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

Report of the Thirteenth Session of the Scientific Committee

Victoria, Seychelles, 6-10 December 2010

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EXECUTIVE SUMMARY

The Thirteenth Meeting of the Scientific Committee (SC) was opened on 6 December 2010, in Victoria, Seychelles, by the Chairperson Dr. Francis Marsac (EU). Representatives from 14 Members, one Cooperating non-Contracting Party, FAO and four observers from inter-governmental and non-governmental organizations attended the meeting.

The SC noted that 15 national reports were presented, an improvement relative to previous years, although still represented less than half the number of Contracting and Cooperating non-Contracting Parties.

The SC expressed its satisfaction to the Secretariat for the amount and quality of the work undertaken during the year, noting the contributions to the scientific activities, including data preparation and analyses for the Working Parties. However, it considers that the staffing level is still insufficient and reiterated its past recommendations for the Commission to provide additional resources to the Secretariat.

Four working party meetings were held in 2009 (Billfish, Ecosystems and Bycatch, Tropical Tunas and Data Collection and Statistics). Complete stock status and technical advice for all IOTC species are provided in the main body of the report, and a summarised version is provided in a table on the following page.

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

For bigeye tuna: Given the uncertainty on estimated MSY values and the levels of error in the nominal catch data for bigeye, the SC recommended than catches are kept at a level not above the catch estimated at the moment of the assessment for 2009, *i.e.* 102,000 t. This value should give low probability of catches exceeding MSY.

For yellowfin tuna: The SC considers that the stock of yellowfin has recently become overexploited or is very close to being overexploited. Management measures should be continued that allow an appropriate control of fishing pressure to be implemented. At this moment, the effect of time-area closures cannot be directly translated into management quantities of direct effect on the status of the stock, such as catches or fishing mortality, so their possible effect on the future evolution of the stock cannot be evaluated. The SC recommends that catches of yellowfin tuna in the Indian Ocean should not increase beyond 300,000 t in order to bring the stock to biomass levels that could sustain catches at the MSY level in the long term. If recruitment continues to be lower than average, catches below 300,000 t would be needed to maintain stock levels.

For swordfish: If the recent declines in effort continue, and catch remains substantially below the estimated MSY of 29,000 t, then there is probably no urgent need to introduce restrictive management actions to the Indian Ocean as a whole. However, continued monitoring is required to manage the uncertainty. It is recommended that catches in the south west should be maintained at levels at or below those observed in 2008 (6,426 t)

The SC agreed that three options should be considered for amendment of Resolution 08/04 concerning the recording of the catch by longline fishing vessels in the IOTC area in order to improve data collection and statistics on sharks that would allow the development of stock status indicators. The SC noted with concern the lack of progress in the reporting of data by CPC's on by-catch species.

The SC reviewed the state of implementation of the Regional Observer Scheme, noting that most countries are still in the initial phases of implementation. The SC adopted minimum data requirements, as well an observer report template to be used until they are open for revision next year.

The SC reviewed the impact of piracy in the western Indian Ocean where decreases in fishing effort, combined with displacement from traditional fishing grounds and changes in fishing practices, have had an effect on total catches, as well as on species and size composition of the catches.

In order to improve the quality of the scientific advice supplied, the SC also agreed to start a process that includes, but is not limited to, the development of a management strategy evaluation, and agreed to updated guidelines for the presentation of the scientific results.

The SC recommended also a schedule of Working Party meetings for 2010 and 2011.

STOCK STATUS SUMMARY FOR THE IOTC SPECIES

Stock	Indicators	Prev. Asm[1]	2010 Asm[2]	Stock status comments	Advice to Commission
Major stocks: *These are the main stocks under exploitation by industrial and artisanal fisheries throughout the Indian Ocean, both in the high seas and in the EEZ of coastal countries. These stocks are the ones that have received, in general, the highest fishing pressure in the region.*					
Albacore *Thunnus alalunga*	Average catch 2005-2009: 39,100 t Catch 2009: 40,700 t MSY: 28,260 t – 34,415 t $F_{2007}F_{MSY}$: 0.48-0.91 $B_{2007}B_0$: > 1	2007		Stock size and fishing pressure were considered to be within acceptable limits in 2008. Since then, a revision of the catch data for recent years has resulted in much higher catch estimates over the past five years compared with the historical average. Mean weight and catch rates of albacore have been stable for over 20 years.	Stock status is uncertain and should be closely monitored to assess the impact of recent changes in catch levels.
Bigeye tuna *Thunnus obesus*	Average catch 2005-2009: 114,600 t Catch 2009: 102,200 t MSY: 114,000 t (95,000 t – 183,000 t) $F_{2009}F_{MSY}$: 0.79 (0.50 – 1.22) SB_{2009}/SB_{MSY} 1.20 (0.88 – 1.68)	2008	2009	The stock is probably not overfished, and overfishing is probably not occurring. However, the stock is probably near full utilization, and the possibility of overfishing cannot be ruled out given the existing uncertainty, and the continuing observed decline in catch rates.	Bigeye catches in the Indian Ocean should be kept at or lower than the 2009 level of 102,000 t.
Skipjack tuna *Katsuwonus pelamis*	Average catch 2005-2009: 502,200 t Catch 2009: 440,600 t MSY: - $F_{2009}F_{MSY}$: - SB_{2009}/SB_{MSY} -			Skipjack is a highly productive species and robust to overfishing. However, this does not exclude completely the possibility for skipjack to become overfished. Recent trends in certain fisheries suggest that the situation of the stock should be closely monitored.	Stock status is uncertain and should be closely monitored.
Yellowfin tuna *Thunnus albacares*	Average catch 2005-2009: 371,200 t Catch 2009: 288,100 t MSY: 320,000t[3] (258-347,000 t)[4] $F_{2009}F_{MSY}$: 0.993 (0.85 – 1.39)[4] SB_{2009}/SB_{MSY} 1.113 (0.93 – 1.25)[4]	2008	2009	Stock is likely to be currently in, or approaching, an overfished state and overfishing has probably been occurring in recent years. If fishing effort displaced because of the piracy problem returns to traditional fishing areas an increase in catches could be expected.	Yellowfin catches in the Indian Ocean should not increase beyond 300,000 t in order to bring the stock to biomass levels that could sustain catches at the MSY level in the long term. If recruitment continues to be lower than average, catches below 300,000 t would be needed to maintain stock levels.
Swordfish *Xiphias gladius*	Average catch 2005-2009: 27,100 t Catch 2009: 22,100 t MSY: 29,000 t (19,000 t–46,000 t) $F_{2008}F_{MSY}$: 0.79 (0.58-0.84) SB_{2008}/SB_{MSY}: 1.31 (1.13-1.46)	2007	2008	The overall stock size and fishing pressure are estimated to be within acceptable limits and the overall level of reduction in stock size probably does not represent a conservation risk. If the southwestern region is analysed as containing a separate stock, results indicate that a substantive decline took place in that area, although recent declines in catch and effort might have brought fishing pressure to sustainable levels.	If the recent declines in effort continue, and catch remains below MSY, then there is no need to introduce restrictive management actions in the Indian Ocean as a whole. Catches in the southwest region should not exceed 2008 levels of 6,400t

[1] This indicates the last year taken into account for assessments carried out before 2010
[2] This indicates the last year taken into account for assessments carried out in 2010
[3] Results obtained with a steepness of the stock-recruitment relationship of 0.8
[4] Range for steepness values of 0.6, 0.7, 0.8 and 0.9

Stock	Indicators	Prev. Asm[1]	2010 Asm[2]	Stock status comments	Advice to Commission
Billfish (other than swordfish) : *This category includes species that are not directly targeted by most fleets, but are caught as by-catch of the main industrial fisheries. They could be important, however, for localised small-scale and artisanal fisheries (e.g. sailfish in the northern Arabian Sea and the Persian Gulf) or as targets in recreational fisheries (e.g. marlins)*					
Blue marlin *Makaira nigricans*	Average catch 2005-2009: 9,350 t Catch 2009: 8,583 t			No quantitative stock assessment is currently available for any of these species in the Indian Ocean and only preliminary stock indicators can be used. Aspects of the biology, productivity and fisheries for these species combined with the lack of data on which to base a more formal assessment is a cause for considerable concern.	Stock status is uncertain
Black marlin *Makaira indica*	Average catch 2005-2009: 5,069 t Catch 2009: 5,410 t				Stock status is uncertain
Striped marlin *Tetrapturus audax*	Average catch 2005-2009: 2,780 t Catch 2009: 2,500 t				Stock status is uncertain
Indo-Pacific Sailfish *Istiophorus platypterus*	Average catch 2005-2009: 24,768 t Catch 2009: 23,220 t				Stock status is uncertain
Neritic tunas: *These are important species for small-scale and artisanal fisheries in the region, almost always caught in the EEZs of IO coastal states. They are caught only occasionally by industrial fisheries, almost never in the high seas. Catches are often reported as aggregates of various species, therefore making it difficult to obtain for stock assessment analyses.*					
Bullet tuna *Auxis rochei*	Average catch 2005-2009: 4,302 t Catch 2009: 4,317 t			No quantitative stock assessment is currently available for bullet tuna in the Indian Ocean, therefore the stock status is uncertain. Catches of bullet tuna are 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.	Stock status is uncertain
Frigate tuna *Auxis thazard*	Average catch 2005-2009: 33.240 t Catch 2009: 33,550 t			No quantitative assessment is available. No reliable indicators	Stock status is uncertain
Narrow-barred Spanish mackerel *Scomberomorus commerson*	Average catch 2005-2009: 110,800 t Catch 2009: 108,600 t			No quantitative assessment is available. No reliable indicators	Stock status is uncertain
Kawakawa *Euthynnus affinis*	Average catch 2005-2009: 119,900 t Catch 2009: 129,850 t			No quantitative assessment is available. Catches have been relatively stable for the past 10 years.	Stock status is uncertain
Longtail tuna *Thunnus tonggol*	Average catch 2005-2009: 103,800 t Catch 2009: 122,400 t			No quantitative assessment is available. No reliable indicators	Stock status is uncertain
Indo-Pacific king mackerel *Scomberomorus guttatus*	Average catch 2005-2009: 38,000 t Catch 2009: 42,330 t			No quantitative assessment is available. No reliable indicators	Stock status is uncertain
Sharks: *Although they are not part of the original list of species under the IOTC mandate, sharks are frequently caught in association with other species as by-catch, and often they are as much a target as tuna for some fleets. As such, IOTC Members and Cooperating non-Contracting Parties are expected to report information at the same level of detail as for regular IOTC species, although there is still insufficient information for formal assessments, The following are the main species caught in tuna fisheries, but the list is not exhaustive.*					
Blue shark *Prionace glauca*	Average catch 2005-2009: Uncertain Catch 2009: Uncertain			No quantitative assessment is available. No reliable indicators	Stock status is uncertain
Silky shark *Carcharhinus falciformis*	Average catch 2005-2009: Uncertain Catch 2009: Uncertain			No quantitative assessment is available. No reliable indicators	Stock status is uncertain
Oceanic whitetip shark *Carcharhinus longimanus*	Average catch 2005-2009: Uncertain Catch 2009: Uncertain			No quantitative assessment is available. No reliable indicators	Stock status is uncertain

Stock	Indicators	Prev. Asm[1]	2010 Asm[2]	Stock status comments	Advice to Commission
Shortfin mako *Isurus oxyrinchus*	Average catch 2005-2009: Uncertain Catch 2009: Uncertain			No quantitative assessment is available. No reliable indicators	Stock status is uncertain
Scalloped hammerhead shark *Sphyrna lewini*	Average catch 2005-2009: Uncertain Catch 2009: Uncertain			No quantitative assessment is available. No reliable indicators	Stock status is uncertain

Key to the colour coding		
	Stock overfished (SB_{year}/SB_{MSY} less than 1)	Stock not overfished (SB_{year}/SB_{MSY} larger or equal to 1)
Stock being overfished (F_{year}/F_{MSY} larger or equal to 1)	(red)	(yellow)
Stock not being overfished (F_{year}/F_{MSY} less than 1)	(orange)	(green)

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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*)
BOBP-IGO	Bay of Bengal Programme – Inter-Governmental Organisation
BUM	Blue marlin (*Makaira nigricans*)
CCSBT	Commission for the Conservation of Southern Bluefin Tuna
CPCs	Contracting parties and cooperating non-contracting parties
COFI	FAO`s Committee on Fisheries
CPUE	Catch per unit of effort
EU	European Union
EEZ	Exclusive Economic Zone
ENSO	El Niño-southern oscillation
F	Fishing mortality; F_{2009} is the fishing mortality estimated in the year 2009
FAD	Fish-aggregating device
FAO	Food and Agriculture Organization of the United Nations
F_{MSY}	Fishing mortality at MSY
GEF	Global Environment Facility
IATTC	Inter-American Tropical Tuna Commission
ICCAT	International Commission for the Conservation of AtlanticTunas
IOTC	Indian Ocean Tuna Commission
IOSSS	Indian Ocean Swordfish Stock Structure
IUCN	International Union for Conservation of Nature
LL	Longline
LOA	Overall length
LSTLV	Large-scale tuna longline fishing vessel
MFCL	Multifan-CL
MLS	Striped marlin (*Tetraturus audax)*
MPA	Marine Protected Area
MSE	Management Strategy Evaluation
MSY	Maximum sustainable yield
NGO	Non-governmental organization
NPA/NPOA	National plan of action
OFCF	Overseas Fishery Cooperation Foundation of Japan
PACP	Projet d'Appui aux Communautés de Pêcheurs
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
WP	Working Party of the IOTC
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 Thirteenth Meeting of the Scientific Committee (SC) was opened on 6 December 2010 Victoria, Seychelles, by the Chairperson Dr. Francis Marsac (European Union).

2. A list of the meeting participants is provided in Appendix I.

3. The SC noted that 15 of the 32 IOTC CPCs were represented at the meeting. The SC acknowledged that the participation has been higher than the previous Session of the SC but that still more than half of the CPCs were not present.

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.

5. The following rapporteurs were appointed to assist the Secretariat and the Chair in preparing the report, Dr. David Wilson, Dr. Charles Anderson, Mr. Renaud Pianet, Dr. Iago Mosqueira and Dr. Laurent Dagorn.

3. ADMISSION OF OBSERVERS

6. Pursuant to Rule XIII.9 of the Rules of Procedure, the SC acknowledged the presence of observers from the ISSF, Birdlife International, SWIOFC, SWIOFP, the special observer from FAO and invited experts from Taiwan,China.

4. PROGRESS REPORT FROM THE SECRETARIAT

7. The Chairman of the SC presented the outcomes of the 14th Session of the Commission held in Busan, Korea in March 2010. He indicated that a first concrete Conservation and Management Measures was adopted (*i.e.* Resolution 10/01) with a time-area closure for longliners and purse-seiners that will be implemented for the first time in February 2011. The Resolution also paves the way for the development of catch allocation in 2012 for yellowfin and bigeye tuna. In addition, 2010 was also marked by the start of the IOTC Regional Observer Scheme, an initiative that the SC has been requested for several years. However, the success of the project in improving the data collection on target and bycatch species will depend on its implementation by the CPCs. At its last Session, the Commission requested the SC to start the development of a Management Strategy Evaluation (MSE), a tool that would allow the assessment of the efficiency of Conservation and Management Measures. Finally, the Chairman noted that the creation of the Meeting Participation Fund (Resolution 10/05) improved the participation of scientists from the developing CPCs, *i.e.* China, Comoros, Indonesia, Iran, Kenya, Madagascar, Maldives, Mauritius, Pakistan, Sri Lanka and Thailand to IOTC meetings in 2010, and thanked the Commission for this initiative.

8. The Kobe process has seen progress with the organization of four joint workshops - on *i)* provision of scientific advice, *ii)* improvement, harmonization and compatibility of monitoring control and surveillance measures, *iii)* bycatch and *iv)* management of tuna fisheries - that brought together the five tuna RFMOs. The recommendations from these four workshops should be reviewed in the context of IOTC.

9. The Executive Secretary presented a summary of the activities of the Secretariat in 2010 and an outline of the activities anticipated for 2011. The Secretariat continued with its role of facilitator of the IOTC process, providing basic support to scientific and compliance activities. Scientific support includes both acquisition and processing of various types of data submitted by countries fishing for tuna, and, since 2010, direct involvement in support to stock assessment activities.

10. The outline for 2011 includes, in addition to the essential support, plans for a revision of the IOTC databases, capacity building efforts through the IOTC-OFCF programme and through collaboration with other regional

initiatives. The activities planned for the Stock Assessment Section were presented in detail, as well as plans for the renewal of the website and further development of information products.

11. The Secretary noted that the staff of the Secretariat will expand with the arrival of the Deputy Secretary early next year, and that steps have been taken to recruit a fisheries statistician to reinforce the Data Section. He also noted the recommendation of the Kobe II Workshop on Bycatch that a post dedicated to bycatch issues be created in all tuna RFMOs. The Secretary also pointed out the need to expand the Secretariat with two additional professional staff members, an assistant to the Compliance officer and a Communication expert.

12. The Secretary informed the SC on the status of the software FINSS. The Secretariat noted that it had completed development of FINSS, indicating that the software is now used in several countries of the region. It was noted that FINSS is open source and therefore could be further developed by any party interested. The Secretariat further noted that Mozambique and Mauritius had hired expertise to further develop FINSS and some members of the African Union were considering implementation and extension of the software to be used for their fisheries.

13. The SC congratulated the Secretariat on the work conducted during 2010 and continues to strongly support the reinforcement of the Secretariat as indicated in previous years and as recommended by the IOTC Performance Review Panel in 2009.

5. PRESENTATION OF NATIONAL REPORTS

14. National Reports were presented by Australia (IOTC-2010-SC-Inf01), China (IOTC-2010-SC-Int07), Comoros (IOTC-2010-SC-Inf04), European Union (IOTC-2010-SC-Inf05), India (IOTC-2010-SC-Inf12), Iran (IOTC-2010-SC-Inf09), Japan (IOTC-2010-SC-Inf11), Kenya (IOTC-2010-SC-Inf06), Korea (IOTC-2010-SC-Inf14), Madagascar (IOTC-2010-SC-Inf10), Maldives (IOTC-2010-SC-Inf15), Mauritius (IOTC-2010-SC-Inf08), Seychelles (IOTC-2010-SC-Inf19), Thailand (IOTC-2010-SC-Inf13) and United Kingdom (IOTC-2010-SC-Inf03). Abstracts of these reports are given in Appendix V. From these reports the SC noted the following matters in particular:

15. The SC noted that more reports were made available in 2010 (15) in comparison with 2009 (14), but expressed its concerned that this still represents less than half of the 32 CPCS. The SC recalled that it was agreed at the 4th session that all CPCs 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. In 2010, the SC has proposed a Template report that was circulated to all the CPCs and was followed by the large majority of them, *i.e.* 13 CPCs followed the new template.

16. The SC inquired about the operation and effectiveness of the electronic logbook programme as well as the status of the electronic video monitoring system that is being trialled in Australia. Australia reported that the electronic logbooks allow data to be collated in real time, which has positive implications for quota management. The electronic video monitoring system is being trialled across various fleets. The SC noted that the video system was intended to be used as a tool to improve the quality logbooks and is not intended to completely replace the deployment of observers on-board fishing vessels.

17. The SC inquired which seabird bycatch mitigation measures were most successful in the Australian tuna and billfish fisheries. Line weighting was judged to be the most effective measure, in conjunction with the deployment of tori lines and night setting, while offal management was considered to be a useful additional measure. Setting with a bait capsule is currently being considered and results will be reported at the WPEB in 2011. The SC also noted that the vitality status of released sharks is not yet recorded in the electronic logbooks, but since it is currently recorded for seabirds and turtles, there is no reason why it could not be adopted for sharks as well.

18. The SC noted that the Australian data collection system was a model case but involved expensive equipment and technology, and encouraged a cost-benefit analysis so that the applicability for other fleets could be explored in the future.

19. The SC noted that the observers on-board longliners from China reported no seabird or turtle bycatch, and queried what mitigation strategies were employed. The SC was informed that tori lines had been used in the southern regions, and that one turtle had been reported before 2008, but none in 2009. Moreover, the SC noted that the bycatch mentioned in the national report was not reported to the Secretariat, and encouraged that this data is submitted timely.

20. The SC appreciated that the National Report of the EU was more consistent across it members countries, however, it noted that, Portugal in particular, did not document several sections of the template, *i.e.* did not provide any spatial data since 2004 neither bycatch data. The SC raised a number of questions with respect to the Spanish longline fleet regarding the 50% decline in swordfish catch as a possible consequence of pirate activity that could have resulted in a displacement of effort and on the absence of seabird bycatch in the report. The SC encouraged that the EU develop CPUE standardization for its longline fleet targeting swordfish, and that such analysis should be presented at the next meeting of the WPB.

21. Tanzania asked why they could not deploy observers on-board EU purse-seiners fishing for tuna under license in their EEZ. The EU informed the SC that it could not deploy observers on its purse-seine fleet due to the lack of room resulting from the presence of security personnel on-board.

22. The SC noted that India presented catch and bycatch data in their National Report which is not submitted to the Secretariat, and was informed that the problem arises because there are many different institutions involved in the collection of statistics which required better coordination. India expects that the situation improve in the near future.

23. The SC noted that Japan did not report on seabird and turtle bycatch in their National Report. Japan mentioned that a process is in place in which bycatch are photographed and the photos are returned to Japan for expert identification, and that this process generates delays in the data availability. The SC noted that the size frequency sampling from the voluntary reporting in the longline fleet was still very poor, and was informed that this would improve through the implementation of the observer project in the framework of the IOTC Regional Observer Scheme.

24. The SC noted that Kenya had not reported catch information for its longline fishery for the year 2009. Kenya informed that, at present, it has only one longliner under its flag and this boat was hijacked by Somali pirates in 2010 and further released, noting that this has delayed data reporting. This information has just been reported to Kenyan authorities and will be submitted to the IOTC Secretariat after verification.

25. The SC noted that average catches by vessel for longliners of Korea are significantly lower than those for other longline fleets. Korea indicated that vessels under its flag operate both in the Indian and Pacific oceans, moving between oceans on a seasonal basis.

26. The SC noted that the report presented by Madagascar does not cover the activities of vessels flagged in Madagascar, of licensed longliners and of artisanal fisheries. Madagascar informed that the two longliners currently under its flag and recorded in the IOTC Record of Authorized Vessels have not operated since 2008, as they are under repair. In addition, it was noted that some shrimp trawlers flagged in Madagascar had been refitted into longliners, and are carrying out exploratory fishing operation for tuna and tuna-like species in the EEZ of Madagascar until the end of 2010. Madagascar indicated that it had not made provisions for these vessels to collect operational data as per the IOTC requirements, indicating that they will compile the information available at the completion of the exploratory phase and report it to the IOTC in 2011. It was also noted that enumerators from the Tuna Statistical Unit of Antsiranana (USTA) will be conducting port sampling in Antsiranana, Majunga and Tamatave and the data collected will also be reported to the IOTC. With respect to coastal fisheries, Madagascar informed that the African Development Bank is financing an 18 months long Project (PACP) to carry out a frame survey of artisanal fisheries in Madagascar. Madagascar indicated that the results from this project relevant to tuna will be reported to the IOTC.

27. The SC acknowledged the effort of Mauritius in the collection of size frequency data from foreign longliners based in Port Louis, in particular size data for albacore on-board the fresh-tuna longline fleet from Taiwan,China. The SC noted that Mauritius had not reported data for its coastal fisheries in 2009, asking if this information could be sent as soon as possible.

28. Tanzania informed the SC that it had been unable to prepare a National Report due to the dual administration dealing with fisheries from Tanzania mainland and Zanzibar. Tanzania indicated that following recent structural changes in the government, they will be able to present a National Report in 2011, including historical catches from at least 2002.

29. The SC noted that Thailand does not collect data for bycatch species, recommending Thailand to make the necessary arrangements for this information to be collected and reported to the IOTC following the agreed standards. Moreover, the SC was informed that, due to the piracy activity in the Western Indian Ocean, the Thai purse-seine fleet has planned to move to the Atlantic Ocean. If the fleet decides to change flag or fishing ground, the Thai Department of Fisheries will officially inform the IOTC.

30. The UK informed the SC that the Marine Protected Area was declared in April 2010 and that since 1st November 2010 a no take zone for commercial fisheries exists in the whole of the Fisheries Conservation and Management Zone, but excludes the territorial waters of Diego Garcia and associated recreational fisheries. The establishment of a MPA in the Chagos archipelago raised concerns of Mauritius, and both parties made a statement on their respective position (Appendix IX).

31. The SC acknowledged the presentation of National Reports by Comoros, Maldives and Seychelles as well as the submission of a National Report from Iran.

32. The SC noted that the new template format for the submission of National Report by CPCs to the Scientific Committee that has been proposed this year was clear and comprehensive. Some small modifications and improvement were made and the template for National Report was endorsed for future meeting of the SC (Appendix VI). The SC asked the CPCs to prepare their National Report in line with this template for its 2011 Session.

6. REPORTS ON THE 2010 WORKING PARTY MEETINGS

6.1 REPORT OF THE WORKING PARTY ON BILLFISH

33. The Eighth Session of the Working Party on Billfish (WPB) took place in Victoria, Seychelles, from 12-16 July 2010. The Chairman of the WPB (Mr. Jan Robinson) provided a summary of the key findings and recommendations arising from the 2010 WPB report (IOTC-2010-WPB-R).

34. Discussions focused on swordfish given the level of information available for assessment purposes and the stock's importance to a number of CPCs.

35. The Chair indicated that the current level of information available to examine the status of istiophorids (marlins and sailfish) was limited and the SC noted substantial uncertainty in the data available. This remains a substantial issue for these stocks, consequently no assessment could be undertaken. The SC encouraged all CPCs to improve data collection and reporting for marlins, including catch data from artisanal and sport fisheries, as this information is crucial to the stock assessment process.

On CPC attendance at meetings of the Working Party on Billfish

36. The SC reiterated previous concerns regarding the low level of participation of scientists to the WPB, in particular scientists from coastal states in the IOTC region, and urged CPCs, in particular Sri Lanka, Iran, Pakistan, India and Indonesia, to make necessary arrangements to attend the next WPB in 2011, particularly given current concerns over the status of the swordfish stock in the Indian Ocean. The SC noted that both Spain and Portugal have important fisheries for swordfish in the Indian Ocean and reiterated its concern that no scientists from these countries have participated in meetings in recent years.

On the development of stock status advice for swordfish

37. The SC agreed that the apparent fidelity of swordfish to particular areas is a matter for concern as this can lead to localised depletion. The reported CPUE trends exhibit different temporal patterns across all areas and particularly a strong decline in the south-west Indian Ocean. The assessment developed at the whole Indian Ocean level employing 3 models suggest that the current status of the stock relative to MSY reference points (*i.e.* F_{MSY}, B_{MSY}) do not show any major signs of overfishing.

38. A fourth assessment, based on the SCAM model, was conducted for the south-west Indian Ocean only, as the strong CPUE decline in this region is a serious source of concerns . The SC agreed that overfishing is occurring in the south-west Indian Ocean, and that the stock in this area is considered to be in an overfished state ($B_{Current}<B_{MSY}$). However, at present, there is insufficient evidence that swordfish in this area constitute a single stock.

39. The SC recommended that the Commission consider appropriate Conservation and Management Measures to control and/or reduce effort on the swordfish stock in the south-west Indian Ocean.

On research projects on swordfish

40. The SC noted the continued work on swordfish tagging projects, including the tagging activities under SWIOFP that was initiated in 2010 using pop-up tags. The project is aimed at determining the level of migration and site fidelity.

41. The SC noted the work carried out to date using genetic techniques under the IOSSS project. This project aims to explore the stock structure of swordfish in the Indian Ocean, including the possibility of sub-stocks.

42. The SC encouraged CPCs to participate or contribute to both projects, in particular to the collection of samples for analysis by IOSSS. IOSSS and Taiwan,China should collaborate on genetic analyses regarding the large scale biological sampling conducted by the observer programme in tropical areas in 2009. Moreover, as samples from northern areas of the Indian Ocean are considered of particular importance.

General issues related to billfish

43. The SC noted the WPB recommendations relating to data acquisition and availability, and agreed that the following issues have to be addressed as a matter of priority. :

- Acquisition of catch-and-effort and size data from drifting gillnet fisheries in Iran and Pakistan
- Identification of marlins by species and an increase in sampling coverage in the artisanal fisheries of Sri Lanka, especially offshore fisheries
- Acquisition of catch-and-effort and size data from sport fisheries, including the preparation and dissemination of reporting forms to Sport Fishing Centres in the region
- Acquisition of statistics on billfish not reported by longline fleets, by species, in particular from India, Philippines, Malaysia and Oman.
- Fresh-tuna longline fishery of Indonesia for which estimated catches of swordfish and marlins may have been underestimated in recent years. Size frequency data have been collected, however the samples cannot be fully broken by month and fishing area (5°x5° grid) and refer mostly to the component of the catch that is unloaded fresh.
- Artisanal fisheries of Indonesia where the catch levels reported in recent years are considerably higher than those reported in the past and for which the quality of the dataset is very poor:
- Implementation of sampling for the collection of biological data for billfish, in particular sex-ratio by length, length-weight and non-standard size – standard length conversion relationships and resulting keys.
- Japan and Taiwan,China: provide the entire size frequency data series for their longline fisheries as per the IOTC standards.

44. The SC endorsed the following research recommendations from the WPB and commended it for its work in 2010.

- Based on recommendations last year and the assessments conducted in 2010, the WPB still considered determination of stock structure as a research priority as the information available tends to indicate localized depletion in certain areas, notably the south-west Indian Ocean. On-going initiatives, such as IOSSS and SWIOFP, should provide better information on the stock structure in 2011/2012.
- The WPB welcomed the introduction of standardised CPUE series in 2010 from La Reunion and Seychelles but identified Spain and Portugal as potentially having useful series for inclusion in assessments in 2011, particularly to further explore the south-west area. The WPB recommended the on-going development of the spatially disaggregated approach.
- The WPB recommended investigation the historical coverage of logbooks for Taiwan,China.

45. The SC agreed that the WPB should examine inter-annual environmental anomalies to describe the inter-annual variability in CPUE and that this work should be pursued in the inter-sessional period. In addition, the effect of shifting effort distribution (*e.g.* caused by piracy) should be investigated.

6.2 REPORT OF THE WORKING PARTY ON ECOSYSTEMS AND BYCATCH

46. The Sixth Session of the Working Party on Ecosystems and Bycatch (WPEB) took place in Victoria, Seychelles from 27-30 October 2010. The Chairperson, Mr Charles Anderson provided a summary of the key findings and recommendation from the 2010 WPEB report (IOTC-2010-WPEB-R).

