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

Report of the Eleventh Session of the Scientific Committee

Victoria, Seychelles, 1-5 December 2008

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EXECUTIVE SUMMARY

The Eleventh Meeting of the Scientific Committee (SC) was opened on 1 December 2008 Victoria, Seychelles, by the Chairperson Dr. Francis Marsac (EC). Representatives from 9 members of the Commission, 1 Cooperating Non-contracting Party, FAO and 4 observers attended the meeting.

The SC noted with concern that only 10 of the 31 IOTC CPC's were represented at the meeting. Furthermore, that only 11 national reports that were made available to the meeting.

Six working party meetings were held in 2008 (Tagging Data Analysis, Billfish, Ecosystems and Bycatch, Tropical Tunas, Methods and Temperate Tunas). The working party on Neritic Tunas was again cancelled due to lack of participants. The work of the other working parties was assisted considerably in 2008 by the presence and input of several internationally renowned fisheries scientists.

Revised stock assessments for albacore tuna, yellowfin tuna and swordfish were received and the following advice is provided:

For albacore tuna: on balance of the information available, the stock is not considered to be overfished and overfishing is not occurring. It is considered that, due to the present situation of the stock and stable effort, the status of the stock of albacore is not likely to change markedly over the next 2-3 years and if the price of albacore remains low compared to other tuna species, no immediate action should be required on the part of the Commission.

For yellowfin: the stock is very close to an overfished state, or already overfished, and the fishing pressure in recent years has exceeded the optimal level. Therefore, the Scientific Committee recommends that the catch of yellowfin tuna does not exceed the average catch for the period 1998-2002 when catches were stable, prior to the exceptional years of 2003-2006 when the stock might have been overexploited. Similarly, the Scientific Committee recommends that the fishing effort does not exceed the level exerted in 2007 when the catch of yellowfin tuna returned to the pre-2003 levels.

For swordfish: overfishing of the stock is not occurring and the stock appears not to be in an overfished state; however, there are indications that there may have been some localised population declines probably related to the intensity of fishing in areas of the southwest Indian Ocean. The Scientific Committee considers that the catches should not increase above the 2006 levels and fishing effort should not increase from the 2007 levels. Furthermore, management measures focussed on controlling and/or reducing effort, especially in the south-west Indian Ocean are recommended.

Complete stock status and technical advice for all IOTC species is provided in the main body of the report, and a summarised version is provided in a table on the following page. The SC adopted in 2008 for the first time a status report on sea turtles.

The SC made a range of recommendations relating to the improvement of data and research activities to the working parties and the national scientists. The SC also made a range of recommendations specifically to the Commission including:

- on the recruitment of a science officer, a communications expert-scientific editor and a database manager to the staff of the Secretariat
- that a working party be set up to further consider the matter of fishing capacity for the purposes of the IOTC.
- that a tagging symposium be held in 2010
- that the Twelfth Session of the SC be held from 30 November to 4 December 2009 in Seychelles and that the Commission to consider holding its annual session not more than three months after this time in order to be able to receive the most up-to-date advice and implement management measures in a timely fashion.

In response to the Commission's request for more information on the technical aspects of IOTC Resolution 05/05 *Concerning the conservation of sharks caught in association with fisheries managed by IOTC*, specifically paragraph 4 "CPC's shall require their vessels to not have onboard fins that total more than 5% of the weight of sharks onboard, up to the first point of landing. The SC recommended that the fin:body weight ratio measure be replaced with a resolution that requires shark fins to be landed attached to the body, either naturally, or by other means.

STOCK STATUS SUMMARY FOR THE IOTC SPECIES

Stock	Average annual catches / MSY	Stock status	Scientific Committee advice to the Commission in 2008
Albacore	av.2003-2007: 25,500 t 2007: 32,200 t MSY: 28,300 t - 34,400 t Ratio of average catch to MSY: 0.90 – 0.74	Stock size and fishing pressure are considered to be within acceptable limits. Catches, mean weight and catch rates of albacore have been stable for over 20 years.	The status of the stock is not likely to change markedly over the next 2-3 years and if the price of albacore remains low compared to other tuna species, no immediate action should be required.
Bigeye	av.2003-2007: 122,000 t 2007: 118,000 t MSY: 95,000 t – 128,000 t Ratio of average catch to MSY: 1.28 – 0.95	Stock size and fishing pressure in 2004 were within acceptable limits. Catch rates have gradually declined since 1980. In 2008, preliminary assessment results based on tagging data suggest a high probability that the stock is not in an overfished state.	Catches should not exceed the MSY and fishing effort should not increase further from the 2004 levels.
Skipjack	av. 2003-2007: 514,000 t 2007: 447,100 t MSY: - Ratio of average catch to MSY: -	Skipjack is a highly productive species. Catches have increased with increasing fishing pressure with no symptoms for concern in the status indicators. Stock size and fishing pressure are considered to be within acceptable limits.	There is no need for immediate concern.
Yellowfin	av. 2003-2007: 434,800 t 2007: 316,700 t MSY: 250,000 t – 360,000 t Ratio of average catch to MSY: 1.74 – 1.21	Stock size is close to or has possibly entered an overfished state. Fishing pressure has been too high in recent years, but was somewhat lower in 2007.	That the catch of yellowfin tuna does not exceed the average catch for the period 1998-2002 (i.e. 330,000 t) and fishing effort does not exceed the level exerted in 2007.
Swordfish	av.2002-2006: 31,000 t 2006: 27,300 MSY: 31,500 t Ratio of average catch to MSY: 0.98	The overall stock size and fishing pressure are within acceptable limits. However, there have been some localised declines possibly related to high fishing pressure in some areas (e.g. in the southwest Indian Ocean area).	Catches should not increase above the 2006 levels and fishing effort should not increase from the 2007 levels. Furthermore, management measures focussed on controlling and/or reducing effort, especially in the south-west Indian Ocean are recommended.
Blue marlin	av.2002-2006: 3,300 t[1] 2006: 4,200 t	No quantitative assessment is available. No reliable indicators	Stock status is uncertain
Black Marlin	av.2002-2006: 11,700 t[1] 2006: 13,600 t	No quantitative assessment is available. No reliable indicators	Stock status is uncertain
Striped marlin	av.2002-2006: 3,100 t[1] 2006: 2,800 t	No quantitative assessment is available. No reliable indicators	Stock status is uncertain
Sailfish	av.2002-2006: 24,000 t[1] 2006: 27,000 t	No quantitative assessment is available. No reliable indicators	Stock status is uncertain
Bullet tuna	av.2002-2006: 2,600 t[1] 2006: 3,500 t	No quantitative assessment is available. No reliable indicators	Stock status is uncertain
Frigate tuna	av.2002-2006: 34,800 t[1] 2006: 41,700 t	No quantitative assessment is available. No reliable indicators	Stock status is uncertain
Spanish mackerel	av.2002-2006: 111,000 t[1] 2006: 124,600 t	No quantitative assessment is available. No reliable indicators	Stock status is uncertain
Kawakawa	av.2002-2006: 109,600 t[1] 2006: 123,000 t	No quantitative assessment is available. No reliable indicators	Stock status is uncertain
Longtail tuna	av.2002-2006: 9,700 t[1] 2006: 9,300 t	No quantitative assessment is available. No reliable indicators	Stock status is uncertain
King mackerel	av.2002-2006: 31,600 t[1] 2006: 28,900 t	No quantitative assessment is available. No reliable indicators	Stock status is uncertain

1 = Catch reported by IOTC fleets, therefore these a minimum catches as the levels of catches by other fleets are unknown

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ACRONYMS AND CODES

ALB	Albacore (*Thunnus alalunga*)
BET	Bigeye tuna (*Thunnus obesus*)
B_{MSY}	Biomass at MSY
BLM	Black marlin (*Makaira indica*)
BUM	Blue marlin (*Makaira nigricans*)
CCAMLR	Convention for the Conservation of Antarctic Marine Living Resources
CCSBT	Commission for the Conservation of Southern Bluefin Tuna
CPC's	Contracting parties and cooperating non-contracting parties
COFI	FAO`s Committee on Fisheries
CPUE	Catch per unit of effort
DWFN	Distant-water fishing nation
EC	European Community
EEZ	Exclusive economic zone
ENSO	El Niño-southern oscillation
F	Fishing mortality; F_{2007} is the fishing mortality estimated in the year 2007
FAD	Fish-aggregating device
FAO	Food and Agriculture Organization of the United Nations
F_{MSY}	Fishing mortality at MSY
IATTC	Inter-American Tropical Tuna Commission
ICCAT	International Commission for the Conservation of AtlanticTunas
IOTC	Indian Ocean Tuna Commission
LL	Longline
LOA	Overall length
LSTLV	Large-scale tuna longline fishing vessel
MLS	Striped marlin (*Tetraturus audax)*
MSY	Maximum sustainable yield
NGO	Non-governmental organization
NPA/NPOA	National plan of action
OFCF	Overseas Fishery Cooperation Foundation of Japan
PS	Purse-seine
RFMO	Regional Fishery Management Organization
RTTP-IO	Regional Tuna Tagging Project of the Indian Ocean
SBT	Southern bluefin tuna (*Thunnus maccoyii*)
SC	Scientific Committee of the IOTC
SKJ	Skipjack tuna (*Katsuwonus pelamis*)
SSB	Spawning stock biomass
SSB_{MSY}	Spawning stock biomass at MSY
SWIOFC	South West Indian Ocean Fisheries Commission
SWIOFP	South West Indian Ocean Fisheries Project
SWO	Swordfish (*Xiphias gladius*)
UNCLOS	United Nations Convention on the Law of the Sea
VPA	Virtual population analysis
WCPFC	Western and Central Pacific Fisheries Commission
WPB	Working Party on Billfish of the IOTC
WPEB	Working Party on Ecosystems and Bycatch of the IOTC
WPM	Working Party on Methods of the IOTC
WPN	Working Party on Neritic Tunas of the IOTC
WPTDA	Working Party on Tagging Data Analysis of the IOTC
WPTe	Working Party on Temperate Tunas of the IOTC
WPTT	Working Party on Tropical Tunas of the IOTC
YFT	Yellowfin tuna (*Thunnus albacares*)

1. OPENING OF THE SESSION

1. The Eleventh Meeting of the Scientific Committee (SC) was opened on 1 December 2008 Victoria, Seychelles, by the Chairperson Dr. Francis Marsac (EC).

2. A list of the meeting participants is provided in Appendix I. The meeting received apologies from Thailand, who, for unforeseen circumstances was unable to travel to Seychelles.

3. The SC noted with concern that only 10 of the 31 IOTC CPC's were represented at the meeting and only four delegations presented credentials.

2. ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION

4. The SC adopted the Agenda as presented in Appendix II. The list of documents presented to the meeting is given in Appendix III.

3. ADMISSION OF OBSERVERS

5. Pursuant to Rule XIII.9 of the Rules of Procedure, the SC acknowledged the presence of Observers from the FAO, Birdlife International, Russian Federation, SWIOFC and invited experts from Taiwan,China.

4. PROGRESS REPORT FROM THE SECRETARIAT

6. The Executive Secretary described the Secretariat's recent activities and other relevant matters concerning the Commission.

7. The SC acknowledged the imminent recruitment of a Stock Assessment Expert as part of the permanent staff of the Secretariat; however, notwithstanding this valuable addition to the staff, considering the current needs of the SC, it recommended to the Commission that the following additional staff be recruited as soon as possible:

- A Science Officer – given the large amount of work required in support of the WPs and capacity building in developing countries, the SC agreed that in the short-term an additional professional scientist be recruited to assist the stock assessment expert.
- A Communications Expert / Scientific Editor – the Executive Secretary informed the SC of the growing demand of information from the IOTC from a wide range of stakeholders, including Members, industry groups, NGO's and the public. The SC acknowledged the need for the Secretariat to have the services of a Communications expert / Scientific Editor who main job would be to disseminate the technical outputs of the Commission results in an appropriate range of user friendly formats to the various stakeholders.
- A Fisheries Statistician - given the large amount of work required in support of the WPs and capacity building in developing countries (with respect to sampling, data management and data reporting), the SC agreed that an additional professional be recruited to assist the current data coordinator

8. Further to the recruitment of the Stock Assessment Expert, some SC members sought clarification of the process to be used to identify the annual work plan of the incumbent. Following discussions the Scientific Committee recommended a set of guidelines for the duties of the Stock Assessment Expert and procedures related to stock assessments. These are given in Appendix IV.

9. The SC acknowledged the work of the Secretariat in arranging for several external scientific experts to participate in the meetings of the 2008 IOTC Working Parties. The SC recognised the valuable contribution that these experts made to the outcomes of the meetings, in particular, these experts were able bring a vast amount of experience and knowledge about tuna fisheries in the other oceans.

10. The SC recommended that, the interaction and collaboration of IOTC scientists and external scientists continue, and when required, external experts be invited to IOTC technical meetings.

11. The SC thanked the external experts and their respective organisations (Secretariat of the Pacific Community – New Caledonia; Imperial College – United Kingdom; Commonwealth Scientific Industrial Research Organisation – Australia; Indian Ocean – South-East Asian Marine Turtle Memorandum of Understanding (UNEP) – Thailand;

Inter-American Tropical Tuna Commission – United States of America; Ministry of Fisheries Agriculture & Marine Resources – Maldives for the time and effort they devoted to IOTC activities in 2008.

5. DATA COLLECTION AND STATISTICS

5.1 STATUS OF THE IOTC DATABASES

12. The Secretariat presented IOTC-2008-SC-07 summarising the main activities carried out in relation to data acquisition and data processing since the last SC meeting, and the status of the data at the IOTC Secretariat.

13. The SC reiterated its concern that the levels of reporting prior to the mandatory deadlines are still very low and that many Indian Ocean coastal countries (several of which are not members of the Commission) have limited statistical systems and lack the ability to provide the fine-scale statistical data required by the IOTC working parties for their stock assessments. In particular, the SC noted the negative consequences that the poor quality data has on the assessments of skipjack and yellowfin. The levels of reporting and a summary of the state of data submissions for 2007 are provided in Appendix V. Low levels of reporting directly affect the reliability of the assessments conducted by the working parties. Late reports compromise the validation, verification and utility of data, especially when data are submitted close to or during Working Party meetings.

14. The SC also noted with concern the increase in catches from gillnet fisheries, noting that a large number of vessels from Iran, Sri Lanka and Pakistan are reported as operating on the high seas, but that the Secretariat has not received complete data sets from the countries involved. A summary table of the catch of tunas and billfish by countries having gillnet fisheries is provided below (Table 1)

Table 1. Gillnet catches (mean annual catch t over the period 2003-2007 estimated from the IOTC database. SKJ = skipjack; YFT = yellowfin, BET = bigeye, SWO = swordfish, MAR = marlins; SFA = sailfish, LOT = longtail tuna).

			Tropical tunas			Billfish			Neritic tunas	
Fleet	% of total gillnet fleet	Total catch (t)	SKJ(t)	YFT(t)	BET(t)	SWO(t)	MAR(t)	SFA(t)	LOT(t)	Other (t)
Iran, Islamic Republic	42	156,060	67,082	30,119			0	9,751	22,158	26,949
Sri Lanka	19	69,704	34,362	18,725	173	1,722	3,991	5,368	0	5,362
Indonesia	15	57,066	11,838	88	166	64	525	420	30,176	13,789
Pakistan	7	26,207	4,308	3,203			0	2,308	5,565	10,824
Oman	2	6,784	67	3,525			0	70	1,821	1,302
Other Fleets	15	54,091	800	1,109	0	0	2,011	2,381	4,944	42,847
Average annual catch over the 2003-07 period		369,912	118,455	56,769	339	1,786	6,527	20,299	64,665	101,073
% Species in the catch from for gillnets			32	15	0	0	2	5	17	27
Total catch IOTC species		1,566,561	509,010	434,784	38,152	31,128	19,104	25,270	93,692	294,688
% taken by gillnet of the total catch for all gears		24	23	13	1	6	34	80	69	34

15. Notwithstanding the current outstanding data issues highlighted above, the SC noted that there is a range of data improvement initiatives currently underway in the Indian Ocean region and requested that the Secretariat work jointly with these initiatives whenever possible maximise the benefits to the IOTC.

16. The SC endorsed the data-related recommendations made by the IOTC working parties in 2008 and these are included in Appendix VI.

5.2 PROGRESS REPORT OF THE IOTC-OFCF PROJECT

Recent activities

17. The recent activities of the IOTC-OFCF[1] Project during 2008 were described in IOTC-2008-SC-INF10. Highlights included:

- Indonesia: preparation of a MOU for technical assistance on the collection of effort data and fresh tuna longline unloadings (approval from Indonesia is pending). The main goal of this programme is to improve vessel identification, so that longliners putting in to Indonesian ports can be identified individually and their activities be monitored over time.

[1] Indian Ocean Tuna Commission - Overseas Fishery Cooperation Foundation of Japan

- Mauritius: collection of information on foreign tuna longline activities at Port Louis, in particular data from fresh-tuna longline and carrier vessels (the numbers of which are believed to be on the increase). This information was used in the estimation of catches of fresh-tuna longliners that are not monitored by the flag countries (Malaysia, Indonesia).

- Yemen: implementation of a programme to obtain yellowfin tuna size data and other relevant historical data. The first phase involves the collection of historical data, and a second phase involves the implementation of field activities in selected locations along the Yemen coast.

- Oman: implementation of a technical agreement for the collection of size data of yellowfin, narrow-barred Spanish mackerel and longtail tuna over the period December 2008 to March 2009.

- Kenya: collection and validation of historical sport fishing data in Kenya. These data continue to be collected by Kenyan authorities independently of the project.

- Thailand: to improve data collection and processing systems for industrial purse seiners of Thailand, the Project provided funds to employ an IT technician to create a database and a (Thai) Manual, and PCs and printers for data entry offices.

- The comprehensive report on IOTC-OFCF Project for the first phase was published in March 2008 and distributed to the organizations associated with the project.

Preliminary plan of work for April 2009 – March 2010

- The level of funding for the third year of the project from April 2009 to March 2010 has not yet been determined. The Second Phase of the IOTC-OFCF Project will be terminated at the end of March 2010 and a comprehensive report will be prepared before this time.

- Indonesia: the sampling program on effort data collection in Indonesia will be implemented from April to December 2009. A training course on logbooks is expected to be implemented in April 2009.

- Oman: support to collect size data will continue until December 2009.

- Yemen - collection of historical data.

18. The SC acknowledged the IOTC-OFCF Project for its ongoing contribution to the improvement of the quality of data collected in several countries of the region. The SC stressed the need for resources to be made available to continue a programme of improving data collection processes in the Indian Ocean fisheries and encouraged IOTC members to provide, on a voluntarily basis, financial resources or expertise to assist with such activities in the region

6. Presentation of National Reports

19. National Reports were presented by Australia (IOTC-2008-SC-INF09), China (IOTC-2008-SC-INF21), EC-France (IOTC-2008-SC-INF11), EC-Spain (IOTC-2008-SC-INF07), Japan (IOTC-2008-SC-INF19), Kenya (IOTC-2008-SC-INF22), Korea (IOTC-2008-SC-INF20), Mauritius (IOTC-2008-SC-INF18), Seychelles (IOTC-2008-SC-INF16), Thailand (IOTC-2008-SC-26), United Kingdom (IOTC-2008-SC-INF12), and South Africa (IOTC-2008-SC-INF17). Abstracts of these reports are given in Appendix VII. From these reports the SC noted the following matters in particular:

20. The SC noted with concern the small number of national reports that were made available to the SC in 2008 (11 reports from an expected 31). The SC recalled that it was agreed at the 4th session that all Contracting and Cooperating non-Contracting Parties would provide written national reports to the SC (following the guidelines set out by the SC – and available on the IOTC website) even when not attending the meeting. The SC has now modified the guidelines to include information on bycatch and mitigation measures implemented by the fleets, and also information from sport fisheries when relevant. Furthermore, the SC requested the SC Chairperson to again present a report on the numbers and completeness of national reports to the Commission at its annual session.

21. The SC requested that Australia confirm to the Secretariat whether the historical catch records submitted include data for the Australian Eastern Tuna and Billfish Fishery (ETBF) that operates in the area of overlap between the WCPFC and IOTC (140 to 150 deg E), noting that no ETBF effort occurred in the area in 2007. The SC also noted that the IOTC does not hold any catch information for the Western Australian sports fishery, and requested that this information be provided in the near future.

22. Seychelles informed the SC that its Government has approved funding for the implementation of an observer programme that will cover the industrial purse seine fishery to a level of 10% of trips starting in 2009, and later extend to the longline fishery. Seychelles also informed the SC that 2007 size frequency data for its industrial longline fishery will be reported to the Secretariat before the end of 2008.

23. The SC commended South Africa for the success it has achieved in reducing the bycatch of seabirds by longliners by 90% in 2007.

24. The SC noted that the annual unloadings of albacore that is reported by Mauritius have, in several years during the last decade, equated to close to the total catches estimated for the Indian Ocean. The SC recommended that Mauritius provide the Secretariat with a breakdown of albacore catches by flag so these data can be compared with the reports from the flag countries.

25. The SC noted that Korea currently has very few observers on board its longline vessels in the Indian Ocean and these observers are the only source of size frequency data for the fleet at present. Korea informed the SC of its plans to increase the numbers of observers and therefore coverage of its Indian Ocean longline fleet in the future; and to this end, it has implemented a training programme for observers.

26. The SC noted with concern that the size data currently being collected by Japan represents only about 1 % of the total number of fish caught by its longline fleet. The SC noted that this lack of information is likely to be compromising the stock assessments of the major tuna species and swordfish and urged Japan to increase the collection of size data to a statistically appropriate level. Japan informed the SC that an observer programme has been initiated to address this problem.

27. The SC also noted that Japan has not yet reported bycatch data for its fisheries. Japan informed the SC that this information will be provided in the near future. The SC recommended that in order to build a historical shark catch series for the Japanese longline fleet, Japan should examine all its data sources; in particular data obtained from its training vessels. Japan informed the SC that it would investigate this matter.

28. Japan informed the SC that there had been a recent change to the national legislation in Japan that is expected to speed up the submission of logbook data to the Fisheries Agency of Japan and the reporting of fisheries statistics to IOTC and other RFMO’s.

29. The SC noted that China currently has very few observers on board its longline vessels in the Indian Ocean and these observers are the one of the sources of size frequency data for the fleet at present. The SC also noted that China submits size frequency data to the Secretariat that are obtained from observer length measurements and derived from weight measurements from logbook records. China informed the SC of its plans to increase the numbers of observers and therefore coverage of its Indian Ocean longline fleet in the future; and to this end, it has implemented a training programme for observers. China also indicated that it would make a concerted effort to collect length information and use these to derive size frequency distributions in the future.

30. FAO informed the Meeting about the next Session of FAO`s Committee on Fisheries (COFI) to held at the beginning of March 2009. The issues of relevance to tuna & tuna-like species that will be considered include:

- the implementation of the Code of Conduct for Responsible Fisheries & the related International Plans of Action
- combating IUU fishing
- securing sustainable small-scale fisheries
- the impacts of climate change on fisheries & aquaculture.

31. The SC was also informed that the process of re-organization of FAO and its Fisheries & Aquaculture Department continues. Notwithstanding this, recent activities of the FAO Fisheries Management and Conservation Service which covers tuna and tuna-like species, include:

- an update of the global data base of (i) tuna catches by species, stock, fishing gear & year & (ii) 5x5 degree catches

- the re-organization of the currently very scattered information on tuna & tuna-like species in the website of FAO`s Fisheries & Aquaculture Department to allow an easy access to this information from few topics for which overviews have been prepared
- the completion of (i) the Proceedings of the Workshop to Further Develop, Test and Apply a Method for the Estimation of Tuna Fishing Capacity from Stock assessment-Related Information, which was hosted by the Inter-American Tropical Tuna Commission in La Jolla, CA, USA in May 2007 and (ii) the related primary publication
- general reviews on the following subjects (being completed, in progress, initiated or planned): on past tuna fisheries management and future challenges; recent developments in the tuna industry; bycatch from tuna fisheries; and the application of the ecosystem approach to tuna fisheries management.

7. REPORTS ON THE 2008 WORKING PARTY MEETINGS

7.1 REPORT OF THE WORKING PARTY ON TAGGING DATA ANALYSIS

32. The first session of the Working Party on Tagging Data Analysis (WPTDA) was held in Seychelles, 30 June to 4 July 2008. The Chairman of the WPTDA (Dr. Alain Fonteneau) presented the report of the meeting (IOTC-2008-WPTDA-R). The objectives of the meeting were to start the analysis of the tagging data gathered by the RTTP-IO in support of the October meeting of the Working Party on Tropical Tuna, where stock assessments should be undertaken using this data.

33. The SC noted that during the main phase of the tagging, the RTTP-IO, almost 170,000 tuna were tagged and released in the western Indian Ocean, and that more tunas have also been tagged by the Small-scale tagging projects in various areas. In June 2007 more than 24,000 of the tagged fished had been recovered and reported — 96% from the purse-seine fishery.

34. The SC agreed that the despite the high risks faced at the beginning of this project, it has been a great success. In comparison to other tagging projects which have short recovery periods, the maximum of number of recoveries was made after 2 months at liberty, allowing the tagged fish to fully mix with the fished population. The minimum average distance travelled between release and recovery was 500 to 600 nautical miles, and the recovery rates were similar for the three species. Despite the tagging taking place in a limited area of the Indian Ocean, after three months, the recoveries were well spread within the entire fishing area of purse seiners.

35. The SC was informed that the first analysis that was undertaken with the tagging data was on growth. Several studies were been presented and they all showed that the growth patterns for yellowfin and bigeye did not follow the Von Bertalanffy growth pattern (as it had been assumed during previous assessments), but instead followed a more complex three stanza growth curve. On the other hand, a Von Bertalanffy curve appears to be valid for skipjack. The limited amount of information on growth of very small fish (from direct aging methods such as otolith readings) and large fish (from tagging) is limited the information on the t0 and Linf parameters, and subsequently introduced difficulties in the modelling of growth.

36. The SC recommended the continued development of growth models using the information from tagging data and new age data from validated otolith readings, and to continue the tag recovery effort in order to have more information on large sized fish, including Linf and the variability of this parameter.

37. The SC was informed that the numbers of tags recovered from artisanal and longline fisheries were very low at the time of the WPTDA. This would severely impact the analysis of the data especially for the bigeye tuna as all the large bigeye are significantly caught only by longliners, while for the yellowfin, the catch of large fish are spread between the longliners and the purse-seiners.

38. The SC noted that the archival tagging experiment undertaken during the RTTP-IO was largely unsuccessful as only a few recoveries were made (<2%). Furthermore, a study of the tagging procedures on film by various experts failed to identify the reasons for the low levels of recoveries.

39. The SC noted that the WPTDA made a range of recommendations in support of the October meeting of the WPTT. These included: to undertake external analysis to provide the parameters for ASPM, to run movement and attrition models and to develop a model to estimate the number of tagged fish that could still be available for recapture. The WPTDA also recommended that an integrated model (such as CASAL, Multifan-CL or SS3) be attempted for the assessment of the yellowfin tuna as they can integrate fisheries statistics and the tagging data..

40. The SC strongly recommended that external analyses using the tag-recovery data continue to be pursued.

41. The SC acknowledged that ideally, tagging projects should be repeated on a regular basis and that a new tagging project that would increase the numbers of releases in the Eastern Indian Ocean be considered. However, the SC recognized that such project would be difficult to implement and require a large amount of funds, and that the short term priority, if funds are limited, should be given to the IOTC to improve fishery statistics in the riparian states.

42. The SC recognized the importance of the tagging project and again extended its congratulations to the team, the fishermen of the tagging vessels, the fishermen cooperating with the project and all other persons that have been contributed to the huge success of this major tagging initiative.

43. The SC endorsed the WPTDA's data and research recommendations (reproduced in Appendix VI) and commended it for its work in 2008

7.2 REPORT OF THE WORKING PARTY ON BILLFISH

44. The Sixth Meeting of the Working Party on Billfish (WPB) took place in Seychelles, 7-11 July, 2008. The Chairman of the WPB (Mr Jan Robinson) introduced the 2008 WPB report (IOTC-2008-WPB-R). The key objectives of the meeting were to undertake a major review of the stock status of swordfish.

45. The SC emphasised the importance of elucidating the stock structure of swordfish in order to manage this stock properly.

46. The SC was satisfied with the swordfish stock assessment conducted by WPB in 2008 as consistent results were obtained from a range of models, i.e., the recent swordfish catch is close to the MSY level.

47. The SC suggested that spatially disaggregated stock assessment models be attempted for swordfish in the future as they can be used to examine specific localised events such as local depletion (that appears to be occurring in south west Indian Ocean areas). The SC suggested that this work could be undertaken within the Secretariat.

48. The SC noted a presentation that made a comparison between the status of scientific knowledge and the conclusions made by the FAO Working Group (WG) on Indian Ocean Tunas and billfishes held in Shimizu in 1979 to provide some historical perspective of the fisheries (IOTC-2008-SC-INF14 and IOTC-2008-SC-INF28). The swordfish catch in 1979 was around 3,000 tons, and came from the equatorial area. Nowadays, the average catch is 20 times greater and most is taken from fishing grounds located in the south tropical areas.

49. The SC recommended that work on stock indicators of other billfish species such as marlins be continued as no stock assessments or robust CPUE indices are available. Istiophorids might be a matter of serious concern as major and continuous trends of nominal CPUE in historical hot spots for these species were presented in the WPB report. The SC recognised that further work is needed on this matter as to which degree these indicators represent abundance.

50. The SC recommended that more information on billfish from sport and artisanal fisheries be collected.

51. Kenya informed the SC that they have tag release data for billfish. The SC was also informed that significant number of tag recapture data exist on billfish from the Indian Ocean among billfish experts out of the region. The SC recommended that the IOTC Secretariat collect all the data already immediately available and approach the major sport fishing bodies in the Indian Ocean regarding access to any other available data sets for use by scientists.

52. The SC endorsed the WPB's data and research recommendations (reproduced in Appendix VI) and commended it for its work in 2008.

7.3 REPORT OF THE WORKING PARTY ON ECOSYSTEMS AND BYCATCH

53. The Fourth Meeting of the Working Party on Ecosystems and Bycatch (WPEB) took place in Thailand from 20 to 22 October 2008. The WPEB Chairperson Mr. Riaz Aumeeruddy reviewed the major outcomes and recommendations outlined in the 2008 WPEB report (IOTC-2008-WPEB-R).

Observer programme

54. The SC agreed that there is an urgent need to quantify the effects of Indian Ocean fisheries on non-target (bycatch) species and to develop mitigation measures to reduce adverse effects on these species.

55. Recognising that accurate data on bycatch can only be obtained through observer programs, the SC strongly recommended that the Commission mandate the WPEB (through the Scientific Committee) to develop regional standards covering data collection, data exchange, training and the development of guidelines for operational aspects of a regional observer program including the standardization of sampling protocols.

56. Of special note, the SC recommended a range of technical points relating to IOTC Recommendation 05/07 *Concerning a management standard for the tuna fishing vessels*, to deploy if appropriate, scientific observers on-board vessels according to the Commission's Resolution;

i. All the major fleets should be covered and the minimum levels of coverage should be such that estimates of total catch have an acceptable precision, including those for rare species

ii. Observers should focus on recording information on discards as the windows of opportunity for obtaining this information are much shorter than those for obtaining information on target species (some of which can be collected at the dock)

iii. The SC also agreed that an observer program should aim to assist members, especially those with major bycatch issues, to improve their bycatch data collection and reporting, particularly on marine turtles and seabirds

iv. The development of a regional observer program should be based on models in place, or in development by other RFMO's, including the WCPFC, CCAMLR and CCSBT to ensure, as far as possible, consistency and the harmonization of protocols to avoid burdensome observer training requirements and to reduce as much as possible multiple reporting formats for countries that are members of multiple RFMOs

v. That a high level of regional coordination be provided by the Commission covering data collection, data exchange, training and the development of guidelines for the operational aspects of such a programme.

Sharks

57. In response to the Commission's request for more information on the technical aspects of IOTC Resolution 05/05 *Concerning the conservation of sharks caught in association with fisheries managed by IOTC,* specifically paragraph 4 "CPC's shall require their vessels to not have onboard fins that total more than 5% of the weight of sharks onboard, up to the first point of landing. CPC's that currently do not require fins and carcasses to be offloaded together at the point of first landing shall take the necessary measures to ensure compliance with the 5% ratio through certification, monitoring by an observer, or other appropriate measures", the SC recommended that the Commission notes that:

i. Though not specified in Resolution 05/05, the SC is of the opinion that the adoption of this management measure appears to be in response to concerns about the threats to shark populations from fishing and the practice of shark finning

ii. The current percentage fins:body weight ratio requirement has no clear scientific basis as a conservation measure for sharks in the Indian Ocean, rather it appears to be aimed at slowing down the rate of fishing or to deter fishing on sharks by not allowing fins only to be landed and requiring vessels to return to port more often to unload fins and body parts

iii. Maintaining the use of the fin:body weight ratios will preclude the collection of essential information on species-level interactions with fishing fleets, crucial for accurate stock assessments for sharks;

iv. Current scientific evidence clearly indicates that percentage fins:body weight varies widely among species, fin types used in calculations, the type of carcass weight used (whole or dressed), and the method of processing used to remove the fins (fin cutting technique)

v. It was recognised that the best way to guarantee that sharks are fully utilised is to require that the trunks be landed with the fins attached, and if fully implemented, this would facilitate the collection of data that would be highly beneficial in shark stock assessments (e.g. data on species, sex ratios, numbers and size distributions of catches), that the Commission may require from the SC (refer to Table 2)

vi. The ultimate production of shark stock assessments would then underpin any future conservation and management actions

vii. The SC agreed that operational factors (e.g. storage methods and product processing) are likely to make a requirement for the natural attachment of fins to the shark carcass difficult for some operators to apply

viii. The SC agreed that all fins landed should be able to be matched to a carcass. In the cases where fins have been removed from the body prior to the landing, the SC agreed that they should be stored in such a way that they can be cross-referenced to the carcasses – for example, they may be numbered or tagged for identification between carcasses and fins.

58. The SC recommended that the fin:body weight ratio measure be replaced with a resolution that requires shark fins to be landed attached to the body, either naturally, or by other means'.

Table 2 – List of technical measures to assess status of sharks with respect to conservation and stock assessment obtained as a result of the work of a sub-working group formed during the 2008 meeting of the IOTC Working Party on Ecosystems and Bycatch to discuss the shark fin:body weight issue.

Type of Measure (ranked by decreasing preference)	Pros	Cons	Notes
1- Land whole shark with fins attached to the body	Full information can be obtained and will enable robust estimates of catches by species, and a wide range of morphometric relationships can be derived	Possible increase of discards	Highly recommended for stock assessment and conservation measures If a vessel has no planned use for the shark bodies, this measure would require that storage space that would otherwise be used for target species would have to be used for sharks. Furthermore, given the presence of fins on the bodies, the stacking of the bodies is less efficacious and overall, fewer sharks can be stored.
2- Land shark with fins separated from carcasses but stored in a way that they can immediately be related to a given carcass	Full information can be obtained and will enable robust estimates of catches by species. Less precise morphometric relationships than in (1) can be expected	Possible increase of discards	Recommended for stock assessment and conservation measures One possibility (among others) is to have the complete set of fins for a given shark placed in a plastic bag, and attached to the torso This measure enables a more optimized use of the haul capacity and is easier to apply on vessels
3- Land fins and body trunks within required fin-to-body ratios all species combined (status quo)	none	Poor level of information obtained. No reliable estimates of total catch or catches by species are possible.	Not recommended by sharks specialist groups (including the IUCN Shark specialist group -IOTC-2008-WPEB-INF01 and the European Elasmobranch Association - IOTC-2008-WPEB-INF04) Cannot be used for stock assessment The 2% or 5% ratio used respectively for dressed and round weight do not reflect the variability among species cutting technique or fin set retained.

59. The SC regretted that no update on National Plans of Action – Sharks from IOTC members were presented at the WPEB meeting. The SC expressed its interest to obtain a report from members that have a NPA-Sharks in 2009.

Seabirds

60. The SC recommended that the WPEB report to the Scientific Committee in 2009 on the levels of seabird and sea turtle mortality due to the fishing methods, longline, gillnet and purse seine.

61. The SC regretted that no update on National Plans of Action – Seabirds from IOTC members were presented at the WPEB meeting. The SC expressed its interest to obtain a report from members that have a NPA-Seabirds, in 2009.

Turtles

62. The SC adopted a draft Executive Summary on sea turtles that had been produced by the Secretariat in collaboration with IOSEA at the request of the WPEB at their meeting in October 2008.

63. The SC recommended that net material used on FADs should be replaced with materials such as non-plastic ropes or non-plastic hoods or straps that will not entangle sea turtles.

64. The SC also recommended that the Secretariat produce a book of sea turtle identification material for the Indian Ocean.

65. The SC noted a range of ongoing problems related to sea turtles and recommended that that the following research be undertaken:

- Recording of basic data on incidentally caught turtles (e.g. location, carapace size, species identification if possible), with a view to enhancing knowledge of the juvenile life stage.

- Ongoing research to test the efficacy of circle hooks in reducing sea turtle mortality.
- Estimate the levels of sea turtle mortality due to various fishing methods, including long line, gillnets and purse seine.
- Describe the sources and scale of ghost fishing taking place in the Indian Ocean.

66. The SC noted that the expansion of gillnet fishing by Pakistan, Iran and Sri Lanka from traditional fishing grounds into high seas areas might increase the interaction with sea turtles and lead to increased mortality.

67. The SC regretted that no update on National Plans of Action – Turtles from IOTC members were presented at the WPEB meeting. The SC expressed its interest to obtain a report from members than have a NPA-Turtles in 2009.

Marine mammals

68. The SC recommended that research on marine mammals be encouraged. Some recommendations for future work in this area included:

- Analysis of purse-seine fishery log-books to elucidate marine mammal diversity and distribution within the Indian Ocean Whale Sanctuary. This work should build on the work on baleen whales by Robineau (1991)[2] using data from the period 1982 to 1985
- Review the existing marine mammal data in the IOTC databases
- Encouragement of national scientists to make reports on the sightings made by observers of all marine mammals observed in operations within the IOTC.

Ecosystem approaches

69. The SC noted that the WPEB had been given an overview of the Ecological Risk Assessment (ERA) project being undertaken in the Pacific Ocean. The purpose of the ERA project is to identify bycatch species at relatively high risk of adverse effects due to fishing, so that the WCPFC can prioritise management actions for such species or further research to quantify in more detail the effects of fishing. The SC recommended that a preliminary examination of the feasibility of undertaking an Ecological Risk Assessment process for IOTC fisheries be undertaken by the Secretariat, in collaboration with WCPFC and ICCAT, and to report on this to the working party in 2009. The SC also recommended that the Secretariat seek funding for this inter-sessional work if necessary.

Other Matters

70. The SC noted that Iran, Sri Lanka, Indonesia, Pakistan and Oman operate gillnet fisheries with high catches of major tuna species (see table 1) and it is recognised that such gears can be a cause of mortality for sharks, sea turtles and marine mammals. The SC urged those IOTC members to improve their level of data reporting including incidental catches of non-tuna species.

71. The SC noted a presentation (IOTC-2008-SC-INF24) on Mitigating ADverse Ecological impacts of open ocean fisheries (MADE). The SC recognised the high degree of interest of this project as it encompasses some of the major issues raised by the WPEB.

72. The SC noted a presentation (IOTC-2008-SC-INF25) on the status of whale sharks around Seychelles. The SC agreed that information on whale shark interactions with Indian Ocean fishing fleets should be included in the developmental process of a regional observer program.

73. The SC endorsed the WPEB's data and research recommendations (reproduced in Appendix VI) and commended it for its work in 2008.

[2] Robineau D (1991) Balaenopterid sightings in the western tropical Indian Ocean (Seychelles area), 1982–1986. UNEP Mar. Mammal Tech Rep 3:171–178

7.4 REPORT OF THE WORKING PARTY ON TROPICAL TUNAS

74. The Tenth Meeting of the Working Party on Tropical Tunas (WPTT) took place in Bangkok, from 23 to 31 November, 2008. The Chairman of the WPTT (Dr Iago Mosqueira) introduced the 2008 WPTT report (IOTC-2008-WPTT-R). The key objectives of the meeting were to undertake a major review of the stock status of yellowfin tuna.

75. The SC noted the following aspects of the report:

- that a large number of documents were presented this year, especially regarding the fisheries and biology of yellowfin, which, in turn, enriched the discussions of the group and laid the platform for a very fruitful meeting
- that considerable work was carried out by the team of RTTP-IO enabling the incorporation of tagging data in the assessment of the yellowfin for the first time
- that the external analysis of tag recapture data provided the working party with valuable insight about the information that can be extracted from tagging data as well as new information about exploitation rates and recruitment estimates.
- that emphasis was made on observer programmes being the only means for obtaining accurate fisheries statistics including data on target, bycatch and associated species. To this end, the WPTT joined the WPEB in strongly recommending that IOTC Recommendation 05/07 Concerning a management standard for the tuna fishing vessels, to deploy if appropriate, scientific observers on-board the vessels according to the Commission's Resolution (Appendix I-ii), become binding on members.

76. The SC acknowledged that considerable work had been carried out by the WPTT intersessionally in 2008 in preparation to the WPTT meeting and thanked all the scientists involved.

77. The SC concurred with the WPTT that the assessment of yellowfin tuna stock in the Indian Ocean is difficult because of the conflicting trends between total annual catches and abundance index (based on the longline CPUE) if data in 1950s and 1960s are included. These trends are not consistent with production-model dynamics, or any known theory of fishing because for any fished stock, dramatic and continuous increase in catches should be accompanied by a decline in abundance. For yellowfin, this is clearly not the case and suggests that there are some major unknown factors influencing the abundance index that need to be accounted for..

78. The SC acknowledged the efforts made to use an integrated stock assessment model that incorporated both fisheries data and tag-recapture data for the first time in 2008. This was applied on yellowfin exclusively. Although not fully satisfactory in terms of results produced and discrepancies in their interpretation, the great potential of such approach is recognised for future assessments and the SC strongly supports the initiatives of the Secretariat to gather experts on these methods at the WPTT in the future. The SC also noted that other models with alternative structures that do not require particular inputs such as tagging or size frequency data, provide valuable alternative views of an assessment situation as well. Thus, the SC agreed that is always a useful exercise to examine the results from a range of models in order to assess the conflicts and consistencies of the different data used in the models. To this end, the SC suggested that a range of stock assessments approaches continues to be conducted (with and without tagging data) in the future.

79. The SC noted that high levels of uncertainty were associated with the yellowfin stock assessment as a result of uncertainty relating to major input data such as movement patterns, growth, steepness[3], etc.. However, it was also recognised that most of the models appear to provide similar perspectives on the status of the yellowfin stocks despite their different levels of complexity and the uncertainties associated.

80. The SC recalled the necessity of establishing a well-agreed growth curve combining information from the tagging data in conjunction with otolith analyses (when available), prior to the runs of the different models, in order to use common reference when those information are to be used as inputs.

[3] The steepness is a parameter of the stock-recruitment relationship reflecting the degree of resistance of a given stock to exploitation, with higher resistance inferred from higher values of steepness.

81. The SC also noted that the information included in the tagging data in relation to movement rates is mostly from the west Indian Ocean area. However, the recoveries in adjacent regions (Arabian Sea, East Indian Ocean, Mozambique Channel), although in limited numbers, are highly informative about large-scale movements and as such should be better accounted for in the next assessment using integrated models.

82. Seychelles presented the latest catch and effort information on tropical tunas from the purse seine vessels based in the Seychelles for the period January to October 2008 (IOTC-2008-SC-INF27) in the West Indian Ocean fishery. The SC noted that the catch for 2008 was similar to that of 2007. By contrast, there was a slight increase of the nominal CPUE which might be linked to a strong reduction of the fishing effort, as a consequence of piracy acts off the coast of Somalia and the departure of some vessels to the Atlantic Ocean. Therefore, the SC agreed to include the implications of these results in the Executive Summary of yellowfin tuna.

83. The SC noted a presentation that made a comparison between the status of scientific knowledge and conclusions at the FAO WG held in Shimizu in 1979 and the information presently obtained on the same stocks by the IOTC in 2008(IOTC-2008-SC-INF14 and IOTC-2008-SC-INF28). In 1979, the yellowfin stock was considered to be fully exploited, following an initial period of increase of longline effort; fast decline of longline CPUE and then stability of catches. The MSY was estimated in the range 40,000 and 60 000 t. The decline of early CPUEs was assumed to be excessive, compared to biomass trend, this decline was attributed to two factors: (1) the early fishing effort being highly mobile and concentrating in areas with high yellowfin densities (that were not representative of regional densities) and (2) the rapid increase in the numbers of longliners fishing for yellowfin increased competition and reduced catch rates due to excessive local fishing effort. It appears now that major changes have been observed in the yellowfin fisheries: total recent catches being multiplied by a factor of 8.5, and the MSY being estimated at about 300 000 tons. Longline catches are now still significant in weight, but catches by various gears have become dominant. No major increase of yellowfin catch would have been expected from the 1979 diagnosis, but it was impossible to estimate the present level of MSY based on the longline fishery data available at that time.

84. Although no comprehensive assessment was carried out for bigeye in 2008, the SC noted that the application of a simple surplus production, including longline CPUE and total catch biomass data, concluded that the probability of B2007 being greater than B_{MSY} was high (86 %). Notwithstanding these results, given the preliminary nature of the work no new advice was provided for the stock.

85. The bigeye stock offers a widely different situation from the 1979 FAO WG. Whereas it was concluded that the stock was still lightly exploited, and that it was impossible to estimate the stock MSY, major changes have occurred since then with total catches being multiplied by a factor of 4.8. Longline catches are still widely dominant in weight, but recent catches of small bigeye are now very significant. A major increase of longline catches due to the introduction of the deep longline in the mid 1970's has been observed in most of the historical fishing areas. It can then be concluded that the increased bigeye catches and the presently estimated MSY are in good agreement with the conclusions of the 1979 WG (IOTC-2008-SC-INF28 and IOTC-2008-SC-INF14).

86. The SC recognised the considerable effort carried out to standardize the CPUE of the purse seine skipjack catch including the use of environmental covariates. Although the results were not conclusive at this time, the SC agreed that work in this area should continue to be pursued in the future.

87. The SC noted that no comprehensive stock assessment was conducted for skipjack tuna in 2008. However, external analyses on the tagging data indicated that exploitation rates of skipjack are relatively low - not exceeding 20% even for the most selected age-range of the stock. Abundance in 2006 was higher than that in 2007 while the relative age-structure remained stable, with a similar decrease in relative abundance from ages 2 to 5. This indicates that the population has a reasonably stable year-class regime at least for the cohorts that encompass the data used in the analysis (2000-2005).

88. The SC noted several points from the presentations of the work of the 1979 FAO WG. Very few calculations were done at the 1979 WG; however, its report contains various discussions that are still relevant today. For instance the discussions on the interaction between fisheries, the stock recruitment relationship and its management implications for tuna stocks, and the causes of the early CPUE declines. Another observation is that the MSY level of these tuna stocks has substantially increased as the fisheries developed (different gear types, increased fishing effort and catches, an increase in the depth of water being fished and wider operational range). This feature reinforces the need to obtain good statistics of catch, effort and size data from all the fisheries, as these data are the backbone of any tuna or billfish stock assessment. Additional biological research and tagging programs are also necessary to enable the use of more advanced modelling techniques.

89. The Scientific Committee endorsed the WPTT's data and research recommendations (reproduced in Appendix VI) and commended it for its work in 2008.

90. In addition, the SC recommended that the priority matters for WPTT to address at its 2009 meeting should be to undertake, in the following order, revised stock assessments for yellowfin and bigeye tuna, and implement a first assessment of skipjack tuna.

91. Reflecting on the use of the tagging data in the 2008 yellowfin work, the SC acknowledged that these data will also have major influence on the understanding of growth, mortality, and migration and as a consequence the stock assessments for yellowfin, bigeye tuna and skipjack tuna in the near future.

7.5 REPORT OF THE WORKING PARTY ON METHODS

92. The Third Meeting of the Working Party on Methods (WPM) took place in Thailand on 25 October 2008. The Caretaker chairman for the meeting (Dr Iago Mosqueira), presented the 2008 WPM report (IOTC-2008-WPM-R).

93. The SC strongly endorsed the WPM recommendation that IOTC work on methods should be carried out in conjunction with other tuna commissions; and that the establishment of channels of communication among interested parties on the various tuna commissions should be explored by both the Chairman and the Secretariat.

94. The SC endorsed the WPM recommendations given in (reproduced in Appendix VI) and commended it for its work in 2008.

7.6 REPORT OF THE WORKING PARTY ON TEMPERATE TUNAS

95. The Second Meeting of the Working Party on Temperate Tunas (WPTe) took place in Thailand on 1 November 2008. On behalf of the Caretaker chairman for the meeting (Dr Francis Marsac), Dr Alain Fonteneau provided an overview of the 2008 WPTe report (IOTC-2008-WPTe-R) by way of a presentation (IOTC-2008-SC-INF29).

96. The SC noted that the WPTe meeting had been added to the 2008 schedule of WP meeting at late notice in response to concerns from the Commission at its June 2008 meeting to the lack of an up-to-date assessment for albacore. The SC congratulated the WPTe for its work, and, in particular, thanked the scientists from Taiwan,China for providing data and a standardised CPUE analysis for the meeting.

97. To a question from the SC on the possible reasons for the undulating trend in annual CPUE of albacore tuna, the Chair of the WPTe informed the SC that this was likely due to changes in targeting practices, driven by changes in the price of albacore compared to other tuna species such as southern bluefin and bigeye.

98. The SC noted that the low prices of albacore tuna (being 2 to 3 times less than yellowfin and bigeye) is a key factor that reduces the incentive for further development of the fishery with recently built longliners. The longline fleet of Taiwan,China targeting albacore is composed of small and relatively old vessels that have lower operational costs than larger and newer vessels (such vessels tend to operate in the tropical tuna fishery).

99. The SC noted a presentation (IOTC-2008-SC-INF28) comparing the knowledge on albacore in 1979 (IOTC-2008-SC-14) with current knowledge based on the 2008 WPTe meeting. Unlike other tuna species, the increase of catch over the period examined was limited (by a factor of 2.1). The bulk of the catches is still due to longliners. Albeit drastic and fast decline of standardized longline CPUEs, the 1979 WG did not express any major concerns. The MSY estimated in 1979 at 15,000- 20 000 t, is just below the current estimate (28,300 t to 34,400 t).

100. The SC endorsed the WPTe's data and research recommendations (reproduced in Appendix VI).

7.7 UPDATE ON THE STATUS OF NERITIC TUNAS

101. The SC expressed it regret that the Working Party on Neritic Tunas meeting scheduled for 15 to 17 November, 2008 in Muscat, Oman was cancelled at the last moment due to a lack of participation. The SC noted that this was the fourth year in a row that this meeting has been cancelled for the same reason.

102. In an effort to ensure that the meeting is held in 2009, the SC recommended that the Caretaker Chair of the Neritics Working (Dr Somvanshi, India) be asked to try to identify potential participants so as to secure a minimum number of 15 participants from as many countries as possible for this meeting.

103. The SC was open to the possibility of holding the meeting in conjunction with other technical meetings in the region (such as the Indian Ocean Rim meeting or SWIOFC) and asked the Chair of the WPN to also investigate this possibility.

104. The Secretariat presented the SC with an update on the status of the IOTC data holdings for neritic species (IOTC-2008-SC-INF23).

8. STATUS OF IOTC STOCKS AND ASSOCIATED SPECIES

105. Note, a table summarising the status and management advice relating to the IOTC species is provided in the Executive Summary of this report (Page 4).

8.1 MANAGEMENT ADVICE FOR TUNAS

106. The Executive Summaries for albacore and yellowfin were adopted by the SC (Appendix VIII), noting that they have been modified to include the results of stock assessments undertaken in 2008 and the advice and recommendations have changed.

107. The Executive Summaries for bigeye and skipjack were adopted by the SC (Appendix VIII), noting that they have been amended slightly to reflect the latest available catch data, but the advice and recommendations remain unchanged.

8.1.1 ALBACORE TUNA (*Thunnus alalunga*)

Current status

108. Based on the preliminary analyses undertaken in 2008 there are no indications that that the albacore stock is over-fished ($B_{2007}/B_{MSY} > 1$) and overfishing is currently likely not occurring for the scenarios envisaged. Point estimates of MSY ranged from 28,260 t to 34,415 t. This indicated that continuous annual catches at a level approaching 38,000 t (equivalent to the historically high level of catch experienced over the period 1998 to 2001) may not be sustainable in the long term.

109. Albacore catches have been around 26,000 t annually over the past five years (2003-2007) and this level is only slightly higher than the historical average annual catch taken for the past 50 years (23,000 t). Other fisheries-based indicators show considerable stability over long periods. The mean weight of albacore in the catches has remained relatively stable over a period of more than 50 years. Furthermore, the average weight of albacore in the Indian Ocean is higher than that reported in the other oceans and is likely to result in a higher yield per recruit. The catch rates of albacore have also been stable over the past 20 years.

110. Because of the low value of albacore and, as a likely result, low profitability of the albacore longline fishery compared to the fisheries for other tuna species, there is likely to be very little incentive for an increase in fishing effort on this species in the immediate future.

111. On balance of the information available, albacore is considered to be not overfished and overfishing is not occurring.

Recommendation

112. The Scientific Committee acknowledges the preliminary nature of the albacore tuna assessment in 2008, but on balance of the available stock status information and stable effort considers that the status of the stock of albacore is not likely to change markedly over the next 2-3 years and if the price of albacore remains low compared to other tuna species, no immediate action should be required on the part of the Commission. The Scientific Committee recommend that a new albacore tuna assessment be presented to the Scientific Committee at the latest in 2010.

8.1.2 BIGEYE TUNA (*Thunnus obesus*)

Current status

113. The results of the stock assessments conducted in 2006 were broadly similar and, in general, were more optimistic than previous ones. The ASPM results indicate that the 2005 catch is close to the MSY. Furthermore, spawning stock biomass seems to be above the level that would produce MSY, and the fishing mortality in 2004 seems to below the MSY level. Current (2004) catches of juveniles bigeye by the surface fleets are also less detrimental in terms of yield-per-recruit that previous patterns.

114. However, the current outlook could revert to a more pessimistic one, if the exploitation pattern is to return to the pre-2003 levels, as expected. Changes in the fishery occurred in 2003 and 2004, but these were due to the exceptional catches of yellowfin, which seem to be the result of anomalous conditions. In 2005, the fishery is

already showing a return to the previous pattern of exploitation, which is likely to increase the catches of bigeye tuna associated with floating objects.

115. If the level in catch in numbers of juvenile bigeye tuna by purse seiners fishing on floating objects returns to pre-2003 levels, this is likely to be detrimental to the stock, as fish of these sizes are below the optimum size for maximum yield-per-recruit.

116. The Scientific Committee also noted that juvenile bigeye tuna are caught in the FAD purse-seine fishery that targets primarily skipjack tuna. Some measures to reduce the catches of bigeye tuna in this fishery could be expected to result in a decrease in the catches of skipjack tuna.

Recommendation

117. In view of the most current assessment, the Scientific Committee recommended that catches should not exceed the MSY and fishing effort should not increase further from the 2004 levels.

8.1.3 SKIPJACK TUNA (*Katsuwonus pelmis*)

Current status and recommendation

118. The high productivity life history characteristics of skipjack tuna suggest this species is resilient and not prone to overfishing, and the stock status indicators indicate that there is no need for immediate concern about the status of skipjack tuna.

8.1.4 YELLOWFIN TUNA (*Thunnus albacares*)

Current status

119. Estimates of current status of the stock in relation to biomass and fishing mortality reference points were sensitive to the value assumed for steepness of the stock-recruitment relationship so the following results are reported with respect to a range of plausible steepness values (0.6 to 0.8).

120. Estimates of total and spawning stock (adult) biomass are above or just below their respective MSY-based reference points i.e. B_{2007}/B_{MSY} ranged from 1.13 to 0.93 and SB_{2007}/SB_{MSY} ranged from 1.18 to 0.61, indicating that the stock is close to, or possibly has recently entered, an over-fished state.

121. Current (2007) fishing mortality estimates were above their respective MSY-based reference points for all but one of the assessments examined, i.e. F_{2007}/F_{MSY} ratios range from 0.9 to 1.60 indicating that overfishing is occurring. This current degree of overfishing is somewhat lower than that estimated occurred during the 2003-2006 period when the $F_{2003\text{-}2006}/F_{MSY}$ ratio ranged from 1.22 to 1.75.

122. The stock assessments, including independent analyses of the tagging data, indicate that recruitment has declined in recent years.

123. The estimates of MSY ranged between 250,000 t and 300,000 t based on the integrated assessment that used the tagging data, although other model results expand this range to 360,000 t. The 2007 catch of 317,000 t may have been above the MSY while annual catches over the period 2003-2006 (averaging 464,000 t) were substantially higher than this range of MSY estimates.

Outlook

124. Catches in 2007 (317,000 t) were slightly lower than the average catch taken in period 1998-2002 (336,000 t) i.e. preceding the 2003 to 2006 period when extraordinarily high catches of yellowfin were taken. Purse seine catches in the first nine months of 2008 were slightly higher than those reported for the corresponding period in 2007 indicating that catch levels might be returning to pre-2003 levels. While there is a large amount of uncertainty about likely future catches, recent events in 2008 where some vessels have left the fishery, together with fleets avoiding the historically important fishing grounds in the waters adjacent to Somalia for security reasons, may reduce catches in the short-term to below the pre-2003 levels.

125. Two hypotheses have been put forward in the past to explain the very high catches in the 2003-2006 period: (i) an increase in catchability by surface fleets due to a high level of concentration across a reduced area and depth range, and (ii) increased recruitment over the 1999-2001 period. Recent analyses of environmental and oceanographic conditions appear to be consistent with the first hypothesis, which would mean that the catches likely resulted in a depletion of the stock. Conversely, MFCL accounts for the period of higher catches by estimating substantially higher than average levels of recruitment in 2001, 2002 and 2003. Environmental anomalies also appear to be a factor linked to the lower catches in 2007.

126. The range of model runs indicates that overfishing is currently occurring. Under equilibrium conditions, the recent (2003-2006) and current (2007) levels of fishing mortality will result in the stock becoming overfished ($B_{CURRENT}<B_{MSY}$ and $SB_{CURRENT}<SB_{MSY}$) in the medium term (3-5 years). Recent recruitments (in 2005, 2006 and possibly 2007) are estimated to be below the equilibrium (long-term average) level and if lower recruitment persists then the stock will decline below the MSY level more rapidly. Similarly, overfishing may continue to occur even if fishing pressure returns to pre-2003 catch levels, especially if recruitment continues to be low and the expected decrease in some age classes due to recent low recruitments eventuates.

Recommendation

127. Although important progress in the quality and quantity of analyses conducted, there remain uncertainties in the application of the models that prevented the SC from determining the current status of yellowfin tuna in a precise way. Nevertheless, most of the analyses conducted coincide in indicating that the stock is very close to an overfished state, or already overfished, and that the exploitation rate in recent years has exceeded the optimal level.

128. Therefore, the SC recommends that the catch of yellowfin tuna does not exceed the average catch for the period 1998-2002 (i.e. 330,000 t) when catches were stable, prior to the exceptional years of 2003-2006 when the stock might have been overexploited.

129. Similarly, the Scientific Committee recommends that the fishing effort does not exceed the level exerted in 2007 when the catch of yellowfin tuna returned to the pre-2003 levels.

8.1.5 SOUTHERN BLUEFIN TUNA (*Thunnus maccoyii*)

130. The SC noted the contents of a report on the biology, stock status and management of southern bluefin tuna (IOTC-2008-SC-INF13) and thanked CCSBT for providing it.

8.2 MANAGEMENT ADVICE FOR BILLFISH

131. The Executive Summary for swordfish was adopted by the SC (Appendix VIII), noting that it has been modified to include the results of stock assessments undertaken in 2008 and the advice and recommendations have changed.

132. Executive Summaries for black marlin, blue marlin, striped marlin and Indo-Pacific sailfish were adopted by the SC for the first time in 2008 (Appendix VIII).

8.2.1 SWORDFISH (*Xiphias gladius*)

Current status

133. The overall standardized CPUE of swordfish for the Japanese fleet for all areas of the Indian Ocean shows a general continuous decline over the period 1980 to 2006; however, the last five years have been relatively stable. By contrast the standardized CPUE of swordfish for the Taiwanese fleet is variable but shows no consistent trend. The apparent fidelity of swordfish to particular areas is a matter for concern as this can lead to localised depletion. The CPUE of the Japanese fleet in the south west IO has the strongest decline of the four areas examined in 2008; furthermore, the La Reunion CPUE series shows a declining trend in this area over the last 10 years. In previous years, localised depletion was inferred on the basis of decreasing CPUEs following fine scale analyses of the catch effort data. Therefore the Scientific Committee cannot discount the possibility that localised depletion is still occurring in some areas. Localised depletion has occurred in other parts of the world where swordfish have been heavily targeted. The annual average sizes of swordfish in the respective Indian Ocean fisheries are variable but show no trend. It was considered encouraging that there are not yet clear signals of declines in the size-based indices, but these indices should be carefully monitored. It was noted that since females mature at a relatively large size, a reduction in the biomass of large animals could potentially have a strong effect on the spawning biomass.

134. The results of the 2008 stock assessment were more optimistic than those from 2006 when overfishing was considered to have occurred. Based on the point estimates and confidence limits, on balance the assessment model results indicate that overfishing of the swordfish stock in Indian Ocean is not occurring ($F_{2006}/ F_{MSY} < 1$) and the stock appears not to be in an overfished state ($B_{2006}/ B_{MSY} > 1$. Recent catch levels (averaging 31,900 t per year over the five year period 2002-2006) have been around the current estimate of MSY (31,500 t, 80% confidence limits 24,500 t - 34,400 t).

Recommendation

135. The SC considers that the catches should not increase above the 2006 levels and fishing effort should not increase from the 2007 levels. Furthermore, management measures focussed on controlling and/or reducing effort, especially in the south-west Indian Ocean are recommended.

8.2.2 BLACK MARLIN (*Makaira indica*)

Current status

136. No quantitative stock assessment on black marlin in the Indian Ocean is known to exist and no such assessment has been undertaken by the IOTC Working Party on Billfish. However, a preliminary estimation of stock indicators was attempted on the longline catch and effort datasets from Japan and Taiwan, China that represent the best available information Nominal CPUE exhibited dramatic declines since the beginning of the fishery in two major large fishing grounds (West Equatorial and north-west Australia) and the catches in the initial core areas also decreased substantially. There is considerable uncertainty about the degree to which those indicators represent abundance. Other factors such as changes in targeting practices, discarding practices, fishing grounds and management practices are likely to interact in the depicted trends. Further work must be undertaken to explore and refine those parameters as such approach represents the only way to progress into the analysis of this stock that might be severely affected by fisheries.

Recommendation

137. No quantitative stock assessment is currently available for black marlin in the Indian Ocean, and due to a lack of fishery data for several gears, only preliminary stock indicators can be used. Therefore the stock status is uncertain.

8.2.3 BLUE MARLIN (*Makaira nigricans*)

Current status

138. No quantitative stock assessment on blue marlin in the Indian Ocean is known to exist and no such assessment has been undertaken by the IOTC Working Party on Billfish. However, a preliminary estimation of stock indicators was attempted on the longline catch and effort datasets from Japan and Taiwan, China that represent the best available information Nominal CPUE exhibited dramatic declines since the beginning of the fishery in two major large fishing grounds (West Equatorial and north-west Australia) and the catches in the initial core areas also decreased substantially. There is considerable uncertainty about the degree to which those indicators represent abundance. Other factors such as changes in targeting practices, discarding practices, fishing grounds and management practices are likely to interact in the depicted trends. Further work must be undertaken to explore and refine those parameters as such approach represents the only way to progress into the analysis of this stock that might be severely affected by fisheries.

Recommendation

139. No quantitative stock assessment is currently available for blue marlin in the Indian Ocean, and due to a lack of fishery data for several gears, only preliminary stock indicators can be used. Therefore the stock status is uncertain.

8.2.4 STRIPED MARLIN (*Tetrapturus audax*)

Current status

140. No quantitative stock assessment on striped marlin in the Indian Ocean is known to exist and no such assessment has been undertaken by the IOTC Working Party on Billfish. However, a preliminary estimation of stock indicators was attempted on the longline catch and effort datasets from Japan and Taiwan, China that represent the best available information Nominal CPUE exhibited dramatic declines since the beginning of the fishery in two major large fishing grounds (West Equatorial and north-west Australia) and the catches in the initial core areas also decreased substantially. There is considerable uncertainty about the degree to which those indicators represent abundance. Other factors such as changes in targeting practices, discarding practices, fishing grounds and management practices are likely to interact in the depicted trends. Further work must be undertaken to explore and refine those parameters as such approach represents the only way to progress into the analysis of this stock that might be severely affected by fisheries.

Recommendation

141. No quantitative stock assessment is currently available for striped marlin in the Indian Ocean, and due to a lack of fishery data for several gears, only preliminary stock indicators can be used. Therefore the stock status is uncertain.

8.2.4 INDO-PACIFIC SAILFISH (*Istiophorus platypterus*)

Current status

142. No quantitative stock assessment is currently available for Indo-Pacific sailfish in the Indian Ocean, and due to a paucity of data there a no stock indicators that are considered to be reliable, therefore the stock status is uncertain.

8.3 MANAGEMENT ADVICE ON THE STATUS OF NERITIC TUNAS

143. The Executive Summaries for narrow-barred Spanish mackerel, kawakawa, bullet tuna, longtail tuna, frigate tuna and Indo-Pacific king mackerel were adopted (Appendix VIII), noting that they have been amended slightly to reflect the latest available catch data, but the advice and remains unchanged.

8.3.1 BULLET TUNA (*Auxis rochei*)

Current status and recommendation

144. No quantitative stock assessment is currently available for bullet tuna in the Indian Ocean, therefore the stock status is uncertain. The SC notes the catches of bullet tuna are typically variable but relatively low compared to the other neritic species. The reasons for this are not clear: it may be problem related to reporting, or it may be a normal fluctuation in the fishery. Bullet tuna is a relatively productive species with high fecundity and rapid growth and this makes it relatively resilient and less prone to overfishing. Nevertheless, bullet tuna appears to be an important prey species for other pelagic species including the commercial tunas, therefore it should be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

8.3.2 FRIGATE TUNA (*Auxis thazard*)

Current status and recommendation

145. No quantitative stock assessment is currently available for the frigate tuna in the Indian Ocean, therefore the stock status is uncertain. This species is a relatively productive species with high fecundity and rapid growth and this makes it relatively resilient and not prone to overfishing. Nevertheless, frigate tuna appears to be an important prey species for other pelagic species including the commercial tunas, therefore it should be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

8.3.3 INDO-PACIFIC KING MACKEREL (*Scomberomorus guttatus*)

Current status and recommendation

146. No quantitative stock assessment is currently available for the Indo-Pacific king mackerel in the Indian Ocean, therefore the stock status is uncertain. This species is a relatively productive species with high fecundity and rapid growth and this makes it relatively resilient and not prone to overfishing. The SC recommends Indo-Pacific king mackerel be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

8.3.4 KAWAKAWA (*Euthynnis affinis*)

Current status and recommendation

147. No quantitative stock assessment is currently available for kawakawa in the Indian Ocean, therefore the stock status is uncertain. The SC notes the decline in the catches since 2002. However, the reasons for this are not clear: it may be problem related to reporting, or it may be a normal fluctuation in the fishery — a similar decline occurred in the early 1990's. Nevertheless, the SC recommends that this species be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

8.3.5 LONGTAIL TUNA (*Thunnus tonggol*)

Current status and recommendation

148. No quantitative stock assessment is currently available for longtail tuna in the Indian Ocean, therefore the stock status is uncertain. The SC notes the decline in the catches since 2000. However, the reasons for this are not

clear: it may be problem related to reporting, or it may be a normal fluctuation in the fishery — similar declines occurred in the mid 1980's, early 1990's and mid 1990's. Nevertheless, the SC recommended that this species be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

8.3.6 NARROW-BARRED SPANISH MACKEREL (*Scomberomorus commerson*)

Current status and recommendation

149. No quantitative stock assessment is currently available for narrow-barred Spanish mackerel tuna in the Indian Ocean, therefore the stock status is uncertain. The SC notes that Spanish mackerel is a relatively productive species with high fecundity and this makes it relatively resilient and less prone to overfishing; however, it recommends that this important species be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

8.4 MANAGEMENT ADVICE ON SHARKS AND SEA TURTLES

150. Executive Summaries for blue, silky, oceanic whitetip, shortfin mako, scalloped hammerhead shark remained unchanged from 2007 (Appendix VIII).

151. An Executive Summary for sea turtles was adopted by the SC for the first time in 2008 (Appendix VIII).

9. ACTIVITIES IN RELATION TO THE INDIAN OCEAN TUNA TAGGING PROGRAMME

9.1 ACTIVITIES IN RELATION WITH THE INDIAN OCEAN TUNA TAGGING PROGRAMME

152. The SC was given an update on the tagging activities supervised by the Secretariat. In 2005, the RTTP-IO started under a funding of the 9th European Development Fund from the European Commission. The tagging activities undertaken onboard the two vessels chartered for the RTTP-IO were completed in September 2007. In total 168,163 fish (32% yellowfin, 21% bigeye, 47% skipjack) were tagged and released in the western Indian Ocean, in the area from the Mozambique Channel to the coast of Oman. This represented more than twice the minimum number initially proposed for the project (80,000) and higher than expected numbers of yellowfin tuna and bigeye tuna (which were the main target species of the programme) were recaptured. To-date 26,316 tunas have been recovered mostly by the purse-seine fleet based in Seychelles (96%) but also by artisanal fishermen in Comoros, Tanzania, Yemen, Oman, South Africa. 109 recoveries, have been also reported onboard the different longline fleet operating in the Indian Ocean. The number of recoveries in 2008 (4500) was lower than those obtained in 2006 (6800) and 2007 (15000). This is due in part to the cessation of tagging activities (tagging finished more than a year ago), and because fewer tuna have been unloaded in Seychelles in 2008.

153. To complete the RTTP-IO in the eastern Indian Ocean, the government of Japan funded a range of small-scale projects in 2008; including, activities in Indonesia, the Andaman Islands (India) and Maldives.

154. In Indonesia, a project was implemented with the assistance of the Research Center for Capture Fisheries (RCCF) and the Common Wealth Scientific and Industrial Research Organization (CSIRO) of Australia. The activities in Indonesia showed that it was possible to tag tuna in the region West of Sumatra with a pole-and-line vessel imported from another region (as there is no such fleet in the area). However, certain aspects of the vessel capabilities, in particular its small bait carrying capacity meant that only 726 tunas (63% yellowfin, 37% skipjack) were tagged and released in the Mentawai Strait. Only 12 fish have been recovered, mostly in the region but one was reported in a Thai cannery. During a workshop held in Jakarta in May 2008, it was decided to continue the activities in Indonesia. However, the remaining funds were not sufficient to charter a larger vessel and it was suggested that a pilot project be developed to test alternative fishing and tagging techniques that have proven to be successful in the Pacific Ocean. Unfortunately, it has not been possible to undertake this work so far.

155. In January and February 2008, a project was implemented with the assistance of the Fishery Survey of Indian (FSI) in the Andaman Islands. Two pole-and-line vessels from the Lakshadweep Islands were used by FSI scientists. 1332 tunas (76% skipjack, 24% yellowfin) were tagged. As was the case in Indonesia, the project proved that it was possible to tag fish using pole-and-line technique in a region where this fishing technique is not commonly used; however, again, the small-size of the vessels chartered and their lack of autonomy did not enable sufficient numbers of fish to be tagged. Due to the artisanal nature of most of the fleet in the area, it is difficult to raise the awareness of fishers and only 3 fish have been recovered so far (these were from the Andaman Islands). Due to the logistical difficulties associated with working in the Andaman Islands it was decided not to extend the tagging activities.

156. With the collaboration of the Maldives Research Center (MRC), a second small-scale project was implemented in 2008 after the very successful experiment of 2005. Due to the poor fishing conditions in the area, only 3088 tunas were tagged in 2007 and 2008. Difficulties have been encountered with the cooperation of the fishermen and it appears that implementing the tagging during commercial fishing trips was probably not a good option in Maldives. During the workshop in Jakarta, it was decided to change the strategy by chartering a vessel that will enable a complete control of the tagging activities. The plan is now finalized and the tagging should resume in January/February 2009. It appears during this project that the reporting of the recovered tags by the Maldivian fishermen had probably decreased (fishermen keeping the tags and higher number of recoveries in Thai canneries) and the tag recovery scheme was adapted with the cooperation of the companies buying the fish who are now paying directly the reward to the fishermen. At the end of August, 10% of the fish have been recovered and reported to MRC.

157. The SC noted the databases of all the small-scale projects, and of past tagging experiments will soon be merged with the RTTP-IO database so there will be one common tagging database for all the projects. The database of the RTTP-IO is cleaned and validated on an ongoing basis by the Chief Coordinator of the project and the Publicity and Tag Recovery Officer, and available on request from Secretariat..

158. The SC noted that the expected results in the Eastern Indian Ocean tagging work were not realised in 2008 and acknowledged that this was due in part to unexpected oceanographic conditions, an earthquake and the limited size of the charter vessel used. Notwithstanding this the results were interesting and promising in particular for the growth of the small fish (<30cm) that were tagged in Indonesia. The SC gave its support to the continuation of the activities in Maldives.

159. The SC recognized that estimation of the reporting rate is an essential element for the use of tagging data in stock assessments. The tag seeding activities continued in 2008 and to date more than 2900 tags have been seeded onboard the purse-seine fleet based in Seychelles. In 2008, 350 tags were seeded and the seeding activities will last until the end of the recoveries. The SC recommended that tag seeding experiments continue till the end of the recovery activities to follow up on the reporting rates, and that all efforts be made by the members having longline fleets to recover the tags.

