fishing areas, thereby increasing fishing pressure on this species, although no analysis was presented.

52. 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 CPCs most affected by these activities, including Japan, Republic of Korea and Taiwan,China.

Other new information

53. The WPTmT **NOTED** the other information paper on albacore biology, IOTC–2011–WPTmT03–INF03, provided to the meeting, as detailed in IOTC–2011–WPTmT03–02.

9. REVIEW OF NEW INFORMATION ON THE STATUS OF ALBACORE TUNA

9.1 Data for input into stock assessments (stock status indicators for albacore):

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

54. The WPTmT **NOTED** paper IOTC–2011–WPTmT03–15 which provided a standardization of the CPUE for the Japanese longline fishery for albacore in the Indian Ocean for the period 1960–2010, including the following abstract provided by the authors:

"*The albacore in the Indian Ocean has been exploited since the early 1950s. The albacore catch has been increasing with fluctuation, and it reached about 48,000 t in 2008 at the historical highest level, though the range of the catch had been from 10,000 t to 30,000 t during the period from the 1960s to the mid 1990s. Japanese longline fishery commenced in this Ocean in 1952. The fishery caught albacore ranging from 9,000 to 18,000 t in the 1960s that corresponds to the beginning of the long history of the fishery. Since then the catch decreased rapidly and reached 400 t in 1977. This drastic change is due to the change of target species of the longline fishery, i.e., yellowfin tuna and albacore to southern bluefin tuna and bigeye tuna, during the 1970s. The catch continued to be a low level ranging from 400 t to 2,500 t until early 1990s. After that the catch slightly increased and was 6,200 t in 2006, which was highest during the past 40 years. However, it is still about one third of the catch at the peak in 1964. Summary of albacore fishery in the Indian Ocean by Japanese longline is reported by Matsumoto and Uosaki (2011). For the Indian albacore caught by Japanese longline fishery, CPUE standardization using the General Linear Model (GLM) with the assumption that the error structure belongs to log-normal had been carried out for 1960-1991 (Uozumi, 1994) and for 1960-2002 (Uosaki, 2004). However, possibly GLM with negative binominal error structure is better for standardization of albacore CPUE by Japanese longline which includes certain amount of zero catch data. In this document, the standardization of albacore CPUE by Japanese longline was conducted based on two models mentioned above and the results were compared, and discussed which model is more appropriate.*"

55. The WPTmT **NOTED** a range of matters regarding this paper, as provided in the CPUE discussion summary, below.

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

56. The WPTmT **NOTED** paper IOTC–2011–WPTmT03–16 which provided a standardized CPUE for albacore based on Taiwan,China longline catch and effort statistics from 1980 to 2010, including the following abstract provided by the authors:

"*Standardized abundance indices of albacore, dating from 1980 to 2010, based on Taiwanese longline catch and effort statistics by using Generalized Liner Model (GLM) procedure were carried out in present study. Four 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 2010. Standardized quarterly CPUE series from the 1st quarter of 1980 to the 3rd quarter of 2010 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. Efforts have been made in this paper to improve the delineation of subdivision in the Indian longline fishing areas, based on Taiwanese longline reported area-time catch and effort of tunas. Yearly CPUE trend of 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 2010. 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. The CPUEs obtained in the late 2000s appeared to be along with the downward trend of such a cycle."

57. The WPTmT **NOTED** a range of matters regarding this paper, as provided in the CPUE discussion summary, below.

Taiwan,China – Subdivision of the Indian Ocean for Catch-per-unit-effort analysis

58. The WPTmT **NOTED** paper IOTC–2011–WPTmT03–18 which provided a scrutinisation of the subdivision of the Indian Ocean for the albacore CPUE trend, from 1980 to 2010 for the Taiwan,China longline fleet, including the following abstract provided by the authors:
"*It has been notified for quite a long time that the factor of "subarea" in GLM analyses always played the major and significant role in explanatory of total variability. Although, numerically speaking, the contrasts in mean square obtained from two different subarea setups might not big enough to be statistically significant, it is still worthwhile to scrutinize the true facts behind those subdivision reasonings. In addition to conventional area subdivision mainly based on its posterior catch composition, the authors bring in the element of number of hooks per basket information, which is generally available since 1995 because of new log book format. It is noticed by this analyses that (1) within the range of number of hooks (5 to 21+) per basket, two distinct groups were identified: using 5-12 hooks per basket and that of 13-21+ group; (2) catch of 5-12 hooks group appeared targeting on albacore, whereas 13-21+ hooks group appeared more on bigeye, all types of hooks seems workable for yellowfin without any preference; and (3) area distribution of 5-12 hooks appeared more concentrated within the 30-40 degree S zonation, while the 13-21+ hooks more concentrated in 10 degree N to 15 degree S zonation. Clustering technique by using within-block overall mean catch composition as its character vector were also applied and resulted in a tree structure of 4 groups of fishing block. Comparing these 4 group with aforementioned area distribution of hooks group and major species caught, it is noticed that cluster group 2 corresponding to bigeye and cluster group 3 corresponding to albacore. Although cluster group 1 and 4 seemed to be closely nearby, it is determined that cluster group1 corresponding to yellowfin and cluster group 4 appeared to be a independent group based on its species composition is different from others.*"

59. The WPTmT **NOTED** that, as the paper was only provided at the start of the meeting, it was difficult for participants to comment and contribute to discussions other than at a cursory level following the papers presentation. A summary of the key points discussed regarding this paper are provided in the CPUE discussion summary, below.

CPUE information papers

60. The WPTmT **NOTED** the information papers IOTC–2011–WPTmT03–INF04, 05 and 06, related to CPUE standardisations provided by the Invited Expert (Dr. Simon Hoyle). The core elements from each paper have been incorporated into the CPUE discussion summary below, for working papers IOTC–2011–WPTmT03–15, 16 and 18.

CPUE discussion summary

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

- The WPTmT **AGREED** that changes in species targeting is the most important issue to address in CPUE standardisations, and that the following points should be taken into consideration:
  i. While hooks between floats (HBF) provides some indication of setting depth, it is generally considered not to be a sufficient indicator of species targeting. HBF is just one aspect of the setting technique, which can vary by species, area, set-time, and other factors.
  ii. Highly aggregated (e.g. 5x5 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 models). Adding a small constant to the lognormal model may be okay if there are few zeroes, but may not be appropriate for areas with many zero catches (e.g. north of 10^{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. The WPTmT **AGREED** that often these variables do not have as much explanatory power as, or may be confounded with, fixed spatial effects. This may indicate that model-derived environmental fields are not accurate enough at this time, or there may need to be careful consideration of the mechanisms of interaction to include the variable in the most informative way.