6.2.1. ON ECOSYSTEMS AND BYCATCH DATA ISSUES

47. The SC noted that the continued lack of data collection and reporting on ecosystem and bycatch matters, despite the requirements as detailed in the IOTC Resolutions on sharks, seabirds and marine turtles, is preventing the WPEB from progressing on the estimation of bycatch and ecosystem effects.

48. The SC urged all CPCs to comply with data collection and reporting requirements as outlined in the relevant Resolutions relating to ecosystems and bycatch. The SC stressed that this recommendation is made by the WPEB and endorsed the SC every year since 2006 and, therefore, asked the Commission to consider appropriate mechanisms to encourage members to comply with reporting requirements, and to provide historical data..

49. The SC recommended that the actions described in Table 1, Table 2, Table 3 and Table 4 on sharks, seabirds, marine turtles and marine mammals respectively, be taken by CPCs to improve the standing of the data on non-tuna species held by the Secretariat.

Table 1. 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, Oman, Philippines, South Korea and India.
	Longliners targeting swordfish	EU-Spain, Seychelles
	Artisanal fisheries with large catches of pelagic sharks	Sri Lanka, Pakistan, Iran, Indonesia, Yemen
Historical catch level estimates by species and year	Fresh-tuna and/or deep-freezing longliners	Taiwan,China, Indonesia, Japan, South Korea
	Purse seine	EC and the Seychelles (before 2003)
Logbook coverage set to produce acceptable levels of precision (CV to be initially set at less than 20%) in the catch-and-effort statistics for the main species of sharks.	All industrial fleets	
Research on identification of shark species from fins and processed body parts.	All fleets	
Discard levels:		
Implementing levels of observer coverage as requested by the Commission (*i.e.* 5% of the fishing events on Industrial fisheries and 5% of the fishing trips on artisanal fisheries).	All fleets	
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	
Observers collecting size frequency data for main shark species, including discards	All industrial fleets	
Biological data:		
Collecting data that can be used to derive length-weight keys (where appropriate by season and sex), ratios of fin-to-body weight, non-standard measurements-fork length keys and processed weight-live weight keys.	All fleets	
Research required while fins are unloaded detached from carcasses:		
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	

Table 2. 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 All fisheries using gillnets on the high seas	Longline: Taiwan,China, Japan, Indonesia, Malaysia, Philippines, Spain, Portugal, Seychelles and South Korea Iran, Pakistan, Sri Lanka
Provision of data collected through observer programmes, as specified by the Commission.		
Detailed estimation of seabird bycatch, by species and year, including the precision of such estimates.		
Research on the effect of seabird bycatch mitigation measures.		

Table 3. Steps to improve the certainty of statistics on incidental catches of MARINE TURTLES

Data / information / work required	Fishery	Major fleets involved
Provision of data collected through observer programmes and estimates of total levels of bycatch of marine turtles, as specified by the Commission.	Countries having industrial longline fisheries	China, Taiwan,China, Indonesia and Japan
	Gillnet / gillnet-longline	Gillnet fisheries operating on the high seas (Pakistan and Iran) Gillnet fisheries operating in coastal waters (India, Indonesia, Oman and Yemen) Gillnet/longline fishery of Sri Lanka

	Industrial purse seine fleets	EU (before 2003), Seychelles, Iran, Japan and Thailand
Further research on interactions between Fish Aggregating Devices (FADs) and marine turtles, including mortality rates by species, area and type of FAD used	Industrial purse seine fleets	EU, Seychelles, Iran, Japan, Thailand
Further research on marine turtle bycatch mitigation measures for longline fisheries, *e.g.* examination of setting techniques and hook types.	Countries having industrial longline fisheries	Taiwan,China, Indonesia and Japan
Initiate research on marine turtle bycatch monitoring and mitigation measures for gillnet fisheries	Gillnet fisheries on the high seas Coastal gillnet fisheries	Iran, Pakistan and Sri Lanka India, Indonesia, Oman and Yemen

Table 4. Steps to improve the certainty of statistics on incidental catches of MARINE MAMMALS

Data / information / work required	**Fishery**	**Major fleets involved**
Provision of historical data on incidental catches of marine mammals, by species and fishing area.	Industrial longline fisheries	Longline: Taiwan,China, Japan, Indonesia, Malaysia, Philippines, Spain, Portugal, Seychelles and South Korea
Provision of data collected through observer programmes, as specified by the Commission.	Gillnet fisheries on the high seas	Iran, Pakistan, Sri Lanka

50. The SC recommended that, in addition to the implementation of the Regional Observer Scheme, the collection of scientific data by all other means available including auto-sampling (collection of data by trained crew) and electronic monitoring (sensors and video cameras) be encouraged and developed as a mechanism to improve data collection on bycatch.

6.2.2. On Sharks:

51. The SC noted that the majority of the WPEB participants made two major recommendations among others (Appendix IV) that are: *i)* the current 5% fin to body ratio rule should be replace by the landing of sharks with fins naturally attached in order to improve data collection at species level while contributing to deter finning practices, and *ii)* the list of sharks to be recorded on longline logbooks (Resolution 08/06) should be expanded from the current three up to eleven species and species groups.

On the shark fin to body weight ratio

52. The SC noted Japan's operational concerns whereby storage of sharks with fins attached was considered a safety risk to working crews (knife-like frozen fins), would waste storage space and would cause damage to other species in the wells. Some other CPCs expressed difficulty in marketing if shark were frozen with fins attached. Japan indicated that the 5% fin to body ratio rule was already well established amongst tuna RFMOs and that 5% is in the lower limit of the scientifically evaluated range (4-21%).

53. Some CPCs recalled that the operational difficulties expressed by Japan could be remedied by partially cutting the fins and then folding and strapping them to the trunk, and that this method is already being used by a number of CPCs. At the point of landing, the species can be identified with great accuracy and if need be the fins separated for sale separately. But some CPCs suggested that this method still has the same problem as mentioned earlier regarding safety and marketing.

54. The SC, with the exception of Japan, China and Korea, agreed that while operational/practical constraints of various scientific recommendations can be included in advice, it should not inhibit the SC from making recommendations to the Commission.

55. The SC recalled its previous advice that the fins to body 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 finning.

56. However, the SC acknowledged that operational factors (*e.g.* storage methods and product processing) were considered by some CPCs to make the natural attachment of fins to the shark carcass difficult for some longline operators to apply. Some CPCs indicated that this would be a particular issue for the following fleets, Asian fleets targeting tuna and the Portuguese and Spanish fleets targeting swordfish.

57. Consensus was not reached as to replace the current 5% fin to body ratio rule by the landing of sharks with fins naturally attached. The majority of the SC members agreed that the best way to reduce or avoid the practice of shark finning, ensure accurate catch statistics, and facilitate the collection of biological information is to ensure that all sharks are landed with fins naturally attached to the trunk.

58. CPCs expressed their disappointment with the position taken by Japan on bycatch matters relevant to sharks that was not backed by any scientific evidence. Australia noted that the position taken by Japan in the SC, of not supporting scientifically based recommendations, is in direct contrast to the position taken by the Japanese Commissioner to CITES earlier in 2010.

59. The SC recalled that the WPEB has the mandate to assist the SC on developing recommendations on Ecosystem and Bycatch Issues, while the bycatch joint technical working group[5], if formed, would only have an advisory role towards the 5 tuna RFMOs. The SC encouraged IOTC to take the lead in introducing innovative measures for discussion at this joint TRFMO technical working group..

[5] Proposed by the Joint Tuna RFMOs international workshop on Bycatch held in Brisbane, June 23-25, 2010.

On the addition of shark species and species groups to Resolution 08/04 concerning the recording of the catch by longline fishing vessels in the IOTC area

60. The SC noted the advice from the majority of the WPEB participants to amend Resolution 08/04 in order to improve collection of data on shark bycatch in the Indian Ocean. Such amendment would extend the minimum requirement list of shark species of ecological concern to be recorded in the longline logbooks in order to ensure appropriate reporting of those species.

61. Reservations were expressed by several CPCs because of the potential difficulties of accurate identification and reporting by fishers. The SC recalled that the majority of the WPEB participants mentioned that the new list is composed of easily identifiable species by most fishermen (in some cases are of conservation concern, being listed by IUCN as vulnerable or endangered).

62. Japan highlighted the potential risks that if crew were required to record additional shark species in logbooks, it may be detrimental to the data collection on tuna and tuna-like species under extremely busy operation environment. This point of view was not shared by some CPCs because the conservation status for some sharks stocks requires urgent action for data collection and assessment.

63. Japan expressed some concerns on the difficulty they have to amend the logbook too frequently, *i.e.* if the number of shark species was to be increased, because logbooks are legal documents and have to go through a long process to be revised.

64. The SC acknowledged that the newly launched IOTC Regional Observer Scheme should provide some improvement on data collection on shark catches in the tuna fisheries.

65. Although the SC could not reach consensus on a single approach, the SC proposed three options for the consideration of the Commission to progress on this issue:

- **Option 1**: The list of shark species contained in Resolution 08/04, requiring mandatory reporting in longline logbooks, be revised to include eight additional species and species groups as follows:

Under Resolution 08/04	**Under new proposal**	
	Common name	Scientific name
Blue shark	Blue shark	*Prionace glauca*
Mako shark	Mako sharks	*Isurus* spp.
Porbeagle	Porbeagle	*Lamna nasus*
	Great white shark	*Carcharodon carcharias*
	Crocodile shark	*Pseudocarcharias kamoharai*
	Thresher sharks[6]	*Alopias* spp.
	Tiger shark	*Galeocerdo cuvier*
	Oceanic whitetip shark	*Carcharhinus longimanus*
	Other Requiem sharks	*Carcharhinus* spp.
	Hammerhead Sharks	*Sphyrna* spp.
Other sharks	Other sharks	
	Pelagic stingray	*Pteroplatytrygon violacea*

- **Option 2**: A second list of shark species to be included in Resolution 08/04 as a separate section requesting CPCs to report on these additional species/groups on a voluntary basis until CPCs have the capacity to better train crew to identify these shark species/groups. This option would not require changing the current logbook:

Under Resolution 08/04	**Under new proposal**	
No list to be recorded on a voluntary basis in the current Resolution	Common name	Scientific name
	Great white shark	*Carcharodon carcharias*
	Crocodile shark	*Pseudocarcharias kamoharai*
	Thresher sharks[6]	*Alopias* spp.
	Tiger shark	*Galeocerdo cuvier*
	Oceanic whitetip shark	*Carcharhinus longimanus*
	Other Requiem sharks	*Carcharhinus* spp.
	Hammerhead Sharks	*Sphyrna* spp.
	Pelagic stingray	*Pteroplatytrygon violacea*

[6] As per IOTC Resolution 2010/12, catch of Thresher sharks have to be reported but not kept (*i.e.* released if alive of discarded if dead)

- **Option 3**: The list of shark species contained in Resolution 08/04, requiring mandatory reporting in longline logbooks, to be revised to include eight additional species and species groups, as in option 1, EXCEPT for CPCs having a sufficient observer coverage that would be absolve of reporting on this new extended list.

66. The SC added that a sufficient coverage would not be less that 20% of the fishing operations, based on a simulation study presented to the WPEB in 2010.

On the development of shark identification cards

67. The SC noted requests made by several coastal states for technical support in obtaining training materials to improve shark identification, and recommended that the identification cards under current development by the Secretariat are finalized and circulated in 2011.

68. The SC noted that the identification cards are initially intended to be used by observer under the Regional Observer Scheme and elsewhere as funds allow.

On shark stock assessments

69. The SC noted the need for additional expertise in the assessment of shark populations to be brought at the next meeting of the WPEB, so that current data and future assessment needs can be addressed. The SC recommended that shark assessment experts be identified by the Secretariat for participation at the next WPEB and for consideration to be given to funding their attendance.

70. The SC encouraged CPC's to continue research on major pelagic species (*e.g.* blue sharks, silky sharks and oceanic whitetip sharks) and that the possibilities of using a wide range of research techniques (including tags of all types, genetics, stable isotopes), be explored to provide information required for shark assessments.

On NPOA sharks:

71. The SC noted that 7 CPCs have developed and implemented NPOA-sharks and that 8 others are in the process of finalizing their NPOA-sharks (Appendix VIII).

72. The SC recommended that the remaining CPCs provide updates on the progress of developing or implementing NPOA-sharks at the WPEB in 2011.

Other matters on sharks:

73. The SC agreed that peer-reviewed articles relating to pelagic sharks and their fisheries be undertaken to make such information more readily and widely accessible.

74. The SC supported research on mitigation techniques, including the initiatives of the European Union and the International Seafood Sustainability Foundation (ISSF).

75. The SC recommended that the IOTC should continue to collaborate with the CMS MoU on sharks.

76. The SC noted that whale sharks act as natural FADs to tuna, and are particularly vulnerable to being encircled by purse-seine nets. The SC recommended that work be carried out by the WPEB to collect and analyse data, and to conduct research, which could contribute towards an assessment of whale sharks, and in particular to determine if purse-seine setting on whale sharks is still not a problem in the Indian Ocean. The SC also recommended that the WPEB explore the potential for further work on manta rays.

77. The SC recommended that further work to identify catch and catch rate trends and any other indicators of stock status of sharks be carried out and reviewed by the WPEB and that the Ecological Risk Assessment (ERA) undertaken last year on bycatch of sharks in the purse-seine and longline fisheries should be updated for next years' SC meeting, and as resources permit, expand the ERA to other gears.

6.2.3. SEABIRDS

78. The SC noted the proposal from the WPEB to revise Resolution 10/06 to take into account the new scientific information presented to the WPEB in 2010, on *i)* the ineffectiveness of line shooters and offal management as measures to mitigate incidental catches of seabirds, and *ii)* the effectiveness of line weighting regimes in reducing incidental mortality of seabirds.

79. The SC noted the following text from the WPEB report (IOTC-2010-WPEB-R):

"*The meeting agreed that IOTC Resolution 10/06 should be revised to reflect the advice that the use of line shooters and offal management be removed from the list of accepted seabird bycatch mitigation measures in table 1 of the Resolution, noting the advice in paragraphe 101 that new information on the efficacy of these measures may be tabled at the Scientific Committee meeting in 2010.*" (paragraph 89).

"*5.5. Review of Resolution 10/06:*

(…) this advice was met with general agreement, but a small minority of scientists expressed reservation about the proposed removal of line shooters and offal management from the list of mitigation measures available. The scientists who expressed those reservations were encouraged to produce research results at the December 2010 Scientific Committee meeting in support of their positions. It was agreed that unless this was done, the advice to the Scientific Committee, to revise the resolution, would stand."

80. The SC noted the presentation given by Japan in response of the above WPEB request for which an abstract was provided:

"*Japan presented effectiveness of the line shooter and the offal control by providing scientific information and also practical efficient methods used by longliners during the operation. Japan considered the new information presented in the last WPEB regarding line shooter and offal management as insufficiently scientifically backed, and, with other oriental longline CPCs, did not support the recommendation of the WPEB.*"

81. The majority of the SC members considered that the presentation by Japan did not meet the request of the WPEB, as it did not contain scientific evidence for the consideration of the SC, but rather provide a few anecdotal lines of evidence. This presentation was not made available in advance of being presented and made reference to journal articles used as lines of evidence. This made critical review, scientific analysis and debate impossible.

On the use of a line shooting device:

82. The SC noted the conclusions of the WPEB that the initial sink rate of branch lines on mainline 'set deep' (a consequence of the use of line shooting device) was slower than when mainline was 'set tight', contrary to what is generally thought to occur by most fishers.

83. Consequently, the SC, with the exception of Japan, agreed with the recommendation of the majority of the WPEB participants that line shooters should not be considered as a mitigation measure because they do not improve initial sink rates.

84. The SC, with the exception of Japan, China and Korea, agreed that in the absence of any scientific information on the effectiveness of line shooters in reducing incidental mortality of seabirds, line shooters should be removed from the list of accepted seabird bycatch mitigation measures in Table 1 of Resolution 10/06 *on reducing the incidental bycatch of seabirds in longline fisheries*.

85. The SC noted that line shooters are a useful line deployment tool and as such they will continue to be used on many vessels because they are considered to improve fishing efficiency.

On the use of weighted branch lines

86. Birdlife International presented successful results in reducing seabird bycatch in the pelagic fishery operating off South Africa by foreign-flagged vessels, following the imposition of a cap on bycatch by individual vessel, a measure started in 2008. All vessels carried fishing observers. Placing a seabird bycatch cap for individual vessels to avoid catching birds improved compliance with mitigation measures and reduced the seabird bycatch rate more than fivefold. The very high compliance with night setting and use of two well-designed tori lines was largely responsible for this success. Experimental mitigation measures using a new branch-line weighting regime, developed with the local South-African longline fleet as well with Japanese scientists and voluntary Japanese longline vessels also proved to be efficient in reducing seabird bycatch.

87. The SC agreed that line weighting of pelagic longlines is likely to be one of the most effective mitigation measures in reducing or eliminating seabird interactions with baited hooks as they are likely to ensure sink rates for dead baits to reach depths of 10 m within 100 m of their deployment (and therefore under protection of the bird scaring lines).

88. The SC noted concerns by some members that weighted branch lines may have negative impacts on catch rates of tuna and tuna-like species and also had safety concerns regarding lead weights. The SC recommended that additional research be carried out in this regard.

89. The SC agreed that a revisited line weighting regime should be pushed forward as an efficient mitigation measure but recommended that more experiments are conducted in order to assess the impact on target species.

On offal management

90. The SC noted that a majority of WPEB participants considered that offal management is generally of little importance to minimising seabird interactions in pelagic fisheries. However, the SC agreed that offal management should be encouraged in IOTC fisheries as good practice, possibly as a subsidiary recommendation not to allow offal discharge during setting or hauling of longline gear.

91. The SC, with the exception of Japan, Korea and China, recommended that in the absence of any scientific observation on the effectiveness of offal discharge management in reducing the incidental mortality of seabirds, that it could be removed from the list of mitigation measures in Table 1 of the Resolution 10/06

92. From the above (paragr.84, 87 and 91), the SC will recommend a major revision of the current Resolution 10/06 *on reducing the incidental bycatch of seabirds in longline fisheries* once line weighting options are assessed.

93. A number of CPCs suggested that meetings could be conveyed bringing scientists, managers and representative from the Industry, in order to study and propose efficient and practical scientifically based mitigation measures for seabirds and other bycatch species.

On Ecological Risk Assessment

94. The SC recommended that work on a Level 2 or possibly a Level 3 Risk Assessment be carried out to highlight areas of elevated risk to at risk seabird species, acknowledging that a Level 3 assessment would require the provision of additional funding to develop a quantitative model-based approach.

On the improvement of seabird identification:

95. The SC urged the Secretariat to complete the seabird identification card project for the consideration of the WPEB in 2011.

96. The SC noted that the identification cards are initially intended to be used by observer under the Regional Observer Scheme and elsewhere as funds allow.

97. The SC encouraged the CPCs to develop systems, such as retention of carcasses for later identification, or establish photo identification processes, to improve identification of seabirds to species level, and recommended for this to be reflected in paragraph 7 of Resolution 10/06.

On gillnet and driftnet interactions with seabirds

98. The SC recommended that CPCs conducting gillnet and driftnet fishing should collect information on seabird interactions and report to the WPEB in 2011. In addition the WPEB should review the study of bycatch in global gillnet and driftnet fisheries, which is currently being undertaken by the Convention on Migratory Species (CMS), and consider recommendations and findings relevant to IOTC fisheries.

On the development of NPOA-seabirds

99. The SC noted that 4 CPCs have developed and implemented NPOA-seabirds and that 1 is in the process of finalizing its NPOA-seabird (Appendix VIII).

100. The SC recommended that concerned CPCs provide updates on the progress of developing or implementing NPOA-seabirds at the WPEB in 2011.

6.2.4. Marine turtles

101. The SC agreed with the recommendation by the WPEB to carry forward all recommendations from the 2009 WPEB report, that have yet to be completed (*i.e.* purse-seine fisheries to use ecological[7] FADs, longline vessel are equipped with the necessary tools to remove hooks from turtles to ensure safe release and minimize post-release mortality).

[7] This terms means improved FAD designs to reduce the incidence of entanglement of bycatch species, using biodegradable material as much as possible.

102.The SC recommended that more research is conducted on longline mitigation measures, and a review of information on interactions and mitigation measures is conducted.

103.The SC recommended that the IOTC Secretariat, its CPCs and IOSEA, increase cooperation, in particular with regard to reviewing and exchanging available information on tuna fisheries-marine turtle interactions and mitigation, and that the Secretariat should attend the International Symposium on 'Circle Hooks in Research, Management and Conservation' to be held in Miami, USA from 4-6 May 2011, and to report the WPEB in 2011.

104.The SC recommended that distant water fishing nations should join the IOSEA MoU, which had initially been directed toward Indian Ocean coastal countries.

105.The SC recommended that the marine turtle identification sheets be finalized by the Secretariat before the next Session of the WPEB, in cooperation with other relevant organizations.

106.The SC recommended that more marine turtle experts should participate at the next Session of the WPEB.

6.2.5. MARINE MAMMALS

107.The SC noted that whales and tunas sometimes associate. The SC recommended that the WPEB carry out an analysis of existing whale sightings data available from the purse-seine fishery, to better understand aspects of this relationship .

108.The SC recommended that countries with tuna driftnet fisheries to study and report on cetacean bycatch.

109.The SC recommended that marine mammal experts, for example from NGOs and IGOs with an interest in the Indian Ocean such as International Whaling Commission, to be encouraged to participate in future meetings of the WPEB.

6.2.6. OTHER ISSUES ON ECOSYSTEMS AND BYCATCH:

110.The SC recommended that more research and monitoring is conducted on the subject of depredation in the Indian Ocean

111.The SC encouraged further work on other fish species commonly caught as bycatch in the purse-seine fisheries, *i.e.* oceanic triggerfish, rainbow runners, dolphin fish to be carried out and reported to the WPEB.

6.3 REPORT OF THE WORKING PARTY ON TROPICAL TUNAS

112.The Twelfth Session of the Working Party on Tropical Tunas (WPTT) took place in Victoria, Seychelles from 18-25 October 2010. The Chairperson, Dr Iago Mosqueira, introduced the report (IOTC-2010-WPTT-R). The key objectives of this meeting were to undertake an assessment of the stock status of yellowfin, an analysis of data and indicators related to skipjack, and then to address several other issues (*e.g.* effects of piracy on fleets activities, time-are closures, introduction to management strategy evaluation, fishing capacity, *etc.*).

113.The SC noted the following

- An exceptional participation to this meeting (42 scientists) that was made possible notably with the help of the Meeting Participation Fund,
- Several issues related to data availability remain unresolved despite substantial progress, mainly because of the increase of artisanal and semi-industrial fisheries,
- A large number and the wide scope of documents presented (55) with new information on some domains (fisheries, biology, environmental effects) , part of them based on analyses of tagging data

114.The CS acknowledged that considerable work had been carried out by the Secretariat for the excellent preparation of necessary datasets that allowed essential analyses to be conducted prior to the meeting, and thanked the Secretariat and all the scientists involved.

6.3.1. BIGEYE TUNA

115.As in previous occasions, the assessment was based on the integrated model SS3. Novel aspects of the 2010 assessment were the integration of tagging data from the RTTP-IO, following the recommendation of the SC in 2009, and the systematic exploration of interaction among several key model assumptions.

116.Overall, 288 model runs were conducted suing a combination of several sets of parameters. A synthetic representation of the status of the stock has been produced using a weighting scheme of the results that correspond to the belief associated to different parameters/assumptions tested.

117.The SC recognised that the results indicate a broad range of uncertainty, with the most pessimistic (optimistic) scenarios being related to low (high) values of steepness and a low (high) natural mortality. The fits to the CPUE and recovery data were similar across the various models, and qualitatively, illustrated that data seem to be almost equally consistent with very different stock status interpretations.

118.The SC understood that the summary of this assessment, however, reflected similar conclusions to those made during previous assessments, *i.e.* a situation close to full exploitation with a fishing mortality that was probably slightly below F_{MSY}.

119.The SC endorsed those conclusions, noting that in an application of the precautionary approach, consideration of the current uncertainty would lead to more conservative decisions, in particular, given pending uncertainties on life cycle parameters, series of abundance indices and the existence of poor quality statistics from some of the fisheries.

120.The SC highlighted that the presented Kobe II strategy matrix - a decision table to assist in the evaluation of management options - is a preliminary approach, still exploratory, and must be interpreted with caution because of the uncertainties above mentioned. The SC noted that the matrix presented represents the proportion of cases produced by the 288 models where diagnostics fall below B_{MSY} and above F_{MSY} (*i.e.* non desirable situations). Improvements in the accuracy of those calculations are expected when the potential biases of a larger number of inputs are incorporated in the model

121.As a conclusion, the SC recommended not to exceed the catch level estimated at the time of the assessment for 2009, *i.e.* 102 000 t.

122.The SC recommended that the efforts put in the development of this assessment using SS3 and including the tag data are continued and refined at the next session of the WPTT.

6.3.2. YELLOWFIN TUNA

123.The SC acknowledged that the WPTT followed its 2009 recommendation that several models be used for the assessment of this stock. One production model and two integrated models were implemented.

124.The SC noted the remarks made by the WPTT on the risk that changed in fishery dynamics that are particularly acute for this species might not be properly accommodated by a production model. The SC also noted the conclusions of the WPTT that results from SS3 are still too preliminary to be directly used for management advice. Subsequently, reference is made to precise results from Multifan-CL (MFCL) when providing stock status and management related figures.

125.The SC noted the uncertainties related to *i)* the basic statistics (importance of artisanal and semi-industrial fisheries representing more than 50% of the catch, and insufficient size sampling of longline fleets), *ii)* the CPUE series showing conflicting trends among fleets of Japan and Taiwan,China and across areas; *iii)* possible changes of fleet efficiency and targeting; *iv)* key inputs which are poorly known (*i.e.* steepness, movements across areas, natural mortality, *etc.*). Such uncertainties cause substantial fluctuation of reference values across the various assumptions tested from the input parameters. MSY values are in the range 250,000 – 350 000 t across the various gear selectivities tested, steepness and whether or not a spatial structure is accounted for in the model. Average catches in the 2003-2009 period (310,000 t) were within this range, while the average annual catch for 2003-2006 (464,000 t) is well above the plausible values of MSY. Catches in 2009 (288,000 t) are close to the mid- range of MSY values, but due to the depleted situation of the stock, the corresponding fishing mortality is above the F_{MSY} value.

126.The SC recognized that the probability that the stock has recently become overexploited, or is very close to be so, is very high. It also recalled that this situation might not improve even with catches lower than MSY if recruitment levels continue to be lower than average. Therefore, the SC recommended that the catch of yellowfin does not exceed 300,000 t, while fishing mortality levels from those catches are monitored to ensure they go below the reference value.

127.The SC regretted that no Kobe II strategy matrix was provided for this stock. The reasons for this were both technical, due to some current limitations in the projection capabilities of the assessment software, and statistical, as the necessary exploration and quantification of uncertainties in the assessment could not be carried out in the necessary time frame.

128.The SC also discussed on the choice of steepness values to be used in order to represent the stock trajectory in the Kobe plot. This parameter is known to have a strong impact on the estimated trajectory of the stock. Noting that an analysis conducted in 2008 by the WPTT had estimated that values of steepness in the 0.7-0.8 range were equally likely, the SC decided to represent two trajectories of F and B ratios, for steepness values of 0.7 and 0.8 respectively to illustrate this effect. However, for consistency with last year's approach in the management advice, the value of steepness of 0.8 was considered to represent the status of the stock.

6.3.3. SKIPJACK TUNA

129.The SC noted that, although initially planned, the WPTT was not able to conduct any formal stock assessment for skipjack, due to incomplete CPUE data available, as it was not possible to produce a satisfactory standardized CPUE series for Maldivian pole and line fleet due to of a lack of essential technical and operational information related to fleets and fishing strategy. The SC noted that it was also not possible to estimate standardized CPUE series for the purse-seine fleet.

130.The SC also recognised the strong declining trend of skipjack catches in the Maldives, a reduction of more than 50% between 2006 and 2009, and the lower proportion of large sizes of fish in the recent years. The reduced catches may also be due to reduction in fishing effort due to high fuel prices in 2007 and 2008 and problems in obtaining large quantities of live bait for current fishing fleets. But no complete explanation is currently available on those changes that may appear worrying.

131.The SC highlighted that, despite its status of resilient species to exploitation because of its life history traits, *i.e.* rapid growth, early maturity and high reproductive potential), the eventuality that skipjack stock may become overexploited can no longer be discarded. The recent trends of some fisheries suggest that a close monitoring is required.

132.Being heavily dependent on this resource, economically and for food security, Maldives proposed, as a precautionary approach, that a cap is recommended on total Indian Ocean skipjack catch in the management advice. Such a cap would deliver a message to countries intending to increase their catches that such an expansion is unlikely to be successful. The recommended value of the catch not to be exceeded could be, for example, set at the peak catch of 2006 (622,600 t), or more conservatively at the average catch of the last 5 years (502,200 t). In any case it could be revised at any time, and certainly following the outcome of the proposed stock assessment of skipjack which should be undertaken in 2011.

133.The SC took under consideration the concerns expressed by Maldives. However, it considers premature to propose a recommendation of a catch limit that would not be backed by an assessment or any other quantitative analysis.

134.The SC strongly recommended that a formal assessment of the skipjack stock be a priority task at the next session of the WPTT. The SC recalled that the success of this assessment will depend on the preparation of realistic series of standardized CPUE for Maldivian pole and line fleet and for the European purse seine fleet.

6.3.4. OTHER MATTERS

135.The SC pointed out that tagging data are now routinely used in the assessment of yellowfin stock and for the first time, for bigeye stock, thanks to the use of integrated assessment models. However the SC recalled that external analyses on tag-recovery data are essential to estimate the key input parameters for assessment (*e.g.* natural mortality, growth, exploitation rate, *etc.*) and recommended more analysis before the tagging Symposium planned in 2012.

136.The SC endorsed the data and research recommendations on WPTT (Appendix IV) and commended it for the work achieved in 2010.

6.4 REPORT OF THE WORKING PARTY ON DATA COLLECTION AND STATISTICS

137.The SC endorsed the recommendations from the WPDCS, as presented in Appendix IV of the WPDCS Report. In particular, the SC expressed some concerns about the timeliness of reporting of statistics from some CPCs and the quality of datasets for some fisheries. The SC reiterated its concerns that late reporting compromises the use of catches from recent years for stock assessment and provision of advice to the Commission based on the most recent information. The SC expressed further concern that some parties have failed to address recommendations for a number of years, recommending that these issues are brought to the attention of the Compliance Committee.