160. The SC noted that the numbers of tags recovered by longliners is low (0.4% of the total number recovered) and urged the fishing countries to inform their fleets of the importance of reporting and returning the tags. If the levels of recoveries by longliners continue to be low, this might induce biases in the analysis and result in false conclusions being made from the results of stock assessments.

161. The SC noted that the number of fish tagged has been more than the double of the target and that the funds allocated for the payment of the rewards to the fishermen are likely to run out. It strongly recommended that the recovery activity are maintained through the year 2009 and that funds are made available to the Secretariat to pay additional rewards for tags that will be recovered after the dedicated funds are exhausted.

9.2 TAGGING SYMPOSIUM

162. The SC recommended that a final IOTC Tagging Symposium should be held in the second half of 2010. The symposium is expected to take five days and target a wide range of people, including fishermen, scientists, fishery administrators, media, concerned with the IOTC tagging programme and/or the conservation of tropical tunas in the Indian Ocean. It is envisaged that the IOTC would invite and pay for the participation to the symposium of scientists from all interested coastal countries. Selected international tagging experts will also be invited and sponsored by the IOTC. The symposium will have various major goals, such as:

- Making a full review of all tagging programmes and their recoveries
- Making a full review of all main the results obtained on the three species, yellowfin, skipjack, and bigeye: movements, growth, natural mortality at age, exploitation rates, etc.
- Making a full review of the input of the tagging results in the various assessment models and of the major benefits that have been obtained from these tagging.
- Making a full comparison of the tagging results in the IOTC with the tagging results obtained in other oceans.

163. The symposium should have a good balance of presentations and discussions. A selection of the papers presented to this symposium will be considered for inclusion in a proceedings publication, by the IOTC Secretariat or by a selected Journal.

164. This symposium should be held in a country of the western Indian Ocean that has been supportive of the RTTP-IO. The costs of the symposium are estimated at €100,000 (not including publication costs) and this is expected to be voluntarily obtained from donors.

10. DISCUSSION ON FISHING CAPACITY

165. A range of documents was made available to the SC to assist discussions on fishing capacity[4]: IOTC-2008-SC-08, INF01, INF02, INF03, INF04, INF05, INF08, INF30.

166. EC made a presentation (IOTC-2008-SC-08) that described the documentation and experience available within ICCAT in relation to: techniques for assessing fishing capacity; an overview of the ICCAT experience; and the ICCAT approach to managing fishing capacity. The conclusions from ICCAT are that capacity analysis and management is a complex issue. Addressing fishing capacity (overcapacity) requires more than simply limiting the number of vessels with access to the fishery. In order to consider the issues, detailed information is needed on both the resources and their characteristics, and the number and characteristics of all vessels in all categories that are exploiting tuna resources. Discussions by the SC on estimation of fishing capacity and managing fishing capacity followed this presentation.

167. Factors that contribute to the complexity of analysing capacity include fleet migration between oceans; the fact that tuna fisheries are multispecies fisheries and target switching can occur; the fisheries are prosecuted by a range of vessel-gear types with different characteristics (purse seine, more or less developed use of FADS, longlines, pole and line, multi-gear artisanal fisheries); Increases in fishing power can occur over time with technological development. It was noted that the situation in the IOTC area was particularly complex as about half of the catch is taken by to artisanal fisheries and in itself this is a major factor that complicates management based on capacity controls.

168. The SC received an overview of the report of the workshop on Rights-based Management and Bycatch in International Tuna Fisheries held in La Jolla, USA in May 2008 (IOTC-2008-SC-INF30) to assist discussions.

169. The SC agreed that global overcapacity was a major concern for tuna fisheries in all oceans. Discussing the experience of bodies (e.g. ICCAT, IATTC, and the Kobe Meeting) it was considered that limiting fishing capacity alone is inadequate to provide management of fish stocks, especially at a regional RFMO level. Capacity controls require action at the global level, but there remain significant questions about how to reduce the current excess capacity – any measures cannot be applied to only one part of the total fleet – it must be applied across all vessel gear types. Additionally the work of FAO and the World Bank indicates that rights-based approaches are needed, although allocation of access rights poses its own problems. It was noted that this was also the view expressed in the economic literature on fishing capacity.

170. While it was noted that the best outcomes from capacity limitation would be achieved if it was implemented at the global level, and that the establishment of such controls would facilitate alternative local (RFMO) management actions (e.g. based on quotas) the SC agreed that it was important to explore what IOTC could do to add value to the existing studies and provide to the information needed by the Commission.

171. The Secretariat outlined actions that had already been taken that would contribute to the debate on fishing capacity by any Working Group and by the Commission.

172. With respect to documenting capacity, the Secretariat: i) maintains a list of authorised vessels ; ii) maintains a list of active vessels based on reports received from CPCs once a year for vessels active in the previous year; iii) maintains fishing craft statistics (numbers by category). However it was noted that concerning vessel characteristics, details are incomplete (e.g. no information on well size, vessels report either gross tonnage or gross registered tonnage, but not consistently one or the other)

173. With respect to existing capacity controls, two resolutions exist, one to limit vessels targeting tropical tunas (Resolution 06/05) and one to limit vessels targeting swordfish and albacore (Resolution 07/05). However, due to target switching it is not clear how effective these are. Also provision still exists for coastal states to increase

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[4] Fishing capacity is the amount of fish (or fishing effort) that can be produced over a period of time (e.g. a year or a fishing season) by a vessel or a fleet if fully utilized and for a given resource condition. Full utilization, in this context, means normal, but unrestricted, use, rather than some physical or engineering maximum (IOTC-2008-SC-INF02).

capacity within their fleet development plans. This suggests that fishing capacity management alone is not adequate to manage the fisheries within IOTC. This reflects the conclusions derived globally.

174. Australia, working with the Secretariat is providing funds for an external study to explore fishing capacity in the IOTC area. This will be similar to the studies conducted in the WCPFC area (IOTC-2008-INF05 and INF08). Terms of reference are currently being finalised and project is expected to start by April 2009.

175. The SC recommended to the Commission that a working party be set up to further consider the matter of fishing capacity for the purposes of the Commission. To this end the SC drafted a terms of reference for this working party for the consideration of the Commission at its next meeting (Appendix IX).

11. SCHEDULE OF WORKING PARTY MEETINGS IN 2009

176. The SC agreed to the following schedule of working party meetings for 2009 and recommended that it be put before the Commission for endorsement.

Working Party	Date and place	Major topics to be covered
Billfish	6 to 10 July. Seychelles.	• Stock assessment for swordfish • Review stock indicators for marlins and sailfish
Ecosystems and Bycatch	12 to 14 October (3 days), Seychelles	• Review data available at the Secretariat • Review availability of observers data • Analysis of new information on sharks, seabirds, sea turtles and sea mammals • Consideration of ecosystem approaches (including ERA)
Tropical Tunas	15 to 23 October (5 days), Seychelles	• Stock assessment for yellowfin tuna • Stock assessment for skipjack tuna • Stock assessment for bigeye tuna • External analyses from tagging data (15 October)
Fishing Capacity	22 October (1 day), Seychelles	• to be determined by the Commission
Neritic tunas	To be advised	-

12. OTHER MATTERS

12.1 ACTIVITY REPORT ON THE LONGLINE FLEET FROM TAIWAN,CHINA

177. The SC noted a presentation (IOTC-2008-SC-INF31) on the activities of the longline fleet from Taiwan, China. The SC thanked the invited Experts for this update.

12.2 DISCUSSION ON IMPROVING/UPDATING FORMATS FOR THE PROVISION OF ADVICE

178. The SC was informed by the Executive Secretary of plans by the Secretariat to improve a range information outputs, including:

- Data summaries: the old hardcopy document is to replaced with a dynamic information system on line from the IOTC web site
- Executive Summaries: an iterative process will be used to update the Executive Summaries to include references that will allow readers to have on-line access to the supporting documents.
- ASFA: a complete set of IOTC documents up to the end of 2008 will be posted in ASFA in the near future.

179. The SC recommended that the Secretariat process the ASFA references such that they are updated on an annual basis.

180. The SC stressed the need to have the data summary interface and recommended that the Secretariat secure the funds for this work to be completed in 2009.

181. The SC was reminded by the Executive Secretary about the growing demand for IOTC information from a wide range of stakeholders, including Members, industry groups, NGO's and the public. The SC acknowledged the need for the technical outputs of the Commission to be disseminated in a more user-friendly format. To this

end, the SC agreed to the inclusion of a Stock Status summary in the SC Report, and the production of facts sheets. The SC requested that the facts sheets would be developed in consultation with the SC.

182. The SC noted that some IPTP documents are not readily available to all IOTC members and recommended that the Executive Secretary make arrangements so that the documents become available to all IOTC members.

183. The SC noted the recent release of the Atlas of Tuna Fisheries and Resources in Indonesia (Indian Ocean) (IOTC-2008-SC-INF06).

12.3 EU PROJECT TXOTX (TECHNICAL EXPERTS OVERSEEING THIRD COUNTRY EXPERTISE)

184. The SC noted a presentation (IOTC-2008-SC-INF33) on the three year TXOTX project that started in September 2008 will support the development of a network of fisheries research between 12 member institutions, with the aim to improve coordination of research programmes. The network is expected to increase knowledge on fisheries resources in support to the formulation of scientific and technical advice in members and will improve dialogue with research communities, policy-makers and stakeholders in the concerned geographic areas. The Seychelles Fisheries Authority and AZTI will be responsible with respect to IOTC activities.

12.4 SOUTH WEST INDIAN OCEAN FISHERIES PROJECT

185. An update on the progress of the South West Indian Ocean Fisheries Project (SWIOFP) was provided to the Scientific Committee on behalf of the Project's Interim Regional Executive Secretary (IOTC-2008-SC-INF32). Following the Project's launch in mid-2008, most of the first year activities will focus on data collation and gap analyses for each of the components, including that for pelagic resources. A joint cruise by SWIOFP and the Agulhas Somali Current Large Marine Ecosystem (ASCLME) programme (with the EAF-Nansen Programme) in support of studies on the role of meso-scale eddies in the production and catchability of large pelagics in the Mozambique Channel constitutes the only field activity in 2008. The presentation noted the synergies between IOTC and SWIOFP/ASCLME in terms of furthering knowledge on pelagic species and for strengthening ecosystem approaches to fisheries management.

12.5 SOUTH WEST INDIAN OCEAN FISHERIES COMMISSION

186. SWIOFC updated the SC on the 3rd Session of SWIOFC Scientific Committee held in Mozambique, 16- 19 September, 2008. Of note was that SWIOFC members are taking steps to ensure catches from foreign fleets are separated from to the national statistics reported to FAO. The two projects: ASCLME that is undertaking an environmental baseline assessment of the Agulhas and Somali Current Large Marine Ecosystems in order to capture existing information relevant to their management; identify and fill information gaps needed to improve LME-based management decision-making in the two LMEs; and ascertain the role of external forcing functions (such as the Mascarene Plateau and the South Equatorial Current) and SWIOFP (see above) are considered to be of direct benefit to the SWIOFC provide an opportunity for complementing the work of the Scientific Committee of the IOTC. This can be achieved through the collaboration between IOTC and SWIOFC. Specific cooperation could be forged in the area of the data and information sharing on artisanal and sports fisheries with regard to billfish, neritic tuna, sharks and sea turtles.

187. The SC reiterated its interest in working with regional organisations such as SWIOFC and agreed that it would be advantageous to hold relevant IOTC meetings in conjunction with SWIOFC meeting to take advantage of the presence of SWIO scientists that may otherwise not be able to attend IOTC meetings.

12.6 ELECTION OF A CHAIR

188. The current Chair of the SC, Dr Francis Marsac, was unanimously re-elected as Chair of the SC for the next biennium. Dr Tom Nishida was re-elected as Vice Chair.

12.7 TIME AND PLACE FOR THE NEXT SESSION OF THE SCIENTIFIC COMMITTEE

189. The Scientific Committee recommended that its Twelfth Session be held from 30 November to 4 December 2009 in Seychelles and asked the Commission to consider holding its annual session not more than three months after this time in order to be able to receive the most up-to-date advice and implement management measures in a timely fashion.

13. Summary of Recommendations made in 2008

13.1 Recommendations – on data and research

190. The following recommendations relate mainly to data and research the activities of the working parties and national scientists and should be considered as priority items compared to the complete list of data and research activities recommended by the working parties (Appendix VI).

1. Further to the recruitment of the Stock Assessment Expert, some SC members sought clarification of the process to be used to identify the annual work plan of the incumbent. Following discussions the Scientific Committee recommended a set of guidelines for the duties of the Stock Assessment Expert and procedures related to stock assessments. These are given in Appendix IV. (Paragraph 8)

2. The SC recommended that, the interaction and collaboration of IOTC scientists and external scientists continue, and when required, external experts be invited to IOTC technical meetings. (Paragraph 10)

3. The SC endorsed the data-related recommendations made by the IOTC working parties in 2008 and these are included in Appendix IV. (Paragraph 16)

4. The SC noted that the annual unloadings of albacore that is reported by Mauritius have, in several years during the last decade, equated to close to the total catches estimated for the Indian Ocean. The SC recommended that Mauritius provide the Secretariat with a breakdown of albacore catches by flag so these data can be compared with the reports from the flag countries. (Paragraph 24)

5. The SC also noted that Japan has not yet reported bycatch data for its fisheries. Japan informed the SC that this information will be provided in the near future. The SC recommended that in order to build a historical shark catch series for the Japanese longline fleet, Japan should examine all its data sources; in particular data obtained from its training vessels. Japan informed the SC that it would investigate this matter. (Paragraph 27)

6. The SC recommended the continued development of growth models using the information from tagging data and new age data from validated otolith readings, and to continue the tag recovery effort in order to have more information on large sized fish, including Linf and the between individual variability of this parameter. (Paragraph 36)

The SC noted that the WPTDA made a range of recommendations in support of the October meeting of the WPTT. These included: to undertake external analysis to provide the parameters for ASPM, to run movement and attrition models and to develop a model to estimate the number of tagged fish that could still be available for recapture. The WPTDA also recommended that an integrated model (such as CASAL, Multifan-CL or SS3) be attempted for the assessment of the yellowfin tuna as they can integrate fisheries statistics and the tagging data.

7. The SC strongly recommended that external analyses using the tag-recovery data continue to be pursued. (Paragraphs 39-40)

8. The SC endorsed the WPTDA’s data and research recommendations (reproduced as Appendix VI) and commended it for its work in 2008. (Paragraph 43)

9. The SC recommended that work on stock indicators of other billfish species such as marlins be continued as no stock assessments or robust CPUE indices are available. Istiophorids might be a matter of serious concern as major and continuous trends of nominal CPUE in historical hot spots for these species were presented in the WPB report. The SC recognised that further work is needed on this matter as to which degree these indicators represent abundance. (Paragraph 49)

10. The SC recommended that more information on billfish from sport and artisanal fisheries be collected. (Paragraph 50)

11. Kenya informed the SC that they have tag release data for billfish. The SC was also informed that significant

number of tag recapture data exist on billfish from the Indian Ocean among billfish experts out of the region. The SC recommended that the IOTC Secretariat collect all the data already immediately available and approach the major sport fishing bodies in the Indian Ocean regarding access to any other available data sets for use by scientists. (Paragraph 51)

12. The SC endorsed the WPB's data and research recommendations (reproduced as Appendix VI) and commended it for its work in 2008. (Paragraph 52)

13. The SC recommended that the WPEB report to the Scientific Committee in 2009 on the levels of seabird and sea turtle mortality due to the fishing methods, longline, gillnet and purse seine. (Paragraph 60)

14. The SC noted a range of ongoing problems related to sea turtles and recommended that that the following research be undertaken: (Paragraph 65)

- Recording of basic data on incidentally caught turtles (e.g. location, carapace size, species identification if possible), with a view to enhancing knowledge of the juvenile life stage.
- Ongoing research to test the efficacy of circle hooks in reducing sea turtle mortality.
- Estimate the levels of sea turtle mortality due to various fishing methods, including long line, gillnets and purse seine.
- Describe the sources and scale of ghost fishing taking place in the Indian Ocean.

15. The SC recommended that future research on marine mammals be encouraged. Some recommendations for future work in this area included: (Paragraph 68)

- Analysis of purse-seine fishery log-books to elucidate marine mammal diversity and distribution within the IOWS. This work should build on the work on baleen whales by Robineau (1991) using data from the period 1982 to 1985
- Review the existing marine mammal data in the IOTC databases
- Encouragement of national scientists to make reports on the sightings made by observers of all marine mammals observed in operations within the IOTC.

16. The SC endorsed the WPEB's data and research recommendations (reproduced as Appendix VI) and commended it for its work in 2008. (Paragraph 73)

17. The Scientific Committee endorsed the WPTT's data and research recommendations (reproduced as Appendix VI) and commended it for its work in 2008. (Paragraph 89)

18. In addition, the SC recommended that the priority matters for WPTT to address at its 2009 meeting should be to undertake, in the following order, revised stock assessments for yellowfin and bigeye tuna, and implement a first assessment of skipjack tuna. (Paragraph 90)

19. The SC strongly endorsed the WPM recommendation that IOTC work on methods should be carried out in conjunction with other tuna commissions; and that the establishment of channels of communication among interested parties on the various tuna commissions should be explored by both the Chairman and the Secretariat. (Paragraph 93)

20. The SC endorsed the WPM recommendations given in (reproduced as Appendix VI) and commended it for its work in 2008. (Paragraph 96)

21. The SC endorsed the WPTe's data and research recommendations (reproduced as Appendix VI). (Paragraph 100)

22. In an effort to ensure that the meeting is held in 2009, the SC recommended that the Caretaker Chair of the Neritics Working (Dr Somvanshi, India) be asked to try to identify potential participants so as to secure a minimum number of 15 participants from as many countries as possible for this meeting. (Paragraph 102)

23. The SC recognized that estimation of the reporting rate is an essential element for the use of tagging data in stock assessments. The tag seeding activities continued in 2008 and to date more than 2900 tags have been seeded onboard the purse-seine fleet based in Seychelles. In 2008, 350 tags were seeded and the seeding activities will last until the end of the recoveries. . The SC recommended that tag seeding experiments continue till the end of the recovery activities to follow up on the reporting rates, and that all efforts be made by the members having longline fleets to recover the tags. (Paragraph 159)

13.2 RECOMMENDATIONS TO THE COMMISSION - GENERAL

191. The following recommendations are addressed specifically to the Commission and/or relate to the work of the Secretariat.

24. The SC acknowledged the imminent recruitment of a stock assessment expert as part of the permanent staff of the Secretariat; however, notwithstanding this valuable addition to the staff, considering the current needs of the Scientific Committee, it recommended to the Commission that the following additional staff be recruited as soon as possible (Paragraph 7):

- A Science Officer – given the large amount of work to done in support of the WPs and capacity building in developing countries, the SC agreed in the short-term a additional professional scientist be recruited to assist the stock assessment expert.
- A Communications Expert / Scientific Editor – the Executive Secretary informed the SC of the growing demand of IOTC information from a wide range of stakeholders, including Members, industry groups, NGO's and the public. The SC acknowledged the need for the Secretariat to have the services of a Communications expert / Scientific Editor who main job would be to disseminate the technical outputs of the Commission results in an appropriate range of user friendly formats to the various stakeholders.
- A Fisheries Statistician - given the large amount of work to done in support of the WPs and capacity building in developing countries (with respect to sampling and data management and reporting), the SC agreed that an additional professional be recruited to assist the current data coordinator

25. Recognising that accurate data on bycatch can only be obtained through observer programs, the SC strongly recommended that the Commission mandate the WPEB (through the Scientific Committee) to develop regional standards covering data collection, data exchange, training and the development of guidelines for operational aspects of a regional observer program including the standardization of sampling protocols. (Paragraph 55)

26. Of special note, the SC recommended a range of technical points relating to IOTC Resolution 05/07 *Concerning a management standard for the tuna fishing vessels*, to deploy if appropriate, scientific observers on-board vessels according to the Commission's Resolution: (Paragraph 56)

   i. All the major fleets should be covered and the minimum levels of coverage should be such that estimates of total catch have an acceptable precision, including those for rare species;

   ii. Observers should focus on recording information on discards as the windows of opportunity for obtaining this information are much shorter than those for obtaining information on target species (some of which can be collected at the dock).

   iii. The SC also agreed that an observer program should aim to assist members, especially those with major bycatch issues, to improve their bycatch data collection and reporting, particularly on marine turtles and seabirds;

   iv. The development of a regional observer program should be based on models in place, or in development by other RFMO's, including the WCPFC, CCAMLR and CCSBT to ensure, as far as possible, consistency and the harmonization of protocols to avoid burdensome observer training requirements and to reduce as much as possible multiple reporting formats for countries that are members of multiple RFMOs;

   v. That a high level of regional coordination be provided by the Commission covering data collection, data exchange, training and the development of guidelines for the operational aspects of such a programme.

27. In response to the Commission's request for more information on the technical aspects of IOTC Resolution

05/05 *Concerning the conservation of sharks caught in association with fisheries managed by IOTC*, specifically paragraph 4 "CPC's shall require their vessels to not have onboard fins that total more than 5% of the weight of sharks onboard, up to the first point of landing. CPC's that currently do not require fins and carcasses to be offloaded together at the point of first landing shall take the necessary measures to ensure compliance with the 5% ratio through certification, monitoring by an observer, or other appropriate measures", the SC recommended that the Commission notes that: (Paragraph 57)

i. Though not specified in Resolution 05/05, the SC is of the opinion that the adoption of this management measure appears to be in response to concerns about the threats to shark populations from fishing and the practice of shark finning;

ii. The current percentage fins:body weight ratio requirement has no clear scientific basis as a conservation measure for sharks in the Indian Ocean, rather it appears to be aimed at slowing down the rate of fishing or to deter fishing on sharks by not allowing fins only to be landed and requiring vessels to return to port more often to unload fins and body parts;

iii. Maintaining the use of the fin:body weight ratios will preclude the collection of essential information on species-level interactions with fishing fleets, crucial for accurate stock assessments for sharks;

iv. Current scientific evidence clearly indicates that percentage fins:body weight varies widely among species, fin types used in calculations, the type of carcass weight used (whole or dressed), and the method of processing used to remove the fins (fin cutting technique);

v. It was recognised that the best way to guarantee that sharks are fully utilised is to require that the trunks be landed with the fins attached, and if fully implemented, this would facilitate the collection of data that would be highly beneficial in shark stock assessments (e.g. data on species, sex ratios, numbers and size distributions of catches), that the Commission may require from the SC (Table 2);

vi. The ultimate production of shark stock assessments would then underpin any future conservation and management actions;

vii. The SC agreed that operational factors (e.g. storage methods and product processing) are likely to make a requirement for the natural attachment of fins to the shark carcass difficult for some smaller operators to apply.

viii. The SC agreed that all fins landed should be able to be matched to a carcass. In the cases where fins have been removed from the body prior to the landing, the SC agreed that they should be stored in such a way that they can be immediately cross-referenced to the carcasses – for example, they may be numbered and wired or bagged together they may be numbered or tagged for identification between carcasses and fins

28. The SC recommended that the fin:body weight ratio measure be replaced with a resolution that requires shark fins to be landed attached to the body, either naturally, or by other means.(Paragraph 58)

29. The SC recommended that net material used on FADs should be replaced with materials such as non-plastic ropes or non-plastic hoods or straps that will not entangle sea turtles. (Paragraph 63)

30. The SC also recommended that the Secretariat produce a book of sea turtle identification material for the Indian Ocean. (Paragraph 64)

31. The SC noted that the WPEB had been given an overview of the Ecological Risk Assessment (ERA) project being undertaken in the Pacific Ocean. The purpose of the ERA project is to identify bycatch species at relatively high risk of adverse effects due to fishing, so that the WCPFC can prioritise management actions for such species or further research to quantify in more detail the effects of fishing. The SC recommended that a preliminary examination of the feasibility of undertaking an Ecological Risk Assessment process for IOTC fisheries be undertaken by the Secretariat, in collaboration with WCPFC and ICCAT, and to report on this to the working party in 2009. The SC also recommended that the Secretariat seek funding for this inter-sessional work if necessary. (Paragraph 69)

32. The SC noted that the number of fish tagged has been more than the double of the target and that the funds allocated for the payment of the rewards to the fishermen are likely to run out. It strongly recommended that the recovery activity are maintained through the year 2009 and that funds are made available to the Secretariat to pay additional rewards for tags that will be recovered after the dedicated funds are exhausted. (Paragraph 161)

33. The SC recommended that a final IOTC Tagging Symposium should be held in the second half of 2010. The symposium is expected to take five days and target a wide range of people, including fishermen, scientists, fishery administrators, media, concerned with the IOTC tagging programme and/or the conservation of tropical tunas in the Indian Ocean. It is envisaged that the IOTC would invite and pay for the participation to the symposium of scientists from all interested coastal countries. Selected international tagging experts will also be invited and sponsored by the IOTC. The symposium will have various major goals. (Paragraph 162)

34. The SC recommended to the Commission that a working party be set up to further consider the matter of fishing capacity for the purposes of the Commission. To this end the SC drafted a terms of reference for this working party for the consideration of the Commission at its next meeting (Appendix IX). (Paragraph 175)

35. The SC agreed to the schedule of working party meetings for 2009 and the major topics to be covered, and recommended that it be put before the Commission for endorsement. (Paragraph 176) Five working party meetings are scheduled: billfish, ecosystems and bycatch, tropical tunas, fishing capacity and neritic tunas (see Section 11 for more information).

36. The SC recommended that the Secretariat process the ASFA references such that they are updated on an annual basis. (Paragraph 179)

37. The SC stressed the need to have the data summary interface and recommended that the Secretariat secure the funds for this work to be completed in 2009. (Paragraph 180)

38. The SC noted that some IPTP documents are not readily available to all IOTC members and recommended that the Executive Secretary make arrangements so the documents become available to all IOTC members. (Paragraph 182)

39. The Scientific Committee recommended that its Twelfth Session be held from 30 November to 4 December 2009 in Seychelles and asked the Commission to consider holding its annual session not more than three months after this time in order to be able to receive the most up-to-date advice and implement management measures in a timely fashion. (Paragraph 189)

13.3 RECOMMENDATIONS TO THE COMMISSION – ON THE STATUS OF THE STOCKS

192. The following recommendations were extracted from Section 8 of this report. A table summarising the status and management advice relating to the IOTC species is provided in the Executive Summary of this report (Page 4).

TUNAS

ALBACORE TUNA (*Thunnus alalunga*)

40. The Scientific Committee acknowledges the preliminary nature of the albacore tuna assessment in 2008, but on balance of the available stock status information and stable effort considers that the status of the stock of albacore is not likely to change markedly over the next 2-3 years and if the price of albacore remains low compared to other tuna species, no immediate action should be required on the part of the Commission. The Scientific Committee recommend that a new albacore tuna assessment be presented to the Scientific Committee at the latest in 2010.

BIGEYE TUNA (*Thunnus obesus*)

41. In view of the most current assessment, the Scientific Committee recommended that catches should not exceed the MSY and fishing effort should not increase further from the 2004 levels.

SKIPJACK TUNA (*Katsuwonus pelmis*)

42. The high productivity life history characteristics of skipjack tuna suggest this species is resilient and not prone to overfishing, and the stock status indicators indicate that there is no need for immediate concern about the status of skipjack tuna.

YELLOWFIN TUNA (*Thunnus albacares*)

43. Although important progress in the quality and quantity of analyses conducted, there remain uncertainties in the application of the models that prevented the SC from determining the current status of yellowfin tuna in a precise way. Nevertheless, most of the analyses conducted coincide in indicating that the stock is very close to an overfished state, or already overfished, and that the exploitation rate in recent years has exceeded the optimal level.

44. Therefore, the SC recommends that the catch of yellowfin tuna does not exceed the average catch for the period 1998-2002 (i.e. 330,000 t) when catches were stable, prior to the exceptional years of 2003-2006 when the stock might have been overexploited. Similarly, the Scientific Committee recommends that the fishing effort does not exceed the level exerted in 2007 when the catch of yellowfin tuna returned to the pre-2003 levels.

SOUTHERN BLUEFIN TUNA (*Thunnus maccoyii*)

45. Managed by CCSBT.

BILLFISH

SWORDFISH (*Xiphias gladius*)

46. The SC considers that the catches should not increase above the 2006 levels and fishing effort should not increase from the 2007 levels. Furthermore, management measures focussed on controlling and/or reducing effort, especially in the south-west Indian Ocean are recommended.

BLACK MARLIN (*Makaira indica*)

47. No quantitative stock assessment is currently available for black marlin in the Indian Ocean, and due to a lack of fishery data for several gears, only preliminary stock indicators can be used. Therefore the stock status is uncertain.

BLUE MARLIN (*Makaira nigricans*)

48. No quantitative stock assessment is currently available for blue marlin in the Indian Ocean, and due to a lack of fishery data for several gears, only preliminary stock indicators can be used. Therefore the stock status is uncertain.

STRIPED MARLIN (*Tetrapturus audax*)

Recommendation

49. No quantitative stock assessment is currently available for striped marlin in the Indian Ocean, and due to a lack of fishery data for several gears, only preliminary stock indicators can be used. Therefore the stock status is uncertain.

INDO-PACIFIC SAILFISH (*Istiophorus platypterus*)

50. No quantitative stock assessment is currently available for Indo-Pacific sailfish in the Indian Ocean, and due to a paucity of data there a no stock indicators that are considered to be reliable, therefore the stock status is uncertain.

NERITIC TUNAS

BULLET TUNA (*Auxis rochei*)

51. No quantitative stock assessment is currently available for bullet tuna in the Indian Ocean, therefore the stock status is uncertain. The SC notes the catches of bullet tuna are typically variable but relatively low compared to the other neritic species. The reasons for this are not clear: it may be problem related to reporting, or it may be a normal fluctuation in the fishery. Bullet tuna is a relatively productive species with high fecundity and rapid growth and this makes it relatively resilient and less prone to overfishing. Nevertheless, bullet tuna appears to be an important prey species for other pelagic species including the commercial tunas, therefore it should be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

FRIGATE TUNA (*Auxis thazard*)

52. No quantitative stock assessment is currently available for the frigate tuna in the Indian Ocean, therefore the stock status is uncertain. This species is a relatively productive species with high fecundity and rapid growth and this makes it relatively resilient and not prone to overfishing. Nevertheless, frigate tuna appears to be an important prey species for other pelagic species including the commercial tunas, therefore it should be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

INDO-PACIFIC KING MACKEREL (*Scomberomorus guttatus*)

53. No quantitative stock assessment is currently available for the Indo-Pacific king mackerel in the Indian Ocean, therefore the stock status is uncertain. This species is a relatively productive species with high fecundity and rapid growth and this makes it relatively resilient and not prone to overfishing. The SC recommends Indo-Pacific king mackerel be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

KAWAKAWA (*Euthynnis affinis*)

54. No quantitative stock assessment is currently available for kawakawa in the Indian Ocean, therefore the stock status is uncertain. The SC notes the decline in the catches since 2002. However, the reasons for this are not clear: it may be problem related to reporting, or it may be a normal fluctuation in the fishery — a similar decline occurred in the early 1990's. Nevertheless, the SC recommends that this species be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

LONGTAIL TUNA (*Thunnus tonggol*)

55. No quantitative stock assessment is currently available for longtail tuna in the Indian Ocean, therefore the stock status is uncertain. The SC notes the decline in the catches since 2000. However, the reasons for this are not clear: it may be problem related to reporting, or it may be a normal fluctuation in the fishery — similar declines occurred in the mid 1980's, early 1990's and mid 1990's. Nevertheless, the SC recommended that this species be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

NARROW-BARRED SPANISH MACKEREL (*Scomberomorus commerson*)

56. No quantitative stock assessment is currently available for narrow-barred Spanish mackerel tuna in the Indian Ocean, therefore the stock status is uncertain. The SC notes that Spanish mackerel is a relatively productive species with high fecundity and this makes it relatively resilient and less prone to overfishing; however, it recommends that this important species be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

14. ADOPTION OF THE REPORT

193. The Report of the Eleventh Session of the Scientific Committee was adopted on Friday 5 December 2008.

APPENDIX I
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APPENDIX II
AGENDA OF THE IOTC SCIENTIFIC COMMITTEE –11TH SESSION

(for more information refer to the annotated agenda, document IOTC-2008-SC-01)

1. **Opening of the Session**
2. **Adoption of the Agenda and arrangements for the Session**
3. **Admission of observers**
4. **Update on Commission and secretariats activities**
5. **Data Collection and Statistics**
6. **Presentation of National Reports**
7. **reports on 2008 working party meetings**

   TAGGING DATA ANALYSIS (IOTC-2008-WPTDA-R)

   BILLFISH (IOTC-2008-WPB-R)

   ECOSYSTEMS AND BYCATCH (IOTC-2008-WPEB-R).

   TROPICAL TUNAS (IOTC-2008-WPTT-R).

   METHODS (IOTC-2008-WPM-R).

   TEMPERATE TUNAS (IOTC-2008-WPTE-R).

   NERITIC TUNAS.
8. **Status of Tuna and Tuna-like resources in the Indian Ocean**

   TUNAS (IOTC-2008-SC-03)

   BILLFISH (IOTC-2008-SC-04)

   OTHER SPECIES
9. **Activities in relation with the Indian Ocean Tuna Tagging Programme**
10. **Discussion on fishing capacity**

    (IOTC-2008-SC-INF01, INF02, INF03, INF04, INF05, INF08)
11. **Schedule of Working Party meetings in 2009**
12. **Other matters**

    DISCUSSION ON IMPROVING/UPDATING FORMATS FOR THE PROVISION OF ADVICE

    Data summaries, referenced based Executive Summaries, stock status summaries, fact sheets
    Access to documents (IOTC, IPTP)

    EU PROJECT TXOTX (TECHNICAL EXPERTS OVERSEEING THIRD COUNTRY EXPERTISE)

    SOUTH WEST INDIAN OCEAN FISHERIES PROGRAMME (SWIOFP) – UPDATE

    ELECTION OF CHAIRPERSON
13. **Adoption of the Report**

APPENDIX III
LIST OF DOCUMENTS / LISTE DES DOCUMENTS

Reference / Référence	Title / Titre
IOTC-2008-SC-01	[E] Draft agenda for the Scientific Committee - 2008 [F] Ordre du jour prévisionnel de la Comité scientifique - 2008
IOTC-2008-SC-02	[E + F] List of documents / Liste des documents
IOTC-2007-SC-03, rev1	[E+F] Executive summaries of the status of the major Indian Ocean tunas. *IOTC Secretariat* / Résumés exécutifs sur l'état des principaux thons de l'ocean Indien. *Secrétariat de la CTOI*
IOTC-2008-SC-04, rev1	[E+F] Executive summaries of the status of Indian Ocean billfish / Résumés exécutifs sur l'état des poissons porte-epees de l'ocean Indien. *IOTC Secretariat / Secrétariat de la CTOI*
IOTC-2008-SC-05	[E+F] Executive summaries of the status of Indian Ocean neritic tunas / Résumés exécutifs sur l'état des thons nérétiques de l'ocean Indien. *IOTC Secretariat / Secrétariat de la CTOI*
IOTC-2008-SC-06, rev1	[E+F] Executive summaries of the status of the Indian Ocean sharks and sea turtles / Synthèses sur l'état des ressources de requins et des tortues de mer de l'océan Indien. *IOTC Secretariat / Secrétariat de la CTOI*
IOTC-2008-SC-07	[E] Report on IOTC data collection and statistics. *IOTC Secretariat* [F] Rapport de la CTOI sur la collecte des données et des statistiques - provisoire. *Secrétariat de la CTOI*
IOTC-2008-SC-08	[E] A review of the ICCAT experience on tuna fishing capacity assessment and management. *H. Murua, P. de Bruyn and H. Arrizabalaga.* [F] Un examen de l'expérience de l'ICCAT sur l'évaluation et la gestion de la capacité de pêche au thon. *H. Murua, P. de Bruyn and H. Arrizabalaga.*
IOTC-2008-WPEB-R	[E] Report of the Fourth Session of the IOTC Working Party on Ecosystems and Bycatch [F] Rapport de la quatrième session du groupe de travail de la CTOI sur les écosystèmes et les prises accessoires.
IOTC-2008-WPM-R	[E] DRAFT Report of the Third Session of the IOTC Working Party on Methods [F] Projet Rapport de la 3e session du Groupe de travail de la CTOI sur la méthodologie
IOTC-2008-WPTe-R	[E] Report of the Second Session of the IOTC Working Party on Temperate Tunas [F] Rapport de la seconde session du groupe de travail de la CTOI sur les thons tempérés
IOTC-2008-WPTT-R	[E] Report of the Tenth Session of the IOTC Working Party on Tropical Tunas. [F] Rapport de la 10e session du Groupe de travail de la CTOI sur les thons tropicaux
IOTC-2008-WPB-R	[E] Report of the Sixth Session of the IOTC Working Party on Billfish [F] Rapport de la sixième session du Groupe de travail de la CTOI sur les poissons porte-épées
IOTC-2008-WPTDA-R	[E] Report of the First Session of the IOTC Working Party on Tagging Data Analysis [F] Rapport de la première session du groupe de travail de la CTOI sur l'analyse des données de marquage
Information papers	
IOTC-2008-SC-INF01	Bayliff, W.H.; Leiva Moreno, J.I. de; Majkowski, J. (eds.) Second Meeting of the Technical Advisory Committee of the FAO Project "Management of Tuna Fishing Capacity: Conservation and Socio-economics". Madrid, Spain, 15–18 March 2004. FAO Fisheries Proceedings. No. 2. Rome, FAO. 2005. 336p.
IOTC-2008-SC-INF02	Bayliff, W.H.; Majkowski, J. (eds.) Methodological Workshop on the Management of Tuna Fishing Capacity: Stock Status, Data Envelopment Analysis, Industry Surveys and Management Options. La Jolla, California, United States of America, 8–12 May 2006. FAO Fisheries Proceedings. No. 8. Rome, FAO. 2007. 218p.
IOTC-2008-SC-INF03	Methods to estimate fishing capacity, using stock assessment information: sensitivity tests and application to Pacific, Atlantic and Indian Ocean tuna stocks. *H. Arrizabalaga*
IOTC-2008-SC-INF04	Workshop to Further Develop, Test and Apply a Method for the Estimation of Tuna Fishing Capacity from Stock Assessment-Related Information La Jolla, California, USA. 14-16 May 2007
IOTC-2008-SC-INF05	A survey of purse seine fishing capacity in the Western and Central Pacific Ocean 1998-2003. Prepared by Gillett, Preston and Associates Vanuatu for the U.S. Department Of Commerce National Oceanic and Atmospheric Administration National Marine Fisheries Service Pacific Island Region Administrative Report AR-PIR-03-04.
IOTC-2008-SC-INF06	Atlas of Tuna Fisheries and Resources in Indonesia (Indian Ocean). *Eddrisea, F., Duto, N., Fujiwara, S., Itoh, K., and Nishida, T.* (Note this is a hard copy document only)
IOTC-2008-SC-INF07	National Report. 2008 UE-Spain
IOTC-2008-SC-INF08	Report of a Survey to Establish the Capacity of Longline and Pole-and-Line Fleets in the Western and Central Pacific Ocean Prepared by Gillett, Preston and Associates for the U.S. Department of Commerce National Oceanic and Atmospheric Administration National Marine Fisheries Service Pacific Island Region Administrative Report AR-PIR-07-01.
IOTC-2008-SC-INF09	Australia National Report
IOTC-2008-SC-INF10	The joint IOTC-OFCF Project Report 2008
IOTC-2008-SC-INF11	UE-France - rapport national.
IOTC-2008-SC-INF12	United Kingdom National Report.
IOTC-2008-SC-INF13	Report on biology, stock status and management of southern bluefin tuna: 2008. *CCSBT*
IOTC-2008-SC-INF14	State of selected stocks of tuna and billfish in the pacific and indian oceans. FAO Fisheries Technical Paper No. 200.
IOTC-2008-SC-INF15	Report of The Workshop on Stock Assessment of Yellowfin Tuna in the Indian Ocean. Colombo, Sri Lanka 7 - 12 October 1991. Indo- Pacific Tuna Development and Management Programme
IOTC-2008-SC-INF16	Seychelles National Report 2008
IOTC-2008-SC-INF17	National Report of South Africa
IOTC-2008-SC-INF18	National Report of Mauritius

Reference / Référence	Title / Titre
IOTC-2008-SC-INF19	National Report of Japan
IOTC-2008-SC-INF20	National Report of Korea
IOTC-2008-SC-INF21	Chinese tuna longline fishery in the Indian Ocean in 2007
IOTC-2008-SC-INF22	National Report of Kenya (2008)
IOTC-2008-SC-INF23	Status of IOTC databases for neritic tunas. *IOTC Secretariat*
IOTC-2008-SC-INF24	MADE: Mitigating adverse ecological impacts of open ocean fisheries. *L. Dagorn*.
IOTC-2008-SC-INF25	Status of Whale Sharks Around Seychelles. [Power Point presentation] *D. Rowat , C. W. Speed, M. Gore, M. G. Meekan, I. R. Lawler, C. J.A. Bradshaw*.
IOTC-2008-SC-INF26	National Report of Thailand
IOTC-2008-SC-INF27	Updated analysis of the SFA 2008 PS data: 2008 effects of the closed area in Somalia
IOTC-2008-SC-INF28	Shimizu June 1979: 30 years after, what's new in the IO, in terms of stock status and fisheries? [Power Point presentation] *A. Fonteneau*
IOTC-2008-SC-INF29	A summarized presentation of the report of the 2nd IOTC WP of the albacore meeting held in Bangkok, November 1st 2008. [Power Point presentation]. *A. Fonenteau*
IOTC-2008-SC-INF30	Report of a workshop on a rights-based management and buybacks in international tunas fisheries. La Jolla, USA – 5-9 May 2008.
IOTC-2008-SC-INF31	Brief report on Taiwanese tuna longline fisheries operating in the Indian Ocean.
IOTC-2008-SC-INF32	South West Indian Ocean Fisheries Project (SWIOFP). *A fisheries research and management module within a Large Marine Ecosystem (LME) framework. J. Robinson for SWIOFP*
IOTC-2008-SC-INF33	TXOTX Fisheries research network [Power Point presentation]. *H. Murua*

APPENDIX IV
GUIDELINES FOR THE DUTIES OF THE IOTC STOCK ASSESSMENT EXPERT

The Scientific Committee recommended the following set guidelines for the duties of the Stock Assessment Expert (SAE) and related procedures on SA (Stock assessments).

a) SA should be carried out in principle by the Working Parties (WP). In order to assist this task, basic duty for the SAE is to participate in all WP meetings conducting SA and to provide professional advices. SAE would also carry out analytical runs together with the members of WP using the agreed method.
b) If, during WP meetings or SC, specific SA (e.g. integrated models) and related tasks are identified to be conducted before the next WP meetings, WP or SC can request such tasks to SAE. This work should be carried out in close collaboration with interested scientists from the WP.
c) If such requests are submitted intersessionally, a Steering Committee (St. C) will be established (consisted of the Chair of WP and SC, SAE and interested scientists) as early as possible before the WP sessions. The SAE will coordinate the St. C, who will adopt preferred methods, software, data, parameters, sensitivity runs etc. on behalf of WP members.
d) The WP should be kept informed of the progress of the work conducted by SAE and interesting scientists.
e) All the work conducted by SAE and interested scientists should be presented in WP meetings including output & input files, any software developed etc. This information can eventually be placed in the public domain after reviewed by the WP and will remain at the Secretariat for future consultation by any interested scientists.
f) WP scientists can carry out any other SA analyses and present the results in WP meetings. The SAE can present any complementary analyses relevant to the work agreed by the St .C.
g) An important task for SAE is, to the extent possible, to provide trainings on SA models and practical sessions for scientists in member countries in order for them to be able to apply SA models by themselves and/or with SAE.

APPENDIX V
AVAILABILITY OF IOTC STATISTICS FOR THE YEAR 2007

Excerpt from document IOTC-2008-SC-07

Tables 2i-2v (below) list the fleets for which the Secretariat received or estimated catches for the year 2007. The fleets are listed according to the size of their most recent catches. The standing of the catch, effort, size frequency and craft statistics information received is indicated using colours. Timeliness of reporting and data source are also shown. The availability and standing of statistics for tropical tunas (2i), temperate tunas (2ii), billfish (2iii), neritic tunas (2iv) and sharks, seabirds and sea turtles (2v) are presented separately. The availability of statistics on fishing crafts operating for each fleet is also presented in a separate table (2vi).

Timeliness and completeness of data

IOTC statistics were available for 15 countries before the deadline of June 30 (cf. 15 in 2007). Partial statistics were provided in most cases. Requests were sent to over fifty countries[5] in March-April 2008. Second and third requests were needed in most cases. The amount of data available before the deadline was similar than that in 2007.

Table 1 shows the extent to which 2007 catch data was available in the IOTC Nominal Catches (NC) database by the deadline for data submission (30 June) and before the Scientific Committee Meeting (November 2008). 36% of the catch was available by 30 June and 71% of the catch was available by November. The proportion of statistics available for 2006 is shown for comparison. Levels of reporting were generally lower in 2008, especially for nominal catches data.

Late reports compromise the validation, verification and utility of data, especially when data are submitted close to or during Working Party meetings.

Table 1. Proportion of the NC, CE and SF statistics available at the IOTC Secretariat compared to the total catches estimated for 2007 (as of 20th November 2008).

Statistics available for 2007	Estim. Catch	NC		CE		SF	
		BD	SC	BD	SC	BD	SC
IOTC species 1000t	1394	508	986	328	689	405	692
%Available for 2007		**36**	**71**	**24**	49	29	**50**
%Available for 2006		42	79	33	49	31	42
Tropical tunas 1000t	866	372	744	279	570	337	590
Temperate tunas 1000t	41	9	39	9	19	6	9
Billfish 1000t	70	26	53	16	30	2	18
Neritic tunas 1000t	416	101	150	24	70	60	75

Estim. Catch: Total catches estimated. **NC**: Amount of catch available. **CE**: Amount of catch for which catches and effort are available. **SF**: Amount of catch for which size frequency data are available. Available before the deadline for data submission (**BD**, 30th June) and at the time of the Scientific Committee Meeting (**SC**)

[5] Note that specific requests were sent to EC countries having vessels known to operate in the IOTC Area (France, Italy, Portugal, Spain and the UK)

Table 2: Availability of IOTC statistics for the year 2007

Gear	Industrial purse seine (**PS**), industrial longline (**LL**) and artisanal gears (**ART**)		**NC**	Nominal Catch	Fully available
Catch	Recent catches amounting to (thousands of tonnes)		**CE**	Catch and Effort	Partially available
			SF	Size Frequency	Not available
TI	Timeliness	Good (before 1st July)	**SO**	Data Source	Statistics fully available from flag country
		Fair (whithin July)			Statistics partially available from flag country
		Poor (after 1st August)			Statistics available from sources other than flag country

2i – Tropical tunas (Yellowfin, bigeye and skipjack tuna)

Gear	Fleet	Availability of statistics: Catch	Sps	NC	CE	SF	TI	SO	Comments
PS	EUROPEAN COMMUNITY	186.9	SY						Effort from supply vessels not available
	SEYCHELLES	49.7	SY						Effort from supply vessels not available
	THAILAND	11.4	SB						Effort from supply vessels not available
	FRANCE-TERRITORIES	9.1	SY						
	JAPAN	5.8	S						
	IRAN I R	2.8	Y						
	AUSTRALIA	Conf	Y						Data confidential
	NEI	0.1	S						
LL	CHINA	10.0	BY						SF data partially available from observers
	TAIWAN,CHINA	61.9	BY						
	JAPAN	39.6	YB						
	INDONESIA	15.9	YB						NC/SF not available for longliners not based in Indonesia
	SEYCHELLES	7.9	BY						SF not available for deep-freezing longliners
	INDIA	5.6	Y						
	KOREA REP	4.9	YB						SF data partially available from observers
	PHILIPPINES	3.2	BY						CE not available per 5 degrees area
	OMAN	2.2	B						
	MALAYSIA	2.1	YB						Statistics not available for longliners not based in Malaysia
	EUROPEAN COMMUNITY	1.8	BY						Statistics not available for Spain longliners
	TANZANIA	0.4	BY						
	THAILAND	0.2	BY						
	SOUTH AFRICA	0.2	Y						
	BELIZE	0.2	Y						CE not available per 5 degrees area
	MAURITIUS	0.2	Y						
	MADAGASCAR	0.1	YB						
	KENYA	0.0	BY						
	GUINEA	0.0	Y						
	SENEGAL	0.0	Y						
	AUSTRALIA	Conf	Y						Data confidential
	NEI-FROZEN[1]	13.2	YB						
	NEI-FRESH[2]	4.5	BY						
Artisanal	MALDIVES	118.5	SY						CE confidential; SF not available per gear
	SRI LANKA	102.7	SY						CE/SF not available per 5 degrees area
	IRAN I R	81.6	SY						SF not available per 5 degrees area
	INDONESIA	52.2	SY						
	OMAN	17.9	Y						NC not available by gear
	INDIA	16.8	SY						
	YEMEN AR RP	15.9	Y						CE incomplete (only two governorates)
	PAKISTAN	9.2	YS						
	COMOROS	9.1	YS						
	FRANCE-TERRITORIES	0.8	SY						
	TANZANIA	0.6	Y						
	EUROPEAN COMMUNITY	0.1	Y						
	MAURITIUS	0.1	Y						
	KENYA	0.1	Y						NC not by species or gear
	JORDAN	0.1	S						
	UK-TERRITORIES	0.0	Y						CE not available by species
	SEYCHELLES	0.0	Y						
	EAST TIMOR	0.0	Y						
	AUSTRALIA	0.0	Y						CE confidential
	SOUTH AFRICA	0.0	Y						

Sps Yellowfin tuna (Y), bigeye tuna (B) and skipjack tuna (S)
Conf Catches confidential (included in NEI)
1 Vessels whose catches are not reported by their flag states
2 Non-reporting vessels from India and Indonesian vessels operating in countries other than Indonesia

Table 2ii – Temperate tunas (albacore tuna and swordfish)

Gear	Fleet	Availability of statistics: Catch	Sps	NC	CE	SF	TI	SO	Comments
PS	AUSTRALIA	4.8	S	Green	Green	Green	Blue	Blue	CE confidential
PS	EUROPEAN COMMUNITY	0.6	A	Green	Green	Green	Blue	Blue	Effort from supply vessels not available
PS	SEYCHELLES	0.1	A	Green	Green	Green	Blue	Blue	Effort from supply vessels not available
PS	FRANCE-TERRITORIES	0.0	A	Green	Green	Green	Blue	Blue	
LL	CHINA	0.1	A	Green	Green	Red	Yellow	Blue	
LL	TAIWAN,CHINA	16.9	A	Green	Red	Red	Cyan	Blue	
LL	JAPAN	10.0	AS	Green	Green	Red	Cyan	Blue	
LL	INDONESIA	2.8	AS	Orange	Red	Orange	Yellow	Cyan	NC/SF not available for longliners not based in Indonesia
LL	EUROPEAN COMMUNITY	1.4	A	Orange	Orange	Red	Blue	Blue	Statistics not available for Spain longliners
LL	BELIZE	0.7	A	Green	Orange	Red	Blue	Blue	CE not available per 5 degrees area
LL	OMAN	0.6	A	Red	Red	Red	Yellow	White	
LL	KOREA REP	0.5	A	Green	Green	Orange	Yellow	Blue	SF data partially available from observers
LL	SEYCHELLES	0.4	A	Green	Green	Red	Blue	Blue	
LL	MALAYSIA	0.3	A	Orange	Orange	Red	Blue	Blue	Statistics not available for longliners not based in Malaysia
LL	THAILAND	0.2	A	Green	Green	Red	Blue	Blue	
LL	PHILIPPINES	0.2	A	Green	Orange	Red	Blue	Blue	CE not available per 5 degrees area
LL	MAURITIUS	0.1	A	Red	Red	Red	Yellow	White	
LL	SOUTH AFRICA	0.0	A	Green	Green	Green	Yellow	Blue	
LL	MADAGASCAR	0.0	A	Red	Red	Red	Yellow	White	
LL	TANZANIA	0.0	A	Red	Red	Red	Yellow	White	
LL	NEI-FROZEN[1]	0.5	A	Red	Red	Red	Yellow	White	
LL	NEI-FRESH[2]	1.1	A	Red	Red	Red	Yellow	White	
ART	EUROPEAN COMMUNITY	0.0	A	Green	Green	Red	Blue	Blue	

Sps Southern bluefin tuna (S) and albacore (A)
1 Vessels whose catches are not reported by their flag states
2 Non-reporting vessels from India and Indonesian vessels operating in countries other than Indonesia

Table 2iii – Billfish (swordfish, marlins, sailfish and spearfish)

Gear	Fleet	Availability of statistics: Catch	Sps	NC	CE	SF	TI	SO	Comments
LL	CHINA	0.5	S	Green	Green	Red	Yellow	Blue	
LL	TAIWAN,CHINA	10.6	SM	Green	Red	Red	Cyan	Blue	
LL	EUROPEAN COMMUNITY	9.4	S	Orange	Orange	Red	Blue	Blue	Statistics not available for Spain longliners
LL	JAPAN	4.2	SM	Green	Green	Red	Blue	Blue	
LL	INDONESIA	3.1	SM	Orange	Red	Orange	Yellow	Cyan	NC/SF not available for longliners not based in Indonesia
LL	SEYCHELLES	1.1	S	Green	Green	Orange	Blue	Blue	SF not available for deep-freezing longliners
LL	GUINEA	0.8	S	Red	Red	Red	Yellow	White	
LL	MAURITIUS	0.7	S	Red	Red	Red	Yellow	White	
LL	MALAYSIA	0.4	SM	Orange	Orange	Orange	Blue	Blue	Statistics not available for longliners not based in Malaysia
LL	INDIA	0.4	SM	Red	Red	Red	Yellow	White	
LL	KOREA REP	0.4	SM	Green	Green	Orange	Yellow	Blue	SF data partially available from observers
LL	OMAN	0.4	S	Red	Red	Red	Yellow	White	
LL	SOUTH AFRICA	0.3	S	Green	Green	Green	Yellow	Blue	
LL	KENYA	0.2	S	Green	Red	Red	Yellow	Blue	
LL	PHILIPPINES	0.2	S	Green	Orange	Red	Blue	Blue	CE not available per 5 degrees area
LL	SENEGAL	0.1	S	Red	Red	Red	Yellow	White	
LL	TANZANIA	0.1	MS	Red	Red	Red	Yellow	White	
LL	MADAGASCAR	0.1	S	Red	Red	Red	Yellow	White	
LL	BELIZE	0.0	S	Green	Orange	Red	Blue	Blue	CE not available per 5 degrees area
LL	THAILAND	0.0	MS	Green	Green	Red	Blue	Blue	
LL	AUSTRALIA	Conf	Y	Green	Green	Green	Blue	Blue	Data confidential
LL	NEI-FROZEN[1]	1.5	MS	Red	Red	Red	Yellow	White	
LL	NEI-FRESH[2]	2.0	S	Red	Red	Red	Yellow	White	
Artisanal	SRI LANKA	11.9	FM	Green	Orange	Orange	Cyan	Blue	CE/SF not available per 5 degrees area
Artisanal	INDIA	7.8	F	Red	Red	Red	Yellow	White	
Artisanal	IRAN I R	6.2	F	Green	Red	Red	Blue	Blue	
Artisanal	PAKISTAN	3.4	M	Green	Red	Red	Blue	Blue	
Artisanal	INDONESIA	1.7	M	Red	Red	Red	Yellow	White	
Artisanal	TANZANIA	0.9	M	Red	Red	Red	Yellow	White	
Artisanal	YEMEN AR RP	0.6	F	Red	Orange	Red	Cyan	Yellow	CE incomplete (only two governorates)
Artisanal	COMOROS	0.4	F	Red	Red	Red	Yellow	White	
Artisanal	OMAN	0.3	F	Orange	Red	Red	Yellow	Blue	NC not available by gear
Artisanal	MAURITIUS	0.3		Red	Red	Red	Yellow	White	
Artisanal	KENYA	0.2	F	Orange	Orange	Orange	Blue	Blue	Data available from Sport fisheries only
Artisanal	UN ARAB EMIRATES	0.1		Red	Red	Red	Yellow	White	
Artisanal	EUROPEAN COMMUNITY	0.0	M	Green	Green	Red	Blue	Blue	
Artisanal	FRANCE-TERRITORIES	0.0	M	Red	Red	Red	Yellow	White	
Artisanal	SAUDI ARABIA	0.0	F	Red	Red	Red	Yellow	White	
Artisanal	SEYCHELLES	0.0	F	Green	Green	Red	Yellow	Blue	
Artisanal	UK-TERRITORIES	0.0	M	Green	Orange	Red	Yellow	Blue	CE not available by species

Sps Swordfish (S), blue marlin and/or black marlin and/or striped marlin (M), Indo-Pacific sailfish (F) and short-billed spearfish (P)
Conf Catches confidential (included in NEI)
1 Vessels whose catches are not reported by their flag states
2 Non-reporting vessels from India and Indonesian vessels operating in countries other than Indonesia

2iv – Neritic tunas (Frz, Lot, Kaw, Com, Gut)

Gear	Fleet	Availability of statistics					TI	SO	Comments
		Catch	Sps	NC	CE	SF			
PS	IRAN I R	2.3	L						
	AUSTRALIA	1.4	K						Data confidential
	THAILAND	0.3							NC/CE not by species
	SEYCHELLES	0.1	F						Statistics incomplete
	EUROPEAN COMMUNITY	0.1	F						Statistics incomplete
LL	INDONESIA	0.1	W						NC/SF not available for longliners not based in Indonesia
	EUROPEAN COMMUNITY	0.0							Statistics not available for Spain longliners
	CHINA	0.0	W						
	TAIWAN,CHINA	0.0	W						
	SOUTH AFRICA	0.0	W						
	OMAN	0.0	W						
	INDIA	0.0							
	NEI-FROZEN[1]	0.0	W						
	NEI-FRESH[2]	0.0	W						
Artisanal	INDONESIA	117.6	KL						
	INDIA	104.5	CK						
	IRAN I R	60.2	LK						SF not available per 5 degrees area
	MALAYSIA	22.3	KL						
	THAILAND	18.7	KL						
	PAKISTAN	14.5	CL						
	OMAN	13.2	LC						
	MADAGASCAR	12.0	C						
	YEMEN AR RP	11.2	LK						CE incomplete (only two governorates)
	SRI LANKA	8.3	CK						CE/SF not available per 5 degrees area
	SAUDI ARABIA	7.8	C						
	UN ARAB EMIRATES	7.7	CL						
	MALDIVES	6.6	CF						CE confidential; SF not available per gear
	QATAR	2.0	C						
	TANZANIA	1.5	C						
	KENYA	1.2	C						NC not by species or gear
	COMOROS	0.7	K						
	EGYPT	0.7							
	SEYCHELLES	0.4	K						
	AUSTRALIA	0.3	C						CE confidential
	KUWAIT	0.2	G						
	ERITREA	0.1	C						
	BANGLADESH	0.1							
	BAHRAIN	0.1	C						
	JORDAN	0.1							
	DJIBOUTI	0.1	K						
	EUROPEAN COMMUNITY	0.0	W						
	SUDAN	0.0	C						
	SOUTH AFRICA	0.0	G						
	UK-TERRITORIES	0.0	K						

Sps Longtail tuna (**L**), frigate tuna and/or bullet tuna (**F**), kawakawa (**K**), narrow-barred Spanish mackerel (**C**), Indo-Pacific king mackerel (**G**)

1 Vessels whose catches are not reported by their flag states

2 Non-reporting vessels from India and Indonesian vessels operating in countries other than Indonesia

2v – Sharks seabirds and sea turtles

Gear	Fleet	Species: Sharks NC	Sharks CE	Sharks SF	Sea Birds	Sea Turtles	Comments
PS	EUROPEAN COMMUNITY				n/a		Preliminary results from observer programmes reported to WPEB
	SEYCHELLES				n/a		
	THAILAND				n/a		
	IRAN I R				n/a		
	AUSTRALIA	n/a			n/a	n/a	
	FRANCE-TERRITORIES				n/a		Preliminary results from observer programmes reported to WPEB
	JAPAN				n/a		
	NEI				n/a		
LL	CHINA						NC/CE not by species and do not include discards
	TAIWAN,CHINA						NC/CE Not by species and do not include discards
	JAPAN						
	INDONESIA						NC/CE Not by species and do not include discards
	EUROPEAN COMMUNITY						NC/CE not available for all fleets and/or not by species
	SEYCHELLES						NC/CE not by species; NC/CE likely to be incomplete
	KOREA REP						NC/CE Ndo not include discards; SF data from observers
	OMAN						
	PHILIPPINES						
	MALAYSIA						NC/CE Not by species and do not include discards
	BELIZE						NC/CE Not by species and do not include discards
	MAURITIUS						
	GUINEA						
	THAILAND						
	SOUTH AFRICA						Preliminary results from observer programmes reported to WPEB
	AUSTRALIA						
	KENYA						NC Not by species and do not include discards
	SENEGAL						
	INDIA						
	MADAGASCAR						
	NEI-FROZEN[1]						
	NEI-FRESH[2]						
Artisanal	IRAN I R				n/a		NC catches presumed to be high
	MALDIVES				n/a		NC catches presumed to be low
	INDONESIA				n/a		NC catches presumed to be high
	INDIA				n/a		NC catches presumed to be high
	SRI LANKA				?		NC/CE Not by species
	OMAN				n/a		NC Not by species
	YEMEN AR RP				n/a		CE Not by species and only from two governorates
	PAKISTAN				n/a		NC catches presumed to be high
	MALAYSIA				n/a		NC/CE Not by species
	THAILAND				n/a		NC catches presumed to be low
	MADAGASCAR				n/a		NC catch levels unknown
	COMOROS				n/a		NC catch levels unknown
	UN ARAB EMIRATES				n/a		NC catches presumed to be low
	SAUDI ARABIA				n/a		NC catch levels unknown
	QATAR				n/a		NC catches presumed to be low
	TANZANIA				n/a		NC catches presumed to be low
	KENYA				n/a		NC/CE only available for sport fishery
	EGYPT				n/a		NC catches presumed to be low
	FRANCE-TERRITORIES				n/a		NC catch levels unknown
	SEYCHELLES				n/a		NC catches presumed to be low
	EUROPEAN COMMUNITY				n/a		NC Not by species
	MAURITIUS				?		NC catches presumed to be low
	AUSTRALIA				?		
	KUWAIT				n/a		NC catches presumed to be low
	ERITREA				n/a		NC catches presumed to be low
	JORDAN				n/a		NC catches presumed to be low
	BANGLADESH				n/a		NC catches presumed to be low
	BAHRAIN				n/a		NC catches presumed to be low
	DJIBOUTI				n/a		NC catches presumed to be low
	SUDAN				n/a		NC catches presumed to be low
	UK-TERRITORIES				n/a		NC/CE Not by species
	SOUTH AFRICA				?		
	EAST TIMOR				n/a		NC catches presumed to be low

Catches of seabirds are not likely to occur (n/a) or may occur (?)

1 Vessels whose catches are not reported by their flag states

2 Non-reporting vessels from India and Indonesian vessels operating in countries other than Indonesia

2vi – Fishing craft statistics and list of active vessels

Gear	Industrial purse seine (**PS**), industrial longline (**LL**) and artisanal gears (**ART**)	**Availability**	Fully available Partially available Not available
Catch	Recent catches amounting to (thousands of tonnes)		
Craft	Number of craft operated (2006) (blank if unknown)	**SO** Data Source	Statistics fully available from flag country Statistics partially available from flag country Statistics available from sources other than flag country
FC	Fishing craft		
AV	List of active vessels		

Gear	Fleet	Availability				SO	Comments
		Catch	Craft	FC	AV		
PS	EUROPEAN COMMUNITY	187.5	41				
	SEYCHELLES	49.9	10				
	THAILAND	11.7	9				
	FRANCE-TERRITORIES	9.1	2				
	AUSTRALIA	6.3	11				Does not include vessels operating between 140 East and 150 East
	JAPAN	5.8	3				
	IRAN I R	5.2	9				
	SUPPLY VESSELS-NEI		14				Names and characteristics of supply vessels not fully available
LL	CHINA	10.6	67				
	TAIWAN,CHINA	89.3	782				
	JAPAN	53.8	215				Number of crafts from the IOTC active vessels list
	INDONESIA	21.9	1,075				Statistics not available for longliners not based in Indonesia
	EUROPEAN COMMUNITY	12.7	102				FC statistics are based on the IOTC active vessels list (Spain)
	SEYCHELLES	9.4	27				
	INDIA	6.0	81				FC statistics are based on the IOTC record of authorized vessels
	KOREA REP	5.8	31				
	PHILIPPINES	3.6	17				
	OMAN	3.2	29				Number of crafts from the IOTC active vessels list
	MALAYSIA	2.9	33				Statistics not available for longliners not based in Malaysia
	BELIZE	0.9	10				
	MAURITIUS	0.9	10				Number of crafts from the IOTC active vessels list
	GUINEA	0.9	3				Previous year data repeated
	SOUTH AFRICA	0.5	24				
	TANZANIA	0.5	3				Number of crafts from the IOTC active vessels list
	THAILAND	0.5	3				
	KENYA	0.2	1				FC statistics are based on the IOTC record of authorized vessels
	MADAGASCAR	0.1	2				Previous year data repeated
	SENEGAL	0.1	3				Previous year data repeated
	NEI-FRESH	16.3	24				Third parties reports
	NEI-FROZEN[1]	6.5	15				Third parties reports
Artisanal	INDONESIA	171.6					Includes large scale purse seiners; catches aggregated
	IRAN I R	148.0	6,760				No data for vessels operating outside the EEZ of Iran
	INDIA	129.1					
	MALDIVES	125.0	973				Includes large scale baitboats; catches aggregated
	SRI LANKA	122.9	42,678				No data for vessels operating outside the EEZ of Sri Lanka
	OMAN	31.4					Data reported in Arabic; pending translation
	YEMEN AR RP	27.7					
	PAKISTAN	27.1	2,308				No data for vessels operating outside the EEZ of Pakistan
	MALAYSIA	22.3					
	THAILAND	18.7	930				
	MADAGASCAR	12.0					
	COMOROS	10.3					
	UN ARAB EMIRATES	7.9					
	SAUDI ARABIA	7.8					
	TANZANIA	3.1					
	QATAR	2.0					
	KENYA	1.5					
	FRANCE-TERRITORIES	0.8					
	EGYPT	0.7					
	SEYCHELLES	0.4					
	MAURITIUS	0.4					
	AUSTRALIA	0.3	58				Does not include vessels operating between 140 East and 150 East
	EUROPEAN COMMUNITY	0.2	256				Does not refer to high seas or large scale vessels
	KUWAIT	0.2					
	JORDAN	0.1					
	ERITREA	0.1					
	BANGLADESH	0.1					
	BAHRAIN	0.1	100				
	DJIBOUTI	0.1					
	SUDAN	0.0					
	UK-TERRITORIES	0.0	47				
	SOUTH AFRICA	0.0	14				
	EAST TIMOR	0.0					

1 Vessels whose activities are not reported by the flag states

APPENDIX VI
RECOMMENDATIONS FROM THE MOST RECENT MEETINGS OF THE IOTC WORKING PARTIES

Billfish – from IOTC-2008-WPB-R

Priorities

RESPONSE TO THE REQUEST FROM THE COMMISSION IN RELATION TO APPARENT LOCALISED SWORDFISH DEPLETIONS

1. Following the presentation of the 2004 report of the Scientific Committee (IOTC-2004-SC-R) to the Commission at S9, the Commission noted (Paragraph 21) the technical recommendations made by the SC regarding the status of the swordfish resource and agreed that the issue of local depletion was serious and requested the SC to undertake area-specific analyses, with particular emphasis for the southwest Indian Ocean, for the Commission's future consideration.
2. The WP includes in its advice in 2008 its concerns about the possibility of localised depletion occurring in the south west IO area. To better understand the situation in the SW IO, the WP recommended that the La Reunion CPUE be standardised, and that that changes in standardised CPUE trends be interpreted alongside size data. In addition, the WP began to develop new tools (e.g. a spatially disaggregated production model) to examine further this issue. In 2008 the results were preliminary but further development of the model should be a priority for the future. The WP noted that tagging of swordfish would provide direct estimates of movement and mixing rates of swordfish and would help to determine the degree to which localized depletion might be occurring. Conventional and electronic tagging programmes were encouraged.

Recommendations to improve the data available to IOTC

1. Improve the catch and effort data from artisanal fisheries, by:

- Members having artisanal fisheries for swordfish and marlins, notably Sri Lanka, to improving their collection and reporting of species and gear information.
- Members having artisanal fisheries for sailfish, notably Iran , Oman India and Pakistan, to providing catch and effort data for those fisheries
- Members increasing sampling coverage to obtain acceptable levels of precision in their catch and effort statistics.

2. Improve the recovery of existing catch and effort data from sport fisheries, by:

- The Secretariat to identify the major sports fishing bodies in the Indian Ocean and approach them regarding access to any available data sets.
- The Secretariat to make a special request to members in this year's SC meeting reminder to integrate analyses of sport fisheries data in their National Reports.

3. Improve the catch and effort data from industrial fisheries by:

- Members having industrial fisheries for swordfish, marlins and sailfish to improving their collection and reporting of species information. This should include tools to assist fishers and data collectors to correctly identify billfish species
- The Republic of Korea improving the consistency of its catch and effort statistics.
- Indonesia and Taiwan,China collecting and reporting catch and effort data for their fresh tuna longliner fleets.
- The EC-Spain LL to provide catches of marlins and sailfish by time and area strata.
- The UK long line fleet to provide catch and effort for all species.
- Members reporting on IOTC species taken as bycatch.
- Members ensuring that log book coverage is appropriate to produce acceptable levels of precision in their catch and effort statistics.
- Members with observer programmes to analyse the data collected to estimate retained catches and discards and the precision of these estimates.

4. Increase the amount of size data available to the Secretariat by:

- The EC and India collecting and reporting size data for their longline fleets, notably for marlins and sailfish.
- Taiwan,China collecting and providing size data from their fresh tuna longliners.
- Japan increasing size sampling coverage from its longline fleet.
- Members having sport fisheries collecting and reporting size data to the Secretariat.
- Members collecting and reporting size data for artisanal fisheries for billfish, in particular gillnet fisheries of Iran, India and Pakistan.
- Members reviewing their existing sampling schemes to ascertain that the data collected are representative of their fisheries and provide the results to the Secretariat.

5. Reduce uncertainty in the following biological parameters important for the assessment of stock status of IOTC species by:

- Conversion relationships: Members submitting to the Secretariat the basic data that would be used to establish length-age keys, length-weight keys, processed weight-live weight keys for billfish species.
- Obtaining sex ratio information by size and area.
- Analysis of the apparent stability in the catch size data and whether the existing data are representative of the fishery.

Research recommendations

1) Swordfish stock structure and migratory range — using genetics techniques: The WPB encourages IOTC members to participate or contribute to the planned IOSSS project as much as possible, in particular in the collection of samples for analysis by the project. Samples from northern areas of the Indian Ocean are of particular importance.

2) Swordfish stock structure and movement rates — using tagging techniques: *Including:*

- Scientific tagging, primarily with electronic tags
- Encouraging longline fishermen and observers to tag small swordfish and where possible mark fish with OTC.
- Use the existing momentum for tag recovery process under the RTTP-IO
- Collaborate with the (pop up) tagging initiatives of SWIOFP and MADE.

3) Swordfish growth: The WPB recommended researchers to undertake growth studies and report on these regularly to the WPB. This should include opportunistic tagging and OTC work (i.e. For age validation studies – see growth below), comparisons of methods and results from previous studies (e.g. The study by IFREMER in La Reunion in 1999-2001).

4) Size data analyses: Conversion of lengths to ages using different assumptions on sex ratios at size/age for the Taiwanese, Japan and EC fleets size data.

5) Stock status indicators: Further research is recommended concerning the definition and estimation of stock indicators that reflect the status of stocks of billfish species.

The WP requested the Secretariat to coordinate the exploration of indicators from available data and report these to the next meeting of the WPB. This work should include the types of analyses given in Section 3.

6) CPUE Standardization:

- Examine the relationship between the number of hooks per basket and hook depth
- Improving the definition of variables that could be used as a proxy for targeting. In addition to hooks per basket considerations, this should include examining the effects of set-times, moon-phase, light-sticks, bait-types and species composition.
- Examine methods to better account for the influence of zero catches in CPUE analyses
- Consideration of alternative ways of combining area-specific indices into a global index using different weighting schemes. Consider alternative methods of estimating fish densities in areas across the species range that have not been fished consistently over time.

- Continue the work on integration of environmental factors – validation for factors such as sheer currents. Catch rate data should be examined at a fine scale, particularly in relation to oceanographic variability that is available at a fine scale.
- Use of same space and time scales

Given the importance of these recommended actions to the swordfish assessment, the WPB encourages a collaborative approach to the work be taken.

Efforts should be made to provide additional CPUE series from other fisheries (e.g. La Réunion, Seychelles) for the next WPB.

7) ***STOCK ASSESSMENT:*** Further development of stock assessment models for swordfish in particular, production models, spatial models – including models that examine localised depletion, age structured models and habitat-based models.

8) ***RESEARCH ON ISTIOPHORIDS:*** The WPB recommended that the following research on istiophorids be undertaken.