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

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

63. The WPTmT **NOTED** that of the CPUE series available for assessment purposes, listed below, only the Taiwan,China series was used in the stock assessment model for 2011 for the reasons discussed above (shown in Fig. 8).
    - Japan data (1960–2010): Series1 from document IOTC–2011–WPTmT03–15.
    - Japan data (1970–2010): Series 2 from document IOTC–2011–WPTmT03–15.
    - Taiwan,China data (1980–2010): Series from document IOTC–2011–WPTmT03–16.

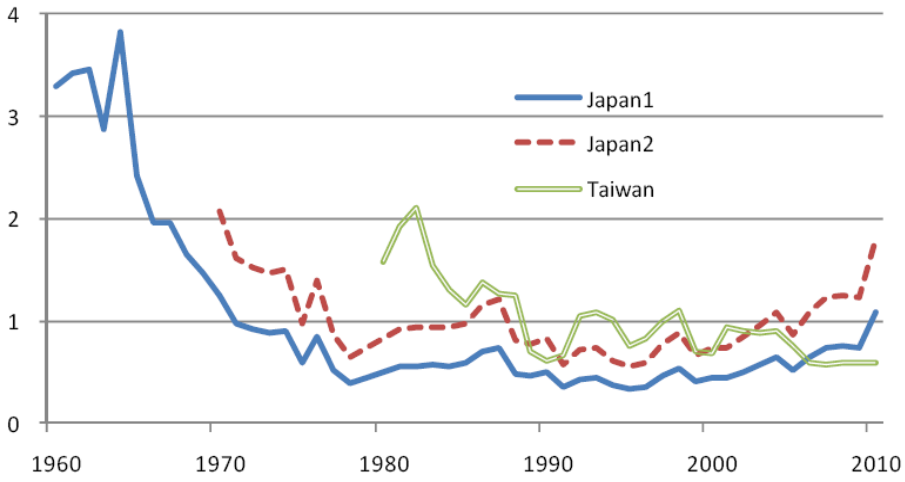


Fig. 8. Comparison of the three CPUE series for Indian Ocean albacore. Series have been rescaled relative to their respective means from 1960–2010.

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

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

Stock assessment

66. The WPTmT **NOTED** that only a single quantitative modelling method, a highly aggregated "A Stock Production Model Including Covariate" (ASPIC) surplus production model, was applied to the albacore assessment in 2011.

67. Noting that the only stock assessment for albacore was not made available by the authors until the 19th September, 2011 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 no later than 15 days before the commencement of the relevant meeting.

68. 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.

Invited Expert information paper

69. The WPTmT **NOTED** the information paper IOTC–2011–WPTmT03–INF02 provided by the Invited Expert (Dr. Simon Hoyle). This information paper presents the current stock assessment of albacore tuna (*Thunnus alalunga*) in the South Pacific Ocean. The assessment uses the integrated stock assessment model known as MULTIFAN-CL (MFCL), under the assumption that there is a single stock of albacore tuna in the south Pacific Ocean.

70. The WPTmT **NOTED** that the data requirements for integrated catch-at-length stock assessment models (such as MULTIFAN-CL and Stock Synthesis) include time series of catch for all fisheries, and size and CPUE data for a subset of fisheries. Required biological inputs include growth curves, length-weight relationships, maturity ogives, and estimates of natural mortality. Many of these input requirements are available or could be developed for Indian Ocean albacore.

Age-aggregated production model (ASPIC)

71. The WPTmT **NOTED** paper IOTC–2011–WPTmT03–17 Rev_1 which provided a stock assessment for albacore in the Indian Ocean by A Stock-Production Model Incorporating Covariates (ASPIC), including the following abstract provided by the authors:

    "*Japanese STD CPUE and catch are not well reflected, that is the reason why we could not get convergences in the ASPIC analyses with Japanese STD CPUE. This was also observed at the 1st WPTmT in Japan in 2004. ACPIC analyses could not get reasonable parameter estimations as all the analyses included Japanese CPUE. On the other hand, Taiwanese STD CPUE vs. Catch in 1980-2010 is reasonably reflected, that is the reason why we could get the convergence for this case. This was also observed at the 2nd WPTmT in Thai in 2008. In that time, only Taiwan STD CPUE was used and reasonable parameters were estimated. The Kobe plot 1 shows the large confidential surfaces which imply that ASPIC analyses include large uncertainties. The current status of the Indian Ocean albacore stock is in the beyond MSY level for F ratio (Fratio=1.61) while TB ratio is close to its MSY level (0.86). The recent catch levels are about 40,000 which is 10,000 tons higher than the estimated MSY (about 30,000 tons). Hence the albacore stock is considered to be in the overfished status. F ratio is considered to be very serious as KOBE plot 1 shows that large part of the 95% confidential surfaces cover more on F (MSY) levels (red area), while TB (Total biomass) ratio is less around the border of the MSY level. According to KOBE II (risk assessments), if catch at the MSY level were maintained, then TB will exceed TB(MSY) in 80% of the probability and F(MSY) in 70% in 2020 (10 years later). Under such circumstances, both catch and F should be kept below MSY levels until the risk probability will decrease."*

72. The WPTmT **NOTED** Table 1 which provides an overview of the key features of the stock assessment model used in 2011.

Table 1. Summary of final model features as applied to the Indian Ocean albacore resource in 2011.

Model feature	ASPIC
Software availability	NMFS toolbox
Population spatial structure / areas	1
Number CPUE Series	1
Uses Catch-at-length	No
Age-structured	No
Sex-structured	1
Number of Fleets	1
Stochastic Recruitment	No

73. The WPTmT **NOTED** the key assessment results for the age-aggregated production model (ASPIC) as shown below (Tables 2 and 3; Fig. 9).

Table 2. Key management quantities from the ASPIC assessment, for the aggregate Indian Ocean.