138.The SC thanked the OFCF for its continuous support to improving the quality of statistics at the IOTC and activities to enhance capacity in coastal countries of the region, and recommended the IOTC-OFCF Project to continue this work.

139.The SC agreed on the usefulness of implementing a scoring system to assess the quality of the statistics available at the IOTC, as proposed by the WPDCS, encouraging the IOTC Secretariat to continue with this work. The SC noted that quality indicators for catch data can be used as a proxy to uncertainty in order to derive alternative catch series for main IOTC species. The SC agreed that this proposal shall be further explored. The SC noted that full implementation of both systems is likely to be an onerous task, and set priority for initial work to be conducted on yellowfin, bigeye and swordfish. The SC requested the Secretariat to present a first attempt to the next meeting of the WPDCS or, if time allows, to the next meeting of the WPTT.

140.The SC noted the changes in the estimates of catches of albacore, following new information available at the Secretariat, the new estimates of catch since 2003-09 being dramatically higher than those used in the latest assessments of this stock. In light of these changes the SC agreed on the need for a new stock assessment of this species in 2011.

141.The SC endorsed the minimum data requirements for gillnet and pole-and-line fisheries. In order to complete this work, the SC recommended that this minimum requirement are translated into proposal of Resolutions for the recording of catch by gillnet and pole-and line fisheries in the IOTC area for presentation at the next meeting of the Commission.

142.The SC recalled provisions of Resolution 10/01 *for the conservation and management of tropical tunas in the IOTC area of competence* calling the Secretariat to initiate a study on catch reporting systems in countries fishing for IOTC species, in particular yellowfin tuna and bigeye tuna, in order to assess the likelihood of reporting near real-time catches of these species, by month. The SC noted the information provided by the WPDCS and acknowledged that, under the current arrangements, reporting of this information will be difficult, especially for the coastal fisheries.

6.5. GENERAL COMMENT ON STOCK ASSESSMENTS ANALYSIS CONDUCTED BY THE WORKING PARTIES:

143.The SC noted that the complete and detailed stock assessment documents are not always made available at the WPs and requested that for all future WPs, complete stock assessment documents, describing the analysis, its assumption and its results, as well as associated model diagnostics and input/ouput files are provided and archived so as to facilitate transparency in the process of stock assessment for IOTC stocks.

144.The SC also requested that choice of particular assumption, *e.g.* steepness of the stock recruitment relationship, are fully justified and described in the report of the relevant WP.

145.The SC revised the stock assessment guidelines previously agreed to at his 10th Session in 2007, which are applicable to all IOTC WP (Appendix X). The SC reminded scientists conducting stock assessment that these guidelines provide a minimum set of outputs required for WP participants to be able to properly analyse the results presented. As such, scientists and WP participants should ensure that these guidelines are followed to the extent possible, and WP chairs should make every possible effort to make sure this is done so.

7 PROGRESS IN ADDRESSING RECOMMENDATIONS OF THE KOBE II WORKSHOPS AND OF THE PERFORMANCE REVIEW PANEL

146.The SC was presented with a table that summarized all the recommendations (Appendix IX) made by the joint tuna RFMO workshops on the provision of Scientific Advice, held in Barcelona and on Bycatch, held in Brisbane in June 2010 and the progress achieved in the context of IOTC.

147.The SC noted that most of these recommendations are addressed by the IOTC, however, it recommended that some improvements are made for some of them

148.In particular, regarding the data (*i.e.* fisheries statistics, biological data, *etc.*) collected for the provision of the scientific advice, the SC noted that under the current rule of confidentiality of the IOTC (Resolution 98/02 *on data confidentiality policy and procedures*), fine scale operational data could not be made available for all fisheries. It also noted that the size-frequency sampling effort remains inadequate for some distant water longline fleets, and recommended this to be addressed as a matter of priority. The SC recognized that ecosystem modelling has yet to be fully implemented in IOTC area, largely because of it requirements for data and expertise, and encouraged such development in the near future as well as collaboration with programs integrating ecosystem and socio-economic approaches (such as CLIOTOP) to support the conservation of multi-species resources.

149.Regarding bycatch, the SC strongly endorsed the proposed concept of a Bycatch Joint Working Group, and recommended the Secretariat and WPEB make all efforts to expedite its formation. The SC fully supported participation that would facilitate better coordination and avoidance of duplication between t-RFMOs. However, the SC reminded that such a Bycatch Joint Working Group will not replace or undermine the work of the WPEB of the IOTC. The SC strongly endorsed the proposal made that a Bycatch officer should be hired as a permanent staff member of the Secretariat of each of the 5 tuna RFMOs, and developed ToR for such an officer to be recruited at the IOTC Secretariat (Appendix IX). This specialist should attend, with the Chairman of the WPEB, future Kobe Bycatch meetings, and meetings of the Bycatch Joint Working Group.

150.In addition, the SC reviewed the recommendation of the IOTC performance review panel conducted in 2008.

151.The SC strongly supported the recommendation to increase the IOTC staff resource and the proposal of the Secretariat for a budget for the 2011-2012 biennium that would include additional professional staff.

152.The SC was informed the recommendation of producing an online IOTC Data summary should be completed in 2011.

8 EXAMINATION OF THE EFFECTS OF PIRACY ACTS ON TUNA FISHERIES IN THE WESTERN INDIAN OCEAN

153.A study on the effect of piracy on the European and Seychelles purse-seine fleet operating in the western Indian Ocean was presented to the SC (IOTC-2010-SC-09) as this fishery has been particularly affected by Somali piracy in the recent years. Several vessels left the Indian Ocean and the overall carrying capacity of the fleet decreased by 25% between 2005-2008 and 2009. To address security issues, fishing companies defined in 2008 a large exclusion zone, extending some 500nm off the Somali coast. This area supplied more than 25% of the total catch of the fishery during 2001-2007. The exclusion zone resulted in some reallocation of the European fleet toward the eastern part of the North Equatorial Area (NEqA) during the typical season of FAD-fishing (June-November) in the Somali basin. The European purse seine fleet catches in the exclusion zone decreased from an average of 90,000 t during 2001-2007 to less than 50,000 t in 2008. This was mainly due to the decrease in fishing effort, as measured by space occupancy, set number, and searching time for the French component of the fishery. The effort and catch concomitantly increased in the eastern part of the NEqA. Overall, the catch of the French fleet in the whole NEqA decreased by 5.4% in 2008 relative to 2001-2007 but increased by more than 25% relative to 2007. Consideration of a subset of French vessels that operated in the WIO during 2001-2010 confirmed that these vessels were able to recoup most losses in adjacent areas. In 2009, military and private security intervention reduced the risk from piracy and enabled European purse seiners to move back to the Somali basin. The fishing effort of the fleet subsequently increased in the exclusion zone and led to catch levels similar to 2002-2007 for the French fleet. At the same time effort and catches strongly decreased in the eastern part of the NEqA. Some changes in species composition (*i.e.* an increasing proportion of skipjack and bigeye) and size structure of the catch (*i.e.* more smaller fishes) were observed in 2008-2009 due to the changes in spatial distribution of the French fleet as well as the increased tendency to fish on log-associated schools. The current logistical constraints imposed on the French purse seiners (*i.e.* operating in pairs and fishing alternately, and reduced cruise length) combined with the decreased number of vessels in the WIO seems to have modified their fishing strategy by reducing their ability to explore large areas and track free swimming schools. The increase in fishing on log-associated schools might have strong effects on the yield-per-recruit expected from the fishery, as well as levels of bycatch that have not been monitored by EU observers since summer 2009.

154.There were 20 attacks against European purse seiners between May 2007 and May 2010. Two Spanish purse seiners were hijacked, in April 2008 and October 2009. As a direct result of the threat of piracy, five French, seven Spanish and four Thai purse seiners have left the WIO, mostly for the Atlantic. Due to a cap on fishing capacity in the ICCAT area, no more European purse seiners can move to the Atlantic.

155.The SC also noted that most Japanese, Korean and Taiwan,China longliners have left the Somali area and that some have moved to other oceans. As a consequence, the Japanese longline effort decreased dramatically in the western Indian Ocean, while it increased slightly in the eastern Indian Ocean. It was also noted that; while longline activity was conducted traditionally in July and December-January around the Chagos archipelago, in 2009 vessels were present in the area all year round. This change could be due to the eastward displacement of vessels avoiding the risk of pirate attack. It is also noted that some vessels may have moved southward, increasing the fishing effort on albacore.

156.The SC noted that piracy activity has also impacted the local fleets of Kenya and Seychelles, and has also a significant impact on the countries' economies.

157.The SC noted that the increased FAD fishing by purse seiners has resulted in increased catches of small bigeye and skipjack, and probably also of bycatch species. The SC recommended keeping careful track of bigeye catches, and to integrate the changes in fishing pattern and catch into future stock assessments

158.Finally, the SC noted that the piracy in the western Indian Ocean is also impacting research programmes in the Indian Ocean, and in particular the interruption of the EU observer programme.

9 STATUS OF TUNA AND TUNA-LIKE RESOURCES IN THE INDIAN OCEAN

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

9.1 MANAGEMENT ADVICE FOR TUNAS

160.The Executive Summaries for bigeye and yellowfin were adopted by the SC (Appendix VII), noting they have been modified to include the results of stock assessments undertaken in 2010 and the advice and recommendations have changed.

161.The Executive Summary for skipjack was adopted by the SC (Appendix VII), noting they have been amended slightly to reflect the latest available catch data, and the advice and recommendations have changed to express the concerns of the SC and the need to conduct a first assessment of the stock in 2011.

162.The Executive Summary for albacore was adopted by the SC (Appendix VII), noting that new information for the estimation of catches has been provided, and change drastically the catches of albacore since 2003. The advice and recommendations were amended to reflect concerns of the SC and the need for a new assessment to be conducted in 2011.

163.The SC noted that most tuna fleets operating in the Indian Ocean do not target or catch a single stock or species. The multi-species nature of the fishery, both industrial and artisanal, implies that management measures directed towards a single stock are very likely to have effect on other stocks as well. The direction and magnitude of these secondary effects cannot always be directly inferred given the adaptability of the various fleets.

9.1.1 ALBACORE TUNA (*Thunnus alalunga*)

Current status

164.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.

165.The estimates of catches of albacore in recent years have changed substantially, especially since 2003. This is due to a review of the catches of Indonesian longliners Albacore catches have been around 39,100 t annually over the past five years (2005-2009) and this level is only much higher than the historical average annual catch taken for the past 50 years (24,300 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.

166.Because of the low value 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. However, displacement of effort that might have resulted from the increasing piracy in the western Indian Ocean could have some impact on the fishery and the revised catches of Indonesian longliners have drastically increased the total catch since 2003.

Recommendation

167.The SC acknowledged the preliminary nature of the albacore tuna assessment in 2008, but noting the available stock status information 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. However, new information and estimation for the Indonesian longline fishery has increase the total catch at levels above the estimated MSY.

168.The SC recommended that a new albacore tuna assessment be presented to the Scientific Committee at the latest in 2011.

9.1.2 BIGEYE TUNA (*Thunnus obesus*)

Current status

169.The central tendencies of the stock status results from the WPTT 2010 were similar to those presented in 2009, while the uncertainty was recognized to be greater. The weighted results suggest that the stock is probably not overfished, and overfishing is probably not occurring (relative to MSY reference points). However, the stock is probably near full exploitation, and the possibility of overfishing cannot be ruled out on the basis of the estimated uncertainty, and the continuing observed decline in CPUE.

Outlook

170.The recent declines in longline effort, particularly from the Taiwanese longline fleet, are thought to be causing the recent declines in catches, and this is relieving some of the pressure on this stock. Changes in purse seine effort in the west Somali basin are expected to be less important than those of the longline fleet for this stock.

171.The changes imposed on the operation of the purse seine fleets by the security situation in their fishing grounds has increased the effort directing to fishing around FADs. This has led to an increase in the catches of juvenile bigeye which could have a negative effect on the outlook for the stock. These changes in the pattern of exploitation should be carefully monitored, and if they persist they should be incorporated in future analyses.

Recommendation

172.Given the uncertainty on estimated MSY values and the levels of error in the nominal catch data for bigeye, the SC recommended than catches are kept at a level not above the catch estimated at the moment of the assessment for 2009, *i.e.* 102,000 t. This value should give low probability of catches exceeding MSY.

9.1.3 SKIPJACK TUNA (*Katsuwonus pelamis*)

Current status

173.Skipjack tuna are widely regarded to be resilient to over-exploitation due to their life-history characteristics (*i.e.* rapid growth, early maturation and high reproductive potential). However, this does not exclude completely the possibility for skipjack to become overfished. Recent trends in certain fisheries suggest that the situation of the stock should be closely monitored and, thus, WPTT recommends that new attempts are made to assess the status of the stock during the next Session of the WPTT in 2011.

Outlook

174. Although there is no scientific basis for urgent concern about the status of the population of skipjack and the recent catches are considered to be sustainable, taking into account *i)* the Precautionary Approach for fishery management, *ii)* the rapid development of some artisanal and semi-industrial fleets and *iii)* that the catches could not be increased continuously; the SC highlights that some management options should be considered. It is also noted that increasing catches of skipjack could lead to corresponding increase in fishing mortality for other species that are harvested in combination with skipjack in certain fisheries.

Recommendation

175. Given the limited nature of the work carried out on the skipjack in 2010, no management advice is provided for the stock.

9.1.4 YELLOWFIN TUNA (*Thunnus albacares*)

Current status

176. Estimates of total and spawning stock biomass show a marked decrease over the last decade, accelerated in recent years by the high catches of 2003-2006. It appears that the stock is currently overfished or approaching an overfished state, and overfishing has probably been occurring over recent years. The effect on the standing stock of the high catches of the 2003-2006 period is still noticeable as biomass appears to be decreasing despite catches returning to pre-2003 levels.

177. The estimates of MSY are between 250,000 t and 350,000 t in different stock assessment models and for different stock-recruitment relationships and spatial model structures. The mean catch over the 2007-2009 period of 310,000 t is in the middle of that range while annual catches over the period 2003-2006 (averaging 464,000 t) were substantially higher than any of the MSY estimates.

178. The main mechanism that appears to be behind the very high catches in the 2003-2006 period is an increase in catchability by surface and longline fleets due to a high level of concentration across a reduced area and depth range. This was likely linked to the oceanographic conditions at the time generating high concentrations of suitable prey items that yellowfin exploited. A possible increase in recruitment in previous years, and thus in abundance, cannot be completely ruled out, but the signal estimated by the assessment models implies that the contribution of recruitment to the increase in catches is likely to be minor.. This means that those catches probably resulted in substantial stock depletion.

179. Various indicators of catch rates for different fleets and areas appear to confirm this downward trend in abundance. Recruitment is estimated by the model to have been low over the course of the last five years.

Outlook

180. Catches in 2009 (288,000 t) were on the mid-range of MSY values. Improvements in the status of the stock, even with those lower catches, are dependent of future recruitments returning to the higher levels observed in the past.

181. The reduction in catches observed has been influenced by the reduction in effort and the decline of efficiency for most industrial fleets, consequence of the security situation in the Somali area. An improvement in this situation could rapidly reverse these changes in fleet activity and lead to an increase in effort that the stock might not be able to sustain in its current state, as catches would then be likely to exceed MSY levels.

182. Fishing mortality is likely to have exceeded the MSY-related levels in recent years, therefore some reduction in catch or fishing effort could be required to return to exploitation rates comparable to those related to MSY levels.

Recommendation

183. The SC considers that the stock of yellowfin has recently become overexploited or is very close to be so. Management measures should be continued that allow an appropriate control of fishing pressure to be implemented.

184. At this moment, the effect of time-area closures cannot be directly translated into management quantities of direct effect on the status of the stock, such as catches or fishing mortality, so their possible effect on the future evolution of the stock cannot be evaluated.

185. The SC recommends that catches of yellowfin tuna in the Indian Ocean should not increase beyond 300,000 t in order to bring the stock to biomass levels that could sustain catches at the MSY level in the long term. If recruitment continues to be lower than average, catches below 300,000 t would be needed to maintain stock levels.

186. The SC recommends that the situation of this stock is closely monitored.

9.1.5 SOUTHERN BLUEFIN TUNA (*Thunnus maccoyii*)

187. The SC noted the contents of a report on the biology, stock status and management of southern bluefin tuna (IOTC-2010-SC-Inf02) and thanked CCSBT for providing it.

9.2 MANAGEMENT ADVICE FOR BILLFISH

188. The Executive Summary for swordfish was adopted by the SC (Appendix VII), noting that it has been modified to include the results of stock assessments undertaken in 2010. Therefore, the advice and recommendations have changed.

189. Executive Summaries for black marlin, blue marlin, striped marlin and Indo-Pacific sailfish were adopted by the SC (Appendix VII), noting that it has been slightly modified to reflect the latest available catch data, while the advice and recommendation remained unchanged.

9.2.1 SWORDFISH (*Xiphias gladius*)

Current status

190. The WPB considers that MSY-related reference points are probably not being exceeded for the Indian Ocean population as a whole, and the overall level of depletion probably does not represent a conservation risk.

191. The potentially high levels of depletion in the SW remain a special concern. The preliminary assessment for this sub-region confirms that the pessimistic indicators are consistent with a sub-population that has experienced overfishing for several recent years ($F>F_{MSY}$) and remains currently overfished ($B<B_{MSY}$). Recent declines in catch and effort have probably brought the fishing mortality level down to sustainable levels (point estimates suggest that $F_{2008}<F_{MSY}$). However, there are a number of unresolved problems with the model and data, including inconsistencies among different CPUE series and the size composition data.

192. Further development is encouraged to improve the assessments, in particular the abundance indices in the south-west region.

Outlook

193. The continued decrease in longline catch and effort in recent years has substantially lowered the pressure on the Indian Ocean stock as a whole, and fishing probably does not represent a high conservation risk at present. However, catches still exceed some of the more pessimistic MSY estimates.

194. If the pessimistic stock assessments for the south-west are accurate (and if this region does represent a distinct sub-population), then the decreased catch and effort have greatly reduced the pressure on this sub-population. However, further reductions would be required to be certain that rebuilding was initiated.

Recommendation

195. If the recent declines in effort continue, and catch remains substantially below the estimated MSY of 29,000 t, then there is probably no urgent need to introduce restrictive management actions to the Indian Ocean as a whole. However, continued monitoring is required to manage the uncertainty.

196. It is recommended that catches in the south west should be maintained at levels at or below those observed in 2008 (6,426 t), until either *i)* there is clear evidence that substantial rebuilding is occurring (through recruitment or immigration) or *ii)* further analyses indicate that the current assessment is inappropriate.

9.2.2 BLACK MARLIN (*Makaira indica*)

Current status

197.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. 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.

198.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.

Recommendation

199.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. However, aspects of the biology, productivity and fisheries for this species combined with the lack of data on which to base a more formal assessment is a cause for considerable concern. Research emphasis on improving indicators and exploration of stock assessment approaches for data poor fisheries are warranted.

9.2.3 BLUE MARLIN (*Makaira nigricans*)

Current status

200.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 3, 4 and 5). 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.

201.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.

Recommendation

202.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. However, aspects of the biology, productivity and fisheries for this species combined with the lack of data on which to base a more formal assessment is a cause for considerable concern. Research emphasis on improving indicators and exploration of stock assessment approaches for data poor fisheries are warranted.

9.2.4 STRIPED MARLIN (*Tetrapturus audax*)

Current status

203.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 3, 4 and 5). 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.

204.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.

Recommendation

205.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. However, aspects of the biology, productivity and fisheries for this species combined with the lack of data on which to base a more formal assessment is a cause for considerable concern. Research emphasis on improving indicators and exploration of stock assessment approaches for data poor fisheries are warranted.

9.2.4 INDO-PACIFIC SAILFISH (*Istiophorus platypterus*)

Current status

206.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.

Recommendation

207.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. However, aspects of the biology, productivity and fisheries for this species combined with the lack of data on which to base a more formal assessment is a cause for considerable concern. Research emphasis on improving indicators and exploration of stock assessment approaches for data poor fisheries are warranted.

9.3 MANAGEMENT ADVICE ON THE STATUS OF NERITIC TUNAS

208.The Executive Summaries for narrow-barred Spanish mackerel, kawakawa, bullet tuna, longtail tuna, frigate tuna and Indo-Pacific king mackerel were adopted (Appendix VII), noting that they have been amended slightly to reflect the latest available catch data as well as more information on the availability of statistics, but the advice and remains unchanged.

9.3.1 BULLET TUNA (*Auxis rochei*)

Current status and recommendation

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

210.The SC recommended that bullet tuna be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

9.3.2 FRIGATE TUNA (*Auxis thazard*)

Current status and recommendation

211.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.

212.The SC recommended that frigate tuna be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

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

Current status and recommendation

213.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.

214.The SC recommended that indo-pacific king mackerel be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

9.3.4 KAWAKAWA (*Euthynnis affinis*)

Current status and recommendation

215.No quantitative stock assessment is currently available for kawakawa in the Indian Ocean, therefore the stock status is uncertain. The SC notes that catches have been relatively stable for the past 10 years.

216.The SC recommended that kawakawa be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

9.3.5 LONGTAIL TUNA (*Thunnus tonggol*)

Current status and recommendation

217.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.

218.The SC recommended that longtail tuna be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

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

Current status and recommendation

219.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.

220.The SC recommended that narrow-barred Spanish mackerel be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

9.4 MANAGEMENT ADVICE ON SHARKS

221.Executive Summaries for blue, silky, oceanic whitetip, shortfin mako, and scalloped hammerhead sharks were adopted, noting that they have been amended to increase their clarity and reflect the latest available biological information. In addition, catch figures based on available data for each species in the IOTC database was included, noting that this does not reflect the total catch for those species (Appendix VII).

222.As a Conservation and Management Measure was adopted by the Commission in 2010, *i.e.* Resolution 10/12 *on the conservation of thresher sharks (family Alopiidae) caught in association with fisheries in the IOTC area of competence*, the SC recommended that an executive summary is developed by the WPEB for this group of species for consideration at its 14th Session in 2011.

223.Following a proposal of amendment to Resolution 08/04 *concerning the recording of the catch by longline fishing vessels in the IOTC area*, on the modification of the list of shark species to be recorded in the logbooks, the SC noted that, if the Resolution was amended in that respect, the respective executive summaries for those added species should be developed by the WPEB for consideration at its 14th Session in 2011.

Current status

224.The SC noted the paucity of information available on sharks and that the situation is not expected to improve in the short to medium term. There is no quantitative stock assessment and few basic fishery indicators currently available for any shark species in the Indian Ocean. While stocks status are highly uncertain, they are likely to be poor.

Recommendation

225.The SC recommended that mechanisms are developed by the Commission to encourage CPCs to comply with their reporting requirement on sharks.

226.The SC agreed that three options should be considered for amendment of Resolution 08/04 *concerning the recording of the catch by longline fishing vessels in the IOTC area* in order to improve data collection and statistics on sharks that would allow the development of stock status indicators.

9.5 MANAGEMENT ADVICE ON MARINE TURTLES

227.An Executive Summary for marine turtles (green, hawksbill, leatherback, loggerhead, olive ridley and flatback turtles) was adopted, noting that they have been amended slightly to reflect the latest available biological and general historical information on exploitation patterns, as well as the addition of the key elements of Resolution 09/06 relating to data collection and reporting, handling and mitigation measures, however, the stock status and management advice remains unchanged. Executive Summaries for sea turtles have been slightly modified to include new information (Appendix VII).

Current status

228.The SC noted that the International Union for Conservation of Nature (IUCN) has classified the olive ridley turtle as vulnerable, the green and loggerhead turtles as endangered and the hawksbill and leatherback turtles as critically endangered. It is important to point out that a number of international global environmental accords (*e.g.* CMS, CBD), as well as numerous fisheries agreements obligate States to provide protection for these species.

229.While the status of marine 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 marine turtles due to capture by gillnets and to a lesser extent purse seine fishing (*i.e.* entanglement on FADs) and longline is not known. Notwithstanding this, the SC acknowledged that the impact on marine turtle populations from fishing for tuna and tuna-like species may increase if fishing pressure increases, or if the status of the marine turtle populations worsens due to other factors such as an increase in fishing pressure from other fisheries or anthropological or climatic impacts.

230.No assessment has been undertaken for marine turtles due to the lack of data from CPCs. However, a number of comprehensive assessments of the status of Indian Ocean marine turtles are available from other sources.

Outlook

231.Resolution 09/06 *on marine turtles includes* an evaluation requirement by the SC in time for the 2011 meeting of the Commission. However, given the lack of reporting of marine turtle interactions by CPCs to date, such an evaluation cannot be undertaken at this stage.

Recommendation

232.The SC recommended that mechanisms are developed by the Commission to encourage CPCs to comply with their reporting requirement on marine turtles. The SC also recalled its recommendation from 2009 that Resolution 09/06 does apply to leatherback turtles in its entirety, and that the term ‘hard-shelled’ should be removed from Resolution 09/06 when the resolution is revised.

9.6 MANAGEMENT SEABIRDS

233.An Executive Summary for seabirds was adopted by the SC(Appendix VII), outlining the current state of knowledge for seabird distributions, the current understanding of interactions between IOTC fisheries and seabirds, current management concerns, management measures currently in place by the IOTC to enhance the conservation of seabirds, and gaps in knowledge of fishery impacts with seabirds and noting that they have been amended to reflect new information available.

Current status

234.No assessment has been undertaken by the IOTC WPEB for seabirds due to the lack of data from CPCs. The SC noted the current IUCN threat status for each of the seabird species reported as caught in IOTC longline fisheries to date.

Outlook

235.Resolution 10/06 *on reducing the incidental bycatch of seabirds in longline fisheries* includes an evaluation requirement by the Scientific Committee in time for the 2011 meeting of the Commission. However, given the lack of reporting of seabird interactions by CPCs to date, such an evaluation cannot be undertaken at this stage.

Recommendation

236.The SC recommended that mechanisms are developed by the Commission to encourage CPCs to comply with their reporting requirement on seabirds.

237.The SC recommended that a major revision of the Resolution 10/06 *on reducing the incidental bycatch of seabirds in longline fisheries* should be considered, in the near future, once its impact is examined. Such revision may include the removal of the use of line shooters and offal management from the list of seabird mitigation measures.

10. OUTLOOK ON TIME-AREA CLOSURES ISSUES

238.The Secretariat presented a simple analysis which assessed the effect of the time-area closure adopted in Resolution 10/01 *for the conservation and management of tropical tunas stocks in the IOTC area of competence,* which defined a time-area closure off the Somali coast, between 0°-10° North and 40°-60° East, for the month of November for purse-seine and February for longline fisheries. Assuming that all effort in the closure area had disappeared from the fishery, the mean annual catch reduction estimated to have occurred, relative to the catch from the whole Indian Ocean fishery, in the period 1990-2009 was estimated to have been less than 2% for each of yellowfin, skipjack and bigeye, with the maximum annual reduction across all years and species less than 4%. If the effort from the closure was assumed to redistribute outside of the region, and achieve catch rates equivalent to the outside fleet during the closure, then mean annual catch reductions less than 0.5% were estimated for each species, the maximum catch reduction was estimated at less than 2%, and in some cases annual catches were estimated to increase by up to 1.4%. Additional scenarios were presented in which the closure was extended to one quarter, and was permanent. However, it was recognized that proper evaluation and comparison of alternative time/area closures should account for fleet behaviour and fish movement dynamics, and could be very difficult.

239.The SC noted that various factors would make the analysis of the effect of this closure on the stock after its implementation even more difficult. One is the effect of piracy activities in the closure area on the spatial distribution and patterns of activity of the purse-seine and longline fleets. Another is the permanent closure of the area around of the Chagos archipelago to all fishing. Historical levels of catch for some stocks, for example yellowfin, in this area have been significantly higher for a number of years that those obtained in the area affected by Resolution 10/01.

240.The SC highlighted the fact that the management objectives of this closure were not clear enough. If the current Resolution intends, as it can be inferred from its text, to reduce the overall pressure on the yellowfin and bigeye stocks, then the results presented in this study indicate that alternative spatial and/or temporal strata would need to be added for the reduction of catches to be of a significant level.

241.The link between time-area closures and their expected effects on overall catch was also considered by the SC as a key element for the success of such a management measure. The SC pointed out that such a link is generally weak and always difficult to quantify, given the ability of the fleets to adapt to this kind of changes in their operational situation. Finally, the fact that this management measure applies only to two of the fleets catching tropical tuna was also noted.

242.The SC recognized concerns by Seychelles that displacement of the purse-seine fleets resulting from the time-area closure may lead in changes of the behaviour off pirates and possible added risk to the local fleet of Seychelles.

11. UPDATE ON THE IMPLEMENTATION OF THE IOTC REGIONAL OBSERVER SCHEME

243.As recommended last year by the SC, a technical workshop was organized in May regarding the IOTC Regional Observer Scheme. The meeting was conveyed *i)* to define a minimum dataset to be collected by observer, *ii)* to develop an IOTC observer manual and *iii)* to produce an Observer Trip Report template for the submission of the observer data to the Secretariat as per requested in Resolution 10/04.

244.The SC noted the progress made with the different documents and forms being produced and made available prior to the official launch of the scheme on the 1st July 2010. The SC endorsed the recommendation of the technical workshop that a list of accredited scientific observers should be submitted to the Secretariat and recommended that CPCs do so within the best delays.

245.The SC examined the Observer Trip Report Template produced by the technical workshop, however, recognizing the difficulties for some CPCs to fill all the data fields as required, the SC recommended that this template report should be used until it is revised at the next Session of the WPDCS in 2011.

246.The SC recalled that the Resolution 98/02 *on data confidentiality policy and procedures for fine-scale data* apply to the observer data generated by the scheme and endorsed the recommendation of the technical workshop that authorization to use observer data is sought from the CPC that owes the data.

247.China, Japan, Korea and Thailand recalled that the length of industrial longlines used on their fleet exceeds 100 nautical miles and expressed their difficulties to report observer data by 1° squares. Moreover, taking into account the duration of the observer trip onboard deep-freezing longliners, *i.e.* over three months, they informed that the 90days period for the submission of observer report is too short. These issues should be revisited in the next technical session to be held in the WPDCS in 2011.

248.All the CPCs represented at the meeting, informed the SC on the status of their national implementation of the IOTC Regional Observer Scheme (Table 5).