- In collaboration with sports fishing bodies, the collection of biometric and morphometric data.
- Increased tagging of billfish in the Indian Ocean should be encouraged on an opportunistic basis.
- Popup satellite tagging experiments should be conducted on an opportunistic basis on blue, black and striped marlins to provide information on biology, including long-term vertical behaviour, movement and mixing rates. Collaboration with relevant SWIOFP initiatives should be explored

Tropical tunas – from IOTC-2008-WPTT-R

DATA

1. That the actions in Table 1 (Page 8) be taken to improve the standing of the data on tropical tuna species currently available at the Secretariat (Paragraph 5). These are:

1. To improve the certainty of catch and effort data available for artisanal fisheries:

- Yemen, Comoros and Madagascar implement fisheries statistical collection and reporting systems.
- Sri Lanka strengthen its data collection systems with an emphasis on providing data by species and gear.
- Maldives, Iran and Pakistan provide catch and effort data for their artisanal fisheries, notably gillnets, pole and lines and handlines.
- Countries having emerging hand line fisheries, notably Maldives, Sri Lanka and Indonesia, make the necessary arrangements to collect and provide statistics for those fisheries.
- Countries having fisheries likely to catch significant amounts of bigeye tuna, notably Maldives, Indonesia and Sri Lanka make the necessary arrangements to ensure that the catches estimated for this species are sufficiently precise.
- Fisheries data collection agencies in each country, notably those in India and Sri Lanka, collaborate to produce one consistent set of catch statistics.

Countries increasing sampling coverage to obtain acceptable levels of precision in their catch and effort statistics.

2. To improve the certainty of catch and effort data available for industrial fisheries:

- Indonesia and Malaysia collect catch and effort information for their fresh tuna and/or deep-freezing longline fleets, including those not based in Indonesia
- Taiwan,China collect and provide catch and effort data for their fresh tuna longline fleets.
- India collect and provide catch and effort data for its longline fleet.
- Iran report catch and effort data for its industrial purse seine fleet.
- Countries having industrial fleets ensure that log book coverage is appropriate to produce acceptable levels of precision in their catch and effort statistics.
- Countries having industrial fleets implement or increase coverage of existing Vessel Monitoring Systems in order to be able to validate data collected through logbooks.
- Countries having industrial fleets increase observer coverage to produce acceptable levels of precision in their estimates of

bycatch and discard levels.

- Countries having industrial fleets provide estimates of discard levels of tropical tuna species.

Countries having industrial fleets provide information on the activities of vessels presumed to be from non-reporting fleets.

3. To increase the amount of size data available to the Secretariat:

- Pakistan, Comoros, Indonesia and Yemen collect and provide size data for tropical tunas taken by artisanal fisheries, especially gillnet, handline and troll fisheries.
- India provide its size data available for tropical tunas.
- Maldives provide size frequency data by gear
- Thailand and Iran collect and provide size data for their industrial purse seine fleets
- Taiwan,China collect and provide size data from their fresh tuna longliners.
- Indonesia and Malaysia collect and provide size data for their longline vessels based in other countries
- China, Oman, Philippines, Seychelles and South Korea provide size data from their longline fleets.
- Japan increase size sampling coverage of its longline fleet.

Countries catching significant amounts of tropical tunas review their existing sampling schemes to ascertain that the data collected are representative of their fisheries.

4. To reduce uncertainty in biological parameters important for the assessment of tropical tuna species:

- Conversion relationships: Countries catching significant amounts of tropical tunas providing the basic data that would be used to establish length-weight keys, non-standard measurements-fork length keys, processed weight-live weight keys for these species.
- Countries collecting biological information on tropical tunas caught in their fisheries, preferably through observer programmes, and providing this information (including the raw data where possible) to the Secretariat.

The WPTT was informed about a statistical analysis presented by SPC scientists to the WCPFC Scientific Committee (in August 2008) that indicated that the results of species and size sampling carried out on purse seine catches in the Pacific Ocean since the early 1980's may be biased due to factors such as pre sorting of tunas, structural grab sampling and/or heterogeneity of size composition in small and large schools. While it is not known whether these biases exist in the data obtained from the Indian Ocean, the WPTT agreed that this matter should be investigated (Paragraph 6).

5. To this end, and given the global nature of the matter, the WPTT recommended that an international working group be organized in 2009 to bring together scientists working in the Atlantic, Indian, Eastern and Western Pacific oceans in order to examine the issues of potential biases in the current purse seine sampling programmes and where necessary identify ways to improve the multispecies sampling schemes (Paragraph 7).

OBSERVER PROGRAMMES

6. The WPTT concurred that the only means for obtaining accurate fisheries statistics including data on target, bycatch and associated species is from observer programmes. To this end, the WPTT joined the WPEB in strongly recommending that IOTC Recommendation 05/07 Concerning a management standard for the tuna fishing vessels, to deploy if appropriate, scientific observers on-board the vessels according to the Commission's Resolution (Appendix I-ii), become binding on members (Paragraph 46).

7. Furthermore, noting that data from existing and future observer programmes have the potential to improve the stock assessment analyses, the WPTT recommended that arrangements be instituted to develop a central database of observer data to allow for archiving and analyses of these data with appropriate security and confidentiality arrangements (Paragraph 47).

DATA ANALYSES

The average of the "3Best" monthly catches are calculated on the estimated total catches by the combined longline fleets, monthly & by 5°squares........The analysis of the cumulative catches in the 20 « best 5° squares » fished monthly by longliners shows that a small numbers of heavily squares tend to produce a large percentage of the yearly catches......... The reason for the use of these two indicators is to better understand the relationship between CPUEs (assumed to be *representative of local densities) and total catches, that are the consequence of three combined parameters: (1) local biomass, (2) local fishing effort and (3) fish availability to the gear deployed & its targeting. These results are a potential source of information, allowing a better understanding in the changes of stock status, in the understanding of national CPUEs, in the changes of fisheries behaviour (by flag) and in the rates of tuna concentration in given strata (spawning or/and feeding strata)......[The] apparent inconsistency between CPUE and catch is rather striking and it should be further analyzed (Paragraph 36 abbreviated).*

8. As an extension of this work, the WPTT recommended that some extra analyses be undertaken to examine the phenomenon of vessels causing a temporary localised depletion in a particular area and consider how the complete distribution of relative rankings have changed over time (Paragraph 37).

A first attempt at incorporating technological and environmental factors in order to explain changes in catch rates of yellowfin by the purse seine fleet was documented in IOTC-2008-WPTT-26...... (Paragraph 71 abbreviated).

Results presented for both logbook level and aggregated catch data appear to be affected by the technological changes know to have taken place in the fishery, with CPUE levels showing increasing trends probably due to the difficulty of accounting for differences between nominal and effective effort. A suggestion was made that non-linear relationships like the one observed for thermocline depth would be better treated by linearizing them through an appropriate transformation (Paragraph 72).

9. The WPTT recognised the usefulness of this and similar exercises at understanding the impact on catch rates of various factors affecting the fishery and strongly recommended that work continue to develop reliable abundance indices for tropical tunas taken by the industrial purse seine fisheries (Paragraph 73).

10. The WPTT acknowledged the considerable work that has been undertaken in recent years to develop and improve the CPUE indices for tropical tunas. With respect to future work in this area, the WPTT recommended that the relationship between CPUE and biomass be examined, especially for the longline and purse seine fisheries, and be reported back to the WPTT in 2009 (Paragraph 74).

11. The WPTT acknowledged the considerable advance in the knowledge gained from the first year of analyses of the tagging data and strongly recommended that further analyses of the tagging data continue in support of the assessments of the tropical tuna species (Paragraph 82).

12. Overall, the WPTT strongly recommended that the development of the MFCL model on Indian Ocean tunas continue and that in addition to further refinement of the yellowfin tuna assessment, assessments for bigeye and skipjack be attempted. The WPTT noted that this work should include further analyses to determine the most representative spatial structure for the fisheries and explore various mixing rate scenarios (Paragraph 106).

13. The WPTT was briefly informed of an ongoing project that aims to study the economic factors linked to efficiency changes in the purse seine fleet. This study will look into the history of technological change and the associated investments and returns. The WPTT expressed its interest in receiving the results of this study and recommended that such type of analysis be carried out more frequently. It was also noted that beyond technology, skippers are a major variable to consider, as their experience and abilities change greatly and might explain a large percentage of the variability in catches within the fleet (Paragraph 124)

14. Recent declines of catch rates have appeared in both the industrial purse seine fishery and Maldives artisanal fishery. While the activities of pirates from Somalia have meant that vessels have been avoiding traditional skipjack fishing grounds it appears that the decline of catches in the Maldives fishery could be due to environmental causes such as anomalously high sea surface temperatures. The marked increase of the fuel price has also substantially reduced the fishing operations in the Maldivian fishery. Given the varied nature of the factors influencing catches of skipjack, the WPTT recommended that any standardization of catch rates from these two fisheries incorporate environmental covariates, technological and economic trends (Paragraph 127).

Ecosystems and bycatch – from IOTC-2008-WPEB-R

Data

That the actions in Table 2 be taken to improve the standing of the data on non-tuna species currently available at the Secretariat (Paragraph 9). There are:

Steps to improve the certainty of fisheries statistics for SHARKS:

Data / information / work required	Fishery	Major fleets involved
Retained catches		
Historical catch and effort information	Fresh-tuna and/or deep-freezing longliners	Taiwan,China, Indonesia, Japan, China, Seychelles, Malaysia, South Korea and India.
	Longliners targeting swordfish	Spain, France (La Reunion), Seychelles, Mauritius
	Artisanal fisheries with large catches of pelagic sharks	Sri Lanka. Pakistan , Iran, Oman and Yemen
Historical catch level estimates by species and year.	Fresh-tuna and/or deep-freezing longliners	Taiwan,China, Indonesia, Japan, South Korea
Ensuring that logbook coverage is appropriate to produce acceptable levels of precision for shark catch and effort statistics.	All fleets	
Research on how to identify shark species from fins and processed body parts.	All fleets	
Discard levels		
Implementing levels of observer coverage that will produce acceptable levels of precision in estimates of discard levels.	All industrial fleets.	
Estimating levels of discards for sharks, at least by large species groups or if possible, by species.	All fleets using sharks for their fins,	
Estimates of historical discard levels for sharks by species and year	All industrial fleets,	
Size frequency data:		
Collecting and reporting size frequency information for the main shark species caught by their fisheries, including all historical data available.	All industrial fleets, notably longline fleets	Industrial fleets monitored through observers
Biological data:		
Collecting data that can be used to derive length-weight keys, ratios of fin-to-body weight, non-standard measurements-fork length keys and processed weight-live weight keys.	All fleets	
Collecting biological information on sharks to the extent possible ,	All fleets	
Research on: • Identification of sharks through fins validated by using DNA techniques • The use of shark fins to derive catch estimates in weight by species/species group and fishery. • The use of shark fins to derive length frequencies by species.	All fleets	

Steps to improve the certainty of statistics on incidental catches of SEABIRDS:

Data / information / work required	Fishery	Major fleets involved
Provision of historical data on incidental catches of seabirds, by species and fishing area, indicating the type of mitigation measure/s used in each case.	Industrial longline fisheries operating south of 30°S.,	Taiwan,China, Japan, Indonesia and South Korea,
Estimating total bycatches of seabirds for their fisheries, per species and year, including the precision of such estimates.	Industrial longline fisheries operating south of 30°S.,	Taiwan,China, Japan, Indonesia and South Korea,
Research on the effect of seabird bycatch mitigation measures.	Industrial longline fisheries operating south of 30°S.,	

Steps to improve the certainty of statistics on incidental catches of SEA TURTLES:

Data / information / work required	Fishery	Major fleets involved
Collect data on incidental catches of sea turtles, by species and fishing area,	Countries having industrial longline fisheries,,	Taiwan,China, Indonesia and Japan

including the condition of the sea turtle at release		
	Gillnet / gillnet-longline	Gillnet fisheries operating in the Arabian Sea (Pakistan, Sri Lanka and Iran) and the gillnet/longline fisheries of Sri Lanka, Yemen and Oman.,
	Industrial purse seine fleets	EC and Seychelles
Research on: • interactions between Fish Aggregating Devices (FAD's) and sea turtles, including mortality rates by species, area and type of FAD's used	Industrial purse seine fleets	
Research on: • sea turtle bycatch mitigation measures for longline fisheries, e.g. examination of setting techniques and hook types.	Countries having industrial longline fisheries,,	
Research on: • sea turtle bycatch mitigation measures for gillnet fisheries	Countries having gillnet fisheries,,	

That IOTC member countries with major fisheries send trained and knowledgeable scientists to working party on bycatch and ecosystem meetings in the future (Paragraph 14).

That IOTC Recommendation 05/07 *Concerning a management standard for the tuna fishing vessels*, to deploy if appropriate, scientific observers on-board the vessels according to the Commission's Resolution (Appendix I-ii), become binding on members (Paragraph 17).

That the Commission mandate the WPEB (though the Scientific Committee) to develop regional standards covering data collection, data exchange, training and the development of guidelines for the operational aspects of such programmes and use these to assist members, especially those with major bycatch issues, improve their bycatch data collection and reporting (Paragraph 19).

Sharks

In response to a request from the Commissions for more information on the technical aspects of IOTC Resolution 05/05 *Concerning the conservation of sharks caught in association with fisheries managed by IOTC*, the WPEB recommended the advice relating to Paragraph 34 be put forward to the Scientific Committee for its consideration (Paragraph 35).

That CPCs that are conducting research cruises and observer programs, develop digital photo archives of shark species and make it available to IOTC for wider use (Paragraph 40).

That stock assessments be initiated for sharks in the Indian Ocean to the extent possible, given the current data limitations (Paragraph 42).

Sea turtles

That the Secretariat to follow up the book written by SPC on sea turtle identification and use this as a basis for the production of sea turtle identification material for the Indian Ocean (Paragraph 60).

That a draft Executive Summary be developed by the Secretariat in collaboration with sea turtle experts, in particular IOSEA, and be presented to the Scientific Committee in 2008 (Paragraph 61).

That net material used on FADs should be replaced with materials such as non-plastic ropes or non-plastic hoods or straps that will not entangle sea turtles (Paragraph 63).

Ecosystem approaches

That the Secretariat examines the possibility of undertaking an ERA and report on this to the working party next year (Paragraph 83).

That close collaboration and collaborative work should be pursued with WCPFC and ICCAT with respect to ERA (Paragraph

84).

That interested scientists keep abreast of CLIOTOP activities and collaborate to the extent possible (Paragraph 98).

Tagging data analysis – from IOTC-2008-WPTDA-R

Status of the Indian Ocean Tagging Programme – small-scale tagging operations in the Indian Ocean

1. The WP noted that funds from the Japanese Government are still available, and recommended that further pop-up tagging continue in the Maldives (2 popup tags have already been deployed) – paragraph 8.

Status of the RTTP-IO and small-scale tagging project data

2. The WP recommended that lengths not be calculated when weight data only are available – paragraph 18.
3. The WP acknowledged the improvements in the quality of the databases and recommended that work continue in order to obtain the best possible databases before the meeting of the WP on Tropical Tunas in October 2008 – paragraph 21.

Estimating growth

4. The WP recommended that the current and historical methods used to examine the otoliths be compared; and if possible, some of the historical otoliths be re-read by the workers currently examining the RTTP-IO otoliths – paragraph 36.
5. The WP also recommended that it was important that the validation of otoliths be carried out across the full size range of fish being aged. Furthermore, the variance of age estimates should be evaluated to determine whether statistically significant differences exist between readers and for individual readers – paragraph 37.
6. The WP recommended investigations to quantify post-mortem shrinkage in tuna length caused by freezing – paragraph 41.

Estimating tag shedding rates and tag reporting rates

7. The WP recommended that work comparing the return rates of double tagged fish with those of single tagged fish from the same school or area time strata be conducted – paragraph 56
8. The WP strongly recommended that the tag seeding programme continue for the duration of the RTTP-IO as it is essential that estimates of reporting rates are available across the entire duration of the project – paragraph 62.

Movement

9. The WP recommended that the CPUE data be integrated with the tagging data to better understand the movements of the tagged tunas – paragraph 70.
10. The WP recommended that analyses examining tuna movement and environmental factors be undertaken in the future – paragraph 74.

Other analyses: comparison of tagging programmes

11. WP recommended that an in-depth comparative analysis of tagging results between oceans, primarily based on analytical models, be undertaken in the future – paragraph 95.

Recommendations relating to new information for the assessments of tropical tunas

12. In the past more traditional methods such as VPA, ASPM and production and delay-difference models have been used on yellowfin and bigeye and the continued exploration of the data using these methods is to be recommended for the Tropical tunas Working Party meeting in October – paragraph 96.

Other business: the tagging data users policy

13. The WP recommended that such final symposium would be very important, in term of communication as well that in term of full use of its scientific results, and that funding be sought for the symposium, its organization and the publication, probably in 2010 – paragraph 103.

Other business: other matters

14. The WP strongly recommended that the tagging data be used in ecosystem models – paragraph 108.
15. The WP recommended that the IOTC Scientific Committee should make a firm recommendation that tagging programs should be undertaken on a routine basis as being an essential component in stock assessment and then in stock conservation – paragraph 110.

16. The WP recommended that ad hoc funding and facilities should be sought and obtained by the IOTC in order to allow their full participation to this incoming work – paragraph 111.

Temperate tunas – from IOTC-2008-WPTe-R

Data

That the actions in Table 1 be taken to improve the standing of the data on tropical tuna species currently available at the Secretariat (Paragraph 20). These are:

1. To improve the certainty of catch and effort data available for industrial fisheries by:

- India report catches for its commercial longline fleet.
- Indonesia increase sampling coverage on by-catch unloaded by fresh-tuna and deep-freezing longliners operating under its flag.
- Indonesia and Malaysia collect catch and effort information for their fresh tuna and/or deep-freezing longline fleets, including those not based in Indonesia.
- Taiwan,China collect and provide catch and effort data for their fresh tuna longline fleets.
- Countries having industrial fleets ensure that log book coverage is appropriate to produce acceptable levels of precision in their catch and effort statistics.
- Countries having industrial fleets implement or increase coverage of existing Vessel Monitoring Systems in order to be able to validate data collected through logbooks.
- Countries having industrial fleets provide information on the activities of vessels presumed to be from non-reporting fleets.

2. To increase the amount of size data available to the Secretariat:

- Thailand and Iran collect and provide size data for their industrial purse seine fleets
- Taiwan,China collect and provide size data from their fresh tuna longliners.
- Indonesia and Malaysia collect and provide size data for their longline vessels based in other countries
- China, Philippines, Seychelles and South Korea provide size data from their longline fleets.
- Japan increase size sampling coverage from its longline fleet.
- Countries catching significant amounts of temperate tunas review their existing sampling schemes to ascertain that the data collected are representative of their fisheries.

3. To reduce uncertainty in biological parameters important for the assessment of temperate tuna species:

- Conversion relationships: Countries catching significant amounts of albacore provide the basic data that would be used to establish length-weight keys, non-standard measurements-fork length keys, processed weight-live weight keys and length-age keys for these species.
- Countries collect biological information on albacore caught in their fisheries, preferably through observer programmes, and provide this information (including the raw data) to the Secretariat.
- Countries conduct studies on growth of albacore in the Indian Ocean

COLLECTION OF BIOLOGICAL SAMPLES

That the Secretariat should maintain a database of tuna prices so these data can be readily available to scientists include in their analyses and assist them interpret tuna targeting and catch rates (Paragraph 35).

That genetics work be conducted to better understand the stock structure of Atlantic and Indian ocean albacore (Paragraph 38).

That [the above genetics work] be augmented by tagging albacore to between understand the movement of albacore and the degree of mixing between oceans (Paragraph 39).

The WPTe recommended that gonads be collected and examined to confirm the spawning time and location of the spawning area that are presently hypothesized for albacore (Paragraph 40).

That IOTC scientist collaborate more with ICCAT scientists to improve understanding of the stocks (Paragraph 41).
IMPROVING CPUE
That the following matters be taken into account in the next CPUE analysis: (a) area should be more representative of the fishery (b) processing to be conducted from individual sets instead of aggregated data (c) examination of the effects of targeting practices on albacore, bigeye, swordfish and southern bluefin (d) incorporation of oceanographic information and environmental factors such as SST, temperature at depths and Chlorophyll content (e) examination of hook per basket (f) take into account the changes in the fleet characteristics over time (Paragraph 50).

Methods – from IOTC-2008-WPM-R

Data
That an international working group be organized in 2009 to bring together scientists working in the Atlantic, Indian, Eastern and Western Pacific oceans in order to examine the issues of potential biases in the current purse seine sampling programmes and where necessary identify ways to improve the multispecies sampling schemes and understand the implications for analyses of the data collected (Paragraph 14).
The WPM recommended that IOTC work on methods should be carried out in conjunction with other tuna commissions. The possibility of establishing some channels of communication among interested parties on the various tuna commissions should be explored by both the chairman and the Secretariat (Paragraph 15).
That work needs to undertaken to examine the efficiency of sampling programmes, understand the effect of sample size, and obtain variance estimates for samples (which are required for some assessment models). A suggestion was made for this matter to be tackled in co-operation with researchers in other oceans, possibly using the opportunities for collaboration the Kobe agreement provides (Paragraph 16).
The WPM joined the WPTT and the WPEB in strongly recommending that IOTC Recommendation 05/07 Concerning a management standard for the tuna fishing vessels, to deploy if appropriate, scientific observers on-board the vessels according to the Commission's Resolution (Appendix I-ii), become binding on members (Paragraph 18).

APPENDIX VII
NATIONAL REPORT ABSTRACTS

AUSTRALIA

Document IOTC-2008-SC-INF09: Pelagic longline and purse seine are the two main fishing methods used by Australian vessels to target tuna and billfish in the Indian Ocean Tuna Commission (IOTC) area. In 2007, only three Australian longliners, from the Western Tuna and Billfish Fishery, operated in the IOTC area and caught *. t of broadbill swordfish,* t of yellowfin tuna and * t of bigeye tuna. These catches represent less than 15 percent of the peak catches taken in 2001. The number of active longliners and levels of fishing effort have declined substantially in recent years due to reduced profitability, primarily as a result of lower fish prices and higher operating costs. The estimated catch of southern bluefin tuna in the purse seine fishery was 4822 t in 2007. The 2007 purse seine catch of skipjack tuna was * t, a decrease of more than 90 percent from that caught in 2001 (1039 t).

* = confidential information

BELIZE

No report supplied.

CHINA

Document IOTC-2008-SC-INF21: Since mainland China began its tuna longline fishery in the Indian Ocean in 1995, longlining fishing has been the only fishing methods applied by the fishing fleets for tuna and tuna-like species in IOTC waters. In 1998, the number of fishing boats was 120, most of them were small non-professional boats reconstructed from trawlers or gill-netters which previously operated along Chinese coastal waters. After 1998 number of fishing boats decreased due to the poor management, low economic performance and a shifting of the fishing grounds to the Pacific Ocean. The total number of tuna fishing boats registered with IOTC Secretariat was 93 in 2001, 63 in 2002 and remains at 67 in 2007. The number of the larger scale deep frozen longliners increased from 16 in 2003 to 41 in 2007. The area fished by the Mainland China fleet in 2007 was 40-85ºE, 25ºN-25ºS.

COMOROS

No report supplied.

ERITREA

No report supplied.

EC-FRANCE

Document IOTC-2008-SC-INF11: Three fleets are operating tuna fishing activities in the Indian Ocean: purse seiners which mainly operate from the Seychelles, longliners based in Reunion, and to a lesser extent the artisanal fishery in Reunion. Although not EU flagged, the results of the two French purse seiners based in Mayotte are included in this report. The total catch of tuna and tuna-like species for the French fleet in the Indian Ocean reached 82,450 tonnes in 2007, which is much lower than the total catch observed in 2006 (105,078 t).

For the purse seine fishery, following the unusual 2003-2005 period marked by very high yellowfin catches on free schools, and a relative normalization in 2006 with more typical catch per species distribution, total catch in 2007 sharply decreased despite a strong increase of nominal effort and a stable number of sets. The catch distribution per species has been atypical, with a sharp drop in catches of yellowfin and skipjack, and a strong increase in the bigeye catch. Catch per search day and catch per set trends are globally similar. Note that in 2007 catches were concentrated between the African coast (though over 300 miles off the coasts along Somalia due to piracy risks) and 60°E, catches north of the Mozambique Channel (12-14°S) occurred again, and purse seiners nearly disappeared from the African coastline between 6 and 12°S which was an area of high concentration of big yellowfin tunas between 2003 and 2005. Generally, the average weights remained high and stable in 2007 whereas the weights of bigeye and mostly skipjack have decreased.

The longline fleet based in Reunion increased in 2007 by six 16 meter-units. The total number of longliners has increased from 30 in 2004 to 45 in 2007. Although swordfish remains the target species of this fleet, more tuna (yellowfin, bigeye and albacore) than swordfish is caught. In 2007, 45 longliners caught 3,319 tonnes, which is a similar level to the one of previous years but this is mainly due to the increase in the effort. Between 1994 and 2004, only swordfish was measured but since the beginning of 2005 the main species of large pelagics caught by the Reunion longline fleet have been sampled.

The artisanal fleet represents 80 % of the Reunion fishing vessels. The fleet consists mainly of 5-7 m motorized boats and 7-12 m more powerfully motorized boats, both using mainly line fishing techniques (troll, bottom, set and drifting lines) and gillnet. The catch of large pelagics represent an important part of the catch of this fleet (over 60% in tonnes); 370 tonnes were reported in 2007.

Most of the recommendations made by the different Working Parties concerning France have been or are about to be implemented; more details can be found in the EU-France National Report (IOTC-2008-SC-INF11). Among them, the observer programmes implemented onboard French purse seiners (2005) and longliners (2007) have continued. A first analysis of the results using joint data from French and Spanish purse seiners over the period 2003-2007 was presented to the Working Party on Ecosystems and Bycatch (IOTC-2008-WPEB-12); it allowed the first estimates of total discards and bycatch by species group.

The IRD tuna research system includes observatory-type activities (OSIRIS Unit) and a research programme on dynamics of the tropical ecosystem (THETIS Unit); they should be reunited within a single structure early in 2009. Most of the projects are funded through international, European or national bids. The current projects, already mentioned in last session's National Report (REMIGE, CEDER, CLIOTOP and 4 PFRP projects) continued in 2007. These projects aim at understanding the effect of climate on spatial dynamics of marine predators (tunas, seabirds, pinnipeds) and on fisheries. Two of the PFRP projects deal with the articulation between local-scale movements around FADs and large-scale movements outside FADs; they also include development of new memory tags. ASCLME and SWIOFP international projects have entered their first year of implementation in 2008 and campaigns at sea are planned from 2008 to 2010. Three new projects won bids in 2007 and started in 2008: European-funded MADE (Mitigating Adverse Effects of fisheries) will study bycatch mitigation measures in longline and purse seine fisheries; French-funded BIOPS (BIOdiversité Pélagique : Suivi par indicateurs écosystémiques) will draw up an inventory of pelagic biodiversity and assess the effects of fishing on this biodiversity; European-funded GAP explores the contribution of complementary information from other than scientific actors to improve the management of halieutic resources. A new project, AMPED, obtained funding in 2008 for a start in 2009. It is a 4 year-project focused on protected marine areas that should be developed in coastal and high sea environments. High sea fisheries in the Indian ocean are one of the studies undertaken in this project. These projects fall within the scope of a better accounting for the ecosystem dimension in fisheries management. The two IRD departments actively participated in the work conducted by the IOTC in its Working Parties and also in research on high sea ecosystems. These activities are detailed in the National Report (IOTC-2008-SC-IINF11).

The Ifremer implemented a new system of fisheries monitoring (SIH : Système d'Information Halieutique) in 2005 to improve the quality and storage of statistical data. It is now fully operational. Following the workshop held in September 2006, the international programme on swordfish should begin in 2008 with the participation of about ten Indian Ocean fishing countries. The programme includes genetic study of stock(s), microchemistry of otoliths, acquisition of data on biology for this species and study of external parasites as possible geographical marker. Within the scope of SWIOFP, two programmes are being discussed with concerned countries: implementation of FADs with monitoring of aggregation and assessment of the impacts of these devices on fishing; study of turtles migration routes between breeding and feeding sites.

The ECOMAR laboratory of the University of Reunion, in collaboration with CNRS and IRD, is conducting research on seabirds ecology and its use as bio-indicator of high sea ecosystems health situation. These activities include field operations on the main South West Indian Ocean colonies and research aiming at building the most relevant indicators connecting oceanographic environment, seabird behaviour and intensity of fishing effort by fleets.

EC-SPAIN

Document IOTC-2008-SC-INF07: Two fleets are operating in the Indian Ocean: the purse seine fleet targeting tropical tuna (yellowfin, skipjack and bigeye) and the longline fleet targeting swordfish. In 2007 a total of 21 purse seiners and 25 longliners operated in the area. Purse seiners' carrying capacity for most of the boats is higher than 1,200 t. Longline vessels range from 27 to 42 meters in length. Spanish total catches in 2007 were as follows: 37,763 t of yellowfin , 65,006 t of skipjack , 9,756 t of bigeye , 246 t of albacore and 4,796 t of swordfish , resulting in a grand total of 117,644 t. Purse seine catch in 2007 decreased by 12% as a consequence of the important decrease (by 12%) of the catch of skipjack and (by 12%) of yellowfin. Tropical multispecies tuna sampling in 2007 has been carried out to a good level of coverage: 1,382 samples and 263,498 fish were measured. In 2003 a biological sampling program (including sex ratio and maturity) in the Seychelles cannery was started. For the longline fleet, in 2007, 14,616 swordfish have been measured and sex at age for most spatio-temporal strata has been obtained through biological sampling.

Regarding research, two Spanish research Institutes (IEO and AZTI) are involved in the tropical tuna scientific groups, while IEO is also involved in swordfish research. Since the beginning of the 1990's a Spanish expert on fisheries has been permanently based in Mahé. Scientists involved in these fisheries have actively participated in the meetings and activities of the DWS, WPTT, WPEB and the SC. This year, 12 documents have been presented. Research programs are or will be conducted in order to implement the scientific recommendations, in particular: for collecting information on supply vessels and fishing on FADs. For this purpose a joint IEO-AZTI working plan has been established. To estimate the by-catch associated with the purse seine fishery, a total of 9 trips have been covered by observers in the Indian Ocean in 2004, 12 trips in 2005, 13 in 2006, 19 in 2007 and 12 in 2008 until now. Traditional opportunistic tagging is still being carried out tentatively on both swordfish and other associated species by the voluntary tagging done by the commercial fleet and by the scientific observers on board. During the year 2007 a total of 31 pelagic fish were tagged and released, 12 of them were swordfish specimens and 19 bycatch fishes, without any recapture so far.

In 2008 two pilot actions of experimental fishes have been carried out in the Indian Ocean on vessels with Spanish flag. The first one (17/11/2007 to 15/03/2008) was realized by one vessel in the confluence of the Atlantic and Indian oceans (25ºS-35ºS and 30ºE-50ºE). Abundant biological information was obtained and 57 tunas were tagged with conventional tags and 6 with pop-up tags during the pilot action. The second pilot action (01/07/2008 to 31/10/2008) was developed by two vessels in different areas (0º-20ºS and 50ºE-60ºE the first one; 20ºS-30ºS and 35ºE-65ºE the second one). Experiences of fishes on tropical tunas together with an opportunistic tagging of 30 tunas with conventional tags were carried out during this pilot action.

FRANCE

Included in the report of EC-France.

GUINEA

No report supplied.

INDIA

No report supplied.

IRAN

No report supplied.

JAPAN

Document IOTC-2008-SC-INF19: No abstract supplied.

KENYA

Document IOTC-2008-SC-INF22: Tuna fishery in Kenya is exploited by artisanal, recreational and longlining. The artisanal fleet targets tuna by use of gillnets, handline and longlines. The three gears are mostly used by the artisanal fishers who exploit up to 10 nm miles when the sea is calm but remain inshore during the south eastern monsoon winds when the sea is rough. The artisanal tuna catches have been decreasing for the past three years after a peak season in 2004. Tuna catches have been on the decline with 2007 being the lowest for the last five years. Most of the recreational fishery in Kenya is by the Big game fishery mostly targeting Sailfish, Marlins and Swordfishes. The landings are also composed of considerable amounts of tuna, mainly the yellowfin tuna. The department in conjunction with IOTC and OFCF computerized historical catch data for the two main sports fishing clubs in Kenya.

In 2008 two longliners operated under the Kenyan flag. There are around 2,368 fishing crafts of which only 194 are motorized. 8% of the fishermen fish for tuna as their main target species. 33 purse seiners usually get annual licences. The number of long line licences issued in 2006 was 59 compared to 49 during the year 2007. The amount of tuna being received at the Kenyan tuna factory in 2007 decreased by 26% compared to 2006. Currently, the artisanal skipjack, yellowfin and bigeye tuna data and neritic tuna data has been reported aggregated. From 2009, the department will carry out sampling programmes aimed at coming up with the actual catches per species for the tuna and other pelagics of commercial concern, including sharks and rays.

In 2007 the department started the National plan of action for the sharks which is still in the preparation. Action plans for the seabirds and turtles have not yet been formulated. The VMS for vessels fishing in the Kenyan EEZ has already been procured and just awaits installation. It is hoped that the system will be operation as from February 2009. National research programs on pelagics have not been taking place in Kenya. This is mainly due to the logistical problems in undertaking the activity. However, with the entry of a second longliner in the country's fleet, the possibility of undertaking the same are getting higher.

REPUBLIC OF KOREA

Document IOTC-2008-SC-INF20: The Korean tuna longline fishery has shown a decreasing trend from the late 1970s to recent years in both number of fishing vessels and annual catches. In 2007, total catch amounted to 5,860 t by 31 longliners in the Indian Ocean, which is low compared to 2006. The catch consisted of 411 t of southern bluefin tuna, 3,452 t of yellowfin tuna, 115 t of albacore, 1,291 t of bigeye tuna, 180 t of other tunas, 399 t of billfishes and 12 t of sharks. The National Fisheries Research and Development Institute (NFRDI) began to operate fisheries observer program in 2002 to monitor Korean distant-water fisheries for tunas and to meet the requirements of regional fisheries bodies. In 2007, one Korean observer monitored one of the Korean tuna longline vessels in the south-western Indian Ocean

MADAGASCAR

No report supplied.

MALAYSIA

No report supplied.

MAURITIUS

Document IOTC-2008-SC-18: The tuna fishery forms the basis of local tuna processing industry in Mauritius. Tuna transshipment has been a valuable tuna fishery related activity since early sixties.. An artisanal fishery has also been developed around fish aggregating devices, catches consisting mainly of tuna and dolphin fish. The sport fishery also lands an important quantity of tuna and tuna-like fishes. A swordfish fishery is also being developed.

OMAN

No report supplied.

PAKISTAN

No report supplied.

PHILIPPINES

No report supplied.

SIERRA LEONE

No report supplied.

SEYCHELLES

Document IOTC-2008-SC-INF16: In 2007 there was a slight decrease of 2 % in number of licences issued to purse seiners; however, the total carrying capacity of the entire purse seine fleet remained more or less unchanged. The nominal effort exerted in 2007 was the highest observed over the past 5 years despite a slight drop (10%) in total number of sets made. The total catch for the entire fleet dropped by 37% to the lowest catch reported over the past 5 years. Both skipjack tuna and yellowfin tuna recorded sharp declines in catches in 2007, corresponding to a 35% reduction of yellowfin and 43% reduction of skipjack on free swimming school and FAD associated schools respectively. For the Seychelles purse seine fleet no change in carrying capacity was observed in 2007, and likewise the fishing effort remained more or less constant. The total catch for the Seychelles fleet decreased by 37%, corresponding with a 37% reduction of yellowfin on free swimming school and a 48% reduction of skipjack on logs associated schools respectively.

In 2007 there was a sharp decrease of 53% in number of licenses issued to longliners to fish inside the Seychelles EEZ. Fishing effort and total reported catch for the entire fleet showed a decreasing trend between 2006 and 2007. The fishing effort for the Seychelles fleet remained constant and likewise no significant change was recorded in their total reported. During 2007, four semi industrial vessels conducted 40 longline fishing trips targeting swordfish (compared with 40 trips conducted by six vessels in 2006). Total catches increased by 13%, although fishing effort dropped slightly by 1%. For the first time since the beginning of the fishery (1995) tuna dominated the catch with 51%, whilst swordfish was 45%. Shark fishing activities continued in 2007 although at a lower level than in 2006 (60 fishing trips compared to 97). Six semi industrial vessels landed a total of 20.42 t of shark meat and 18.57 t of shark fins representing an increase of 20% in shark meat and a decrease of 17% in total shark fins landed respectively.

SRI LANKA

No report supplied.

SUDAN

No report supplied.

TANZANIA

No report supplied.

THAILAND

Document IOTC-2008-SC-INF26: Neritic tuna and king mackerel species in the Andaman Sea Coast, Thailand comprise six species (*Thunnus tonggol, Euthynnus affinis, Auxis thazard, Katsuwonus pelamis and Sarda orientalis, Scomberomorus spp*.). The fishing gear used to catch neritic tuna or tuna-like include purse seine, king mackerel gill net and trawl, but purse seine is the main fishing gear. Neritic tuna catches decreased from 45,083 t in 1997 to 15,000 t in 1999 and since then has been stable at around 17,000 t. These neritic tuna species are more or less have similar production trends.

Thailand has three distance tuna longliners that had operated since 2000 on the high seas. Catches of longliners have varied from 94-460 t. The main fishing grounds of these longliners is in the Western Indian Ocean. Bigeye tuna has been the main species, followed by albacore, yellowfin tuna, marlins and sharks.

Six Thai tuna purse seiners have operated in the Indian Ocean since 2005. The number of vessels decreased to five from January to June 2007 and since then the catches have been from only four vessels. The fishing grounds are mainly in the west Indian Ocean and skipjack tuna comprises the highest percentage of catch composition in almost all of the fishing areas. The total catch of the year 2007 was 11,748 t which was down approximately 52 % from that in 2006 (22,509 t). The highest catch was taken in October while CPUE was also highest, 78.54 t/haul. The size distributions of skipjack tuna, yellowfin tuna and bigeye tuna have reported in this paper.

The national research programs implemented by the Department Of Fisheries are also reported in the document.

UNITED KINGDOM

Document IOTC-2008-SC-INF12: The UK National Report summarises fishing by vessels licensed to fish for tuna and tuna like species in the British Indian Ocean Territory (Chagos Archipelago) Fisheries Conservation and Management Zone (FCMZ) during the 2007 / 2008 fishing season. Five UK flagged vessels were also registered with IOTC to fish during 2008, but they did not fish in the BIOT FCMZ, and are reported to IOTC by the UK Department for Environment Food and Rural Affairs (DEFRA) through the EU. In 2007/08 75 licences were issued to 41 longline vessels of two size classes (±100 GRT). The estimated total catch was 1,366t comprising 31% yellowfin tuna, 63% bigeye tuna, and 6% other species. 57 licences were issued to 54 Purse seine vessels that year. The total catch for the 20087/08 season by purse seiners was 23,418t. The reported species composition (before correction) was yellowfin tuna, 79.09%; skipjack tuna, 12.70%; bigeye tuna, 7.44%; and, albacore, 0.77%. It is estimated that a further 24.6t of tuna and tuna like species were landed by recreational fishers on Diego Garcia in 2007. The five UK vessels caught tba tonnes from the IOTC area of which swordfish (tba%) and sharks (tba%) were the predominant species. There was no BIOT or UK observer programme during 2007/08. Some data on non target species and discards is however available in logbooks, and 79 tonnes of sharks were landed by longline vessels in 2008, representing 5.8% of the catch. New stock assessment models were applied to the assessment of yellowfin, bigeye and skipjack tunas for the WPTT in October. Minor changes to BIOTAs systems have been introduced as a result of IOTC SC and Commission recommendations and resolutions.

VANUATU

No report supplied.

SENEGAL

No report supplied.

SOUTH AFRICA

Document IOTC-2008-SC-INF17: No abstract supplied.

URUGUAY

No report supplied.

APPENDIX VIII
EXECUTIVE SUMMARIES ON THE STATUS OF IOTC SPECIES, SHARKS AND SEA TURTLES

Executive summary of the status of the albacore tuna resource

(as adopted by the IOTC Scientific Committee, December 2008)

BIOLOGY

Albacore (*Thunnus alalunga*) is a temperate tuna living mainly in the mid oceanic gyres of the Pacific, Indian and Atlantic oceans. Indian Ocean albacore is distributed from 5°N to 40°S. In the Pacific and Atlantic oceans there is a clear separation of southern and northern stocks associated with the oceanic gyres that are typical of these areas. In the Indian Ocean, there is probably only one southern stock because there is no northern gyre.

Albacore is a highly migratory species and individuals swim large distances during their lifetime. It can do this because it is capable of thermoregulation, has a high metabolic rate, and advanced cardiovascular and blood/gas exchange systems. Pre-adults (2-5 year old albacore) appear to be more migratory than adults. In the Pacific Ocean, the migration, distribution availability, and vulnerability of albacore are strongly influenced by oceanographic conditions, especially oceanic fronts. It has been observed on all albacore stocks that juveniles concentrate in cold temperate areas (for instance in a range of sea-surface temperatures between 15 and 18°C), and this has been confirmed in the Indian Ocean where albacore tuna are more abundant north of the subtropical convergence (an area where these juvenile were heavily fished by driftnet fisheries during the late 1980's). It appears that juvenile albacore show a continuous geographical distribution in the Atlantic and Indian oceans in the north edge of the subtropical convergence. Albacore may move across the jurisdictional boundary between ICCAT and IOTC.

The maximum age reported for Indian Ocean albacore is eight years. However, this may be an underestimate as albacore have been reported live to at least 10 years in the Pacific Ocean.

Little is known about the reproductive biology of albacore in the Indian Ocean but it appears, based on biological studies and on fishery data, that the main spawning grounds are located east of Madagascar between 15° and 25°S during the 4th and 1st quarters of each year (Figure 1). In the Pacific Ocean, albacore grow relatively slowly (compared to skipjack and yellowfin) and become sexually mature at about 5-6 years old. Like other tunas, adult albacore spawn in warm waters (SST>25°C). It is likely that the adult Indian Ocean albacore tunas do yearly circular counter-clockwise migrations following the surface currents of the south tropical gyre between their tropical spawning and southern feeding zones. In the Atlantic Ocean, large numbers of juvenile albacore are caught by the South African pole-and-line fishery (catching about 10.000 t yearly) and it has been hypothesized that these juveniles may be taken from a mixture of fish born in the Atlantic (north east of Brazil) and from the Indian Ocean.

Overall, the biology of albacore stock in the Indian Ocean is not well known and there is relatively little new information on albacore stocks.

FISHERIES

Albacore are caught almost exclusively under drifting longlines (98 %), and between 20° and 40°S (Table 1, Figure 1), with remaining catches recorded under purse seines and other gears (Table 1).

A fleet using drifting gillnets targeting juvenile albacore operated in the southern Indian Ocean (30° to 40° South) between 1985 and 1992 harvesting important amounts of this species. This fleet, from Taiwan,China, ceased fishing with this gear in 1992 due to a worldwide ban on the use of drifting gillnets. Albacore is currently both a target species and a bycatch of industrial longline fisheries and a bycatch of other fisheries.

The catches of albacore increased rapidly during the first years of the fishery, remaining relatively stable until the mid-1980s, except for some very high catches recorded in 1973, 1974 and 1982 (Figure 2). The catches increased markedly during the 1990's due to the use of drifting gillnets, with total catches reaching around 30,000 t. Catches have steadily increased since 1993, after the drop recorded in 1992 and 1993 as a consequence of the end of the drifting gillnet fishery. Catches between 1998 and 2001 were relatively high (ranging from 37,700 t to 40,600 t). By contrast, the average annual catch for the period from 2003 to 2007 was 25,500 t.

Longliners from Japan and Taiwan,China have been operating in the Indian Ocean since the early 1950s and they have been the major fishers for albacore since then (Table 1 and Figure 3). 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 changing the target species mainly to southern bluefin and bigeye tuna, then ranged between 200 t to 2,500 t as albacore became a bycatch fishery. In recent years the Japanese albacore catch has been around 2,000 to 6,000 t. By contrast, catches by Taiwanese 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. Since 2003 the albacore catches by Taiwanese longliners have been less that 16,900 t. The catches of albacore by longliners from the Republic of Korea, recorded since 1965, have never been above 10,000 t. Important albacore catches of around 3,000 t to 5,000 t have been recorded in recent years for a fleet of fresh-tuna longliners operating in Indonesia (Figure 2).

Large sized albacore are also taken seasonally in certain areas (Figure 4), most often in free-swimming schools, by the purse seine fishery.

A feature of Indian Ocean albacore fisheries is that it is the only ocean where juvenile albacore are rarely targeted by fisheries. In the Atlantic and Pacific oceans surface fisheries often actively target small albacore to the extent that juveniles contribute to the majority of albacore catches. This, however, does not discount the possibility that the juvenile albacore from the Indian Ocean are not being subjected to significant levels of fishing pressure as the small fish targeted off the west coast of South Africa may have migrated to the Atlantic Ocean from the Indian Ocean.

The mean prices obtained for albacore tuna are lower than those for bigeye, yellowfin and swordfish (Figure 5) and the Taiwanese longliners operating in the albacore fishery are the oldest, less efficient vessels of the fleet, using regular longlines. Given the lower profitability of the albacore longline fishery compared to the fisheries for other tuna species, there is likely to be very little incentive for an increase in fishing effort on this species in the immediate future.

AVAILABILITY OF INFORMATION FOR STOCK ASSESSMENT

Nominal Catch (NC) Data

The catches of albacore recorded in the IOTC databases are thought to be complete, at least until the mid-1980s. The fleets for which the majority of the catches of albacore are recorded have always reported good catch statistics to the IOTC. The catches of albacore recorded for Illegal and/or Unregulated and/or Unreported (IUU) fleets (recorded mostly as NEI- in the IOTC Database), which have been operating in the Indian Ocean since the early 1980s, have always been estimated by the Secretariat. In recent years the quantities of the NEI catches have decreased markedly.

Catch-and-Effort (CE) Data

Catch and effort data are fully or almost fully available up to the early 1990s but only partially available since then, due to the almost complete lack of catch and effort records from IUU and the Indonesian longline fleet.

The effort statistics are thought good quality for most of the fleets for which long catches series are available, with the exception of the Republic of Korea and Philippines. The use of data for these countries is, therefore, not recommended.

Size Frequency Data

The size frequency data for the Taiwanese longline fishery for the period 1980-2006 is now available. In general, the amount of catch for which size data for the species are available before 1980 is still very low. The data for the Japanese longline fleets is available; however, the number of specimens measured per stratum has been decreasing in recent years. Few data are available for the other fleets.

STOCK ASSESSMENT

In 2008, an age structured production model was used to examine the effect of the interaction between age at selection by the fishery and age-at-maturity and how this might affect stock status. The total catch biomass (1950-2007) and Taiwanese long-line CPUE data (1980-2006) was used to estimate the parameters of the model. Two scenarios were examined: Case 1 where selection begins one age-class before maturation i.e selectivity is at age 4 and maturity is at age 5; and Case 2 where selection follows the maturity ogive i.e. selectivity is at age 5 and maturity is at age 5, but spawning occurs before fishing.

194. For both scenarios there was no outstanding indications that the stock was over-fished (B_{2007}/B_{MSY} >1), or that overfishing is occurring ($h_{CURRENT} < h_{MSY}$); however, there were considerable differences in the estimates of other stock parameters (the current levels of exploitation rate and current relative to MSY levels). It appears that the interaction of age-at-maturity and age-at-selection has a major influence on the results. In scenario 1 fish are available to the fishery a little earlier than they mature (it does not fully select immature fish but assumes the fishery begins to take fish before they can effectively spawn). For scenario 2 the ages at selection and maturation are the same and, given that the population model assumes that fishing occurs post-spawning, all fish are allowed to spawn at least once before they are exploited. This makes a large difference to the estimated MSY levels. For the values of steepness here (in fact even for lower values) if the fish are permitted to spawn at least once before being exploited then the model estimates that population can permanently sustain very high levels of exploitation.

195. For scenario 1, MSY was estimated to be 28,260 t (95% CI = 25,353t -31,333 t) and for scenario 2, MSY was estimated to be 34,415 t (28,414t -38,037 t). Both scenarios indicated that annual catches at the historically high level experienced over the period 1998 to 2001 (range 35,000 to 43,000 t, average 38,300 t) would likely exceed MSY levels.

196. There appears to be a well defined spatial nature to the dynamics of albacore, with relatively few juvenile and immature fish being available to the fishery compared to mature fish. With more information on the spawning condition of fish by location, growth and maturity, as well as improvements to the current indices of abundance and how to interpret the catch data, a well defined spatial assessment model for albacore may be possible in the future.

MANAGEMENT ADVICE

Current status

Based on the preliminary analyses undertaken in 2008 there are no indications that that the albacore stock is over-fished (B_{2007}/B_{MSY} >1) and overfishing is currently likely not occurring for the scenarios envisaged. Point estimates of MSY ranged from 28,260 t to 34,415 t. This indicated, that continuous annual catches at a level approaching 38,000 t (equivalent to the historically high level of catch experienced over the period 1998 to 2001) may not be sustainable in the long term.

Albacore catches have been around 26,000 t annually over the past five years (2003-2007) and this level is only slightly higher than the historical average annual catch taken for the past 50 years (23,000 t). Other fisheries-based indicators show considerable stability over long periods. The mean weight of albacore in the catches has remained relatively stable over a period of more than 50 years. Furthermore, the average weight of albacore in the Indian Ocean is higher than that reported in the other oceans and is likely to result in a higher yield per recruit. The catch rates of albacore have also been stable over the past 20 years (Figure 6).

Because of the low value of albacore and, as a likely result, low profitability of the albacore longline fishery compared to the fisheries for other tuna species, there is likely to be very little incentive for an increase in fishing effort on this species in the immediate future.

On balance of the information available, albacore is considered to be not overfished and overfishing is not occurring.

Recommendation.

The Scientific Committee acknowledges the preliminary nature of the albacore tuna assessment in 2008, but on balance of the available stock status information and stable effort considers that the status of the stock of albacore is not likely to change markedly over the next 2-3 years and if the price of albacore remains low compared to other tuna species, no immediate action should be required on the part of the Commission. The Scientific Committee recommend that a new albacore tuna assessment be presented to the Scientific Committee at the latest in 2010.

ALBACORE TUNA SUMMARY

Maximum Sustainable Yield:	Point estimates ranged from 28,260 t to 34,415 t
Preliminary catch in 2007 *(data as of October 2008)*	32,200 t
Mean catch over the last 5 years (2003-07)	25,500 t
Catch in 2006	24,700 t
Current Replacement Yield	-
Relative Biomass ($B_{current}/B_{MSY}$)	1.39 – 1.95
Relative Fishing Mortality ($F_{current}/F_{MSY}$) – given as exploitation rates (h)	$h_{CURRENT}/h_{MSY}$ point estimates ranged from 0.48 to 0.91

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Table 1. *Best scientific estimates of the catches of albacore tuna (as adopted by the IOTC Scientific Committee) by gear and main fleets for the period 1958-2007 (in thousands of tonnes).*
Data as of October 2008

Gear	Fleet	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84
Purse seine	France																											0.3
	Spain																											0.2
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	Total																							*0.0*	*0.0*	*0.0*	*0.0*	*0.6*
Longline	China																											
	Taiwan,China	1.0	1.2	1.1	1.4	1.3	1.6	1.5	1.1	1.7	1.6	7.6	7.7	7.2	7.0	7.0	12.0	17.4	6.4	9.7	9.8	12.8	15.0	11.0	12.3	21.9	17.0	13.9
	Japan	6.3	10.4	11.1	15.2	17.6	12.6	17.8	11.4	13.1	14.1	10.1	8.6	4.9	3.3	1.4	2.0	2.8	1.3	1.2	0.4	0.4	0.4	0.6	1.2	1.3	1.7	1.8
	Indonesia																	0.0	0.1	0.1	0.1	0.2	0.3	0.2	0.2	0.2	0.2	0.3
	Korea, Republic of								0.5	0.6	6.2	0.9	4.4	1.6	2.4	3.8	9.1	9.7	3.9	4.2	2.1	4.6	2.0	1.8	0.9	0.6	0.6	0.4
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.0	0.8	0.2	0.6	0.5	0.5	0.4	0.2	0.1	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.2	0.2
	Total	*7.3*	*11.6*	*12.1*	*16.6*	*19.0*	*14.1*	*19.4*	*13.2*	*15.6*	*22.0*	*19.3*	*20.8*	*14.4*	*13.3*	*12.7*	*23.4*	*30.2*	*11.6*	*15.3*	*12.5*	*18.1*	*17.7*	*13.7*	*14.7*	*24.2*	*19.6*	*16.7*
Gillnet	Taiwan,China																									0.1	0.1	
	Total																									*0.1*	*0.1*	
Other gears	*Total*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.4*	*0.0*	*0.1*
All	*Total*	*7.3*	*11.6*	*12.1*	*16.6*	*19.0*	*14.2*	*19.4*	*13.2*	*15.6*	*22.0*	*19.3*	*20.9*	*14.4*	*13.3*	*12.8*	*23.5*	*30.3*	*11.7*	*15.3*	*12.5*	*18.1*	*17.7*	*13.7*	*14.7*	*24.7*	*19.8*	*17.3*

Gear	Fleet	Av03/07	Av58/07	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07
Purse seine	France	0.4	0.2	0.5	0.2	0.2	0.2	0.0	0.0	0.9	1.4	0.3	0.3	0.4	0.4	0.5	0.5	0.2	0.4	0.7	0.3	0.6	0.1	0.1	0.9	0.3
	Spain	0.3	0.2	0.1		0.0	0.1		0.1	1.1	1.5	0.9	1.8	0.6	0.8	1.0	0.3	0.2	0.4	0.3	0.2	0.5	0.1	0.0	0.4	0.2
	Other Fleets	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.2	0.3	0.4	0.1	0.5	0.4	0.4	0.5	0.8	0.2	0.4	0.3	0.3	0.4	0.1	0.0	0.3	0.2
	Total	*0.8*	*0.5*	*0.7*	*0.2*	*0.2*	*0.3*	*0.0*	*0.3*	*2.2*	*3.3*	*1.3*	*2.6*	*1.3*	*1.6*	*2.0*	*1.6*	*0.6*	*1.2*	*1.3*	*0.8*	*1.5*	*0.2*	*0.2*	*1.5*	*0.7*
Longline	China																									
	Taiwan,China	12.5	10.7	6.2	11.1	13.1	11.0	7.1	5.8	13.1	11.1	12.0	14.4	14.2	16.9	15.2	21.6	22.5	21.7	26.9	21.5	13.1	12.5	10.4	9.5	16.9
	Japan	4.6	4.7	2.3	2.5	2.3	1.3	0.9	1.0	1.0	1.8	1.3	1.8	2.0	2.4	3.2	3.2	2.3	2.6	3.0	3.2	2.3	3.6	4.1	6.4	6.4
	Indonesia	3.2	0.7	0.3	0.1	0.3	0.3	0.4	0.4	0.3	0.5	0.4	0.6	0.7	1.3	1.6	1.5	1.7	2.7	2.9	2.6	4.8	4.2	2.6	2.2	2.2
	NEI-Deep-freezing	1.0	1.5	0.0	0.7	0.7	1.7	1.0	1.2	2.5	1.8	3.2	4.2	4.2	7.3	4.8	9.0	9.5	8.2	5.8	3.8	1.4	0.7	1.8	0.7	0.5
	France-Reunion	0.5	0.1							0.0	0.0	0.1	0.1	0.1	0.3	0.2	0.3	0.3	0.5	0.6	0.3	0.3	0.4	0.7	0.5	0.8
	NEI-Fresh Tuna	0.5	0.1					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.2	1.1	1.1
	Belize	0.5	0.1																	1.4	0.6	0.2	0.1	0.7	0.7	0.7
	Spain	0.4	0.1													0.0	0.0	0.0	0.1	0.2	0.2	0.1	0.1	0.8	0.6	0.6
	Seychelles	0.4	0.1															0.0	0.4	0.8	1.1	1.2	0.1	0.1	0.1	0.4
	Korea, Republic of	0.2	1.3	0.5	0.4	0.4	0.4	0.3	0.2	0.3	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.1	0.4	0.2	0.3	0.3
	Other Fleets	0.8	0.3	0.0	0.1	0.1	0.2	0.5	0.5	0.6	0.7	0.6	0.8	0.4	0.2	0.2	0.7	0.5	0.2	0.3	0.2	0.3	0.4	0.6	1.0	1.7
	Total	*24.5*	*19.6*	*9.3*	*14.7*	*17.0*	*14.9*	*10.2*	*9.0*	*17.8*	*16.0*	*17.7*	*22.1*	*21.8*	*28.6*	*25.5*	*36.4*	*37.1*	*36.5*	*42.0*	*33.7*	*23.7*	*22.3*	*22.2*	*23.1*	*31.4*
Gillnet	Taiwan,China	0.0	1.9	0.7	18.2	14.0	14.4	10.6	25.7	9.0	2.6															
	Total	*0.0*	*1.9*	*0.7*	*18.2*	*14.0*	*14.4*	*10.6*	*25.7*	*9.0*	*2.6*															
Other gears	*Total*	*0.1*	*0.1*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.1*	*0.0*	*0.0*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.1*	*0.1*	*0.1*	*0.2*	*0.1*	*0.1*
All	*Total*	*25.5*	*22.1*	*10.8*	*33.2*	*31.3*	*29.6*	*20.8*	*35.1*	*29.1*	*22.0*	*19.1*	*24.7*	*23.1*	*30.2*	*27.6*	*38.0*	*37.7*	*37.8*	*43.4*	*34.6*	*25.3*	*22.7*	*22.5*	*24.7*	*32.2*

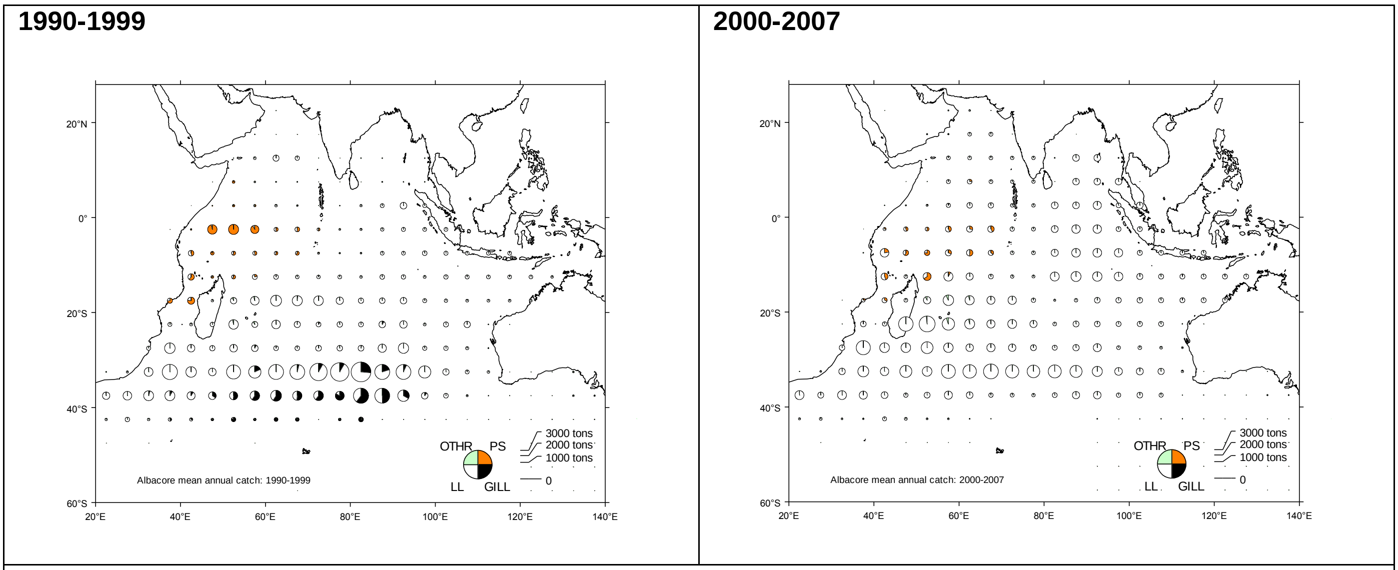


Figure 1. *Average annual albacore catches by gear during the periods 1990-1999 and 2000-2007. LL = longline, PS = purse seine, SU = pole and line. Data as of October 2008*

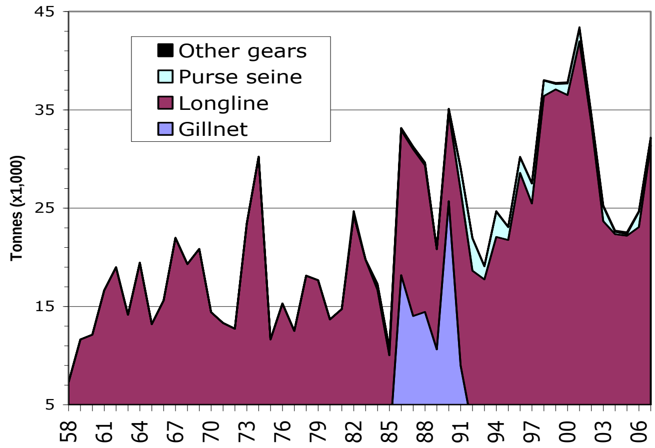


Figure 2. *Annual of catches albacore (t x 1000) by gear from 1958 to 2007. Data as of October 2008*

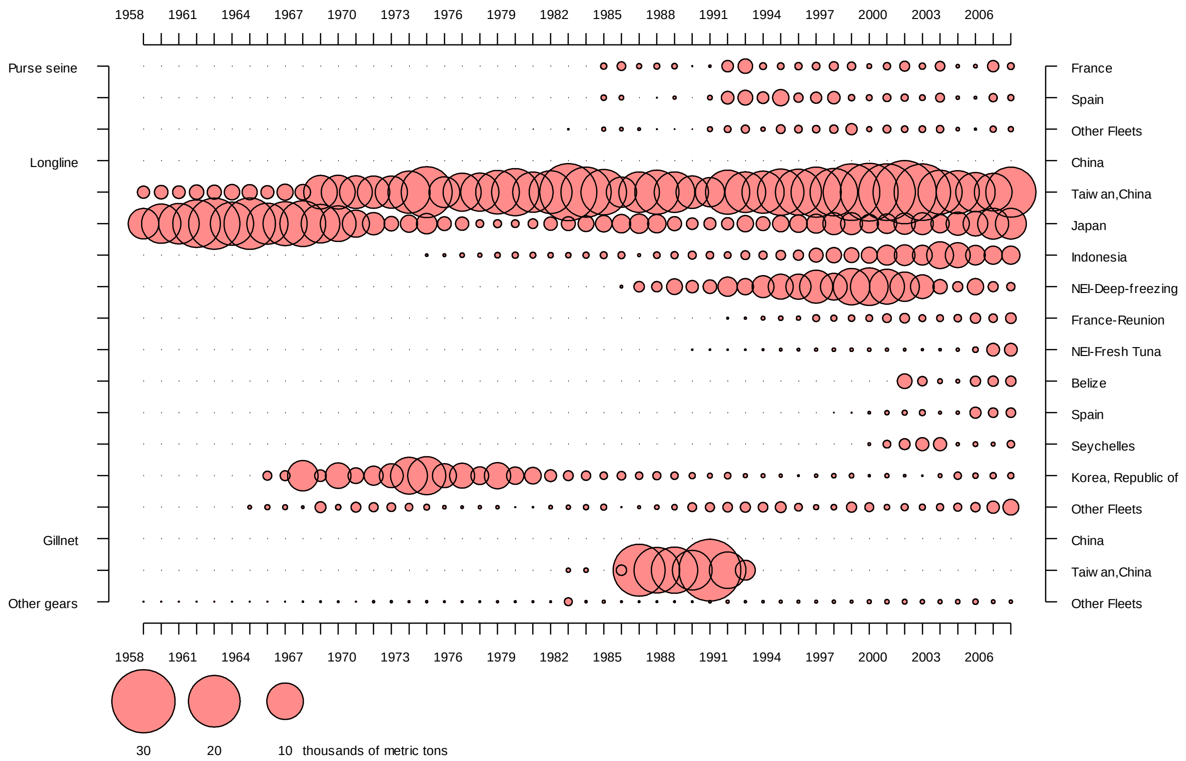


***Figure 3.** Catches of albacore by flag in the Indian Ocean for the period 1958- 2007.*

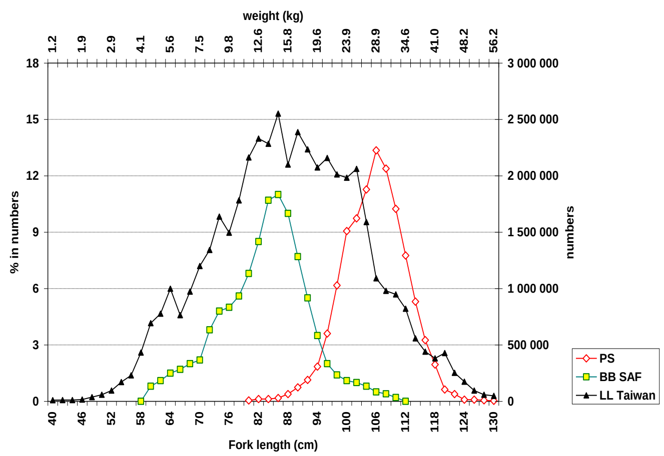


***Figure 4.** Average sizes of albacore taken by various fisheries in the Indian Ocean, longliners and purse seiners, and by the pole-and-line fishery in the west coast of South Africa (Atlantic Ocean).'*

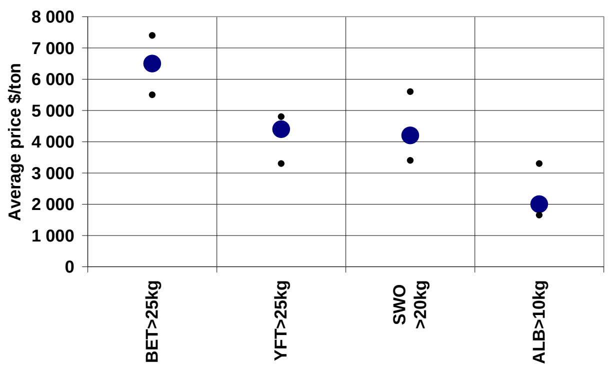


***Figure 5.** Average market price ($USD) for bigeye (BET), yellowfin (YFT), swordfish (SWO) and albacore tuna (ALB) in 2007.*

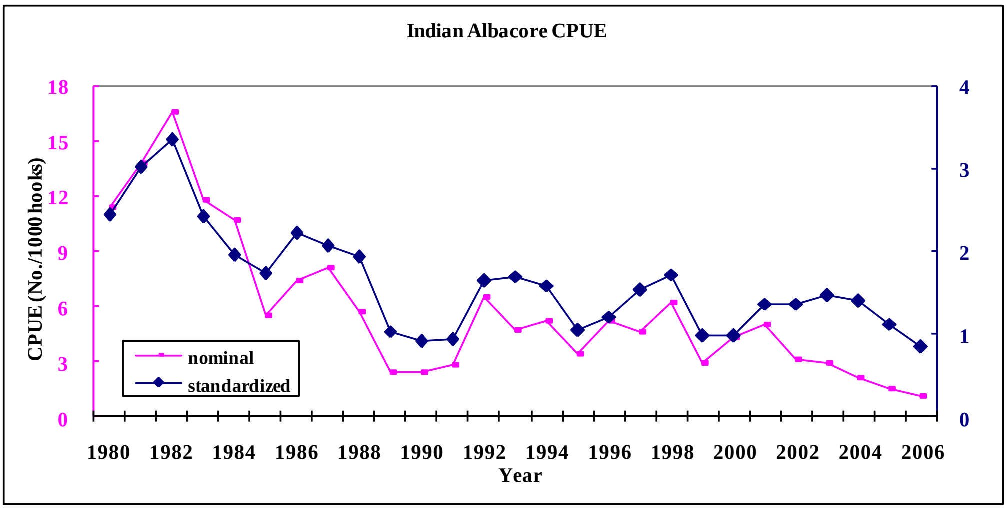


Figure 6. *Nominal and standardised CPUE indices for albacore derived for the Taiwanese longline fleet in the Indian Ocean.*

Executive summary of the status of the bigeye tuna resource

(as adopted by the IOTC Scientific Committee, December 2008)

BIOLOGY

Bigeye tuna *(Thunnus obesus)* inhabit the tropical and subtropical waters of the Pacific, Atlantic and Indian Oceans in waters down to around 300 m. Juveniles frequently school at the surface underneath floating objects with yellowfin and skipjack tunas. Association with floating objects appears less common as bigeye grow older.

The tag recoveries from the RTTP-IO provide evidence of rapid and large scale movements of juvenile bigeye in the Indian Ocean, thus supporting the current assumption of a single stock for the Indian Ocean. The new information on the apparent movements of tagged bigeye is presented in Figure 1. The average minimum distance between juvenile bigeye release and recapture positions is estimated at 525 nautical. miles. The range of the stock (as indicated by the distribution of catches) includes tropical areas, where reproduction occurs, and temperate waters which are believed to be feeding grounds. Of the three tropical tuna species, bigeye tuna lives the longest (probably more than 15 years) and that makes it the species most vulnerable, in relative terms, to over-exploitation. Bigeye have been reported to grow to 200 cm (fork length) long and over 200 kg and start reproducing when they are approximately three years old, at a length of about 100 cm.

The analyses of tag/recovery data from the RTTP-IO widely support the hypothesis of a multi-stanza growth pattern for bigeye tuna, with slow growing juveniles. This pattern is similar to the multi-stanza growth pattern now estimated for yellowfin..

THE FISHERIES

Bigeye tuna is mainly caught by industrial fisheries and appears only occasionally in the catches of artisanal fisheries. Total annual catches have increased steadily since the start of the fishery, reaching the 100,000 t level in 1993 and peaking at 150,000 t in 1999. Total annual catches averaged 121,700 t over the period 2003 to 2007. Bigeye tunas have been caught by industrial longline fleets since the early 1950's, but before 1970 they only represented an incidental catch. After 1970, the introduction of fishing practices that improved the access to the bigeye resource and the emergence of a sashimi market made bigeye tuna a target species for the main industrial longline fleets. Total catch of bigeye by longliners in the Indian Ocean increased steadily from the 1950's to reaching 100,000 t in 1993 and around 140,000–150,000 t for a short period from 1997-1999. (Figure 2). The average annual catch by longliners for the period from 2003 to 2007 was 96,200t. Taiwan,China is the major longline fleet fishing for bigeye and it currently takes just under 50% of the total catch (Table 1). Large bigeye tuna (averaging just above 40 kg) are primarily caught by longlines, and in particular deep longliners (Figure 3). Since the early 1990's, bigeye tuna has been caught by purse seine vessels fishing on tunas aggregated on floating objects. Total catch of bigeye by purse seiners in the Indian Ocean reached 40,700 t in 1999, but the average annual catch for the period from 2003 to 2007 was 23,900 t (Table 1). Forty to sixty boats have operated in this fishery since 1984. Purse seiners mainly take small juvenile bigeye (averaging around 5 kg) whereas longliners much larger and heavier fish (Figures 3 and 4), and while purse seiners take much lower tonnages of bigeye compared to longliners (Figure 2), they take larger numbers of individual fish (Figure 5).

By contrast with yellowfin and skipjack tunas, for which the major catches take place in the western Indian Ocean, bigeye tuna is also exploited in the eastern Indian Ocean (Figures 2 and 6). The relative increase in catches in the eastern Indian Ocean in the late 1990's was mostly due to increased activity of small longliners fishing for fresh tuna. This fleet started operating around 1985. In the western Indian Ocean, the catches of bigeye are mostly the result of the activity of large longliners and purse seiners.

AVAILABILITY OF INFORMATION FOR ASSESSMENT PURPOSES

The reliability of the total catches has continued to improve over the past years, although still up to 25% of the catch has to be estimated. The fact that most of the catch of bigeye tuna comes from industrial fisheries has facilitated the estimation of total catches. Catch and effort data, potentially useful to construct indices of abundance, is also considered to be of good overall quality. Size-frequency information is considered to be relatively good for most of the purse-seine fisheries, but insufficient for the longline fisheries. This is due primarily to a lack of reporting from the Korean fleets in the 1970's, lack of reporting from Taiwanese fleets since 1989 and insufficient sample sizes in recent years in the Japanese fishery.

A range of information on biological parameters has been recently obtained from the RTTP-IO tagging programme and this has already greatly improvedd the knowledge on bigeye growth and movement patterns. The recovery data that are already available will also soon enable direct estimates of natural mortality of juveniles. These improved data will be of major importance to improve the outputs of analytical models that are using this information.

In the case of the purse-seine fishery, it was not possible to derive indices of abundance from catch-and-effort information, because the interpretation of nominal fishing effort was complicated by the use of FADs and increases in fishing efficiency that were difficult to quantify. In the case of the longline fisheries, indices of abundance were derived, although there still remain uncertainties whether they fully take into account targeting practices on different species (Figure 7).

The Japanese longline standardised CPUE (1960 to 2004) for the Indian Ocean tropical waters is currently used to derive the index of bigeye abundance. In 2006, sea surface temperature and gear characteristics were included in the GLM standardisation procedure. This index generally declined from 1960 until 2002, with the exception of higher values in 1977 and 1978. Abundance values in 2003 and 2004 were higher than the lowest historical value in 2002 (Figure 7). A similar analysis of the Taiwanese CPUE series was also presented in 2006. After standardisation, this index shows a variable but generally decreasing trend, similar to that of the Japanese fleet (Figure 7). This is in contrast with previous years, when significant differences could be observed between both indices; and appears to be the result of an increase in the information input into the analysis by Taiwanese researchers. Given that the standardisation procedure of the Taiwanese index is still work in progress, the WPTT decided to apply the Japanese index in the recent stock assessment runs, while recognizing and encouraging the significant improvements achieved in the generation of an index of abundance for the Taiwanese fleet.

Catch at size and catch at age data were updated in 2006. Given that a catch-at-size matrix is an integral part of both length and age based assessment methods, the WPTT expressed their ongoing concerns about the low levels of size sampling being collected in the Indian Ocean. Notwithstanding these concerns the WPTT was encouraged by the potential of the information being obtained from the RTTP-IO in the belief that this programme is going to be important alternative source of size data in the very near future.

STOCK ASSESSMENT

In 2006, five stock assessment models were applied to the Indian Ocean bigeye tuna stock using an agreed list of input parameters. Ten year projections were also carried out for a range of scenarios.