Management Quantity	Aggregate Indian Ocean
2010 catch estimate (1000 t)	43.7
Mean catch from 2006–2010 (1000 t)	41.1
MSY (1000 t) (80% CI)	29.9 (21.5–33.1)
Data period used in assessment	1980–2010
F_{2010}/F_{MSY} (80% CI)	1.61 (1.19–2.22)
B_{2010}/B_{MSY} (80% CI)	0.89 (0.65–1.12)
SB_{2010}/SB_{MSY}	–
B_{2010}/B_{1980} (80% CI)	0.39 (n.a.)
SB_{2010}/SB_{1980}	–
$B_{2010}/B_{1980, F=0}$	–
$SB_{2010}/SB_{1980, F=0}$	–

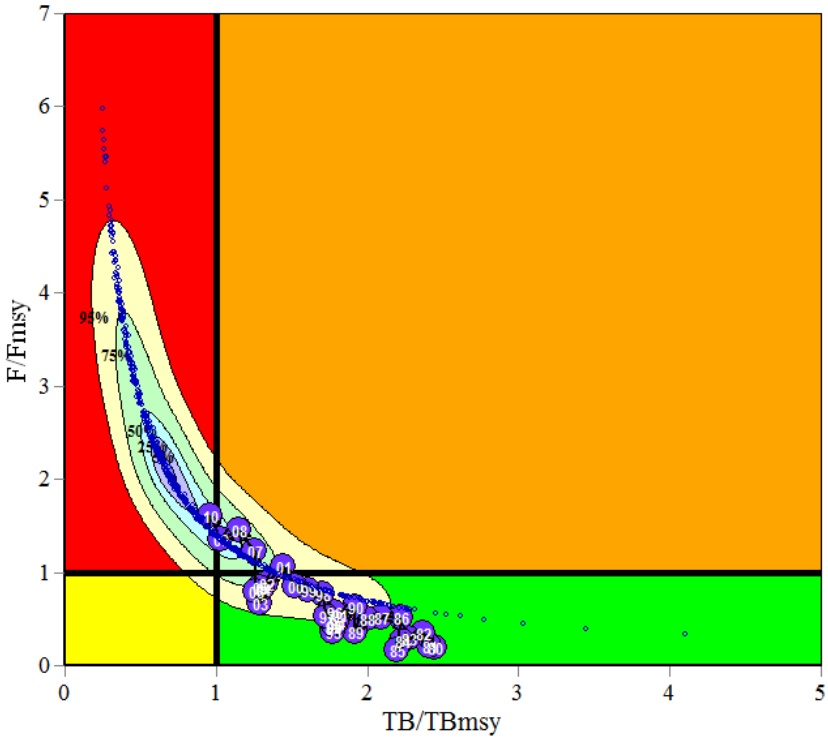


Fig. 9. ASPIC Aggregated Indian Ocean assessment Kobe plot (95% bootstrap confidence surfaces shown around 2010 estimate). Fixed B(1980)/K=0.9. Blue circles indicate the trajectory of the point estimates for the TB ratio and F ratio for each year 1980–2010.

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

Reference point and projection timeframe	Alternative catch projections (relative to 2010) and probability (%) of violating reference point				
	60%	**80%**	**100%**	**120%**	**140%**
$B_{2013} < B_{MSY}$	76.2	78.2	84.0	94.6	98.8
$F_{2013} > F_{MSY}$	65.2	87.2	95.4	99.0	99.4
$B_{2020} < B_{MSY}$	64.0	91.2	98.2	99.2	99.6
$F_{2020} > F_{MSY}$	48.0	95.4	99.6	99.8	100

74. 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 catch data prior to 1980 were included, 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. The Working paper IOTC–2011–WPTmT03–19: *A note on the ASPIC Fox model and Indian Ocean albacore assessment*, examined this issue and found that the long catch time series tends to result in MSY estimates that approach 0. This causes a numerical failure. However, it appears that a range of MSY values may be reasonably consistent with the data.

75. The WPTmT **AGREED** that the Fox model should be given a realistic biological constraint of B(1980) < carrying capacity (B(1980)/K=0.9), otherwise the model estimates B(1980) >> K.

76. 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.

77. 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. At this time, the WPTmT had limited confidence in the assessment results.

10. DEVELOPMENT OF TECHNICAL ADVICE ON THE STATUS OF THE ALBACORE TUNA STOCK

Albacore

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

78. 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 39% of the level observed in 1980. There were 20 years of moderate fishing before 1980, and the catch has more than doubled since 1980. Catches have increased substantially since the previous albacore assessment when there was considered to be a risk that $SB<SB_{MSY}$, so the risk will have increased further. It is considered likely that recent catches have been above MSY, recent fishing mortality exceeds F_{MSY} ($F_{2010}/F_{MSY} > 1$). There is a moderate risk that total biomass is below B_{MSY} ($B_{2010}/B_{MSY} \approx 1$).

Outlook. Maintaining or increasing effort will probably result in further declines in 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.

79. 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.
- Current catches (average ~41,000 t over the last five years, ~44,000 t in 2010) likely exceed MSY (29,900 t, range: 21,500–33,100 t). Maintaining or increasing effort will probably 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 (Table 3). However, a number of inconsistencies between the model and data were noted for future investigation.

10.1 Update of species Executive Summaries

80. The WPTmT **NOTED** paper IOTC–2011–WPTmT03–09 which aimed to encourage the WPTmT to develop clear and concise draft Executive Summaries for albacore for the consideration of the Scientific Committee.

81. The WPTmT **NOTED** that Recommendation 30 from the IOTC performance review panel states: "New guidelines for the presentation of more user friendly scientific reports in terms of stock assessments should be developed. …".).

82. The WPTmT **NOTED** that the IOTC currently uses the reference points of SB_{MSY} (or B_{MSY}) and F_{MSY} in providing its advice on stock status to the Commission and typically represents the advice as a ratio of current spawning biomass (SB_{curr}), total biomass (B_{curr}) or fishing rates/mortality to SB_{MSY}, B_{MSY} and F_{MSY} respectively; species with current spawning biomass estimates $<SB_{MSY}$ or $<B_{MSY}$ are considered overfished, and fishing mortality $>F_{MSY}$ is considered overfishing. There are currently no agreed harvest strategies, explicit target of limit reference points or decision rules that are followed when reference points are being approached or have been reached. Stocks of tuna and tuna-like species under the IOTC mandate are currently classified independently in each of the two categories described above (overfished and overfishing). Within these two categories there is a positive and a negative, as well as an uncertain status.