Table 5. Progress on the implementation of observer programme in IOTC CPCs

CPCs	Progress	List of accredited observers submitted?	Observer Trip Report submitted?
Australia	Australia has an observer programme that complies with the IOTC Regional Observer Scheme.	No	No
China	China has an observer programme and	No	No
Comoros	Comoros does not have vessel more than 24m on which observer should be placed, and is currently developing a data collection system with the IOTC-OFCF project to monitor its artisanal fishery. 3 observers are currently being trained under the IOC Regional Monitoring Project.	NA	-
European Union	EU has an observer programme on-board its purse-seine fleets, however the programme is now stopped due to the piracy activity in the western Indian Ocean. New arrangements are sought out with the operators and the programme could resume in 2011. EU has or is developing observer programmes on-board its longline fleets, *i.e.* La Réunion, Spanish and Portuguese fleets.	No	No
India	India has not developed any observer programme so far.	No	No
Japan	Japan has started an observer programme on the 1st of July 2010, and 18 observers are currently being deployed in the Indian Ocean.	No	No
Kenya	Kenya is developing an observer programme and 5 observers have been trained under the SWIOFP training.	No	No
Korea	Korea has an observer programme since 2002 with 3 observers being deployed in the Indian Ocean giving a 14.5% coverage of the fishing	No	No

	operation in 2009.		
Madagascar	Madagascar is developing an observer programme. 5 and 3 observers have been trained respectively under the SWIOFP and the IOC projects	No	No
Maldives	Maldives only has an artisanal fishery which is monitored by field samplers at landing sites.	NA	-
Mauritius	Mauritius has not developed an observer programme, however, 5 and 3 observers have been trained respectively under the SWIOFP and the IOC projects.	No	No
Seychelles	Seychelles is developing an observer programme. 4 and 3 observers have been trained respectively under the SWIOFP and the IOC projects	No	No
Tanzania	-	No	No
Thailand	Thailand has not developed an observer programme so far.	No	No
United Kingdom	UK does not have a fleet active in the Indian Ocean.	NA	-

12. IMPLEMENTATION OF A MANAGEMENT STRATEGY EVALUATION (MSE)

249.The Secretariat presented a review of MSE in the IOTC, in relation to how the commitment to pursue this approach might be progressed further and could improve the management advice provided to the Commission. It was noted that, in addition to some preliminary work directly focussed on developing MSE for bigeye and yellowfin in the WPTT, a range of activities were being pursued that are aimed at improving management advice, and are complementary to the objectives of MSE in the longer term. These activities include advances in stock assessment uncertainty quantification, recognition of the need for defining appropriate reference points and management objectives (in addition to MSY defaults), introduction of management advice to the Commission in the form of Kobe II Strategy Matrices decision tables, and increased communication among scientists, managers and scientists in some CPCs. It was suggested that the Working Party on Methods might be reactivated as an appropriate forum for guiding these processes further, including MSE development.

250.The SC noted that MSE has proven very useful in other domestic and international fisheries. The tripartite meetings (managers, industries and scientists) were recognized as a particularly valuable part of the process. The Second Seychelles Tuna Conference was suggested as a possible opportunity to coordinate an initial tripartite meeting.

251.It was recognized that the Methods Working Group should be used to coordinate IOTC MSE activities, including mapping out the future steps required. Invited experts with relevant experience in other fisheries would be sought out to broaden the perspective on the process, providing stakeholder education and technical guidance.

252.The SC supported the development of a MSE under the IOTC framework, and recommended that a meeting is organized in 2011 that will gather the scientist, managers and representative of the industry.

13. SCHEDULE OF MEETINGS IN 2011

253.The SC agreed to the following schedule of working party meetings for 2011 and recommended that is be put before the Commission for endorsement at its 15th Session.

Working Party	Date, venue	Priority tasks
Billfish (WPB)	4-8 July (5 days), Seychelles	• Stock assessment for swordfish • Review stock indicators for istiophorids
Temperate Tuna (WPTe)	11-12 July (2 days), Seychelles	• Stock assessment for albacore
Tropical Tuna (WPTT)	16-23 October (8 days), Maldives	• Stock assessment for skipjack (priority 1) • Stock assessment for yellowfin (priority 2) • Stock assessment for bigeye (priority 3) • External analyses on tagging data • Discussion on fishing capacity
Ecosystems and Bycatch (WPEB)	24-27 October (4 days), Maldives	• Review data available • Review observer data • Analysis of new information on sharks, seabirds, marine turtles and marine mammals • Consideration of multispecific ecosystem approaches
Data Collection and Statistics (WPDCS)	8-10 December (3 days), Seychelles	• Review statistics held at the Secretariat • Review and revision on Regional Observer Scheme reporting forms
Neritic Tuna (WPNT)	April – May, To be advised	-
Methods (WPM)	February, To be advised	• Development of a road map for the MSE process

254.The SC acknowledged that if the three species of tropical tuna were to be assessed by the WPTT, additional resources, *e.g.* consultant(s) would be needed.

255.The SC recommended that, together with the Working Party on methods, the tripartite meeting on the MSE process with scientists, managers and representatives from the industry is organized.

256.For 2012, the SC recommended that the WPB, WPEB, WPTT, WPDCS and WPTe meet.

257.The SC recommended that its Fourteenth Session be held from 12th to 17th December 2011 (6 days) 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.

14. OTHER MATTERS

14.1. *RULES FOR THE APPOINTMENT OF EXTERNAL EXPERTS AND CONSULTANTS*

258.Taking into account the need for additional resources to be dedicated to stock assessment and other analyses, and the benefit of external expertise during WP meetings, the SC noted that roles and simple procedures should be defined for the selection and nomination of consultants and external experts.

259.The need for consultant(s) that would be hired by the Secretariat to conduct some specific tasks, should be assessed by the relevant WP. Terms of reference prepared by the Chair of the said WP, and a brief résumé of the potential consultant(s) should be circulated among a group made of recurrent participants for endorsement, noting that the final decision remains with the Chair of the SC and the Executive Secretary of IOTC.

260.External experts should bring additional expertise to the WP and could assist, for example, with stock assessment work. Potential external expert should be proposed by WP participants with a brief résumé, and selected by the Chairs of the SC and of the relevant WP with the Executive Secretary of IOTC.

261.Japan expressed concerns on the above procedures which should be re-discussed at the next Session of the SC in 2011.

14.2. *EU PROJECT TXOTX (TECHNICAL EXPERTS OVERSEEING THIRD COUNTRY EXPERTISE) - UPDATE*

262.The SC was presented with an update on the three year TXOTX project that started in 2008. The project is supporting the development of a network of fisheries research initiatives with the aim to improve coordination of research programmes in different areas. The network is expected to review methodologies applied in assessment and management procedures regionally, in order to identify data and research gaps and opportunities for greater research coordination that could promote future. One of the case studies is focused on tuna RFMOs, including IOTC, which will help to map the research and funding scheme that is being carried out by different bodies in the region. The first phase of the project, data gathering and preliminary synthesis of the data compilation was presented for discussion during the 1st expert workshop of the project held in January 2010 in London. This workshop brought together international experts with experience of different RFMOs, international agencies and other stakeholders, who shared with the project partners their knowledge on research activities in support of fisheries management. After the feedback received from the experts during the workshop, the project partners are reviewing and performing a global synthesis of the information to recommend specific research topics and areas for future research to fill identified gaps and to improve co-ordination of a regional research programmes. Final results and recommendations would be presented and discussed. The final expert workshop will be organized at the beginning of 2011 to review all the evaluation and recommendations arisen during the project with various stakeholders.

14.3. EU PROJECT MADE (MITIGATING ADVERSE ECOLOGICAL IMPACTS OF OPEN OCEAN FISHERIES) - UPDATE

263.The SC was updated on the activities of the European MADE project after its second year of implementation in the Indian Ocean. Some field activities were delayed due to the piracy issue (an 8-month extension of the project was consequently requested to the EC). Collaborative work has started with related projects: the French CAT project on FADs (ORTHONGEL), the Spanish project on FADs (ANABAC), the ISSF project on bycatch, and SWIOFP. A summary of progress on activities done in the Indian Ocean was presented for each of the three objectives of the project: (1) to reduce by-catch of sharks and juvenile swordfish by pelagic longliners, (2) to reduce by-catch of sharks, turtles and small tuna by tuna purse seiners, (3) to assess the effects of FADs on fish ecology. In 2010, the project has contributed to the IOTC WP with 3 papers in the WPTT (mainly dealing with the effects of FADs on the behavioural ecology of tunas) and 8 in the WPEB (majority on sharks). The project will be involved in the scientific organization of the FAD Symposium that will be held in Tahiti (November 2011).

14.4. THE RESEARCH PROJECT OF THE INTERNATIONAL SUSTAINABILITY SEAFOOD FOUNDATION (ISSF)

264.The SC was informed of a research project that has been launched by ISSF to find bycatch mitigation techniques in tropical purse seine fisheries. The project is based on two platforms that feed into each other: (1) Workshops with skippers and scientists are held to review techniques known to work in other regions and to identify techniques that could potentially work; and, (2) at-sea research using dedicated chartered vessels to tests experimentally various techniques. Using a dedicated vessel provides unique opportunities because the scientists direct the fishing operations experimentally, as opposed to observing regular fishing operations opportunistically. The project is global in nature and will focus principally (although not exclusively) on FAD fishing, with emphasis on reducing the catch of tunas of undesirable size, sharks and sea turtles. The project has a Steering Committee made up of scientists from around the world who have multi-disciplinary areas of expertise. The first research cruise is expected to begin at the end of January 2011 in the Eastern Pacific and will focus on the behavior of tunas around FADs and on using techniques to maximize the catch of skipjack while minimizing the catch of small bigeye and yellowfin. A second cruise is being planned for the Indian Ocean later in the year, focusing on mitigating shark bycatches.

265.Noting that finding more selective fishing methods and reducing waste is an important objective for all fisheries; the SC welcomed the project and endorsed it. It also noted that the project would be complementary to the European MADE project, which is already making good progress on similar areas.

14.5. SOUTH WEST INDIAN OCEAN FISHERIES PROGRAMME (SWIOFP) - UPDATE

266.The SC was updated on the progress of the South West Indian Ocean Fisheries Project. The project carried out a three-week observer training course covering pelagics, demersal and crustacean fisheries in August 2010. Five fisheries observers from each of the SWIOFP countries were trained. For the tuna fisheries, the observers were trained on the IOTC recommended protocols. The SWIOFP observer programme will be implemented through the competent authorities in each of the countries, with a strong focus on by-catch. A total of 800 days have been earmarked for the pelagic fisheries (450 days for purses seine and 300 days for longliners). The project however, recognizes the constraints of deploying observers in respect to piracy activities in the Western Indian Ocean. With the assistance of FAO-EAF Nansen Project, the IOTC and SWIOFC, the project conducted two weeks stock assessment training in Mombasa in September, with plans to conduct a follow up stock assessment training in 2011. The project has started research on FADs (Mauritius) and a number of research activities on large pelagics are planned in 2011, including the deployment of a series of anchored FADs in SWIO member countries with corresponding research for the development of sustainable local FAD fisheries, as well as work on the distribution, migration, stock discrimination, biological reference points on a variety of large pelagic fishes (some activities are carried in collaboration with the MADE project).

267.The SC recognized the value-added of the SWIOFP, in particular regarding the training of observers that will help the countries of the region to increase their capacity to deploy observers onboard their fleet and comply with Resolution 10/04 *on a regional observer scheme*.

14.6. COOPERATION WITH SOUTHWEST INDIAN OCEAN FISHERY COMMISSION (SWIOFC)

268.The Secretary of the South West Indian Ocean Fisheries Commission (SWIOFC), Mr Aubrey Harris, informed that the 4th Scientific Committee (SC) meeting had taken place the previous week in Seychelles attended by 10 of the 12 member countries. Based on reports made by members, the SWIOFC SC reviewed the status of some 140 fish species or groups caught within their EEZs. It examined this review process and will be making more detailed species-specific assessments in a demersal working group to be held next year together with SWIOFP and the EAF-Nansen project. Those countries with depleted resources informed of the research and management actions that they were taking in order to rehabilitate these stocks before the WSSD target date of 2015. The Committee examined the support towards an EAF approach that is being provided by the two major regional fisheries projects and agreed to the establishment of a baseline for the implementation of EAF in the SWIOFC area, against which future progress could be gauged. In response to a request made at the 4th SWIOFC, and within the context of on-going collaboration with the IOTC Secretariat, the SWIOFC SC was appraised of a procedure of estimating tuna catches in the EEZ's of coastal countries based on public domain data, including its constraints and limitations. The session was well received by the members who were encouraged to follow up with the IOTC Secretariat. The SWIOFC SC is grateful for this exchange from the IOTC Secretariat and supported several of its delegates to attend this IOTC SC. The SWIOFC SC will be reporting to the 5th Session of the Commission which is due to take place in Maldives, 13-16 March 2011.

14.7. ARRANGEMENTS FOR THE TAGGING SYMPOSIUM

269.The Indian Ocean Tuna Tagging Programme that was implemented between 2002 and 2009 tagged and released around 200,000 tuna in the whole Indian Ocean, of which more than 30,000 were recovered. The data generated already provided new and useful results (*e.g.* growth, natural mortality, exploitation rates, *etc.*), and is now routinely used in the integrated stock assessments for yellowfin, and was used for the first time in an exploratory stock assessment for bigeye.

270.A symposium to present and discuss results from this programme will be held during the first quarter of 2012, with financial support from the EU DG-Mare and IOTC. In this regard, the SC recommended that a Steering Committee, including Dr. A. Fonteneau, Dr. J.P. Hallier, the IOTC Executive Secretary, the Chairs of the SC and the WPTT as well as other experts, should be appointed soon. This Steering Committee will be in charge of defining the contents of the symposium and will promote it in order to maximize the participation from international experts.

14.8. UPDATE ON FAO ACTIVITIES ON TUNA FISHERIES

271.The SC was updated on FAO's activities on tuna and tuna-like species, starting with global reviews on *i)* the biological characteristics of tuna and tuna-like species, *ii)* the worldwide status of tuna resources, *iii)* challenges of tuna fisheries management, *iv)* trends in the tuna industry, *v)* by-catches of tuna fisheries, *vi)* marine resources off Pacific islands, where most tuna catches are taken. Updates of the global data bases were provided for *i)* tuna catches by species, FAO statistical area and year, *ii)* tuna catches by species, stock, fishing gear and year and *iii)* tuna catches by species, fishing gear, 5x5 degree catches, year and quarter. The SC was informed on the creation of a new thematic area on tuna in the website of FAO Fisheries and Aquaculture Department from where all scattered information on tuna can be easily accessed through the topics of *i)* tuna resources, *ii)* tuna fisheries and utilizations and *iii)* FAO activities on tuna. FAO has developed an involvement in major plans of the Global Environmental Facility (GEF) to improve the fisheries and biodiversity on the high seas, which will be implemented in close collaboration with the tuna RFMOs, UN agencies, NGOs and the tuna industry. The next Session of FAO`s Committee on Fisheries (COFI) will be held at the end of January 2011 to be followed by the 3rd Meeting of RFB Secretariats Network (RSN).

14.9. Discussions on improving/updating formats for the provision of Scientific Advice

272.The SC agreed that some improvements could be brought in the provision of Scientific Advice to the Commission, in particular in the stock status summary for the IOTC species in the Executive Summary of the SC report.

273.The SC supported the principle of peer-reviews of stock assessments made by the WP. It was suggested that the chair of the SC with the chair of the WP set up a proposal for such a procedure, that will be discussed with the Secretariat in terms of budget and funding. Then, such a proposal will be discussed at the next SC meeting.

274.The SC noted that some analyses developed by WP can be limited due to recurrent lack of data by some CPCs. The SCs supported the development of a quantitative scoring system that would help to identify CPCs that need assistance to improve the provision of good quality data. Moreover, the scoring of particular datasets would allow highlighting those where specific effort should be devoted.

275.The SC noted the general lack of compliance with IOTC Resolutions on data collection and reporting relevant to the work of the Scientific Committee. The SC recommended that the Commission considers developing a Monitoring Scheme to verify if CPCs are taking all necessary steps to comply with IOTC Resolutions and other obligations relevant to the work of the Scientific Committee, by identifying areas in which further work is needed and recommending actions to be taken to address non-compliance. Such a scheme should also provide a basis for identifying areas in which technical assistance and capacity building are needed to assist CPC's to address compliance gaps.

276.The SC noted the late submission of most of the documents submitted to the Secretariat for the 13th session of the Scientific Committee meeting and stressed the need for members to submit documents requiring CPCs to consult with internal experts, as early as possible. Therefore, the SC recommended that for its future meetings all documents, essential to develop potential recommendations by the SC, should be submitted to the Secretariat no later than 15 days prior to the start of the SC meeting and be posted to the IOTC website. This was considered sufficient time for CPCs to carry out internal consultations with relevant experts. If such documents could not be submitted 15 days prior, the relevant author(s) should notify the Secretariat and SC Chair, who will inform CPCs of the pending late document. Documents not requiring a decision/recommendation by the SC, can only be provided to the Secretariat prior to the commencement of the SC, and would be considered 'information' documents.

15. Election of the Chairman for the new Biennium

277.As there were no nomination from the floor, and noting the satisfaction of the Members with the work conducted by the current officials, the SC decided to extend the mandate of the Dr. Francis Marsac (European Union) as Chairperson, and Dr. Tsutomu Nishida (Japan) as Vice-Chairperson, for one year beyond the limits established by the Rules of Procedure. This decision should be interpreted as exceptional and it should not be considered as a precedent for future situations.

16. Summary of the SC Recommendation in 2010

16.1. Recommendations – on data and research

278.The following recommendations relate mainly to data and research activities of WPs and national scientists. They should be considered as priority items compared to the complete list of data and research activities recommended by the WPs (Appendix IV).

1. The SC recalled that it was agreed at the 4th session that all CPCs 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. (paragraph 15)
2. The SC noted that the Australian data collection system was a model case but involved expensive equipment and technology, and encouraged a cost-benefit analysis so that the applicability for other fleets could be explored in the future. (paragraph 18)
3. Moreover, the SC noted that the bycatch reported in the national report [of China] was not reported to the Secretariat, and

encouraged that this data is submitted timely. (paragraph 19)

4. The SC encouraged that the EU develop CPUE standardization for its longline fleet targeting swordfish, and that such analysis should be presented at the next meeting of the WPB (paragraph 20).
5. The SC noted that Mauritius had not reported data for its coastal fisheries in 2009, asking if this information could be sent as soon as possible. (paragraph 27)
6. The SC noted that Thailand does not collect data for bycatch species, recommending Thailand to make the necessary arrangements for this information to be collected and reported to the IOTC following the agreed standards. (paragraph 29)
7. The SC asked the CPCs to prepare their National Report in line with this template for its 2011 Session. (paragraph 32)
8. The SC encouraged all CPCs to improve data collection and reporting for marlins, including catch data from artisanal and sport fisheries, as this information is crucial to the stock assessment process. (paragraph 35)
9. The SC reiterated previous concerns regarding the low level of participation of scientists to the WPB, in particular scientists from coastal states in the IOTC region, and urged CPCs, in particular Sri Lanka, Iran, Pakistan, India and Indonesia, to make necessary arrangements to attend the next WPB in 2011, particularly given current concerns over the status of the swordfish stock in the Indian Ocean. The SC noted that both Spain and Portugal have important fisheries for swordfish in the Indian Ocean and reiterated its concern that no scientists from these countries have participated in meetings in recent years (paragraph 36)
10. The SC encouraged CPCs to participate or contribute to both projects, in particular to the collection of samples for analysis by IOSSS. (paragraph 42)
11. The SC noted the WPB recommendations relating to data acquisition and availability, and agreed that the following issues have to be addressed as a matter of priority (paragraph 43):
    - Acquisition of catch-and-effort and size data from drifting gillnet fisheries in Iran and Pakistan
    - Identification of marlins by species and an increase in sampling coverage in the artisanal fisheries of Sri Lanka, especially offshore fisheries
    - Acquisition of catch-and-effort and size data from sport fisheries, including the preparation and dissemination of reporting forms to Sport Fishing Centres in the region
    - Acquisition of statistics on billfish not reported by longline fleets, by species, in particular from India, Philippines, Malaysia and Oman.
    - Fresh-tuna longline fishery of Indonesia for which estimated catches of swordfish and marlins may have been underestimated in recent years. Size frequency data have been collected, however the samples cannot be fully broken by month and fishing area (5°x5° grid) and refer mostly to the component of the catch that is unloaded fresh.
    - Artisanal fisheries of Indonesia where the catch levels reported in recent years are considerably higher than those reported in the past and for which the quality of the dataset is very poor:
    - Implementation of sampling for the collection of biological data for billfish, in particular sex-ratio by length, length-weight and non-standard size – standard length conversion relationships and resulting keys.
    - Japan and Taiwan,China: provide the entire size frequency data series for their longline fisheries as per the IOTC standards.
12. The SC endorsed the following research recommendations from the WPB and commended it for its work in 2010 (paragraph 44).
    - Based on recommendations last year and the assessments conducted in 2010, the WPB still considered determination of stock structure as a research priority as the information available tends to indicate localized depletion in certain areas, notably the south-west Indian Ocean. On-going initiatives, such as IOSSS and SWIOFP, should provide better information on the stock structure in 2011/2012.
    - The WPB welcomed the introduction of standardised CPUE series in 2010 from La Reunion and Seychelles but identified Spain and Portugal as potentially having useful series for inclusion in assessments in 2011, particularly to further explore the SW area. The WPB recommended the on-going development of the spatially disaggregated approach.
    - The WPB recommended investigation the historical coverage of logbooks for Taiwan,China.
13. The SC agreed that the WPB should examine inter-annual environmental anomalies to describe the inter-annual variability in CPUE and that this work should be pursued in the inter-sessional period. In addition, the effect of shifting effort distribution (e.g. cause by piracy) should be investigated. (paragraph 45).
14. The SC recommended that, in addition to the implementation of the Regional Observer Scheme, the collection of scientific data by all other means available including auto-sampling (collection of data by trained crew) and electronic

monitoring (sensors and video cameras) be encouraged and developed as a mechanism to improve data collection on bycatch. (paragraph 50)

15. The SC encouraged CPC's to continue research on major pelagic species (e.g. blue sharks, silky sharks and oceanic whitetip sharks) and that the possibilities of using a wide range of research techniques (including tags of all types, genetics, stable isotopes), be explored to provide information required for shark assessments. (paragraph 70).
16. The SC recommended that work be carried out by the WPEB to collect and analyse data, and to conduct research, which could contribute towards and assessment of whale sharks, and in particular to determine if purse-seine setting on whale sharks is still not a problem in the Indian Ocean. The SC also recommended that the WPEB explore the potential for further work on manta rays (paragraph 76).
17. The SC recommended that further work to identify catch and catch rate trends and any other indicators of stock status of sharks be carried out and reviewed by the WPEB and that the Ecological Risk Assessment (ERA) undertaken last year on bycatch of sharks in the purse-seine and longline fisheries should be updated for next years' SC meeting, and as resources permit, expand the ERA to other gears. (paragraph 77).
18. The SC recommended that additional research be carried out in this regard [on negative impacts on catch rates of tuna and tuna-like species]. (paragraph 88)
19. The SC recommended that work on a Level 2 or possibly a Level 3 Risk Assessment be carried out to highlight areas of elevated risk to at risk seabird species, acknowledging that a Level 3 assessment would require the provision of additional funding to develop a quantitative model-based approach. (paragraph 94)
20. The SC recommended that CPCs conducting gillnet and driftnet fishing should collect information on seabird interactions and report to the WPEB in 2011. (paragraph 98).
21. The SC agreed with the recommendation by the WPEB to carry forward all recommendations from the 2009 WPEB report, that have yet to be completed (i.e. purse-seine fisheries to use ecological[8] FADs, longline vessel are equipped with the necessary tools to remove hooks from turtles to ensure safe release and minimize post-release mortality). (paragraph 101).
22. The SC recommended that more research is conducted on longline mitigation measures, and a review of information on interactions and mitigation measures is conducted. (paragraph 102).
23. The SC noted that whales and tunas sometimes associate. The SC recommended that the WPEB carry out an analysis of existing whale sightings data available from the purse-seine fishery, to better understand aspects of this relationship. (paragraph 107).
24. The SC recommended that countries with tuna driftnet fisheries to study and report on cetacean bycatch (paragraph 108).
25. The SC recommended that more research and monitoring is conducted on the subject of depredation in the Indian Ocean (paragraph 110).
26. The SC encouraged further work on other fish species commonly caught as bycatch in the purse-seine fisheries, i.e. oceanic triggerfish, rainbow runners, dolphin fish to be carried out and reported to the WPEB (paragraph 111).
27. The SC recommended that the efforts put in the development of this assessment using SS3 and including the tag data are continued and refined at the next session of the WPTT (paragraph 122).
28. The SC strongly recommended that a formal assessment of the skipjack stock be a priority task at the next session of the WPTT. (paragraph 134).
29. The SC recalled that external analyses on tag-recovery data are essential to estimate the key input parameters for assessment (e.g. natural mortality, growth, exploitation rate, etc.) and recommended more analysis before the tagging Symposium planned in 2012. (paragraph 135).
30. The SC endorsed the data and research recommendations on WPTT (Appendix IV) and commended it for the work achieved in 2010 (paragraph 136).
31. The SC thanked the OFCF for its continuous support to improving the quality of statistics at the IOTC and activities to enhance capacity in coastal countries of the region, and recommended the IOTC-OFCF Project to continue this work. (paragraph 138).
32. The SC noted that the complete and detailed stock assessment documents are not always made available at the WPs and

[8] This terms means improved FAD designs to reduce the incidence of entanglement of bycatch species, using biodegradable material as much as possible.

requested that for all future WPs, complete stock assessment documents, describing the analysis, its assumption and its results, as well as associated model diagnostics and input/ouput files are provided and archived so as to facilitate transparency in the process of stock assessment for IOTC stocks (paragraph 143).

33. The SC also requested that choice of particular assumption, e.g. steepness of the stock recruitment relationship, are fully justified and described in the report of the relevant WP. (paragraph 144).

34. It also noted that the size-frequency sampling effort remains inadequate for some distant water longline fleets, and recommended this to be addressed as a matter of priority. The SC recognized that ecosystem modelling has yet to be fully implemented in IOTC area, largely because of it requirements for data and expertise, and encouraged such development in the near future as well as collaboration with programs integrating ecosystem and socio-economic approaches (such as CLIOTOP) to support the conservation of multi-species resources. (paragraph 148).

35. The SC recommended keeping careful track of bigeye catches, and to integrate the changes in fishing pattern and catch into future stock assessments (paragraph 157).

36. The SC supported the development of a MSE under the IOTC framework, and recommended that a meeting is organized in 2011 that will gather the scientist, managers and representative of the Industry (paragraph 251).

37. The SC recommended that a Steering Committee [for the Tagging Symposium], including Dr. A. Fonteneau, Dr. J.P. Hallier, the IOTC Executive Secretary, the Chairs of the SC and the WPTT as well as other experts, should be appointed soon. (paragraph 269)

38. The SC supported the principle of peer-reviews of stock assessments made by the WP. It was suggested that the chair of the SC with the chair of the WP set up a proposal for such a procedure, that will be discussed with the Secretariat in terms of budget and funding (paragraph 273).

39. The SC recommended that for its future meetings all documents, essential to develop potential recommendations by the SC, should be submitted to the Secretariat no later than 15 days prior to the start of the SC meeting and be posted to the IOTC website. (paragraph 276)

16.2. *Recommendations to the Commission – General*

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

1. The SC congratulated the Secretariat on the work conducted during 2010 and continues to strongly support the reinforcement of the Secretariat as indicated in previous years and as recommended by the IOTC Performance Review Panel in 2009.

On Billfish

2. The SC recommended that the Commission consider appropriate Conservation and Management Measures to control and/or reduce effort on the swordfish stock in the south-west Indian Ocean. (paragraph 39)

On Bycatch Data

3. The SC urged all CPCs to comply with data collection and reporting requirements as outlined in the relevant Resolutions relating to ecosystems and bycatch. The SC stressed that this recommendation is made by the WPEB and endorsed the SC every year since 2006 and, therefore, asked the Commission to consider appropriate mechanisms to encourage members to comply with reporting requirements, and to provide historical data. (paragraph 48)

4. The SC recommended that the actions described in Table 1, Table 2, Table 3 and Table 4 on sharks, seabirds, marine turtles and marine mammals respectively, be taken by CPCs to improve the standing of the data on non-tuna species held by the Secretariat. (paragraph 49)

On Sharks

5. The SC recalled its previous advice that the fins to body 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 finning. (paragraph 55)

6. Consensus was not reached as to replace the current 5% fin to body ratio rule by the landing of sharks with fins naturally attached. The majority of the SC members agreed that the best way to reduce or avoid the practice of shark finning, ensure accurate catch statistics, and facilitate the collection of biological information is to ensure that all sharks are landed with fins naturally attached to the trunk. (paragraph 57)

7. The SC encouraged IOTC to take the lead in introducing innovative measures for discussion at this joint TRFMO technical working group. (paragraph 59)

8. Although the SC could not reach consensus on a single approach, the SC proposed three options to be envisaged by the Commission to progress on this issue (paragraph 65).

- **Option 1**: The list of shark species contained in Resolution 08/04, requiring mandatory reporting in longline logbooks, be revised to include eight additional species and species groups as follows:

Under Resolution 08/04	**Under new proposal**	
	Common name	Scientific name
Blue shark	Blue shark	*Prionace glauca*
Mako shark	Mako sharks	*Isurus* spp.
Porbeagle	Porbeagle	*Lamna nasus*
	Great white shark	*Carcharodon carcharias*
	Crocodile shark	*Pseudocarcharias kamoharai*
	Thresher sharks[9]	*Alopias* spp.
	Tiger shark	*Galeocerdo cuvier*
	Oceanic whitetip shark	*Carcharhinus longimanus*
	Other Requiem sharks	*Carcharhinus* spp.
	Hammerhead Sharks	*Sphyrna* spp.
Other sharks	Other sharks	
	Pelagic stingray	*Pteroplatytrygon violacea*

- **Option 2**: A second list of shark species to be included in Resolution 08/04 as a separate section requesting CPCs to report on these additional species/groups on a voluntary basis until CPCs have the capacity to better train crew to identify these shark species/groups. This option would not require changing the current logbook:

Under Resolution 08/04	**Under new proposal**	
No list to be recorded on a voluntary basis in the current Resolution	Common name	Scientific name
	Great white shark	*Carcharodon carcharias*
	Crocodile shark	*Pseudocarcharias kamoharai*
	Thresher sharks**Error! Bookmark not defined.**	*Alopias* spp.
	Tiger shark	*Galeocerdo cuvier*
	Oceanic whitetip shark	*Carcharhinus longimanus*
	Other Requiem sharks	*Carcharhinus* spp.
	Hammerhead Sharks	*Sphyrna* spp.
	Pelagic stingray	*Pteroplatytrygon violacea*

- **Option 3:** The list of shark species contained in Resolution 08/04, requiring mandatory reporting in longline logbooks, to be revised to include eight additional species and species groups, as in option 1, EXCEPT for CPCs having a sufficient observer coverage that would be absolve of reporting on this new extended list.