Results

From the range of MSY estimates, the SC chose the value of 111,200 t. This was the MSY estimated by the ASPM and it was reported ahead of the estimates from the other methods because ASPM results have been reported in previous executive summaries; and the WPTT noted that several of the other assessment approaches used in 2006 needed further exploration and development. Given that the mean annual catch for the period 2003-2007 was 121,700 t and the preliminary catch estimate for 2007 is 117,900 t, it appears that the stock is being exploited at around its maximum level. Results from the ASPIC analysis plotting the annual catches as a function of fishing mortality illustrate the MSY and its uncertainty (Figure 8).

Despite the broad agreement of the models in estimating MSY, they produced quite different estimates of absolute levels of virgin and current biomass, and thus in the ratios of current levels of F and SSB to MSY. This was probably due to how the variations in CPUE were interpreted by each model. While acknowledging the value of assessing the status of bigeye from a wide range of modelling perspectives, the WPTT recommended that the results of the ASPM (Table 2) would be used in the Bigeye Executive Summary in 2006.

The ASPM results indicate that the 2005 catch is close to the MSY. Furthermore, spawning stock biomass appears to be above the level that would produce MSY, and the fishing mortality in 2004 appears to below the MSY level.

Biomass trajectories indicate that the spawning stock biomass is currently just above the MSY level, but it has been declining since the late 1970's (Figure 9). Similarly, the current fishing mortality is estimated be to just above the MSY level, but fishing mortality has been increasing steadily since the 1980's (Figure 10).

Ten year projections were carried out using the following scenarios:

- constant catch at 2004 levels
- with a 10% reduction in 2004 catch levels
- constant F at 2004 levels, at 2000-02 levels and at 1998-01 levels

If 2004 catch levels were to continue, SSB is predicted to decline gradually over the next 10 years (Figure 11). At a constant catch equivalent to 10 % below the 2004 catch level, the rate of decline in SSB is less severe.

Three different scenarios of fishing mortality at age were selected as they reflected different patterns of exploitation for juvenile and adult bigeye. In the period 1998-2000, the fishing pressure on juveniles was higher than it was during the period 2000-2002. The 2004 scenario reflects a fishery in which there was relatively lower pressure on juveniles compared to the other time periods. Scenarios based on F levels were presented, and the results indicate that the three levels considered (2004, 2000-02 and 1998-2001) would not have a strong effect in the trajectories of future SSB, as the differences are relatively minor given the current level of uncertainty (Figure 13).

The effects of the three scenarios of fishing mortality were also considered in terms of yield per recruit. A multi-fleet YPR analysis indicated that an exploitation pattern such as the one observed in 2004 would have a positive impact on the yield per recruit obtained, when compared to the 2000-02 and 1998-01 fishing mortalities by fleet. A slightly higher yield per recruit resulted from a pattern of exploitation in which there was lower pressure on juveniles. Yield per recruit increased from 1.98 kg for the 1998-2001 pattern of exploitation, to 2.06 kg for the 2000-02 pattern, up to 2.22 kg if the 2004 pattern of exploitation were to be retained.

Despite the progress made in the 2006 assessments, uncertainties in the results and projections still exist. These uncertainties relate to:

- Uncertainties concerning the available indices of abundance.
- How well the model structures used in the assessments approximate the true dynamics of the population, and about the quality of the estimation of some of the model key parameters.
- Insufficient size information for the catches of longline fisheries, especially in recent years.
- Uncertainties associated with estimating catch-at-size and catch-at-age.
- Uncertainty about the natural mortality at various life stages, including uncertainty about the functional form of its dependency with age.
- Uncertainty about the changes in catchability of the different fisheries involved, especially in the purse-seine fishery. Future consideration of an increase in efficiency could result in a more pessimistic appraisal of the stock status. For example, it is possible that the fishing mortality that would result in the MSY has already been exceeded.

Notes about exploitation patterns

The exploitation patterns observed in 2003 and 2004 could be considered anomalous, and heavily influenced by the high abundances of yellowfin tuna, which concentrated the activity of the surface fleets. The decrease in the fishing pressure on bigeye currently observed is likely to be temporal, as the fleets appear to have come back in the second half of 2005 to their previous pattern of activity.

Two other factors could also influence the short term evolution of the fishery. Rising fuel costs appear to be having an effect on the operating procedures of the surface fleets. Distances travelled at night, and consequently the number of FADs visited, are being reduced to save on fuel costs. The effect of this change could be however reduced by the increasing use of supply vessels, tasked with visiting FADs and informing purse seiners of the abundance of fish around them. The second factor is the limitation on the activity of all fishing fleets on the coast and EEZ of Somalia, due to the increase in the activity of pirates in the area. Some purse seine fleets have receive indications from their governments not to venture into those waters. An important fishery on FADs has traditionally taken place in this area on the last quarter of the year, with significant catches of juvenile bigeye. Because of piracy acts off Somalia, the fishery has shifted into the South of the Arabian Sea, north of 10°N – an area where there are relatively few bigeye and where juvenile bigeye is not taken at FADs.

Another factor to consider when analysing the possible futures trends in SSB is the increasing trend in effective fishing power observed in the fleets.

In 2008 a simple surplus production model was applied to Japanese longline CPUE and total catch biomass data. Parametric boot-strap approaches were used to explore the uncertainty in the key parameters. Monte Carlo distributions for key parameters (M, age at maturity and steepness) were defined then used to estimate r the intrinsic rate of increase parameter for the surplus production model.

This was considered to be a preliminary analysis; however, the results indicated that the probability of B_{2007} being greater than B_{MSY} was high (i.e. there was an 86% chance). Notwithstanding these results, given the limited nature of the work carried out on bigeye in 2008, no new advice was provided for the stock.

MANAGEMENT ADVICE

The results of the stock assessments conducted in 2006 were broadly similar and, in general, were more optimistic than previous ones. The ASPM results indicate that the 2005 catch is close to the MSY. Furthermore, spawning stock biomass seems to be above the level that would produce MSY, and the fishing mortality in 2004 seems to below the MSY level. Current (2004) catches of juveniles bigeye by the surface fleets are also less detrimental in terms of yield-per-recruit that previous patterns.

However, the current outlook could revert to a more pessimistic one, if the exploitation pattern is to return to the pre-2003 levels, as expected. Changes in the fishery occurred in 2003 and 2004, but these were due to the exceptional catches of yellowfin, which seem to be the result of anomalous conditions. In 2005, the fishery is already showing a return to the previous pattern of exploitation, which is likely to increase the catches of bigeye tuna associated with floating objects.

If the level in catch in numbers of juvenile bigeye tuna by purse seiners fishing on floating objects returns to pre-2003 levels, this is likely to be detrimental to the stock, as fish of these sizes are below the optimum size for maximum yield-per-recruit.

The Scientific Committee also noted that juvenile bigeye tuna are caught in the FAD purse-seine fishery that targets primarily skipjack tuna. Some measures to reduce the catches of bigeye tuna in this fishery could be expected to result in a decrease in the catches of skipjack tuna.

In view of the most current assessment, the SC recommended that catches should not exceed the MSY and fishing effort should not increase further from the 2004 levels.

BIGEYE TUNA SUMMARY

Maximum Sustainable Yield:	111,200 t (95,000 – 128,000)
Preliminary catch in 2007 *(data as of October 2008)*	117,900 t
Catch in 2006	112,100 t
Mean catch over the last 5 years (2003-2007)	121,700 t
Current Replacement Yield	-
Relative Biomass (SSB_{2004}/SSB_{MSY})	1.34 (1.04 – 1.64)
Relative Fishing Mortality (F_{2004}/F_{MSY})	0.81 (0.54 – 1.08)
90% Confidence intervals provided in brackets	

***Table 1**. Best scientific estimates of the catches of bigeye tuna (as adopted by the IOTC Scientific Committee) by gear and main fleets for the period 1958-2007 (in thousands of tonnes).*

Data as of October 2008

Gear	Fleet	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84
Purse seine	Spain																											0.8
	France																								0.0	0.0	0.2	2.3
	NEI-Other																										0.0	0.5
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.5
	Total																					*0.0*	*0.0*	*0.0*	*0.0*	*0.1*	*0.6*	*4.0*
Longline	China																											
	Taiwan,China	1.5	1.5	1.3	1.9	1.2	1.7	1.8	1.4	2.2	2.3	7.2	8.0	10.0	5.6	5.5	4.0	6.0	5.3	4.2	6.2	4.9	7.4	8.9	6.8	11.3	11.3	10.9
	Japan	10.2	8.4	14.8	13.0	17.3	11.6	16.0	17.6	21.4	21.8	23.6	14.4	12.7	11.2	8.3	5.2	6.9	5.5	2.1	3.1	10.9	4.2	5.9	7.8	11.4	18.3	14.0
	Indonesia																0.0	0.2	0.4	0.3	0.3	0.4	0.4	0.5	0.5	0.8	1.9	2.4
	Seychelles																										0.0	0.1
	Korea, Republic of								0.2	0.2	0.6	6.8	7.6	3.5	4.9	4.9	7.3	14.7	26.2	21.8	26.1	34.1	21.5	19.3	19.4	19.5	17.4	11.8
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.4	0.1	1.9	0.5	1.6	1.3	1.2	1.0	0.6	0.2	0.1	0.2	0.2	0.0	0.2	0.3	0.3	0.5	0.6
	Total	*11.7*	*9.9*	*16.1*	*15.0*	*18.5*	*13.3*	*18.0*	*19.5*	*24.1*	*24.8*	*39.5*	*30.5*	*27.8*	*23.0*	*20.0*	*17.4*	*28.4*	*37.7*	*28.6*	*35.9*	*50.6*	*33.5*	*34.9*	*34.8*	*43.4*	*49.5*	*39.7*
Other gears	*Total*	*0.1*	*0.1*	*0.0*	*0.1*	*0.1*	*0.1*	*0.1*	*0.0*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.1*	*0.1*	*0.1*	*0.2*	*0.1*	*0.2*	*0.4*
All	*Total*	*11.7*	*9.9*	*16.1*	*15.0*	*18.5*	*13.4*	*18.1*	*19.6*	*24.2*	*24.8*	*39.6*	*30.5*	*27.9*	*23.0*	*20.1*	*17.6*	*28.5*	*37.8*	*28.7*	*36.1*	*50.7*	*33.6*	*35.0*	*35.1*	*43.6*	*50.3*	*44.1*

Gear	Fleet	Av03/07	Av58/07	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07
Purse seine	Spain	9.4	3.8	1.3	1.8	5.0	6.8	5.9	4.9	6.0	3.6	5.4	5.9	12.2	11.4	15.9	11.2	16.0	11.3	7.8	10.9	8.5	8.6	10.3	10.0	9.8
	France	5.8	2.8	4.3	7.1	7.0	6.2	3.6	4.6	5.4	3.8	5.0	5.4	7.3	6.9	7.8	6.4	8.5	6.7	5.5	7.3	5.3	5.8	6.5	5.3	6.1
	Seychelles	4.0	0.7							0.0	0.0					0.9	2.0	3.0	1.8	2.8	3.7	3.4	4.4	4.8	3.5	3.9
	Thailand	1.5	0.2																0.2	0.1				1.6	4.0	1.7
	NEI-Ex-Soviet Union	1.3	0.5						0.0		0.4	1.0	0.3	1.3	1.1	1.2	1.9	3.9	2.9	2.6	0.7	2.4	2.2	1.4	0.7	
	NEI-Other	1.0	1.1	0.6	1.0	0.8	0.8	0.5	1.0	1.5	0.9	1.9	2.5	3.4	3.4	6.2	5.2	7.5	6.0	3.1	4.1	2.4	0.9	0.6	0.6	0.5
	Other Fleets	0.9	0.8	0.9	0.7	0.7	1.3	2.0	2.2	2.6	2.5	2.6	4.8	4.2	1.7	2.0	1.6	1.7	1.1	1.8	2.4	0.8	0.5	0.8	0.7	1.8
	Total	*23.9*	*9.9*	*7.2*	*10.6*	*13.4*	*15.1*	*12.0*	*12.7*	*15.6*	*11.3*	*16.0*	*18.9*	*28.4*	*24.5*	*34.0*	*28.3*	*40.7*	*29.9*	*23.7*	*29.0*	*22.8*	*22.4*	*26.1*	*24.7*	*23.7*
Longline	China	7.5	1.1											0.2	0.6	1.7	2.3	2.4	2.8	3.1	2.8	4.6	8.3	8.9	8.7	7.2
	Taiwan,China	45.8	18.0	12.2	16.8	17.6	19.4	19.9	20.8	29.0	24.0	39.7	27.8	32.7	29.8	34.1	39.7	37.1	36.4	42.1	50.2	60.0	56.9	40.2	35.8	36.1
	Japan	13.3	12.5	17.2	15.8	15.5	12.3	7.7	8.2	7.8	5.6	8.3	17.5	17.2	16.5	18.8	17.1	14.0	13.6	13.0	13.9	10.0	10.6	12.5	14.0	19.2
	Indonesia	9.1	5.8	2.4	0.7	2.4	3.2	4.5	4.5	4.5	7.6	7.9	10.8	12.2	23.2	27.9	26.1	30.5	20.9	21.1	26.3	11.8	10.3	8.8	7.2	7.2
	Seychelles	5.3	0.6	0.1									0.0	0.0	0.1	0.0	0.1	0.1	0.5	1.0	2.2	3.7	7.0	6.1	4.1	5.6
	NEI-Deep-freezing	4.4	3.2	0.1	1.1	0.9	2.9	2.8	4.4	5.5	3.8	10.7	8.1	9.7	13.0	10.8	16.7	16.7	14.0	8.3	8.3	5.6	6.5	4.5	2.5	2.9
	NEI-Fresh Tuna	3.7	1.3					1.9	2.6	2.3	2.6	2.9	4.6	3.8	4.3	5.3	4.7	4.8	4.6	0.6	2.0	2.6	3.4	3.6	4.5	4.5
	Korea, Republic of	2.5	8.4	12.8	11.9	14.4	17.1	12.2	10.7	2.3	4.8	5.3	8.8	6.6	11.7	11.1	3.6	1.5	3.6	1.6	0.2	1.2	2.5	2.7	3.1	3.1
	Philippines	1.5	0.3														1.4	1.0	1.3	0.9	0.8	1.4	0.9	1.5	1.8	2.1
	NEI-Indonesia Fresh	0.0	1.5		0.1		2.0	7.5	9.2	9.4	11.4	9.2	11.9	6.5	2.7	2.9	0.2	0.0								
	Other Fleets	3.0	0.7	0.0	0.3	0.3	0.2	0.0	0.0	0.0	0.3	0.5	0.2	0.1	0.2	0.2	0.4	0.9	0.9	2.7	2.5	2.2	2.5	2.9	3.2	3.9
	Total	*96.2*	*53.3*	*44.9*	*46.6*	*51.2*	*57.0*	*56.6*	*60.4*	*60.8*	*60.1*	*84.5*	*89.7*	*88.9*	*101.9*	*112.9*	*112.3*	*109.0*	*98.6*	*94.3*	*109.2*	*103.1*	*109.0*	*91.7*	*85.0*	*91.9*
Other gears	*Total*	*1.7*	*0.5*	*0.3*	*0.2*	*0.4*	*2.2*	*0.7*	*0.7*	*0.7*	*0.5*	*0.6*	*0.7*	*1.2*	*0.9*	*0.9*	*0.9*	*1.2*	*0.6*	*1.1*	*1.2*	*1.3*	*1.2*	*1.2*	*2.4*	*2.2*
All	*Total*	*121.7*	*63.7*	*52.4*	*57.5*	*65.0*	*74.3*	*69.3*	*73.8*	*77.1*	*71.9*	*101.1*	*109.3*	*118.5*	*127.4*	*147.7*	*141.6*	*150.8*	*129.1*	*119.1*	*139.4*	*127.2*	*132.6*	*118.9*	*112.1*	*117.9*

Table 2. *2006 bigeye tuna stock assessment. Summary of results obtained by the ASPM stock assessment methods. B = Total biomass, SSB = spawning stock biomass. Brackets contain 90 % CI's.*

	ASPM Results
B_0	1,380,000 t
B_{2004}	720,000 t
B_{MSY}	
Ratio B_{2004} / B_0	0.52 (0.43-0.61)
Ratio B_{2004} / B_{MSY}	
SSB_0	1,150,000 t
SSB_{2004}	430,000 t
SSB_{MSY}	350,000 t
Ratio SSB_{2004} / SSB_{MSY}	1.34 (1.04-1.64)
Ratio SSB_{2004} / SSB_0	0.39 (0.31-0.47)
MSY	111,195 t (94,738-127,652)
C_{2004}	126,518 t
F_{2004}	0.29
F_{MSY}	0.30
Ratio F_{2004} / F_{MSY}	0.81 (0.54-1.08)

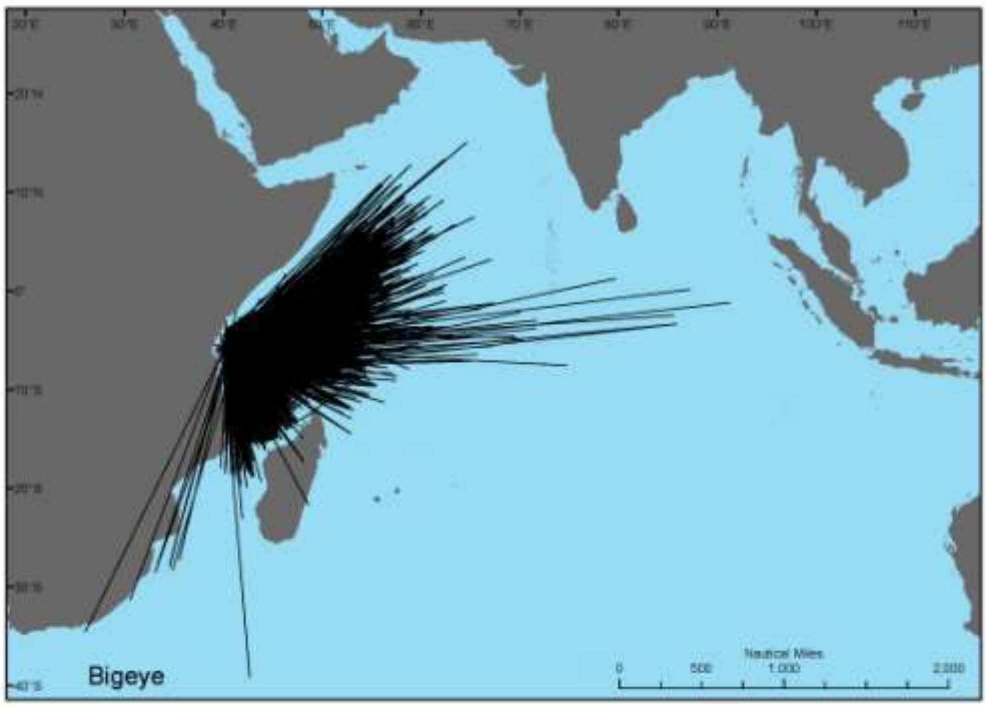


Figure 1. *Tag recapture trajectories for bigeye tuna tagged in the south west Indian Ocean by the RTTP-IO.* *Data as of December 2008.*

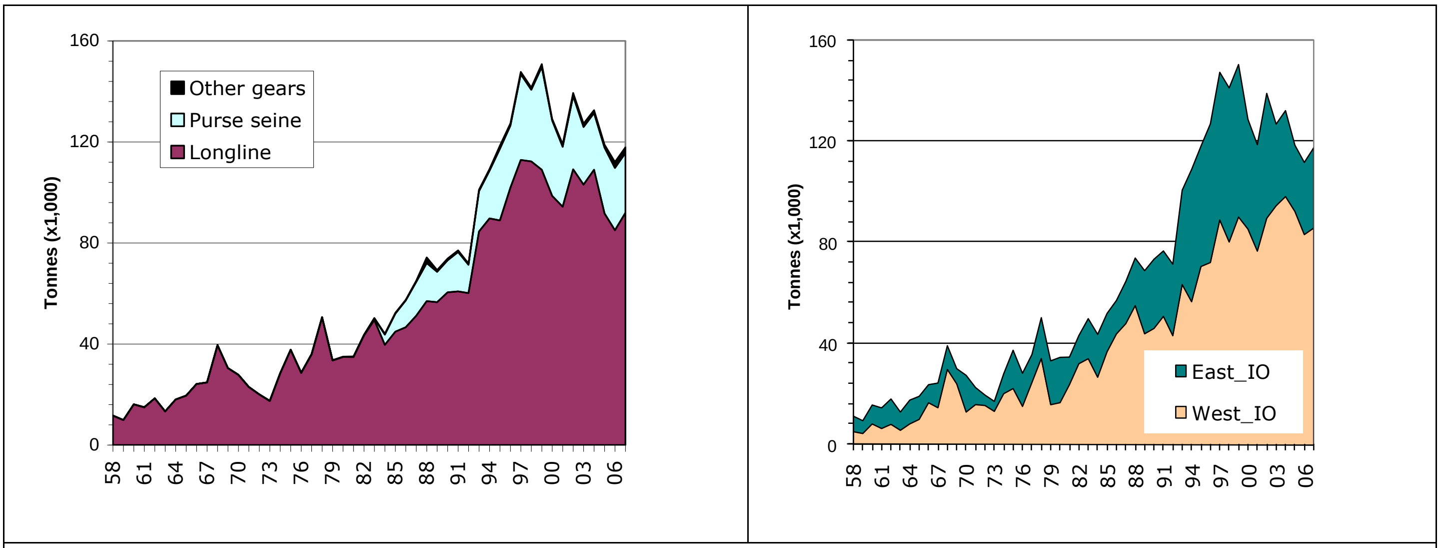


Figure 2. *Yearly catches (thousand of metric tonnes) of bigeye tuna by gear from 1958 to 2007 (left) and by area (Eastern and Western Indian Ocean, right.* Data as of October 2008

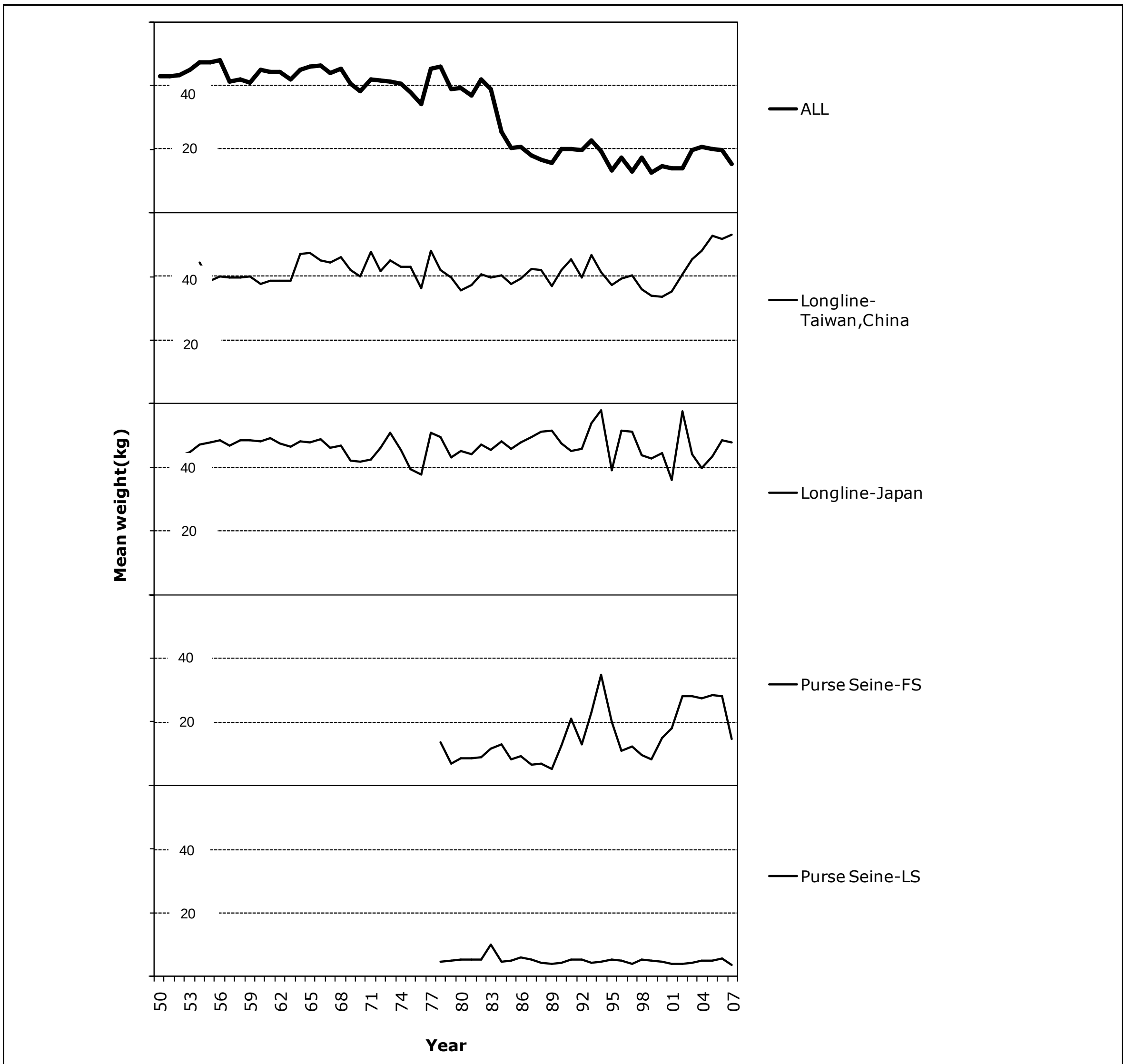


Figure 3*. Mean weight of bigeye measured from purse seine and longline catches over time. FS = free school; LS = log school.*

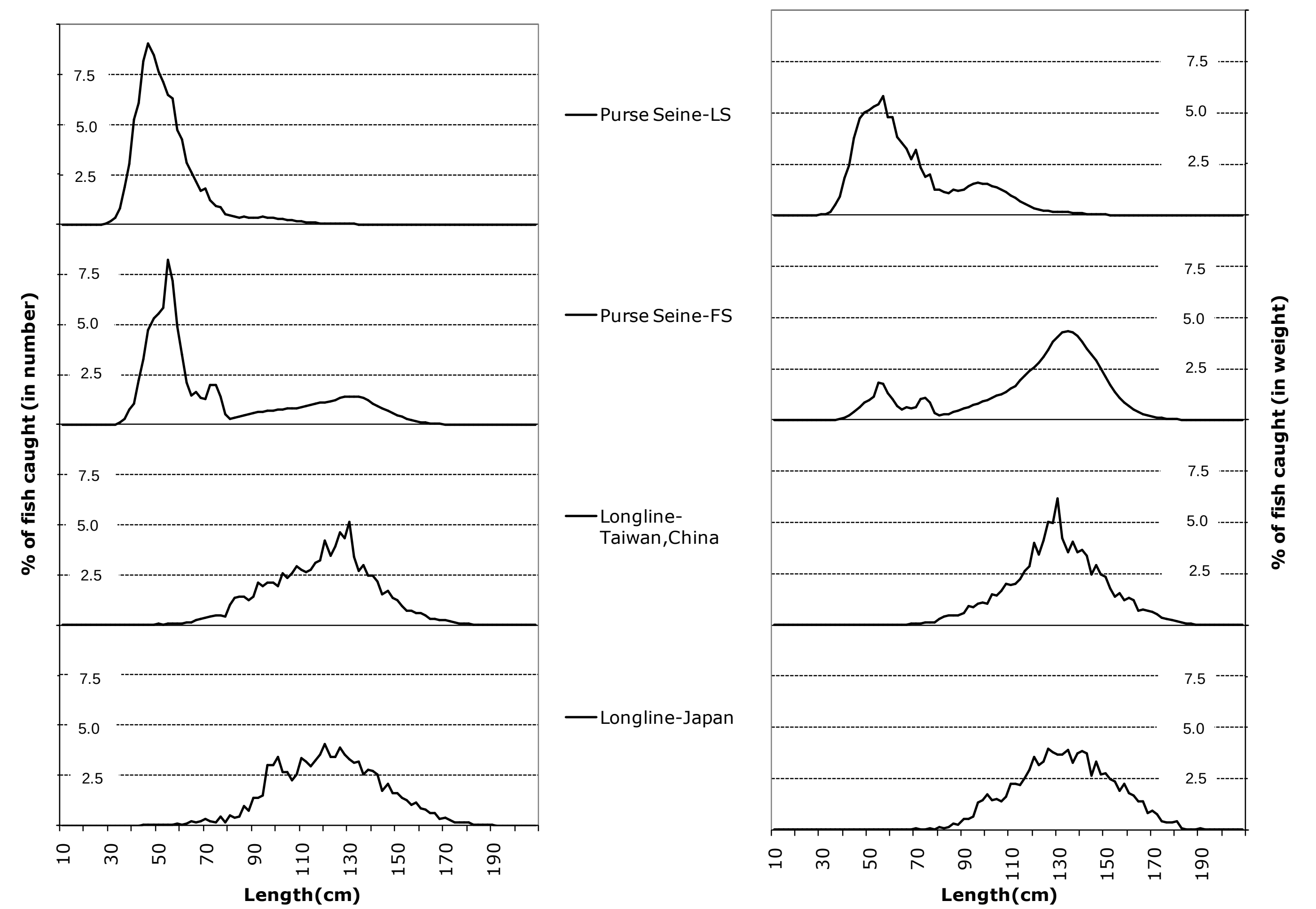


Figure 4. *Mean catch at size of bigeye measured from purse seine and longline catches from 1998-2007, in numbers (left panels) and weight (right panels). LS = log school; FS = free school.*

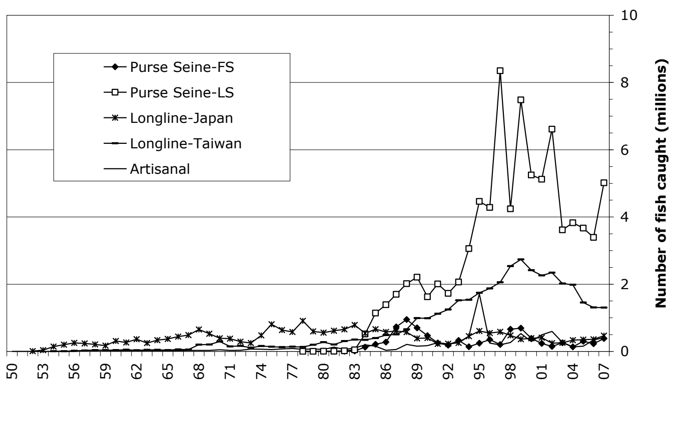


Figure 5. *Catch in numbers of bigeye tuna by gear (PS: purse seine (free school and log school); LL: longline and other gears). Data as of October 2008*

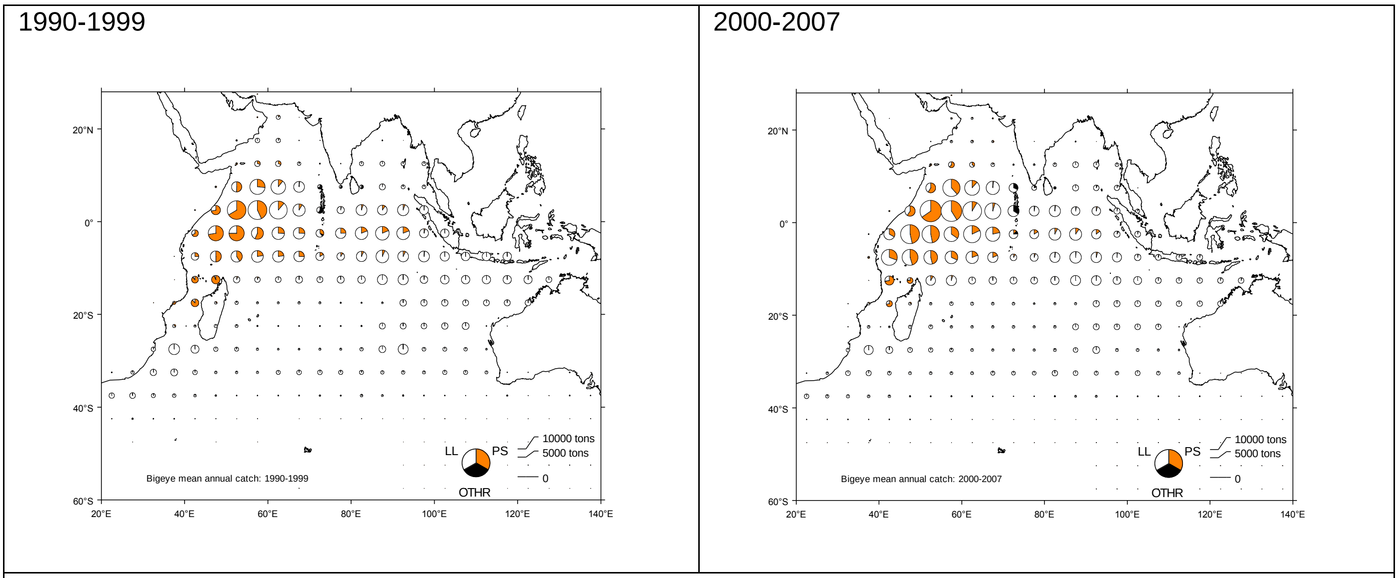


Figure 6. *Average annual bigeye catches by gear during the periods 1990-1999 and 2000-2007. LL = longline, PS = purse seine, SU = pole and line.* *Data as of October 2008*

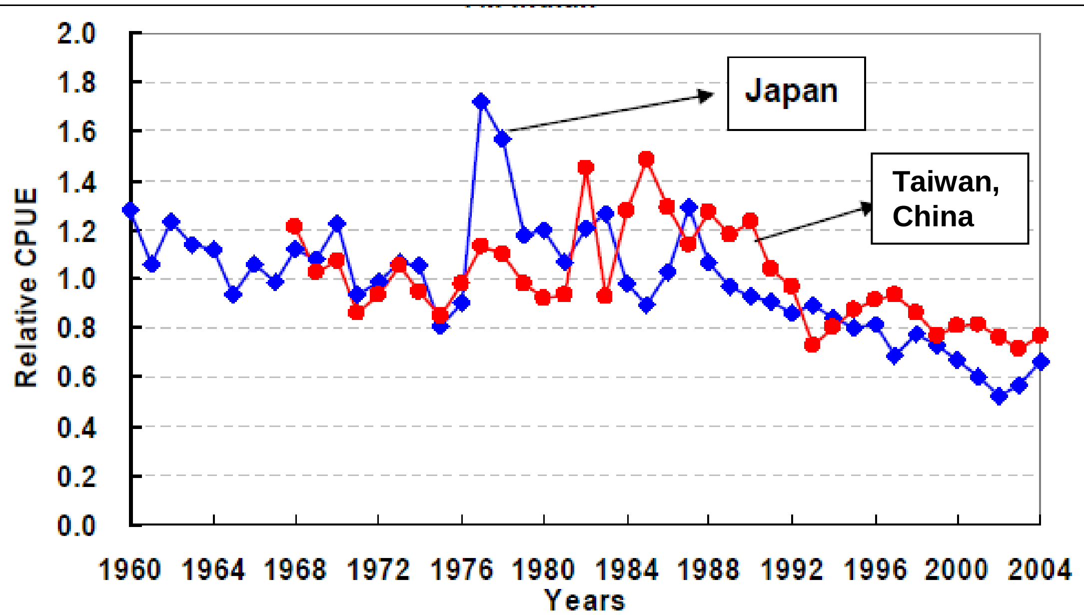


Figure 7. *Standardised CPUE indices for the Japanese and Taiwanese longline fleets in the Indian Ocean tropical waters*

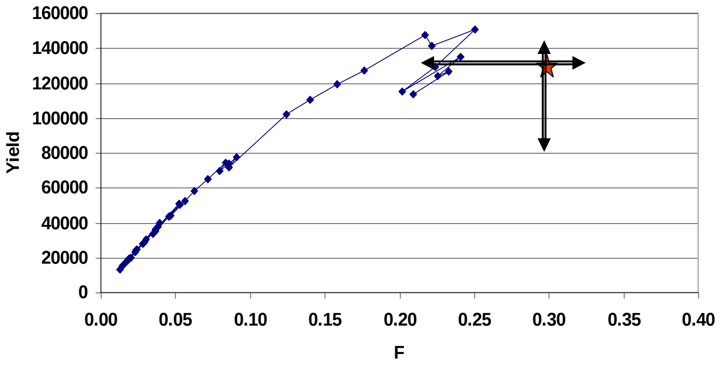


Figure 8*. 2006 bigeye tuna stock assessment: Plot of annual bigeye tuna catches as a function of mean fishing mortality derived from the ASPIC model. The star represents MSY and the arrowed lines represent the associated uncertainty (source A. Fonteneau).*

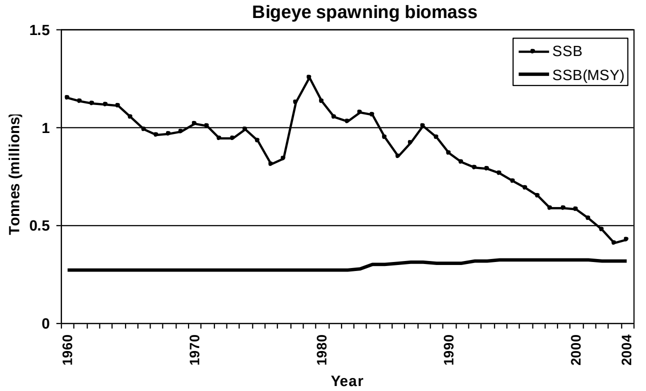


Figure 9*. 2006 bigeye tuna stock assessment (ASPM): Spawning stock trajectories relating estimates of annual spawning stock size and the estimated maximum sustainable yield of the spawning stock biomass.*

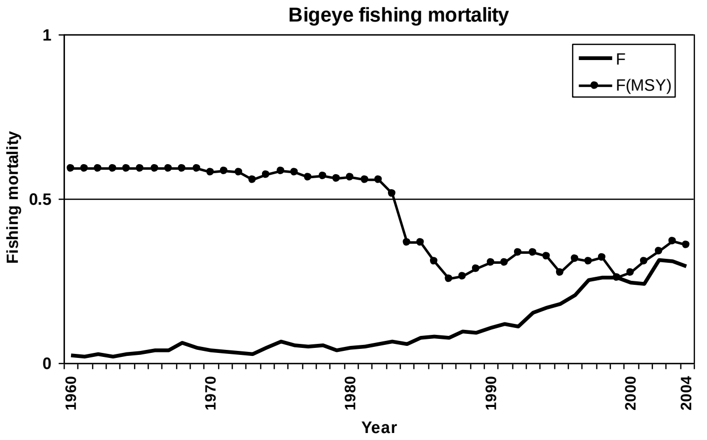


Figure 10*. 2006 bigeye tuna stock assessment (ASPM): Fishing mortality trajectories relating estimates of annual fishing mortality and the estimated maximum sustainable level of fishing mortality.*

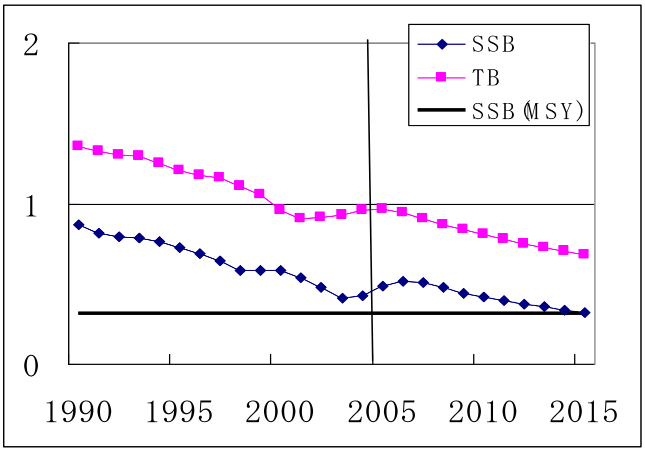
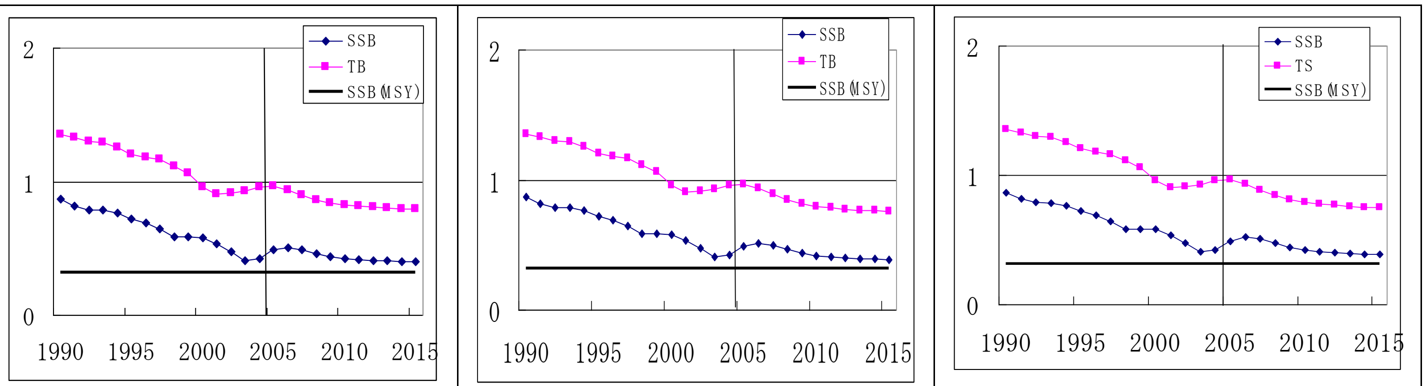


Figure 11*. 2006 bigeye tuna stock assessment: Forward projections from the ASPM model illustrating trends in total biomass and spawning biomass for bigeye tuna in the Indian Ocean if catches were maintained at the 2004 level.*



(a) F (2004) = 0.293

(b) F (2000-2002) = 0.265

(c) F (1998-2001) = 0.251

Figure 12. *2006 bigeye tuna stock assessment: Forward projections from the ASPM model illustrating trends in total biomass and spawning biomass for bigeye tuna in the Indian Ocean at various levels of fishing mortality (a) F in 2004 (b) F between 2000-02 (c) F between 1998 and 2001.*

Executive summary of the status of the skipjack tuna resource

(as adopted by the IOTC Scientific Committee, December 2008)

BIOLOGY

Skipjack tuna (*Katsuwonus pelamis*) is a cosmopolitan species found in the tropical and subtropical waters of the three oceans. It generally forms large schools, often in association with other tunas of similar size such as juveniles of yellowfin and bigeye.

Skipjack exhibits characteristics that result in a higher productivity when compared to other tuna species. Tagging recoveries of the RTTP-IO show that skipjack is exploited for at least 4 to 5 years in the Indian Ocean. This species has a high fecundity, and spawns opportunistically throughout the year in the whole inter-equatorial Indian Ocean (north of 20°S, with surface temperature greater than 24°C) when conditions are favourable. The size at first maturity is about 41-43 cm for both males and females (and as such most of the skipjack taken by the fisheries are fish that have already reproduced).

The growth of skipjack has now been estimated utilising the RTTP-IO tag/recovery data. These results are consistent with the results obtained in the mid 1990's using data from the IPTP tagging programme in Maldives. Skipjack recoveries indicate that the species is highly mobile, and covers large distances. The average distance between skipjack tagging and recovery positions is estimated at 640 naut. miles.

The tag recoveries from the RTTP-IO provide evidence of rapid, large scale movements of skipjack tuna in the Indian Ocean, thus supporting the current assumption of a single stock for the Indian Ocean. The new information on the spatial distribution of tagged fish is presented in Figure 1.

Because of the above characteristics, skipjack tuna stocks are considered to be resilient and not prone to overfishing.

FISHERIES

Catches of skipjack increased slowly from the 1950s, reaching around 50,000 t at the end of the 1970s, mainly due to the activities of baitboats (or pole and line) and gillnets. The catches increased rapidly with the arrival of the purse seiners in the early 1980s, and skipjack became one of the most important tuna species in the Indian Ocean. Annual total catches exceeded 400,000 t in the late 1990's and the average annual catch for the period from 2003 to 2007 was 509,000 t (Figure 2, 3 and Table 1). Preliminary data indicate that catches in 2007 may have been the lowest reported since 2002 447,100 t).

In recent years, the proportions of the catch taken by the industrial purse seine fishery and the various artisanal fisheries (baitboat, gillnets and others) have been fairly consistent, the majority of the catch originating from the western Indian Ocean (Figure 3). In general, there is low inter-annual variability in the catches taken in the Indian Ocean compared to those taken in other oceans.

The increase of skipjack catches by purse seiners is due to the development of a fishery in association with Fish Aggregating Devices (FADs). Currently, 80 % of the skipjack tuna caught by purse-seine is taken under FADs. Catch rates by purse seiners show an increasing trend in two of the three main fishing areas (Figure 4) possibly due to an increase in fishing power and to an increase in the number of FADs (and the technology associated with them) in the fishery.

The Maldivian fishery has effectively increased its fishing effort with the mechanisation of its pole and line fishery since 1974, and the use of anchored FADs since 1981. Skipjack represents some 75 % of its total catch, and catch rates have regularly increased since the beginning of the 1980s (Figure 5).

Little information is available on the gillnet fisheries (mainly from Sri Lanka, Iran, Pakistan, India and Indonesia). However, it is estimated that the gillnet fisheries take around 30 to 40 % of the total catch of skipjack.

The average weight of skipjack caught in the Indian Ocean is around 3.0 kg for purse-seine , 2.8 kg for the Maldivian baitboats and 4-5 kg for the gillnet (Figure 6). For all fisheries combined, it fluctuates between 3.0-3.5 kg; this is larger than in the Atlantic, but smaller than in the Pacific.

Catch rates declined in 2007 in both the industrial purse seine fishery and Maldives artisanal fishery. While the activities of pirates off the coast of Somalia have meant that vessels have been avoiding traditional skipjack fishing grounds where catch rates were high, it appears that the decline in catch rates in the Maldives fishery could be due to environmental causes such as higher than average sea surface temperatures. The marked increase of the fuel price appears also to have substantially reduced the fishing operations in the Maldivian fishery.

AVAILABILITY OF INFORMATION FOR STOCK ASSESSMENT

In 2008, a review of skipjack was undertaken including the examination of a range of stock status indicators and exploitation rates derived from external analyses of the tagging data.

Fishery indicators

As an alternative, the WPTT decided to analyse various fishery indicators to gain a general understanding of the state of the stock. Several of these indicators were updated in 2008.

1. **Trends in catches**: The trend in catches indicate a large and continuous increase in the catches of skipjack tuna since the mid-1980’s (Figure 3). This is mainly due to the expansion of the FAD-associated fishery in the western Indian Ocean. There is no sign that the rate of increase in the catches of skipjack is diminishing.
2. **Nominal CPUE Trends:** Figure 4 shows the catch and nominal CPUE trends of the purse seine fishery for three major skipjack fishing areas: East-Somalia, North-West Seychelles and Mozambique Channel. In the Somalia and North-West Seychelles areas, catches have been variable but generally increasing. In each of these areas, despite some inter annual variation, the current nominal CPUE’s are around the same as those of the early 1990’s. Since this is a period during which it is believed that effective purse-seine effort has increased substantially (increase of efficiency), it is likely that the true abundance in these areas has decreased. In itself, this is not unexpected given the large increase in catches over that period. However, as these areas may be source of skipjack recruitment to the Maldives artisanal fishery, there is a potential for interactions to occur between these fisheries.

In 2008, attempts to calculate standardised CPUEs from the purse seine fishery were carried out. The standardized CPUE showed a declining trend from 1984 to 1998, then an increase till 2003 and a marked decrease from 2006 to 2007. This analysis is still provisional and could be much improved by incorporating detailed information reflecting changes in the fishing power and efficiency of purse seiners over time.

3. **Average weight in the catch by fisheries:** The average weights of skipjack taken by various gears and all gears combined have remained relatively stable since 1991 (Figure 6). The purse seine and the baitboat fisheries take the greatest catch of fish around 40-65 cm while 70-80 cm fish are mainly taken by the gillnet fisheries.
4. **Number of 1 CWP squares visited or fished:** This indicator (Figure 7) reflects the spatial extension of a fishery. Trends observed in the number of CWP with effort or catch since 1991 suggest that the area exploited by the purse-seine fishery has changed little since 1991, apart in 1998 when a particularly strong El Niño episode resulted in a much wider spatial distribution of the fishery.

Length-based analyses

The WPTT has not developed a formal stock assessment for skipjack tuna; however, a length-based cohort analysis has been carried out to analyze skipjack catches and length frequencies. In the 1980’s, there was a marked increase of catches of smaller size fish (40-60 cm) due to the development of the purse seine fishery (Figure 8). The largest skipjack (60 cm+) tend to be taken by the artisanal fisheries (e.g. gillnets, troll line and handlines) and the Maldives’s pole-and-line fishery (Figure 9). The marked increase in the catch of large skipjack (60-70 cm) by gillnets since 2000 is reflected by marked increase of the mean weight of skipjack caught by this gear (Figure 6).

Interaction between skipjack fisheries and other species

Purse seiners catch 40-60 cm skipjack whereas artisanal fisheries catch 60-70 cm fish (Figure 9), thus the fishing pressure applied by purse seiners on smaller size skipjack is likely to affect the catches of larger sized skipjack by the artisanal fisheries. Furthermore, large numbers of juvenile bigeye and yellowfin tuna are caught in the course of purse-seine sets on FADs that target skipjack tuna.

Managers need to be aware that such interactions between fleets, gears and species have the potential to cause competition and conflict and may affect the efficacy of management measures aimed at particular fleets or gears in isolation. For example, the western Indian Ocean purse-seine fishery for small skipjack versus the Maldivian baitboat fishery for larger skipjack; and the purse seine fishery for skipjack which catches juvenile bigeye versus the bigeye longline fishery; the purse seine catch of juvenile yellowfin on FADs versus their catch of large free school yellowfin). Such interactions have to be taken in account when management decisions are considered.

STOCK ASSESSMENT

No quantitative stock assessment is currently available for skipjack tuna in the Indian Ocean. The range of stock indicators available to the Scientific Committee does not signal that there are any problems in the fishery currently.

External analyses on the tagging data were conducted in 2008. For both 2006 and 2007 the estimated numbers of skipjack recruits in the Western Indian Ocean were larger than those for both bigeye and yellowfin (even though they included older aged fish), confirming that substantially larger numbers of skipjack are present in the Indian Ocean compared to yellowfin and bigeye tuna. Exploitation rates of skipjack are relatively low - not exceeding 20% even for the most selected age-range of the stock. Abundance in 2006 was estimated to be higher than that in 2007, while the relative age-structure remained stable, with a similar decrease in relative abundance from ages 2 to 5. This indicates that the population has a reasonably stable year-class regime at least for the cohorts that encompass the data used in the analysis (2000-2005).

The Scientific Committee also notes that in most fisheries, declining catches combined with increasing effort are usually indicators that a stock is being exploited close or above its MSY. In the case of skipjack tuna, catches have continued to increase as effort has increased. However, the Scientific Committee noted that skipjack catches declined in 2007 and this trend appears to have continued in 2008 (based on 2008 purse seine data), and the causes of this decline should be examined. Furthermore, the majority of the catch comes from fish that are sexually mature (greater than 40 cm) and therefore likely to have already reproduced.

The Scientific Committee noted that, although there might be no reason for immediate concern, it is clear that the catches cannot be increased at the current rate indefinitely and that the potential interaction between fisheries could be a source of increasing concern. Therefore, it recommends that skipjack be monitored regularly.

MANAGEMENT ADVICE

The high productivity life history characteristics of skipjack tuna suggest this species is resilient and not prone to overfishing, and the stock status indicators indicate that there is no need for immediate concern about the status of skipjack tuna.

SKIPJACK TUNA SUMMARY

Maximum Sustainable Yield:	unknown
Preliminary catch in 2007 *(data as of October 2008)*	447,100 t
Catch in 2006	612,900 t
Mean catch over the last 5 years (2003-07)	509,000 t
Current Replacement Yield:	-
Relative Biomass (B_{cur}/B_{MSY}):	unknown
Relative Fishing Mortality (F_{cur}/F_{MSY}):	unknown

***Table 1.** Best scientific estimates of the catches of skipjack tuna (as adopted by the IOTC Scientific Committee) by gear and main fleets for the period 1958-2007 (in thousands of tonnes).Data as of October 2008*

Gear	Fleet	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84
Purse seine	Spain																											6.4
	France																								0.2	1.0	9.4	27.3
	NEI-Other																										0.4	8.2
	Indonesia	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.3	0.3	0.4	0.6	0.4	0.4	0.6	0.7	0.7	1.0	1.2	1.0
	Japan																				0.1	0.9	0.6	0.4	0.1	0.5	0.6	0.7
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.8	2.7	1.5	3.1
	Total	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.4*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.1*	*0.2*	*0.2*	*0.3*	*0.3*	*0.4*	*0.6*	*0.6*	*1.3*	*1.2*	*2.1*	*2.7*	*5.2*	*13.1*	*46.8*
Baitboat	Maldives	10.0	10.0	9.0	8.0	8.0	8.0	8.0	14.1	16.9	18.9	17.5	19.6	27.6	28.0	17.5	19.5	22.5	14.9	18.6	13.7	13.2	17.3	22.2	19.6	15.3	19.3	32.3
	Indonesia	0.8	0.8	0.8	1.0	1.0	1.0	1.1	1.2	1.3	1.3	1.4	1.5	1.1	1.1	1.7	1.9	2.1	3.2	4.3	3.2	3.1	4.7	5.2	5.3	7.7	9.1	7.8
	India	0.3	0.2	0.4	0.6	0.2	0.4	0.3	0.3	0.2	0.3	0.3	0.3	0.3	0.6	0.6	2.6	0.8	1.0	1.9	1.3	1.7	2.3	2.7	1.7	2.2	2.5	3.2
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.3	5.0	10.8	2.1	0.1	0.6	0.8	0.4	0.0	0.2	0.7	0.6	0.4
	Total	*11.1*	*11.0*	*10.2*	*9.6*	*9.2*	*9.4*	*9.3*	*15.6*	*18.4*	*20.5*	*19.2*	*21.3*	*29.2*	*29.8*	*20.1*	*29.1*	*36.2*	*21.3*	*24.9*	*18.8*	*18.8*	*24.6*	*30.1*	*26.8*	*25.9*	*31.4*	*43.7*
Gillnet	Sri Lanka	1.8	1.9	2.4	3.0	4.5	6.1	5.8	5.6	6.4	7.1	8.0	8.9	6.9	5.0	8.9	10.5	9.3	7.2	12.7	12.6	14.8	12.4	16.3	18.4	18.0	16.3	13.3
	Indonesia	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.3	0.3	0.5	0.5	0.5	0.8	1.1	0.8	0.8	1.2	1.3	1.4	2.0	2.4	2.0
	Pakistan	0.9	0.9	1.2	1.0	1.6	2.4	3.4	3.6	4.9	4.7	4.7	4.3	3.9	3.2	3.8	3.0	4.1	4.5	4.2	3.8	2.2	3.8	1.8	2.7	3.4	1.1	1.2
	Other Fleets	0.3	0.3	0.5	0.8	0.2	0.4	0.4	0.3	0.3	0.4	0.4	0.3	0.4	0.7	0.8	3.2	1.0	1.3	2.6	1.5	2.0	2.8	0.2	0.3	0.6	0.3	0.4
	Total	*3.2*	*3.3*	*4.3*	*5.0*	*6.6*	*9.2*	*9.8*	*9.9*	*11.8*	*12.6*	*13.5*	*13.9*	*11.5*	*9.2*	*13.9*	*17.2*	*15.0*	*13.9*	*20.7*	*18.8*	*19.9*	*20.2*	*19.7*	*22.8*	*24.0*	*20.2*	*17.0*
Line	Indonesia	0.4	0.3	0.3	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.5	0.5	0.8	0.9	1.0	1.5	2.0	1.5	1.4	2.2	2.4	2.4	3.6	4.2	3.6
	Other Fleets	0.5	0.5	0.6	0.7	1.0	1.4	1.3	1.2	1.4	1.6	1.8	2.0	3.1	2.8	3.1	3.7	3.5	3.5	4.7	4.2	4.2	3.8	4.7	5.1	3.3	3.4	3.4
	Total	*0.8*	*0.8*	*1.0*	*1.2*	*1.4*	*1.8*	*1.8*	*1.8*	*2.0*	*2.2*	*2.4*	*2.7*	*3.6*	*3.3*	*3.9*	*4.6*	*4.4*	*5.0*	*6.7*	*5.7*	*5.6*	*6.0*	*7.1*	*7.5*	*6.8*	*7.6*	*7.0*
Other gears	Indonesia	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.4	0.4	0.3	0.3	0.5	0.5	0.6	0.9	1.2	0.9	0.8	1.2	1.4	1.4	2.1	2.4	2.1
	Other Fleets	0.2	0.2	0.4	0.4	0.4	0.3	0.3	0.3	0.5	0.4	0.6	0.3	0.2	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	*0.4*	*0.4*	*0.6*	*0.6*	*0.7*	*0.5*	*0.6*	*0.7*	*0.9*	*0.7*	*1.0*	*0.7*	*0.5*	*0.4*	*0.7*	*0.5*	*0.6*	*0.9*	*1.2*	*0.9*	*0.9*	*1.3*	*1.4*	*1.4*	*2.1*	*2.4*	*2.1*
All	*Total*	*15.7*	*15.7*	*16.2*	*16.6*	*18.1*	*21.1*	*22.0*	*28.1*	*33.4*	*36.2*	*36.3*	*38.8*	*45.0*	*42.9*	*38.8*	*51.8*	*56.5*	*41.5*	*54.1*	*44.7*	*46.5*	*53.4*	*60.4*	*61.2*	*64.0*	*74.6*	*116.5*

Gear	Fleet	Av03/07	Av58/07	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07
Purse seine	Spain	86.1	28.5	18.6	19.1	27.9	39.7	63.9	47.9	41.8	46.7	51.3	61.6	69.6	66.3	62.9	58.6	74.3	79.4	68.5	91.3	88.0	64.4	94.3	118.9	65.0
	France	39.7	19.2	29.8	36.1	35.6	36.1	43.1	29.0	39.4	45.0	48.2	58.4	48.7	40.1	31.3	30.3	42.7	39.9	36.3	54.4	38.9	38.0	43.2	48.1	30.4
	Seychelles	38.0	5.8							1.8	0.6					4.9	10.7	15.8	11.6	26.2	29.9	36.8	30.0	46.0	47.5	29.7
	NEI-Ex-Soviet Union	11.3	4.0						0.7		10.1	8.7	8.2	18.4	14.7	11.2	10.2	17.3	19.8	19.2	6.8	24.7	17.8	11.3	2.8	
	NEI-Other	7.2	7.6	8.4	6.4	4.8	7.0	7.9	11.0	10.8	10.8	17.4	24.5	22.3	18.4	24.3	31.2	33.4	40.8	26.4	31.9	20.6	4.7	4.0	4.5	2.2
	Thailand	6.7	0.7																1.1	0.5				8.0	16.9	8.4
	Indonesia	6.4	1.6	1.1	1.1	1.3	1.4	1.6	1.4	1.5	1.6	1.9	2.0	1.9	2.7	3.1	2.9	3.0	3.0	3.6	2.3	2.4	3.3	3.0	11.7	11.7
	Japan	2.6	3.6	0.3	0.6	0.9	2.3	3.4	10.9	15.9	31.6	31.3	20.1	16.1	7.0	6.7	5.7	4.6	2.3	1.8	1.9	2.4	1.5	3.1	2.0	4.0
	Other Fleets	2.5	3.2	3.2	4.5	10.1	7.9	8.4	8.8	13.1	6.4	7.1	6.3	3.9	2.7	4.9	3.2	9.4	4.9	9.7	22.4	0.0	0.1	1.2	6.3	5.0
	Total	*200.6*	*74.4*	*61.5*	*67.7*	*80.6*	*94.3*	*128.5*	*109.7*	*124.3*	*153.0*	*165.9*	*181.2*	*180.9*	*151.8*	*149.4*	*152.9*	*200.6*	*202.8*	*192.1*	*240.9*	*214.0*	*159.8*	*214.1*	*258.6*	*156.5*
Baitboat	Maldives	115.0	44.6	42.2	45.1	42.6	58.2	57.8	60.7	58.3	57.6	58.0	69.0	69.9	66.2	68.1	77.8	92.3	78.8	86.8	113.9	107.5	104.5	130.4	136.7	95.8
	Indonesia	14.5	8.6	8.5	8.1	10.0	10.5	12.3	10.7	11.5	12.1	14.4	15.1	14.5	19.8	23.4	21.6	22.2	22.1	26.5	17.3	18.0	24.7	22.1	3.8	3.8
	India	4.4	2.9	3.1	4.0	5.4	4.7	5.9	5.4	5.6	5.9	12.7	6.8	6.9	7.2	7.8	2.0	2.3	4.6	2.7	3.2	3.1	4.0	0.4	7.2	7.2
	Other Fleets	0.0	0.6	0.4	0.5	0.6	0.5	0.5	0.6	0.6	0.7	0.7	0.1	0.5	0.2	0.0	1.9	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	*133.9*	*56.7*	*54.2*	*57.7*	*58.7*	*73.9*	*76.5*	*77.5*	*76.0*	*76.3*	*85.8*	*90.8*	*91.8*	*93.4*	*99.3*	*103.3*	*117.4*	*105.5*	*116.1*	*134.3*	*128.6*	*133.2*	*152.9*	*147.8*	*106.8*
Gillnet	Sri Lanka	68.7	26.1	14.9	14.6	15.3	15.9	17.4	20.5	23.1	27.0	31.5	38.8	40.6	47.3	56.1	56.9	72.6	79.4	74.7	72.9	83.0	83.2	48.0	60.2	69.3
	Iran, Islamic Republic	67.1	9.0					0.3	0.8	1.1	4.3	4.4	7.4	1.1	2.5	8.3	4.7	13.9	18.5	23.2	23.1	36.0	53.6	79.4	98.8	67.6
	Indonesia	10.7	2.9	2.2	2.1	2.6	2.7	3.2	2.8	3.0	3.2	3.8	3.9	3.8	5.2	6.1	5.6	5.8	5.8	6.9	4.5	4.7	6.4	5.8	18.3	18.3
	Pakistan	4.3	3.9	2.0	1.5	3.7	5.6	7.5	7.7	7.5	6.1	6.9	8.1	7.1	4.4	4.6	4.5	4.9	4.7	3.7	3.5	3.4	3.7	4.1	5.2	5.2
	Other Fleets	1.0	0.9	0.5	0.5	0.5	0.6	0.9	0.9	0.6	0.7	1.1	1.2	1.4	1.2	1.8	0.6	0.7	0.8	1.1	0.4	0.5	0.7	1.0	1.3	1.3
	Total	*151.8*	*42.8*	*19.6*	*18.8*	*22.2*	*24.8*	*29.3*	*32.6*	*35.4*	*41.3*	*47.7*	*59.5*	*54.1*	*60.5*	*76.9*	*72.4*	*97.8*	*109.1*	*109.6*	*104.4*	*127.6*	*147.6*	*138.3*	*183.7*	*161.7*
Line	Indonesia	11.1	4.4	3.9	3.7	4.6	4.8	5.7	4.9	5.3	5.6	6.6	6.9	6.7	9.1	10.8	9.9	10.2	10.2	12.2	8.0	8.3	11.4	10.2	12.8	12.8
	Other Fleets	7.1	3.9	3.2	3.3	3.3	3.4	6.2	6.3	6.3	10.7	7.7	4.5	4.7	4.5	4.8	4.5	3.5	3.9	4.0	4.8	4.0	9.5	6.2	8.2	7.7
	Total	*18.2*	*8.3*	*7.1*	*7.0*	*7.9*	*8.3*	*11.8*	*11.3*	*11.6*	*16.2*	*14.4*	*11.5*	*11.4*	*13.6*	*15.6*	*14.4*	*13.8*	*14.1*	*16.2*	*12.8*	*12.2*	*20.9*	*16.3*	*21.0*	*20.5*
Other gears	Indonesia	4.3	2.3	2.3	2.2	2.7	2.8	3.3	2.9	3.0	3.2	3.8	4.0	3.8	5.3	6.2	5.7	5.9	5.9	7.1	4.6	5.3	7.0	6.2	1.4	1.4
	Other Fleets	0.3	0.2	0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.2	0.6	0.1	0.3	0.3	0.2
	Total	*4.6*	*2.5*	*2.3*	*2.2*	*2.7*	*2.9*	*3.4*	*3.0*	*3.1*	*3.3*	*4.1*	*4.1*	*4.0*	*5.4*	*6.3*	*5.8*	*6.0*	*5.9*	*7.1*	*4.8*	*6.0*	*7.1*	*6.5*	*1.8*	*1.7*
All	*Total*	*509.0*	*184.7*	*144.7*	*153.4*	*172.2*	*204.1*	*249.5*	*234.0*	*250.4*	*290.1*	*317.8*	*347.1*	*342.2*	*324.6*	*347.5*	*348.9*	*435.6*	*437.5*	*441.0*	*497.2*	*488.4*	*468.5*	*528.1*	*612.9*	*447.1*

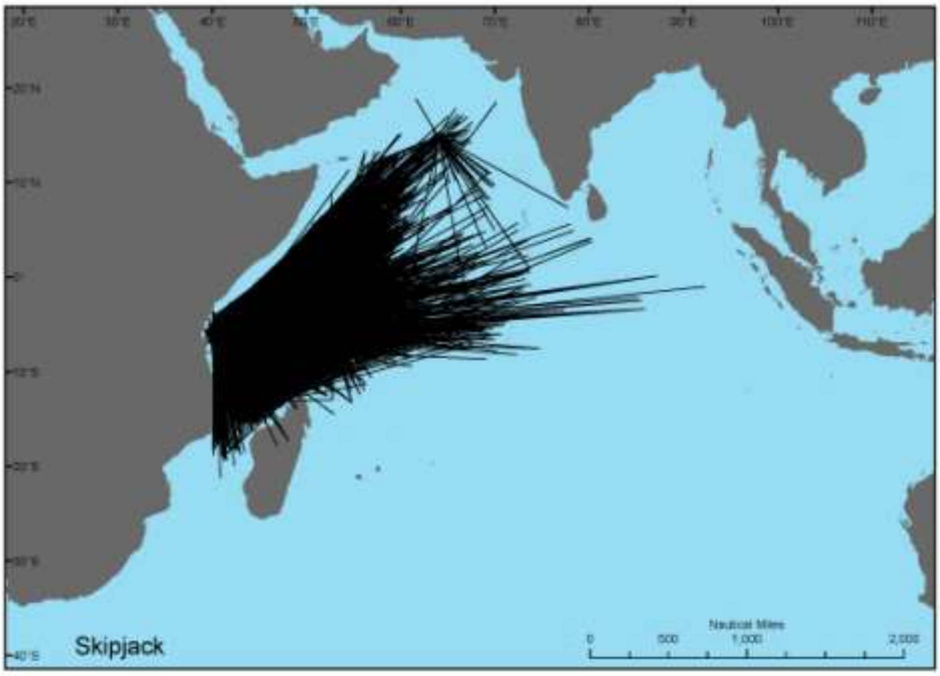


Figure 1. *Tag recapture trajectories for skipkjack tuna tagged in the south west Indian Ocean by the RTTP-IO. Data as of December 2008.*

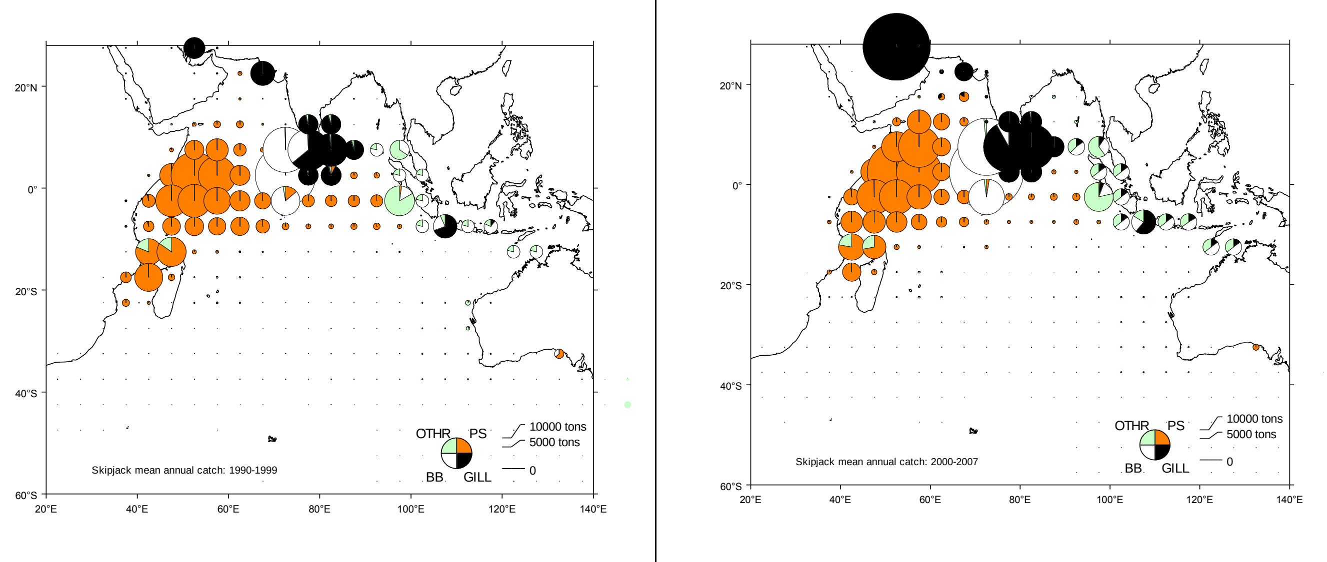


Figure 2. *Average annual skipjack catches by gear during the periods 1990-1999 and 2000-2007. LL = longline, PS = purse seine, GILL = gillnet, BB = bait boat/pole and line, OTHR = other gears. Note, due to a lack of spatial information, gillnet catches are aggregated into one 5 degree square, when in reality they have been taken over a wider area. Data as of October 2008*

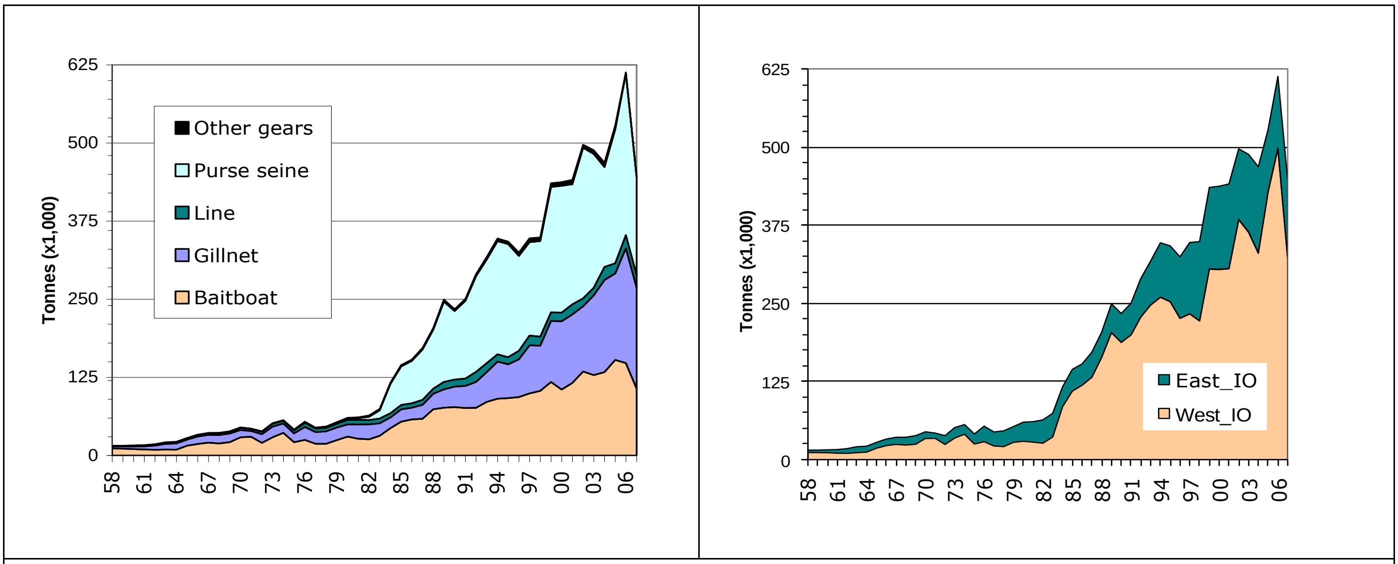


Figure 3. *Yearly catches (thousand of metric tonnes) of skipjack tuna by gear (left) and by area (Eastern and Western Indian Ocean (right) from 1958 to 2007. Data as of October 2008*