83. The WPTmT **NOTED** that, at the Fifteenth Session of the Indian Ocean Tuna Commission, the Commission made the following request of the Scientific Committee, and by default, the Working Parties:

> "*The Commission noted the provision by the Scientific Committee of the Kobe II matrix for bigeye tuna and swordfish, and recognized that it is a useful and necessary tool for management. The Commission requests that such matrices be provided for all stock assessments by the species Working Parties, in particular for yellowfin tuna, and for these to be included in the report of the Scientific Committee in 2011 and all future reports*." (IOTC–2011–S15–R, para. 37).

84. The WPTmT **ENDORSED** the new Executive Summary format (IOTC–2011–WPTmT03–09) to be used in developing the draft albacore resource Executive Summaries for the Scientific Committee's consideration.

85. The WPTmT **RECOMMENDED** that the Scientific Committee:
- **NOTE** the current definition of overfishing used by the IOTC, where fishing mortality is in excess of F_{MSY} ($F_{curr}/F_{MSY} > 1$) is considered overfishing;
- **NOTE** that fishing mortality in excess of F_{MSY} is not always defined as overfishing (within tRFMOs) if the stock is well above the B_{MSY} level, although no specific threshold has been defined;
- **CONSIDER** the current definition of overfishing ($F_{curr}/F_{MSY} >1$), and determine that if in situations where the biomass of a given stock is well above B_{MSY}, but $F_{curr}/F_{MSY} >1$, under what circumstances should a stock be classified as subject to overfishing;
- **NOTE** the draft resource stock status summary for albacore (*Thunnus alalunga*) – Appendix VI.

86. The WPTmT **RECOMMENDED** that the IOTC Secretariat update the draft stock status summary for albacore with the latest 2010 catch data, and for these to be provided to the Scientific Committee as part of the draft Executive Summaries, for its consideration.

10.2 Review of current Conservation and Management Measures for temperate tuna species

87. The WPTmT **NOTED** paper IOTC–2011–WPTmT03–10 which aimed to encourage the WPTmT to review the existing Conservation and Management Measures (CMMs) relating to albacore, and as necessary to 1) provide recommendations to the Scientific Committee on whether modifications may be required; and 2) recommend whether other CMMs may be required.

88. The WPTmT **AGREED** that it did not have any comments at this stage on potential revisions to the current Conservation and Management Measures of the IOTC.

11. RESEARCH RECOMMENDATIONS AND PRIORITIES

11.1 Development a draft work plan for the WPTmT

CPUE standardisation

89. The WPTmT **AGREED** that there was an urgent need to investigate the CPUE issues as outlined in paragraph 61 and for this to be a high priority research activity for the albacore resource in the Indian Ocean in 2012.

Stock assessment

90. The WPTmT **AGREED** that there was an urgent need to carry out revised stock assessments for the albacore resource in the Indian Ocean in 2012, and **RECOMMENDED** that the Scientific Committee consider recommending that the Commission consider approving funds for this purpose.

Stock structure

91. 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 the Scientific Committee develop a research plan that includes the determination of albacore stock structure, migratory range and movement rates in the Indian Ocean as a high priority research project, at its 2011 annual meeting.

Additional core topics for research

92. 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.

Ongoing research projects by CPCs for 2012

93. The WPTmT **NOTED** the lack of research programs on albacore currently being undertaken by CPCs in the IOTC area of competence and **RECOMMENDED** CPCs who did not have participants present at the WPTmT03, to provide details of current research projects on albacore to the Scientific Committee at its meeting in December 2011.

12. OTHER BUSINESS

12.1 Southern Bluefin tuna

94. The WPTmT **NOTED** the summary report on the biology, stock status and management of southern bluefin tuna and thanked the CCSBT Secretariat for providing it.

12.2 Date and place of the Fourth Session of the Working Party on Temperate Tunas

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

96. Following a discussion on who would host the Fourth Session of the WPTmT, the WPTmT **RECOMMENDED** that the IOTC Secretariat liaise with ICCAT to determine if it would be feasible to hold the next meeting of the WPTmT in conjunction with the equivalent ICCAT meeting in September or October 2012. It was **AGREED** that if this was not possible, then the next WPTmT meeting be held in conjunction with the WPTT or WPB meeting. The exact dates and meeting location will be confirmed and communicated by the IOTC Secretariat to the Scientific Committee for its consideration at its next session to be held in December 2011.

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

97. The WPTmT **NOTED** with thanks, the outstanding contributions of the invited expert for the meeting, Dr. Simon Hoyle (Secretariat of the Pacific Community (SPC) – Oceanic Fisheries Program) and encouraged him to maintain links with IOTC scientists to aid in the improvement of stock assessment approaches for IOTC stocks.

98. 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 2012, by an Invited Expert:
    - Expertise: experience with CPUE analysis and standardisation for albacore.
    - Priority areas for contribution: stock assessment for albacore.

12.4 Election of a Chairperson and Vice-Chairperson of the Working Party on Temperate Tunas for the Next Biennium

99. The WPTmT **THANKED** the Acting-Chair for the Third Session of the WPTmT, Dr. Dae Yeon Moon for his outstanding chairmanship throughout the meeting.

100. The WPTmT **CONSIDERED** candidates for the positions of Chair and Vice-Chair of the WPTmT for the next biennium. Dr. Zang Geun Kim was nominated and elected as Chair, and Dr. Tsutomu Nishida was nominated and elected as Vice-Chair of the WPTmT for the next *biennium*.

101. The WPTmT **RECOMMENDED** that the Scientific Committee note the new Chair (Dr. Zang Geun Kim) and Vice-Chair (Dr. Tsutomu Nishida) of the WPTmT for the next *biennium*.

12.5 Review of the draft, and adoption of the Report of the Third Session of the Working Party on Temperate Tunas

102. The WPTmT **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPTmT03, provided at Appendix IV.

103. The report of the Third Session of the Working Party on Temperate Tunas (IOTC–2011–WPTmT03–R) was **ADOPTED** on the 22 September 2011.