9. The SC noted requests made by several coastal states for technical support in obtaining training materials to improve shark identification, and recommended that the identification cards under current development by the Secretariat are finalized and circulated in 2011. (paragraph 67)

10. The SC recommended that shark assessment experts be identified by the Secretariat for participation at the next WPEB and for consideration to be given to funding their attendance. (paragraph 69)

11. The SC recommended that the remaining CPCs provide updates on the progress of developing or implementing NPOA-sharks at the WPEB in 2011. (paragraph 72).

12. The SC recommended that the IOTC should continue to collaborate with the CMS MoU on sharks (paragraph 75).

ON SEABIRDS

13. The SC, with the exception of Japan, China and Korea, agreed that in the absence of any scientific information on the effectiveness of line shooters in reducing incidental mortality of seabirds, line shooters should be removed from the list of accepted seabird bycatch mitigation measures in Table 1 of Resolution 10/06 on reducing the incidental bycatch of seabirds in longline fisheries. (paragraph 84)

14. The SC agreed that a revisited line weighting regime should be pushed forward as an efficient mitigation measure but

[9] As per IOTC Resolution 2010/12, catch of Thresher sharks have to be reported but not kept (*i.e.* released if alive of discarded if dead)

recommended that more experiments are conducted in order to assess the impact on target species. (paragraph 89)

15. The SC, with the exception of Japan, Korea and China, recommended that in the absence of any scientific observation on the effectiveness of offal discharge management in reducing the incidental mortality of seabirds, that it could be removed from the list of mitigation measures in Table 1 of the Resolution 10/06. (paragraph 91)
16. From the above (paragr.84, 87 and 91), the SC will recommend a major revision of the current Resolution 10/06 on reducing the incidental bycatch of seabirds in longline fisheries once line weighting options are assessed. (paragraph 92).
17. The SC urged the Secretariat to complete the seabird identification card project for the consideration of the WPEB in 2011 (paragraph 95).
18. The SC encouraged the CPCs to develop systems, such as retention of carcasses for later identification, or establish photo identification processes, to improve identification of seabirds to species level, and recommended for this to be reflected in paragraph 7 of Resolution 10/06. (paragraph 97).
19. The SC noted that 4 CPCs have developed and implemented NPOA-seabirds and that 1 is in the process of finalizing its NPOA-seabird (Appendix VIII). (paragraph 100).

ON MARINE TURTLES

20. The SC recommended that the IOTC Secretariat, its CPCs and IOSEA, increase cooperation, in particular with regard to reviewing and exchanging available information on tuna fisheries-marine turtle interactions and mitigation, and that the Secretariat should attend the International Symposium on ‘Circle Hooks in Research, Management and Conservation’ to be held in Miami, USA from 4-6 May 2011, and to report to be to the WPEB in 2011 (paragraph 103).
21. The SC recommended that distant water fishing nations should join the IOSEA MoU, which had initially been directed toward Indian Ocean coastal countries. (paragraph 104).
22. The SC recommended that the marine turtle identification sheets be finalized by the Secretariat before the next Session of the WPEB, in cooperation with other relevant organizations. (paragraph 105).
23. The SC recommended that more marine turtle experts should participate at the next Session of the WPEB (paragraph 106).
24. The SC recommended that marine mammal experts, for example from NGOs and IGOs with an interest in the Indian Ocean such as International Whaling Commission, to be encouraged to participate in future meetings of the WPEB (paragraph 109).

ON DATA COLLECTION AND STATISTICS

25. The SC endorsed the recommendations from the WPDCS, as presented in Appendix IV of the WPDCS Report. In particular, the SC expressed some concerns about the timeliness of reporting of statistics from some CPCs and the quality of datasets for some fisheries. The SC reiterated its concerns that late reporting compromises the use of catches from recent years for stock assessment and provision of advice to the Commission based on the most recent information. The SC expressed further concern that some parties have failed to address recommendations for a number of years, recommending that these issues are brought to the attention of the Compliance Committee. (paragraph 137).
26. The SC agreed on the usefulness of implementing a scoring system to assess the quality of the statistics available at the IOTC, as proposed by the WPDCS, encouraging the IOTC Secretariat to continue with this work (…).The SC requested the Secretariat to present a first attempt to the next meeting of the WPDCS or, if time allows, to the next meeting of the WPTT. (paragraph 139).
27. The SC endorsed the minimum data requirements for gillnet and pole-and-line fisheries. In order to complete this work, the SC recommended that this minimum requirement are translated into proposal of Resolutions for the recording of catch by gillnet and pole-and line fisheries in the IOTC area for presentation at the next meeting of the Commission. (paragraph 141).

ON PROGRESS IN ADDRESSING RECOMMENDATIONS OF THE KOBE II WORKSHOPS AND OF THE PERFORMANCE REVIEW PANEL

28. Regarding bycatch, the SC strongly endorsed the proposed concept of a Bycatch Joint Working Group, and recommended the Secretariat and WPEB make all efforts to expedite its formation. The SC fully supported participation that would facilitate better coordination and avoidance of duplication between t-RFMOs. However, the SC reminded that such a Bycatch Joint Working Group will not replace or undermine the work of the WPEB of the IOTC..The SC strongly endorsed the proposal made that a Bycatch officer should be hired as a permanent staff member of the Secretariat of each of the 5 tuna RFMOs, and developed ToR for such an officer to be recruited at the IOTC Secretariat (Appendix IX). This specialist should attend, with the Chairman of the WPEB, future Kobe Bycatch meetings, and meetings of the Bycatch Joint Working Group. (paragraph 149).

29. The SC strongly supported the recommendation to increase the IOTC staff resource and the proposal of the Secretariat for a budget for the 2011-2012 biennium that would include additional professional staff (paragraph 151).

On the Regional Observer Scheme

30. The SC endorsed the recommendation of the technical workshop that a list of accredited scientific observers should be submitted to the Secretariat and recommended that CPCs do so within the best delays (paragraph 244).
31. The SC examined the Observer Trip Report Template produced by the technical workshop, however, recognizing the difficulties for some CPCs to fill all the data fields as required, the SC recommended that this template report should be used until it is revised at the next Session of the WPDCS in 2011 (paragraph 245).

On the Schedule of Meetings for 2011

32. The SC agreed to the following schedule of working party meetings for 2011 and recommended that is be put before the Commission for endorsement at its 15th Session (paragraph 253).
33. The SC recommended that, together with the Working Party on methods, the tripartite meeting on the MSE process with scientists, managers and representatives from the industry is organized. (paragraph 255).
34. For 2012, the SC recommended that the WPB, WPEB, WPTT, WPDCS and WPTe meet. (paragraph 256).
35. The SC recommended that its Fourteenth Session be held from 12th to 17th December 2011 (6 days) 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 257).

On Other Matters

36. The SC recommended that the Commission considers developing a Monitoring Scheme to verify if CPCs are taking all necessary steps to comply with IOTC Resolutions and other obligations relevant to the work of the Scientific Committee, by identifying areas in which further work is needed and recommending actions to be taken to address non-compliance. (paragraph 275).

16.3. Recommendations to the Commission – On the status of the stocks

280.The following recommendations were extracted from Section 9 of this report. A table summarizing he status and management advice relating to IOTC species is provided in the Executive Summary of this report (Page 4).

TUNAS

Albacore tuna (*Thunnus alalunga*)

The SC acknowledged the preliminary nature of the albacore tuna assessment in 2008, but noting the available stock status information 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. However, new information and estimation for the Indonesian longline fishery has increase the total catch at levels above the estimated MSY.

The SC recommended that a new albacore tuna assessment be presented to the Scientific Committee at the latest in 2011.

Bigeye tuna (*Thunnus obesus*)

Given the uncertainty on estimated MSY values and the levels of error in the nominal catch data for bigeye, the SC recommended than catches are kept at a level not above the catch estimated at the moment of the assessment for 2009, *i.e.* 102,000 t. This value should give low probability of catches exceeding MSY.

Skipjack tuna (*Katsuwonus pelamis*)

Given the limited nature of the work carried out on the skipjack in 2010, no management advice is provided for the stock.

YELLOWFIN TUNA (*Thunnus albacares*)

The SC considers that the stock of yellowfin has recently become overexploited or is very close to be so. Management measures should be continued that allow an appropriate control of fishing pressure to be implemented.

At this moment, the effect of time-area closures cannot be directly translated into management quantities of direct effect on the status of the stock, such as catches or fishing mortality, so their possible effect on the future evolution of the stock cannot be evaluated.

The SC recommends that catches of yellowfin tuna in the Indian Ocean should not increase beyond 300,000 t in order to bring the stock to biomass levels that could sustain catches at the MSY level in the long term. If recruitment continues to be lower than average, catches below 300,000 t would be needed to maintain stock levels.

The SC recommends that the situation of this stock is closely monitored.

SOUTHERN BLUEFIN TUNA (*Thunnus maccoyii*)

Manage by the CCSBT.

BILLFISH

SWORDFISH (*Xiphias gladius*)

If the recent declines in effort continue, and catch remains substantially below the estimated MSY of 29,000 t, then there is probably no urgent need to introduce restrictive management actions to the Indian Ocean as a whole. However, continued monitoring is required to manage the uncertainty.

It is recommended that catches in the south west should be maintained at levels at or below those observed in 2008 (6,426 t), until either *i)* there is clear evidence that substantial rebuilding is occurring (through recruitment or immigration) or *ii)* further analyses indicate that the current assessment is inappropriate.

BLACK MARLIN (*Makaira indica*)

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. However, aspects of the biology, productivity and fisheries for this species combined with the lack of data on which to base a more formal assessment is a cause for considerable concern. Research emphasis on improving indicators and exploration of stock assessment approaches for data poor fisheries are warranted.

BLUE MARLIN (*Makaira nigricans*)

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. However, aspects of the biology, productivity and fisheries for this species combined with the lack of data on which to base a more formal assessment is a cause for considerable concern. Research emphasis on improving indicators and exploration of stock assessment approaches for data poor fisheries are warranted.

STRIPED MARLIN (*Tetrapturus audax*)

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. However, aspects of the biology, productivity and fisheries for this species combined with the lack of data on which to base a more formal assessment is a cause for considerable concern. Research emphasis on improving indicators and exploration of stock assessment approaches for data poor fisheries are warranted.

INDO-PACIFIC SAILFISH (*Istiophorus platypterus*)

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. However, aspects of the biology, productivity and fisheries for this species combined with the lack of data on which to base a more formal assessment is a cause for considerable concern. Research emphasis on improving indicators and exploration of stock assessment approaches for data poor fisheries are warranted.

NERITIC TUNAS

BULLET TUNA (*Auxis rochei*)

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.

The SC recommended that bullet tuna be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

FRIGATE TUNA (*Auxis thazard*)

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.

The SC recommended that frigate tuna be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

INDO-PACIFIC KING MACKEREL (*Scomberomorus guttatus*)

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 recommended that indo-pacific king mackerel be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

KAWAKAWA (*Euthynnis affinis*)

No quantitative stock assessment is currently available for kawakawa in the Indian Ocean, therefore the stock status is uncertain. The SC notes that catches have been relatively stable for the past 10 years.

The SC recommended that kawakawa be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

LONGTAIL TUNA (*Thunnus tonggol*)

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.

The SC recommended that longtail tuna be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

NARROW-BARRED SPANISH MACKEREL (*Scomberomorus commerson*)

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.

The SC recommended that narrow-barred Spanish mackerel be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

SHARKS

The SC recommended that mechanisms are developed by the Commission to encourage CPCs to comply with their reporting requirement on sharks.

The SC agreed that three options should be considered for amendment of Resolution 08/04 *concerning the recording of the catch by longline fishing vessels in the IOTC area* in order to improve data collection and statistics on sharks that would allow the development of stock status indicators.

MARINE TURTLES

The SC recommended that mechanisms are developed by the Commission to encourage CPCs to comply with their reporting requirement on marine turtles. The SC also recalled its recommendation from 2009 that Resolution 09/06 does apply to leatherback turtles in its entirety, and that the term 'hard-shelled' should be removed from Resolution 09/06 when the resolution is revised.

SEABIRDS

The SC recommended that mechanisms are developed by the Commission to encourage CPCs to comply with their reporting requirement on seabirds.

The SC recommended that a major revision of the Resolution 10/06 *on reducing the incidental bycatch of seabirds in longline fisheries* should be considered, in the near future, once its impact is examined. Such revision may include the removal of the use of line shooters and offal management from the list of seabird mitigation measures.

17. ADOPTION OF THE REPORT

281. The report of the thirteenth Session of the Scientific Committee was adopted on Friday 09 December 2010.

APPENDIX I
LIST OF PARTICIPANTS

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APPENDIX II
AGENDA OF THE 13TH SESSION OF THE IOTC SCIENTIFIC COMMITTEE

1. **OPENING OF THE SESSION**
2. **ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION**
3. **ADMISSION OF OBSERVERS**

   The Third Session of the Commission decided that its subsidiary bodies would be open to the participation of observers from Member parties of FAO, from international organisations and from non-governmental organisations which had attended previous meetings or were admitted to attend Commission Sessions.

4. **UPDATE ON COMMISSION AND SECRETARIAT ACTIVITIES**

   The Secretariat will report on the outcomes of the 14th Session of the Commission and its own activities during the year 2010. It will also outline the technical activities planned for 2011 regarding, acquisition, processing, and dissemination of information regarding tuna fisheries in the Indian Ocean, and the workplan for the IOTC Secretariat.

5. **PRESENTATION OF NATIONAL REPORTS**

   Delegates from Member Parties and Cooperating Non-contracting Parties will report on their tuna fisheries, statistical systems and research programmes, as well as on measures taken to implement Scientific Committee recommendations. National Reports should follow the new template provided in the IOTC Circular 72 which is available on the web site

6. **REPORTS ON 2010 WORKING PARTY MEETINGS**

   6.1 BILLFISH (IOTC-2010-WPB-R)

   6.2 ECOSYSTEMS AND BYCATCH (IOTC-2010-WPEB-R).

   6.3 TROPICAL TUNAS (IOTC-2010-WPTT-R).

   6.4 DATA COLLECTION AND STATISTICS (IOTC-2010-WPDCS-R).

7. **PROGRESS IN ADDRESSING RECOMMENDATIONS OF THE KOBE II WORKSHOPS AND THE PERFORMANCE REVIEW PANEL**
8. **EXAMINATION OF THE EFFECTS OF PIRACY ACTS ON TUNA FISHERIES IN THE WEST INDIAN OCEAN**

   Parties are invited to report on the effect of piracy on their tuna fleets, catches and CPUEs.

9. **STATUS OF TUNA AND TUNA-LIKE RESOURCES IN THE INDIAN OCEAN**

   The Scientific Committee is invited to bring to the attention of the Commission any actions that might need to be taken, arising from the recommendations of these Working Parties considering these resources.

   Management Advice and/or Executive Summaries should be adopted by the Scientific Committee prior to their transmission to the Commission. The latest Executive Summaries are available from IOTC-2009-SC-R.

   9.1 TUNAS (IOTC-2010-SC-03)

   9.1.1 Development of advice on the status of the albacore tuna resource.

   9.1.2 Development of advice on the status of the yellowfin tuna resource.

   9.1.3 Development of advice on the status of the bigeye tuna resource.

   9.1.4 Development of advice on the status of the skipjack tuna resource.

   9.2 BILLFISH (IOTC-2010-SC-04)

   9.2.1 Development of advice on the status of the swordfish resource

9.2.2 Development of advice on the status of the blue marlin, black marlin, striped marlin and indo-Pacific sailfish resources

9.3 OTHER SPECIES

9.3.1 Development of advice on the status of the neritic tuna resources (IOTC-2010-SC-05).

9.3.2 Development of advice on the status of sharks (IOTC-2010-SC-06).

9.3.3 Development of advice on the status of sea turtles (IOTC-2010-SC-07).

9.3.4 Development of advice on the status of seabirds (IOTC-2010-SC-08)

9.3.5 Report on biology, stock status and management of southern bluefin tuna (from CCSBT) (IOTC-2009-SC-Inf02)

10. OUTLOOK ON TIME-AREA CLOSURES ISSUES

The Commission, at its 14th Session, has tasked the Scientific Committee to evaluate the effect of the time-area closures set out in Resolution 10/01 at its 2011 meeting. However, some considerations can be discussed during the present session, based on the experience of time-closures in other oceans and preliminary analyses on the Indian Ocean presented to the Scientific Committee.

11. UPDATE ON THE IMPLEMENTATION OF THE OBSERVER REGIONAL SCHEME

11.1 REPORT OF THE TECHNICAL MEETING ON THE IOTC REGIONAL OBSERVER SCHEME (IOTC-2010-ROS-R)

11.2 ADOPTION OF AN IOTC MANUAL FOR OBSERVERS, AND OBSERVER TRIP REPORT TEMPLATE

11.3 NATIONAL IMPLEMENTATION BY CPCS

The IOTC Regional Observer Scheme started on July 1st, 2010 (Resolution10/04). CPCs should report on the action taken for its implementation in their respective countries

12. IMPLEMENTATION OF A MANAGEMENT STRATEGY EVALUATION (MSE)

13. SCHEDULE OF WORKING PARTY MEETINGS IN 2011

14. OTHER MATTERS

14.1 RULES FOR THE APPOINTMENT OF EXTERNAL EXPERTS AND CONSULTANTS

14.2 EU PROJECT TXOTX (TECHNICAL EXPERTS OVERSEEING THIRD COUNTRY EXPERTISE) - UPDATE

14.3 EU PROJECT MADE (MITIGATING ADVERSE ECOLOGICAL IMPACTS OF OPEN OCEAN FISHERIES)- UPDATE

14.4 THE RESEARCH PROJECT OF THE INTERNATIONAL SEAFOOD SUSTAINABILITY FOUNDATION (ISSF)

14.5 SOUTH WEST INDIAN OCEAN FISHERIES PROGRAMME (SWIOFP) – UPDATE

14.6 COOPERATION WITH SOUTHWEST INDIAN OCEAN FISHERY COMMISSION (SWIOFC)

14.7 ARRANGEMENTS FOR THE TAGGING SYMPOSIUM

14.8 UPDATE ON FAO ACTIVITIES ON TUNA FISHERIES

14.9 DISCUSSIONS ON IMPROVING/UPDATING FORMATS FOR THE PROVISION OF SCIENTIFIC ADVICE

15. ELECTION OF THE CHAIRMAN FOR THE NEW BIENNUM

16. ADOPTION OF THE REPORT

APPENDIX III
LIST OF DOCUMENTS

Reference / Référence	Title / Titre
IOTC-2010-SC-01	[E] Draft agenda for the Scientific Committee - 2009 [F] Ordre du jour prévisionnel de la Comité scientifique - 2009
IOTC-2010-SC-02	[E] List of documents [F] Liste des documents
IOTC-2010-SC-03	[E] Executive summaries of the status of the major Indian Ocean tunas. *IOTC Secretariat* [F] Résumés exécutifs sur l'état des principaux thons de l'océan Indien. *Secrétariat de la CTOI*
IOTC-2010-SC-04	[E] Executive summaries of the status of Indian Ocean billfish [F] Résumés exécutifs sur l'état des poissons porte-épées de l'océan Indien. IOTC Secretariat / Secrétariat de la CTOI
IOTC-2010-SC-05	[E] Executive summaries of the status of Indian Ocean neritic tunas [F] Résumés exécutifs sur l'état des thons néritiques de l'Océan Indien. *IOTC Secretariat / Secrétariat de la CTOI*
IOTC-2010-SC-06	[E] Executive summaries of the status of the Indian Ocean sharks [F] Synthèses sur l'état des ressources de requins de l'Océan Indien. *IOTC Secretariat / Secrétariat de la CTOI*
IOTC-2010-SC-07	[E]Executive summaries of the status of the Indian Ocean sea turtles [F] Synthèses sur l'état des ressources de tortues de mer de l'Océan Indien. *IOTC Secretariat / Secrétariat de la CTOI*
IOTC-2010-SC-08	[E] Executive summaries of the status of the Indian Ocean seabirds [F] Synthèses sur l'état des ressources d'oiseaux marins de l'océan Indien. *IOTC Secretariat / Secrétariat de la CTOI*
IOTC-2010-SC-09	[E] Analysis of the effects of Somali piracy on the European tuna purse seine fisheries of the Indian Ocean [F]Analyse des effets de la piraterie Somalienne sur les pêcheries de senneurs Européens dans l'Océan Indien. *Chassot, E., Dewals, P., Floch, L., Lucas, V., Morales-Vargas, M., and D. Kaplan.*
IOTC-2010-SC-10	[E] Status of National Plans of Action on Sharks and Seabirds [F] Statut des Plan d'Action Nationaux sur les Requins et les Oiseaux de mer.
IOTC-2010-SC-11	[E] IOTC Observer Manual [F] Manuel d'Observateur CTOI
IOTC-2010-SC-12	[E] Observer Trip Report Template [F] Modèle de Rapport de Marée Observateur
IOTC-2010-SC-13	[E] Progress on recommendations from the Kobe II workshops and from the Performance Review Panel [F] Progrès sur les recommandations des ateliers Kobe II et du Comité d'Evaluation des Performances.
IOTC-2010-SC-14	[E] Estimates of the Catch Reductions that might have been achieved historically through the application of the Time/Area Closures proposed in IOTC Resolution 10/01. [F] Estimation des réductions des captures qui auraient pu avoir été atteintes historiquement suite à l'application des fermetures spatio-temporelles proposées dans la Résolution 10/01 de la CTOI.
IOTC-2010-SC-15	[E] Management Strategy Evaluation [F] Evaluation des Stratégies de Gestion
IOTC-2010-WPB-R	[E] Report of the eight Session of the IOTC Working Party on Billfish [F] Rapport de la huitième session du Groupe de travail de la CTOI sur les poissons porte-épées
IOTC-2010-WPEB-R	[E] Report of the sixth Session of the IOTC Working Party on Ecosystems and Bycatch [F] Rapport de la sixième Session du groupe de travail de la CTOI sur les écosystèmes et les prises accessoires.
IOTC-2010-WPTT-R	[E] Report of the twelfth Session of the IOTC Working Party on Tropical Tunas. [F] Rapport de la douzième session du Groupe de travail de la CTOI sur les thons tropicaux
IOTC-2010-WPDCS-R	[E] Report of the seventh Session of the IOTC Working Party on Data Collection and Statistics [F] Rapport de la septième session du Groupe de travail de la CTOI sur la collecte des données et les statistiques
Information papers / Documents d'information	
IOTC-2010-SC-Inf01	Australia National Report / Rapport National Australia
IOTC-2010-SC-Inf02	Report on biology, stock status and management of southern Bluefin tuna, 2010 / Rapport sur la biologie, le statut du stock et la gestion du thon rouge du Sud, 2010. *CCSBT*
IOTC-2010-SC-Inf03	UK(BIOT) National Report / Rapport National RU(BIOT)
IOTC-2010-SC-Inf04	Comoros National Report / Rapport National Comores
IOTC-2010-SC-Inf05	European Union National Report / Rapport National Union Européenne
IOTC-2010-SC-Inf06	Kenya National Report / Rapport National Kenya
IOTC-2010-SC-Inf07	China National Report / Rapport National Chine
IOTC-2010-SC-Inf08	Mauritius National Report / Rapport National Maurice

Reference / Référence	Title / Titre
IOTC-2010-SC-Inf09	IR of Iran National Report / Rapport National RI d'Iran
IOTC-2010-SC-Inf10	Madagascar National Report / Rapport National Madagascar
IOTC-2010-SC-Inf11	Japan National Report / Rapport National Japon
IOTC-2010-SC-Inf12	India National Report / Rapport National Inde
IOTC-2010-SC-Inf13	Thailand National Report / Rapport National Thaïlande
IOTC-2010-SC-Inf14	Korea National Report / Rapport National Corée
IOTC-2010-SC-Inf15	Maldives National Report / Rapport National Maldives
IOTC-2010-SC-Inf16	South Africa National Report / Rapport National Afrique du Sud
IOTC-2010-SC-Inf17	Kobe II-Bycatch Workshop - Brisbane2010
IOTC-2010-SC-Inf18	Kobe II-Science Workshop - Barcelona2010
IOTC-2010-SC-Inf19	Seychelles National Report / Rapport National Seychelles
IOTC-2010-SC-Inf20	Seabird bycatch on pelagic long-lines in the IOTC area off South Africa in 2007 and 2008: the effect of individual vessel limits on bycatch rates. *Ryan, P.G., Goren, M., Petersen, S.L. and Smith, C.*
IOTC-2010-SC-Inf21	Guidelines for the preparation of National Reports to the ITC Scientific Committee

APPENDIX IV
RECOMMENDATIONS FROM THE MEETINGS OF THE IOTC WORKING PARTIES HELD IN 2011

RECOMMENDATIONS OF THE EIGHTH SESSION OF THE WORKING PARTY ON BILLFISH

1. With regards to data acquisition and availability, the WPB agreed that the following issues have to be addressed as a matter of priority:
   a. Acquisition of statistics from drifting gillnet fisheries in Iran and Pakistan, in particular catch-and-effort and size data
   b. Identification of marlins by species and increase in sampling coverage in the artisanal fisheries of Sri Lanka, especially offshore fisheries
   c. Acquisition of catch-and-effort and size data from sport fisheries. Preparation and dissemination of reporting forms to Sport Fishing Centres in the region.
   d. Acquisition of statistics of billfish not reported by longline fleets, by species, in particular India, Philippines, Malaysia, Oman and Indonesia.
   e. Implementation of sampling for the collection of biological data for billfish, in particular sex-ratio by length, length - weight and non-standard size – standard length conversion relationships and resulting keys
2. In 2010, the WPB identified the following new issues concerning the statistics available for billfish species, urging the parties concerned to address these issues as a matter of priority. The WPB requested the IOTC Secretariat to assist developing countries in the IOTC region in addressing the issues identified, where required.
3. Artisanal fisheries of Indonesia: The catches of billfish reported by Indonesia for its artisanal fisheries in recent years are considerably higher than those reported in the past. The quality of the dataset for the artisanal fisheries of Indonesia is thought to be very poor.
4. Longline fishery of Indonesia: The catches of swordfish and marlins estimated for the fresh tuna longline fishery of Indonesia may have been underestimated in recent years due to them not being sampled in port.
5. Gillnet fisheries of Iran and Pakistan: To date, Iran and Pakistan have not reported size frequency data for their gillnet fisheries.
6. Gillnet/longline fishery of Sri Lanka: Although Sri Lanka has reported length frequency data for swordfish and marlins in recent years, the lengths reported are considered highly uncertain, due to mislabelling of marlins and likely sampling bias (large specimens of swordfish and marlins are highly processed and not sampled).
7. Longline fishery of Indonesia: Indonesia has reported size frequency data for its fresh-tuna longline fishery in recent years. However, the samples cannot be fully broken by month and fishing area (5x5 grid) and refer mostly to the component of the catch that is unloaded fresh. The quality of the samples in the IOTC database is for this reason uncertain.
8. In addition, the WP recommended that Japan and Taiwan,China provide the entire size frequency data series for their longline fisheries as per the IOTC standards.
9. The WPB recommended that the Chair of the WPB works intersessionally with the IOTC Secretariat in the preparation of a template logbook form for gillnet fisheries, to be presented to the next session of the IOTC Scientific Committee.
10. With regards to research, the WPB agreed that the following issues have to be addressed as a matter of priority:
    a. Based on recommendations last year and the assessments conducted in 2010, the WPB still considered determination of stock structure as a research priority as the information available tends to indicate localized depletion in certain areas, notably the SW. Ongoing initiatives, such as IOSSS and SWIOFP, should provide better information on the stock structure in 2011/2012. IOSSS and Taiwan,China to discuss collaboration on genetic analyses regarding the large scale biological sampling conducted by the observer programme in tropical areas in 2009. The WPB continued to encourage the countries in the region to cooperate with those initiatives. These programmes should also be complemented by support to tagging programmes in both longline and sport fisheries.
    b. The WPB welcomed the introduction of standardised CPUE series in 2010 from La Reunion and Seychelles but identified Spain and Portugal as potentially having useful series for inclusion in assessments in 2011, particularly to further explore the SW area. The WPB recommended the ongoing development of the spatially disaggregated approach.
    c. The WPB recommended investigation the historical coverage of logbooks for Taiwan,China.
11. In 2010, the WPB identified the following new issues concerning research on billfish species.
12. The WPB recommended examining inter-annual anomalies as an appropriate way to identify environmental effects that are relevant for describing inter-annual variability in CPUE and that this work should be pursued in the inter-sessional period.
13. The WPB recommended continued exploration of the apparent depletion in the SW area.

RECOMMENDATIONS OF THE SIXTH SESSION OF THE WORKING PARTY ON ECOSYSTEMS AND BYCATCH

On Data

1. The WPEB expressed strong concern about the lack of implementation of IOTC measures concerning bycatch data collection and reporting by most IOTC CPCs, noting that it is impossible for the WPEB to fulfil its mandate without appropriate data. Therefore the WPEB urged all countries concerned to address the issues identified on Table 2 as soon as possible, requesting the IOTC Secretariat to assist countries in the implementation of these activities, where required and possible.
2. The WPEB recommended the actions described in Table 2, Table 3, Table 4 and Table 5 be taken to improve the standing of the data on non-tuna species currently available at the Secretariat.
3. The WPEB recommended that, in addition to the implementation of the Regional Observer Scheme, the collection of scientific data by all other means available including auto-sampling (collection of data by trained crew) and electronic monitoring (sensors and video cameras) be encouraged and developed.
4. The WPEB noted that Resolution 10/04 does not require that detailed observer data be submitted to IOTC. However, in order for the scientists of the WPEB to undertake comprehensive analysis on bycatch such data are required, and the WPEB recommended that all the data gathered by national observer projects should be submitted to the Secretariat.

On Sharks

5. The majority of the WPEB proposed that sharks be landed with fins attached (which includes partially cut and folded).
6. The majority of the WPEB proposed to update the list in Resolution 08/04 of shark species requiring mandatory reporting in longline logbooks.
7. The WPEB reiterated the need for better collection and reporting of catch (including historical data), landings and biological data on sharks.
8. The WPEB recommended work to collect data and conduct research which could contribute towards and assessment of whale sharks and to explore the potential for further work on manta rays.
9. The WPEB recommended work to identify catch ad catch rate trends and any other indicators of stock status of sharks
10. The WPEB recommended that the IOTC Secretariat complete the shark ID cards before its next meeting
11. The WPEB noted the need for expertise in shark assessment, and recommended the participation of appropriate experts at its next session.
12. The WPEB recommended that research programmes be continued on the major pelagic species (namely blue sharks, silky sharks and oceanic whitetip sharks)and that the possibilities of using a wide range of research techniques (including tags of all types, genetics, stable isotopes), be explored to provide information required for stock assessments.
13. The WPEB recommended that all IOTC CPCs should start or complete their NPOA-sharks
14. The WPEB recommended that peer-reviewed reviews of the literature relating to pelagic sharks and their fisheries be undertaken to make such information more readily and widely accessible.
15. The WPEB supported research on mitigation techniques, including the initiatives of the EU and ISSF.
16. The WPEB recommended that the IOTC should continue to collaborate with Kobe process and with the CMS MoU on sharks.
17. The WPEB recommended that the IOTC Secretariat should engage a staff member for bycatch issues (with draft TORs to be developed for the SC).