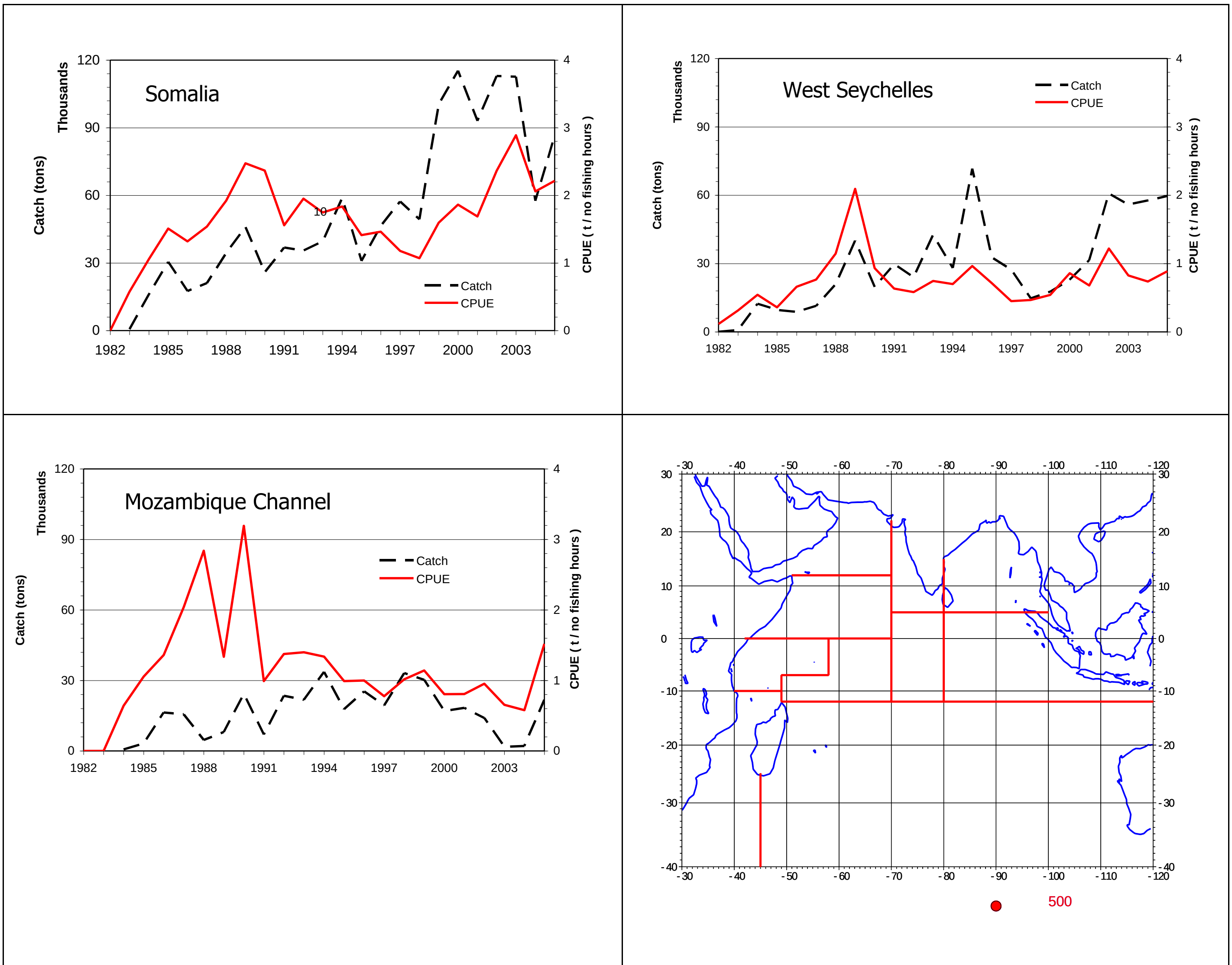


Figure 4. *Nominal CPUEs for three important purse seine fishing ground areas: East Somalia (top left); Mozambique Channel (top right) and North-West Seychelles (bottom left). Areas used for the calculation of the CPUE trends are represented (bottom right). Data as of July 2006*

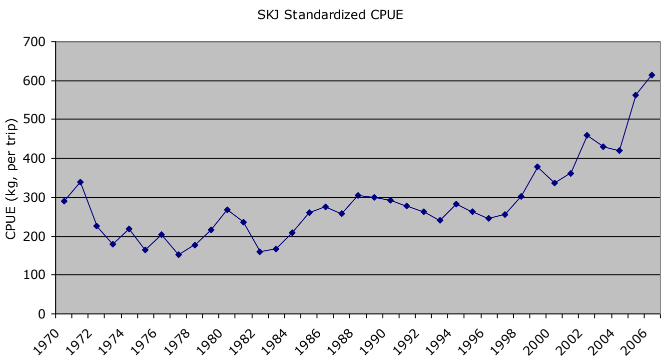


Figure 5. *Time series of CPUE, nominal and adjusted effort of the Maldivian baitboats fishery, 1970-2002 (from IOTC-2007-WPTT-R).*

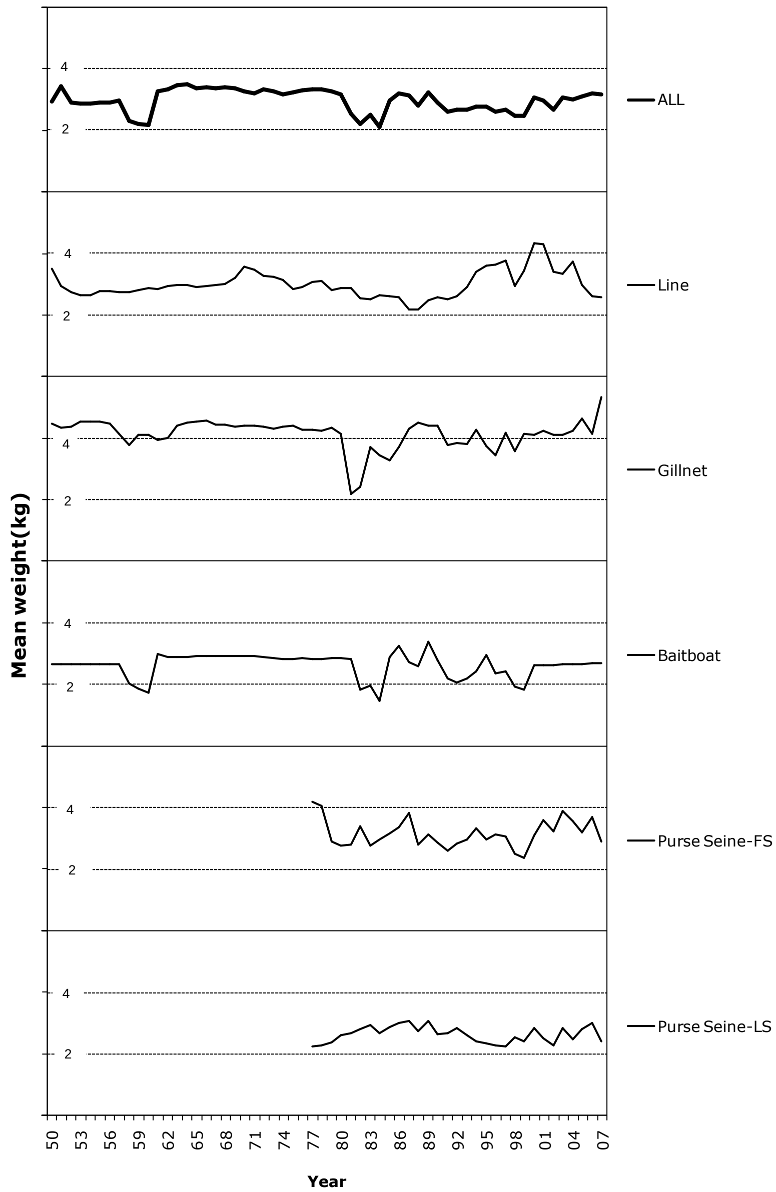


Figure 6. *Skipjack tuna average weight by main gear (from size-frequency data) and for the whole fishery (estimated from the total catch at size), 1950-2007. FS = free school; LS = log school*

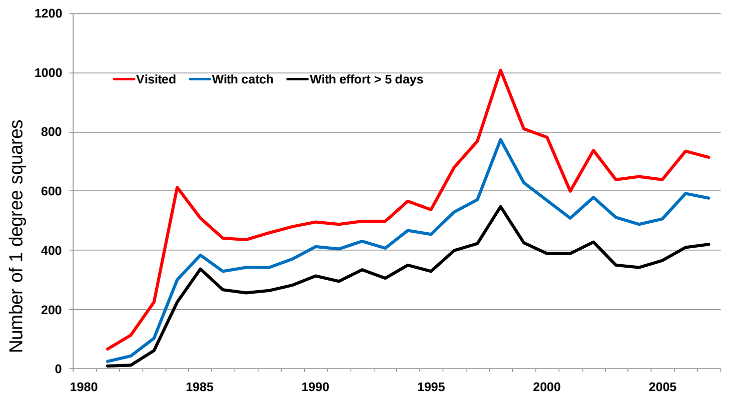


Figure 7. *Number of one degree CWP squares explored by the purse seine fishery.*

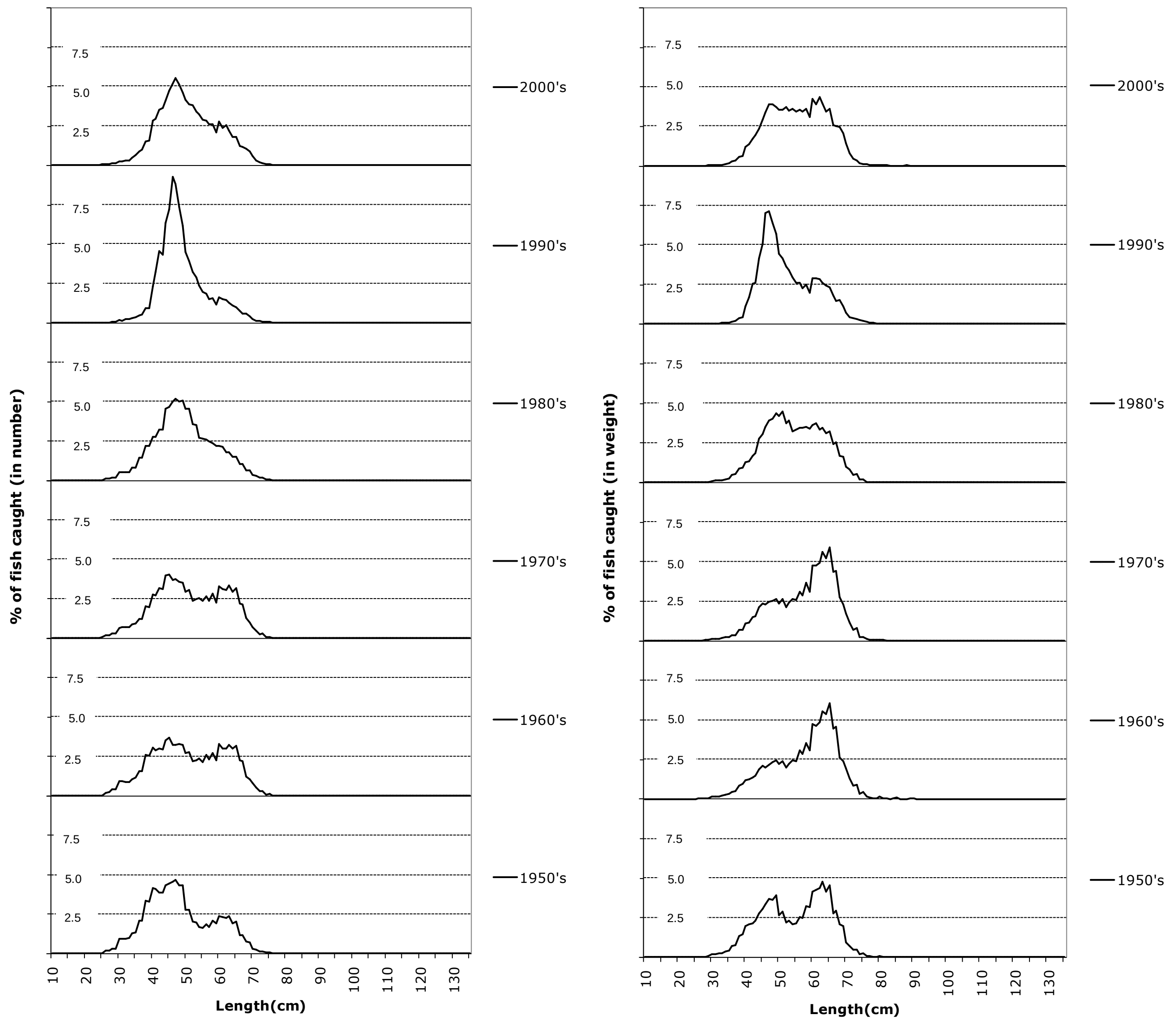


***Figure 8**. Mean catch by size of skipjack tuna in numbers (left panels) and weight (right panels) from the 1950's to present.*

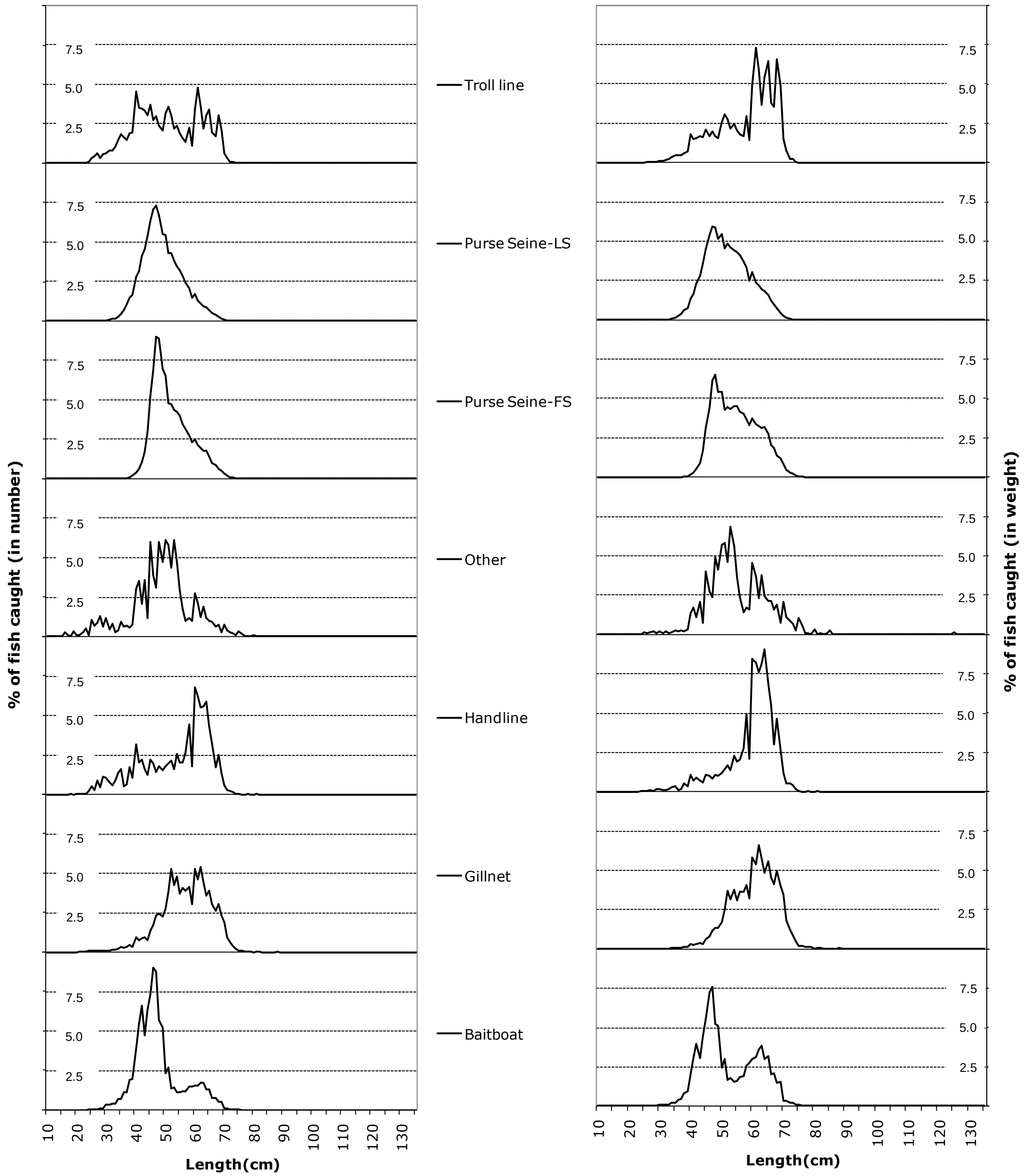


***Figure 9.** Mean catch at size of skipjack tuna by gear for 1998-2007: in number (left panels) and in weight (right panels). FS = free school. LS = log school.*

Executive summary of the status of the yellowfin tuna resource

(as adopted by the IOTC Scientific Committee, December 2008)

BIOLOGY

Yellowfin tuna *(Thunnus albacares)* is a cosmopolitan species distributed mainly in the tropical and subtropical oceanic waters of the three major oceans, where it forms large schools. The sizes exploited in the Indian Ocean range from 30 cm to 180 cm fork length. Smaller fish (juveniles) form mixed schools with skipjack and juvenile bigeye tuna and are mainly limited to surface tropical waters, while larger fish are found in surface and sub-surface waters. Intermediate age yellowfin are seldom taken in the industrial fisheries, but are abundant in some artisanal fisheries, mainly in the Arabian Sea.

The tag recoveries of the RTTP-IO provide evidence of large movements of yellowfin tuna, thus supporting the assumption of a single stock for the Indian Ocean. The average minimum distance travelled by yellowfin between being tagged and recovered is 525 nautical miles. Both RTTP-IO and fisheries data indicate that medium sized yellowfin concentrate for feeding in the Arabian Sea. The new information on the spatial distribution of tagging and recovery positions is presented in Figure 1.

Longline catch data indicates that yellowfin are distributed continuously throughout the entire tropical Indian Ocean, but some more detailed analysis of fisheries data suggests that the stock structure may be more complex. A study of stock structure using DNA was unable to detect whether there were subpopulations of yellowfin tuna in the Indian Ocean.

Spawning occurs mainly from December to March in the equatorial area (0-10°S), with the main spawning grounds west of 75°E. Secondary spawning grounds exist off Sri Lanka and the Mozambique Channel and in the eastern Indian Ocean off Australia. Yellowfin size at first maturity has been estimated at around 100 cm, and recruitment occurs predominantly in July. Newly recruited fish are primarily caught by the purse seine fishery on floating objects. Males are predominant in the catches of larger fish at sizes than 150 cm (this is also the case in other oceans).

Tag-recovery data, recent age readings of otoliths and modal progressions provide support to a multi-stanza growth pattern for yellowfin but more work is needed to accurately model this complex growth pattern so it can be used in stock assessments.

Direct estimates of natural mortality (M) have been estimated for juvenile (40 cm to 100 cm long) yellowfin in the Indian Ocean using the data from the RTTP-IO. The current estimates (0.8 for 0 to 1 year old fish and 0.4 for fish 2 years and over) is much lower that previously assumed levels.

Feeding behaviour of yellowfin has been extensively studied and it is largely opportunistic, with a variety of prey species being consumed, including large concentrations of crustaceans that have occurred recently in the tropical areas and small mesopelagic fishes which are abundant in the Arabian Sea. It has also been observed that large yellowfin can feed on very small prey, thus increasing the availability of food for this species. Archival tagging of yellowfin has shown that yellowfin can dive very deep (over 1000m) probably to feed on meso-pelagic prey.

FISHERY

Catches by area, gear, country and year from 1958 to 2007 are shown in Table 1 and illustrated in Figure 2. Contrary to the situation in other oceans, the artisanal fishery component in the Indian Ocean is substantial, taking approximately 20-25 % of the total catch.

The geographical distribution of yellowfin tuna catches in the Indian Ocean in recent years by the main gear types is shown in Figure 3. Most yellowfin tuna are caught in Indian Ocean north of 12°S and in the Mozambique Channel (north of 25°S).

Although some Japanese purse seiners have fished in the Indian Ocean since 1977, the purse seine fishery developed rapidly with the arrival of European vessels between 1982 and 1984. Since then, there has been an increasing number of yellowfin tuna caught although a larger proportion of the catches is made of adult fish, when compared to the case of the bigeye tuna purse-seine catch. Purse seiners typically take fish ranging from 40 to 140 cm fork length (Figure 4) and smaller fish are more common in the catches taken north of the equator (Figure 5). Catches of yellowfin increased rapidly to around 128,000 t in 1993. Subsequently, they fluctuated around that level, until 2003 and 2004 when they were substantially higher (224,200 t and 228,600 t, respectively). In recent years, catches appear to be higher in the first quarter of the year (Figure 6). The amount of effort exerted by the EU purse seine vessels (fishing for yellowfin and other tunas) varies seasonally and from year to year. Since 2000 between 800 and 1200 boat days per month were fished annually (Figure 7).

The purse seine fishery is characterized by the use of two different fishing modes: the fishery on floating objects (FADs), which catches large numbers of small yellowfin in association with skipjack and juvenile bigeye, and a fishery on free swimming schools, which catches larger yellowfin on mixed or pure sets. Between 1995 and 2003, the FAD component of the purse seine fishery represented 48-66 % of the sets undertaken (60-80 % of the positive sets) and took 36-63 % of the yellowfin catch by weight (59-76 % of the total catch). Since 1997, the proportion of log sets has steadily decreased from 66 % to 48 %.

The longline fishery started in the beginning of the 1950's and expanded rapidly over the whole Indian Ocean. It catches mainly large fish, from 80 to 160 cm fork length (Figure 4), although smaller fish in the size range 60 cm – 100 cm have been taken by longliners from Taiwan,China since 1989 in the Arabian Sea. The longline fishery targets several tuna species in different parts of the Indian Ocean, with yellowfin and bigeye being the main target species in tropical waters. The longline fishery can be subdivided into an industrial component (deep-freezing longliners operating on the high seas from Japan, Korea and Taiwan,China) and an artisanal component (fresh tuna longliners). The total longline catch of yellowfin reached a maximum in 1993 (196,000 t). Since then, catches have typically fluctuated between 80,000 t and 123,000 t.

Artisanal catches, taken by bait boat, gillnet, troll, hand line and other gears have increased steadily since the 1980s. In recent years the total artisanal yellowfin catch has been around 130,000-140,000 t, with the catch by gillnets (the dominant artisanal gear) at around 80,000 t to 90,000 t.

Yellowfin catches in the Indian Ocean during 2003, 2004, 2005 and 2006 were much higher than in previous years but have returned to a lower level in 2007, while bigeye catches remained at their average levels. Purse seiners currently take the bulk of the yellowfin catch, mostly from the western Indian Oceana around Seychelles. In 2003, 2004, 2005 and 2006, purse seine total catches made in this area were 224,200 t, 228,600 t, 194,500 t, 159,800 t, respectively. Similarly, artisanal yellowfin catches have been near their highest levels and longliners have reported higher than normal catches in the tropical western Indian Ocean during this period. In 2007, purse seine catches decreased to their lowest levels since 1990 with a total catch of 97,600 t.

Yellowfin catches in number by gear (purse seine, longline and other methods) are reported in Figure 8. Current estimates of annual mean weights of yellowfin caught by different gears and by the whole fishery are shown in Figure 9. After an initial decline, mean weights in the whole fishery remained quite stable from the 1970s to the early 1990s. Since 1993, mean weights in the catches in the industrial fisheries have declined. Prior to 2003, although total catch in biomass has been stable for several years, catches in numbers have continued to increase, as there has been more fishing effort directed towards smaller fish. As described above, this situation changed during 2003 and 2004; where most of the very large catches were obtained from fish of larger sizes.

AVAILABILITY OF INFORMATION FOR ASSESSMENT PURPOSES

The reliability of the estimates of the total catch has continued to improve over the past few years, and the Secretariat has conducted several reviews of the nominal catch databases in recent years. This has led to marked increases in estimated catches of yellowfin tuna since the early 1970s. In particular, the estimated catches for the Yemen artisanal fishery have been revised upwards sharply, based on new information, but they still remain highly uncertain.

Estimates of annual catches at size for yellowfin were calculated using the best available information prior to the 2008 WPTT meeting. A number of papers dealing with fisheries data, biology, CPUE trends and assessments were discussed by the WPTT in 2008, and additional data analyses were performed during that meeting. Estimated catches at age were calculated using the catch-at-size data and two alternative growth curves. The growth curves were used to develop natural mortality at age, maturity at age and average weight at age schedules. M was assumed to be higher on juvenile than adult fish.

In 2008, new areas were defined and a new standardised Japanese longline CPUE for yellowfin tuna (1960 to 2007) was derived for each of the areas. The CPUE indices are variable from year to year but generally decline steeply from 1960 until the late 1970's. From the late 1970's to the early 1990's the index is relatively stable. From the mid 1990's to 2007 the index is at lower levels than previously, but again relatively stable (Figure 10)..

A new standardised CPUE for yellowfin tuna caught in the Taiwanese longline fishery (1979 to 2007) was also developed in 2008. Overall, the indices have been variable from year to year, but relatively stable. The catch rate has shown a slowly increasing trend since 1997 (Figure 11).

In 2008, attempts to calculate standardized CPUEs from the purse seine fishery were carried out. GLM results showed that standardized CPUE for small and large yellowfin fluctuate without trend over the whole period 1984-2007. This analysis is still provisional and could be much improved by incorporating detailed information reflecting changes in the fishing power and efficiency of purse seiners over time

Since the early 1990's the Taiwanese fleet has concentrated its operation in the Arabian Sea area whereas the Japanese fleet has operated more in the central and western Indian Ocean. It appears that the Japanese and Taiwanese longline fisheries are now spatially distinct and both indices of abundance need to be viewed and modelled separately.

STOCK ASSESSMENT

197. The assessment of yellowfin tuna stock in the Indian Ocean is difficult because of the conflicting trends between total annual catches and abundance index (based on the longline CPUE) if data in 1950s and 1960s are included. These trends are not consistent with production-model dynamics, or any known theory of fishing because for any fished stock, dramatic and continuous increase in catches should be accompanied by a decline in abundance. For yellowfin, this is clearly not the case and suggests that there are some major unknown factors influencing the abundance index that need to be accounted for.

A range of assessments were presented in 2008, and the WPTT was able to consider in great detail their outputs as well as elaborate on further scenarios and assumptions to be explored. Most of the models appear to provide similar perspectives on the status of the stocks despite their different levels of complexity and the uncertainties.

An assessment model (Multifan-CL) was applied this year that was able to make use of the tagging data obtained through the RTTP-IO programme. The results from this model demonstrated the value of the tagging information for assessment purposes and improved the basis for the advice this group was able to provide compared with previous assessments of this stock. The value of this source of information is likely to increase over time as more tag are returned, over a wider area and for older fish, and as analyses on this dataset progress and improve.

All assessments are greatly dependent on the use of the longline CPUE series as indices of abundance of the stock. Although current standardization procedures applied various technological and environmental variables into the model it is uncertain if it could fully explain the change in fishing efficiency.

A simple surplus production model was used to explore the relative information content of the Japanese and Taiwanese longline CPUE. The two CPUE series were used separately and in combination. Both series produced very similar biomass trends over time and the early rapid declines in CPUE for low, stable catch levels seen in both series cannot be explained as reductions in abundance. Based on the production model results, the predicted stock status was very similar for all cases. Overall, the results indicated that the biomass is below the MSY-based level and that the catch and harvest rates are slightly above MSY levels.

A Stock Synthesis 2 (SS2) model using catch-at-length data, growth and a CPUE series to model the stock dynamics encountered difficulty in estimating some parameters and the MSY reference values. A model run using both the Japanese and Taiwanese longline CPUEs, and separating the PS fishery according to fishing mode, estimated values of MSY to be around the 300,000 t and would indicate that the stock was above the B_{MSY} level.

An Age-structured Production Model (ASPM) used catch-at-age data and a CPUE series to estimate biomass trends and management-related parameters. Eighty-two scenarios were examined; however, only three scenarios were able to produce converged estimates and provide biologically reasonable results. The results suggest that Indian Ocean yellowfin tuna is now entering into an overfished status after four years of high catches (2003-2006) and the stock will be likely recover to the SSB_{MSY} level in a few years if the catch does not exceed the level of catch in 2007 (316,000 t).

Multifan-CL is a size-based, age- and spatially-structured population model that has the functionality to integrate the tagging data obtained from the Indian Ocean Tagging Programme. The model integrates information on the dynamics of the fish population, the fishery and tagged fish and creates observation models for the data and outputs estimates of a range of fisheries management parameters. Results obtained appear to indicate that recent levels of fishing mortality are at an historical high level and the stock has experienced a period of overfishing during 2003-2006 (i.e. Fcurrent > F_{MSY}) for all values of steepness. Current catches are likely to be higher than the estimated MSY, which ranges from 250,000 to 300,000 t, depending on the shape of the stock-recruitment relationship. Biomass based reference points also vary with the assumed level of steepness. For the lowest value of steepness (0.60), spawning biomass in 2007 is estimated to be below the MSY level (SB/SB_{MSY} = 0.94); i.e. the stock is in an overfished state. For higher values of steepness, recent (2007) biomass is above the MSY level (SBcurrent\SB_{MSY} ranged from 1.13-1.03) and the stock is not in an overfished state. The model estimates that recent recruitment has been lower than average and on this basis total and spawning biomass could be expected to decline further over the next few years.

MANAGEMENT ADVICE

Current status

Estimates of current status of the stock in relation to biomass and fishing mortality reference points were sensitive to the value assumed for steepness of the stock-recruitment relationship so the following results are reported with respect to a range of plausible steepness values (0.6 to 0.8).

Estimates of total and spawning stock (adult) biomass are above or just below their respective MSY-based reference points i.e. B_{2007}/B_{MSY} ranged from 1.13 to 0.93 and SB_{2007}/SB_{MSY} ranged from 1.18 to 0.61, indicating that the stock is close to, or possibly has recently entered, an over-fished state..

Current (2007) fishing mortality estimates were above their respective MSY-based reference points for all but one of the assessments examined, i.e. F_{2007}/F_{MSY} ratios range from 0.9 to 1.60 indicating that overfishing is occurring. This current degree of overfishing is somewhat lower than that estimated occurred during the 2003-2006 period when the $F_{2003\text{-}2006}/F_{MSY}$ ratio ranged from 1.22 to 1.75.

The stock assessments, including independent analyses of the tagging data, indicate that recruitment has declined in recent years.

The estimates of MSY ranged between 250,000 t and 300,000 t based on the integrated assessment that used the tagging data, although other model results expand this range to 360,000 t. The 2007 catch of 317,000 t may have been above the MSY while annual catches over the period 2003-2006 (averaging 464,000 t) were substantially higher than this range of MSY estimates.

Outlook

Catches in 2007 (317,000 t) were slightly lower than the average catch taken in period 1998-2002 (336,000 t) i.e. preceding the 2003 to 2006 period when extraordinarily high catches of yellowfin were taken. Purse seine catches in the first seven months of 2008 were slightly higher than those reported for the corresponding period in 2007 indicating that catch levels might be returning to pre-2003 levels. While there is a large amount of uncertainty about likely future catches, recent events in 2008 where some vessels have left the fishery, together with fleets avoiding the historically important fishing grounds in the waters adjacent to Somalia for security reasons, may reduce catches in the short-term to below the pre-2003 levels.

Two hypotheses have been put forward in the past to explain the very high catches in the 2003-2006 period: (i) an increase in catchability by surface fleets due to a high level of concentration across a reduced area and depth range, and (ii) increased recruitment over the 1999-2001 period. Recent analyses of environmental and oceanographic conditions appear to be consistent with the first hypothesis, which would mean that the catches likely resulted in a depletion of the stock. Conversely, MFCL accounts for the period of higher catches by estimating substantially higher than average levels of recruitment in 2001, 2002 and 2003. Environmental anomalies also appear to be a factor linked to the lower catches in 2007.

The range of model runs indicate that overfishing is currently occurring. Under equilibrium conditions, the recent (2003-2006) and current (2007) levels of fishing mortality will result in the stock becoming overfished ($B_{CURRENT}<B_{MSY}$ and $SB_{CURRENT}<SB_{MSY}$) in the medium term (3-5 years). Recent recruitments (in 2005, 2006 and possibly 2007) are estimated to be below the equilibrium (long-term average) level and if lower recruitment persists then the stock will decline below the MSY level more rapidly. Similarly, overfishing may continue to occur even if fishing pressure returns to pre-2003 catch levels, especially if recruitment continues to be low and the expected decrease in some age classes due to recent low recruitments eventuates.

Recommendation.

Although important progress was made in the quality and quantity of analyses conducted in 2008, there remain uncertainties in the application of the models that prevented the Scientific Committee from determining the current status of yellowfin tuna in a precise way.

Nevertheless, most of the analyses conducted coincide in indicating that the stock is very close to an overfished state, or already overfished, and that the exploitation rate in recent years has exceeded the optimal level.

Therefore, the Scientific Committee recommends that the catch of yellowfin tuna does not exceed the average catch for the period 1998-2002 (i.e. 330 000 t) when catches were stable, prior to the exceptional years of 2003-2006 when the stock might have been overexploited.

Similarly, the Scientific Committee recommends that the fishing effort does not exceed the level exerted in 2007 when the catch of yellowfin tuna returned to the pre-2003 levels.

YELLOWFIN TUNA SUMMARY

Maximum Sustainable Yield (2007):	The results from 2008 assessment results ranged from (250,000 t – 360,000 t)
Preliminary catch in 2007 *(data as of October 2008)*	316,700 t
Catch in 2006	407,900 t
Mean catch over five years before 2003 (1998 – 2002)	336,500 t
Current Replacement Yield	-
Relative Biomass B_{2007}/ B_{MSY}	1.13 to 0.93
Relative Fishing Mortality $F_{2007}/_{FMSY}$	0.9 to 1.60

***Table 1.** Best scientific estimates of the catches of yellowfin tuna (as adopted by the IOTC Scientific Committee) by gear and main fleets for the period 1957 to 2007.* Data as of October 2008

Gear	Fleet	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84
Purse seine	Spain																											11.5
	France																								0.2	1.0	10.5	36.7
	NEI-Other																										0.7	8.4
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.2	0.5	0.4	0.3	0.1	0.3	1.6	1.8
	Total	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.1*	*0.1*	*0.0*	*0.0*	*0.0*	*0.1*	*0.0*	*0.0*	*0.1*	*0.1*	*0.1*	*0.0*	*0.0*	*0.2*	*0.5*	*0.4*	*0.3*	*0.3*	*1.3*	*12.7*	*58.3*
Baitboat	Maldives	1.9	1.9	1.0	1.4	1.4	1.4	1.4	1.0	1.4	1.6	1.6	1.7	2.3	1.4	2.5	6.9	5.0	4.6	5.2	4.9	3.8	4.4	4.4	5.6	4.5	7.7	8.2
	Other Fleets	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.8	1.3	0.3	0.2	0.2	0.4	0.5	0.5	0.6	0.5	0.2	0.3
	Total	*2.0*	*2.0*	*1.0*	*1.5*	*1.5*	*1.5*	*1.5*	*1.0*	*1.5*	*1.7*	*1.7*	*1.8*	*2.4*	*1.5*	*2.7*	*7.7*	*6.3*	*4.9*	*5.4*	*5.1*	*4.2*	*4.8*	*4.9*	*6.1*	*5.0*	*7.9*	*8.5*
Longline	China																											
	Taiwan,China	1.8	2.4	2.2	2.9	3.5	3.4	2.9	2.2	4.4	3.4	22.7	21.1	14.9	11.9	11.8	5.7	4.4	4.6	3.4	8.1	4.2	3.7	3.8	4.1	4.7	5.6	5.8
	Japan	22.6	22.2	36.1	32.7	44.2	22.0	22.2	24.9	40.8	30.2	48.3	23.1	10.3	13.4	7.9	3.9	4.9	6.4	2.8	2.1	4.6	3.3	3.2	4.9	7.3	7.8	7.9
	Indonesia																0.1	0.3	0.7	1.0	1.3	1.3	1.4	2.1	2.6	2.7	0.8	0.8
	Korea, Republic of								0.1	0.1	0.4	5.3	9.1	5.2	7.4	10.3	10.8	13.2	13.4	13.7	33.1	26.5	18.0	13.2	12.4	19.4	16.2	10.2
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.5	0.1	2.4	0.6	1.9	1.6	1.5	1.2	0.7	0.2	1.1	0.9	0.2	0.4	0.5	0.4	0.4	0.7	0.7
	Total	*24.5*	*24.6*	*38.3*	*35.6*	*47.7*	*25.4*	*25.3*	*27.7*	*45.7*	*34.0*	*78.6*	*53.9*	*32.4*	*34.4*	*31.5*	*21.7*	*23.5*	*25.3*	*21.9*	*45.4*	*37.0*	*26.9*	*22.8*	*24.4*	*34.5*	*31.2*	*25.5*
Gillnet	Sri Lanka	1.1	1.2	1.5	1.8	2.7	3.6	3.5	3.3	3.7	4.1	4.6	5.1	4.0	2.9	4.4	5.4	4.8	3.9	7.0	6.4	6.9	7.6	8.3	9.6	9.5	9.1	6.4
	Oman	0.3	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.5	1.5	1.8	2.0	2.2	2.4	2.2	2.7	2.5	1.9	0.8	2.5
	Pakistan	0.7	0.7	0.9	0.8	1.2	1.8	2.5	2.7	3.6	3.5	3.5	3.2	2.9	2.4	2.8	2.2	3.0	3.3	3.1	2.8	1.6	2.8	1.3	2.0	2.5	0.8	0.9
	Other Fleets	0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.6	0.2	0.3	0.8	0.3	0.4	0.6	0.7	0.5	1.0	0.4	0.5
	Total	*2.2*	*2.3*	*2.8*	*3.1*	*4.3*	*5.8*	*6.4*	*6.4*	*7.7*	*8.1*	*8.6*	*8.8*	*7.3*	*5.7*	*7.9*	*8.7*	*9.6*	*9.3*	*12.9*	*11.6*	*11.3*	*13.1*	*13.0*	*14.7*	*14.8*	*11.2*	*10.3*
Line	Yemen	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.8	1.0	1.1	1.2	1.3	1.2	1.3	1.0	0.9	1.6	2.6
	Oman	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.8	1.0	1.1	1.2	1.3	1.2	1.5	1.4	1.0	0.5	1.3
	Comoros													0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	Maldives													0.3	0.2	0.2	0.3	0.3	0.3	0.5	0.4	0.5	0.7	0.7	0.7	0.3	0.3	0.3
	Other Fleets	0.8	0.8	1.0	1.2	1.2	1.5	1.7	1.5	1.6	1.7	1.9	2.0	1.5	1.6	2.2	3.1	2.2	1.8	2.7	6.1	5.8	5.7	5.2	3.9	5.0	3.9	3.3
	Total	*1.2*	*1.3*	*1.4*	*1.6*	*1.6*	*1.9*	*2.1*	*1.9*	*2.0*	*2.3*	*2.4*	*2.6*	*2.3*	*2.4*	*3.1*	*4.1*	*4.4*	*4.2*	*5.6*	*9.0*	*9.0*	*8.9*	*8.9*	*7.1*	*7.4*	*6.5*	*7.7*
Other gears	*Total*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.3*	*0.2*	*0.2*	*0.3*	*0.3*	*0.6*	*0.7*	*0.8*	*1.0*	*1.3*	*1.4*	*1.3*	*0.9*	*0.9*	*0.5*	*1.0*
All	*Total*	*30.0*	*30.4*	*43.7*	*42.0*	*55.3*	*34.9*	*35.6*	*37.4*	*57.3*	*46.4*	*91.6*	*67.4*	*44.7*	*44.2*	*45.6*	*42.6*	*44.4*	*44.4*	*46.6*	*72.4*	*63.3*	*55.5*	*51.2*	*53.5*	*63.9*	*69.9*	*111.2*

Gear	Fleet	Av03/07	Av58/07	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07
Purse seine	Spain	69.2	23.0	18.4	20.0	26.3	44.9	41.1	43.7	44.0	37.8	47.8	43.1	65.1	59.4	61.0	38.6	51.9	49.4	47.7	53.4	79.0	80.8	77.5	70.9	37.8
	France	52.2	20.2	39.1	43.3	46.8	59.9	38.4	45.3	38.1	45.3	39.5	35.8	39.6	35.6	31.2	22.4	30.8	37.7	34.1	36.4	63.3	63.5	57.2	44.3	32.7
	Seychelles	32.6	4.5							0.4	0.2					2.8	7.4	9.8	11.6	12.9	16.6	33.3	48.8	36.5	28.1	16.1
	NEI-Other	9.0	6.5	9.4	6.3	5.2	7.9	4.5	11.9	11.9	8.1	15.5	19.7	19.3	16.7	21.9	20.3	25.8	27.1	18.9	19.1	24.5	10.1	4.4	3.7	2.5
	Iran, Islamic Republic	7.4	1.3								1.5	2.4	1.9	3.0	1.6	1.9	3.3	2.5	2.2	2.2	5.0	8.3	11.0	7.3	8.4	2.3
	NEI-Ex-Soviet Union	7.4	2.7						0.8		5.2	8.7	5.8	14.6	11.7	9.8	5.3	11.8	10.9	8.9	2.2	15.1	13.8	7.8	0.4	
	Other Fleets	3.1	2.7	2.0	4.1	5.7	6.1	5.9	7.0	11.1	14.3	13.7	7.3	6.6	4.7	3.7	3.3	2.3	1.5	5.5	6.5	0.8	0.5	3.9	4.1	6.2
	Total	*181.0*	*60.8*	*69.0*	*73.8*	*84.0*	*118.8*	*89.8*	*108.7*	*105.5*	*112.4*	*127.5*	*113.7*	*148.3*	*129.8*	*132.3*	*100.5*	*134.9*	*140.4*	*130.1*	*139.1*	*224.2*	*228.6*	*194.5*	*159.8*	*97.6*
Baitboat	Maldives	14.9	6.7	6.9	6.2	7.4	5.9	5.5	4.9	7.0	8.0	9.3	12.4	11.8	11.5	12.2	13.0	12.6	10.0	11.1	16.3	16.1	14.4	14.9	15.8	13.2
	Other Fleets	1.4	0.5	0.6	0.5	0.5	0.3	0.3	0.4	0.5	0.6	0.6	0.6	0.6	0.6	0.7	0.6	0.7	0.8	0.7	0.7	0.8	0.6	2.7	1.5	1.5
	Total	*16.3*	*7.2*	*7.5*	*6.7*	*7.9*	*6.3*	*5.8*	*5.3*	*7.6*	*8.6*	*9.9*	*13.0*	*12.3*	*12.1*	*12.9*	*13.6*	*13.3*	*10.8*	*11.8*	*17.0*	*16.8*	*15.0*	*17.6*	*17.3*	*14.8*
Longline	China																									
	Taiwan,China	41.5	17.9	7.3	16.2	22.3	22.7	22.4	31.6	30.7	56.0	88.2	34.1	23.1	27.9	18.4	23.4	17.7	17.4	26.9	33.2	29.7	49.8	67.6	34.7	25.7
	Japan	19.6	14.9	9.5	10.7	8.3	9.3	4.6	6.3	4.4	5.7	5.7	9.7	8.0	12.8	15.6	16.8	14.7	15.5	13.9	13.9	17.2	16.0	21.5	23.1	20.3
	Indonesia	12.9	7.6	0.8	0.7	1.3	2.3	3.8	4.6	5.5	9.3	10.8	14.8	16.7	31.8	38.2	35.7	41.7	29.6	28.4	24.2	20.2	15.3	12.0	8.5	8.5
	NEI-Fresh Tuna	6.9	4.8					11.9	16.6	14.4	16.7	16.5	23.7	17.1	17.7	21.2	16.6	14.8	13.3	0.9	3.3	4.6	5.8	6.9	8.5	8.5
	NEI-Deep-freezing	4.1	2.9	0.1	1.1	1.2	3.4	3.2	6.7	5.9	8.9	23.8	9.9	6.9	12.1	5.9	9.8	7.7	6.6	4.2	5.3	3.3	6.8	6.8	2.0	1.5
	Korea, Republic of	3.3	7.2	12.5	15.5	13.2	14.1	8.7	7.5	3.2	4.4	4.3	3.9	2.6	3.8	4.0	2.6	1.0	2.0	1.6	0.3	2.2	4.2	3.5	3.4	3.4
	NEI-Indonesia Fresh Tuna	0.0	2.0		0.1		2.7	10.3	12.6	12.9	15.6	12.6	16.3	8.9	3.7	4.0	0.3	0.0								
	Other Fleets	15.9	4.0	0.3	1.0	0.6	0.4	0.4	0.1	1.9	20.1	34.4	8.0	5.2	3.9	2.0	4.0	6.0	5.6	5.3	4.6	7.6	12.3	26.2	18.1	15.5
	Total	*104.2*	*61.2*	*30.5*	*45.2*	*46.9*	*54.9*	*65.2*	*86.0*	*78.8*	*136.7*	*196.4*	*120.4*	*88.6*	*113.6*	*109.1*	*109.3*	*103.7*	*89.9*	*81.2*	*84.8*	*84.7*	*110.2*	*144.6*	*98.2*	*83.5*
Gillnet	Iran, Islamic Republic	30.1	7.3					1.0	2.3	3.2	12.1	13.3	19.5	22.5	28.5	20.0	18.0	24.3	13.5	18.0	19.0	29.5	39.7	35.8	32.1	13.6
	Sri Lanka	37.5	13.3	6.9	7.1	7.4	7.7	8.3	9.6	11.6	13.9	16.6	21.5	18.9	23.7	29.5	29.2	37.0	33.8	30.7	32.4	38.5	39.3	26.5	38.9	44.1
	Oman	6.3	3.0	1.2	1.4	3.1	8.3	8.7	7.7	2.8	7.0	5.9	5.0	9.5	4.6	3.4	6.3	3.8	3.7	3.3	3.0	7.2	13.8	7.9	1.4	1.4
	Pakistan	3.2	2.9	1.5	2.6	2.4	3.8	8.6	3.3	4.9	3.9	2.6	2.4	2.1	3.2	3.9	3.9	9.3	5.3	3.9	3.4	3.6	3.4	2.2	1.7	5.1
	Other Fleets	1.9	0.7	1.1	0.6	0.8	0.5	0.7	1.0	0.8	0.9	0.9	0.9	0.8	0.9	1.0	0.8	0.9	1.0	0.9	0.9	1.0	0.8	2.2	2.8	2.8
	Total	*79.0*	*27.2*	*10.7*	*11.6*	*13.8*	*20.4*	*27.3*	*23.8*	*23.4*	*37.8*	*39.3*	*49.3*	*53.8*	*60.8*	*57.8*	*58.2*	*75.3*	*57.2*	*56.7*	*58.7*	*79.7*	*97.0*	*74.5*	*76.8*	*67.1*
Line	Yemen	24.0	7.3	3.3	4.1	4.8	5.5	6.3	7.1	7.9	8.7	7.8	8.5	13.4	15.2	17.3	19.3	21.4	23.4	25.5	27.5	25.7	31.7	26.8	19.6	16.3
	Oman	10.2	3.0	0.7	0.7	1.7	4.5	4.8	4.3	6.0	6.0	5.3	13.5	9.1	5.2	6.2	4.4	3.5	3.3	2.9	2.2	2.3	9.6	7.3	15.9	15.9
	Comoros	6.2	2.1	0.2	0.2	0.2	0.2	3.7	3.7	3.7	5.0	5.0	5.9	5.9	5.8	5.6	5.6	5.5	5.9	5.5	5.9	6.1	6.2	6.2	6.2	6.2
	Maldives	5.6	0.9	0.2	0.2	0.2	0.3	0.3	0.2	0.2	0.3	0.3	0.2	0.3	0.3	0.3	0.6	0.7	1.6	2.5	4.2	2.5	6.8	5.5	5.8	7.4
	Other Fleets	6.8	3.6	5.0	5.7	4.7	4.3	3.1	3.6	3.9	3.9	4.3	4.4	4.4	4.3	4.3	3.8	4.1	4.7	4.4	4.3	4.3	4.4	11.1	7.2	7.1
	Total	*52.8*	*17.0*	*9.4*	*10.9*	*11.7*	*14.9*	*18.1*	*18.9*	*21.7*	*23.8*	*22.7*	*32.5*	*33.0*	*30.8*	*33.7*	*33.6*	*35.0*	*38.9*	*40.8*	*44.1*	*40.8*	*58.6*	*56.8*	*54.8*	*52.9*
Other gears	*Total*	*1.5*	*0.9*	*0.9*	*1.2*	*1.5*	*3.2*	*3.0*	*2.7*	*0.4*	*0.7*	*0.6*	*1.2*	*3.3*	*2.2*	*0.6*	*1.0*	*0.6*	*0.6*	*0.5*	*0.5*	*1.4*	*1.9*	*2.3*	*0.9*	*0.8*
All	*Total*	*434.8*	*174.3*	*128.0*	*149.4*	*165.8*	*218.5*	*209.2*	*245.4*	*237.4*	*320.0*	*396.5*	*330.1*	*339.3*	*349.4*	*346.4*	*316.2*	*362.9*	*338.0*	*321.1*	*344.4*	*447.7*	*511.2*	*490.4*	*407.9*	*316.7*

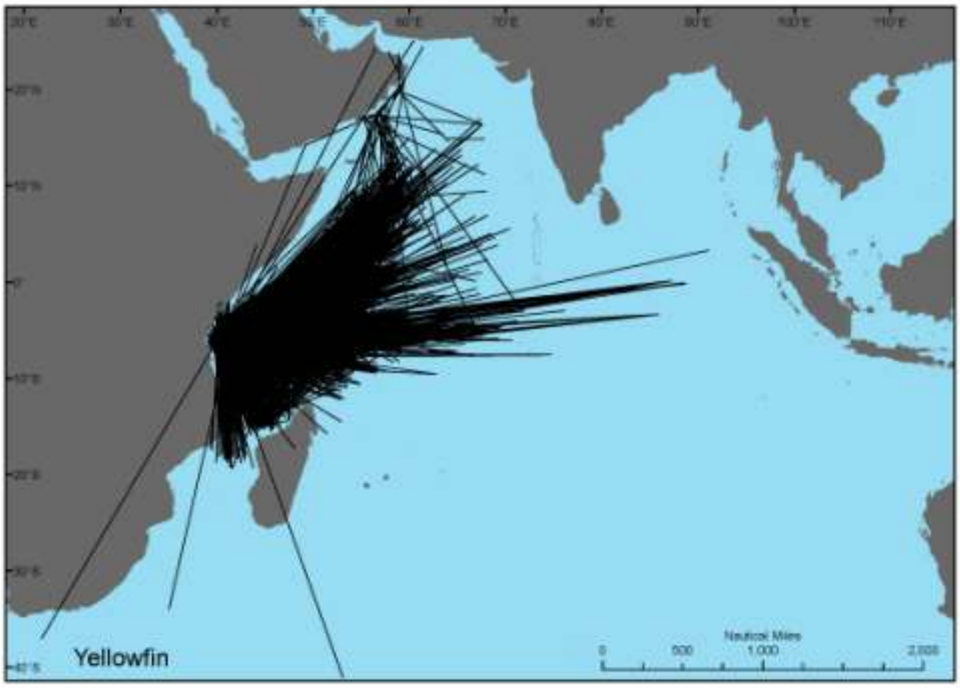


Figure 1. *Tag recapture trajectories for yellowfin tuna tagged in the south west Indian Ocean by the RTTP-IO. Data as of December 2008.*

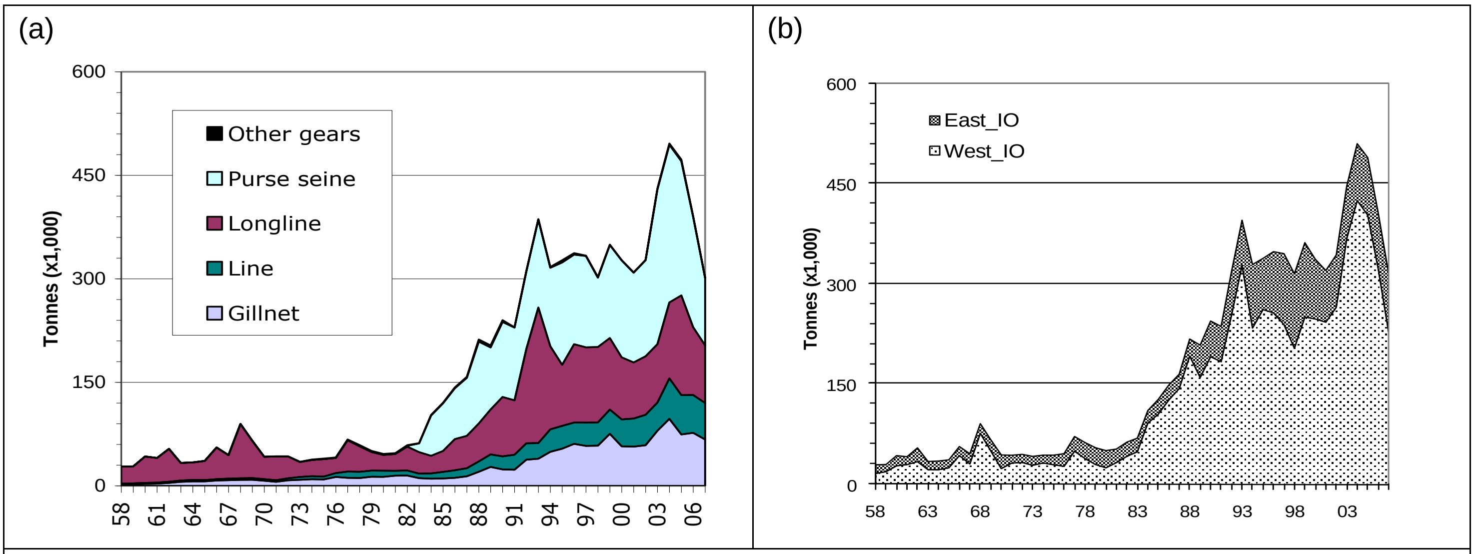


Figure 2. *Yearly catches (tonnes x 1000) of yellowfin by (a) gear and (b) area (to be updated) from 1958 to 2007.*

Data as of October 2008

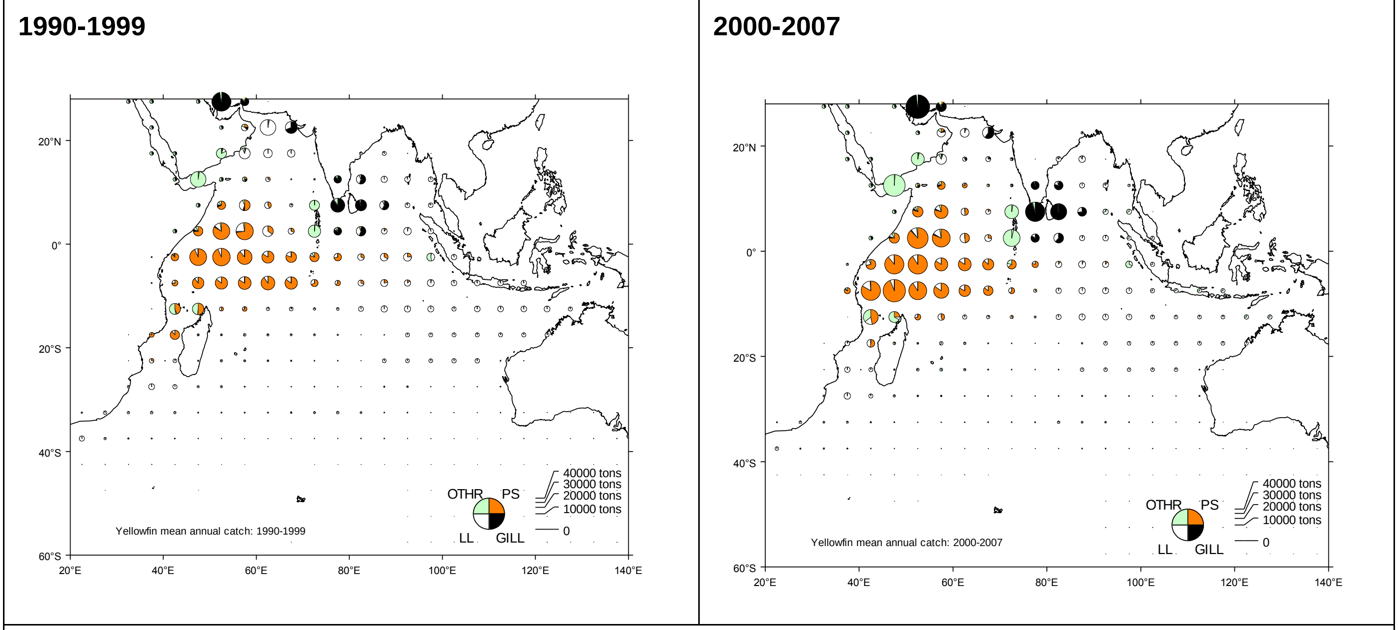


Figure 3. *Location and size of yellowfin tuna catches (mean annual catches for the period indicted) in the Indian Ocean by gear type. GILL = gillnet, LL = longline, PS = purse seine.* *Data as of October 2008*

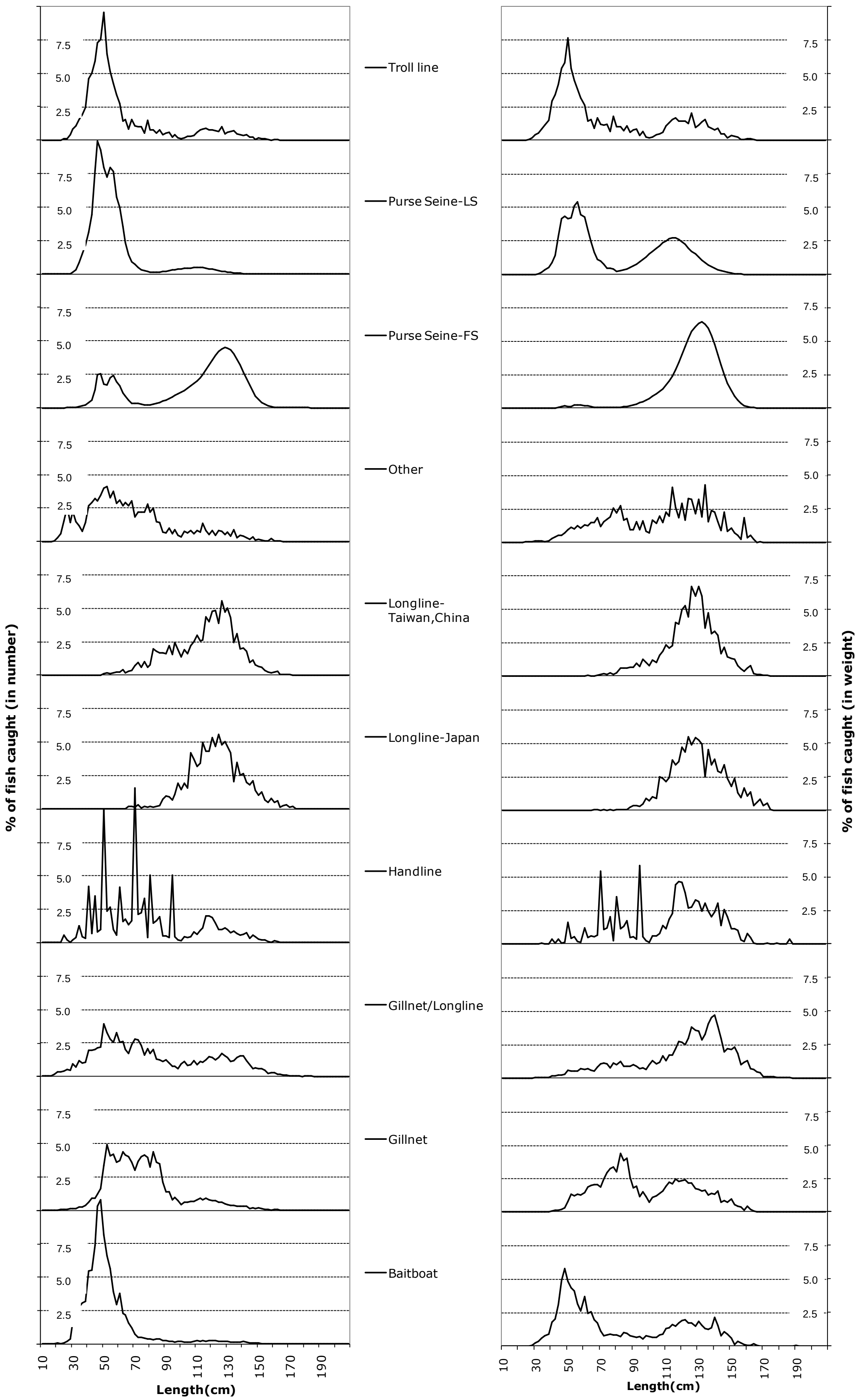


Figure 4. *Mean catch at size of yellowfin tuna measured from purse seine, longline, baitboat, line (hand line and troll line), gillnet and other gears catches from 1998-2007: in numbers (left panels) and weight (right panels). FS = free school. LS = log school.*

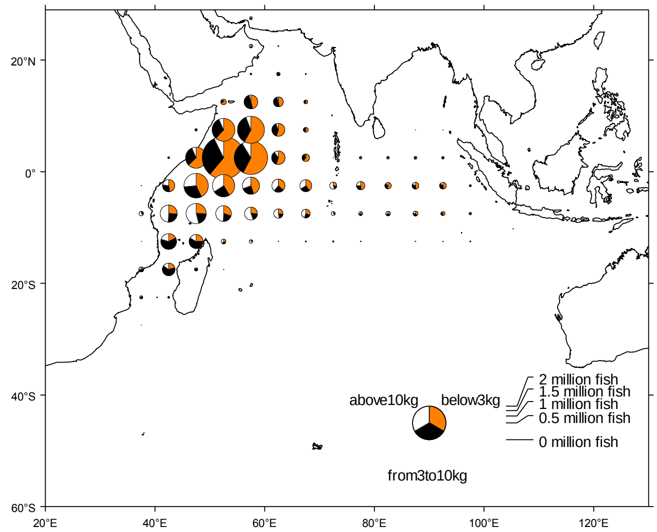


Figure 5. *Yellowfin tuna**:** location of catches of small (<3 kg) medium (3-10 kg) and large (>10 kg) sized fish taken by purse seiners from 2000 to 2007.*

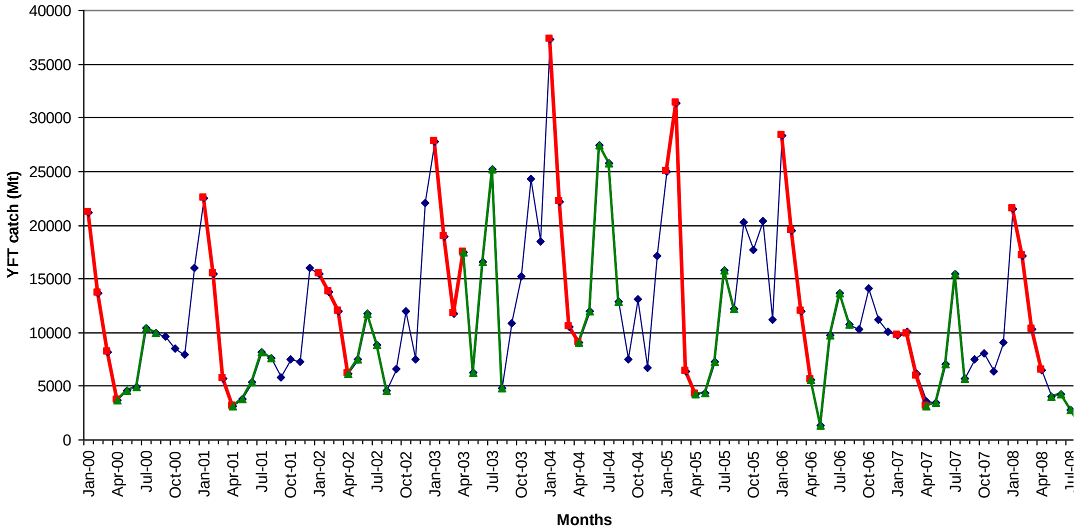


Figure 6. *Yellowfin tuna**:** quarterly catches by purse seiners in the Indian Ocean over the period 2000 to 2008. The first quarter of each year is indicated by the red line.*

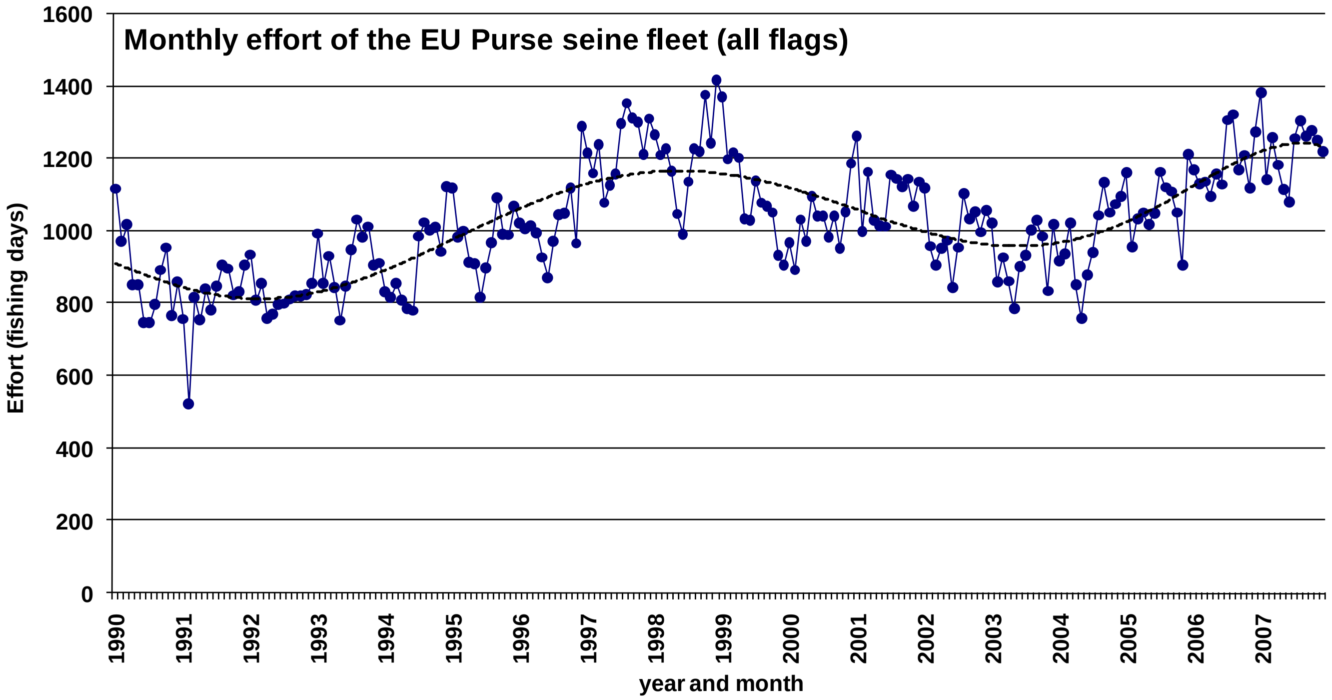
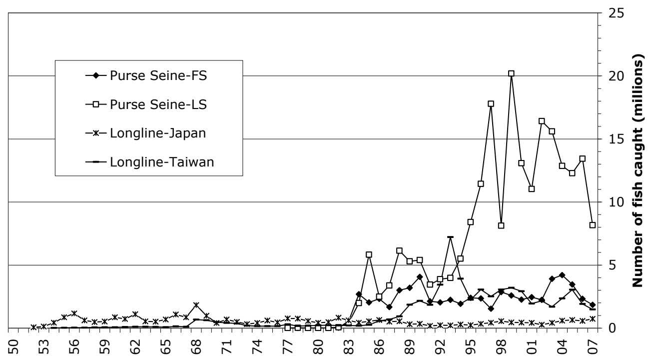


Figure 7. *Amount of effort (boat days per month) exerted by the EU purse seine fleet in the Indian Ocean.(to be updated)*



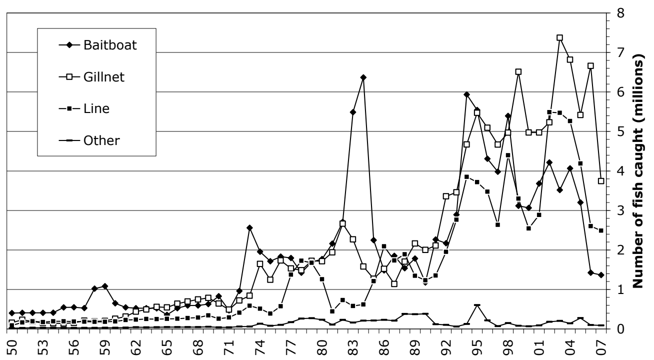


Figure 8. *Annual catches (numbers) of yellowfin tuna by gear from 1958 to 2007*
Industrial fleets (left) and artisanal fleets (right)

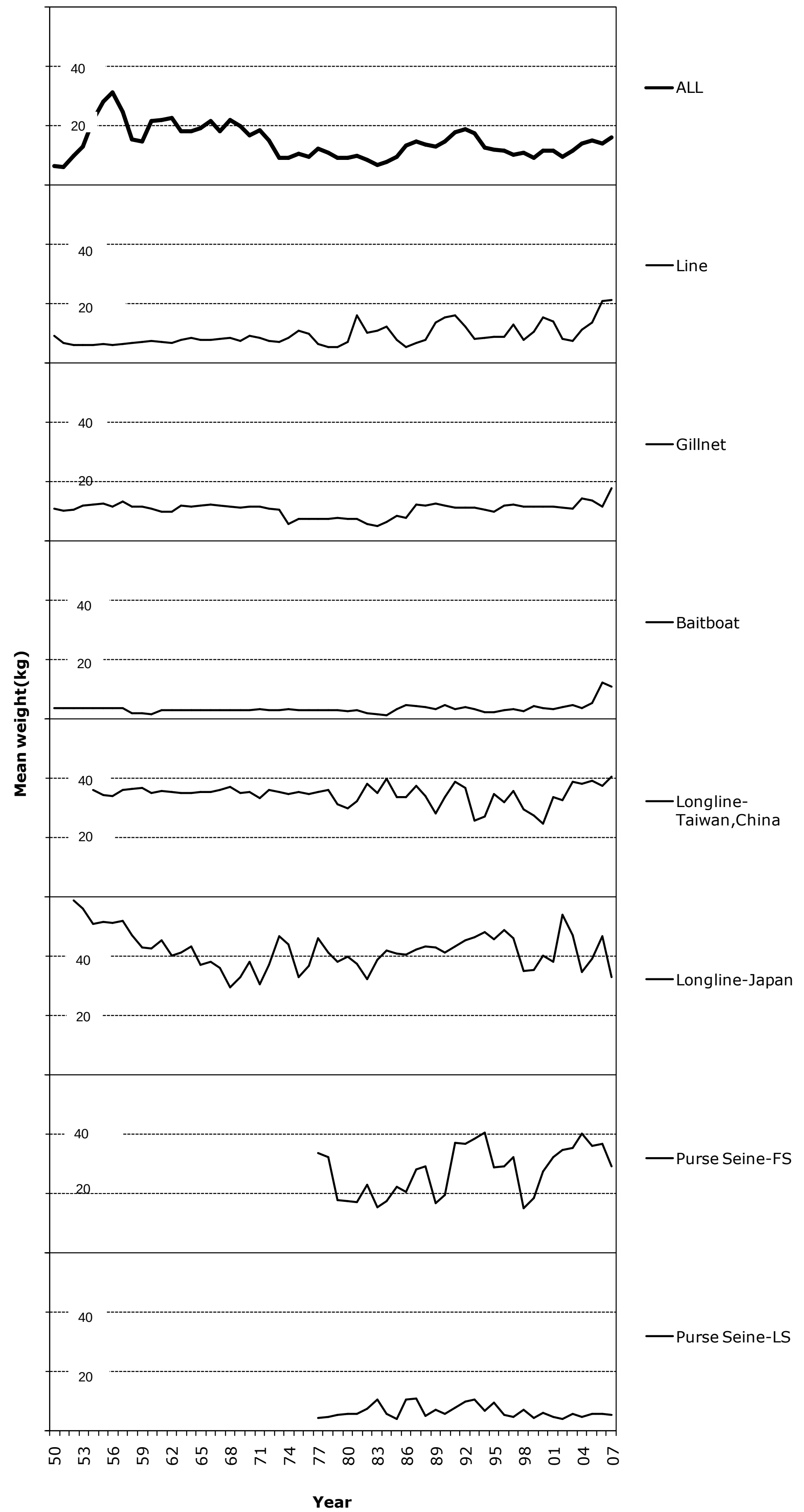


Figure 9. *Mean weight (kg) of yellowfin tuna individuals in the catch by gear and for all gear-types (estimated from the total catch at size). FS = free school. LS = log school.*

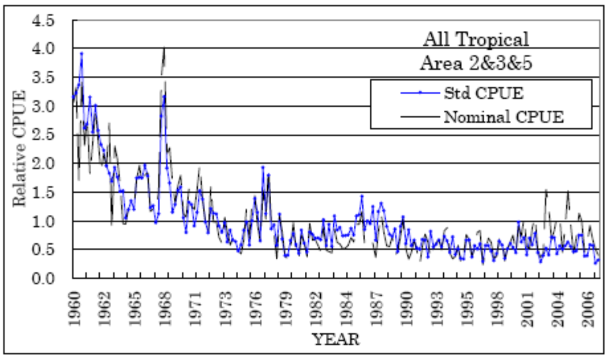


***Figure 10**. Nominal and Standardised CPUE for the Japanese longline fishery catching yellowfin tuna*

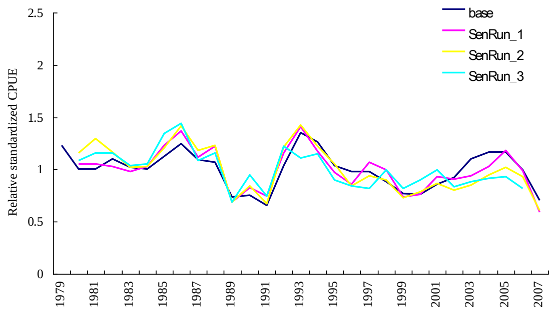


***Figure 11**. Standardised CPUE for the Taiwanese longline fishery catching yellowfin tuna*

Executive summary of the status of the Indian Ocean swordfish resource

(as adopted by the IOTC Scientific Committee, December 2008)

BIOLOGY

Swordfish (*Xiphius gladius*) is a large oceanic apex predator that inhabits all the world's oceans and in the Indian Ocean ranges from the northern coastal state coastal waters to 50°S. Swordfish is known to undertake extensive diel vertical migrations, from surface waters during the night to depths of 1000m during the day, in association with movements of the deep scattering layer and cephalopods, their preferred prey. By contrast with tunas, swordfish is not a gregarious species, although densities increase in areas of oceanic fronts and seamounts.