APPENDIX I
LIST OF PARTICIPANTS

Chairperson
Dr. Dae Yeon Moon
National Fisheries Research and Development Institute – Republic of Korea
dymoon@nfrdi.go.kr

Invited Expert
Dr. Simon Hoyle
Secretariat of the Pacific Community – Oceanic Fisheries Program
SimonH@spc.int

Other Participants
Dr. Zang Geun Kim
National Fisheries Research and Development Institute – Republic of Korea
zgkim@nfrdi.go.kr

Dr. Dale Kolody
Indian Ocean Tuna Commission – Secretariat
dale.kolody@iotc.org

Dr. Jaebong Lee
National Fisheries Research and Development Institute – Republic of Korea
leejb@nfrdi.go.kr

Dr. Sung Il Lee
National Fisheries Research and Development Institute – Republic of Korea
silee@nfrdi.go.kr

Mrs. Pattira Lirdwitayaprasit
Department of Fisheries, Thailand. Deep sea fishery technology research and development institute – Thailand
Pattiral_deepsea@yahoo.com

Mr. Takayuki Matsumoto
National Research Institute of Far Seas Fisheries – Japan
matumot@affrc.go.jp

Mr. Julien Million
Indian Ocean Tuna Commission – Secretariat
julien.million@iotc.org

Dr. Tsutomu (Tom) Nishida
National Research Institute of Far Seas Fisheries (NRIFSF), Fisheries Research Agency – Japan
tnishida@affrc.go.jp

Mr. Jeongseok Park
International Fisheries Organization Division
Ministry for Food, Agriculture, Forestry and Fisheries
Republic of Korea
Email: jspark3985@paran.com

Dr. Lilis Sadiyah
Research Center for Fisheries Management and Conservation, Ministry for Marine Affairs and Fisheries – Indonesia
lilis_sadiyah@yahoo.com

Dr. Siquan Tian
Distant Water Fisheries Branch of China Fisheries Association
Shanghai Ocean university
China
E-mail: sqtian@shou.edu.cn

Dr. David Wilson
Indian Ocean Tuna Commission – Secretariat
david.wilson@iotc.org

Prof. Lixiong Xu
Distant Water Fisheries Branch of China Fisheries Association
Shanghai Ocean University
China
E-mail: lxxu@shou.edu.au

Dr. Shean-Ya Yeh
National Taiwan University, Institute of Oceanography
Taiwan,China
sheanya@ntu.edu.tw

APPENDIX II
AGENDA FOR THE THIRD WORKING PARTY ON TEMPERATE TUNAS

Date: 20–22 September 2011
Location: Novotel Hotel Busan Ambassador
1405-16, Jung-dong, Haeundae-gu
Busan, Republic of Korea
Time: 09:00 – 17:00 daily

1. **ELECTION OF A CHAIR AND A VICE–CHAIR** (Secretariat)
2. **OPENING OF THE MEETING** (Chair)
3. **ADOPTION OF THE AGENDA** (Chair)
4. **OUTCOMES OF THE THIRTEENTH SESSION OF THE SCIENTIFIC COMMITTEE**
5. **OUTCOMES OF THE FIFTEENTH SESSION OF THE COMMISSION**
6. **PROGRESS ON THE RECOMMENDATIONS OF WPTmT02**
7. **REVIEW OF DATA AVAILABLE FOR TEMPERATE TUNA SPECIES**
   - 7.1. Review of the statistical data available for albacore (Secretariat)
   - 7.2. Data from other sources (papers from CPCs)
   - 7.3. Recommendations to the Scientific Committee concerning data.
8. **NEW INFORMATION ON BIOLOGY, ECOLOGY, FISHERIES AND ENVIRONMENAL DATA RELATING TO TEMPERATE TUNAS**
   - 8.1. Review new information on the biology, stock structure, their fisheries and associated environmental data (CPC papers)
   - 8.2. Effect of piracy on temperate tuna catches.
9. **REVIEW OF NEW INFORMATION ON THE STATUS OF ALBACORE TUNA**
   - 9.1. Data for input into stock assessments:
     - Catch and effort
     - Catch at size
     - Growth curves and age–length key
     - Catch at age
     - Nominal and standardised CPUE indices
   - 9.2. Stock assessments
   - 9.3. Selection of Stock Status indicators
10. **DEVELOPMENT OF TECHNICAL ADVICE ON THE STATUS OF THE ALBACORE TUNA STOCK**
    - 10.1. Update of species Executive Summaries (Chair)
    - 10.2. Review of current Conservation and Management Measures relating to temperate tuna species (Secretariat and Chair).
11. **RESEARCH RECOMMENDATIONS AND PRIORITIES**
    - 11.1. Development of a draft work plan for the WPTmT.
12. **OTHER BUSINESS**
    - 12.1. Southern bluefin tuna
    - 12.2. Date and place of the Fourth Session of the WPTmT
    - 12.3. Development of priorities for an Invited Expert at the next WPTmT meeting
    - 12.4. Election of a Chairperson and Vice-Chairperson for the next biennium
    - 12.5. Review of the draft, and adoption of the Report of the Third Session of the WPTmT.