On Seabirds

18. The WPEB recommended that following the Level 1 Risk Assessment, work commence on a Level 2 or

possibly Level 3 Risk Assessment to highlight areas of elevated risk to the high priority species. A highly quantified model-based Level 3 analysis would require the provision of additional resources.

19. The WPEB recommended that the Secretariat finalize the production of seabird identification sheets.
20. The WPEB proposed a revision to Resolution 10/06 to take into account the new scientific information on the negative impacts of line shooters on sink rates, and consequent risk that this poses to seabird bycatch, on the effectiveness of line weighting regimes and the absence of any scientific information on the effectiveness of offal discard management in reducing incidental mortality of seabirds, noting that more scientific information may be provided during the Scientific Committee.
21. The WPEB recommended that the National Action Plan for Amsterdam Albatross, currently being finalized by France, be submitted to the WPEB for review in 2011.
22. The WPEB encouraged CPCs to develop systems, such as retention of carcasses for later identification, or establish photo identification processes, to improve identification of seabirds to species level.
23. The WPEB recommended that CPCs conducting gillnet and driftnet fishing should collect information on seabird interactions and report back to at WPEB 2011. In addition the WPEB should review the study of bycatch in global gillnet and driftnet fisheries, which is currently being undertaken by the Convention on Migratory Species (CMS), and consider recommendations and findings relevant to IOTC fisheries.
24. The WPEB recommended that CPCs fulfil their FAO obligation to assess the need for NPOA-seabird and develop plans if appropriate. To assist in this the Secretariat should prepare a table summarising progress towards the development of NPOA-Seabirds by CPCs for the next Scientific Committee.

On Marine Turtles

25. The WPEB recommended to carry forward recommendations from 2009 that have yet to be completed (*i.e.* purse-seine fisheries to use ecological and biodegradable FADs, longline vessel are equipped with the necessary tools to remove hooks from turtles to ensure safe release and minimize post-release mortality).
26. The WPEB recommended to select the fisheries with the highest bycatch rates and to direct the recommendations in particular to those fleets and countries.
27. The WPEB encouraged that more research is conducted on longline mitigation measures, and a review of information on interactions and mitigation measures is conducted.
28. The WPEB recommended that more cooperation is developed between the IOTC Secretariat, its CPCs and IOSEA, in particular with regard to review and exchange available information on tuna fisheries-turtle interactions and mitigation. It also recommended that distant water fishing nations should join the MoU, which had initially been directed toward Indian Ocean coastal countries.
29. The WPEB recommended that the comprehensive 'Assessment of the conservation status of the leatherback turtle in the Indian Ocean and South-East Asia', prepared by IOSEA in 2006, be reviewed, especially with regard to its recommended follow-up.
30. The WPEB recommended that the sea turtles identification sheets should be finalized by the Secretariat before the next Session of the WPEB, in cooperation with other relevant organisations.
31. The WPEB recommended that a matrix is developed in order to follow the implementation of the IOTC Recommendations and Resolutions related to bycatch and in particular to the sea turtles in the different CPCs.
32. The WPEB recommended that more turtle experts should participate at the next Session of the WPEB.

On Marine Mammals

33. The WPEB recommended that countries with tuna driftnet fisheries to study and report on cetacean bycatch.
34. The WPEB recommended that available whale data from the European purse-seine fishery to be reviewed and analysed.
35. The WPEB recommended that marine mammal experts, for example from NGOs and IGOs with an interest in the Indian Ocean such as International Whaling Commission, to be encouraged to participate in future meetings of the WPEB.

On Other Species

36. The WPEB encouraged further work on other fish species commonly caught as bycatch in the purse-seine

fisheries, *i.e.* oceanic triggerfish, rainbow runners, dolphin fish, *etc.*

37. The WPEB encouraged research on anchored FADs and their effect on bycatch.
38. The WPEB recommended that any data collected in Maldives on anchored FADs is made available to researchers.

On Depredation

39. The WPEB recommended that more research and monitoring is conducted on the subject of depredation in the Indian Ocean.

On Ecosystem Approaches

40. The WPEB recommended that the ERA undertaken last year on bycatch of sharks in the purse-seine fishery should be updated for next year and recommended that as priority an ERA should be undertaken on sea turtle bycatch within the purse-seine fishery

RECOMMENDATIONS OF THE TWELFTH SESSION OF THE WORKING PARTY ON TROPICAL TUNAS

On Data

1. The WPTT noted that some of the issues identified in Table 1 have been outstanding for several years urging the countries concerned to consider addressing such issues as soon as possible. In this regard, the WPTT requested the countries concerned to report to the next meeting of the WPTT about the actions undertaken and progress achieved in addressing these issues. In addition, the WPTT requested the IOTC Secretariat to follow-up on these issues, assisting the countries concerned where required (paragraph 6).
2. The WPTT recommended that complete and good quality data should be reported to the Secretariat as per IOTC requirements for all the fisheries, and that this issue is brought to the attention of the Scientific Committee with a view of reporting to the Compliance Committee (paragraph 9).
3. The WPTT recommended that the Secretariat maintains its support to developing countries in the IOTC region regarding data collection and processing, through the IOTC-OFCF Project or other initiatives (paragraph 11).
4. The WPTT acknowledged the important information provided in relation to Iran's yellowfin fisheries as well as yellowfin biology and ecology in that area. The WPTT further noted that, to date, the IOTC has not received information concerning the fishery information from Iran and, thus, the WPTT recommended that effort are carried out to collect and report to IOTC the necessary information on Iran's fishery statistics (paragraph 61)
5. The WPTT noted that the purse-seine fleet is still unloading significant amount of fish in Antsiranana port, however, it noted that data on artisanal catches are still missing from the database hosted at the Secretariat. It encouraged that a statistical system is developed and implemented in order to report on those catches, which are being estimated by the Secretariat at the moment (paragraph 66).
6. As the catch statistics provided by Sri Lanka to Sri Lanka do not contain estimates of bigeye catches, the WPTT recommended that the species composition obtained in this study is provided to IOTC Secretariat in order to improve Sri Lanka catch statistics in IOTC (paragraph 76).
7. The WPTT acknowledged that biology of the fish in the area is unknown and noted that fisheries data for the region is very scarce. It recommended that detailed fisheries data and statistics are reported to the Secretariat for the region (paragraph 97).

On Data Analysis

8. The amount of data generated during the tagging programme is being used in multiple ways by scientists and is bringing to the table a considerable amount of new information on this species in the Indian Ocean. The WPTT encouraged further analysis to be conducted on the tagging data (paragraph 21, 34, 46).
9. Various studies undertaken for the 10th Session of the WPTT demonstrated that growth is following a multi

stanza pattern. Since that study, more recapture of large fish have been reported, and the analysis should be updated in order for the various models to estimate a reliable L_{inf}. However, the WPTT recognized that a lot of information is being missed due to the lack of reporting by the longline fisheries of the Indian Ocean which could provide valuable returns of large tagged fish (paragraph 22).

10. Various studies undertaken for the 10th Session of the WPTT demonstrated that growth is not following a Von Bertalanffy curve but a multi-stanza pattern, but the lack of recoveries of large fish did not allow the various models used to reliable estimate the asymptotic length, L_{inf}, at that time. New analyses have been conducted and preliminary results were presented during this session of the WPTT, which recommended that they are pursued further, as they include new recoveries of large fish (paragraph 35).
11. Various studies undertaken for the 10th Session of the WPTT demonstrated that growth is following a Von Bertalanffy curve, however these analysis should be refined as since then, numerous new recaptures have been reported (paragraph 47).
12. The WPTT noted that the proportion of bigeye and yellowfin in the catch from the Thai purse seiners is very different from the proportion of bigeye and yellowfin in the European and Seychelles purse seine fleets which are operating in the same area. In fact, there is far more bigeye in the Thai catch. The WPTT recommended to investigate this issue, as this could come from a problem in the sampling (paragraph 56).
13. The WPTT recommended that more work is carried out on catchability and selectivity of longliners and purse-seiners integrating the environmental factors described in this study. It was also noted that these data should be analysed at different scale in order to identify “hot spots” (paragraph 78).
14. The WPTT recommended the use of Brownie and Petersen models to derive more consistent natural mortality rates based on the latest RTTP-IO data (paragraph 101).
15. The WPTT recommended that further exploration of this analysis is conducted, especially on the reasons for the estimates of F at age obtained. Explorations of alternative estimators using the same data should also be attempted in order to understand how much of results observed are driven by the data and how much is dependent on the assumptions of the model being violated. The WPTT also encouraged the development of a multiyear Brownie-Petersen estimator to directly estimate M for next year meeting (paragraph 105).
16. The assessment using MFCF is still a work in progress, and would need to be pursued and refined at the next Session of the WPTT. In the meantime, the WPTT recommended to explore the possibility of developing a Kobe II Strategy Matrix for MFCL which could be presented at the next Session of the Scientific Committee (paragraph 153).
17. The MFCL and SS3 integrated models enabled scientists to use the fisheries and tagging data, as well as other information for and the WPTT recommended their use in the future (paragraph 154).
18. The group acknowledged that in the current WPTT session several different models were presented, which allowed the contrasting of model results and the simulation of different dynamics and hypothesis. To this end, the WPTT suggested that a range of stock assessments approaches continues to be conducted, integrated or not, in the future (paragraph 155).
19. The group recommended that the efforts put in the development of this [bigeye] assessment using SS3 and including the tag data are continued, and refined at the next Session of the WPTT (paragraph 190).
20. The use of a FAD-deployment database available in the Maldives was encouraged in future approaches to improve the time series of CPUE by including the number of FADs in the catch rates standardization process (paragraph 200). Acknowledging the usefulness of standardizing CPUE for skipjack, the WPTT recommended that the work is pursued and that progress are presented at the next Session (paragraph 203).
21. It was noted that skipjack assessment are difficult to conduct in all RFMOs, however the group recommended that a stock assessment is conducted next year, and that a range of models as well as of fisheries indicators should be used to give a comprehensive picture of the current stock status (paragraph 205).
22. The WPTT considered that MSE and similar procedures are of great interest for IOTC and encouraged researchers to work on this issue over the coming year (paragraph 230).
23. The participation of Dr Adam Langley, as a consultant with expertise on integrated stock assessment models, was also welcomed, and the WPTT recommended that his engagement be renewed for the coming year (paragraph 243).

On Research

24. The WPTT acknowledged the importance and implications on the assessment of yellowfin tuna of the results

[sex ratio by length] discussed in this paper and, thus, the WPTT recommended that effort are directed to measure the sex and length for any large tagged recovered fish (paragraph 80).

25. The WPTT acknowledged the importance of biological information to be considered in the assessment models. With respect to future work in this area, the WPTT recommended that the gonad collection and calculation of the gonadosomatic index for yellowfin continue (paragraph 95).
26. The low rate of recovery from the longline fleets, able to capture larger fish, was noted as limiting the use of the tagging data to inform on some of growth parameters for yellowfin and bigeye. The asymptotic length of fish, L_{inf}, can only be reliable estimated if a sufficient number of fish are tagged and recovered that have grown to very large sizes. The WPTT encouraged scientists involved with those fleets to step up their efforts to aid at the recovery of tagged fish caught by those gears (paragraph 211).

On Management

27. The WPTT recommends that catches of yellowfin tuna in the Indian Ocean should not increase beyond 300,000 t in order to bring the stock to biomass levels that could sustain catches at the MSY level in the long term. If recruitment continues to be lower than average, catches below MSY would be needed to maintain stock levels (paragraph 171).
28. Under the light of this the WPTT recommends that bigeye catches are kept at or lower than the 2009 level (paragraph 197).

On Piracy

29. The WPTT recommended that French scientists investigate further these changes in activity, possibly by means of VMS data. The WPTT noted that there were also some significant effects on the Spanish and Seychelles purse-seine fleet affecting their fishing strategy, and that this should be investigated as well (paragraph 232).
30. An on-going analysis on the effects of the piracy activities on catch rates of purse seine fleets was mentioned to the WPTT. The authors were encouraged to present their findings at the next meeting of the Scientific Committee (paragraph 234).

On the Meeting Participation Fund

31. The WPTT acknowledged with satisfaction the participation of several scientists from the IOTC developing Members, *i.e.* China, Comoros, Iran, India, Kenya, Indonesia, Madagascar, Sri-Lanka, Thailand and Cooperating non-Contracting Parties, *i.e.* Maldives. It was noted that this was made possible by the Meeting Participation Fund decided by the Commission at its 14th Session in 2010 (Resolution 10/05). The WPTT firmly welcomed this initiative as this has significantly increased the number of countries present at WPTT meetings. The WPTT encouraged the Scientific Committee to inquiry the Commission on possible avenues to maintain this fund (paragraph 241).

Recommendations of the Seventh Session of the Working Party on Data Collection and Statistics

1. The WPDCS stressed the need to maximize participation of scientists from coastal countries to future meetings of the WPDCS urging countries in the region to make the necessary arrangements to attend future meetings.
2. The WPDCS noted that the issues listed on paragraphs 17 and 18 of the WPDCS Report represent a first attempt to identify the main problems existing at present, recommending that these issues be addressed as a matter of priority.
3. Statistics not available:
    - Very incomplete statistics from the industrial longline fishery of India.
    - Complete lack of statistics from the artisanal fisheries in Yemen.
    - Complete lack of statistics from industrial longliners operating under flags of non-reporting countries.

- Lack of size frequency data for the fresh-tuna longline fisheries of Taiwan,China.
- Lack of statistics from industrial longliners of Indonesia and Malaysia not based in their territories.
- Lack of catch-and-effort data for longliners from Indonesia.
- Lack of catch-and-effort data and detailed size frequency data for the oceanic gillnet fisheries of Pakistan and Iran and the gillnet/longline fishery of Sri Lanka.
- Lack of catch-and-effort and size frequency data for the artisanal fisheries of India.
- Complete lack of statistics from the artisanal fisheries of Madagascar and Comoros.

4. Statistics incomplete:
   - Insufficient time-area coverage for size sampling data for important longline fleets, in particular Japan.
   - Catches not fully by species and/or gear for large-scale and medium-scale purse seine fisheries of Indonesia, Malaysia and Thailand and for the gillnet/longline fishery of Sri Lanka.
   - Size frequency statistics not reported by IOTC standards for the fisheries of Japan, Indonesia and Malaysia.
   - Total levels of bycatch of sharks, seabirds and marine turtles unknown.
5. The WPDCS noted the changes in the estimates of catches of albacore following a review by the Secretariat using data provided by the ISSF and Export Statistics from Indonesia. The WPDCS noted that the new catches estimated for 2003-09 represent more than twice catch values in the past. It was also noted that the new catches derived for the fisheries in Madagascar may be too high. The WPDCS requested the Secretariat to follow-up on these issues to ensure that the catches in the IOTC database are as accurate as possible.
6. The WPDCS urged countries having fisheries for neritic tuna species to collect the data requested as soon as possible and report this information to the IOTC.
7. The WPDCS reiterated the need for Japan to increase length frequency sampling on its longline fleet, including length frequency data for main shark species.
8. The WPDCS noted that, to date, no countries have provided lists of certified observers or observer reports to the Secretariat, urging the countries concerned to provide this information as soon as possible.
9. The WPDS endorsed the process currently being undertaken by the Secretariat to develop a scoring system to assess the quality of data being reported to the Secretariat. The WPDCS noted that the allocation of scores to all data items in the IOTC databases will require a lot of time and effort from the Secretariat, agreeing that the process shall be implemented gradually, with yellowfin tuna, bigeye tuna and swordfish assessed at the start.
10. The WPDS noted that although there are some concerns in describing additional uncertainty in stock assessment advice to the Commission, it was agreed that the inclusion of upper and lower bounds for possible catch histories would be important to include in sensitivity analysis during the stock assessment process.
11. The WPDS recommended that the Secretariat develop a range of uncertainty estimates (alternate catch histories) for a single species for consideration by the WPTT and/or WPDS in 2011.
12. The WPDCS noted that Iran has requested the assistance of the IOTC Secretariat to address the recommendations from the IOTC Scientific Committee, recommending that the Secretariat plans for a visit to Iran during 2011 and reports back on the findings to the next meeting of the WPDCS
13. The WPDCS recommended that Sri Lanka reports the catch-and-effort data available to the IOTC, as per the existing IOTC standards.
14. The WPDCS expressed concern that, to its knowledge, no actions have been undertaken to address these issues, recommending the Secretariat to contact Pakistan to follow-up on these issues.
15. The WPDCS agreed on the need to implement minimum requirements for gillnet and pole-and-line fisheries as soon as possible, in line with those implemented for industrial purse seine and longline fisheries. The WPDCS agreed on the minimum requirements for gillnet (as presented in Appendix VI) and pole-and-line (as presented in Appendix VII) fisheries. The WPDCS also agreed that initially these requirements should apply only to decked vessels 15 meters length overall or greater.
16. The WPDCS noted that the identification of bigeye tuna, marlins, sharks and marine turtles by species may be difficult by fishermen onboard fishing vessels, recommending that the Secretariat disseminate identification cards for these and other species, in particular to countries having gillnet fisheries.
17. The WPDCS recalled its recommendation for scientists from the EU and Thailand to explore the use of size data collected on EU vessels for the same areas and periods to adjust the species composition from logbooks reported by Thai purse seiners.
18. The WPDCS noted with concern that Indonesia and Malaysia have not reported catches or other statistics for

longliners under their flag based outside their territories. The WPDCS urged these countries to make the necessary arrangements for these data to be collected and provided in the future.

19. The WPDCS recommended that the Secretariat assist Iran in the estimation of catches and reporting of data to the IOTC.
20. The WPDCS recommended that countries having sampling schemes or planning to implement those assess the precision of estimates of catches from those schemes considering different levels of coverage and report the results to the WPDCS. The WPDCS requested the IOTC Secretariat to assist countries, as required.
21. The WPDCS noted that paragraph 9 of Resolution 10/04 contains provisions for the reporting of numbers of fishing vessels monitored and the coverage achieved by gear type, by year to both, the Executive Secretary and the Scientific Committee. The WPDCS recommended that this information is also provided along with the statistics reported to the IOTC (IOTC Resolution 10/02).
22. The WPDCS noted that, to date, many countries have not completed questionnaires, encouraging countries to provide this information as soon as possible and requested the Secretariat to report progress to the next meeting of the WPDCS.
23. The WPDCS noted that Thailand and Mauritius are currently the only source for size frequency data for fresh-tuna longliners, as Indonesia has discontinued data collection for its fishery. The WPDCS recommended that, in order to increase sample numbers, the IOTC Secretariat considers providing assistance to these countries, where required.
24. The WPDCCS recommended that the Secretariat continue to provide assistance to the Maldives to improve its data holdings.
25. The WPDCS noted that, in addition to the activities implemented with the assistance of the IOTC-OFCF Project, the SWIOFP is to implement a catch assessment survey for fisheries around anchored FADs, recommending that IOTC-OFCF and SWIOFP coordinate their work so as to avoid duplication of efforts.
26. The WPDCS noted that the same number of natural and artificial FADs have been reported for purse seiners under EU-France, agreeing that these figures are not reliable, as the numbers of FADs are likely to change significantly depending on the season. The WPDCS recommended EU scientists to look into this issue and report to the next meeting of the WPDCS.
27. The WPDCS thanked the OFCF for extending its support to improving statistical systems in the region, to assist countries in the implementation of sampling schemes (IOTC Resolution 10/04), recommending that the Project considers extending assistance in the future.
28. The WPDCS recommended that countries that benefitted from activities funded by the IOTC or the IOTC-OFCF Project make every possible effort to maintain these activities once the support is discontinued.

APPENDIX V
NATIONAL REPORT ABSTRACTS

AUSTRALIA

Document IOTC-2010-SC-Inf01. 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) Convention Area. In 2009, four Australian longliners (three from the Western Tuna and Billfish Fishery and one from the Eastern Tuna and Billfish Fishery) operated in the IOTC Convention Area. Together they caught 19.9 t of albacore tuna (*Thunnus alalunga*), 61.7 t of bigeye tuna (*Thunnus obesus*), 11.7 t of yellowfin tuna (*Thunnus albacares*), 349.3 t of broadbill swordfish (*Xiphius gladius*) and 0.3 t of striped marlin (*Tetrapturus audax*). These catches represent less than 14 per cent of the peak catches taken by Australian vessels fishing in the IOTC Convention Area in 2001, for these five species combined. 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 catch of southern bluefin tuna (*Thunnus maccoyii*) in the purse seine fishery was 4882 t in 2009. The 2009 purse seine catch of skipjack tuna (*Katsuwonus pelamis*) was 855 t, representing 82 per cent of the peak catches taken by Australian vessels fishing in the IOTC Convention Area in 2001 (1039 t). In 2009, approximately 11 t of shark were landed by the Australian longline fleet operating in the IOTC Convention Area.

BELIZE

No report supplied.

CHINA

Document IOTC-2010-SC-INF07. Longlining is the only fishing method used by Chinese vessels to catch tuna and tuna-like species in the IOTC waters. The number of longliners operating in the Indian Ocean reduced from 46 in 2008 to 32 in 2009 due to piracy, with the main fishing area of 40 ºE ~ 85ºE and 5ºN ~15ºS. Chinese fishing fleet caught 4,500 t of tunas in 2009, 36.6 % lower than the previous year, among which 2661 t of bigeye tuna, 453 t of yellowfin tuna, 241 t of swordfish , 241 MT of blue shark, 75 t of shortfin mako, 56 t of oceanic whitetip shark ,389 t of albacore and 196 t of other fishes.

Two observers were placed on board the tuna longliners in the Indian Ocean in 2009, covering the area of 15°00´S~ 32°00´S and 60°00´E ~ 80°00´E. 100 % log book coverage has been implemented and 80% of the log books have been returned by the end of November 2010. China provided length frequency data for four species (ALB, BET, YFT and SWO) caught by longliners operating in IOTC waters.

COMOROS

Document IOTC-2010-SC-INF04. Fishing in Comoros is exclusively artisanal, and operated on 3-9 m motorized or non-motorized wooden or fibreglass non-decked vessels. Comorian fishing exploits mainly pelagic species (*Thunnus albacares, Katsuwonus pelamis, Istiophorus platypterus, Thunnus obesus, Euthynnus affinis*) and contributes entirely to the population's diet, while providing 55% of total jobs in the agricultural sector, *i.e.* about 8,000 fishermen. According to the latest statistics in 1994, the production was estimated at about 9,822 tonnes. Troll line, drop line and few nets for small pelagic species are the main fishing techniques used. A trip lasts between one to seven days. For technical and financial reasons, since 1995 we haven't been able to continue data collection and processing. Thanks to technical and financial support from the IOTC and the OFCF, Comoros will be able to start anew the statistical programme early in 2011.

Semi-industrial and industrial fishing are non-existent in Comoros at the national level. This fishing activity is operated by a foreign fleet through a Fishing Agreement. The catch of this fleet isn't unloaded nor transhipped in the country.

ERITREA

No report supplied.

EUROPEAN UNION

OVERVIEW

Document IOTC-2010-SC-Inf05. In compliance with IOTC Resolution 10/02, scientific data on all fleets were submitted to the IOTC. The EU fleet is composed of different EU Member State fleets (Spain, France, Portugal and United Kingdom) which submitted their respective scientific data at various times.

All the data required for the work of the Scientific Committee, in compliance with the established legislation, were provided to the IOTC. Following internal reorganization in some research institutes and/or bodies responsible for scientific data management, the submission of some information was delayed. However, the European scientists who participated in IOTC Working Parties also submitted, during their participation, some of the data required for the work undertaken by the Working Parties. In addition, EU experts attending the Scientific Committee will also be able to provide updated or additional information to the data already submitted.

The European Union continues its efforts to harmonize scientific data management, collection and provision.

EU-FRANCE

Concerning France, three fleets are operating tuna fishing activities in the Indian Ocean: purse seiners operating mainly from the Seychelles, longliners based in Reunion, and to a lesser extent the small fishery in Reunion. Although not EU flagged, the results of the French purse seiners based in Mayotte are included in this report. Total tuna catch for French purse seiners in the Indian Ocean amounted to 71,000 tonnes in 2009, which is a markedly lower level than in 2008 (85,000 t) due to a marked decrease in the fishing effort (3,315 fishing days in 2009 instead of 4,844 days in 2008). The species distribution of the catch is marked by a decrease in the catch of yellowfin tunas and stability in the catch of skipjack tunas, linked to a strong proportion of log-associated sets in 2009. Spatial distribution of catches has once again been heavily affected by the impact of piracy. Finally, the observer programme implemented since 2005 that allowed to provide a preliminary assessment of discards and bycatch had to be stopped in mid-2009 due to security reasons and lack of room onboard vessels.

The longline fleet based in Reunion consisted in 2009 of 43 vessels, 15 units over 16 meters of length and 28 units under 16 meters of length. Swordfish remains the target species of this fleet, but tuna catches (yellowfin, bigeye and albacore) have become a majority. The catch and effort data for 2009 are not available for temporary technical reasons. In 2008, the catch amounted to almost 2,600 t, which corresponds to a decrease compared to 2007 (3,300 t) and can be explained partly by a decrease in the fishing effort of some vessels. An observer programme started in 2007, with a 2% coverage rate.

The artisanal fleet represents 80 % of the Reunion fishing vessels. The fleet consists mainly of 2 types of vessels: 5-7 m motorized boats (192 vessels) and 7-12 m more powerfully motorized boats (63 vessels). Most of these vessels use line fishing techniques (troll, bottom, set and drifting lines) and gillnet. The catches of large pelagic fish represent an important portion of the catch of this fleet (over 60% in tonnes); 439 t were estimated in 2009 compared to the 380 t in 2008.

Most of the recommendations made by the Scientific Committee and the different Working Parties concerning France have been or are about to be implemented; more details can be found in the report.

The current French tuna research system (IRD & Ifremer) includes observatory-type activities and a research programme on dynamics of the tropical ecosystem, most of the projects being funded through international, European or national bids. This document provides a description and a progress report on the different projects that continued or started in 2009-2010: SWIOFP, CLIOTOP, MESOBIO, MADE, CAT, ISSF, PROSPER, AMPED, RequIEP, IOSS-Espadon, ANCRE, DYMITYLE. Overall, France actively participated in all the Working Parties organized by the IOTC, with almost 30 scientific contributions presented.

EU-SPAIN

Two Spanish 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 2006 a total of 15 purse seiners and 15 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 2009 were as follows: 33,511 t of yellowfin (YFT), 66,570 t of skipjack (SKJ), 11,781 t of bigeye (BET), 52 t of albacore (ALB) and 3,306 t of swordfish (SWO), resulting in a grand total of 115,220 t. Purse seine catch in 2009 decreased by 10% as a consequence of the important decrease (by 27%) of the catch of yellowfin and (by 10%) of bigeye. Also, longline catch of SWO decreased in 2009 in 16%.Tropical multispecies tuna sampling in 2009 has been carried out to a good level of coverage: 477 samples and 91,694 fish were measured. In 2003 a biological sampling program (including sex ratio and maturity) in the Seychelles cannery was started. A total of 16,148 swordfish (24.5% of the annual catch in number) have been individually measured during 2009. Sex at size data and other biological parameters has been also 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. A Spanish expert on tropical tuna fisheries has been permanently based in Mahé since the beginning of the 90's. Scientists involved in these fisheries have actively participated in the meetings and activities of the DWS, WPTT, WPFC, WPEB and the SC. Thirteen documents have been presented related with tuna, tuna-like and bycatch activities. Research programs are conducted in order to implement the scientific recommendations.

EU-UNITED KINGDOM

In 2009 3 UK vessels operated in the IOTC convention area fishing under EU partnership agreements with Madagascar and Mozambique. Landings totaled 1363 t with the majority of the catch consisting of blue shark (347 t), Yellowfin tuna (108 t) and swordfish (783 t). In 2009 all UK vessels were prohibited from finning sharks at sea and now all sharks must be landed with fins attached. UK vessel owners are also asked to submit details of all interactions with sea birds and sea turtles in the course of their fishing activities.

Logbook data collection is organised at UK ports following vessels landings. In recent years we have had issues with data verification for certain species of fish as the systems in UK did not have the relevant codes. They were wrongly attributed as other species and this is in the process of being corrected. UK vessels operating in the convention area must be fitted with the appropriate fully operational VMS equipment. There were no scientific observer programmes on UK registered vessels in 2009/10.

UK actively participates in the Scientific Committee through the representative of the British Indian Ocean Territories.

EU-PORTUGAL

The catches composition caught by Portuguese longline fleet reflects an activity directed to migratory pelagic fish, namely blue shark (*Prionace glauca*) and swordfish (*Xiphias gladius*), the main species being caught incidentally the finfishes (Osteichthyes), shortfin mako (*Isurus oxyrhinchus*) and tunas (*Thunnus* spp).

Since 2004, the licensing of Portuguese vessels under the Indian Ocean Tuna Commission (IOTC) is conditioned by the implementation of the IOTC Resolution 03/01, which was limited from this year onwards, following the 2003 limitation on the number of licensed vessels.This limitation in number of vessels corresponds to the overall tonnage in GRT or GT given that the possible replacement of the licensed vessels must not lead to any increase of the overall tonnage.The increase in the number of Portuguese vessels, from 2006, was due to a margin that was found in the global licensing of the European Community as a Contracting Party.

Portugal held the data cross-check between fishing logbooks and VMS data in order to achieve a breakdown of catches in rectangles of size 5º x 5º. The 2009 data were the first of this breakdown and responds to an IOTC obligation concerning the catch and effort reporting.

EU-ITALY

No report supplied.

FRANCE

Included in the EU National Report.

GUINEA

No report supplied.

INDIA

Document IOTC-2010-SC-Inf12. Artisanal fisheries for tunas existed in India from time immemorial. However, this fishery was confined to certain pockets of the country, mainly in the Lakshadweep Islands. In the recent past, the tuna fishery in India has expanded mainly by the encouragement through the Government policies for diverting the overcapacity in the continental shelf areas to the oceanic waters. Results of the survey conducted by the Government agencies, revealing high potential for tuna fisheries in the waters around India attracted the entrepreneurs to oceanic fisheries and slowly, but steadily, the country is emerging as a major tuna fishing country in the region. However, this expansion is allowed taking care of the potential as well as the share of the nation in the tuna stocks of the Indian Ocean as a coastal nation.