Genetic studies of the stock structure of swordfish in the Indian Ocean have failed to reveal spatial heterogeneity, and for the purposes of stock assessments one pan-ocean stock has been assumed. However, spatial heterogeneity in stock indicators (CPUE trends), indicate the potential for localised depletion of swordfish in the Indian Ocean.

As with many species of billfish, swordfish exhibit sexual dimorphism in maximum size, growth rates and size and age at maturity – females reaching larger sizes, growing faster and maturing later than males. Length and age at 50% maturity in SW Indian Ocean swordfish is 170 cm (maxillary-fork length = LJFL) for females and 120 cm for males. These sizes correspond to ages of 6-7 years and 1-3 years for females and males, respectively.

Swordfish are highly fecund, batch spawners with large females producing many millions of eggs per spawning event. One estimate for Indian Ocean populations suggests that a female swordfish in equatorial waters may spawn as frequently as once every three days over a period of seven months.

Swordfish are long lived – having a maximum age of more than 30 years. The species also exhibits rapid growth in the first year of life - by one year of age, a swordfish may reach 90 cm (~15 kg). The average size of swordfish taken in Indian Ocean longline fisheries is between 40 kg and 80 kg (depending on latitude).

The species life history characteristics of relatively late maturity, long life and sexual dimorphism make it vulnerable to over exploitation.

FISHERIES

Swordfish are taken as a target or by-catch of longline fisheries throughout the Indian Ocean (Figure 1) and is likely to be a component of the "unidentified Billfish" catch by Sri Lankan gill net fisheries in the central northern Indian Ocean

Exploitation of swordfish in the Indian Ocean was first recorded by the Japanese in the early 1950's as a by-catch in their tuna longline fisheries. Over the next thirty years, catches in the Indian Ocean increased slowly as the level of coastal state and distant water fishing nation longline effort targeted at tunas increased. In the 1990's, exploitation of swordfish, especially in the western Indian Ocean, increased markedly, peaking in 1998 at 35,100 t (Figure 2, Table 1). By 2002, twenty countries were reporting catches of swordfish (Figure 3, Table 1). The average annual catch for the period from 2002 to 2006 was 31,900 t and it was 30,100 t in 2005 and 27,300 in 2006. The highest catches are taken in the south west Indian Ocean; however, in recent years the fishery has been extending eastward (Figure 4).

Since the early 1990's China,Taiwan has been the dominant swordfish catching fleet in the Indian Ocean (41-60 % of total catch). Taiwanese longliners, particularly in the south western and equatorial western Indian Ocean, target swordfish using shallow longlines at night. The night sets for swordfish contrast with the daytime sets used by the Japanese and Taiwanese longline fleets when targeting tunas.

During the 1990's a number of coastal and island states, notably Australia, La Reunion/France, Seychelles and South Africa have developed longline fisheries targeting swordfish, using monofilament gear and light sticks set at night. This gear achieves significantly higher catch rates than traditional Japanese and Taiwanese longlines. As a result, coastal and island fisheries have rapidly expanded to take over 10,000 t of swordfish per annum in the late 1990's.

STOCK STATUS

A stock assessment for swordfish was undertaken in 2008.

The overall standardized CPUE of swordfish for the Japanese fleet for all areas of the Indian Ocean shows a general continuous decline over the period 1980 to 2006; however, the last five years have been relatively stable (Figure 5) . By contrast the standardized CPUE of swordfish for the Taiwanese fleet are variable but show no consistent trend (Figure 6).

The apparent fidelity of swordfish to particular areas is a matter for concern as this can lead to localised depletion. The CPUE of the Japanese fleet in the south west IO has the strongest decline of the four areas examined in 2008; furthermore, the La Reunion CPUE series shows a declining trend in this area over the last 10 years. In previous years, localised depletion was inferred on the basis of decreasing CPUEs following fine scale analyses of the catch effort data[6]. Therefore the WPB cannot discount the possibility that localised depletion is still occurring in some areas. Localised depletion has occurred in other parts of the world where swordfish have been heavily targeted.

The annual average sizes of swordfish in the respective Indian Ocean fisheries are variable but show no trend (Figure 7). It was considered encouraging that there are not yet clear signals of declines in the size-based indices, but these indices should be carefully monitored. It was noted that since females mature at a relatively large size, a reduction in the biomass of large animals could potentially have a strong effect on the spawning biomass. The results of the stock assessment were more optimistic than those from 2006 when overfishing was considered to have occurred. Based on the point estimates and confidence limits, on balance the assessment model results indicate that overfishing of the swordfish stock in Indian Ocean is not occurring ($F_{2006}/ F_{MSY} < 1$ – Figure 8) and the stock appears not to be in an overfished state ($B_{2006}/ B_{MSY} > 1$ – Figure 8). Recent catch levels (averaging 31,900 t per year over the five year period 2002-2006) have been around the current estimate of MSY (31,500 t, 80% confidence limits 24,500 t - 34,400 t).

MANAGEMENT ADVICE

The SC considers that the catches should not increase above the 2006 levels and fishing effort should not increase from the 2007 levels. Furthermore, management measures focussed on controlling and/or reducing effort, especially in the south-west Indian Ocean are recommended

SWORDFISH SUMMARY

Maximum Sustainable Yield:	estimates range around 31,500 t.
Preliminary catch in 2006 *(data as of July 2008)*	27,300 t
Catch in 2005	30,100 t
Mean catch over the last 5 years (2002-06)	31,900 t
Current Replacement Yield	-
Relative Biomass (B_{2006}/B_{MSY})	1.31
Relative Fishing Mortality (F_{2006}/F_{MSY})	0.67

[6] Refer to the 2004 report of the WPB (IOTC-2004-WPB-R)

***Table 1**. Best scientific estimates of the catches of swordfish (as adopted by the IOTC Scientific Committee) by gear and main fleets for the period 1957-2006 (in thousands of tonnes).* Data *as of July 2008*

Gear	Fleet	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83
Longline	China																											
	Taiwan,China	0.1	0.1	0.2	0.2	0.3	0.3	0.5	0.5	0.3	0.3	0.2	0.6	0.8	1.2	0.9	0.9	0.6	1.0	0.9	0.9	0.9	0.6	1.1	1.3	1.1	1.5	1.9
	Indonesia																		0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0
	Japan	0.3	0.5	0.5	0.6	0.7	0.8	0.6	0.8	1.0	1.1	1.6	1.1	1.1	1.2	1.1	0.9	0.8	0.8	0.8	0.4	0.3	0.9	0.6	0.6	0.8	1.0	1.2
	Korea, Republic of									0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.1	0.1	0.3	0.5	0.6	0.7	0.8	0.6	0.3	0.4	0.3	0.3
	Other Fleets								0.1	0.2	0.0	0.0	0.1	0.0	0.1					0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	*0.4*	*0.6*	*0.7*	*0.8*	*0.9*	*1.1*	*1.1*	*1.4*	*1.5*	*1.5*	*1.8*	*1.9*	*2.2*	*2.7*	*2.1*	*2.0*	*1.6*	*2.0*	*2.3*	*1.9*	*1.9*	*2.4*	*2.3*	*2.3*	*2.3*	*2.8*	*3.4*
Other gears	*Total*														*0.0*		*0.0*		*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*			
All	***Total***	***0.4***	***0.6***	***0.7***	***0.8***	***0.9***	***1.1***	***1.1***	***1.4***	***1.5***	***1.5***	***1.8***	***1.9***	***2.2***	***2.7***	***2.1***	***2.0***	***1.6***	***2.0***	***2.3***	***1.9***	***1.9***	***2.4***	***2.3***	***2.3***	***2.3***	***2.8***	***3.4***

Gear	Fleet	Av02/06	Av57/06	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06
Longline	China	0.6	0.1												0.1	0.2	0.3	0.1	0.4	0.4	0.3	0.4	0.8	0.7	0.6	0.8
	Taiwan,China	10.9	5.0	1.7	2.0	3.2	3.8	5.4	4.1	3.8	4.7	9.0	15.3	12.5	18.3	17.6	17.2	16.8	14.7	15.2	12.9	13.5	14.4	12.3	7.5	6.8
	Spain	4.5	0.6										0.2	0.7	0.0	0.0	0.5	1.4	2.0	1.0	1.9	3.5	4.3	4.7	5.1	5.2
	NEI-Deep-freezing	3.5	1.4		0.0	0.2	0.2	0.8	0.6	0.8	0.9	1.4	4.2	3.6	5.4	7.7	5.5	7.3	6.5	6.0	2.9	3.1	2.6	5.4	5.4	1.2
	Indonesia	1.9	0.4	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.5	0.5	1.0	1.2	1.1	1.3	0.7	0.6	1.3	2.6	2.4	1.7	1.3
	Japan	1.4	1.2	1.3	2.2	1.3	1.4	1.5	1.0	1.0	0.9	1.7	1.4	2.6	1.7	2.1	2.8	2.2	1.5	1.6	1.2	1.3	1.1	1.2	1.5	1.8
	Portugal	1.2	0.1															0.1	0.2	0.2	0.6	0.8	0.9	0.9	1.1	2.2
	Seychelles	1.1	0.1												0.0	0.1	0.2	0.2	0.3	0.5	0.7	0.6	1.4	1.4	1.2	0.8
	France-Reunion	0.9	0.3								0.0	0.1	0.3	0.7	0.8	1.3	1.6	2.1	1.9	1.7	1.6	0.8	0.8	0.9	1.2	0.9
	Australia	0.8	0.2						0.0		0.0	0.0	0.2	0.1	0.1	0.0	0.0	0.3	1.4	1.8	2.9	1.3	1.8	0.4	0.3	0.3
	Guinea	0.6	0.1																		0.0	0.5	0.5	0.5	0.8	0.8
	Mauritius	0.6	0.1												0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.6	0.7	0.6	0.7
	South Africa	0.5	0.1														0.0	0.4	0.1	0.0	0.3	0.9	0.8	0.2	0.2	0.2
	United Kingdom	0.4	0.0																					0.4	0.6	1.1
	Korea, Republic of	0.2	0.2	0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.2	0.1	0.0	0.1	0.0	0.0	0.1	0.3	0.3	0.2
	NEI-Fresh Tuna	0.1	0.2						0.5	0.7	0.6	0.7	0.7	1.1	0.9	0.9	1.1	1.0	0.9	0.9	0.1	0.0	0.1	0.1	0.1	0.1
	Other Fleets	0.9	0.2	0.0	0.0	0.0	0.1	0.1	0.3	0.4	0.4	0.5	0.4	0.5	0.3	0.2	0.2	1.0	0.7	0.1	1.1	0.7	0.8	0.5	1.2	1.1
	Total	*30.1*	*10.4*	*3.2*	*4.3*	*4.9*	*5.6*	*7.9*	*6.7*	*7.0*	*7.8*	*13.8*	*23.2*	*22.3*	*28.1*	*31.3*	*30.8*	*34.2*	*32.0*	*30.1*	*27.1*	*29.0*	*33.4*	*32.9*	*29.3*	*25.7*
Gillnet	Sri Lanka	1.8	0.4			0.0	0.0	0.0	0.0	0.1	0.2	0.3	1.9	0.9	0.9	1.0	1.3	0.9	1.1	2.8	2.1	2.1	2.3	2.1	0.8	1.6
	Other Fleets		0.0			0.0	0.1	0.3	0.1	0.1	0.0	0.0														
	Total	*1.8*	*0.5*			*0.1*	*0.1*	*0.3*	*0.2*	*0.2*	*0.2*	*0.3*	*1.9*	*0.9*	*0.9*	*1.0*	*1.3*	*0.9*	*1.1*	*2.8*	*2.1*	*2.1*	*2.3*	*2.1*	*0.8*	*1.6*
Other gears	*Total*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.1*	*0.0*	*0.0*	*0.0*	*0.1*	*0.0*	*0.0*	*0.1*	*0.0*	*0.0*
All	***Total***	***31.9***	***10.8***	***3.2***	***4.3***	***4.9***	***5.7***	***8.3***	***6.9***	***7.2***	***8.0***	***14.1***	***25.1***	***23.2***	***29.0***	***32.3***	***32.2***	***35.1***	***33.1***	***32.9***	***29.2***	***31.2***	***35.7***	***35.1***	***30.1***	***27.3***

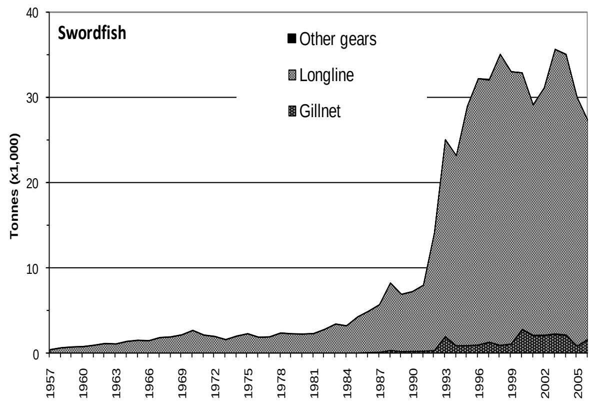


Figure 1. *Catches of Swordfish per gear and year recorded in the IOTC Database (1957-2006).* Data as of July 2008

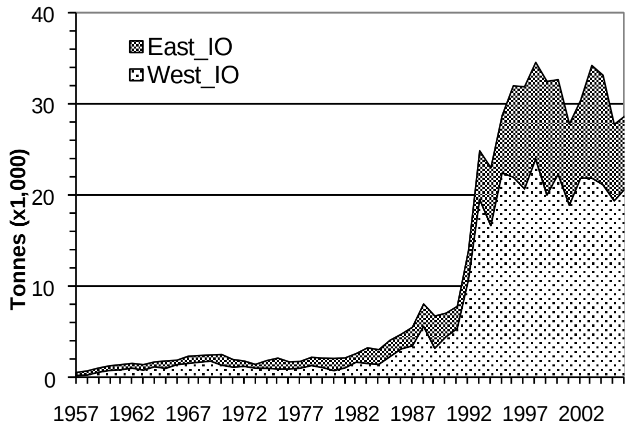
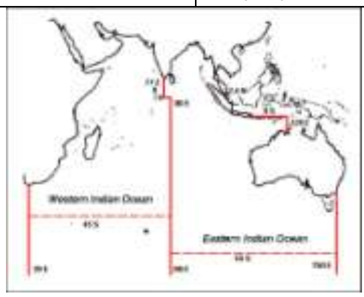


Figure 2. *Trends of the swordfish catches in the western and the eastern area of the Indian Ocean from 1956 – 2006.* Data as of July 2008



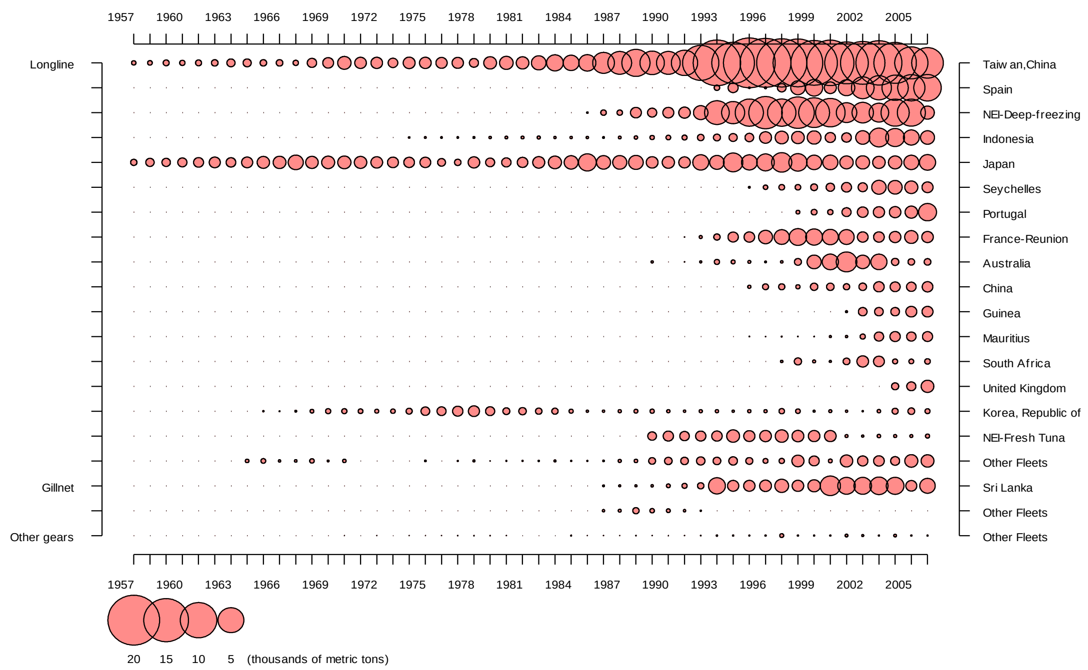
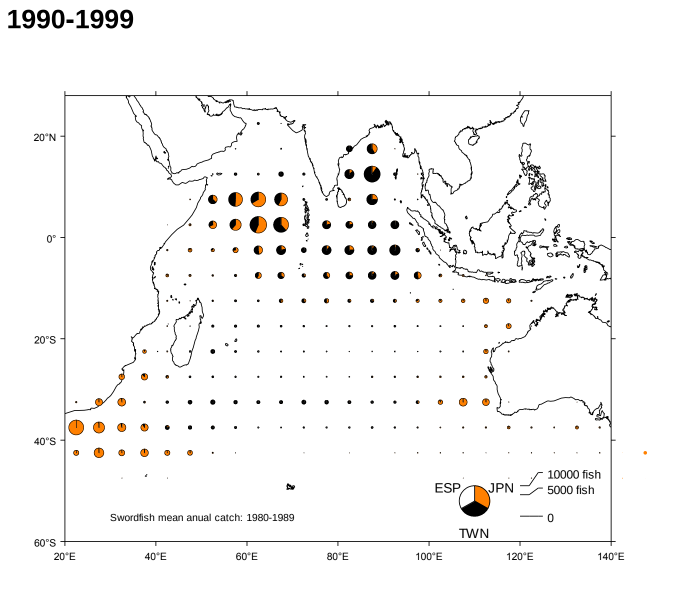


Figure 3. *Catches of swordfish in the Indian Ocean for the period 1957-2006, in thousands of metric tons by gear and country/fleet.* Data as of July 2008



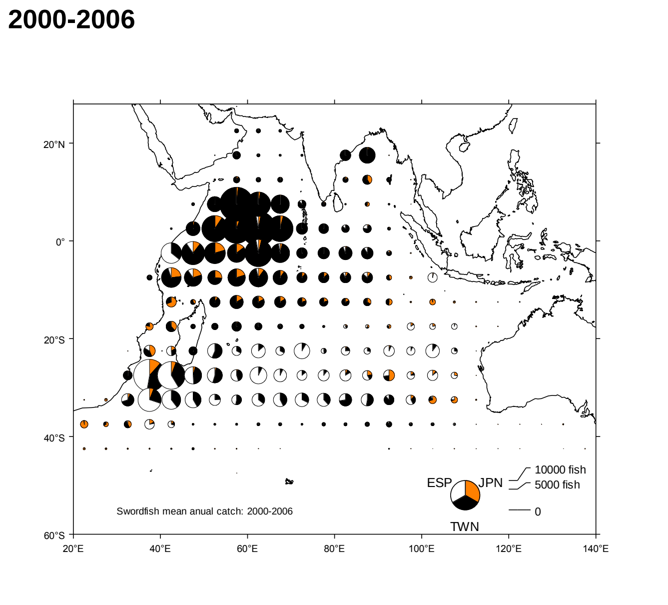


Figure 4. *Mean annual catches of swordfish (t) for the periods 1990 to 1999 and 2000 to 2006 for longline, gillnet and other fisheries in the Indian Ocean.*

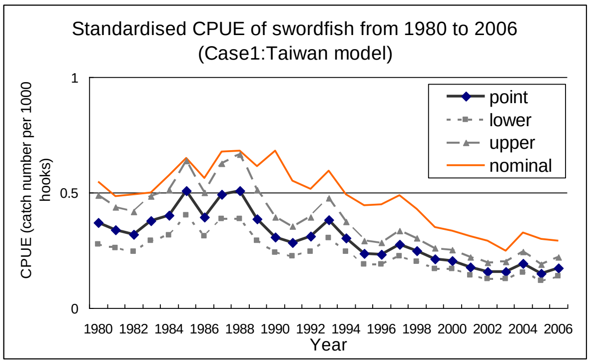


Figure 5: *Standardised CPUE index for the Japanese longline fleet 1980 to 2006.*

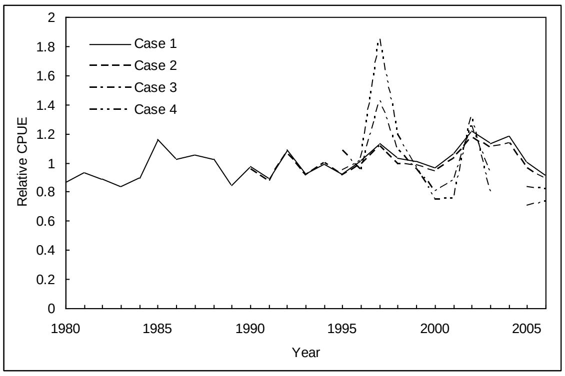


Figure 6: *Standardised CPUE trends for swordfish by the Taiwanese longline fishery in the entire Indian Ocean derived using four model cases. Nominal CPUE is also shown.*

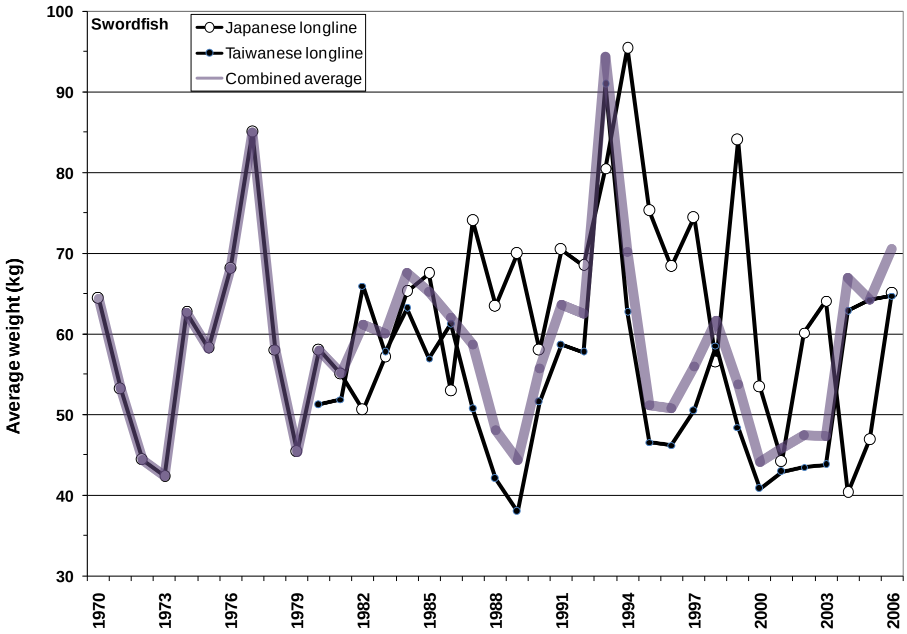


Figure 7. *Trends in average size of swordfish taken by Japanese and Taiwanese longlines in Indian Ocean.*

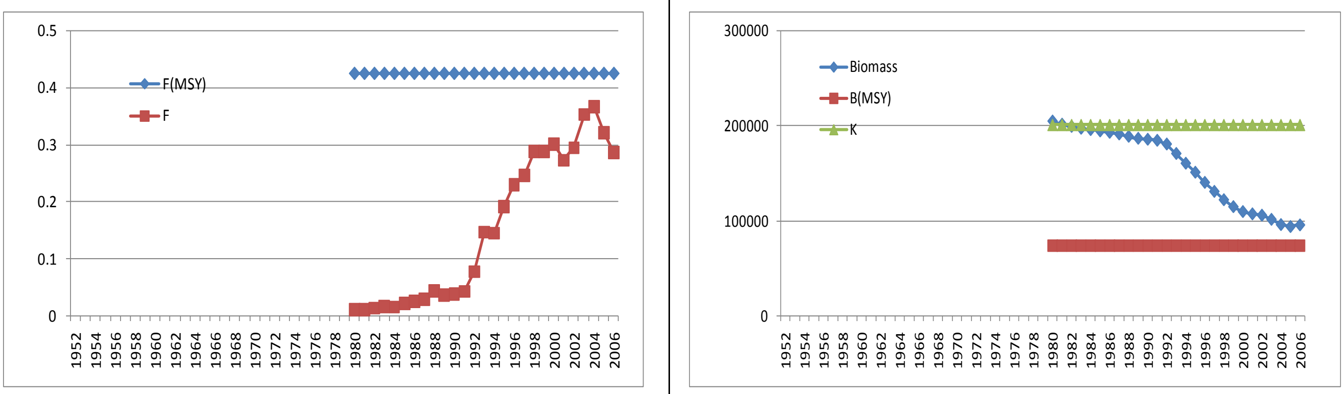


Figure 8. *Results from 2008 swordfish stock assessment (left) fishing mortality trajectories relating estimates of annual fishing mortality and the estimated maximum sustainable level of fishing mortality and (right) comparison of annual biomass estimates, estimated maximum sustainable level of biomass and annual estimates of the biomass equivalent to the carrying capacity of the population.*

Executive summary of the status of black marlin

(as adopted by the IOTC Scientific Committee, December 2008)

BIOLOGY

Black marlin (*Makaira indica*) is mainly found in the tropical and subtropical waters of the Pacific and the Indian Oceans. Individuals have been reported in the Atlantic Ocean but there is no information to indicate the presence of a breeding stock in this area. Black marlin is mainly found in oceanic surface waters above the thermocline and typically near land masses, islands, coral reefs etc; however, they may range to depths of 1000 m.

Little is known on the biology of the black marlin in the Indian Ocean. In other oceans, black marlin can grow up to 4.5 m long and weigh 750kg. Young fish grow very quickly in length then put on weight later in life. In eastern Australian waters black marlin grows from 13 mm long at 13 days old to 1800 mm and around 30 kg after 13 months. Males are in general smaller than females.

Sexual maturity is attained at around 100kg for the females and 50 to 80 kg for males, no spawning grounds have been identified but in Australia spawning individuals apparently prefer water temperatures around 27-28°C. Females may produce up to 40 million eggs.

FISHERIES

Black marlin is caught mainly by longliners and gillnetters in the Indian Ocean (Figure 1). Minimum catch estimates have been derived from very small amounts of information and are therefore highly uncertain. Difficulties in the identification of marlins also contribute to the uncertainties of the information available to the Secretariat.

The minimum average annual catch estimated for the period 2002 to 2006 is around 3,300 t. The distribution of blue marlin catches has changed since the 1980's with most of the catch now taken in the western areas of the Indian Ocean (Figure 2). In recent years, the fleets of Taiwan,China (longline), Sri Lanka (gillnet) and India (gillnets) are attributed with the highest catches of black marlin.

AVAILABILITY OF INFORMATION FOR STOCK ASSESSMENT

There is limited reliable information on the catches of black marlin and no information on the stock structure or growth and mortality of black marlin in the Indian Ocean. For example:

1. **Trends in catches**: catch estimates for black marlin are highly uncertain. Available catch data varies from year to year and mis-identification of marlins is probably common.
2. **Nominal CPUE Trends:** data is available from several fleets (mainly longline) and time periods but this species is not targeted therefore interpretation of catch rates may be problematic as they are likely to be affected by changes in the fisheries targeting other species.
3. **Average weight of fish in the catch:** the average weight of fish is derived from various weight and length information. The reliability of average weight estimates is reduced when relatively few fish out of the total catch are measured.
4. **Sex ratio:** such data are not available to the Secretariat
5. **Lengths of fish being caught –** fish size is derived from various length and weight information. The reliability of the size data is reduced when relatively few fish out of the total catch are measured.

No quantitative stock assessment on black marlin in the Indian Ocean is known to exist and no such assessment has been undertaken by the IOTC Working Party on Billfish. However, a preliminary estimation of stock indicators was attempted on the longline catch and effort datasets from Japan and Taiwan,China that represent the best available information. Nominal CPUE exhibited dramatic declines since the beginning of the fishery in two major fishing grounds (West Equatorial and north-west Australia) and the catches in the initial core areas also decreased substantially (Figures 2, 3 and 4). However, there is considerable uncertainty about the degree to which these indicators represent abundance as factors such as changes in targeting practices, discarding practices, fishing grounds and management practices are likely to interact in the depicted trends.

Further work must be undertaken to derive some stock indicators for this species, because in the absence of a quantitative stock assessment, such indicators represent the only means to monitor the status of the stock and assess the impacts of fishing.

MANAGEMENT ADVICE

No quantitative stock assessment is currently available for black marlin in the Indian Ocean, and due to a lack of fishery data for several gears, only preliminary stock indicators can be used. Therefore the stock status is uncertain.

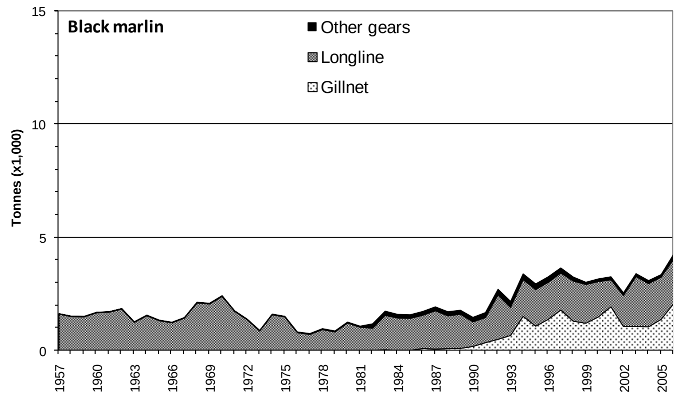


Figure 1: *Estimated catches of black marlin by gear recorded in the IOTC Database (1967-2006). Note, these are minimum catch estimates as they are derived from IOTC fleets only and the levels of catch by other fleets are unknown.*

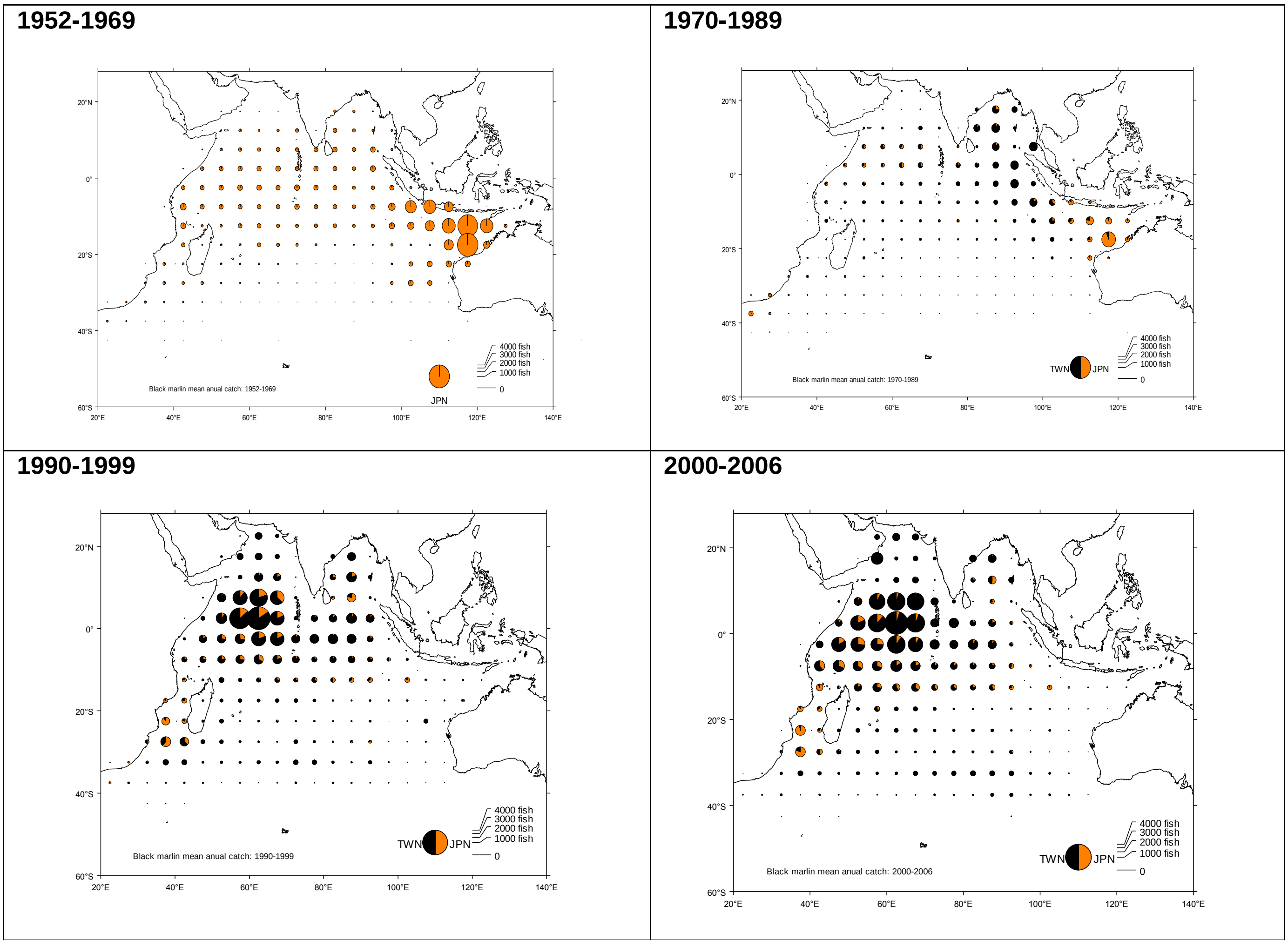


Figure 2: *Mean annual catches of black marlin (number) by Japanese and Taiwanese longline vessels operating in the Indian Ocean over the periods 1952 to 1969 (Japanese fleet only, as no data is available for the Taiwanese fleet from 1954 to 1967), 1970 to 1989, 1990 to 1999 and 2000 to 2006.*

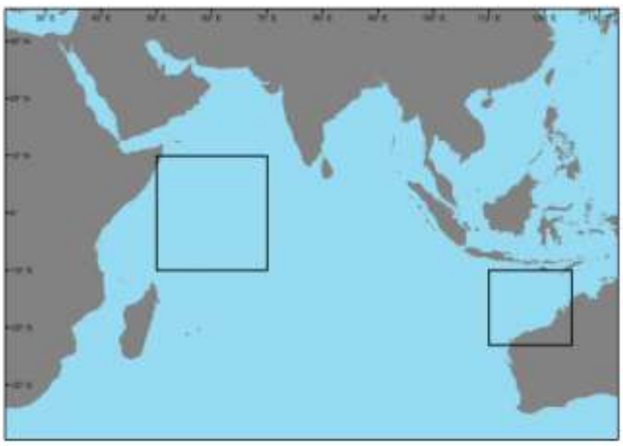


Figure 3. *Major marlin fishing areas (framed): Seychelles and NW Australia.*

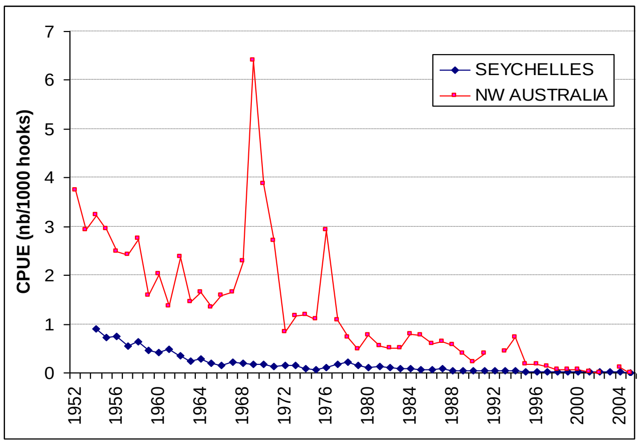


Figure 4. *Nominal yearly CPUE (in numbers / 1000 hooks) of Japanese longliners for black marlin, in each of the two selected areas.*

Executive summary of the status of the blue marlin

(as adopted by the IOTC Scientific Committee, December 2008)

BIOLOGY

Blue marlin[7] (*Makaira nigricans*) is found throughout the tropical and subtropical regions of the Pacific, Indian and Atlantic Oceans. Blue marlin is a solitary species and prefers the warm offshore surface waters (>24°C); it is scarce in waters less than 100m or close to land.

A highly migratory species, the blue marlin is known to make regular seasonal migrations, (in the Atlantic Ocean) moving toward the equator in winter and away again in summer. In the Pacific Ocean one tagged blue marlin is reported to have travelled 3000nm in 90 days.

Blue marlin may live up to 28 years. Females are typically grow larger than males, some attaining over 4 m and exceeding 900 kg. Males grow more slowly than females and generally do not exceed 3 m or 200 kg.

Sexual maturity is attained at between 2 and 4 years of age. A large female can produce in excess of 10 million eggs. Blue marlin is a serial spawner and in some environments females may spawn all year round.

FISHERIES

Blue marlin is caught mainly by longliners and gillnets in the Indian Ocean (Figure 1). Minimum catch estimates have been derived from very small amounts of information and are therefore highly uncertain. Difficulties in the identification of marlins also contribute to the uncertainties of the information available to the Secretariat.

The minimum average annual catch estimated for the period 2002 to 2006 is around 11,700 t. The distribution of blue marlin catches has changed since the 1980's with most of the catch now taken in the western areas of the Indian Ocean (Figure 2). In recent years, the fleets of Taiwan,China (longline), Indonesia (longline), Sri Lanka (gillnet) and India (gillnet) are attributed with the highest catches of blue marlin.

AVAILABILITY OF INFORMATION FOR STOCK ASSESSMENT

There is limited reliable information on the catches of blue marlin and no information on the stock structure or growth and mortality of blue marlin in the Indian Ocean. For example:

1. **Trends in catches**: catch estimates for blue marlin are highly uncertain. Available catch data varied from year to year and mis-identification of marlins is probably common.
2. **Nominal CPUE Trends:** data is available from several fleets (mainly longline) and time periods but this species is not targeted therefore interpretation of catch rates may be problematic as they are likely to be affected by changes in the fisheries targeting other species.
3. **Average weight of fish in the catch:** the average weight of fish is derived from various weight and length information. The reliability of average weight estimates is reduced when relatively few fish out of the total catch are measured.
4. **Sex ratio:** such data are not available to the Secretariat
5. **Lengths of fish being caught –** fish size is derived from various length and weight information. The reliability of the size data is reduced when relatively few fish out of the total catch are measured.

No quantitative stock assessment on blue marlin in the Indian Ocean is known to exist and no such assessment has been undertaken by the IOTC Working Party on Billfish. However, a preliminary estimation of stock indicators was attempted on the longline catch and effort datasets from Japan and Taiwan,China that represent the best available information. Nominal CPUE exhibited dramatic declines since the beginning of the fishery in two major fishing grounds (West Equatorial and north-west Australia) and the catches in the initial fishing grounds areas also decreased substantially (Figures 2, 3 and 4). There is considerable uncertainty about the degree to which those indicators represent abundance as factors such as changes in targeting practices, discarding practices, fishing grounds and management practices are likely to interact in the depicted trends.

Further work must be undertaken to derive some stock indicators for this species, because in the absence of a

[7] Some scientists consider that blue marlin comprises two different species, *M. mazara* and *M. nigricans* based on differences in the lateral line. More commonly, however, these two species are lumped together as a single species.

quantitative stock assessment, such indicators represent the only means to monitor the status of the stock and assess the impacts of fishing.

MANAGEMENT ADVICE

No quantitative stock assessment is currently available for blue marlin in the Indian Ocean, and due to a lack of data for several gears, only preliminary stock indicators can be used. . Therefore the stock status is uncertain.

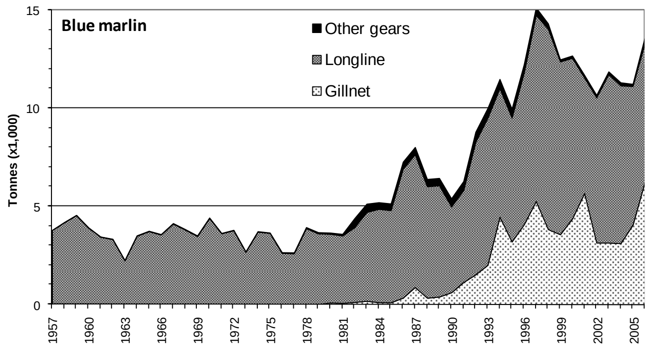


Figure 1: *Estimated catches of blue marlin by gear recorded in the IOTC Database (1967-2006). Note, these are minimum catch estimates as they are derived from IOTC fleets only and the levels of catch by other fleets are unknown*

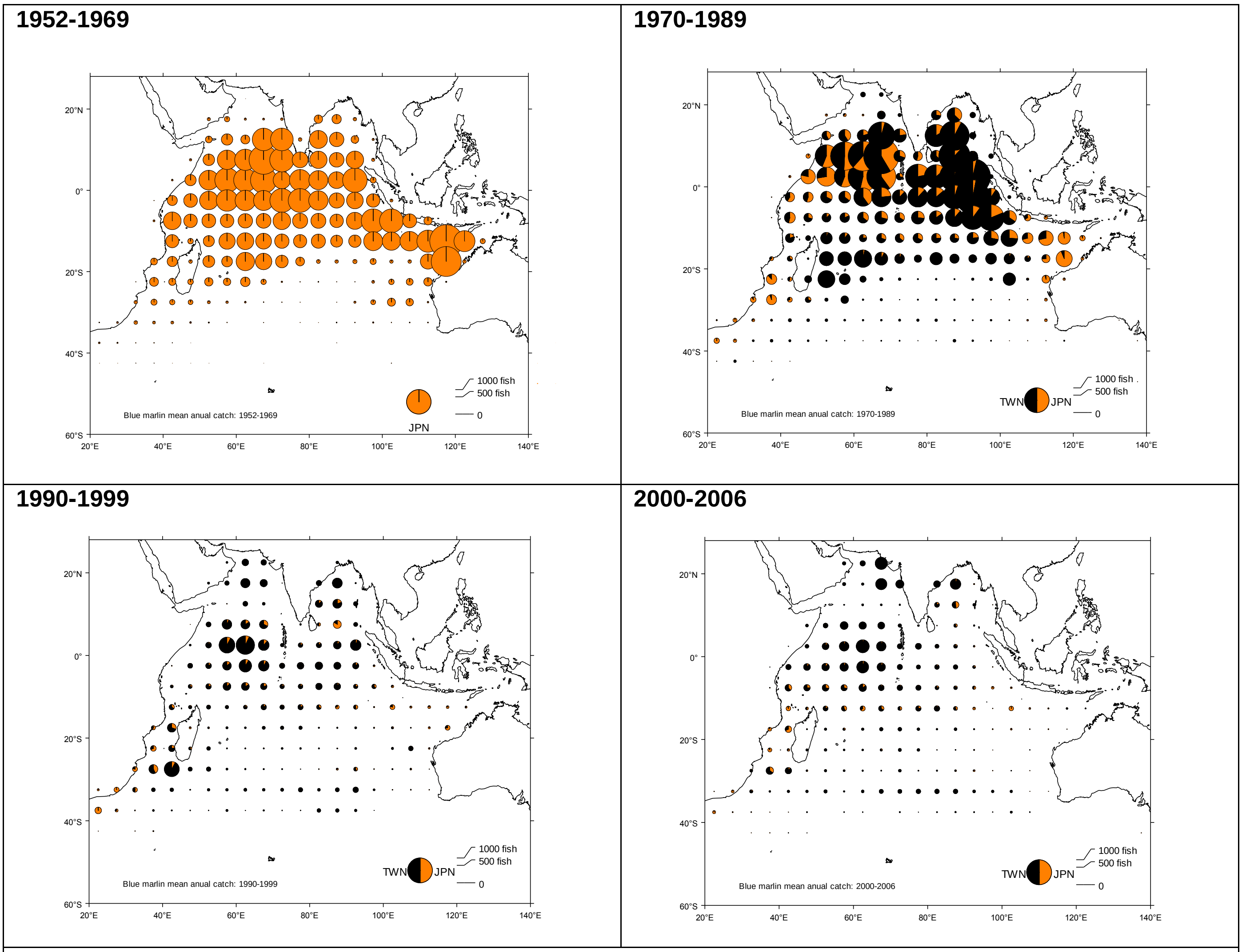


Figure 2: *Mean annual catches of blue marlin (number) by Japanese and Taiwanese longline vessels operating in the Indian Ocean over the periods 1952 to 1969 (Japanese fleet only, as no data is available for the Taiwanese fleet from 1954 to 1967), 1970 to 1989, 1990 to 1999 and 2000 to 2006.*

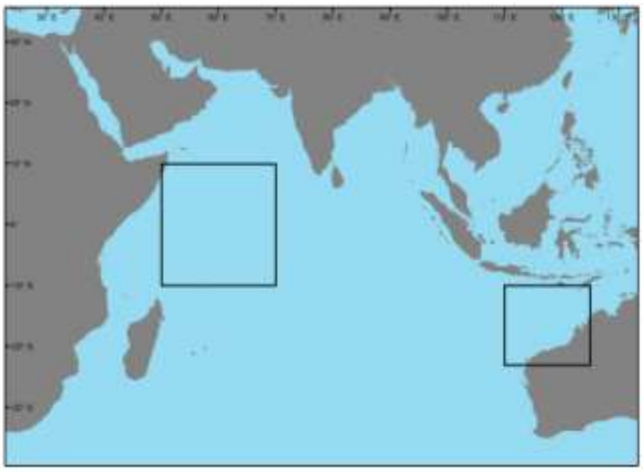


Figure 3. *Major marlin fishing areas (framed): Seychelles and NW Australia.*

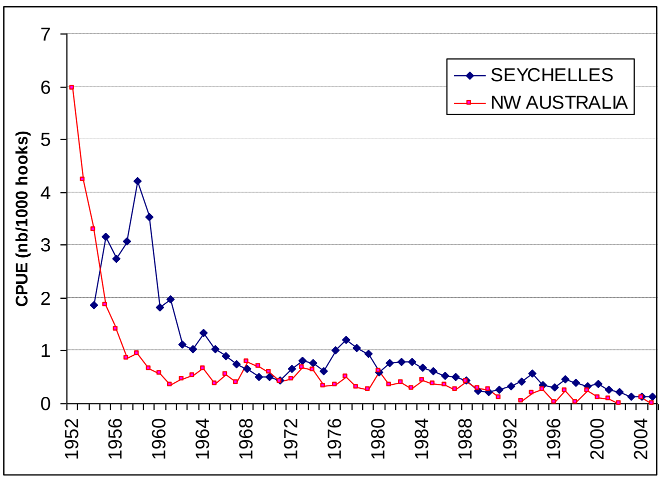


Figure 4. *Nominal yearly CPUE of Japanese longliners for blue marlin, in each of the two selected areas.*

Executive summary of the status of the striped marlin

(as adopted by the IOTC Scientific Committee, December 2008)

BIOLOGY

The striped marlin (*Tetrapturus audax*) occurs in both the Pacific and Indian Oceans. Its distribution is different from other marlins in that it prefers more temperate or cooler waters and tends to be less migratory. Striped marlin is rarely found in the Atlantic Ocean. In the Indian Ocean seasonal concentrations of striped marlin occur in four main regions: off the east African coast (0º-10ºS), the south and western Arabian Sea, the Bay of Bengal, and north-western Australian waters.

Striped marlins may live up to 10 years and are relatively fast growing. The larger individuals may exceed 3 m long and 240 kg. Striped marlin is the smallest of the marlin species; but unlike the other marlin species, striped marlin males and females grow to a similar size.

Sexual maturity is attained at between 2 and 3 years of age and a large female can produce in excess of 20 million eggs. Unlike the other marlins which are serial spawners, striped marlin appear to spawn once per season

Striped marlin belong to the genus *Tetrapturus* whereas black and blue marlins belong to the genus *Makaira*. Stripped marlins can be distinguished from the blue and black marlins by a range of morphological and genetic characteristics; however, the distinction between the striped marlin and the white marlin (*T. albidus*) is apparently less clear and is the subject ongoing debate among scientists.

The stock structure of striped marlin in the Indian Oceans is uncertain.

FISHERIES

Striped marlin is caught mainly by longliners in the Indian Ocean (Figure 1). Minimum catch estimates have been derived from very small amounts of information and are therefore highly uncertain. Difficulties in the identification of marlins also contribute to the uncertainties of the information available to the Secretariat.

The minimum average annual catch estimated for the period 2002 to 2006 is around 3,100 t. The distribution of striped marlin catches has changed since the 1980’s with most of the catch now taken in the western areas of the Indian Ocean (Figure 2). In recent years, the fleets of Taiwan,China (longline) and to a lesser extent Indonesia (longline) are attributed with the highest catches of striped marlin.

AVAILABILITY OF INFORMATION FOR STOCK ASSESSMENT

There is limited reliable information on the catches of striped marlin and no information on the stock structure or growth and mortality of striped marlin in the Indian Ocean. For example:

1. **Trends in catches**: catch estimates for striped marlin are highly uncertain. Available catch data varied from year to year and mis-identification of marlins is probably common.
2. **Nominal CPUE Trends:** data is available from several fleets (mainly longline) and time periods but this species is not targeted therefore interpretation of catch rates may be problematic as they are likely to be affected by changes in the fisheries targeting other species.
3. **Average weight of fish in the catch:** the average weight of fish is derived from various weight and length information. The reliability of average weight estimates is reduced when relatively few fish out of the total catch are measured.
4. **Sex ratio:** such data are not available to the Secretariat
5. **Lengths of fish being caught –** fish size is derived from various length and weight information. The reliability of the size data is reduced when relatively few fish out of the total catch are measured.

No quantitative stock assessment on striped marlin in the Indian Ocean is known to exist and no such assessment has been undertaken by the IOTC Working Party on Billfish. However, a preliminary estimation of stock indicators was attempted on the longline catch and effort datasets from Japan and Taiwan,China that represent the best available information. Nominal CPUE exhibited dramatic declines since the beginning of the fishery in two major fishing grounds (West Equatorial and north-west Australia) and the catches in the initial core areas also decreased substantially (Figures 2, 3 and 4). There is considerable uncertainty about the degree to which those indicators represent abundance as factors such as changes in targeting practices, discarding practices, fishing grounds and management practices are likely to interact in the depicted trends.

Further work must be undertaken to derive some stock indicators for this species, because in the absence of a quantitative stock assessment, such indicators represent the only means to monitor the status of the stock and assess the impacts of fishing.

MANAGEMENT ADVICE

No quantitative stock assessment is currently available for striped marlin in the Indian Ocean, and due to a lack of fishery data for several gears, only preliminary stock indicators can be used .Therefore the stock status is uncertain.

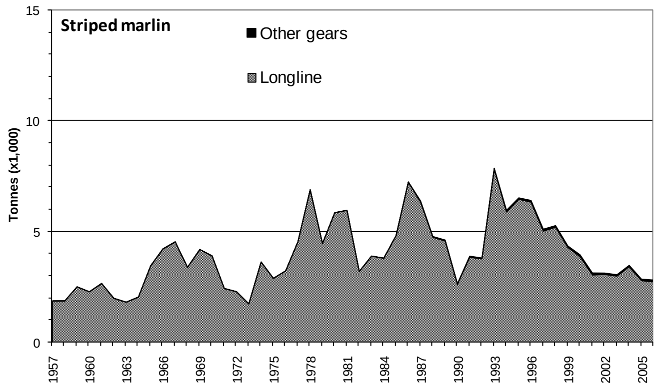


Figure 1: *Estimated catches of striped marlin by gear recorded in the IOTC Database (1967-2006). Note, these are minimum catch estimates as they are derived from IOTC fleets only and the levels of catch by other fleets are unknown*

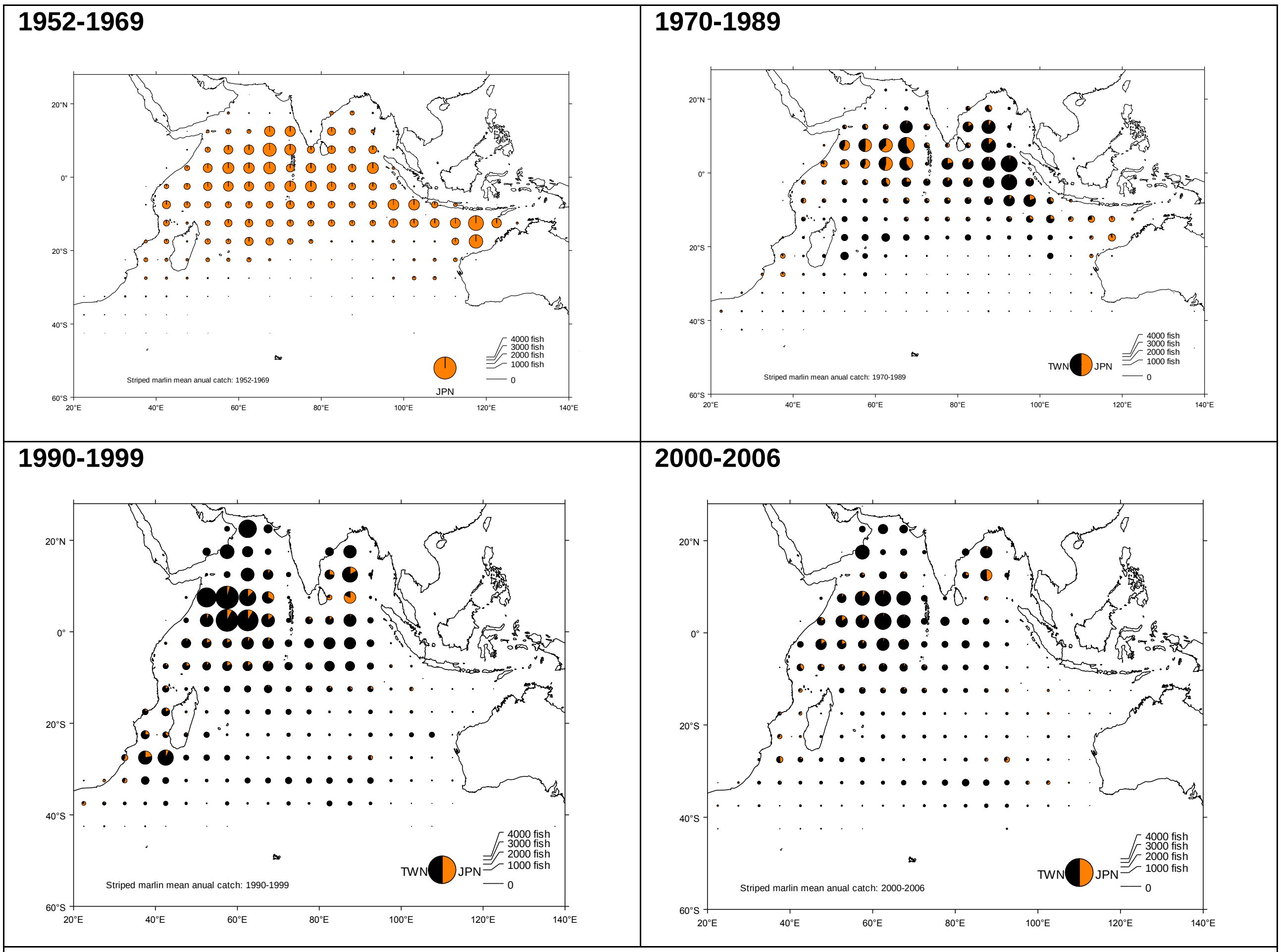


Figure 2: *Mean annual catches of striped marlin (number) by Japanese and Taiwanese longline vessels operating in the Indian Ocean over the periods 1952 to 1969 (Japanese fleet only, as no data is available for the Taiwanese fleet from 1954 to 1967), 1970 to 1989, 1990 to 1999 and 2000 to 2006.*

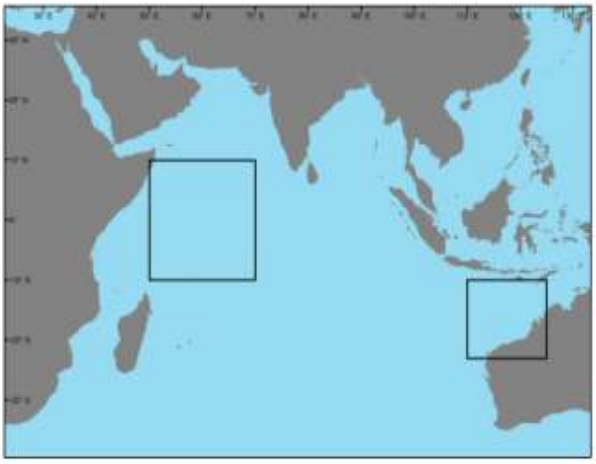


Figure 3. *Major marlin fishing areas (framed): Seychelles and NW Australia.*

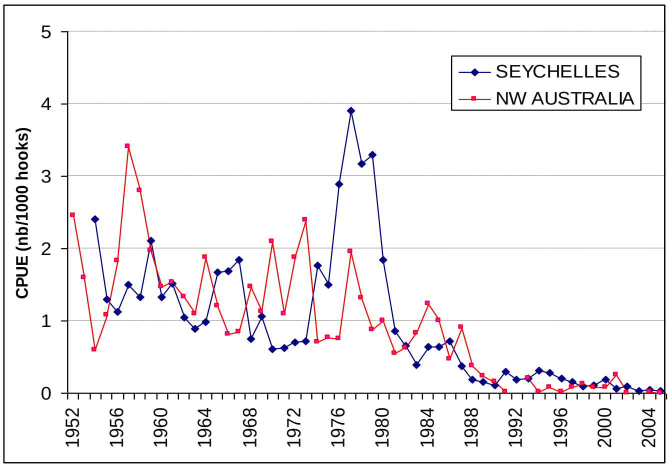


Figure 4*. Nominal yearly CPUE of Japanese longliners for striped marlin, in each of the two selected areas.*

Executive summary of the status of the Indo-Pacific sailfish

(as adopted by the IOTC Scientific Committee, December 2008)

BIOLOGY

Indo-Pacific sailfish[8] (*Istiophorus platypterus*) is found throughout the tropical and subtropical regions of the Pacific and the Indian Oceans. It is mainly found in surface waters above the thermocline, close to coasts and islands. Indo–Pacific sailfish is a highly migratory species and renowned for its speed and (by recreational fishers) for its jumping behaviour — one individual has been reported swimming at speeds in excess of 110 km/h over short periods.

In the Indian Ocean, some sailfish make regular seasonal migrations to Arabian Gulf waters, aggregating around October to April each year before moving northwest into Iranian waters. It is not known, however, where the population goes over the period from July to September.

The Indo-Pacific sailfish is one of the smallest-sized billfish species, but is relatively fast growing. Individuals may grow to over 3 m and up to 100kg, and live to around 7 years.

The stock structure of Indo-Pacific sailfish in the Indian Oceans is uncertain.

FISHERIES

Indo-Pacific sailfish is caught mainly by gillnets and to a much lesser extent by troll and handlines, and longlines. This species is also a popular catch for sport fisheries, e.g. off Kenya.

Minimum catch estimates have been derived from very small amounts of information and are therefore highly uncertain. Unlike the other billfish, sailfish are probably more reliably identified because of the large and distinctive first dorsal fin that runs most of the length of the body.

The minimum average annual catch estimated for the period 2002 to 2006 is around 24,000 t. In recent years, the countries attributed with the highest catches of Indo-Pacific sailfish are situated in the Arabian Sea and are Iran, Sri Lanka, India and Pakistan. Smaller catches are reported for line fishers in Comores and Mauritius and by Indonesia longliners.

AVAILABILITY OF INFORMATION FOR STOCK ASSESSMENT

There is no information on the stock structure of Indo-Pacific sailfish in the Indian Ocean, and no information on age and growth information in the Indian Ocean. Possible fishery indicators:

1. **Trends in catches**: catch estimates for Indo-Pacific sailfish are highly uncertain and there is little information available for the years prior to 1970. However, catches appear to have been rapidly increasing since the mid 1980's.
2. **Nominal CPUE Trends:** few data are available, furthermore this species is not generally targeted therefore interpretation of catch rates may be problematic as they are likely to be affected by changes in the fisheries targeting other species.
3. **Average weight in the catch by fisheries:** few data are available to the Secretariat.
4. **Sex ratio:** such data are not available to the Secretariat
5. **Number of squares fished:** such data are not available to the Secretariat.

No quantitative stock assessment on Indo-Pacific sailfish in the Indian Ocean is known to exist and no such assessment has been undertaken by the IOTC Working Party on Billfish.

MANAGEMENT ADVICE

No quantitative stock assessment is currently available for Indo-Pacific sailfish in the Indian Ocean, and due to a paucity of data there a no stock indicators that are considered to be reliable, therefore the stock status is uncertain.

[8] There is some debate on whether there is a single worldwide sailfish species, *I. Platypterus*; or two species, being an Indo–Pacific sailfish (*I. platypterus*) and an Atlantic species *I. albicans*.

Executive summary of the status of the bullet tuna resource

(*as adopted by the IOTC Scientific Committee, December 2008*)

BIOLOGY

Bullet tuna (*Auxis rochei*) is an oceanic species found in the equatorial areas of the major oceans. It is a highly migratory species with a strong schooling behaviour. Adults are principally caught in coastal waters and around islands that have oceanic salinities.

Adults can grow to 50 cm fork length. Bullet tuna mature at around two years old — about 35 cm (FL). It is a multiple spawner with fecundity ranging between 31,000 and 103,000 eggs per spawning (according to the size of the fish). Larval studies indicate that bullet tuna spawn throughout its range.

Bullet tuna feed on small fishes, particularly anchovies, crustaceans (commonly crab and stomatopod larvae) and squids. Cannibalism is common. Because of their high abundance, bullet tunas are considered to be an important prey for a range of species, especially the commercial tunas.

No information is available on the stock structure of bullet tuna in Indian Ocean.

FISHERIES

Bullet tuna is caught mainly by gillnet and line across the broader Indian Ocean area (Figure 1). This species is also an important catch for artisanal purse seiners. The catch estimates for bullet tuna were derived from very small amounts of information and are therefore highly uncertain[9] (Figure 2). The catches provided in Table 1 are based on the information available at the Secretariat and the following observations on the catches cannot currently be verified. Estimated catches of bullet tuna reached around 1,000 t in the early 1990's and peaked at 3,500 t in 2007. The average annual catch estimated for the period 2003 to 2007 is 2,600 t. In recent years, the countries attributed with the highest catches of bullet tuna are India, Indonesia and Sri Lanka (Table 1, Figure 3).

The fisheries in the Indian Ocean mainly catch bullet tuna ranging between 15 and 25 cm.

AVAILABILITY OF INFORMATION FOR STOCK ASSESSMENT

There is no information on the stock structure of bullet tuna in the Indian Ocean.

There is some age and growth information available for bullet tuna in the Indian Ocean.

Possible fishery indicators:

1. **Trends in catches**: The catch estimates for bullet tuna are highly uncertain. Catches fluctuate from year to year but have been steadily increasing since the early 1980's.
2. **Nominal CPUE Trends:** data not available to the Secretariat.
3. **Average weight in the catch by fisheries:** data not available to the Secretariat.
4. **Number of squares fished:** data not available to the Secretariat.

STOCK ASSESSMENT

While some localised, sub-regional assessments may have been undertaken, no quantitative stock assessment has been undertaken by the IOTC Working Party on Neritics.

[9] The uncertainty in the catch estimates has been assessed by the Secretariat and is based on the amount of processing required to account for the presence of conflicting catch reports, the level of aggregation of the catches by species and or gear, and the occurrence of unreporting fisheries for which catches had to be estimated.

MANAGEMENT ADVICE

No quantitative stock assessment is currently available for bullet tuna in the Indian Ocean, therefore the stock status is uncertain.

The SC notes that the catches of bullet tuna are typically variable but relatively low compared to the other neritic species. The reasons for this are not clear: it may be problem related to reporting, or it may be a normal fluctuation in the fishery. Bullet tuna is a relatively productive species with high fecundity and rapid growth and this makes it relatively resilient and less prone to overfishing. Nevertheless, bullet tuna appears to be an important prey species for other pelagic species including the commercial tunas, therefore it should be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

BULLET TUNA SUMMARY

Maximum Sustainable Yield:	-
Preliminary catch in 2007 *(data as of October 2008)*	3,500 t
Catch in 2006	3,400 t
Mean catch over the last 5 years (2003-07)	2,600 t
Current Replacement Yield:	-
Relative Biomass ($B_{current}/B_{MSY}$):	-
Relative Fishing Mortality ($F_{current}/F_{MSY}$):	-

Table 1. *Best scientific estimates of the catches of bullet tuna (as adopted by the IOTC Scientific Committee) by gear and main fleets for the period 1958-2007 (in thousands of tonnes).*
Data as of October 2008

Gear	Fleet	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84
Gillnet	India	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.1*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.1*	*0.1*	*0.0*
Line	India	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.1*	*0.0*	*0.0*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
Other gears	India	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Indonesia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
All	*Total*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.2*	*0.1*	*0.2*	*0.2*	*0.2*

Gear	Fleet	Av03/07	Av58/07	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07
Gillnet	Sri Lanka	0.6	0.2		0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.5	0.5	0.8	1.2	1.1	0.3	0.3	0.1	0.9	0.2	0.7	0.3	0.9	0.9
	India	0.5	0.1	0.1	0.2	0.1	0.1	0.2	0.2	0.1	0.2	0.1	0.2	0.1	0.3	0.2	0.2	0.2	0.2	0.3	0.3	0.4		1.1	0.4	0.4
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	*1.1*	*0.3*	*0.1*	*0.2*	*0.1*	*0.1*	*0.2*	*0.2*	*0.3*	*0.3*	*0.2*	*0.7*	*0.6*	*1.1*	*1.4*	*1.4*	*0.6*	*0.6*	*0.3*	*1.2*	*0.6*	*0.7*	*1.4*	*1.3*	*1.4*
Line	India	1.2	0.3	0.1	0.4	0.2	0.3	0.3	0.3	0.3	0.4	0.2	0.5	0.3	0.5	0.4	0.5	0.4	0.5	0.5	0.5	0.8	0.5	1.2	1.7	1.7
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	*1.2*	*0.3*	*0.1*	*0.4*	*0.2*	*0.3*	*0.3*	*0.3*	*0.3*	*0.4*	*0.3*	*0.5*	*0.3*	*0.5*	*0.5*	*0.5*	*0.4*	*0.5*	*0.5*	*0.6*	*0.8*	*0.6*	*1.2*	*1.7*	*1.8*
Other gears	India	0.2	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.2	0.1	0.3	0.3
	Indonesia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
	Total	*0.3*	*0.1*	*0.0*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.1*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.3*	*0.2*	*0.1*	*0.4*	*0.4*
All	*Total*	*2.6*	*0.7*	*0.3*	*0.7*	*0.4*	*0.5*	*0.6*	*0.6*	*0.7*	*0.8*	*0.6*	*1.4*	*1.0*	*1.8*	*2.0*	*2.1*	*1.2*	*1.3*	*1.1*	*2.0*	*1.7*	*1.5*	*2.7*	*3.4*	*3.5*

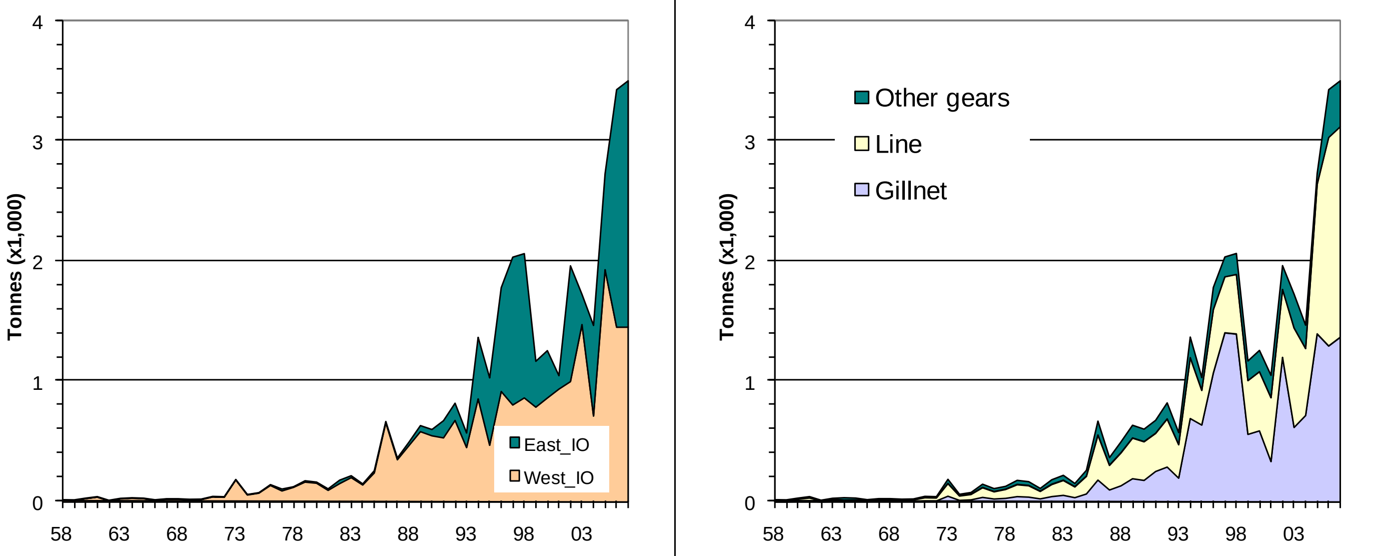


Figure 1. *Bullet tuna: annual catches from 1958 to 2007 by area (left) and gear (right). Data as per October 2008*

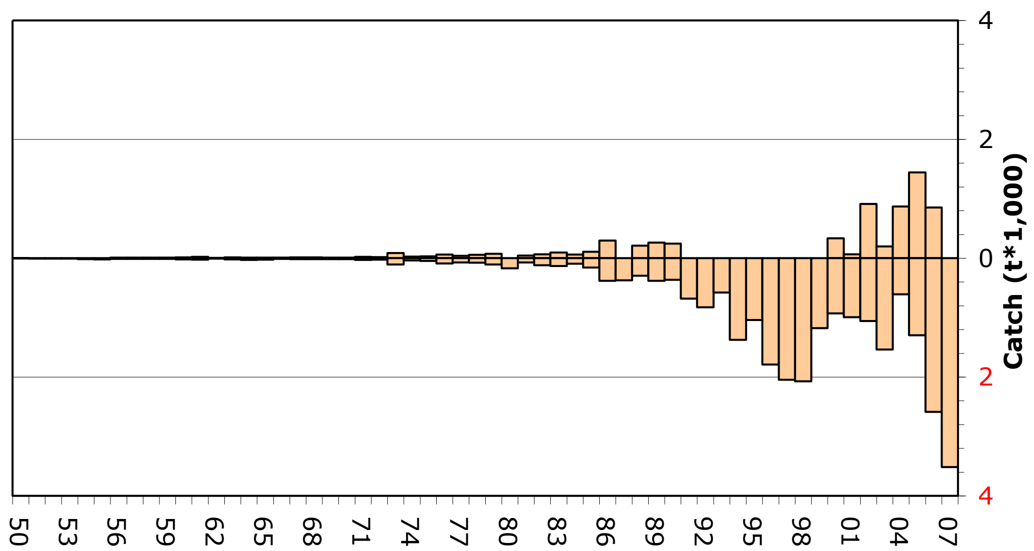


Figure 2. *Bullet tuna: uncertainty of annual catch estimates. The amount of the catch below the zero-line has been categorised as uncertain according to the criteria given in the text.*

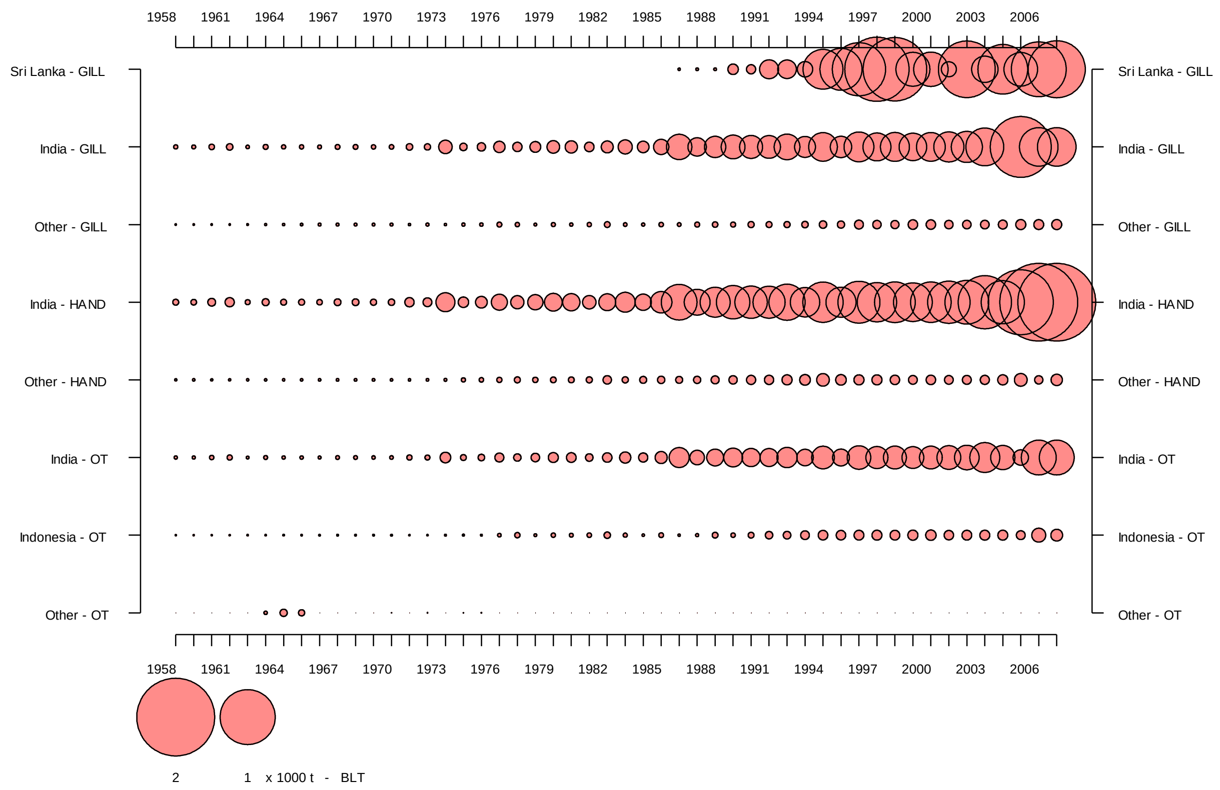


Figure 3. *Bullet tuna: catches by gear and main fleets for the period 1958-2007 (in thousands of tonnes). Data as of October 2008*

Executive summary of the status of the frigate tuna resource

(as adopted by the IOTC Scientific Committee, December 2008)

BIOLOGY

Frigate tuna (*Auxis thazard*) is a highly migratory species found in both coastal and oceanic waters. It is highly gregarious and often schools with other Scombrids.