APPENDIX III
LIST OF DOCUMENTS

Document	Title	Availability
IOTC–2011–WPTmT03–01a	Draft agenda of the Third Working Party on Temperate Tunas	✓(3 August)
IOTC–2011–WPTmT03–01b	Draft annotated agenda of the Third Working Party on Temperate Tunas	✓(5 September)
IOTC–2011–WPTmT03–02	List of documents	✓(5 September)
IOTC–2011–WPTmT03–03	Outcomes of the Thirteenth Session of the Scientific Committee (Secretariat)	✓(18 August)
IOTC–2011–WPTmT03–04	Outcomes of the Fifteenth Session of the Commission (Secretariat)	✓(5 August)
IOTC–2011–WPTmT03–05	Progress made on the recommendations of WPTmT02 (Secretariat and Chair)	✓(23 August)
IOTC–2011–WPTmT03–06	Review of the statistical data available for albacore (M. Herrera and L. Pierre — Secretariat)	✓(5 September)
IOTC–2011–WPTmT03–07	Review of fishery trends for temperate tunas (M. Herrera and J. Million - — Secretariat)	✓(19 September)
IOTC–2011–WPTmT03–08	Albacore Tuna by Thai Tuna Longline Fisheries in the Indian Ocean during 2007–2010 (P. Lirdwitayaprasit, P. Naimee and W. Chumchuen)	✓(5 September)
IOTC–2011–WPTmT03–09	Template for resource Executive Summaries (Secretariat and Chair)	✓(9 August)
IOTC–2011–WPTmT03–10	Review of current Conservation and Management Measures relating to temperate tuna species (Secretariat and Chair)	✓(18 August)
IOTC–2011–WPTmT03–11	A study of fisheries biology for albacore based on Chinese observer data (L. Xu and S.Q. Tian)	✓(15 September)
IOTC–2011–WPTmT03–12	Catch and effort by Korean flagged fleet (Z.G. Kim, M. Dae Yeon, and L. Sung Il)	✓(19 September)
IOTC–2011–WPTmT03–13	Review of Japanese longline fishery and its albacore catch in the Indian Ocean (T. Matsumoto and K. Uosaki)	✓(5 September)
IOTC–2011–WPTmT03–14	Catch and effort information for albacore by Indonesia's Indian Ocean tuna longline fishery based at Benoa fishing port (L. Sadiyah, B. Nugraha and A.A. Widodol)	✓(9 September)
IOTC–2011–WPTmT03–15	Standardization of albacore CPUE by Japanese longline fishery in the Indian Ocean (T. Matsumoto and K. Uosaki)	✓(5 September)
IOTC–2011–WPTmT03–16	Standardized CPUE of Indian albacore (*Thunnus alalunga*) based on Taiwanese longline catch and effort statistics dating from 1980 to 2010 (F.-Chen Chang, L.-Kang Lee, C.-Young Chen and S.-Ya Yeh)	✓(5 September)
IOTC–2011–WPTmT03–17 IOTC–2011–WPTmT03–17Rev_1	Stock and risk assessments of albacore tuna (*Thunnus alalunga*) in the Indian Ocean by A Stock-Production Model Incorporating Covariates (ASPIC) (T. Nishida and T. Matsumoto)	✓(19 September) ✓(22 September)
IOTC–2011–WPTmT03–18	Scrutinizing on the subdivision of Indian Ocean for the betterment of adjusted albacore CPUE trend, dating from 1980 to 2010 of Taiwanese longline fisheries dataset (L.-K. Lee, F.-C. Chang, C.-Y. Chen and S.-Y. Yeh)	✓(20 September)
IOTC–2011–WPTmT03–19	A note on the ASPIC Fox model and Indian Ocean albacore assessment (D. Kolody and S. Hoyle)	✓(22 September)
IOTC–2011–WPTmT03–INF01	IOTC SC – Guidelines for the Presentation of Stock Assessment Models	✓(3 August)
IOTC–2011–WPTmT03–INF02	Stock assessment of albacore tuna in the South Pacific Ocean (S. Hoyle)	✓(16 August)
IOTC–2011–WPTmT03–INF03	Regional study of south Pacific albacore population biology: Year 3 – Biological sampling and analysis (J. Farley, A. Williams, C. Davies and S. Nicol)	✓(22 August)
IOTC–2011–WPTmT03–INF04	Review of IOTC–2011–WPTmT03–15 – Standardization of albacore CPUE by Japanese longline fishery in the Indian Ocean (S. Hoyle)	✓(17 September)
IOTC–2011–WPTmT03–INF05	Review of IOTC–2011–WPTmT03–16 – Standardized CPUE of Indian albacore (*Thunnus alalunga*) based on Taiwanese longline catch and effort statistics dating from 1980 to 2010 (S. Hoyle)	✓(17 September)
IOTC–2011–WPTmT03–INF06	Standardized CPUE for distant–water fleets targeting south Pacific albacore (K. Bigelow and S. Hoyle)	✓(20 September)

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

Note: Appendix references refer to the Report of the Third Session of the Working Party on Temperate Tunas (IOTC–2011–WPTmT03–R)

Review of the data available for temperate tuna species

WPTmT03.01 (para. 13): The WPTmT **NOTED** the main albacore data issues that are considered to negatively affect the quality of the statistics available at the IOTC, by type of dataset and fishery, which are provided in Appendix V, 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.

Logbook coverage

WPTmT03.02 (para. 23): The WPTmT **RECOMMENDED** that the WPDCS monitor that CPCs ensure that logbooks used for their fleets are compliant with the minimum data requirements contained in Resolutions 08/04 *concerning the recording of catch by longline fishing vessels in the IOTC area* and 10/03 *concerning the recording of catch by fishing vessels in the IOTC area* of the Commission (noting Recommendation 11/06 *concerning the recording of catch and effort by fishing vessels in the IOTC area of competence*), and to ensure that logbook coverage is appropriate to produce acceptable levels of precision (CV to be initially set at less than 20%) in their catch and effort statistics for temperate tuna species.

WPTmT03.03 (para. 24): The WPTmT **RECOMMENDED** that the main fleets catching albacore (Japan, Taiwan,China and Indonesia) collect biological information on albacore caught in their fisheries, preferably through observer programmes, and provide this information (including the raw data) to the Secretariat in 2012.

Catch-and-effort and Size data

WPTmT03.04 (para. 25): The WPTmT **RECOMMENDED** that as a matter of priority, India provide catch-and-effort data and size data for temperate tuna, in particular from its commercial longline fleet, as soon as possible, noting that this is already a mandatory reporting requirement.

WPTmT03.05 (para. 2): The WPTmT **RECOMMENDED** that as a matter of priority, Indonesia and Malaysia provide catch-and-effort data and size data for temperate tuna, in particular for their fresh tuna and/or deep-freezing longline fleets, as soon as possible, noting that this is already a mandatory reporting requirement. Reporting should also include data from their vessels operating from other CPCs.

WPTmT03.06 (para. 29): The WPTmT **RECOMMENDED** that size data for albacore from the Japanese longline fleet are collected and reported to the IOTC Secretariat in 2012, with a summary to be provided to the WPTmT.

WPTmT03.07 (para. 30): The WPTmT **RECOMMENDED** that Japan and Taiwan,China 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. In particular Japan to compare length frequency distributions derived from samples collected:

- by fishermen on commercial vessels
- by observers on commercial vessels
- by scientists on research and training vessels.

WPTmT03.08 (para. 31): The WPTmT **RECOMMENDED** that as a matter of priority, the Philippines provide size data for temperate tuna, noting that this is already a mandatory reporting requirement.