The total production of tunas and tuna-like fishes, including neritic and oceanic tunas, billfishes and seerfishes during the year 2009 was 135,262 tonnes, against a total production of 158,458 tonnes during the year 2008. There was a reduction in production by the coastal fishery (132,114 t in 2009 against 155,619 t in 2008) as well as oceanic fishery (3,148 t in 2009 against 2,839 in 2008). There was considerable reduction in the quantity of tuna exports during the financial year 2009-10 in comparison with the year 2008-09 (21936 t against 31,094 t).

IRAN

Document IOTC-2010-SC-Inf10. No abstract supplied.

JAPAN

Document IOTC-2010-SC-Inf11. This national report (Japan) describes following 8 issues in recent years (up to 2010), *i.e.* (a) tuna fishery, (b) catch and effort by species and gear, (c) fleet structure, (d) implementation of Scientific Committee recommendations, (e) ecosystem and bycatch, (g) data collection and processing systems and (h) national research programs.

KENYA

Document IOTC-2010-SC-Inf06. During the year 2009, the tuna catches by artisanal fishermen reduced slightly to 295 tons from the 319 tons. The same was observed in the total catch by the fishers with 2009 level at 8,851 tons compared 9,585 tons landed in 2008. The reduction was also observed from the longliner which caught 359 tons compared to 411 tons in 2008. The number of vessels in the Kenyan artisanal fleet has been on the increase as do the gear mostly targeting tuna and tuna like species. The main target gears for tuna fishery were longline hooks, handlines and trolling lines. During the year, longline sharks catches were reported for two shark species (mako and blue shark) while the rest of the sharks were reported as combined. Logbook validation was carried out this year following the introduction of a Vessel Monitoring System. The number of vessels that called to the Port of Mombasa reduced mainly due to piracy and due many of them operating far away from the port. During the year, only four purse seiners delivered their catch directly to the cannery while the rest came through containers and reefers. The tuna landings reduced from 16,000 tons to 7000 tons during the year making it the worst landings in the near past, a sign of the impact of piracy in the region. The artisanal data collection system saw the introduction of trial sampling as a means of improvement in the data capture. A database was developed and data collector trained to undertake sampling in their daily routines. Recreational fishery landed 126 tons of which 22 tons were tuna. The most dominant tuna species caught was yellowfin the made up 82% of the tuna catches.

REPUBLIC OF KOREA

Document IOTC-2010-SC-Inf14. It is with longliners that the Korean distant-water fishery has engaged in fishing for tunas and tuna-like species in the Indian Ocean in 1957. 21 longliners were operated in 2009, which were the smallest number as it ranged from 31 to 24 during previous 5 years. With this fishing capacity, Korean longliners caught 2,978 t in 2009, which was a bit of small increase in about 8% out of the catch of the year 2008. The catch of 4 target species were 903 t of yellowfin tuna, 694 t of southern bluefin tuna, 495 t of bigeye tuna, 325 t of albacore. In addition, 524 t of billfishes were bycatch. 6 t of sharks were also reported but without species identification. Notably, among target species albacore increased 2.7 times and as bycatch billfishes 1.6 times to the catch of previous year, while other tunas decreased in the vicinity of 10%. In 2009, 3 scientific observers were dispatched for monitoring compliance and scientific data collection and, as results, carried out 14.5 % of observer coverage to the total fishing efforts in terms of the number of hooks used.

MADAGASCAR

Document IOTC-2010-SC-Inf10. The total production of Madagascar's fishery increases continuously, thanks notably to the development of traditional fisheries. The catch of the industrial fishery is also increasing. It is to be noted that the big island didn't have a national tuna fleet despite the efforts deployed since the Regional Tuna Projects. However, following the decline in the shrimp stock in the West of Madagascar, attempts to diversify industrial shrimp fisheries into longline and line tuna fisheries have recently been carried out. These attempts concern 16 Madagascan-flagged vessels. This exploration phase ends this year and next year. Unloading and transhipment activities occur in Majunga and Tamatave ports. Significant efforts will have to be implemented for these Madagascan fishing fleets to determine the scientific information relating to tuna activities. Moreover, artisanal, sport and traditional fisheries are significantly important.

The ambition of the Tuna Statistical Unit in Antsiranana (USTA) is to implement the research programme called "Observatory of surface tuna activities in the Madagascar area", as well as the training, expertise and scientific and technical information actions to carry out in partnership with the stakeholders in this field. In addition, the first session of the National Advisory

Council for Fisheries Management (CCNGP) will be held on November 25th and 26th 2010. This council's role is mainly to provide proposals or recommendations to the conception, orientation and planning of the Ministry's policy concerning fisheries and management of fishery resources.

MALAYSIA

No report supplied.

MAURITIUS

Document IOTC-2010-SC-Inf08. The tuna fishery forms the basis for local fish processing industries. Tuna transhipment at Port Louis is another important fish related activity. In 2009, a total of 604 call of fishing vessels was registered and volume transhipped amounted to 35 087 tonnes of fish. The local longliner unloaded 246 tonnes of tuna and related species. Mauritius issued 192 licenses to foreign vessels to operate in its waters during 2009. The sport fishery lands about 350 tonnes of pelagic fishes mostly for the local market. An artisanal tuna fishery has also been developed around fish aggregating devices. Mauritius is implementing all the recommendations of the Scientific Committee. All tuna statistics collected are processed using FINNS and are transmitted to the IOTC regularly. Mauritius has also developed its NPOA-IUU to prevent, deter and eliminate IUU fishing.

OMAN

No report supplied.

PAKISTAN

No report supplied.

PHILIPPINES

No report supplied.

SIERRA LEONE

No report supplied.

SEYCHELLES

Document IOTC-2010-SC-Inf19. The Seychelles national report summarizes activities of the purse seine, longline and semi Industrial fishery .The total catch for the whole Purse Seine fleet in 2009 is estimated at 260,545 t, representing decrease of 7% over the catches reported for 2008. The mean catch rate stands at 24.3 t/ fishing day. For the Seychelles fleet the total catch for 2009 is estimated at 68,339 t, representing an increase of 21% and the mean catch rate stand at28.10 t/ fishing days. Skipjack remained the dominant species accounting for 57% of the total catch for WIO and 59% for the Seychelles catch.

For the longline fishery, a decrease of 18% was recorded in licensed issued and remarkable increase of 84% in logbook return to SFA. The total catch for the Seychelles fleet in 2009 is estimated at 7,930 t obtained from a fishing effort of 15 million hooks. The number of local semi industrial vessel targeting tuna and swordfish increased from 7 in 2008 to 9 in 2009. The total catch for that fishery stands at 329 t representing an increase of 41 in catches .The fishing effort increased by 40% from 345,237 hooks to 481,668 hooks. The CPUE (0.68 t/1000 hooks) was the lowest recorded since the beginning of the fishery. As for the shark fishery, the shark meat and shark fins landed decreased by 91% and 90% respectively compared to the previous year.

Seychelles has revised its logbook format for the Longliners to ensure IOTC requirements of resolution 08/04 are met, submitted most mandatory statistical data and is working towards the implementation of a national observer program.

SRI LANKA

No report supplied.

SUDAN

No report supplied.

TANZANIA

No report supplied.

THAILAND

Document IOTC-2010-SC-Inf13. Neritic tuna and king mackerel species in the Andaman Sea Coast, Thailand comprise 6 species (*Thunnus tonggol, Euthynnus affinis, Auxis thazard, Katsuwonus pelamis* and *Sarda orientalis, Scomberomorus* spp.). These species were caught from purse seine, king mackerel gill net and trawl, while purse seine was the main fishing gear. The trend of neritic tuna catches have been decreasing from 45,083 t in 1997 to 13,093 metric tons in 1999. The production was quite stable around 17,000 t during 1999 to 2008. These neritic tuna species are more or less have its production trend similarity. Three Thai tuna longliners were operated in the Indian Ocean in 2007 and in 2008-2009 only two Thai tuna longliners kept on fishing there. Fishing grounds were mainly in the western of Indian Ocean. The total catches were 1,026.15 t with 1,429 days of fishing effort. The average catch rate of total catch was the highest at 27.24 number/1,000 hooks in 2007 followed by 16.46 and 14.46 number/ 1,000 hooks in 2008 and 2009. Albacore was the dominant species in 2007 followed by yellowfin tuna and bigeye tuna in 2008 and 2009. For Thai tuna purse seine fishery by four Thai purse seiners, nine hundred fifty three operations were conducted in the Indian Ocean in 2008-2009. Fishing grounds were mainly in the western of the Indian Ocean. In 2008 the total catches were 9,614 t with average catch per unit effort 24.78 t/fishing operation. Skipjack tuna was the dominant species caught with 64% of the total. In 2009 the total catches were 11,084 t with average catch per unit effort 25.42 t/fishing operation. Thai data collection and processing system has classifies in this report.

UNITED KINGDOM

Document IOTC-2010-SC-INF03. The United Kingdom British Indian Ocean Territory [UK (BIOT)] National Report summarises fishing in its recreational fishery in 2009 and that undertaken by foreign vessels licensed to fish for tuna and tuna like species during the 2009 / 2010[10] fishing season and in the period up to 31 October 2010 when commercial fishing ceased. On 1 April 2010 the BIOT Commissioner proclaimed a Marine Protected Area (MPA) in the Territory. No further fishing licences have been issued since that date and the last fishing licences expired on 31 October 2010. Diego Garcia and its territorial waters are excluded from the MPA. The recreational fishery remains operational at present.

BIOT does not operate a flag registry and has no commercial tuna fleet or fishing port. 33.8t of tuna and tuna like species were landed by recreational fishers on Diego Garcia in 2009. Length frequency data were recorded for a sample of 418 yellowfin tuna from this fishery. The mean length was 78cm. Sharks caught in the recreational fishery are released alive. With respect to the licensed foreign tuna fisheries in 2009/10 57 licences were issued to 33 foreign longline vessels. The estimated total catch was 1,503t comprising 19% yellowfin tuna, 60% bigeye tuna, and 21% other species. 37 licences were issued to 36 foreign purse seine vessels and their total catch for the 2009/10 season was 5,255t. A further 30t was caught by a purse seiner between 1 April and 31 October 2010. The total purse seine catch consisted of yellowfin tuna (45.50%), skipjack tuna (37.96%), bigeye tuna (16.50%) and minor catches of albacore (0.04%). There was no BIOT observer programme during 2008/09 on the licensed foreign fishery. Some data on bycatch data is, however, available in BIOT longline logbooks (0.97% Albacore; 5.85% Swordfish; 5.83% Marlins; 4.75% Sharks; 4.04% Other fish nei). Recommendations of the Scientific Committee and those translated into Resolutions of the Commission have been implemented as appropriate by the BIOT Authorities and are reported, as are details of research undertaken.

VANUATU

No report supplied.

MALDIVES

Document IOTC-2010-SC-INF15. The Maldives is traditionally a tuna fishing nation with a long history dating back hundreds of years. Fishing is conducted from pole-and-line vessels using livebait. The fleet was mechanized in the 1970s resulting doubling of tuna catches from about 23,000 t in 1975 to over 54,000 t by early 1985. With further increase in vessel size, engine horse power and therefore vessel efficiency tuna catches increased more or less steadily. Tuna catches increased to an

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[10] For the purposes of this report, the fishing season for the BIOT FCMZ (Chagos Archipelago) is defined as running from the 1st of April through to the 31st of March the following year. This season definition is used because the main historical peaks in the purse seine and longline seasons in the BIOT FCMZ (Chagos Archipelago) occur during the months of December and January.

all time record of 167,000 t in 2006 but have been declining since then. The catch of 2009 was about 95,000 t, more than 50% lower than catches reported in 2006.

Aside from the pole-and-line method, longlining and handlining is also conducted. The former is restricted to a licensed foreign fleet operating in the EEZ of 75 miles and beyond, the latter by the local fishermen targeting surface swimming large yellowfin tuna (> 100 cm FL) in the coastal and offshore areas. Issuing of longline licenses have been suspended since March 2010 due to strong opposition by the pole-and-line fishermen.

The national data collection is based on an enumeration system that requires use of conversion factors to estimate total catch. The conversion factors in use are inadequate both in magnitude and its coverage leading to potential bias in the estimate of total catches. Application of a more comprehensive set of conversion factors are hampered by the lack of in-house technical knowledge and the belief that complete overhauling of the database may be required. The value of time series of skipjack CPUE from Maldives pole-and-line data has been recognized by the WPTT. A preliminary attempt at standardizing Maldives CPUE series was presented at the last WPTT meeting and follow up work has been planned for WPTT 2011. Ecosystem and bycatch issues in Maldives are minimal if not negligible as the catches of tuna from the pole-and-line are highly selective. Occasionally dolphin fish (*Coryphaena hippurus*) and rainbow runner (*Elagatis bipplinuatus*) are taken, often targeted during times of poor tuna fishing, but the quantities of catch are minimal and such events are rare.

Maldives has undertaken two small scale tagging programmes in the 1990s releasing close to 14,000 tags with 10-12% recovery. These data have been analysed contributing to improved understanding of skipjack dynamics in the central Indian Ocean. More recently two small scale tagging programmes were undertaken as complementary activities of the RTTP. A well-established size sampling programme is in place where fishermen field officers are employed to sample their catches. Analyses of these data are submitted to the Working Party on meetings. The recreational fishery is not so developed in the Maldives but tourist resorts undertake some recreational fishing targeting sail fish, wahoo and tuna. Records of these are maintained by the resorts and submitted to the Ministry of Fisheries and Agriculture.

SENEGAL

No report supplied.

SOUTH AFRICA

No report supplied.

URUGUAY

No report supplied.

APPENDIX VI
GUIDELINES FOR THE PREPARATION OF NATIONAL REPORTS TO THE IOTC SCIENTIFIC COMMITTEE

The National Report is due to be submitted no later than 15 days prior to the start of the annual regular session of the Scientific Committee.

Purpose: To provide relevant information to the Scientific Committee on fishing activities of Members and Cooperating Non-Contracting Parties operating in the IOTC area of competence. The report should include all fishing activities for species under the IOTC mandate as well as sharks and other byproduct/ bycatch species as required by the Agreement and decisions by the Commission.

NOTE: The submission of a National Report is Mandatory, irrespective if a CPC intends on attending the annual meeting of the Scientific Committee.

Explanatory note

This report is intended to provide a summary of the main features of the tuna and billfish fisheries for Members and Cooperating Non-Contracting Parties. As such, it does not replace the need for submission of data according to the IOTC Mandatory Data Requirements listed in the relevant IOTC Resolution [currently 10/02].

Mandatory versus Desirable information

National Reports must include all headings as noted in the template below as [Mandatory]. Where data/information is not available for a given [Mandatory] heading, the reason why it is not available should be clearly stated.

Where available, CPCs are encouraged to provide additional information under the headings shown as [Desirable].

For clarification on minimum reporting requirements for the National Report, please contact the Secretariat.

[COUNTRY NAME] National Report to the Scientific Committee of the Indian Ocean Tuna Commission, [YYYY]

Authors

Author/s affiliation [organization/s]

INFORMATION ON FISHERIES, RESEARCH AND STATISTICS

<table>
<tr><td>In accordance with IOTC Resolution 10/02, final scientific data for the previous year was provided to the Secretariat by 30 June of the current year, for all fleets other than longline [e.g. for a National report submitted to the Secretariat in 2010, final data for the 2009 calendar year must be provided to the Secretariat by 30 June 2010)</td><td>YES or NO [delete one]

DD/MM/YYYY [Add submission date here]</td></tr>
<tr><td>In accordance with IOTC Resolution 10/02, provisional longline data for the previous year was provided to the Secretariat by 30 June of the current year [e.g. for a National report submitted to the Secretariat in 2010, preliminary data for the 2009 calendar year was provided to the Secretariat by 30 June 2010).

REMINDER: Final longline data for the previous year is due to the Secretariat by 30 Dec of the current year [e.g. for a National report submitted to the Secretariat in 2010, final data for the 2009 calendar year must be provided to the Secretariat by 30 December 2010).</td><td>YES or NO [delete one]

DD/MM/YYYY [Add submission date here]</td></tr>
<tr><td colspan="2">If no, please indicate the reason(s) and intended actions:</td></tr>
</table>

Executive Summary [Mandatory]

[Include a summary of the key aspects of the National Report for the most recent reporting year. This summary will be included in the Scientific Committee report (300 words maximum)]

Contents [*add a table of contents with page numbers* - Desirable]

1. BACKGROUND/GENERAL FISHERY INFORMATION [MANDATORY]

[add a general description of national fleets including national fisheries, methods and fishing area for the previous year]

2. FLEET STRUCTURE [MANDATORY]

[Add a description of the national fleet structure, by gear type, including vessel size and duration of fishing operations.]

Table 1: Number of vessels operating in the IOTC area of competence, by gear type and size *[minimum – most recent five years; Desirable for as long a period as possible]*

3. CATCH AND EFFORT (BY SPECIES AND GEAR) [Mandatory]

[Add a general description of fishing activities by national fleets (by gear type) in the IOTC area of competence, including changes in fishing patterns, fleet operations and target species.]

Table 2. Annual catch and effort by gear and primary species in the IOTC area of competence *[for the most recent five years at a minimum]*. Include a 'not elsewhere indicated – NEI' category for all other catch combined. [Note: Multiple tables may be required *e.g.* **Table 2a, 2b, 2c). [Mandatory]**

Figure 1. Historical annual catch for the national fleet, by gear and primary species, for the IOTC area of competence for the entire history of the fishery/fleet. **[Mandatory]**

Figure 2a. Map of the distribution of fishing effort, by gear type for the national fleet in the IOTC area of competence (most recent year *e.g.* 2009) [*may require a separate map for each gear type*]. **[Mandatory]**

Figure 2b. Map of the distribution of fishing effort, by gear type for the national fleet in the IOTC area of competence (average of the 5 previous years *e.g.* 2005-2009) [*may require a separate map for each gear type*]. **[Mandatory]**

Figure 3a. Map of distribution of fishing catch, by species for the national fleet, in the IOTC area of competence (most recent year *e.g.* 2009) [*may require a separate map for each species*]. **[Mandatory]**

Figure 3b. Map of distribution of fishing catch, by species for the national fleet, in the IOTC area of competence (average of the 5 previous years *e.g.* 2005-2009) [*may require a separate map for each species*]. **[Mandatory]**

4. RECREATIONAL FISHERY [Mandatory]

[A description of recreational fishing activities in the Convention Area. Include information on catches if available]

5. ECOSYSTEM AND BYCATCH ISSUES [Mandatory]

[A description of the overall environmental issues and progress within national fisheries (eg. ecological risk assessments; bycatch action plans) and for individual species groups including:]

Sharks [Mandatory]

[add a brief summary of key national strategies related to sharks, including the status of the NPOA-sharks, National shark finning regulations and trends in shark interactions]

Table 3: Total number and weight of sharks, by species, retained by the national fleet in the IOTC area of competence [for the most recent five years at a minimum, *e.g.* 2004 to 2009]. [Note: Multiple tables may be required for this item]. **[Mandatory]**

Table 4: Total number of sharks, by species, released/discarded by the national fleet in the IOTC area of competence (for the most recent five years at a minimum, *e.g.* 2004 to 2009). Where available, include life status upon released/discard. [*Note: Multiple tables may be required for this item*]. **[Desirable]**

Seabirds [Mandatory]

[add a brief summary of key national strategies related to seabirds, including NPOA-seabirds, current seabird mitigation measures used by the national longline fleet, recovery plans and interactions]

Marine Turtles [Mandatory]

[add a brief summary of key national strategies related to marine turtles, including recovery plan and interactions]

Other ecologically related species (*e.g.* marine mammals, whale sharks) [Desirable]

[add a brief summary of key national strategies related to other ecologically related species such as marine mammals and whale sharks]

Table 5. Observed annual catches of species of special interest by species (seabirds, marine turtles and marine mammals) by gear for the national fleet, in the IOTC area of competence [for the most recent five years at a minimum, *e.g.* 2004 to 2009 or to the extent available] **[Mandatory]**

6. NATIONAL DATA COLLECTION AND PROCESSING SYSTEMS [Mandatory]

6.1. Logsheet data collection and verification (including date commenced and status of implementation)

6.2. Vessel Monitoring System (including date commenced and status of implementation)

6.3. Observer programme (including date commenced and status; number of observer, include percentage coverage by gear type)

Table 6. Annual observer coverage by operation, *e.g.* longline hooks, purse seine sets (for the most recent five years at a minimum, *e.g.* 2004 to 2009 or to the extent available) **[Mandatory]**

Figure 4. Map showing the spatial distribution of observer coverage. **[Mandatory]** [*Recommended spatial resolution = 1 x 1 degree grid*]

6.4. Port sampling programme [including date commenced and status of implementation]

Table 7. Number of individuals measured, by species and gear] **[Mandatory]**

6.4. Unloading/Transhipment [including date commenced and status of implementation] [Mandatory]

7. NATIONAL RESEARCH PROGRAMS [Desirable]

[*a description of research activities covering target and non-target species e.g. biological studies supporting stock assessments; composition of the catch according to length, weight and sex; research on environmental factors, abundance/biomass surveys, oceanographic and ecological studies, etc.*]

Table 8. Summary table of national research programs, including dates.

Example

Project title	Period	Countries involved	Budget total	Funding source	Objectives	Short description
Programme régional de marquage de thons	2009-2013	EU – France and Spain		ED- DG FISH	Observer program: collection of bycatch data	

8. IMPLEMENTATION OF SCIENTIFIC COMMITTEE RECOMMENDATIONS AND RESOLUTIONS OF THE IOTC RELEVANT TO THE SC. [Mandatory]

Table 9. Respond with progress made to recommendations of the SC and specific Resolutions relevant to the work of the Scientific Committee – the Secretariat to provide a table for completion no later than 60 days prior to the next SC meeting.

9. LITERATURE CITED [Mandatory]

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

EXECUTIVE SUMMARY OF THE STATUS OF THE ALBACORE TUNA RESOURCE

(as adopted by the IOTC Scientific Committee in December 2010)

BIOLOGY

Albacore (*Thunnus alalunga*) is a temperate tuna living mainly in the mid oceanic gyres of the Pacific, Indian and Atlantic oceans.. 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, distributed from 5°N to 40°S, 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 (96% on average for the last 5 years), and between 20° and 40°S (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. 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 since 2007 have been fairly high, exceeding 40,000t, with an average annual catch for the last 5 years of 39,100 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). 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 400 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 17,000 t.

The catches of albacore by longliners from the Republic of Korea, recorded since 1965, have never been above 10,000 t. In addition, important albacore catches of around 15,000 t for the last 3 years, have been recorded for a fleet of fresh-tuna longliners operating in Indonesia (Figure 3).

Large sized albacore are also taken seasonally in certain areas (Figure 5), 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 (Figure 1).

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

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 longline 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.

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.

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.

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.

The estimates of catches of albacore in recent years have changed substantially, especially since 2003. This is due to a review of the catches of Indonesian longliners Albacore catches have been around 39,100 t annually over the past five years (2005-2009) and this level is only much higher than the historical average annual catch taken for the past 50 years (24,300 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.

Because of the low value (Figure 7) 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. However, displacement of effort that might have resulted from the increasing piracy in the western Indian Ocean could have some impact on the fishery and the revised catches of Indonesian longliners have drastically increased the total catch since 2003.

Recommendation.

The SC acknowledged the preliminary nature of the albacore tuna assessment in 2008, but noting the available stock status information 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. However, new information and estimation for the Indonesian longline fishery has increase the total catch at levels above the estimated MSY.

The SC recommended that a new albacore tuna assessment be presented to the Scientific Committee at the latest in 2011.

ALBACORE TUNA SUMMARY

Management quantity	2004- (or most recent assessment)	2008 assessment
Most recent catch	32,900 t (2008)	40,600 t (2009)*
Mean catch over the last 5 years (2005-2009)		39,100 t
MSY	26,380 t	Range: 28,260 t – 34,415 t
$\mathbf{F_{2007}/F_{MSY}}$	1.52	Range: 0.48 – 0.91
$\mathbf{B_{2007}/B_{MSY}}$	0.80	
$\mathbf{SB_{2007}/SB_{MSY}}$		
$\mathbf{B_{2007}/B0}$		
$\mathbf{SB_{2007}/SB0}$		
$\mathbf{B_{2007}/B_{2007,F=0}}$		
$\mathbf{SB_{2007}/SB_{2007,F=0}}$		

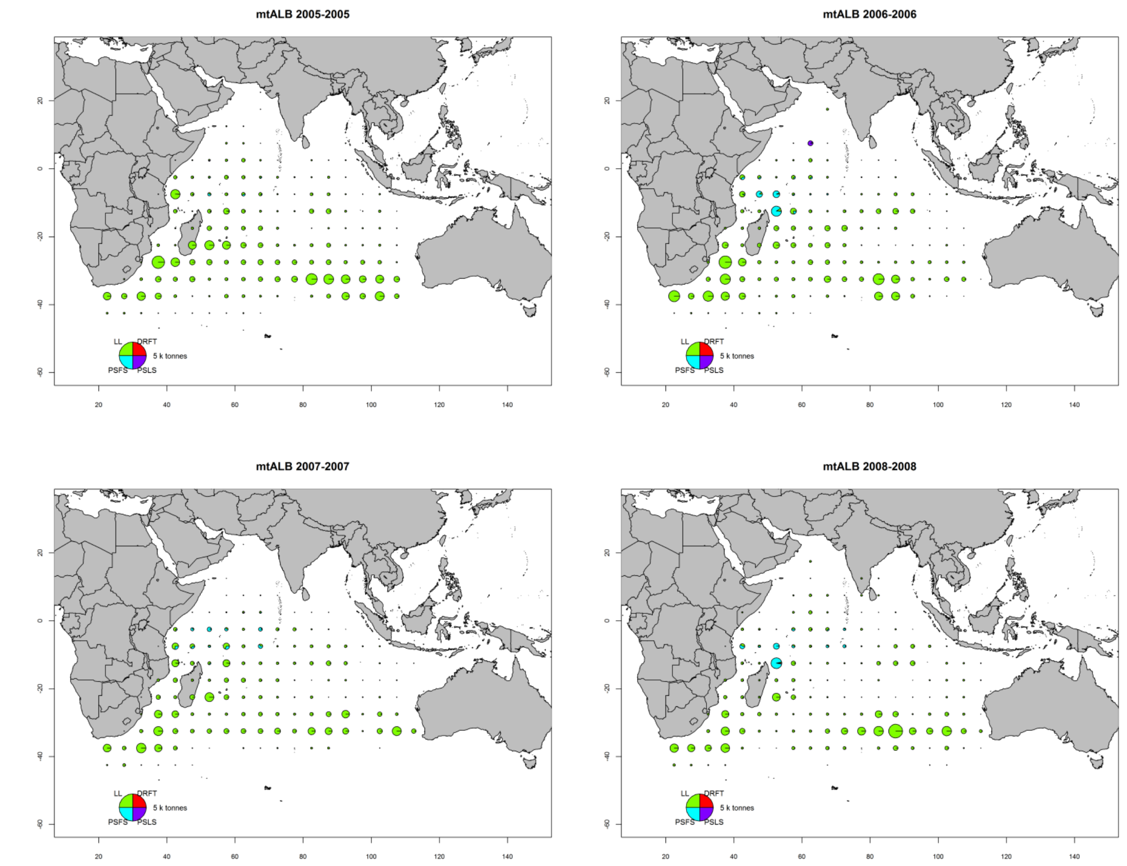
*preliminary catch estimate.

Note: This Executive Summary has been updated to take account of recent catch data. The management advice, and stock assessment results are based on data up to 2007.

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 1960-2009 (in thousands of tonnes). Data as of November 2010.