In other oceans, frigate tuna grows to around 65 cm fork length but the largest size reported for the Indian Ocean is 58 cm (off Sri Lanka).

Size at first maturity is between 29 cm and 35 cm fork length depending on location. In the southern Indian Ocean, the spawning season extends from August to April whereas north of the equator it is from January to April. Fecundity ranges between 200,000 and 1.06 million eggs per spawning (depending on size).

Frigate tuna feeds on small fish, squids and planktonic crustaceans (e.g. decapods and stomatopods). Because of their high abundance, frigate tuna are considered to be an important prey for a range of species, especially the commercial tunas.

No information is available on the stock structure of frigate tuna in Indian Ocean.

FISHERIES

Frigate tuna is taken from across the Indian Ocean area using gillnets, bait boats and lines (Figure 1). This species is also an important catch for industrial purse seiners. The catch estimates for frigate tuna were derived from very small amounts of information and are therefore highly uncertain[10] (Figure 2). The catches provided in Table 1 are based on the information available at the Secretariat and the following observations on the catches cannot currently be verified. Estimated catches have increased steadily since the late 1970's, reaching around 10,000 t in the early 1980's and over 30,000 t by the mid-1990's. The average annual catch estimated for the period 2003 to 2007 is 34,800 t. In recent years, the countries attributed with the highest catches are India , Indonesia , Maldives and Iran and Sri Lanka (Table 1, Figure 3).

The size of frigate tunas taken by the Indian Ocean fisheries typically ranges between 25 and 40 cm depending on the type of gear used, season and location.

AVAILABILITY OF INFORMATION FOR STOCK ASSESSMENT

There is no information on the stock structure of frigate tuna in the Indian Ocean.

Age and growth, fecundity estimates and size at first maturity information is available for frigate tuna in the Indian Ocean.

Possible fishery indicators:

1. **Trends in catches**: The catch estimates for frigate tuna are highly uncertain. Catches fluctuate from year to year but have been steadily increasing since the mid 1950's.
2. **Nominal CPUE Trends:** data not available to the Secretariat.

[10] The uncertainty in the catch estimates has been assessed by the Secretariat and is based on the amount of processing required to account for the presence of conflicting catch reports, the level of aggregation of the catches by species and or gear, and the occurrence of unreporting fisheries for which catches had to be estimated.

3. **Average weight in the catch by fisheries:** data not available to the Secretariat.
4. **Number of squares fished:** data not available to the Secretariat.

STOCK ASSESSMENT

While some localised, sub-regional assessments have been undertaken by national scientists, no quantitative stock assessment has been undertaken by the IOTC Working Party on Neritics.

MANAGEMENT ADVICE

No quantitative stock assessment is currently available for the frigate tuna in the Indian Ocean, therefore the stock status is uncertain. This species is a relatively productive species with high fecundity and rapid growth and this makes it relatively resilient and not prone to overfishing. Nevertheless, frigate tuna appears to be an important prey species for other pelagic species including the commercial tunas, therefore it should be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

FRIGATE TUNA SUMMARY

Maximum Sustainable Yield:	-
Preliminary catch in 2007 *(data as of October 2008)*	41,700 t
Catch in 2006	38,600 t
Mean catch over the last 5 years (2003-07)	34,800 t
Current Replacement Yield:	-
Relative Biomass ($B_{current}/B_{MSY}$):	-
Relative Fishing Mortality ($F_{current}/F_{MSY}$):	-

Table 1. *Best scientific estimates of the catches of frigate tuna (as adopted by the IOTC Scientific Committee) by gear and main fleets for the period 1958-2007 (in thousands of tonnes).*
(Data as of October 2008)

Gear	Fleet	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84
Baitboat	Maldives	0.9	0.9	0.9	1.4	1.4	1.4	1.4	2.3	2.8	2.8	2.8	2.8	1.7	1.7	1.8	3.9	3.5	2.3	1.5	1.8	0.9	0.9	0.8	0.8	1.2	2.0	1.7
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
	Total	*0.9*	*0.9*	*0.9*	*1.4*	*1.4*	*1.4*	*1.4*	*2.3*	*2.8*	*2.8*	*2.8*	*2.8*	*1.7*	*1.7*	*1.8*	*3.9*	*3.5*	*2.4*	*1.5*	*1.8*	*0.9*	*0.9*	*0.8*	*0.8*	*1.2*	*2.0*	*1.8*
Gillnet	India	0.2	0.2	0.3	0.5	0.1	0.3	0.4	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	1.6	0.4	0.6	0.9	0.6	0.9	1.2	1.1	0.7	1.1	1.5	1.0
	Indonesia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.0
	UAE																	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1.0	0.4	0.4
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.1	0.3
	Total	*0.2*	*0.2*	*0.4*	*0.5*	*0.2*	*0.3*	*0.4*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.4*	*0.4*	*1.7*	*0.7*	*0.9*	*1.3*	*1.1*	*1.2*	*1.6*	*1.5*	*1.2*	*2.6*	*2.2*	*1.8*
Line	India	0.1	0.1	0.2	0.3	0.1	0.2	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.9	0.2	0.3	0.5	0.3	0.5	0.6	0.6	0.3	0.5	0.8	0.5
	Indonesia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.0
	Maldives	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.2	0.2	0.2	0.1	0.2	0.2
	Sri Lanka	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.7	0.7	0.5
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2
	Total	*0.2*	*0.2*	*0.3*	*0.4*	*0.2*	*0.3*	*0.4*	*0.4*	*0.4*	*0.4*	*0.4*	*0.4*	*0.3*	*0.3*	*0.3*	*1.0*	*0.5*	*0.5*	*0.8*	*0.7*	*0.8*	*1.0*	*1.0*	*0.9*	*1.6*	*1.8*	*1.5*
Other gears	Indonesia	0.1	0.2	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.3	0.3	0.2	0.2	0.3	0.3	0.3	1.0	2.2	0.7	1.5	1.2	1.6	3.2	1.4	0.5
	Thailand													0.2	0.5	0.4	0.7	0.5	1.2	0.8	0.7	0.9	0.1	0.0	0.1	1.3	0.5	0.6
	India	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.2	0.4	0.2	0.1	0.2	0.3
	Total	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.7*	*0.8*	*0.8*	*1.2*	*1.0*	*1.7*	*2.0*	*3.1*	*1.9*	*1.9*	*1.7*	*1.9*	*4.8*	*2.3*	*1.6*
All	*Total*	*1.5*	*1.5*	*1.8*	*2.5*	*2.0*	*2.3*	*2.5*	*3.2*	*3.7*	*3.8*	*3.7*	*3.7*	*2.9*	*3.2*	*3.4*	*7.8*	*5.7*	*5.5*	*5.7*	*6.7*	*4.8*	*5.4*	*5.1*	*4.9*	*10.2*	*8.3*	*6.6*

Gear	Fleet	Av03/07	Av58/07	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07
Baitboat	Maldives	3.7	2.4	1.3	0.8	1.0	1.4	1.9	3.0	2.3	3.1	5.0	3.8	3.7	6.1	2.3	3.8	3.1	3.7	3.7	3.9	4.1	3.3	4.6	3.2	3.5
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
	Total	*3.8*	*2.4*	*1.3*	*0.9*	*1.0*	*1.5*	*2.0*	*3.1*	*2.3*	*3.2*	*5.1*	*3.8*	*3.7*	*6.1*	*2.3*	*3.9*	*3.1*	*3.7*	*3.7*	*3.9*	*4.2*	*3.3*	*4.6*	*3.3*	*3.6*
Gillnet	India	7.8	2.8	1.7	4.8	2.5	3.4	4.2	4.0	3.9	4.9	3.3	6.1	3.4	6.6	5.8	6.3	5.7	6.2	6.8	7.2	10.1	8.0	2.7	9.1	9.1
	Iran, Islamic R.	2.4	0.5		0.3	0.4	0.3	0.2	0.1	0.5	0.3	0.4	0.2	4.4	0.7	0.6	0.5	0.6	0.8	0.6	0.6	1.1	1.5	1.6	2.4	5.2
	Sri Lanka	1.2	0.6		0.0	0.0	0.0	0.3	0.3	0.2	0.4	1.2	1.7	1.7	2.7	3.9	3.8	1.8	0.6	0.9	2.7	2.1	1.7	1.0	0.7	0.8
	Indonesia	0.7	0.2	0.1	0.0	0.1	0.2	0.1	0.2	0.3	0.4	0.5	0.6	0.5	0.6	0.6	0.6	0.6	0.7	0.5	0.6	0.6	0.6	0.9	0.8	0.8
	UAE	0.2	0.3	0.4	0.5	0.5	0.5	0.5	0.6	0.5	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2
	Other Fleets	0.4	0.3	0.3	0.2	0.4	0.5	0.7	0.5	0.2	0.3	0.3	0.3	0.6	0.6	0.8	0.6	0.7	0.6	0.6	0.3	0.3	0.4	0.4	0.3	0.3
	Total	*12.7*	*4.6*	*2.5*	*5.8*	*3.9*	*5.0*	*6.0*	*5.6*	*5.6*	*6.8*	*6.2*	*9.5*	*11.2*	*11.7*	*12.2*	*12.3*	*9.9*	*9.1*	*9.8*	*11.7*	*14.5*	*12.3*	*6.8*	*13.5*	*16.4*
Line	India	4.8	1.5	0.9	2.4	1.3	1.7	2.1	2.0	2.0	2.5	1.7	3.1	1.7	3.4	3.0	3.2	2.9	3.1	3.4	3.7	4.9	4.4	0.8	6.9	6.9
	Indonesia	0.4	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.8	0.1	0.5
	Maldives	0.3	0.2	0.3	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.5	0.3	0.3	0.4	0.2	0.4	0.3	0.3	0.3	0.3	0.2	0.3	0.4	0.3	0.3
	Sri Lanka	0.0	0.3	0.6	0.6	0.7	0.7	0.8	0.9	1.0	1.2	1.1	1.1	1.0	0.8	0.7	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other Fleets	0.2	0.2	0.2	0.2	0.2	0.3	0.4	0.3	0.2	0.2	0.3	0.4	0.4	0.2	0.4	0.3	0.3	0.3	0.3	0.2	0.1	0.2	0.2	0.3	0.3
	Total	*5.7*	*2.3*	*2.1*	*3.5*	*2.4*	*3.1*	*3.6*	*3.7*	*3.7*	*4.4*	*3.8*	*5.2*	*3.7*	*5.1*	*4.5*	*4.6*	*3.8*	*4.1*	*4.4*	*4.4*	*5.6*	*5.2*	*2.2*	*7.5*	*7.9*
Other gears	Indonesia	9.6	3.2	1.8	0.4	0.8	2.6	1.6	2.7	4.4	4.6	6.0	7.2	7.1	7.5	7.7	7.4	8.1	8.5	7.0	7.5	7.8	7.8	10.1	11.3	10.9
	Thailand	1.4	0.8	1.7	0.8	7.5	1.4	1.1	0.9	0.9	1.2	1.2	0.9	1.4	0.9	0.9	0.6	0.4	1.0	1.0	0.8	1.1	1.1	1.6	1.4	1.6
	Sri Lanka	0.7	0.2			0.0	0.1	0.1	0.2	0.2	0.3	0.4	0.4	0.6	0.6	0.7	0.8	1.0	1.0	0.9	1.0	0.9	0.9	0.4	0.7	0.8
	India	0.5	0.3	0.2	0.6	0.3	0.4	0.5	0.5	0.5	0.6	0.4	0.7	0.4	0.8	0.7	0.8	0.7	0.8	0.8	0.9	1.3	0.8	0.1	0.2	0.2
	Other Fleets	0.5	0.2	0.4	0.4	0.4	0.1	0.4	0.1	0.1	0.0	0.0	0.0	0.1	1.4	0.2	0.0	0.0	0.9	0.5	1.1	0.4	0.4	0.7	0.7	0.2
	Total	*12.7*	*4.7*	*4.1*	*2.2*	*8.9*	*4.7*	*3.7*	*4.4*	*6.0*	*6.7*	*7.9*	*9.4*	*9.6*	*11.3*	*10.3*	*9.7*	*10.2*	*12.2*	*10.3*	*11.3*	*11.5*	*11.0*	*12.8*	*14.2*	*13.8*
All	*Total*	*34.8*	*14.1*	*10.0*	*12.4*	*16.2*	*14.2*	*15.3*	*16.6*	*17.6*	*21.1*	*23.0*	*27.9*	*28.2*	*34.3*	*29.3*	*30.4*	*27.1*	*29.2*	*28.2*	*31.4*	*35.8*	*31.9*	*26.3*	*38.6*	*41.7*

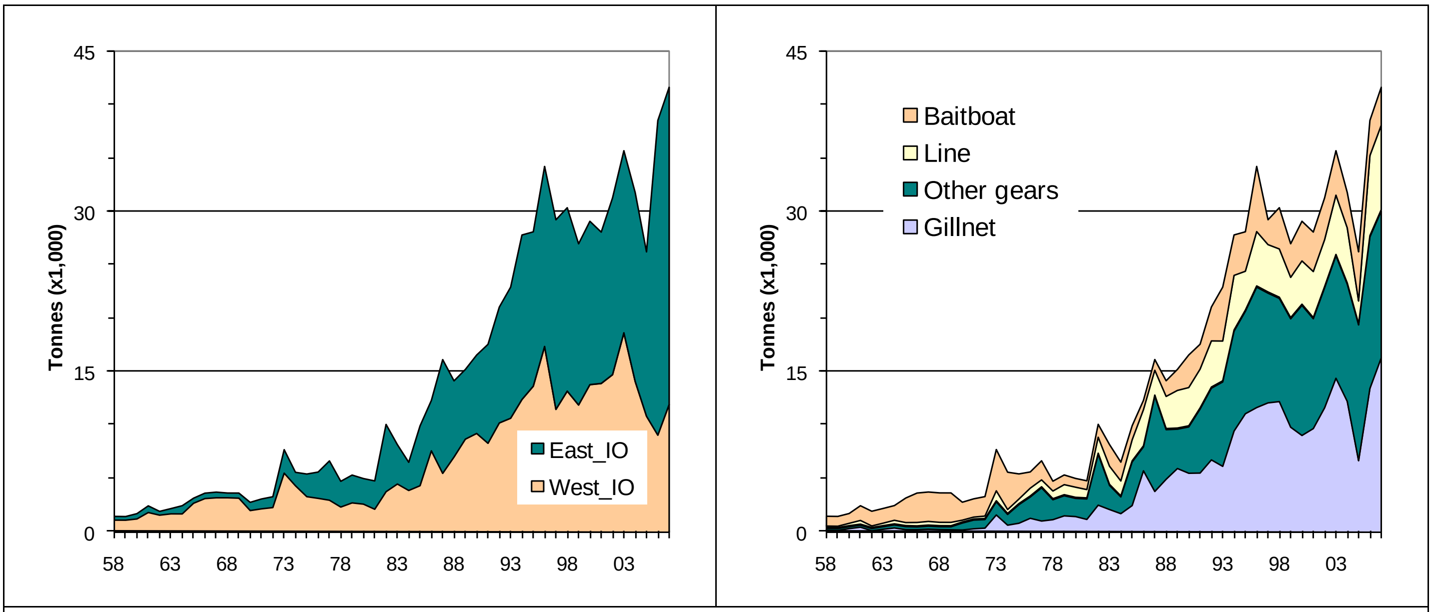


***Figure 1**. Frigate tuna: annual catches from 1958 to 2007 by area (left) and gear (right).* Data as per October 2008

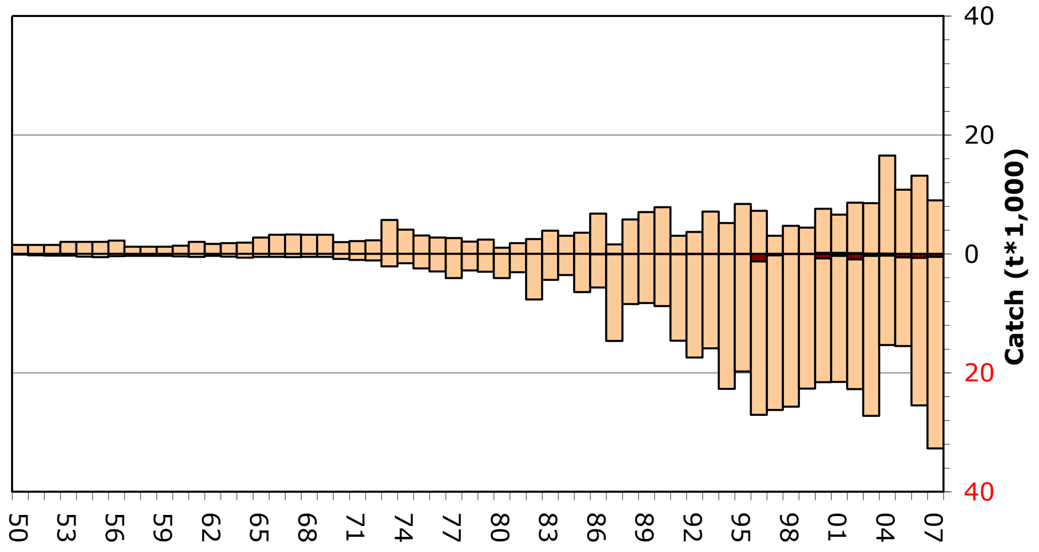


***Figure 2**. Frigate tuna: uncertainty of annual catch estimates. The amount of the catch below the zero-line has been categorised as uncertain according to the criteria given in the text. Dark sections represent estimates of catches by industrial fleets.*

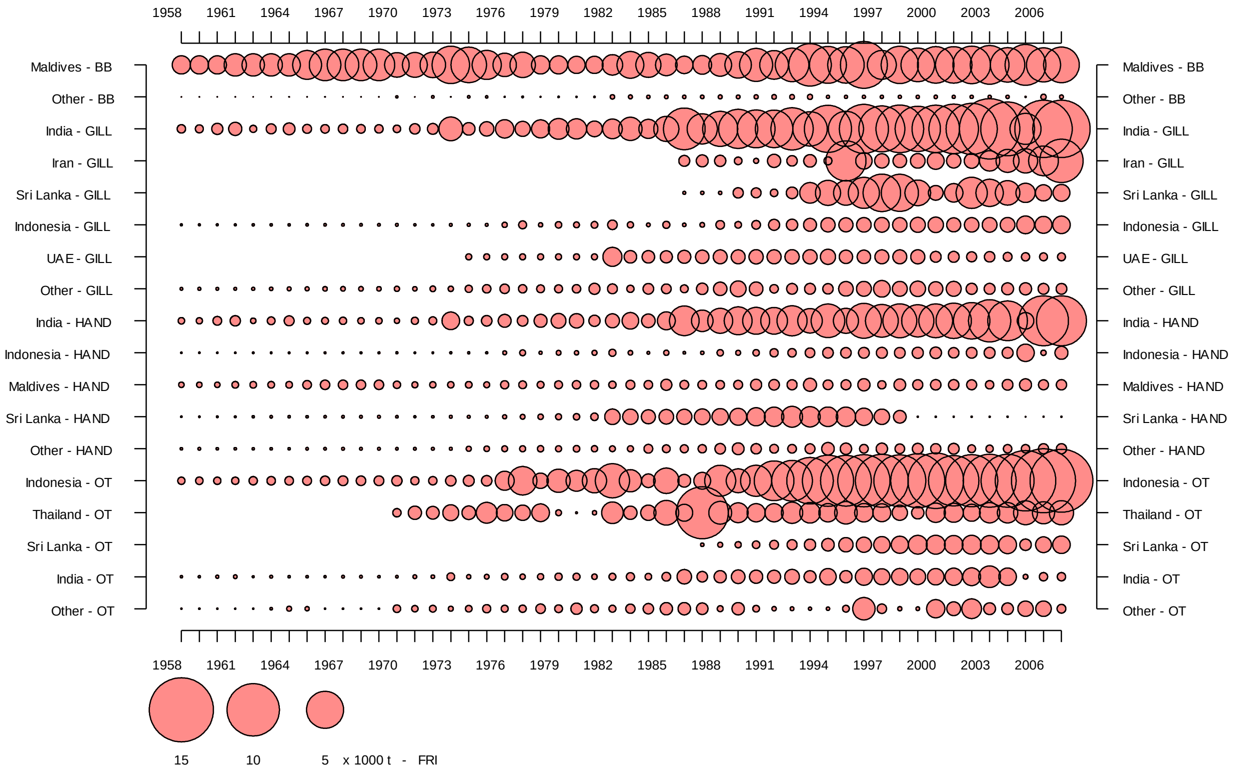


Figure 3. *Frigate tuna: catches by gear and main fleets for the period 1958-2007.(Data as per October 2008)*

Executive summary of the status of the Indo-Pacific king mackerel resource

(as adopted by the IOTC Scientific Committee, December 2008)

BIOLOGY

The Indo-Pacific king mackerel (*Scomberomorus guttatus*) is a migratory species that forms small schools and inhabits coastal waters, sometimes entering estuarine areas. It is found in waters from the Persian Gulf, India and Sri Lanka, Southeast Asia, as far north as the Sea of Japan.

Adults can reach a maximum length of 76 cm fork length. Maturity is reached at around 48-52 cm total length (TL) or 1-2 years old in southern India, and about 40 cm (TL) in Thailand. Based on the occurrence of ripe females and the size of maturing eggs, spawning probably occurs from April to July in southern India and in May in Thailand waters. Fecundity increases with age in the Indian waters, ranging from around 400,000 eggs at age 2 years to over one million eggs at age 4 years.

The Indo-Pacific king mackerel feeds mainly on small schooling fishes (e.g. sardines and anchovies), squids and crustaceans.

No information is available on the stock structure of Indo-Pacific king mackerel stock structure in Indian Ocean.

FISHERIES

The Indo-Pacific king mackerel is mostly caught by gillnet fisheries in the Indian Ocean (Figure 1), in particular artisanal fleets from India and more recently Indonesia (Table 1). The catch estimates for Indo-Pacific king mackerel were derived from very small amounts of information and are therefore highly uncertain[11] (Figure 2). The catches provided in Table 1 are based on the information available at the Secretariat and the following observations on the catches cannot currently be verified. Estimated catches have increased steadily since the mid 1960's, reaching around 10,000 t in the early 1970's and over 30,000 t by 1989. However, for the last 2 years, 2006 and 2007, catches have been decreasing to a level less than 30,000 t. The average annual catch estimated for the period 2003 to 2007 is 31,600 t. In recent years, the countries attributed with the highest catches are Indonesia, India and Iran (Table 1, Figure 3).

AVAILABILITY OF INFORMATION FOR STOCK ASSESSMENT

There is no information on the stock structure of Indo-Pacific king mackerel in the Indian Ocean.

Age and growth, fecundity estimates and size at first maturity information is available for Indo-Pacific king mackerel in the Indian Ocean.

Possible fishery indicators:

1. **Trends in catches**: The catch estimates for Indo-Pacific king mackerel are highly uncertain. Catches fluctuate from year to year but have been steadily increasing since the mid 1960's.
2. **Nominal CPUE Trends:** data not available to the Secretariat.
3. **Average weight in the catch by fisheries:** data not available to the Secretariat.
4. **Number of squares fished:** data not available to the Secretariat.

[11] The uncertainty in the catch estimates has been assessed by the Secretariat and is based on the amount of processing required to account for the presence of conflicting catch reports, the level of aggregation of the catches by species and or gear, and the occurrence of unreporting fisheries for which catches had to be estimated.

STOCK ASSESSMENT

No quantitative stock assessment has been undertaken by the IOTC Working Party on Neritics.

MANAGEMENT ADVICE

No quantitative stock assessment is currently available for the Indo-Pacific king mackerel in the Indian Ocean, therefore the stock status is uncertain. This species is a relatively productive species with high fecundity and rapid growth and this makes it relatively resilient and not prone to overfishing.

The SC recommends Indo-Pacific king mackerel be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

INDO-PACIFIC KING MACKEREL SUMMARY

Maximum Sustainable Yield:	-
Preliminary catch in 2007 *(data as of October 2008)*	28,900 t
Catch in 2006	29,100 t
Mean catch over the last 5 years (2003-07)	31,600 t
Current Replacement Yield:	-
Relative Biomass ($B_{current}/B_{MSY}$):	-
Relative Fishing Mortality ($F_{current}/F_{MSY}$):	-

Table 1. *Best scientific estimates of the catches of Indo-Pacific king mackerel (as adopted by the IOTC Scientific Committee) by gear and main fleets for the period 1958-2007 (in thousands of tonnes).* Data as of October 2008

	Fleet	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84
Gillnet	India	2.1	1.8	2.3	3.1	2.9	2.4	3.2	2.7	2.9	2.9	3.5	3.2	3.8	4.8	6.0	3.9	7.0	6.2	6.9	5.3	4.9	7.6	8.2	7.7	7.8	7.8	11.2
	Indonesia	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.2	0.3	0.3	0.3	0.4	0.6	0.3	0.2	0.2	0.2	0.3	0.3	0.5	0.5	0.5
	Iran, Islamic R.																									1.4	1.6	0.9
	Saudi Arabia																								0.0	0.0	0.0	0.0
	Malaysia	0.2	0.2	0.2	0.2	0.2	0.2	0.5	0.6	0.7	0.6	0.6	0.6								1.3	1.4	1.5	1.2	1.5	1.7	1.5	0.9
	Thailand													0.0		0.0	0.2	0.1	0.1	0.2	0.6	0.3	0.6	0.5	0.6	0.2	0.1	0.1
	Pakistan	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.3	0.3	0.2	0.2	0.4	0.3	0.2	0.2	0.2	0.3	0.3	0.5	0.1	0.4	0.4	0.4	0.3
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
	Total	*2.5*	*2.2*	*2.7*	*3.5*	*3.5*	*3.0*	*4.1*	*3.7*	*4.2*	*4.0*	*4.7*	*4.3*	*4.3*	*5.3*	*6.7*	*4.6*	*7.7*	*7.0*	*7.6*	*7.6*	*7.1*	*10.5*	*10.2*	*10.4*	*12.2*	*12.0*	*14.0*
Line	Indonesia	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.5	0.3	0.2	0.2	0.2	0.2	0.3	0.5	0.5	0.4
	India	0.3	0.3	0.3	0.5	0.4	0.4	0.5	0.4	0.4	0.4	0.5	0.5	0.5	0.7	0.9	0.6	1.0	0.9	1.0	0.8	0.7	1.1	1.2	1.1	1.1	1.1	1.6
	Yemen	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.5	0.5	0.6	0.6	0.7	0.6	0.7	0.6	0.5	0.1	0.8
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	*0.6*	*0.6*	*0.6*	*0.7*	*0.8*	*0.7*	*0.8*	*0.8*	*0.8*	*0.9*	*1.0*	*0.9*	*0.9*	*1.1*	*1.4*	*1.1*	*1.9*	*2.0*	*1.9*	*1.6*	*1.6*	*2.0*	*2.2*	*2.0*	*2.2*	*1.8*	*2.9*
Other gears	India	1.3	1.1	1.4	1.9	1.8	1.5	2.0	1.6	1.8	1.7	2.2	1.9	2.3	3.0	3.7	2.4	4.3	3.8	4.2	3.2	3.0	4.6	5.0	4.7	4.8	4.8	6.9
	Thailand													0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Malaysia																					0.0	0.0	0.0		0.0	0.0	0.0
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
	Total	*1.3*	*1.1*	*1.4*	*1.9*	*1.8*	*1.5*	*2.0*	*1.6*	*1.8*	*1.7*	*2.2*	*1.9*	*2.3*	*3.0*	*3.7*	*2.4*	*4.3*	*3.8*	*4.2*	*3.2*	*3.0*	*4.7*	*5.0*	*4.7*	*4.8*	*4.9*	*6.9*
All	*Total*	*4.4*	*3.8*	*4.8*	*6.2*	*6.0*	*5.2*	*6.9*	*6.1*	*6.8*	*6.6*	*7.8*	*7.1*	*7.5*	*9.4*	*11.8*	*8.1*	*13.8*	*12.8*	*13.7*	*12.5*	*11.8*	*17.1*	*17.4*	*17.1*	*19.2*	*18.7*	*23.9*

Gear	Fleet	Av03/07	Av58/07	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07
Gillnet	India	6.8	6.6	9.8	5.5	7.1	8.6	10.3	7.5	11.4	9.9	12.1	9.3	9.8	7.2	8.2	12.8	7.9	7.8	8.5	9.3	8.7	7.0	6.1	5.9	5.9
	Indonesia	5.5	2.2	0.7	0.7	0.8	4.8	5.9	2.8	2.4	1.0	4.6	2.9	5.5	7.1	6.1	6.1	5.8	6.0	6.8	4.9	5.4	7.3	4.9	4.9	4.9
	Iran, Islamic R.	3.8	1.3	0.5	0.5	0.7	0.7	1.7	2.3	2.5	2.2	1.6	1.6	5.4	4.3	2.3	3.9	3.5	4.1	2.5	4.0	3.7	4.3	3.1	4.0	3.7
	Saudi Arabia	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.7	0.7	0.7
	Malaysia	0.5	0.8	1.2	1.6	1.7	1.4	1.1	1.2	1.3	1.6	1.3	1.2	0.9	0.9	1.0	1.4	0.3	0.4	0.5	0.8	0.7	0.6	0.4	0.5	0.4
	Thailand	0.2	0.2	0.3	0.2	0.4	0.4	0.3	0.3	0.3	0.4	0.5	0.4	0.6	0.5	0.5	0.6	0.8	0.2	0.4	0.4	0.5	0.2	0.1	0.2	0.2
	Pakistan	0.0	0.2	0.4	0.6	0.6	0.7	0.0	0.1	0.9	0.0					0.1	0.1	0.4	0.3	0.2						
	Other Fleets	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.0	0.1	0.2	0.1	0.2	0.2	0.3	0.2	0.3	0.3	0.2	0.2	0.1	0.2	0.1	0.1	0.1
	Total	*17.5*	*11.5*	*12.9*	*9.1*	*11.5*	*16.6*	*19.5*	*14.3*	*18.8*	*15.3*	*20.2*	*15.6*	*22.3*	*20.3*	*18.7*	*25.4*	*19.1*	*19.5*	*19.3*	*20.1*	*19.4*	*20.0*	*15.4*	*16.4*	*16.1*
Line	Indonesia	5.2	2.1	0.7	0.7	0.8	4.5	5.6	2.6	2.3	0.9	4.3	2.8	5.1	6.7	5.8	5.7	5.4	5.7	6.4	4.6	5.1	6.9	4.6	4.6	4.6
	India	1.1	1.0	1.4	0.8	1.0	1.3	1.5	1.1	1.7	1.4	1.8	1.4	1.4	1.1	1.2	1.9	1.1	1.1	1.2	1.4	1.3	1.0	1.2	0.9	0.9
	Yemen	0.2	0.4	0.6	0.7	0.6	0.5	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.1
	Other Fleets	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.0	0.1	0.1	0.2
	Total	*6.6*	*3.4*	*2.8*	*2.2*	*2.4*	*6.3*	*7.6*	*4.3*	*4.5*	*2.9*	*6.6*	*4.8*	*7.1*	*8.2*	*7.4*	*8.0*	*7.0*	*7.2*	*8.0*	*6.3*	*6.7*	*8.3*	*6.2*	*5.8*	*5.9*
Other gears	India	4.5	4.1	6.0	3.4	4.4	5.3	6.3	4.6	7.0	6.1	7.4	5.7	6.0	4.4	5.0	7.9	4.8	4.8	5.2	5.7	5.3	4.6	4.9	3.8	3.8
	Thailand	2.4	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1	1.7	1.7	1.9	0.1	1.3	1.5	1.9	1.8	2.4	2.9	2.4	2.5
	Malaysia	0.6	0.1		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.2	0.8	0.7	0.6	0.6	0.6	0.7	0.6
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0
	Total	*7.5*	*4.7*	*6.0*	*3.4*	*4.4*	*5.3*	*6.4*	*4.6*	*7.1*	*6.1*	*7.4*	*5.7*	*6.0*	*6.1*	*6.8*	*9.8*	*5.9*	*7.3*	*7.5*	*8.3*	*7.8*	*7.7*	*8.4*	*6.9*	*6.9*
All	*Total*	*31.6*	*19.6*	*21.7*	*14.7*	*18.4*	*28.2*	*33.5*	*23.2*	*30.4*	*24.3*	*34.3*	*26.1*	*35.4*	*34.6*	*32.8*	*43.2*	*32.0*	*34.0*	*34.8*	*34.7*	*34.0*	*35.9*	*30.0*	*29.1*	*28.9*

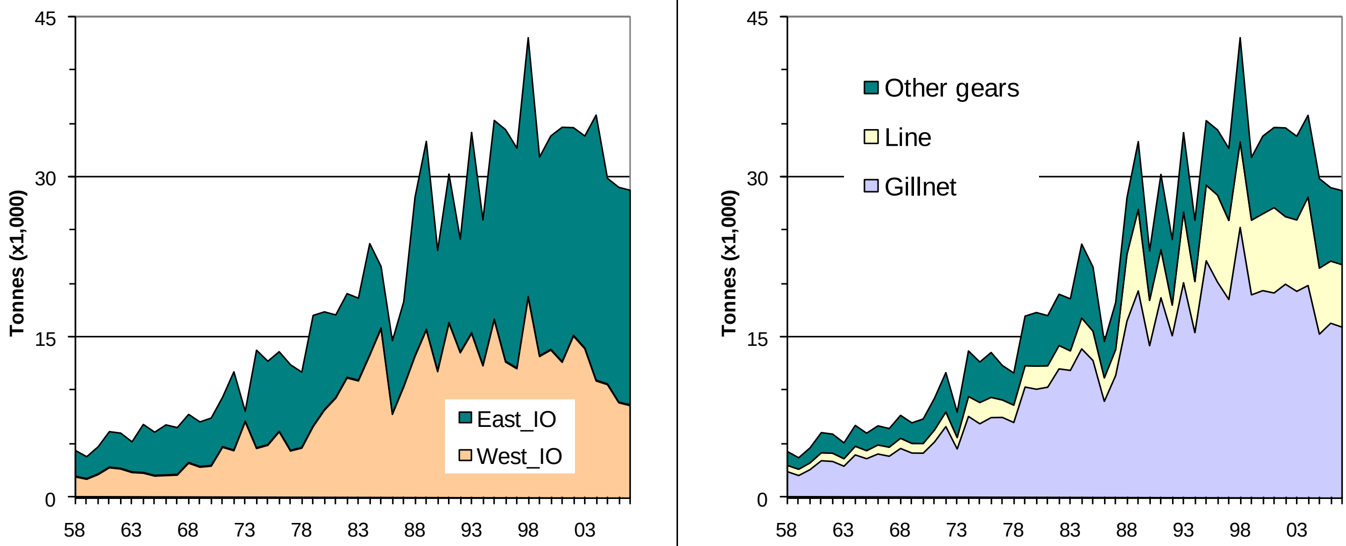


Figure 1. *Indo-Pacific king mackerel: annual catches from 1958 to 2007 by area (left) and gear (right).* *Data as of October 2008*

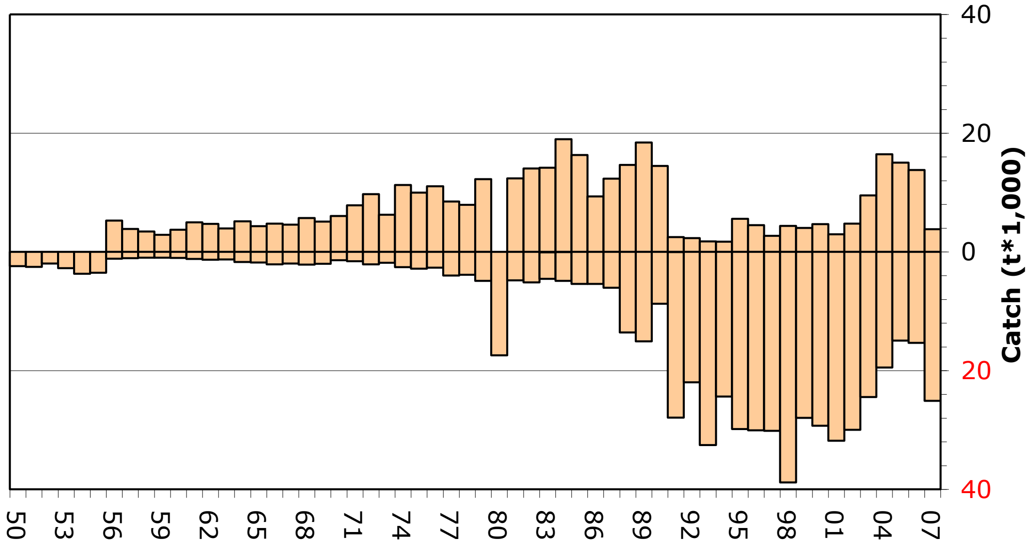


Figure 2. *Indo-Pacific king mackerel: uncertainty of annual catch estimates. The amount of the catch below the zero-line has been categorised as uncertain according to the criteria given in the text.*

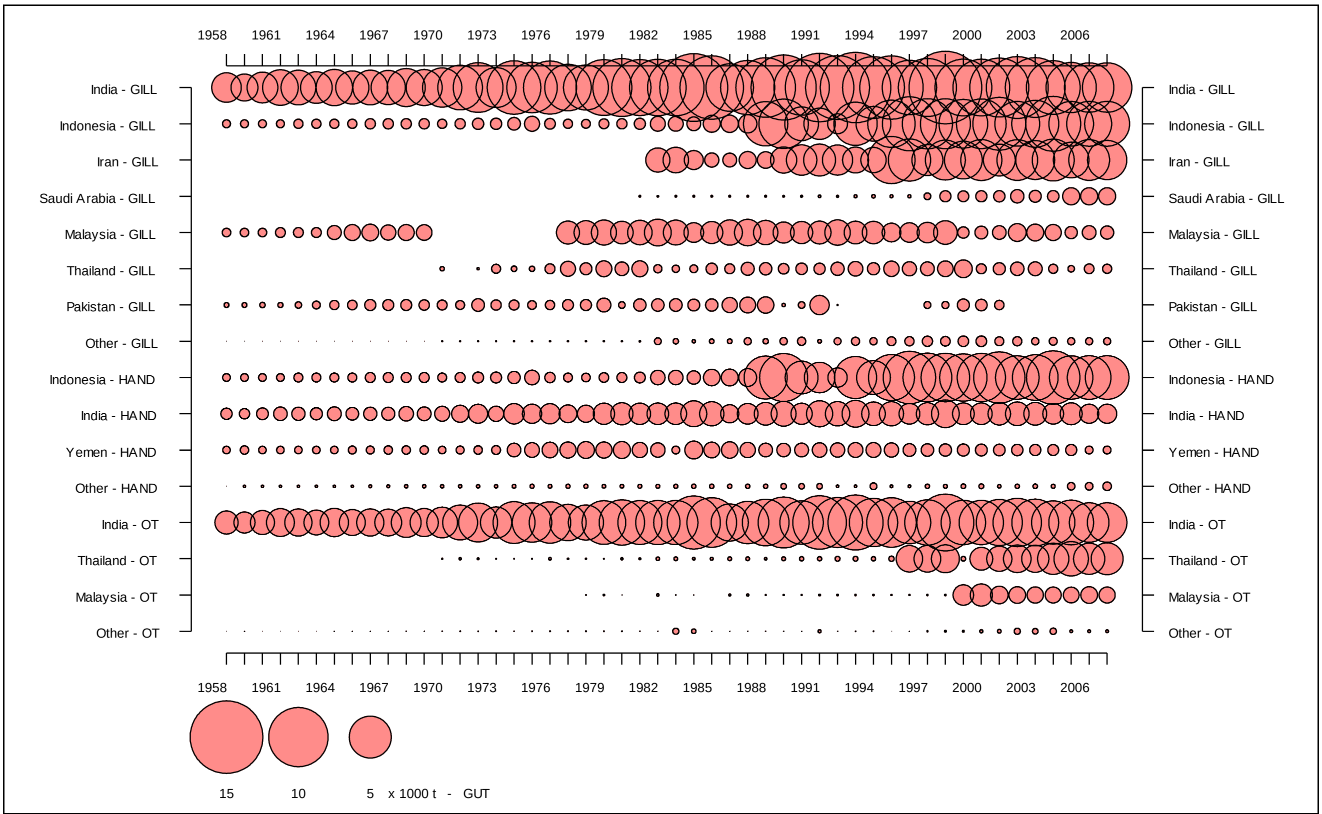


Figure 3. *Indo-Pacific king mackerel: estimated catches by gear and main fleets for the period 1958-2007 (in thousands of tonnes). Data as of October 2008*

Executive summary of the status of the kawakawa resource

(as adopted by the IOTC Scientific Committee, December 2008)

BIOLOGY

Kawakawa (*Euthynnus affinis*) lives in open waters close to the shoreline and prefers waters temperatures ranging from 18° to 29°C. Kawakawa form schools by size with other species sometimes containing over 5,000 individuals. Kawakawa are often found with yellowfin, skipjack and frigate tunas. Kawakawa are typically found in surface waters, however, they may range to depths of over 400 m (they have been reported under a fish-aggregating device employed in 400 m), possibly to feed.

Kawakawa grow a length of 100 cm FL and can weigh up to 14 kg but the more common size is around 60 cm. Juveniles grow rapidly reaching lengths between 50 and 65 cm by three years of age.

On the Natal coast in South Africa, sexual maturity is attained at 45-50 cm and spawning occurs mostly during summer. A 1.4 kg female (48 cm FL) may spawn approximately 0.21 million eggs per batch (corresponding to about 0.79 million eggs per season).

Kawakawa larvae are patchy but widely distributed and can generally be found close to land masses. Large changes in apparent abundance are linked to changes in ocean conditions. This species is a highly opportunistic predator feeding on small fishes, especially on clupeoids and atherinids; also squid, crustaceans and zooplankton.

No information is available on stock structure of kawakawa in Indian Ocean.

FISHERIES

Kawakawa is caught mainly by gillnets and purse seiners (Table 1 and Figure 1) and may be an important by-catch of the industrial purse seiners. The catch estimates for kawakawa were derived from very small amounts of information and are therefore highly uncertain[12] (Figure 2). The catches provided in Table 1 are based on the information available at the Secretariat and the following observations on the catches cannot currently be verified. Annual estimates of catch kawakawa increased markedly from around 10,000 t in the late 1970’s to reach the 50,000 t mark in the mid-1980’s. Since 1997, catches have been around 100,000 t. The average annual catch estimated for the period 2003 to 2007 is 109,600 t. In recent years, the countries attributed with the highest catches are Indonesia, India and Iran (Table 1, Figure 3).

A high percentage of the kawakawa captured by Thai purse seiners in the Andaman sea is comprised of fish 8 to 42 cm long.

AVAILABILITY OF INFORMATION FOR STOCK ASSESSMENT

There is no information on the stock structure of kawakawa in the Indian Ocean.

Numerous studies have been undertaken to investigate the age and the growth of kawakawa. These include various studies based on age and length distributions using various body parts (e.g. vertebrae, dorsal spines, and otoliths). Fecundity of kawakawa has also been studied in the Indian Ocean.

Possible fishery indicators:

[12] The uncertainty in the catch estimates has been assessed by the Secretariat and is based on the amount of processing required to account for the presence of conflicting catch reports, the level of aggregation of the catches by species and or gear, and the occurrence of unreporting fisheries for which catches had to be estimated.

1. **Trends in catches**: The catch estimates for kawakawa are highly uncertain. The trend in catches indicates a large and continuous increase in the catches from the mid-1980's to 2002 (Figure 1). The estimated catches decreased over the period 2002-2005.
2. **Nominal CPUE Trends:** data not available to the Secretariat.
3. **Average weight in the catch by fisheries:** data not available to the Secretariat.
4. **Number of squares fished:** data not available to the Secretariat.

STOCK ASSESSMENT

While some localised, sub-regional assessments may have been undertaken, no quantitative stock assessment has been undertaken by the IOTC Working Party on Neritics.

MANAGEMENT ADVICE

No quantitative stock assessment is currently available for kawakawa in the Indian Ocean, therefore the stock status is uncertain.

The SC notes the catches have been relatively stable for the past 10 years.. Nevertheless, the SC recommends that this species be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

KAWAKAWA SUMMARY

Maximum Sustainable Yield:	-
Preliminary catch in 2007 *(data as of October 2008)*	123,000 t
Catch in 2006	117,000 t
Mean catch over the last 5 years (2003-07)	109,600 t
Current Replacement Yield:	-
Relative Biomass ($B_{current}/B_{MSY}$):	-
Relative Fishing Mortality ($F_{current}/F_{MSY}$):	-

Table 1. *Best scientific estimates of the catches of kawakawa (as adopted by the IOTC Scientific Committee) by gear and main fleets for the period 1958-2007 (in thousands of tonnes). Data as of October 2008.*

Gear	Fleet	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84
Purse seine	Indonesia	1.1	1.1	1.1	1.1	1.4	1.4	1.5	1.6	1.8	1.9	1.8	1.9	2.1	1.4	1.4	2.2	2.4	3.8	7.8	9.7	11.9	8.7	9.8	13.9	16.8	15.2	18.8
	Malaysia	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.4	0.5	0.4	0.3	1.2	0.8	1.0	0.5	0.8	1.2	0.8	0.9	1.7	1.1	2.5	1.1	0.8	1.4	1.7
	Thailand													0.1	0.4	0.4	0.6	0.5	1.1	0.7	0.6	0.8	0.1	0.0	0.0	1.2	0.4	0.6
	India	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.1
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.2	0.8	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	*1.2*	*1.2*	*1.2*	*1.2*	*1.5*	*1.7*	*2.5*	*2.2*	*2.2*	*2.4*	*2.2*	*2.2*	*3.4*	*2.6*	*2.8*	*3.5*	*3.6*	*6.2*	*9.4*	*11.3*	*14.5*	*10.0*	*12.5*	*15.1*	*18.9*	*17.2*	*21.1*
Gillnet	India	1.0	0.9	1.7	2.4	0.7	1.4	1.3	1.0	0.9	1.3	1.2	1.0	1.0	2.1	2.0	9.9	2.8	3.5	6.4	4.4	6.0	8.1	12.8	7.5	7.9	6.1	7.6
	Iran, Islamic R.													0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3		0.2	0.2	0.4	0.7	2.5	3.9
	Pakistan	0.4	0.4	0.4	0.4	0.6	0.9	1.3	1.4	1.8	1.8	1.8	1.6	1.5	1.2	1.4	1.1	1.5	1.7	1.6	1.4	0.8	1.4	0.7	1.0	1.3	0.4	0.5
	Oman	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.4	0.4	0.5	0.5	0.6	0.5	0.7	0.6	0.5	0.2	0.6
	UAE													0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	2.0	0.9	0.9
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.1	0.2	0.3	0.6	0.4	0.3	0.3	0.4	0.8	0.8	0.4	0.7
	Total	*1.4*	*1.4*	*2.3*	*2.9*	*1.4*	*2.4*	*2.7*	*2.5*	*2.9*	*3.2*	*3.1*	*2.8*	*3.0*	*3.6*	*3.9*	*11.6*	*5.1*	*6.2*	*9.6*	*7.1*	*7.8*	*10.6*	*14.8*	*10.6*	*13.1*	*10.6*	*14.2*
Line	Indonesia	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.2	0.3	0.4	0.8	1.0	1.3	0.9	1.0	1.5	1.8	1.6	2.0
	Yemen	0.4	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.4	0.4	0.5	0.5	0.4	0.5	0.5	0.6	0.6	0.6	1.8	0.9	0.9	0.8	1.1
	Oman	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.1	0.3
	Maldives										0.3	0.3	0.4	0.4	0.3	0.4	0.6	0.5	0.3	0.9	0.9	0.7	0.6	0.9	1.0	1.2	1.3	0.7
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.2	0.3	0.3	0.4	0.3	0.3	0.2	0.3	0.4	0.6	0.5	1.0	1.0	1.1
	Total	*0.5*	*0.6*	*0.5*	*0.5*	*0.6*	*0.6*	*0.6*	*0.7*	*0.7*	*1.1*	*1.1*	*1.1*	*1.4*	*1.1*	*1.3*	*1.7*	*1.7*	*1.7*	*2.8*	*2.9*	*3.2*	*2.7*	*4.6*	*4.2*	*5.1*	*4.7*	*5.2*
Other gears	Maldives										0.2	0.2	0.2	0.3	0.2	0.3	0.6	0.4	0.2	0.2	0.2	0.2	0.2	0.3	0.5	1.0	1.1	0.8
	India	0.5	0.5	0.9	1.2	0.4	0.7	0.7	0.6	0.5	0.7	0.7	0.6	0.6	1.2	1.1	4.3	1.5	1.9	3.2	2.2	2.9	3.9	6.3	4.0	4.0	3.2	4.1
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.4
	Total	*0.5*	*0.5*	*0.9*	*1.2*	*0.4*	*0.8*	*0.7*	*0.6*	*0.5*	*0.9*	*0.9*	*0.8*	*0.9*	*1.4*	*1.4*	*4.9*	*2.1*	*2.2*	*3.6*	*2.5*	*3.2*	*4.3*	*6.8*	*4.7*	*5.2*	*4.6*	*5.3*
All	*Total*	*3.7*	*3.7*	*4.9*	*5.9*	*4.0*	*5.5*	*6.5*	*6.0*	*6.2*	*7.6*	*7.3*	*7.0*	*8.6*	*8.9*	*9.4*	*21.7*	*12.6*	*16.3*	*25.3*	*23.9*	*28.8*	*27.7*	*38.7*	*34.6*	*42.3*	*37.1*	*45.9*

Gear	Fleet	Av03/07	Av58/07	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07
Purse seine	Indonesia	34.3	16.2	17.7	18.4	17.4	19.5	22.4	16.6	20.5	17.0	27.8	33.6	33.0	35.0	35.9	34.5	37.5	39.6	32.6	35.0	36.1	39.5	24.1	37.4	34.4
	Malaysia	9.8	2.8	2.5	2.2	1.3	1.9	2.0	3.1	3.4	5.5	3.4	1.9	2.4	4.0	4.2	6.1	5.4	6.9	6.0	10.1	8.7	8.5	7.8	11.4	12.4
	Thailand	8.1	2.7	1.5	0.7	4.5	2.2	2.2	4.5	7.0	7.7	7.2	5.7	8.6	6.4	5.9	4.3	2.6	6.3	6.2	4.9	7.0	7.0	9.7	8.3	8.4
	India	1.0	0.5	0.2	0.4	0.2	0.2	0.5	0.7	1.2	1.5	1.2	0.9	1.1	1.0	1.3	1.2	1.6	1.6	1.4	1.6	1.7	1.0	0.4	1.0	1.0
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	*53.2*	*22.3*	*21.9*	*21.7*	*23.5*	*23.8*	*27.1*	*24.8*	*32.1*	*31.7*	*39.6*	*42.2*	*45.2*	*46.4*	*47.4*	*46.2*	*47.1*	*54.5*	*46.2*	*51.6*	*53.6*	*56.0*	*42.1*	*58.2*	*56.3*
Gillnet	India	17.9	9.0	11.2	12.0	9.3	10.1	17.5	22.4	13.8	17.4	13.8	9.7	12.1	11.1	15.3	14.1	17.8	18.5	15.8	18.3	18.0	12.4	17.4	20.8	20.8
	Iran, Islamic R.	13.1	3.3	1.7	1.9	0.6	2.2	0.8	0.7	0.7	0.7	0.5	2.1	3.9	5.7	7.8	7.9	10.9	13.5	12.5	16.4	14.1	11.6	11.8	12.6	15.6
	Pakistan	2.8	1.7	0.8	1.6	2.0	4.1	1.4	2.1	1.9	1.5	1.5	1.7	1.4	3.0	2.9	3.0	3.6	3.1	2.3	2.0	2.2	2.4	2.9	3.2	3.2
	Sri Lanka	1.6	0.4		0.0	0.0	0.0	0.2	0.1	0.1	0.2	0.1	1.1	1.2	1.5	2.2	2.2	1.4	0.4	1.2	0.8	0.6	1.3	1.6	2.2	2.3
	Oman	1.1	0.6	0.5	0.6	1.4	1.9	1.1	1.2	0.4	1.0	0.6	0.5	1.2	1.5	1.8	1.3	1.0	1.1	1.3	1.0	2.1	1.6	1.2	0.2	0.2
	UAE	0.6	0.8	0.8	1.2	1.8	1.9	2.0	2.1	2.0	2.1	1.2	2.3	2.1	2.1	2.2	2.2	2.2	0.7	0.9	0.7	0.7	0.6	0.6	0.6	0.6
	Other Fleets	1.7	0.7	0.6	0.6	0.7	0.9	0.8	1.0	1.2	1.3	1.1	1.2	1.4	1.2	1.7	1.9	1.4	1.3	1.1	1.3	2.2	1.6	0.9	2.0	1.6
	Total	*38.8*	*16.6*	*15.6*	*18.0*	*16.0*	*21.3*	*23.9*	*29.5*	*20.0*	*24.1*	*18.8*	*18.7*	*23.3*	*26.1*	*33.8*	*32.6*	*38.4*	*38.7*	*35.1*	*40.4*	*39.9*	*31.5*	*36.4*	*41.6*	*44.4*
Line	India	6.3	1.7							4.3	5.5	4.3	3.0	3.8	3.5	4.8	4.4	5.6	5.8	4.9	5.7	5.4	4.2	4.5	8.8	8.8
	Indonesia	3.6	1.7	1.9	1.9	1.8	2.0	2.4	1.7	2.2	1.8	2.9	3.5	3.5	3.7	3.8	3.6	3.9	4.2	3.4	3.7	3.8	4.1	6.2	0.3	3.6
	Yemen	2.5	1.2	2.1	1.4	1.3	1.7	1.3	1.6	1.6	1.7	0.5	1.2	1.3	1.4	1.6	1.8	2.0	2.2	2.4	2.6	1.5	3.0	2.9	2.5	2.8
	Oman	1.3	0.4	0.3	0.3	0.7	1.0	0.5	0.6	0.7	0.5	0.3	0.8	0.6	0.3	0.6	0.3	0.5	0.6	0.6	0.5	0.6	0.7	0.9	2.2	2.2
	Maldives	0.6	0.6	1.4	0.7	0.9	0.6	0.8	1.0	0.8	1.2	1.9	0.9	1.0	1.2	0.6	1.4	0.5	0.5	0.4	0.4	0.5	0.5	0.6	0.3	0.9
	Other Fleets	1.0	0.7	0.9	1.0	2.6	1.2	1.2	1.2	1.5	1.6	1.3	1.5	1.4	1.3	1.3	1.1	0.9	0.5	0.7	0.5	0.7	0.6	1.1	1.4	1.4
	Total	*15.4*	*6.3*	*6.5*	*5.3*	*7.4*	*6.5*	*6.1*	*6.2*	*11.2*	*12.2*	*11.3*	*11.0*	*11.5*	*11.4*	*12.7*	*12.7*	*13.4*	*13.8*	*12.5*	*13.4*	*12.5*	*13.1*	*16.1*	*15.5*	*19.7*
Other gears	Maldives	1.8	0.8	1.0	0.6	0.5	0.6	0.6	1.0	0.8	1.3	1.7	1.7	1.7	2.6	1.5	2.2	1.2	1.4	1.7	1.8	1.9	1.8	2.1	1.3	1.8
	India	0.0	1.8	5.2	5.7	4.3	4.9	8.3	9.7											0.0		0.0				
	Other Fleets	0.4	0.2	0.2	0.2	0.5	0.6	0.3	0.4	0.0	0.1	0.1	0.1	0.3	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.2	0.3	0.3	0.8
	Total	*2.2*	*2.8*	*6.4*	*6.5*	*5.3*	*6.1*	*9.2*	*11.1*	*0.9*	*1.4*	*1.7*	*1.8*	*2.1*	*3.1*	*1.6*	*2.4*	*1.3*	*1.5*	*1.9*	*1.9*	*2.2*	*2.1*	*2.4*	*1.7*	*2.6*
All	*Total*	*109.6*	*47.9*	*50.4*	*51.5*	*52.2*	*57.7*	*66.3*	*71.6*	*64.2*	*69.4*	*71.4*	*73.6*	*82.0*	*87.0*	*95.5*	*93.9*	*100.2*	*108.5*	*95.7*	*107.4*	*108.1*	*102.7*	*96.9*	*117.0*	*123.0*

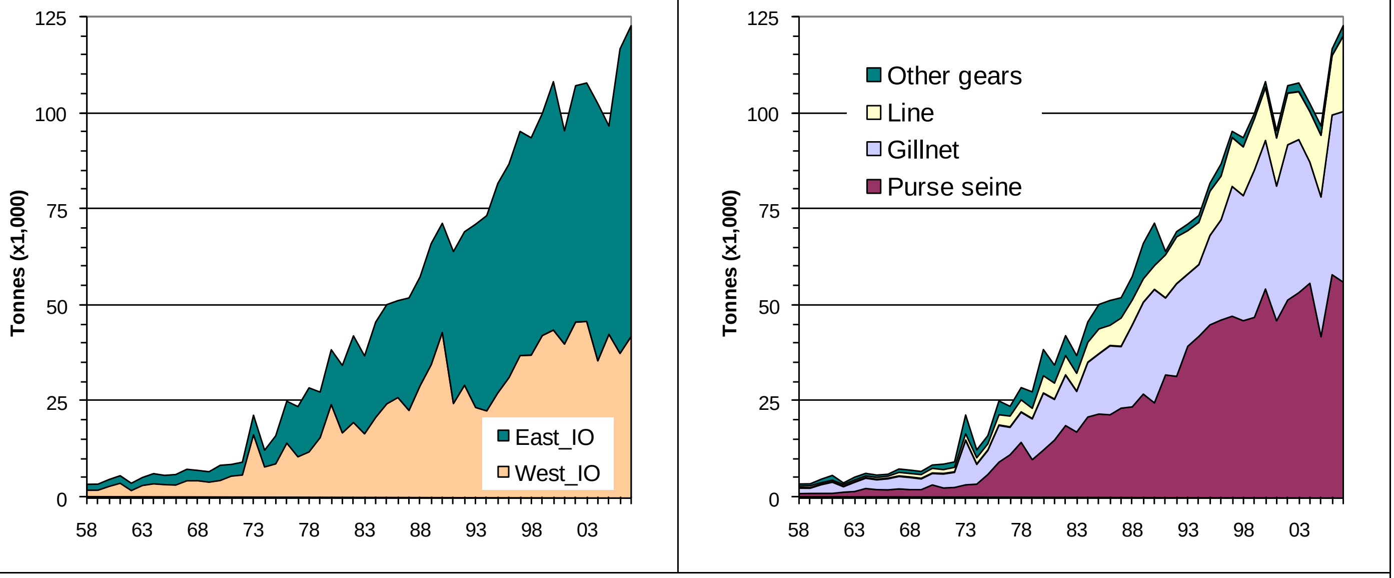


Figure 1. *Kawakawa: (a) annual catches from 1958 to 2007 by (on the left) area i.e. Eastern and Western Indian Ocean and (on the right) gear. Data as of October 2008*

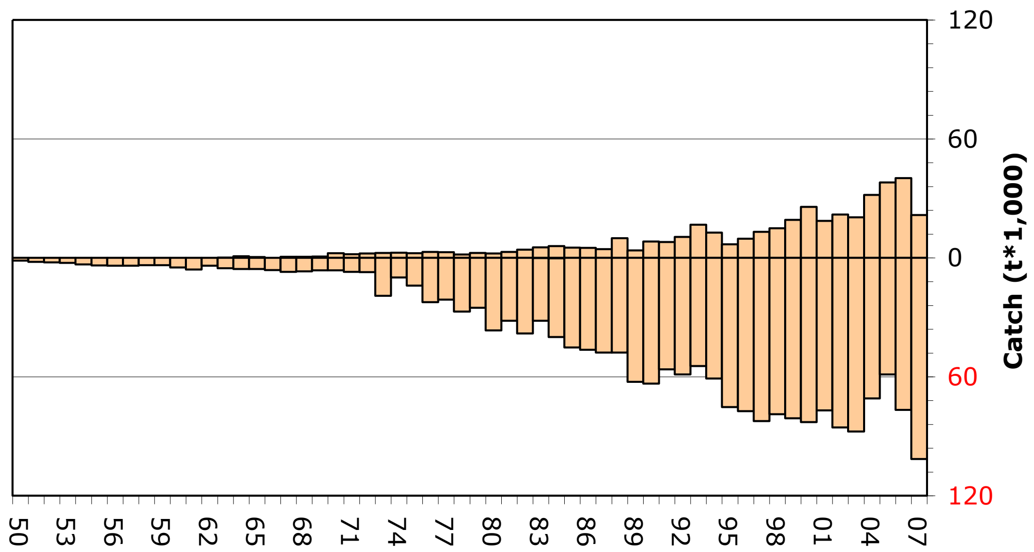


Figure 2. *Kawakawa: uncertainty of annual catch estimates. The amount of the catch below the zero-line has been categorised as uncertain according to the criteria given in the text.*

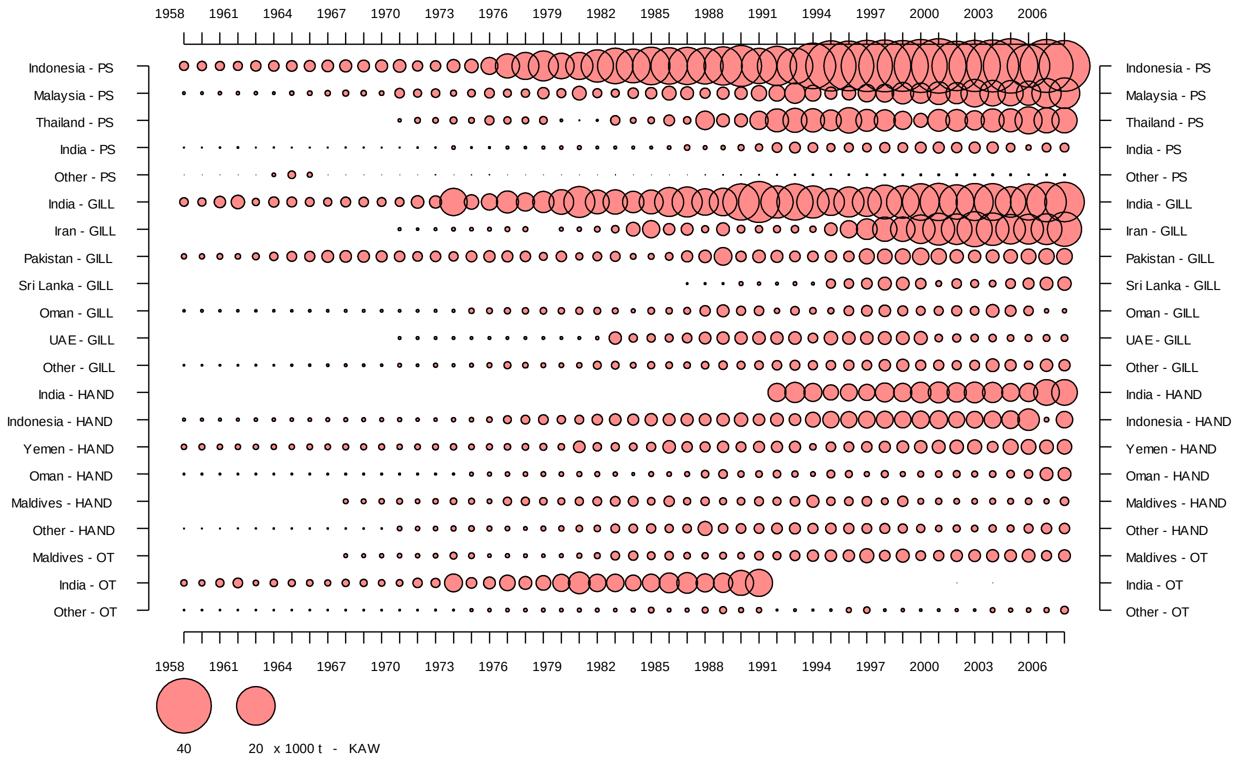


Figure 3. *Catches of kawakawa by gear and main fleets for the period 1958-2007 (in thousands of tonnes).*

Data as of October 2008

Executive summary of the status of the longtail tuna resource

(*as adopted by the IOTC Scientific Committee, December 2008*)

BIOLOGY

Longtail tuna *(Thunnus tonggol)* is an oceanic species that forms schools of varying sizes. It is most abundant over areas of broad continental shelf.

Longtail tuna grows to around 145 cm FL or 35.9 kg, but the most common size in Indian Ocean ranges from 40 to 70 cm. Longtail tuna grows rapidly to reach 40 to 46 cm in FL in one year.

The spawning season varies according to location. Off the west coast of Thailand there are two distinct spawning seasons: January-April and August-September.

Longtail tuna feeds on a variety of fish, cephalopods, and crustaceans, particularly stomatopod larvae and prawns.

No information is available on the stock structure of longtail tuna in the Indian Ocean.

FISHERIES

Longtail tuna is caught mainly by gillnet and in a lesser extent by artisanal purse seiners and most of the catch is taken in the western Indian Ocean area (Figure 1). The catch estimates for longtail tuna were derived from very small amounts of information and are therefore highly uncertain[13] (Figure 2). The catches provided in Table 1 are based on the information available at the Secretariat and the following observations on the catches cannot currently be verified. Estimated catches of longtail tuna increased steadily from the mid 1950's, reaching around 9,000 t in the early 1970's and over 50,000 t by the mid-1980's and peaking at 119,600 t in 2000. The average annual catch estimated for the period 2003 to 2007 is 93,700 t . In recent years, the countries attributed with the highest catches of longtail tuna are Indonesia, Iran, Oman, Yemen and Pakistan (Table 1, Figure 3).

AVAILABILITY OF INFORMATION FOR STOCK ASSESSMENT

There is no information on the stock structure of longtail tuna in the Indian Ocean.

Age and the growth are available for Longtail tuna in other oceans.

Possible fishery indicators:

1. **Trends in catches**: The catch estimates for longtail tuna are highly uncertain. There has been a variable but steady increase in the catches from the mid-1950's (Figure 1). .
2. **Nominal CPUE Trends:** data not available to the Secretariat.
3. **Average weight in the catch by fisheries:** data not available to the Secretariat.
4. **Number of squares fished:** data not available to the Secretariat.

STOCK ASSESSMENT

While some localised, sub-regional assessments may have been undertaken, no quantitative stock assessment has been undertaken by the IOTC Working Party on Neritics.

[13] The uncertainty in the catch estimates has been assessed by the Secretariat and is based on the amount of processing required to account for the presence of conflicting catch reports, the level of aggregation of the catches by species and or gear, and the occurrence of unreporting fisheries for which catches had to be estimated.

MANAGEMENT ADVICE

No quantitative stock assessment is currently available for longtail tuna in the Indian Ocean, therefore the stock status is uncertain.