Observer data from China

WPTmT03.09 (para. 37): Noting that the current information available on albacore biology from the Indian Ocean is limited, the WPTmT **RECOMMENDED** that China provide further updates on research carried out as part of its national observer program, at the next session of the WPTmT and **ENCOURAGED** other CPCs to provide similar research reports on albacore biology, either from data collected through observer programs or other research programs, at the next WPTmT meeting.

WPTmT03.10 (para. 39): Noting that there are difficulties faced by some CPCs in collecting gonad samples from albacore – albacore is generally frozen whole and not gutted, the WPTmT **RECOMMENDED** that CPCs, in particular Japan, 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.

Korean catch and effort for albacore

WPTmT03.11 (para. 41): Noting that the nominal catch (NC) data provided at the WPTmT03 meeting was found to conflict with the NC data history provided by the Republic of Korea for all years prior to 1994, and for catch-and-effort data for most of the history of the longline fleet, the WPTmT **RECOMMENDED** that the Rep. of Korea liaise with the Secretariat to provide a fully justified revised catch history which will replace the data currently held by the Secretariat before the end of 2011.

Indonesian longline fishery

WPTmT03.12 (para. 49): 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 Secretariat, the WPTmT **RECOMMENDED** that Indonesia further strengthen sampling efforts on its coastal and off-shore fisheries in early 2012, where required, and liaise with the Secretariat in order to better determine the catches of albacore by the Indonesian longline fleet.

WPTmT03.13 (para. 50): 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.

Piracy in the Indian Ocean

WPTmT03.14 (para. 52): 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 CPCs most affected by these activities, including Japan, Republic of Korea and Taiwan,China.

CPUE discussion summary

WPTmT03.15 (para. 61): The WPTmT **RECOMMENDED** that the following matters be taken into account when undertaking CPUE standardisation analysis:

- The WPTmT **AGREED** that changes in species targeting is the most important issue to address in CPUE standardisations, and that the following points should be taken into consideration:
  i. While hooks between floats (HBF) provides some indication of setting depth, it is generally considered not to be a sufficient indicator of species targeting. HBF is just one aspect of the setting technique, which can vary by species, area, set-time, and other factors.
  ii. Highly aggregated (e.g. 5x5 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:
  vi. Addition of finer scale (e.g. 5x5 degrees) fixed spatial effects in the model can help to account for heterogeneity within sub-regions.
  vii. 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).
  viii. 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.

ix. 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).

x. The possibility of defining a representative 'space-time' window: if this leads to the identification of a fishery with homogeneous targeting practices, it is probably worthwhile. However, it may not be possible to identify an appropriate window, or the window may be so small that it is not representative of the larger population (or has a high variance).

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

WPTmT03.16 (para. 64): The WPTmT also **ENCOURAGED** data to be used in stock assessments, including CPUE standardisations, be made available not less than three months before each meeting by CPCs and where possible, data summaries no later than two months prior to each meeting, from the IOTC Secretariat; and **RECOMMENDED** that data to be used in stock assessments, including CPUE standardisations be made available not less than 30 days before each meeting by CPCs.

WPTmT03.17 (para. 65): The WPTmT **RECOMMENDED** that a dedicated workshop on CPUE standardization, including issues of interest for other IOTC species should be carried out before the next round of stock assessments in 2012, possibly coordinated under the IOTC Working Party on Methods, and that where possible it should include a range of invited experts, including those working on CPUE standardisation in other ocean/RFMOs.

Stock assessment

WPTmT03.18 (para. 67): Noting that the only stock assessment for albacore was not made available by the authors until the 19th September, 2011 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 no later than 15 days before the commencement of the relevant meeting.

WPTmT03.19 (para. 68): 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.

Albacore: Indian Ocean Stock – Management advice

WPTmT03.20 (para. 78): 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 39% of the level observed in 1980. There were 20 years of moderate fishing before 1980, and the catch has more than doubled since 1980. Catches have increased substantially

since the previous albacore assessment when there was considered to be a risk that $SB<SB_{MSY}$, so the risk will have increased further. It is considered likely that recent catches have been above MSY, recent fishing mortality exceeds F_{MSY} ($F_{2010}/F_{MSY} > 1$). There is a moderate risk that total biomass is below B_{MSY} ($B_{2010}/B_{MSY} \approx 1$).

Outlook. Maintaining or increasing effort will probably result in further declines in 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.

WPTmT03.21 (para. 79): 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.
- Current catches (average ~41,000 t over the last five years, ~44,000 t in 2010) likely exceed MSY (29,900 t, range: 21,500–33,100 t). Maintaining or increasing effort will probably 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 (Table 3). However, a number of inconsistencies between the model and data were noted for future investigation.

Update of species Executive Summaries

WPTmT03.22 (para. 85): The WPTmT **RECOMMENDED** that the Scientific Committee:

- **NOTE** the current definition of overfishing used by the IOTC, where fishing mortality is in excess of F_{MSY} ($F_{curr}/F_{MSY} > 1$) is considered overfishing;
- **NOTE** that fishing mortality in excess of F_{MSY} is not always defined as overfishing (within tRFMOs) if the stock is well above the B_{MSY} level, although no specific threshold has been defined;
- **CONSIDER** the current definition of overfishing ($F_{curr}/F_{MSY} >1$), and determine that if in situations where the biomass of a given stock is well above B_{MSY}, but $F_{curr}/F_{MSY} >1$, under what circumstances should a stock be classified as subject to overfishing;
- **NOTE** the draft resource stock status summary for albacore (*Thunnus alalunga*) – Appendix VI.

WPTmT03.23 (para. 86): The WPTmT **RECOMMENDED** that the IOTC Secretariat update the draft stock status summary for albacore with the latest 2010 catch data, and for these to be provided to the Scientific Committee as part of the draft Executive Summaries, for its consideration.

Development a draft work plan for the WPTmT

WPTmT03.24 (para. 90): The WPTmT **AGREED** that there was an urgent need to carry out revised stock assessments for the albacore resource in the Indian Ocean in 2012, and **RECOMMENDED** that the Scientific Committee consider recommending that the Commission consider approving funds for this purpose.

WPTmT03.25 (para. 91): 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 the Scientific Committee develop a research plan that includes the determination of albacore stock structure, migratory range and movement rates in the Indian Ocean as a high priority research project, at its 2011 annual meeting.

WPTmT03.26 (para. 92): 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.

Ongoing research projects by CPCs for 2012

WPTmT03.27 (para. 93): The WPTmT **NOTED** the lack of research programs on albacore currently being undertaken by CPCs in the IOTC area of competence and **RECOMMENDED** CPCs who did not have participants present at the WPTmT03, to provide details of current research projects on albacore to the Scientific Committee at its meeting in December 2011.

Date and place of the Fourth Session of the Working Party on Temperate Tunas

WPTmT03.28 (para. 96): Following a discussion on who would host the Fourth Session of the WPTmT, the WPTmT **RECOMMENDED** that the IOTC Secretariat liaise with ICCAT to determine if it would be feasible to hold the next meeting of the WPTmT in conjunction with the equivalent ICCAT meeting in September or October 2012. It was **AGREED** that if this was not possible, then the next WPTmT meeting be held in conjunction with the WPTT or WPB meeting. The exact dates and meeting location will be confirmed and communicated by the IOTC Secretariat to the Scientific Committee for its consideration at its next session to be held in December 2011.

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

WPTmT03.29 (para. 98): 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 2012, by an Invited Expert:

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

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

WPTmT03.30 (para. 101): The WPTmT **RECOMMENDED** that the Scientific Committee note the new Chair (Dr. Zang Geun Kim) and Vice-Chair (Dr. Tsutomu Nishida) of the WPTmT for the next *biennium*.

Review of the draft, and adoption of the Report of the Third Session of the Working Party on Temperate Tunas

WPTmT03.31 (para. 102): The WPTmT **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPTmT03, provided at Appendix IV.

APPENDIX V
MAIN ISSUES IDENTIFIED RELATING TO THE STATISTICS OF ALBACORE

Extract from IOTC–2011–WPTmT03–06

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 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. To date, the Secretariat has not received catch-and-effort data for this fishery.
- **Longline** fishery of **India**: In recent years, India has reported very incomplete catches and catch-and-effort data for its commercial longline fishery. The Secretariat has estimated total catches for this period using alternative sources.
- **Drifting gillnet** fisheries of **Iran** and **Pakistan**: To date, none of these countries have reported catches of albacore for their driftnet fisheries.
- Longline fisheries of **Malaysia**, **Philippines**, and **Oman:** None of these countries is reporting catch-and-effort data as per the IOTC standards.

2. Size data from All Fisheries:

- **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.
- **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 **Malaysia**, **Philippines**, and **Oman:** To date, none of these countries has reported size frequency data.

3. Biological data:

- Industrial **longline** fisheries, in particular **Taiwan,China**, **Indonesia**, **and Japan**: The 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 VI
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 – 2011 assessment**		**2011 stock status determination**
			2010[2]
Indian Ocean	Catch 2010:	43,711 t	
	Average catch 2006–2010:	41,074 t	
	MSY (1 model):	29,900 t (21,500–33,100 t)	
	F_{2010}/F_{MSY} (1 model):	>1	
	SB_{2010}/SB_{MSY} (1 model):	≈ 1	
	SB_{2010}/SB_{1980} (1 model):	0.39	

[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 ($SB_{year}/SB_{MSY} \geq 1$)
Stock subject to overfishing($F_{year}/F_{MSY} > 1$)		
Stock not subject to overfishing ($F_{year}/F_{MSY} \leq 1$)		

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 39% of the level observed in 1980. There were 20 years of moderate fishing before 1980, and the catch has more than doubled since 1980. Catches have increased substantially since the previous albacore assessment when there was considered to be a risk that $SB<SB_{MSY}$, so the risk will have increased further. It is considered likely that recent catches have been above MSY, recent fishing mortality exceeds F_{MSY} ($F_{2010}/F_{MSY} > 1$). There is a moderate risk that total biomass is below B_{MSY} ($B_{2010}/B_{MSY} \approx 1$) (Table 1, Fig. 1).

Outlook. Maintaining or increasing effort will probably result in further declines in 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.

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.
- Current catches (average ~41,000 t over the last five years, ~44,000 t in 2010) likely exceed MSY (29,900 t, range: 21,500–33,100 t). Maintaining or increasing effort will probably 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. However, a number of inconsistencies between the model and data were noted for future investigation (matrix not presented here as a result).

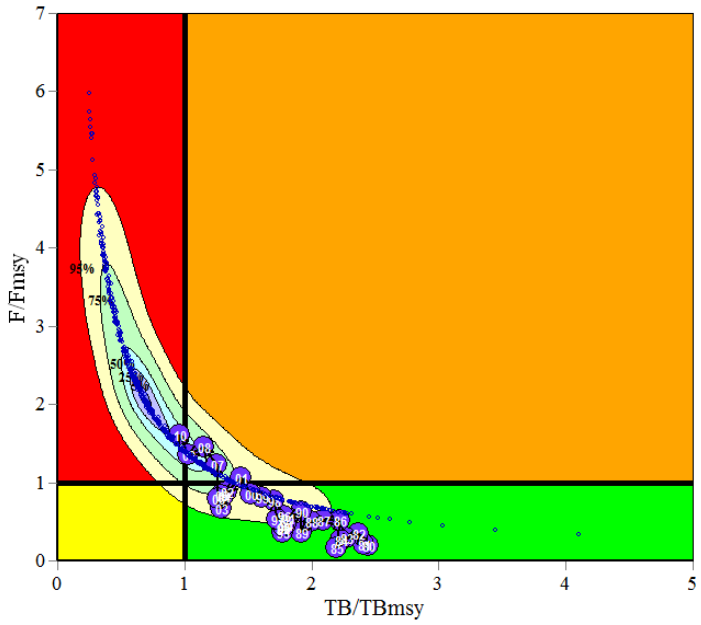


Fig. 1. ASPIC Aggregated Indian Ocean assessment Kobe plot (95% Confidence surfaces shown around 2010 estimate). Fixed B/K=0.9. Blue circles indicate the trajectory of the point estimates for the TB ratio and F ratio for each year 1980–2010 (Note: at this time the WPTmT had limited confidence in the assessment results (refer to paragraphs 71–77 in the report of the WPTmT03 (IOTC–2011–WPTmT03–R) for further clarification).