The SC notes the catches of longtail tuna are increasing and recommended that this species be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

LONGTAIL TUNA SUMMARY

Maximum Sustainable Yield:	-
Preliminary catch in 2007 *(data as of October 2008)*	99,300 t
Catch in 2006	95,800 t
Mean catch over the last 5 years (2003-07)	93,700 t
Current Replacement Yield:	-
Relative Biomass ($B_{current}/B_{MSY}$):	-
Relative Fishing Mortality ($F_{current}/F_{MSY}$):	-

Table 1. *Best scientific estimates of the catches of longtail tuna (as adopted by the IOTC Scientific Committee) by gear and main fleets for the period 1958-2007 (in thousands of tonnes).*

Data as of October 2008

Gear	Fleet	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84
Purse seine	Malaysia	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.4	0.3	0.2	0.6	0.5	0.5	0.3	0.4	0.7	0.4	0.5	0.9	0.6	1.4	0.6	0.5	0.8	1.0
	Thailand													0.0	0.2	0.2	0.3	0.2	0.5	0.3	0.3	0.4	1.8	0.6	1.1	6.9	6.8	5.9
	Indonesia	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.5	0.7	0.8	0.6	0.7	1.0	1.2	1.1	1.3
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	*0.1*	*0.1*	*0.1*	*0.2*	*0.2*	*0.2*	*0.3*	*0.3*	*0.4*	*0.5*	*0.4*	*0.4*	*0.8*	*0.8*	*0.8*	*0.7*	*0.8*	*1.5*	*1.3*	*1.4*	*2.1*	*3.0*	*2.7*	*2.6*	*8.5*	*8.6*	*8.2*
Gillnet	Indonesia	1.0	1.0	1.0	1.0	1.2	1.3	1.3	1.4	1.6	1.7	1.6	1.7	1.9	1.2	1.2	2.0	2.1	3.4	6.9	8.7	10.7	7.8	8.8	12.4	15.0	13.6	16.8
	Iran, Islamic R.													0.6	0.1	0.7	0.9	0.9	0.9	1.4	1.6		0.8	1.0	2.2	2.9	5.6	6.1
	Pakistan	1.0	1.0	1.2	1.1	1.7	2.5	3.5	3.8	5.0	4.9	4.9	4.4	4.0	3.3	3.9	3.1	4.2	4.7	4.4	3.9	2.3	3.9	1.8	2.8	3.5	1.2	1.3
	India	0.4	0.4	0.8	1.1	0.3	0.6	1.1	0.5	0.5	0.5	0.4	0.4	0.3	0.5	0.6	3.0	0.8	1.0	1.5	1.0	1.6	2.0	2.9	1.7	2.6	1.2	1.8
	Oman	0.4	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.6	0.6	2.0	2.4	2.7	2.9	3.1	2.9	3.6	3.4	2.5	1.1	3.3
	UAE	0.9	1.3	1.3	1.3	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.7	0.9	0.9	0.9	0.9	1.5	1.5	1.4	1.4	1.4	1.4	1.4	0.4	4.0	2.6	2.6
	Other Fleets	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.3	0.2	0.4	0.1	0.3	0.5	0.8	0.6	0.3	0.4	0.6	1.4	1.0	0.4	0.5
	Total	*3.7*	*4.2*	*4.7*	*4.8*	*5.2*	*6.4*	*7.8*	*7.8*	*9.2*	*9.5*	*9.3*	*8.9*	*8.5*	*6.7*	*8.3*	*10.5*	*11.8*	*14.4*	*19.2*	*20.1*	*19.3*	*19.3*	*20.0*	*24.3*	*31.5*	*25.7*	*32.3*
Line	Yemen	0.3	0.4	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.3	0.4	0.4	0.5	1.1	1.3	1.4	1.5	1.6	1.5	1.7	1.3	1.2	0.4	1.0
	Oman	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	1.1	1.3	1.4	1.5	1.6	1.5	1.9	1.8	1.3	0.6	1.7
	India	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.5	0.2	0.2	0.4	0.3	0.3	0.5	0.7	0.4	0.6	0.3	0.4
	Other Fleets	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.1	0.0	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.5	0.7
	Total	*0.7*	*0.9*	*0.8*	*0.9*	*0.8*	*0.9*	*0.8*	*0.9*	*0.9*	*1.0*	*1.0*	*1.0*	*0.7*	*0.8*	*0.9*	*1.4*	*2.4*	*2.8*	*3.3*	*3.3*	*3.7*	*3.6*	*4.3*	*3.7*	*3.3*	*1.7*	*3.8*
Other gears	Indonesia	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.5	0.6	0.7	0.5	0.6	0.9	1.1	1.0	1.2
	Oman	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.7	0.8	0.9	1.0	1.0	1.0	1.2	1.1	0.8	0.4	1.1
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.4
	Total	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.8*	*1.0*	*1.4*	*1.6*	*1.8*	*1.5*	*1.8*	*2.0*	*1.9*	*1.6*	*2.6*
All	*Total*	*4.7*	*5.5*	*5.8*	*6.1*	*6.5*	*7.6*	*9.2*	*9.3*	*10.8*	*11.3*	*11.0*	*10.6*	*10.4*	*8.5*	*10.3*	*13.0*	*15.8*	*19.7*	*25.2*	*26.4*	*27.0*	*27.4*	*28.7*	*32.6*	*45.2*	*37.7*	*46.8*

Gear	Fleet	Av03/07	Av58/07	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07
Purse seine	Malaysia	4.2	1.3	1.5	1.2	0.8	0.8	1.1	1.3	1.5	2.4	1.5	0.8	1.0	1.7	1.8	2.6	2.3	3.0	2.6	4.3	3.7	3.6	3.4	4.9	5.3
	Thailand	2.5	1.9	2.2	1.5	1.4	1.2	1.4	1.0	5.3	2.0	3.2	2.0	3.4	4.0	3.7	9.9	5.1	4.4	1.0	2.7	3.2	2.8	1.8	2.4	2.2
	Indonesia	2.4	1.1	1.2	1.3	1.2	1.4	1.6	1.2	1.4	1.2	1.9	2.4	2.3	2.5	2.5	2.4	2.6	2.8	2.3	2.5	2.5	2.8	0.8	3.5	2.2
	Iran, Islamic R.	2.2	0.6								0.6	1.0	0.8	1.3	0.7	0.8	1.5	2.1	2.7	3.0	5.8	3.6	1.5	1.2	2.3	2.3
	Other Fleets	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.3	0.1	0.0	0.0	0.0
	Total	*11.3*	*5.0*	*4.9*	*4.1*	*3.4*	*3.4*	*4.1*	*3.5*	*8.2*	*6.2*	*7.6*	*6.0*	*8.1*	*8.9*	*8.8*	*16.5*	*12.2*	*14.0*	*8.9*	*15.4*	*13.3*	*10.9*	*7.2*	*13.2*	*12.0*
Gillnet	Indonesia	30.2	14.4	15.8	16.5	15.5	17.4	20.0	14.8	18.3	15.2	24.8	30.1	29.5	31.3	32.1	30.9	33.5	35.4	29.1	31.2	32.2	35.3	27.3	27.7	28.4
	Iran, Islamic R.	22.2	9.3	11.8	11.7	12.1	16.9	19.4	14.9	14.6	9.8	8.2	11.5	27.2	16.5	17.9	18.2	21.3	38.7	31.9	24.1	26.7	18.0	17.3	22.8	25.9
	Pakistan	5.6	4.1	2.1	4.4	6.0	6.3	4.9	6.2	6.1	5.8	4.5	5.8	5.0	4.6	5.6	5.5	6.3	6.0	5.2	5.1	6.1	5.3	5.2	5.6	5.7
	India	4.0	2.3	4.5	1.6	3.3	2.4	2.8	3.6	2.9	1.9	2.9	3.0	4.2	3.1	3.3	3.7	6.6	7.3	6.5	4.6	3.0	1.4	3.4	6.1	6.1
	Oman	3.3	2.5	3.6	4.0	9.3	8.5	4.7	3.8	1.4	3.2	4.2	1.8	2.2	3.4	3.6	3.2	3.2	3.4	4.0	4.6	5.8	5.1	4.0	0.7	0.7
	UAE	2.2	2.2	2.4	3.4	3.1	3.4	3.4	3.4	3.3	3.4	3.4	3.8	4.9	5.0	3.2	3.2	3.2	1.5	1.5	1.9	2.9	2.0	2.0	1.9	1.9
	Other Fleets	0.7	0.6	0.7	0.9	1.5	1.2	0.7	0.6	0.8	0.7	1.0	0.7	0.8	1.9	1.8	1.4	1.4	1.2	1.0	1.3	1.1	0.4	0.6	0.8	0.7
	Total	*68.0*	*35.5*	*41.0*	*42.5*	*50.9*	*56.1*	*55.8*	*47.3*	*47.3*	*40.0*	*49.0*	*56.8*	*73.9*	*65.8*	*67.5*	*66.1*	*75.6*	*93.5*	*79.2*	*72.9*	*77.9*	*67.5*	*59.7*	*65.6*	*69.4*
Line	Yemen	6.0	1.8	1.0	0.5	0.6	0.7	0.6	1.3	0.7	1.4	1.8	2.4	2.3	2.6	2.9	3.3	3.6	4.0	4.3	4.7	3.7	5.4	6.3	7.6	7.0
	Oman	4.2	1.6	1.9	2.1	4.9	4.5	2.5	2.0	2.8	1.8	2.5	3.4	1.2	0.8	1.3	0.8	1.5	1.9	1.9	2.1	1.6	2.6	3.1	6.9	6.9
	India	0.6	0.7	1.2	0.4	0.8	0.7	0.7	0.9	1.2	0.8	1.2	1.2	1.7	1.3	1.3	1.5	2.7	3.0	2.6	1.9	1.3	0.5	1.1	0.0	0.0
	Other Fleets	0.8	0.5	0.7	0.8	2.2	0.7	0.7	0.7	0.7	0.7	0.8	1.4	1.2	1.1	0.9	0.9	0.9	0.6	0.6	0.7	0.8	0.7	0.5	0.8	1.0
	Total	*11.6*	*4.6*	*4.7*	*3.8*	*8.5*	*6.6*	*4.6*	*5.0*	*5.4*	*4.6*	*6.2*	*8.4*	*6.4*	*5.7*	*6.5*	*6.6*	*8.7*	*9.4*	*9.6*	*9.4*	*7.3*	*9.2*	*11.0*	*15.4*	*15.0*
Other gears	Indonesia	2.1	1.0	1.1	1.2	1.1	1.2	1.4	1.0	1.3	1.1	1.7	2.1	2.1	2.2	2.2	2.2	2.3	2.5	2.0	2.2	2.3	2.5	2.6	1.2	2.0
	Oman	0.4	0.6	1.2	1.3	3.1	2.8	1.6	1.3	0.1	0.2	0.2	0.3	0.7	1.2	0.2	0.3	0.1	0.1	0.2	0.2	0.6	0.5	0.4	0.2	0.2
	Other Fleets	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.3	0.7
	Total	*2.8*	*1.6*	*2.3*	*2.5*	*4.2*	*4.0*	*3.0*	*2.3*	*1.5*	*1.3*	*1.9*	*2.4*	*2.7*	*3.4*	*2.4*	*2.5*	*2.5*	*2.7*	*2.3*	*2.4*	*3.0*	*3.0*	*3.1*	*1.7*	*2.9*
All	*Total*	*93.7*	*46.7*	*52.9*	*52.8*	*67.0*	*70.1*	*67.5*	*58.1*	*##*	*52.2*	*64.8*	*73.6*	*91.2*	*83.7*	*85.2*	*91.7*	*99.1*	*119.6*	*99.9*	*100.0*	*101.6*	*90.7*	*81.1*	*95.8*	*99.3*

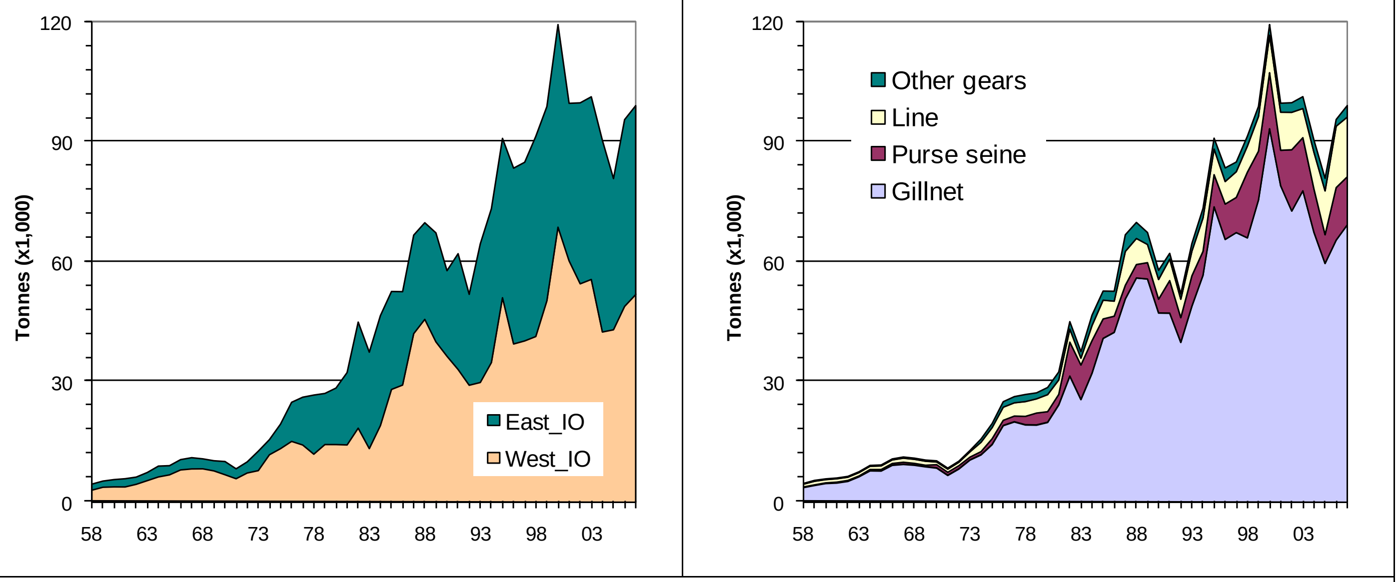


Figure 1*. Longtail tuna: annual catches from 1958 to 2007 by area (left) and gear (right).* *Data as per October 2008*

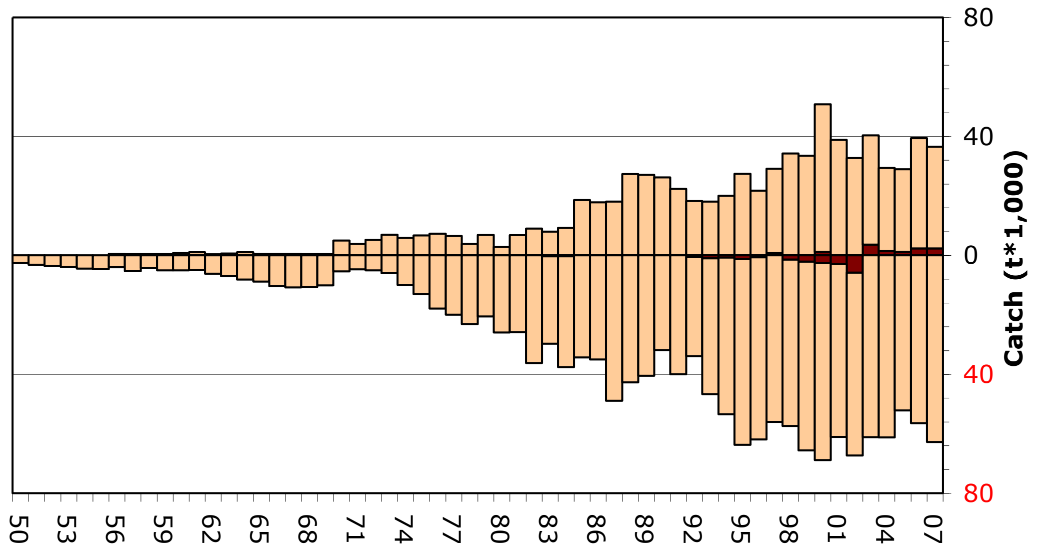


Figure 2*. Longtail tuna: uncertainty of annual catch estimates. The amount of the catch below the zero-line has been categorised as uncertain according to the criteria given in the text. Dark sections represent estimates of catches by industrial fleets*

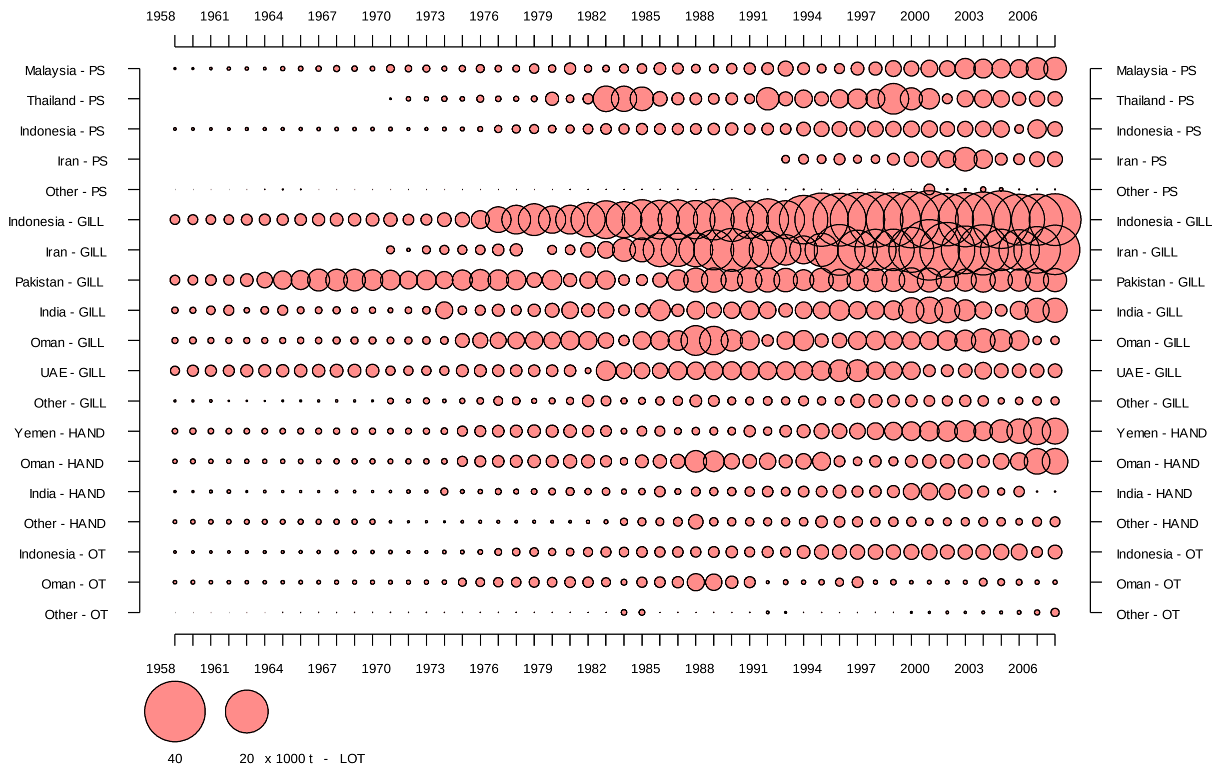


Figure 3. *Longtail tuna: catches by gear and main fleets for the period 1957-2006 (in thousands of tonnes).*

Data as of October 2007

Executive summary of the status of the narrow-barred Spanish mackerel resource

(*as adopted by the IOTC Scientific Committee, December 2008*)

BIOLOGY

The narrow-barred Spanish mackerel or king seer *(Scomberomorus commerson*) is a pelagic, top level predator found throughout tropical marine waters of the Indo-West Pacific. Juveniles inhabit shallow inshore areas whereas adults are found in coastal waters out to the continental shelf. Adults are usually found in small schools but often aggregate at particular locations on reefs and shoals to feed and spawn. Spanish mackerel appear to undertake lengthy migrations. Spanish mackerel feed primarily on small fishes such as anchovies, clupeids, carangids, also squids and shrimps.

Spanish mackerel may live for up to 15 years, and grow to 240 cm fork length or 70 kg. Females are multiple spawners. Year-round spawning has been observed in east African waters, with peaks during late spring to summer (April-July) and autumn (September-November) coinciding with the two seasonal monsoons which generate high abundances of plankton and small pelagic fish. Size at first maturity is estimated to be around 52 cm for males and 81 cm for females.

Genetic studies carried out on *S. commerson* from Djibouti, Oman and U.A.E. showed there were small genetic differences among stocks in these three places.

FISHERIES

Spanish mackerel is targeted throughout the Indian Ocean by artisanal and recreational fishers. The main method of capture is gill net, but significant numbers of are also caught using trolling lines.

The catch estimates for Spanish mackerel were derived from very small amounts of information and are therefore highly uncertain[14] (Figure 2). The catches provided in Table 1 are based on the information available at the Secretariat and the following observations on the catches cannot currently be verified. The catches of Spanish mackerel increased from around 50,000 t the mid-1970's to 100,000 t by the mid-1990's. The current average annual catch is around 116,100 t (for the period 2003 to 2007), with most of the catch obtained taken from the west Indian Ocean area. (Figures 1, 3 and Table 1). In recent years, the countries attributed with the highest catches of Spanish mackerel are Indonesia, Madagascar, Pakistan, Iran and Saudi Arabia.

The size of Spanish mackerel taken varies by location with 32-119 cm fish taken in the Eastern Peninsular Malaysia area, 17-139 cm fish taken in the East Malaysia area and 50-90 cm fish taken in the Gulf of Thailand. Similarly, Spanish mackerel caught in the Oman Sea are typically larger than those caught in the Persian Gulf.

AVAILABILITY OF INFORMATION FOR STOCK ASSESSMENT

Numerous studies have been completed in Indian Ocean to determine the fecundity, the size at first maturity and age and growth parameters.

Genetic studies carried out on *S. commerson* from Djibouti, Oman and U.A.E. showed there were small genetic differences among stocks in these three places, therefore, stock assessment purposes, the use of sub-stocks may be appropriate.

[14] The uncertainty in the catch estimates has been assessed by the Secretariat and is based on the amount of processing required to account for the presence of conflicting catch reports, the level of aggregation of the catches by species and or gear, and the occurrence of unreporting fisheries for which catches had to be estimated.

Possible fishery indicators:

1. **Trends in catches**: The catch estimates for narrow-barred Spanish mackerel are highly uncertain. The trend in catches indicate a large and continuous increase in the catches from the 1970's to 2000, followed by a period of relatively stable catches at around 120,000 t (Figure 1).
2. **Nominal CPUE Trends:** data not available to the Secretariat.
3. **Average weight in the catch by fisheries:** data not available to the Secretariat.
4. **Number of squares fished:** data not available to the Secretariat.

STOCK ASSESSMENT

While some localised, sub-regional assessments have been undertaken, typically by national scientists, no quantitative stock assessment has been undertaken by the IOTC Working Party on Neritics.

MANAGEMENT ADVICE

No quantitative stock assessment is currently available for narrow-barred Spanish mackerel tuna in the Indian Ocean, therefore the stock status is uncertain. The SC notes that Spanish mackerel is a relatively productive species with high fecundity and this makes it relatively resilient and less prone to overfishing; however, it recommends that this important species be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

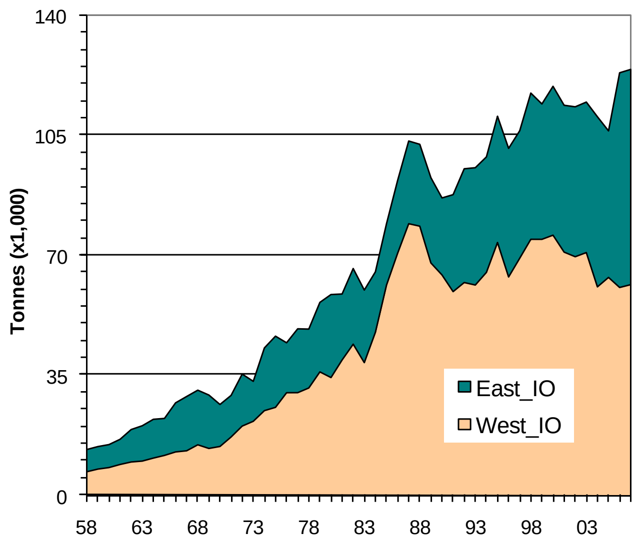
NARROW-BARRED SPANISH MACKEREL SUMMARY

Maximum Sustainable Yield:	-
Preliminary catch in 2007 *(data as of October 2008)*	124,600 t
Catch in 2006	123,600 t
Mean catch over the last 5 years (2003-07)	116,100 t
Current Replacement Yield:	-
Relative Biomass ($B_{current}/B_{MSY}$):	-
Relative Fishing Mortality ($F_{current}/F_{MSY}$):	-

Table 1. *Best scientific estimates of the catches of narrow-barred Spanish mackerel (as adopted by the IOTC Scientific Committee) by gear and main fleets for the period 1958-2007 (in thousands of tonnes).* Data as of October 2008

	Fleet	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84
Gillnet	India	2.3	2.0	2.6	3.4	3.2	2.7	3.1	2.6	2.8	2.7	3.8	3.3	3.8	5.5	6.0	6.1	6.6	6.3	7.3	5.3	5.1	7.9	9.3	7.8	11.0	10.0	10.6
	Indonesia	1.8	1.8	1.8	1.8	2.4	2.4	2.4	2.4	3.0	3.0	3.0	3.0	2.4	3.0	3.6	3.6	4.6	6.5	2.2	3.0	2.6	2.3	3.7	2.7	3.4	4.2	3.5
	Pakistan	1.1	1.1	1.3	1.2	1.8	2.7	3.8	4.1	5.4	5.3	5.3	4.8	4.3	3.5	7.5	4.8	4.4	3.1	3.7	5.4	5.8	9.1	1.9	7.2	7.3	7.9	6.9
	Iran, Islamic R.																									0.1	1.4	0.6
	UAE	1.0	1.6	1.6	1.6	1.8	1.8	1.8	2.0	2.0	2.1	2.1	2.1	2.2	2.4	2.4	2.4	3.7	3.7	3.6	3.6	3.6	3.6	3.6	3.5	6.5	5.4	5.4
	Sri Lanka	1.0	1.2	1.2	1.3	2.1	3.0	2.6	2.2	3.8	5.4	5.3	5.2	3.9	2.6	2.9	3.3	3.2	3.1	3.9	3.8	3.9	4.5	6.1	5.0	4.4	4.0	3.7
	Saudi Arabia																								0.6	0.5	0.7	0.8
	Qatar																									0.2	0.2	0.3
	Malaysia	0.4	0.4	0.4	0.6	0.6	0.6	1.1	1.5	1.6	1.3	1.5	1.4								3.0	3.2	3.6	2.9	3.4	4.1	3.5	2.2
	Oman	0.7	0.9	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.9	0.9	0.9	0.9	0.9	1.0	1.1	3.6	4.2	4.8	5.1	5.5	5.1	6.3	6.0	4.4	2.0	5.8
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.2	0.1	0.0	0.0	0.7	0.7	0.8	0.8	0.8	1.0	1.6	2.7	1.9	2.2	1.7	3.3	2.8	2.7	1.8
	Total	*8.4*	*8.9*	*9.5*	*10.4*	*12.6*	*13.9*	*15.5*	*16.0*	*19.5*	*20.8*	*21.8*	*20.8*	*18.2*	*18.6*	*24.2*	*22.2*	*26.9*	*27.9*	*27.1*	*31.8*	*31.6*	*38.3*	*35.5*	*39.6*	*44.8*	*42.0*	*41.6*
Line	Indonesia	1.3	1.3	1.3	1.3	1.8	1.8	1.8	1.8	2.2	2.2	2.2	2.2	1.8	2.2	2.7	2.7	3.4	4.8	1.6	2.2	1.9	1.7	2.7	2.0	2.5	3.1	2.6
	India	0.3	0.3	0.4	0.5	0.5	0.4	0.5	0.4	0.4	0.4	0.5	0.5	0.6	0.8	0.9	0.9	1.0	0.9	1.1	0.8	0.7	1.1	1.4	1.1	1.6	1.5	1.5
	Saudi Arabia																								0.2	0.2	0.3	0.4
	Yemen	0.8	1.0	0.8	0.8	0.8	0.8	0.8	0.9	0.9	1.0	1.0	1.0	0.8	0.9	1.0	1.1	2.6	3.1	3.5	3.7	4.0	3.7	4.1	3.3	2.9	0.9	4.5
	Oman	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.4	0.5	0.5	0.6	1.9	2.2	2.5	2.7	2.9	2.7	3.3	3.1	2.3	1.0	3.0
	Other Fleets	0.5	0.8	0.6	0.6	0.8	1.1	1.0	1.0	1.4	1.7	1.8	1.7	1.1	0.9	0.9	1.0	1.0	1.1	1.3	1.4	1.4	1.5	2.6	2.0	1.5	2.4	2.2
	Total	*3.3*	*3.9*	*3.5*	*3.6*	*4.3*	*4.5*	*4.4*	*4.5*	*5.3*	*5.8*	*6.0*	*5.9*	*4.7*	*5.3*	*5.9*	*6.2*	*9.9*	*12.0*	*9.9*	*10.7*	*11.0*	*10.7*	*14.1*	*11.8*	*11.0*	*9.2*	*14.2*
Other gears	India	1.4	1.2	1.6	2.1	2.0	1.7	1.9	1.6	1.7	1.7	2.3	2.0	2.3	3.4	3.6	3.7	4.0	3.8	4.5	3.2	3.1	4.8	5.7	4.8	6.7	6.1	6.5
	Thailand													0.1	0.5	0.3	0.1	0.0	0.1	0.7	0.2	0.1	0.1	0.5	0.4	1.3	1.4	0.7
	Indonesia	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.4	0.5	0.6	0.6	0.8	1.1	0.4	0.5	0.4	0.4	0.6	0.4	0.6	0.7	0.6
	Oman	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	1.2	1.4	1.6	1.7	1.8	1.7	2.1	2.0	1.5	0.6	1.9
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.9	0.6	0.3	0.5	0.5	0.7	0.9	0.7	0.6	0.4	0.0	0.6	0.1	0.1
	Total	*2.0*	*1.8*	*2.1*	*2.6*	*2.6*	*2.3*	*2.5*	*2.3*	*2.5*	*2.5*	*3.1*	*2.9*	*3.9*	*5.6*	*5.5*	*5.1*	*6.5*	*6.8*	*7.8*	*6.5*	*6.3*	*7.5*	*9.3*	*7.7*	*10.7*	*9.0*	*9.7*
All	*Total*	*13.7*	*14.5*	*15.1*	*16.6*	*19.5*	*20.6*	*22.5*	*22.7*	*27.3*	*29.1*	*31.0*	*29.6*	*26.8*	*29.5*	*35.7*	*33.6*	*43.3*	*46.7*	*44.8*	*48.9*	*48.8*	*56.6*	*58.9*	*59.0*	*66.5*	*60.2*	*65.5*

Gear	Fleet	Av03/07	Av58/07	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07
Gillnet	India	18.3	9.8	9.3	13.3	10.3	11.7	12.3	9.1	9.8	13.9	11.8	14.0	16.3	14.0	14.5	18.3	17.7	20.8	15.7	20.6	19.4	15.7	13.7	21.4	21.4
	Indonesia	12.2	5.4	3.4	4.2	4.7	5.6	5.4	4.9	5.7	6.1	7.7	7.1	7.4	8.6	8.0	8.9	8.5	10.0	11.5	9.4	9.9	12.4	1.6	24.1	12.8
	Pakistan	7.8	6.5	7.3	7.6	7.7	10.2	6.8	6.3	10.1	8.4	8.4	7.2	8.6	10.1	12.5	12.7	13.2	10.7	9.3	7.9	8.5	8.8	7.2	7.0	7.4
	Iran, Islamic R.	7.7	2.2	0.7	0.7	1.1	1.0	2.5	3.4	3.7	3.3	2.9	3.1	11.1	3.6	3.9	4.0	4.6	7.1	6.1	8.6	8.1	7.1	5.9	8.3	8.9
	UAE	4.2	4.4	4.2	6.7	5.7	6.1	6.4	6.3	6.0	6.2	6.2	6.9	6.8	7.1	8.3	8.6	9.0	8.2	9.0	3.3	4.9	4.4	4.0	4.0	4.0
	Sri Lanka	3.9	3.8	3.8	3.9	4.1	4.2	4.3	4.3	4.1	4.1	4.1	4.1	4.8	3.9	4.2	4.6	4.9	5.0	4.8	4.8	4.7	4.2	1.9	3.8	4.6
	Saudi Arabia	2.9	2.6	7.1	7.7	7.0	7.1	6.7	7.6	7.8	7.9	8.3	8.5	6.0	5.0	3.7	4.7	3.8	3.5	4.8	4.0	3.1	2.9	2.9	2.9	2.9
	Qatar	1.9	0.4	0.3	0.1	0.1	0.1	0.2	0.6	0.7	0.8	0.6	0.4	0.3	0.3	0.4	0.6	0.5	0.8	1.0	1.0	1.9	1.5	1.9	2.0	2.0
	Malaysia	1.2	1.8	2.8	3.6	4.0	3.4	2.5	2.8	3.0	3.7	2.9	2.9	2.0	2.2	2.4	3.2	0.7	0.9	1.1	1.8	1.6	1.5	0.9	1.1	1.0
	Oman	1.2	3.1	10.9	7.7	13.6	15.0	6.0	4.2	1.1	2.2	1.9	1.3	3.3	3.3	4.2	2.3	2.2	1.6	1.8	1.4	2.0	2.0	1.4	0.3	0.3
	Other Fleets	3.1	2.0	2.6	2.8	3.0	2.7	2.6	3.5	3.1	3.5	3.1	2.7	3.3	3.5	3.3	3.8	4.0	2.8	3.4	3.4	3.3	2.9	2.7	3.4	3.4
	Total	*64.4*	*41.9*	*52.5*	*58.4*	*61.3*	*67.2*	*55.8*	*52.9*	*55.3*	*60.0*	*57.9*	*58.1*	*69.8*	*61.6*	*65.2*	*71.7*	*69.1*	*71.3*	*68.6*	*66.2*	*67.5*	*63.3*	*44.1*	*78.4*	*68.7*
Line	Madagascar	12.0	4.3		3.8	7.9	0.4	8.5	10.0	8.0	8.0	10.0	10.0	10.0	10.0	10.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
	Indonesia	9.0	4.0	2.5	3.1	3.5	4.1	4.0	3.6	4.2	4.5	5.7	5.2	5.5	6.3	5.9	6.6	6.3	7.3	8.5	6.9	7.3	9.1	18.8	0.1	9.4
	India	2.9	1.4	1.4	1.9	1.5	1.7	1.8	1.3	1.4	2.0	1.7	2.0	2.4	2.0	2.1	2.7	2.6	3.0	2.3	3.0	2.8	2.3	2.8	3.2	3.2
	Saudi Arabia	2.4	1.0	1.2	1.4	2.0	2.3	2.5	1.3	1.4	2.2	2.6	2.9	0.9	1.0	2.3	2.4	2.7	2.4	2.3	2.3	2.7	2.2	2.4	2.4	2.4
	Yemen	1.7	2.2	3.5	3.8	3.3	2.6	2.3	3.1	3.2	2.6	3.1	3.3	3.0	2.4	2.3	2.2	2.2	2.1	2.0	1.9	1.8	1.8	1.8	1.7	1.5
	Oman	1.6	1.8	5.7	4.1	7.2	7.9	3.1	2.2	2.4	1.2	1.1	2.4	1.8	0.7	1.6	0.6	1.1	0.9	0.9	0.6	0.5	1.0	1.1	2.6	2.6
	Other Fleets	2.2	1.9	2.0	2.4	3.5	2.5	2.6	3.0	3.0	2.5	2.4	2.8	2.4	2.5	2.9	2.8	2.3	2.2	2.6	1.7	2.1	2.1	2.0	2.4	2.5
	Total	*31.8*	*16.5*	*16.3*	*20.6*	*28.8*	*21.5*	*24.8*	*24.5*	*23.6*	*23.0*	*26.6*	*28.6*	*26.1*	*25.0*	*27.0*	*29.2*	*29.1*	*30.0*	*30.6*	*28.5*	*29.3*	*30.6*	*41.0*	*24.4*	*33.7*
Other gears	India	12.2	6.1	5.7	8.1	6.3	7.2	7.5	5.5	6.0	8.5	7.2	8.6	9.9	8.6	8.9	11.2	10.8	12.7	9.6	12.6	11.9	10.2	11.7	13.7	13.7
	Thailand	3.4	1.3	0.9	1.4	1.4	0.7	1.6	1.8	1.8	2.4	2.3	1.8	2.8	3.5	3.5	3.2	2.2	2.1	2.1	2.9	3.0	3.4	3.9	3.4	3.5
	Indonesia	2.0	0.9	0.6	0.7	0.8	0.9	0.9	0.8	1.0	1.0	1.3	1.2	1.2	1.4	1.3	1.5	1.4	1.7	1.9	1.6	1.6	2.1	4.1	0.2	2.1
	Oman	0.1	0.9	3.6	2.5	4.5	5.0	2.0	1.4	0.1	0.2	0.1	0.2	1.0	1.2	0.2	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1
	Other Fleets	2.1	0.6	0.0	0.4	0.6	0.3	0.4	0.1	0.3	0.4	0.4	0.5	0.2	0.2	0.5	0.6	1.7	1.8	1.3	1.8	1.5	1.1	1.8	3.4	2.7
	Total	*19.9*	*9.7*	*10.8*	*13.2*	*13.6*	*14.1*	*12.3*	*9.7*	*9.2*	*12.6*	*11.3*	*12.3*	*15.1*	*14.9*	*14.4*	*16.7*	*16.3*	*18.4*	*15.0*	*19.0*	*18.2*	*16.9*	*21.6*	*20.8*	*22.2*
All	*Total*	*116.1*	*68.1*	*79.5*	*92.2*	*103.7*	*102.7*	*93.0*	*87.1*	*88.0*	*95.6*	*95.9*	*99.0*	*110.9*	*101.5*	*106.7*	*117.7*	*114.5*	*119.7*	*114.1*	*113.7*	*115.0*	*110.8*	*106.6*	*123.6*	*124.6*



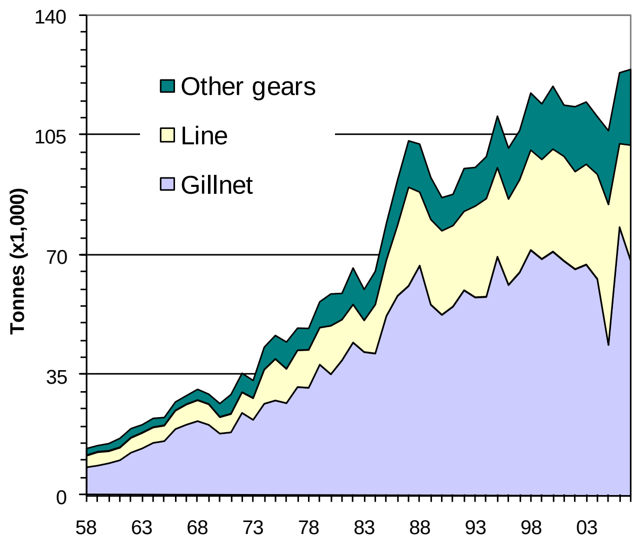


Figure 1. *Narrow-barred Spanish mackerel: (a) annual catches from 1958 to 2007 by (on the left) area i.e. Eastern and Western Indian Ocean and (on the right) gear. Data as of October 2008*

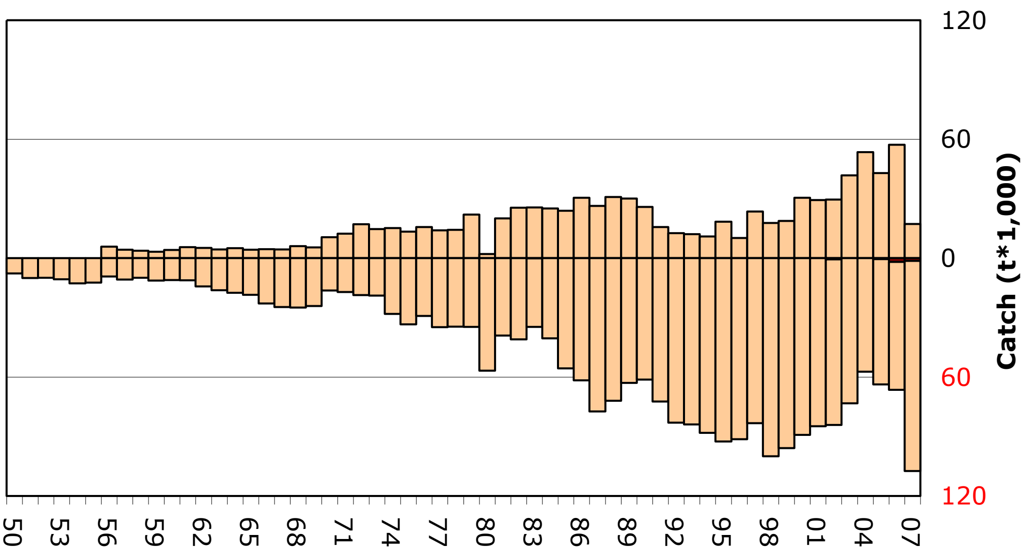


Figure 2*. Narrow-barred Spanish mackerel: uncertainty of annual catch estimates. The amount of the catch below the zero-line has been categorised as uncertain according to the criteria given in the text.*

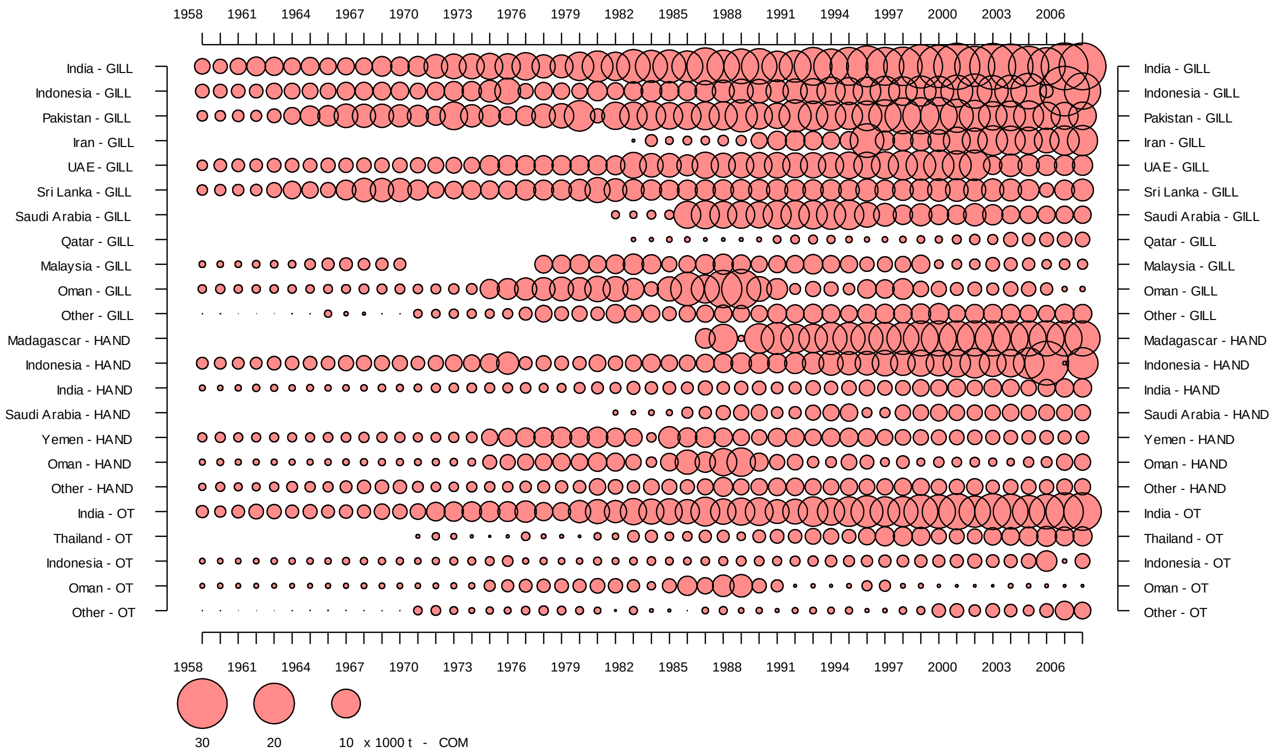


Figure 3. *Narrow barred Spanish mackerel: catches of by gear and main fleets for the period 1958-200 (in thousands of tonnes). Data as of October 2008*

Executive summary of the status of the blue shark resource

(*as adopted by the IOTC Scientific Committee, December 2008*)

BIOLOGY

The blue shark (*Prionace glauca*) is common in pelagic oceanic waters throughout the tropical and temperate oceans worldwide. It has one of the widest ranges of all the shark species. It may also be found close inshore and in estuaries. Blue shark is most common in relatively cool waters (7 to 16°C) often close to the surface. In the tropical Indian Ocean, the greatest abundance of blue sharks occurs at depths of 80 to 220 m, in temperatures ranging from 12 to 25°C. The distribution and movements of blue shark are strongly influenced by seasonal variations in water temperature, reproductive condition, and availability of prey.

The worldwide distribution of the blue shark

The blue shark is often found in large single sex schools containing individuals of similar size. Adult blue sharks have no known predators; however, subadults and juveniles are eaten by both shortfin makos and white sharks as well as by sea lions. Fishing is likely to be a major contributor to adult mortality.

In the Atlantic Ocean, the oldest blue sharks reported were a 16 year old male and a 13 year old female. Longevity is estimated to be between 20-26 years of age and maximum size is around 3.8 m FL. Size increases when latitude decreases.

Sexual maturity is attained at 5 years of age in both sexes. Blue shark is a viviparous species, with a yolk-sac placenta. Once the eggs have been fertilised there is a gestation period of between 9 and 12 months. Litter size is quite variable, ranging from four to 135 pups and may be dependent on the size of the female. The average litter size observed from the Indian Ocean is 38. New-born pups are around 40 to 51 cm in length. Generation time is about eight years. In Indian Ocean, between latitude 2 ºN and 6 ºS, pregnant females are present for most of the year.

FISHERIES

Blue sharks are often targeted by some semi-industrial, artisanal and recreational fisheries and are a bycatch of industrial fisheries (pelagic longline tuna and swordfish fisheries and purse seine fishery). The blue shark appears to have a similar distribution to swordfish. Typically, the fisheries take blue sharks between 1.8-2.4 m fork length or 30 to 52 kg. Males are slightly smaller than the females. In other Oceans, angling clubs are known for organising sharks fishing competitions where blue sharks and mako sharks are targetted. Sport fisheries for sharks are apparently not so common in the Indian Ocean.

There is little information on the fisheries prior to the early 1970’s, and some countries continue not to collect shark data while others do collect it but do not report it to IOTC. It appears that significant catches of sharks have gone unrecorded in several countries. Furthermore, many catch records probably under-represent the actual catches of sharks because they do not account for discards (i.e. do not record catches of sharks for which only the fins are kept or of sharks usually discarded because of their size or condition) or they reflect dressed weights instead of live weights.

In 2005, seven countries reported catches of blue sharks in the IOTC region. These are not given in this summary because their representativeness is highly uncertain. Apparently, as other shark stocks have declined less blue sharks are being discarded.

FAO also compiles landings data on elasmobranchs, but the statistics are limited by the lack of species-specific data and data from the major fleets.

Availability Of Information For Stock Assessment

There is little information on blue shark biology and no information is available on stock structure.

Possible fishery indicators:

5. **Trends in catches**: The catch estimates for blue shark are highly uncertain as is their utility in terms of minimum catch estimates.
6. **Nominal CPUE Trends:** Data not available. There are no surveys specifically designed to assess shark catch rates in the Indian Ocean. Trends in localised areas might be possible in the future (for example, from the Kenyan recreational fishery).
7. **Average weight in the catch by fisheries:** data not available.
8. **Number of squares fished:** CE data not available.

Stock Assessment

No quantitative stock assessment has been undertaken by the IOTC Working Party on Ecosystems and Bycatch.

Management Advice

There is a paucity of information available on this species and this situation is not expected to improve in the short to medium term. There is no quantitative stock assessment or basic fishery indicators currently available for blue shark in the Indian Ocean therefore the stock status is highly uncertain.

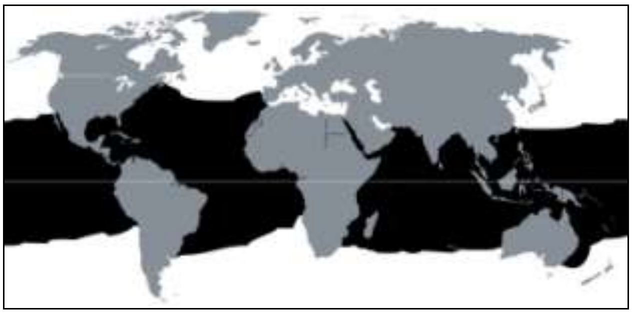
Blue sharks are commonly taken by a range of fisheries in the Indian Ocean and in some areas they are fished in their nursery grounds. Because of their life history characteristics – they are relatively long lived (16-20 years), mature at 4-6 years, and have relativity few offspring (25-50 pups every two years), the blue shark is vulnerable to overfishing.

Executive summary of the status of the silky shark resource

(*as adopted by the IOTC Scientific Committee, December 2008*)

BIOLOGY

The silky shark (*Carcharhinus falciformis*) is one of the most abundant large sharks inhabiting warm tropical and subtropical waters throughout the world.



The worldwide distribution of the silky shark

Although essentially pelagic, the silky shark is not restricted to the open ocean. It also ranges to inshore areas and near the edges of continental shelves and over deepwater reefs. Silky sharks live down to 500 m but has been caught as deep as 4000 m. Typically, smaller individuals are found in coastal waters. Small silky sharks are also commonly associated with schools of tuna.

Silky sharks often form mixed-sex schools containing similar sized individuals. Maximum age is estimated at 20+ years for males and 22+ years for females and maximum size is over 3 m long.

The age of sexual maturity is variable. In the Atlantic Ocean, off Mexico, silky sharks mature at 10-12 years. By contrast in the Pacific Ocean, males mature at around 5-6 years and females mature at around 6-7 year. The silky shark is a viviparous species with a gestation period of around 12 months. Females give birth possibly every two years. The number of pups per litter ranges from 9-14 in the western Indian Ocean, and 2-11 in the central Indian Ocean. Pups measure around 75-80 cm TL at birth and spend first their first few months in near reefs before moving to the open ocean. Generation time is estimated to be 8 years.

FISHERIES

Silky sharks are often targeted by some semi-industrial, artisanal and recreational fisheries and are a bycatch of industrial fisheries (pelagic longline tuna and swordfish fisheries and purse seine fishery). Sri Lanka has had a large fishery for small sized silky shark for over 40 years.

There is little information on the fisheries prior to the early 1970's, and some countries continue not to collect shark data while others do collect it but do not report it to IOTC. It appears that significant catches of sharks have gone unrecorded in several countries. Furthermore, many catch records probably under-represent the actual catches of sharks because they do not account for discards (i.e. do not record catches of sharks for which only the fins are kept or of sharks usually discarded because of their size or condition) or they reflect dressed weights instead of live weights.

Catches of silky shark in the IOTC region are not given in this summary because their representativeness is highly uncertain.

FAO also compiles landings data on elasmobranchs, but the statistics are limited by the lack of species-specific data and data from the major fleets.

AVAILABILITY OF INFORMATION FOR STOCK ASSESSMENT

There is little information available on silky shark biology and no information is available on stock structure.

Possible fishery indicators:

1. **Trends in catches**: The catch estimates for silky shark are highly uncertain as is their utility in terms of minimum catch estimates.

2. **Nominal CPUE Trends:** data not available.
3. **Average weight in the catch by fisheries:** data not available.
4. **Number of squares fished:** CE data not available.

STOCK ASSESSMENT

No quantitative stock assessment has been undertaken by the IOTC Working Party on Ecosystems and Bycatch.

MANAGEMENT ADVICE

There is a paucity of information available on this species and this situation is not expected to improve in the short to medium term. There is no quantitative stock assessment or basic fishery indicators currently available for silky shark in the Indian Ocean therefore the stock status is highly uncertain. Although the Sri Lankan fishery for small sized silky shark has been sustained for over 40 years, the level of catch over this period is uncertain.

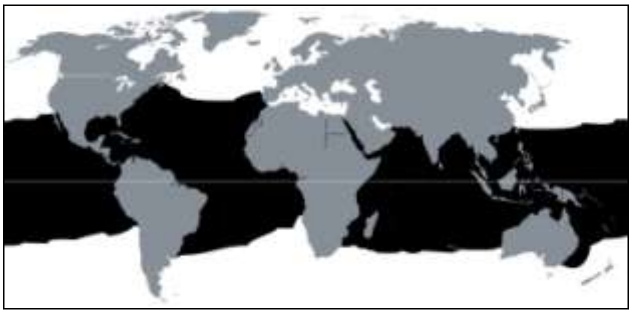
Silky sharks are commonly taken by a range of fisheries in the Indian Ocean and in some areas they are fished in their nursery grounds. Because of their life history characteristics – they are relatively long lived (over 20 years), mature at 6-12 years, and have relativity few offspring (<20 pups every two years), the silky shark is vulnerable to overfishing.

Executive summary of the status of the oceanic whitetip shark resource

(*as adopted by the IOTC Scientific Committee, December 2008*)

BIOLOGY

The oceanic whitetip shark (*Carcharhinus longimanus*) is one of the most common large sharks in warm oceanic waters. It is typically found in shallower waters near oceanic islands.



The worldwide distribution of the oceanic whitetip shark

Oceanic whitetip sharks are relatively large sharks and grow to up to 4 m. Females grow larger than males. The maximum weight reported for this species is 167.4 kg.

Both males and females mature at around 4 to 5 years old or about 1.8-1.9 m TL. Oceanic whitetip sharks are viviparous. Litter sizes range from 1-15 pups, with larger sharks producing more offspring. Each pup is approximately 60-65 cm at birth. In the south western Indian Ocean, whitetips appear to mate and give birth in the early summer, with a gestation period which lasts about one year. The reproductive cycle is believed to be biennial. The locations of the nursery grounds are not well known but they are thought to be in oceanic areas.

The population dynamics and stock structure of the oceanic whitetip shark in the Indian Ocean are not known.

FISHERIES

Oceanic whitetip sharks are often targeted by some semi-industrial, artisanal and recreational fisheries and are a bycatch of industrial fisheries (pelagic longline tuna and swordfish fisheries and purse seine fishery).

There is little information on the fisheries prior to the early 1970's, and some countries continue not to collect shark data while others do collect it but do not report it to IOTC. It appears that significant catches of sharks have gone unrecorded in several countries. Furthermore, many catch records probably under-represent the actual catches of sharks because they do not account for discards (i.e. do not record catches of sharks for which only the fins are kept or of sharks usually discarded because of their size or condition) or they reflect dressed weights instead of live weights.

Catches of oceanic whitetip sharks in the IOTC region are not given in this summary because their representativeness is highly uncertain.

FAO also compiles landings data on elasmobranchs, but the statistics are limited by the lack of species-specific data and data from the major fleets.

AVAILABILITY OF INFORMATION FOR STOCK ASSESSMENT

There is little information available on oceanic whitetip shark biology and no information is available on stock structure.

Possible fishery indicators:

1. **Trends in catches**: The catch estimates for silky shark are highly uncertain as is their utility in terms of minimum catch estimates.
2. **Nominal CPUE Trends:** data not available.
3. **Average weight in the catch by fisheries:** data not available.

4. **Number of squares fished:** CE data not available.

STOCK ASSESSMENT

No quantitative stock assessment has been undertaken by the IOTC Working Party on Ecosystems and Bycatch.

MANAGEMENT ADVICE

There is a paucity of information available on this species and this situation is not expected to improve in the short to medium term. There is no quantitative stock assessment or basic fishery indicators currently available for oceanic whitetip shark in the Indian Ocean therefore the stock status is highly uncertain.

Oceanic whitetip sharks are commonly taken by a range of fisheries in the Indian Ocean. Because of their life history characteristics – they are relatively long lived, mature at 4-5 years, and have relativity few offspring (<20 pups every two years), the oceanic whitetip shark is vulnerable to overfishing.

Executive summary of the status of the shortfin mako shark resource

(*as adopted by the IOTC Scientific Committee, December 2008*)

BIOLOGY

The shortfin mako shark (*Isurus oxyrinchus*) is widely distributed in tropical and temperate waters above 16°C. Makos prefer epipelagic and littoral waters from the surface down to depths of 500 meters. Shortfin mako is not known to school. It has a tendency to follow warm water masses polewards in the summer. Tagging results from the North Atlantic Ocean showed that makos migrated over long distances and this suggests that there is a single well-mixed population in this area. No information is available on stock structure of shortfin mako in Indian Ocean

The worldwide distribution of the shortfin mako shark

The shortfin mako shark is a large and active shark and one of the fastest swimming shark species. It is known to leap out of the water when hooked and is often found in the same waters as swordfish. This species is at the top of the food chain, feeding on other sharks and fast-moving fishes such as swordfish and tunas.

The maximum age of shortfin makos in Northwest Atlantic Ocean is estimated to be over 24 years with the largest individuals reaching 4 m and 570 kg.

Sexual maturity is attained at 7 to 8 years or at around 2.7-3.0 m TL for females and 2.0-2.2 m TL for males. The length at maturity of female shortfin makos differs between the Northern and Southern hemispheres. The nursery areas are apparently in deep tropical waters. Female shortfin makos are ovoviviparous. Developing embryos feed on unfertilized eggs in the uterus during the gestation period which lasts 15-18 months. Litter size ranges from 4 to 25 pups, with larger sharks producing more offspring. Growth of the pups is very fast to reach 70 cm (TL) at birth. The length of the reproductive cycle is around three years. Generation time is estimated to be 14 years.

FISHERIES

Shortfin mako sharks are often targeted by some semi-industrial, artisanal and recreational fisheries and are a bycatch of industrial fisheries (pelagic longline tuna and swordfish fisheries and purse seine fishery). In other Oceans, due to its energetic displays and edibility, the shortfin mako is considered one of the great gamefish of the world.

There is little information on the fisheries prior to the early 1970's, and some countries continue not to collect shark data while others do collect it but do not report it to IOTC. It appears that significant catches of sharks have gone unrecorded in several countries. Furthermore, many catch records probably under-represent the actual catches of sharks because they do not account for discards (i.e. do not record catches of sharks for which only the fins are kept or of sharks usually discarded because of their size or condition) or they reflect dressed weights instead of live weights.

Catches of shortfin mako sharks in the IOTC region are not given in this summary because their representativeness is highly uncertain.

FAO also compiles landings data on elasmobranchs, but the statistics are limited by the lack of species-specific data and data from the major fleets.

AVAILABILITY OF INFORMATION FOR STOCK ASSESSMENT

There is little information available on shortfin mako shark biology and no information is available on stock structure.

Possible fishery indicators:

1. **Trends in catches**: The catch estimates for shortfin mako are highly uncertain as is their utility in terms of minimum catch estimates.
2. **Nominal CPUE Trends:** data not available.
3. **Average weight in the catch by fisheries:** data not available.
4. **Number of squares fished:** CE data not available.

STOCK ASSESSMENT

No quantitative stock assessment has been undertaken by the IOTC Working Party on Ecosystems and Bycatch.

MANAGEMENT ADVICE

There is a paucity of information available on this species and this situation is not expected to improve in the short to medium term. There is no quantitative stock assessment or basic fishery indicators currently available for shortfin mako shark in the Indian Ocean therefore the stock status is highly uncertain.

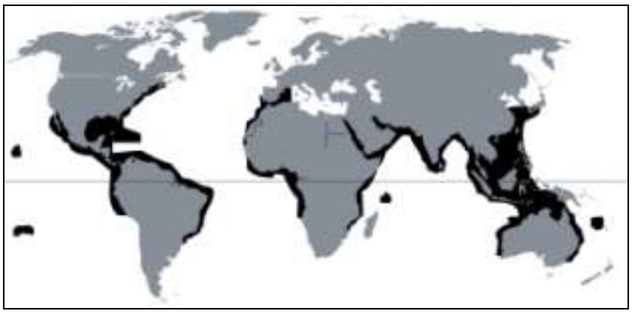
Shortfin mako sharks are commonly taken by a range of fisheries in the Indian Ocean. Because of their life history characteristics – they are relatively long lived (over 24 years), mature at 7-8 years, and have relativity few offspring (<30 pups every three years), the shortfin mako sharks is vulnerable to overfishing.

Executive summary of the status of the scalloped hammerhead shark resource

(*as adopted by the IOTC Scientific Committee, December 2008*)

BIOLOGY

The scalloped hammerhead shark (*Sphyrna lewini*) is widely distributed and common in warm temperate and tropical waters down to 275 m. It is also found in estuarine and inshore waters.



The worldwide distribution of the scalloped hammerhead shark

In some areas, the scalloped hammerhead shark forms large resident populations. In other areas, large schools of small-sized sharks are known to migrate pole wards seasonally.

Scalloped hammerhead sharks feeds on pelagic fishes, other sharks and rays, squids, lobsters, shrimps and crabs.

The maximum age for Atlantic Ocean scalloped hammerheads is estimated to be over 30 years with the largest individuals reaching over 2.4 m.

Males in the Indian Ocean mature at around 1.4-1.65 m TL. Females mature at about 2.0 m TL. The scalloped hammerhead shark is viviparous with a yolk sac-placenta. The young are around 38-45 cm TL at birth, and litters consist of 15-31 pups. The reproductive cycle is annual and the gestation period is 9-10 months. The nursery areas are in shallow coastal waters.

FISHERIES

Scalloped hammerhead sharks are often targeted by some semi-industrial, artisanal and recreational fisheries and are a bycatch of industrial fisheries (pelagic longline tuna and swordfish fisheries and purse seine fishery).

There is little information on the fisheries prior to the early 1970's, and some countries continue not to collect shark data while others do collect it but do not report it to IOTC. It appears that significant catches of sharks have gone unrecorded in several countries. Furthermore, many catch records probably under-represent the actual catches of sharks because they do not account for discards (i.e. do not record catches of sharks for which only the fins are kept or of sharks usually discarded because of their size or condition) or they reflect dressed weights instead of live weights.

Catches of scalloped hammerhead sharks in the IOTC region are not given in this summary because their representativeness is highly uncertain.

FAO also compiles landings data on elasmobranchs, but the statistics are limited by the lack of species-specific data and data from the major fleets.

AVAILABILITY OF INFORMATION FOR STOCK ASSESSMENT

There is little information available on scalloped hammerhead shark biology and no information is available on stock structure.

Possible fishery indicators:

1. **Trends in catches**: The catch estimates for scalloped hammerhead are highly uncertain as is their utility in terms of minimum catch estimates.
2. **Nominal CPUE Trends:** data not available.

3. **Average weight in the catch by fisheries:** data not available.
4. **Number of squares fished:** CE data not available.

STOCK ASSESSMENT

No quantitative stock assessment has been undertaken by the IOTC Working Party on Ecosystems and Bycatch.

MANAGEMENT ADVICE

There is a paucity of information available on this species and this situation is not expected to improve in the short to medium term. There is no quantitative stock assessment or basic fishery indicators currently available for scalloped hammerhead shark in the Indian Ocean therefore the stock status is highly uncertain.

Scalloped hammerhead sharks are commonly taken by a range of fisheries in the Indian Ocean. They are extremely vulnerable to gillnet fisheries. Furthermore, pups occupy shallow coastal nursery grounds, often heavily exploited by inshore fisheries. Because of their life history characteristics – they are relatively long lived (over 30 years), and have relativity few offspring (<31 pups each year), the scalloped hammerhead shark is vulnerable to overfishing.

Executive summary of the status of sea turtles in the Indian Ocean

(*as adopted by the IOTC Scientific Committee, December 2008*)

OVERVIEW OF THE SEA TURTLE SPECIES

Six species of sea turtles[15] inhabit the Indian Ocean and likely interact with the fisheries for tuna and tuna-like species.

Green turtle

The green turtle (*Chelonia mydas*) is the largest of all the hard-shelled sea turtles, growing up to one meter long and weighing 130-160 kg. Adult green turtles are unique among sea turtles in that they are herbivorous, feeding on seagrasses and algae. Green turtles reach sexual maturity between 20 and 50 years. Females return to their natal beaches (i.e. the same beaches where they were born) every 2 to 4 years to nest, laying several clutches of about 125 eggs at roughly 14-day intervals several times in a season. However, very few hatchlings survive to reach maturity – perhaps fewer than one in 1,000.

The green turtle is globally distributed and generally found in tropical and subtropical waters along continental coasts and islands between 30°N and 30°S. Green turtles primarily use three types of habitat: oceanic beaches (for nesting), convergence zones in the open ocean, and benthic feeding grounds in coastal areas. Adult migrate from foraging areas to mainland or island nesting beaches and may travel hundreds or thousands of kilometers each way. After emerging from the nest, hatchlings swim to offshore areas, where they are believed to live for several years, feeding close to the surface on a variety of pelagic plants and animals. Once the juveniles reach a certain age/size range, they leave the pelagic habitat and travel to nearshore foraging grounds.

The Indian Ocean hosts some of the largest nesting populations of green turtles in the world, particularly on oceanic islands in the southwest and on islands in SE Asia. Many of these populations are now recovering after intense exploitation in the last century greatly reduced the populations; some populations are still declining. The green turtle is one of the most widely distributed and commonest of the marine turtle species in the Indian Ocean.

Hawksbill turtle

The hawksbill (*Eretmochelys imbricata*) turtle is small to medium-sized compared to other sea turtle species. In the Indian Ocean, adults weigh 45 to 70 kg, but can grow to as large as 90 kg. Female hawksbills return to their natal beaches every 2-3 years to nest. A female hawksbill may lay 3-5, or more, nests in a season, which contain an average of 130 eggs.

Hawksbill turtles use different habitats at different stages of their life cycle, but are most commonly associated with coral reefs. Post-hatchlings (oceanic stage juveniles) are believed to occupy the pelagic environment. After a few years in the pelagic zone, small juveniles recruit to coastal foraging grounds. This shift in habitat also involves a shift in feeding strategies, from feeding primarily at the surface to feeding below the surface primarily on animals associated with coral reef environments.

Hawksbill turtles are circumtropical, typically occurring from 30°N to 30°S latitude. Adult hawksbill turtles are capable of migrating long distances between nesting beaches and foraging areas, which are comparable to migrations of green and loggerhead turtles.

In modern times hawksbills are solitary nesters (although some scientists postulate that before their populations were devastated they may have nested on some beaches in concentrations) and thus, determining population trends or estimates on nesting beaches is difficult. Decades long protection programs in some places, particularly in the

15 The following biological information on marine turtle species found around the Indian Ocean is derived largely from the NOAA Fisheries, Office of Protected Resources, website: (http://www.nmfs.noaa.gov/pr/species/turtles/), supplemented by other sources (such as a website of the Australian Government, Department of Environment, Water, Heritage and the Arts for information on the Flatback turtle)

Indian Ocean, have resulted in population recovery. Hawksbills – although generally not found in large concentrations, are widely distributed in the Indian Ocean. The largest populations of hawksbills in or around the Indian Ocean (which are among the largest in the world) occur in the Seychelles, Indonesia and Australia.

Leatherback turtle

The leatherback (*Dermochelys coriacea*) is the largest turtle and the largest living reptile in the world. Mature males and females can grow to 2 m and weigh almost 900 kg. Females lay clutches of approximately 100 eggs on sandy, tropical beaches. They nest several times during a nesting season.

The leatherback is the only sea turtle that lacks a hard, bony shell and adults are capable of tolerating a wide range of water temperatures. The leatherback is the most wide ranging marine turtle species, and regularly migrates enormous distances, e.g. between the Indian and south Atlantic Oceans. They are commonly found in pelagic areas, but they also forage in coastal waters. The distribution and developmental habitats of juvenile leatherbacks are poorly understood. While the leatherback is not as common in the Indian Ocean as other species, important nesting populations are found in and around the Indian Ocean, including in Indonesia, South Africa, Sri Lanka and India's Andaman and Nicobar Islands

Loggerhead turtle

The loggerhead turtle (*Caretta caretta*) may grow to one meter long and weigh around 110 kg. It reaches sexual maturity at around 35 years of age. Loggerheads are circumglobal, occurring throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans.

Loggerheads nest in relatively few countries in the Indian Ocean and the number of nesting females is generally small, except on Masirah Island (Sultanate of Oman) which supports one of only two loggerhead nesting beaches in the world that have greater than 10,000 females nesting per year. The hatchlings and juveniles are pelagic, living in the open ocean, while the adults forage in coastal areas. Studies in the Atlantic and Pacific Oceans show that loggerheads can spend decades living on the high seas, crossing from one side of an ocean basin to another.

Olive ridley

The olive ridley (*Lepidochelys olivacea*) turtle is considered the most abundant sea turtle in the world, with an estimated 800,000 nesting females annually. Adults are relatively small, weighing on average around 45 kg. Their size and morphology varies from region to region..

The olive ridley is globally distributed in the tropical regions of the South Atlantic, Pacific, and Indian Oceans. It is mainly a pelagic species, but it has been known to inhabit coastal areas, including bays and estuaries. Olive ridleys often migrate great distances between feeding and breeding grounds. They mostly breed annually and have an annual migration from pelagic foraging, to coastal breeding and nesting grounds, back to pelagic foraging. They can dive to depths of about 150 m to forage. Olive ridleys reach sexual maturity in around 15 years, a young age compared to some other sea turtle species. Females nest every year, once or twice a season, laying clutches of approximately 100 eggs.

The olive ridley has one of the most extraordinary nesting habits in the natural world. Large groups of turtles gather off shore of nesting beaches. Then, all at once, vast numbers of turtles come ashore and nest in what is known as an "arribada". During these arribadas, hundreds to thousands of females come ashore to lay their eggs. In the northern Indian Ocean, arribadas occur on three different beaches along the coast of India. Gahirmatha (Orissa, India) used to be one of the largest arribada nesting sites in the world. However, arribada nesting events have been less frequent there in recent years and the average size of nesting females has been smaller, indicative of a declining population. Declines in solitary nesting of olive ridleys have been recorded in Bangladesh, Myanmar, Malaysia, and Pakistan. In particular, the number of nests in Terengganu, Malaysia has declined from thousands of nests to just a few dozen per year. Solitary nesting also occurs extensively throughout this species' range. Despite the enormous numbers of olive ridleys that nest in Orissa, this species is not generally common throughout much of the Indian Ocean.

Flatback turtle

The flatback turtle (*Natator depressus*) nests exclusively along the northern coast of Australia. It gets its name from its relatively flat, smooth shell, unlike other marine turtles which have a high domed shell. The flatback is a medium-sized marine turtle, growing to up to one meter long and weighing up to 90 kg. It is carnivorous, feeding mostly on soft-bodied prey such as sea cucumbers, soft corals, jellyfish, molluscs and prawns.

Flatback turtles are found in northern coastal areas, from Western Australia's Kimberley region to the Torres Strait extending as far south as the Tropic of Capricorn. Feeding grounds also extend to the Indonesian Archipelago and the Papua New Guinea Coast. Although flatback turtles do occur in open seas, they are common in inshore waters and bays where they feed on the soft-bottomed seabed.

Flatbacks have the smallest migratory range of any sea turtle species, though they do make long reproductive migrations of up to 1300 km. This restricted range means that the flatback is vulnerable to habitat loss, especially breeding sites

AVAILABILITY OF INFORMATION ON THE INTERACTIONS BETWEEN SEA TURTLES AND FISHERIES FOR TUNA AND TUNA-LIKE SPECIES

IOTC and the Indian Ocean -- South-East Asian Marine Turtle Memorandum of Understanding, an agreement under the Convention on Migratory Species (IOSEA) are actively collecting a range of information on fisheries and sea turtle interactions. The IOSEA database covers information from a wider range of fisheries and gears than IOTC does.

The IOSEA Online Reporting Facility[16] compiles information through IOSEA National Reports on potential sea turtle fisheries interactions, as well as various mitigation measures put in place by its Signatory States and collaborating organisations. For example, members provide information on fishing effort and perceived impacts of fisheries that may interact with sea turtles, including longlines, purse seines, FADs, and gillnets.

While the information is incomplete for some countries and is generally descriptive rather than quantitative, it has begun to provide a general overview of potential fisheries interactions as well as their extent. No information is available for China, China,Taiwan, Japan, Republic of Korea (among others) which are not yet signatories to IOSEA Information is also provided on such mitigation measures as appropriate handling techniques, gear modifications, spatial/temporal closures etc.

IOSEA is collecting all of the above information with a view to providing a regional assessment of member States' compliance with the FAO Guidelines on reducing fisheries interactions with marine turtles.

The IOTC has implemented data collection measures to better understand the nature and extent of the interactions between fisheries for tuna and tuna-like species in the Indian Ocean and sea turtles.

IOTC members have implemented a number of national observer programmes that are providing information on the levels of sea turtle bycatch. While there have been the recent improvements in the observer data from purse seine operations, coverage of longline and artisanal fleets remains low.

Purse seine

EC observers (covering on average 5 % of the operations annually) reported 74 sea turtles were caught by French and Spanish purse seiners over the period 2003 to 2007[17]. The most common bycatch species reported are olive ridley, green and hawksbill and these were mostly caught on log sets and returned to the sea alive.

Long line

While information on most of the major longline fleets is currently not available, in the South African longline fisheries the sea turtle bycatch mainly comprises leatherback turtles, with lesser amounts of loggerheads, hawksbills and greens[18]. Estimated average catch rates of sea turtles ranged from 0.005 to 0.3 turtles per 1000 hooks and varied by location, season and year. The highest catch rate reported in one trip was 1.7 turtles per 1000 hooks in oceanic waters.

The Soviet Indian Ocean Tuna Longline Research Programme undertaken in the western Indian Ocean from 1964 to 1988 reported catching 2 sea turtles from a total of 1346 sets (around 660,00 hooks)[19].

[16] (www.ioseaturtles.org/report.php) and Dr Jack Fraizer (Smithsonian Institution)

[17] IOTC-2008-WPEB-08

[18] IOTC-2006-WPBy-15

[19] IOTC-2008-WPEB-10

Over the period 1997 to 2000, the Programme Palangre Réunionnais[20] examined sea turtle bycatch on 5,885 longline sets in the vicinity of Reunion Island (19-25° S, 48-54° E). The fishery caught 47 leatherbacks, 30 hawksbills, 16 green turtles and 25 unidentified sea turtles. This equated to a catch rate of less than 0.02 sea turtles per 1000 hooks over the 4 years.

Gillnets

Overall, the incidental captures of sea turtles by longlines and purse seine fishing is considered to be relatively minor compared to that of gillnets. While the IOTC currently has virtually no information on sea turtle-gillnet interactions, the IOSEA database indicates that the gillnet fisheries occur in about 90% of IOSEA members in the Indian Ocean, and the fishery is considered to have moderate to relatively high impact on sea turtles in about half of these IOSEA member States.

IOTC'S APPROACH TO ENHANCE THE CONSERVATION OF SEA TURTLES

The IOTC collaborates with IOSEA. With 28 Signatory States bordering the Indian Ocean and contiguous waters, the IOSEA MoU is the world's largest intergovernmental agreement focusing on the conservation of marine turtles and their habitats.

In accordance with the FAO Technical Guidelines to Reduce Sea Turtle Mortality in Fishing Operations IOTC encourages its members to implement the following range of measures to mitigate the impact of fishing operations on sea turtles:

A. In general

i) Requirements for appropriate handling, including resuscitation or prompt release of all bycaught or incidentally caught (hooked or entangled) sea turtles.
ii) Retention and use of necessary equipment for appropriate release of bycaught or incidentally caught sea turtles.

B. For purse seine fisheries

i) Avoid encirclement of sea turtles to the extent practical.
ii) Develop and implement appropriate gear specifications to minimize bycatch of sea turtles.
iii) If encircled or entangled, take all possible measures to safely release sea turtles.
iv) For fish aggregating devices (FADs) that may entangle sea turtles, take necessary measures to monitor FADs and release entangled sea turtles, and recover these FADs when not in use.

C. For longline fisheries

i) Development and implementation of appropriate combinations of hook design, type of bait, depth, gear specifications and fishing practices in order to minimize bycatch or incidental catch and mortality of sea turtles.
ii) Retention and use of necessary equipment for appropriate release of bycaught and incidentally caught sea turtles, including de-hooking, line cutting tools and scoop nets.

The Commission also encourages members to collect and voluntarily provide the Scientific Committee with all available information on interactions with sea turtles in fisheries targeting the species covered by the IOTC Agreement, including successful mitigation measures, incidental catches and other impacts on sea turtles in the IOTC Area, such as the deterioration of nesting sites and swallowing of marine debris.

In an effort to better understand the situation the IOTC has implemented data collection measures to improve the collection of scientific data regarding all sources of mortality for sea turtle populations, including but not limited to, data from fisheries within the IOTC Area to enhance the proper conservation of sea turtles

198. IOSEA has also been collecting information on progress made towards the completion of national plans of action for sea turtles. According to information available as at November 2008, six Indian Ocean IOSEA

[20] Poisson F. and Taquet M. (2001) L'espadon: de la recherche à l'exploitation durable. Programme palangre réunionnais, rapport final, 248 p. available in the website www.ifremer.fr/drvreunion

Signatory States (Australia, Comoros, Myanmar, Saudi Arabia, Seychelles, United Kingdom) already have national action plans in place while another ten (Bangladesh, Eritrea, Indonesia, Kenya, Madagascar, Pakistan, South Africa, Sri Lanka, Thailand, United Republic of Tanzania) are working towards this end.

MANAGEMENT CONCERNS

The IOTC notes that the World Conservation Union (IUCN) has classified the olive ridley turtle as vulnerable, the green turtle and loggerhead turtle as endangered and the hawksbill turtle and leatherback turtle as critically endangered.

While the status of sea turtles is affected by a range of factors such as degradation of nesting beaches and targeted harvesting of eggs and turtles, the level of mortality of sea turtles due to capture by gillnets and to a lesser extent purse seine fishing and longline is not known. Notwithstanding this, it is acknowledged that the impact on sea turtle populations from fishing for tuna and tuna-like species may increase if fishing pressure increases, or if the status of the sea turtle populations worsens due to other factors such as an increase in fishing pressure from other fisheries or anthropological or climatic impacts.

APPENDIX IX
TERMS OF REFERENCE FOR AN IOTC WORKING GROUP ON CAPACITY ANALYSIS

Background

The Commission has requested information on fishing capacity within the IOTC area in order to inform its management decisions.

Capacity analysis must be linked to policy needs. It must be set in context:

Globally overcapacity exists relative to tuna fishery resources. It is a global problem that requires a coordinated global response. Nevertheless there are issues that IOTC can examine 'locally';

- The fisheries are multispecies for tunas and tuna like species though some targeting is possible and therefore target switching can complicate evaluation of fishing capacity.
- It is a multi-gear fishery with vessels of different characteristics (purse seine +/- FADS; longlines; pole and line, multi-gear artisanal fisheries); increases in fishing power can occur over time with technological development.
- In addition to existing fleets with historical rights there are fleet development plans of coastal states.
- In the IOTC area artisanal fisheries are a particular factor that needs to be considered. They account for about half the catch.

Terms of Reference:

The Working Party on Fishing Capacity is expected to undertake the following work over several years. This working party shall not only focus on estimation of fishing capacity. It should also provide information that will enable the implementation of capacity controls by IOTC.

1) Review methods reviewed by the FAO Technical Advisory Committee on Tuna Fishing Capacity and by other RFMOs, national management bodies, and other institutions to estimate and manage fishing capacity;
2) Investigate the most suitable methods currently available to determine fishing capacity that can be applied in the Indian Ocean. Review any additional data requirements to apply those methods in IOTC;
3) Define the factors affecting fishing capacity that can be managed by IOTC;
4) Determine the fishing capacity of the existing tuna fishing fleets relative to the status of the resources;
5) Determine the relative fishing capacities of different vessel/gears categories.