Gear	Fleet	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	85	86
Purse seine	France																									0.3	0.5	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	0.3	0.2	0.0
	Total																					0.0	0.0	0.0	0.0	0.6	0.7	0.2
Longline	Taiwan,China	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	6.2	11.1
	Indonesia															0.0	0.1	0.1	0.1	0.2	0.3	0.2	0.2	0.2	0.2	0.3	0.3	0.1
	Japan	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	2.3	2.5
	NEI-Deep-freezing																										0.0	0.7
	Korea, Republic of						0.5	0.6	6.2	0.9	4.4	1.7	2.4	3.8	9.1	9.8	3.9	4.3	2.2	4.7	2.0	1.9	1.0	0.7	0.6	0.4	0.5	0.4
	Other Fleets	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.0	0.8	0.2	0.7	0.6	0.5	0.4	0.2	0.1	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.2	0.3	0.0	0.1
	Total	12.1	16.6	19.0	14.2	19.4	13.2	15.6	22.0	19.3	20.9	14.4	13.3	12.7	23.5	30.2	11.7	15.4	12.6	18.2	17.7	13.7	14.8	24.2	19.6	16.8	9.3	14.8
Gillnet	Taiwan,China																							0.1	0.1		0.7	18.2
	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	0.1	0.1	0.0	0.7	18.2
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	0.4	0.1	0.1	0.0	0.0
All	*Total*	12.1	16.6	19.0	14.2	19.4	13.2	15.6	22.0	19.4	20.9	14.5	13.4	12.8	23.5	30.3	11.8	15.4	12.6	18.2	17.7	13.8	14.8	24.7	19.8	17.4	10.8	33.2

Gear	Fleet	Av05/09	Av60/09	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09
Purse seine	France	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	1.0	0.3
	Other Fleets	0.4	0.3	0.0	0.1	0.0	0.3	1.4	1.9	1.0	2.3	0.9	1.2	1.5	1.1	0.4	0.8	0.6	0.5	0.9	0.2	0.1	0.7	0.4	0.5	0.1
	Total	0.9	0.6	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	1.4	0.4
Longline	Taiwan,China	13.3	11.3	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	15.3	14.2
	Indonesia	12.8	2.1	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	3.2	2.8	5.9	12.6	11.6	7.8	13.4	17.1	14.1
	Japan	4.8	4.5	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	6.2	5.3	4.8	3.6
	India	2.0	0.2														0.0			0.0	0.8	0.6	0.7	2.1	3.5	2.9
	NEI-Fresh Tuna	1.1	0.1			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	0.0	0.0	0.1	0.2	0.5	1.4	1.8	1.4
	NEI-Deep-freezing	0.7	1.5	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	0.9	0.2	0.2	0.3
	France-Reunion	0.6	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	0.5	0.5
	Belize	0.5	0.1															1.4	0.6	0.2	0.1	0.7	0.7	0.9	0.3	0.2
	Spain	0.5	0.1											0.0	0.0	0.0	0.1	0.2	0.2	0.1	0.1	0.8	0.6	0.6	0.3	0.3
	Korea, Republic of	0.2	1.3	0.4	0.4	0.3	0.2	0.3	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.1	0.4	0.2	0.3	0.1	0.1	0.4
	Other Fleets	1.2	0.4	0.1	0.2	0.5	0.5	0.6	0.7	0.6	0.8	0.4	0.2	0.2	0.7	0.6	0.6	1.2	1.5	1.5	0.4	0.6	1.0	1.6	1.6	1.2
	Total	37.7	21.7	17.0	14.9	10.2	9.0	17.8	16.0	17.8	22.0	21.8	28.6	25.5	36.4	37.1	36.5	42.4	33.9	24.7	31.5	31.7	28.6	43.3	45.7	39.1
Gillnet	Taiwan,China	0.0	1.9	14.0	14.4	10.6	25.7	9.0	2.6																	
	Total	0.2	1.9	14.0	14.4	10.6	25.7	9.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4
Other gears	*Total*	0.4	0.1	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	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.7	0.7
All	*Total*	39.1	24.3	31.3	29.7	20.9	35.1	29.2	22.0	19.2	24.7	23.2	30.2	27.6	38.1	37.8	37.9	43.9	34.8	26.4	31.9	32.0	30.2	44.6	48.2	40.6



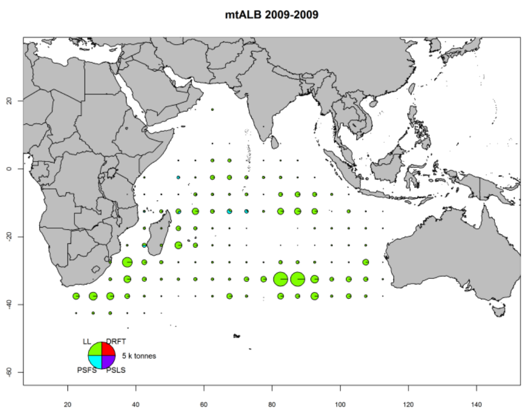


Figure 1. Albacore catches by gear from 2005 to 2009 LL = longline, PSFS = purse-seine free school, PSLS = purse-seine log school, DRFT = drifnet. Data as of December 2010

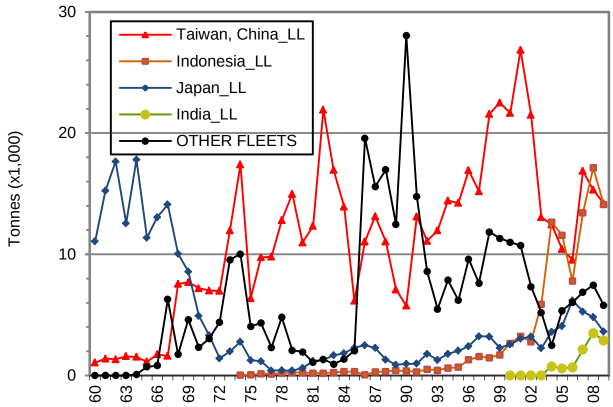


Figure 2. Catches of albacore per fleet and year recorded in the IOTC Database (1960-2009). Data as of December 2010

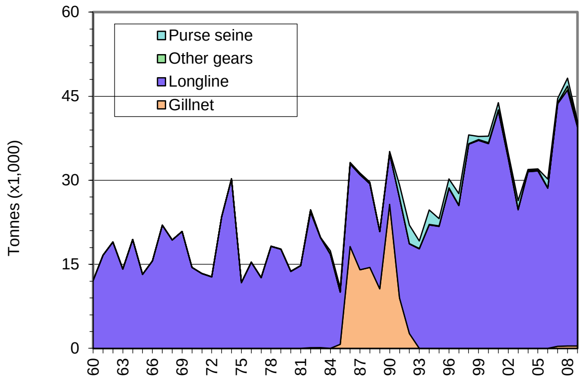


Figure 3. Annual of catches albacore (thousand of metric tonnes) by gear from 1960 to 2009. Data as of December 2010

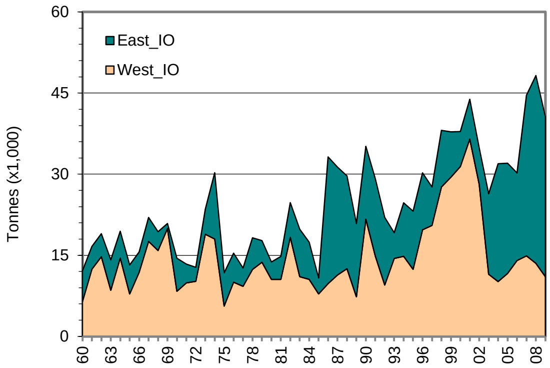


Figure 4. Catches of albacore in relation to the eastern and western areas of the Indian Ocean (1960-2009).Data as of December 2010

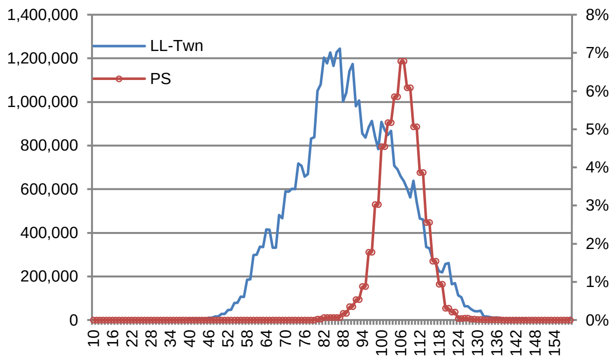


Figure 5. Average sizes of albacore taken by longline (Taiwan,China) and purse-seine fisheries in the Indian Ocean for the period 1980-2009.. Data as of December 2010.

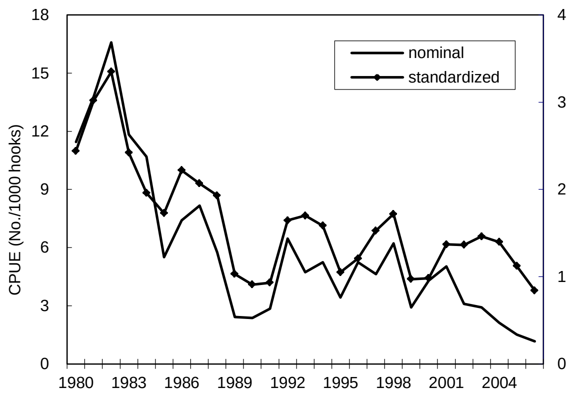


Figure 6. Nominal and standardised CPUE indices for the Taiwanese longline fishery for albacore in the Indian Ocean from 1980 to 2006. (IOTC-2008-WPTe-05)

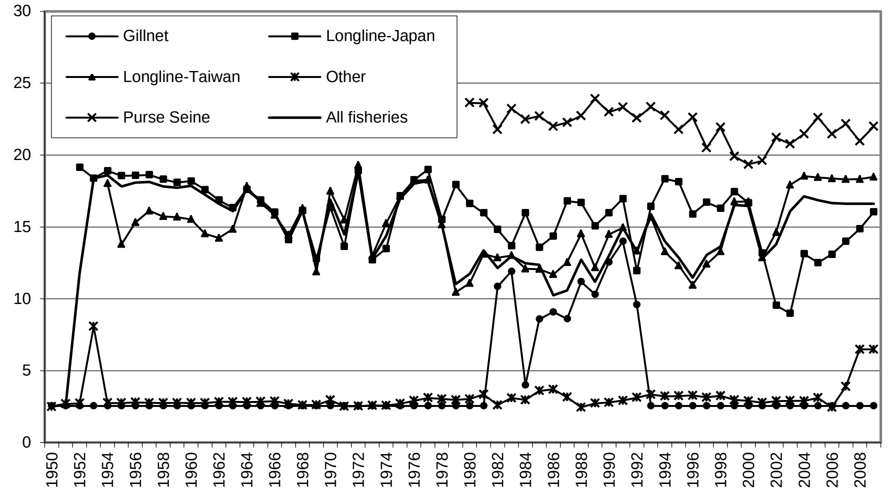


Figure 7. Average weight of albacore per fleet (*i.e.* gillnet, LL Japan, LL Taiwan,China, Purse-Seine, other) from 1950 to 2009 in kg. Data as of December 2010.

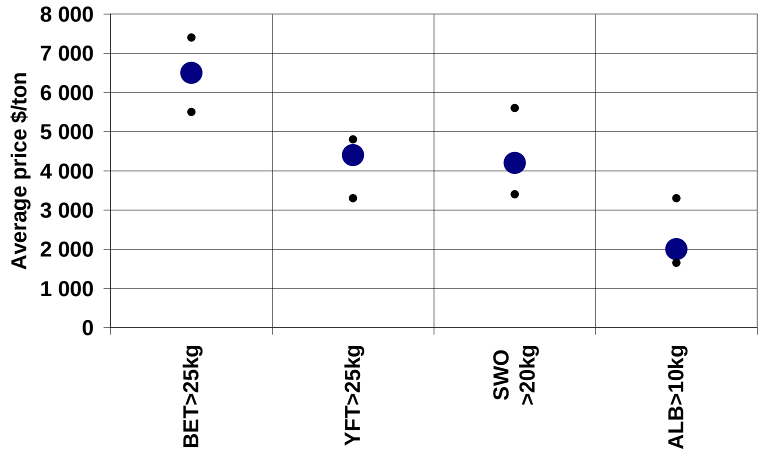


Figure 7. Comparison of the prices of albacore with other species. Data from 2008.

EXECUTIVE SUMMARY OF THE STATUS OF THE BIGEYE TUNA RESOURCE

(as adopted by the IOTC Scientific Committee in December 2010)

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 the positions of reease and recapture for juvenile bigeye is estimated at 657 nautical miles (IOTC-2009-WPTT-24). 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 supports the hypothesis of a two-stanza growth pattern for bigeye tuna with slow growing juveniles, although more work is needed due to limited size range studied . This pattern would be similar to the two-stanza growth pattern now estimated for yellowfin.

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 1993and peaking at 150,000 t in 1999. Total annual catches averaged 122,000 t over the period 2004 to 2008.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 the1950's to reaching 100,000 t in 1993 and around 140,000–150,000 t for a short period from 1997-1999 (Figure 1). The average annual catch by longliners for the period from 2005 to 2009 was 85,400t. Taiwan,China is the major longline fleet fishing for bigeye and it currently takes just under 43.5% of the total longline catch (Figure 5). However, the catches of Taiwanese longliners have decreased markedly in recent years, with current catches of bigeye tuna amounting to less than half the catches recorded in the mid 2000’s. Large bigeye tuna (averaging just above 40 kg) are primarily caught by longlines, and in particular deep longliners. Since the mid 1980’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 2005 to 2009 was 26,800 t. Purse seiners mainly take small juvenile bigeye (averaging around 5 kg) whereas longliners catch much larger and heavier fish; and while purse seiners take much lower tonnages of bigeye compared to longliners, they take larger numbers of individual fish (Table 1).

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). 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 15% 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 obtained from the RTTP-IO tagging programme and this has already greatly improved the knowledge on bigeye growth and movement patterns. Various studies using the tagging data demonstrated that growth is following a multi stanza pattern. However, the lack of recoveries of large fish did not allow the various models used to estimate a reliable L_{inf}. This lack is mainly due to the lack of reporting by the longline fisheries of the Indian Ocean. These data was also analysis to provide estimation of natural mortality at age. A study was undertaken in 2008 but would need to be updated with the new data available. 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 quantification of nominal fishing effort is difficult because the rate of increase in fishing efficiency (use of FADs, technological improvements) is considered a complex exercise. 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 2009) for the Indian Ocean tropical waters is currently used to derive the index of bigeye abundance both for the whole IO and main fishing areas, *i.e.* assessment areas 1, 2, 3,4 and 5 (Figure 1). Since 2006, sea surface temperature and gear characteristics have been included in the GLM standardisation procedure. In the whole Indian Ocean, 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 value in 2002 (Figure 7) and remain around lowest value of the time series, reaching the lowest historical value in 2009. A similar analysis of the Taiwanese CPUE series was also presented in 2009 for the period 1979-2009. After standardisation, this index showed a stable period at the beginning of the series until 2000 then markedly increased up to 2005 to decrease thereafter to the lowest value of the time series in 2007. In 2008 a small increased was observed (Figure 7). A significant difference could be observed between both indices; which, in turn, make the contradictory signals difficult to be used in conjunction in the assessment. 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 up to 2009. Given that a catch-at-size matrix is an integral part of both length and age based assessment methods, the WPTT re-expressed their 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, however reporting rates from the longline fisheries are still very low.

STOCK ASSESSMENT

In 2010, the bigeye assessment represented a synthesis of 288 Stock Synthesis (SS3) models that attempted to encompass the uncertainty and interactions in several key assumptions.

Results

The median stock status results from the WPTT 2010 were similar to those presented in 2009, while the uncertainty was recognized to be greater. The central results suggest that the stock is probably not overfished, and overfishing is probably not occurring (relative to MSY reference points). However, the stock is probably near full exploitation, and the possibility of overfishing cannot be ruled out on the basis of the estimated uncertainty, and the continuing decline in CPUE.

The MSY estimate of 114,000 t represents the median of the point estimates of the full range of models that were combined with a weighting scheme that assigned a different plausibility to the different assumptions (IOTC-2010-WPTT-R). Given that the mean annual catch for the period 2005-2009 was 114,600 t, it appears that the stock is being exploited at around its maximum level. The Kobe plot is shown in Figure 8.

The WPTT undertook projections in stock status under a range of management scenarios for the firt time, following recommendation by the Kobe II meeting in Barcelona in June 2010 to harmonise technical advice to managers across RMFOs. The Kobe II Strategy Matrix for bigeye tuna (table 1) provides a first indication of the likely directions and levels of change in risk associated with various catch levels. Only a limited number of sources on uncertainty have been introduced in the analysis, while possible errors and biases in other inputs and parameters have not been incorporated, nor the strength of their influence explored. Until all significant sources of uncertainty are taken into account, the figures presented in this table should not be considered as precise calculations of changes in the risk levels of exceeding reference values.

Despite the progress made in the 2010 assessment, uncertainties in the results and projections still exist, and many of these uncertainties are not likely to be easily eliminated:

- Uncertainties concerning the available indices of abundance (*i.e.* in relation to targeting shifts, increasing efficiency and changes in the distribution of effort,).
- Insufficient size sampling for the catches of longline fisheries, especially in recent years.
- Uncertainty about the natural mortality at various life stages, including uncertainty about the functional form of its dependency with age.
- The growth curve should be revised to better represent the size of fish aged 0-1 year.
- Further exploration of the integration of the tag data is recommended, including separation of the European and non-European PSLS fleets, and analysis to understand the conflicts between the tagging data and the PS size composition, and the appropriate period of incomplete tag mixing.

Table 6. Kobe 2 Strategy matrix derived from the weighted stock status grid.

Stock status Reference Point	Projection Time frame	Weighted proportion of scenarios that violate the Reference Point				
		C(2009) -40%	C(2009) -20%	C(2009)	C(2009) +20%	C(2009) +40%
$P(B_t<B_{MSY})$	In 3 years	0.19	0.24	0.28	0.40	0.50
	In 10 years	0.19	0.24	0.30	0.55	0.73
$P(F_t>F_{MSY})$	In 3 years	<0.01	0.06	0.22	0.50	0.68
	In 10 years	<0.01	0.06	0.24	0.58	0.73

Notes about exploitation patterns

The exploitation patterns observed from 2003 to 2005 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 temporary, as the fleets appeared to come back to their previous pattern of activity by the second half of 2006.

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 The various developments in the fishery related to the security situation in the waters around Somalia are clearly apparent in maps of the spatial distribution of effort for the main fleets operating in the area (figure 6). Effort was redistributed away from the coasts of Somalia as the number of piracy events increased, and lead to a large decrease in activity, especially by purse seiners, in the second quarter of 2009. The establishment of security measures on board the vessels has brought a return to a nearly-normal distribution of effort, although a number of boats that had left the Indian Ocean have not returned. However, fishing strategies have been modified (*e.g.* French vessels fishing in pairs, reduction of the length of the trips), and it is expected that catch rates and total catch could be significantly impacted

The possibility of an increasing trend in longline fishing power (beyond that which might be corrected for in the CPUE standardization) was admitted in some of the assessment scenarios in 2010, but alternative scenarios based on specific analyses are encouraged for the future.

MANAGEMENT ADVICE

Most tuna fleets operating in the Indian Ocean do not target or catch a single stock or species. The multi-species nature of the fishery, both industrial and artisanal, implies that management measures directed toward a single stock are very likely to have effect on other stocks as well. The direction and magnitude of these secondary effects cannot always be directly inferred given the adaptability of the various fleets.

Current status

The central tendencies of the stock status results from the WPTT 2010 were similar to those presented in 2009, while the uncertainty was recognized to be greater. The weighted results suggest that the stock is probably not overfished, and overfishing is probably not occurring (relative to MSY reference points). However, the stock is probably near full exploitation, and the possibility of overfishing cannot be ruled out on the basis of the estimated uncertainty, and the continuing observed decline in CPUE.

Outlook

The recent declines in longline effort, particularly from the Taiwanese longline fleet, are thought to be causing the recent declines in catches, and this is relieving some of the pressure on this stock. Changes in purse seine effort in the west Somali basin are expected to be less important than those of the longline fleet for this stock.

The changes imposed on the operation of the purse seine fleets by the security situation in their fishing grounds has increased the effort directing to fishing around FADs. This has led to an increase in the catches of juvenile bigeye which could have a negative effect on the outlook for the stock. These changes in the pattern of exploitation should be carefully monitored, and if they persist they should be incorporated in future analyses.

Recommendations

Given the uncertainty on estimated MSY values and the levels of error in the nominal catch data for bigeye, the SC recommended than catches are kept at a level not above the catch estimated at the moment of the assessment for 2009, *i.e.* 100,000 t. This value should give low probability of catches exceeding MSY.

BIGEYE TUNA SUMMARY

Management quantity	2009 assessment	2010 assessment
Most recent catch	107,000 t (2008)	102,200 t (2009)*
Mean catch over the last 5 years (2005-2009)		114,600 t
Maximum Sustainable Yield	110,000 t Range: 100,000 t – 115,000 t	114,000 t (3) (5^{th} - 95^{th}) : 95,000 t – 183,000 t
$F_{Current}/F_{MSY}$	0.90	0.79 (3) (5^{th} - 95^{th}) : (0.50 – 1.22)
$B_{Current}/B_{MSY}$	1.17(1)	
$SB_{Current}/SB_{MSY}$	1.17(2)	1.20 (3) (5^{th} - 95^{th}): (0.88 – 1.68)
$B_{Current}/B_0$	0.42(1)	
$SB_{Current}/SB_0$	0.34(2)	0.34 (3) (5^{th} - 95^{th}) : (0.26 – 0.40)
$B_{Current}/B_{Current,F=0}$		
$SB_{Current}/SB_{Current,F=0}$		

*preliminary catch estimate.

(1)Estimated through ASPIC
(2)Estimated through ASPM
(3)Estimated from 288 SS3 models – 50^{th} percentile and (5^{th} - 95^{th}) percentiles from the weighted distribution of point estimates

Table 2. Best scientific estimates of the catches of bigeye tuna (as adopted by the IOTC Scientific Committee) by gear and main fleets for the period 1960-2009 (in thousands of tonnes). Data as of November 2010.

Gear	Fleet	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	85	86
Purse seine	Spain																									0.8	1.3	1.8
	France																						0.0	0.0	0.2	2.3	4.3	7.1
	NEI-Other																								0.0	0.5	0.6	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	0.1	0.3	0.5	0.9	0.7
	Total																			*0.0*	*0.0*	*0.0*	*0.0*	*0.1*	*0.6*	*4.0*	*7.2*	*10.6*
Longline	Taiwan,China	*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*	*5.4*	*4.2*	*6.2*	*4.9*	*7.4*	*8.9*	*6.8*	*11.3*	*11.3*	*10.9*	*12.2*	*16.8*
	Japan	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	17.2	15.8
	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	2.4	0.7
	India																								0.0	0.0	0.0	0.0
	Seychelles																								0.0	0.1	0.1	
	NEI-Deep-freezing																										0.1	1.1
	Korea, Republic of						0.2	0.2	0.6	6.8	7.7	3.6	4.9	5.0	7.4	14.8	26.4	22.0	26.4	34.3	21.5	19.5	19.5	19.6	17.4	11.8	12.9	11.9
	NEI-Indonesia																											0.1
	Other Fleets	0.0	0.0	0.0	0.0	0.2	0.4	0.4	0.1	2.1	0.5	1.7	1.4	1.3	1.0	0.6	0.2	0.1	0.2	0.2	0.0	0.2	0.4	0.3	0.5	0.8	0.0	0.3
	Total	*16.1*	*15.0*	*18.5*	*13.3*	*18.0*	*19.6*	*24.2*	*24.8*	*39.7*	*30.6*	*28.0*	*23.2*	*20.2*	*17.6*	*28.5*	*38.0*	*28.7*	*36.2*	*50.8*	*33.5*	*35.0*	*34.9*	*43.5*	*49.6*	*39.9*	*44.9*	*46.7*
Other gears	*Total*	*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*	*0.2*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.5*	*0.4*	*0.5*	*0.8*	*0.7*	*0.7*
All	*Total*	*16.2*	*15.0*	*18.6*	*13.4*	*18.1*	*19.7*	*24.3*	*24.9*	*39.8*	*30.7*	*28.1*	*23.3*	*20.3*	*17.8*	*28.7*	*38.1*	*29.0*	*36.6*	*51.1*	*33.8*	*35.3*	*35.4*	*44.0*	*50.7*	*44.7*	*52.8*	*58.0*
Gear	**Fleet**	**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**	**85**	**86**

Gear	Fleet	Av05/09	Av60/09	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09
Purse seine	Spain	10.9	4.3	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	12.5	11.8
	France	6.1	3.1	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	6.7	5.8
	Seychelles	4.9	0.9					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	5.4	6.8
	Thailand	2.4	0.2														0.2	0.1				1.6	4.0	1.7	2.3	2.3
	NEI-Other	0.6	1.1	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	0.7	0.6
	Other Fleets	2.0	1.4	0.7	1.3	2.0	2.2	2.6	2.9	3.7	5.1	5.5	2.8	3.2	3.5	5.7	4.0	4.4	3.1	3.2	2.7	2.3	1.3	1.9	1.9	2.7
	Total	*26.8*	*11.1*	*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*	*29.5*	*30.1*
Longline	Taiwan,China	33.3	19.0	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	24.3	30.2
	Japan	13.5	12.5	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	13.9	18.2	13.8	9.0
	Indonesia	9.6	6.4	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	22.0	27.0	13.3	11.9	9.9	8.9	11.5	9.4	8.2
	China	6.5	1.2									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	5.0	2.7
	India	5.7	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	2.5	4.5	7.2	6.6	7.8
	Seychelles	4.9	0.8								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	4.4	4.5
	NEI-Fresh Tuna	3.6	1.4			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	4.4	3.6	4.5	1.8
	NEI-Deep-freezing	2.8	3.3	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	3.7	2.4	1.7	1.7
	Korea, Republic of	1.7	8.4	14.4	17.2	12.2	10.7	2.3	4.8	5.3	8.9	6.6	11.9	11.1	3.6	1.5	3.6	1.6	0.2	1.2	2.5	2.7	3.1	1.3	0.5	0.7
	Philippines	1.6	0.3												1.4	1.0	1.3	0.9	0.8	1.4	0.9	1.5	1.8	2.1	1.9	0.5
	NEI-Indonesia Fresh	0.0	1.5		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	2.2	0.8	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	2.0	1.9	2.0	2.3	2.5	2.4
	Total	*85.4*	*56.3*	*51.2*	*57.0*	*56.6*	*60.5*	*60.8*	*60.2*	*84.6*	*89.9*	*88.9*	*102.1*	*112.9*	*112.3*	*109.0*	*98.6*	*95.2*	*109.9*	*104.6*	*113.6*	*94.4*	*90.9*	*97.6*	*74.5*	*69.4*
Other gears	*Total*	*2.4*	*1.0*	*0.9*	*2.8*	*1.3*	*1.2*	*1.2*	*1.0*	*1.3*	*1.4*	*2.0*	*1.7*	*1.7*	*1.7*	*2.0*	*1.5*	*1.9*	*2.1*	*2.2*	*2.1*	*1.5*	*2.7*	*2.7*	*2.7*	*2.7*
All	*Total*	*114.6*	*68.4*	*65.5*	*74.9*	*69.9*	*74.3*	*77.6*	*72.4*	*101.9*	*110.2*	*119.3*	*128.3*	*148.6*	*142.3*	*151.7*	*130.0*	*120.7*	*141.0*	*129.6*	*138.1*	*121.9*	*118.3*	*124.1*	*106.7*	*102.2*

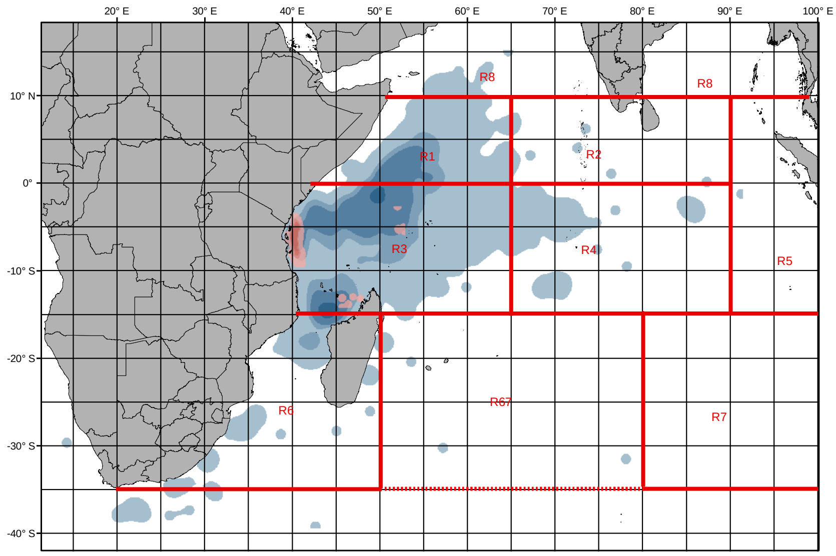


Figure 1. Assessment areas and densities of Releases (red) and Recoveries (blue) of bigeye tuna during the RTTP-IO. Data as of December 2010.

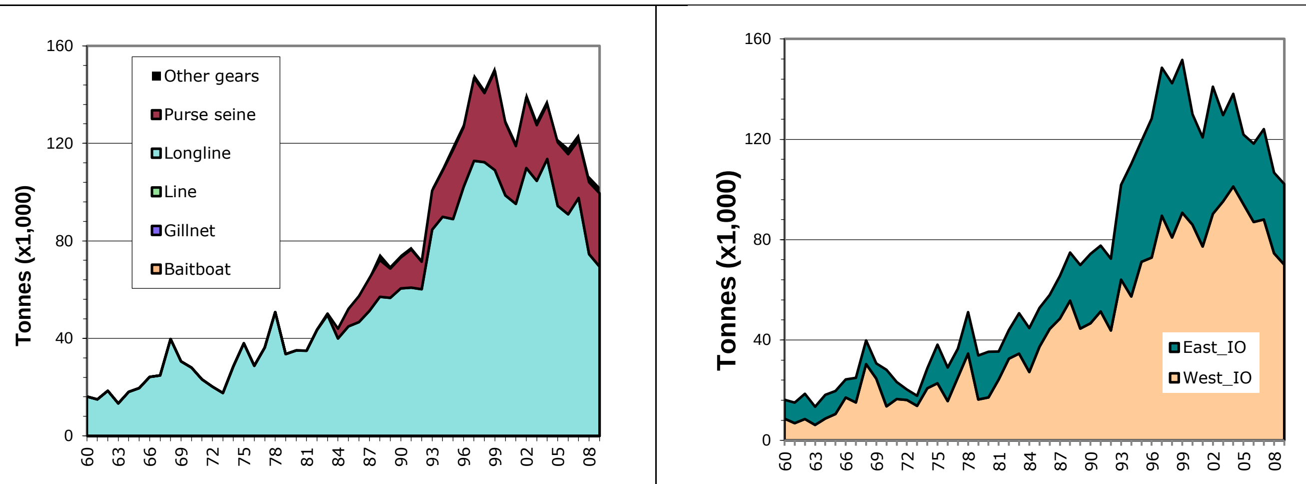
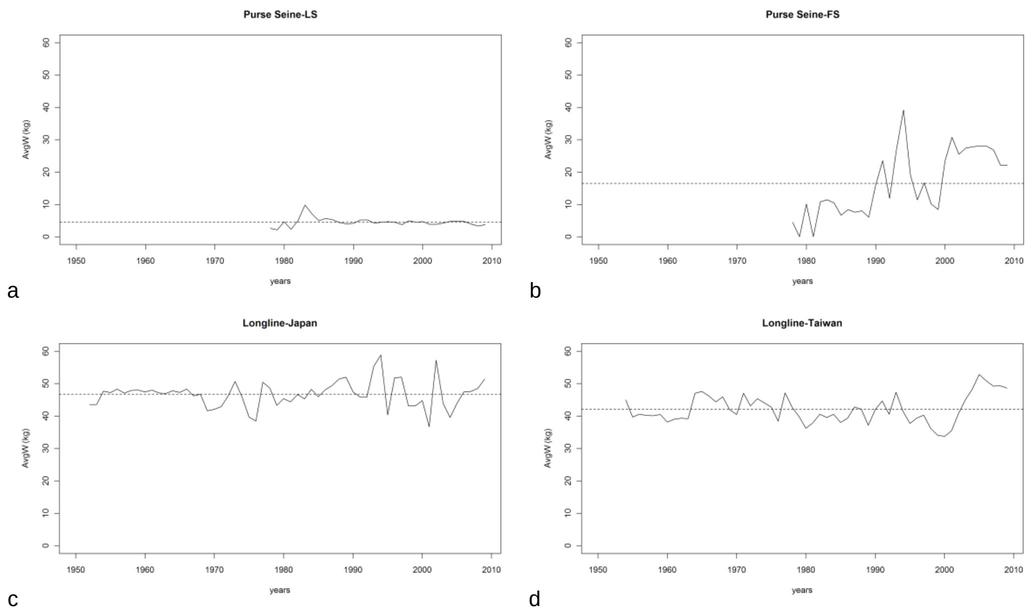


Figure 2. Yearly catches (thousand of metric tonnes) of bigeye tuna by gear from 1960 to 2009 (left) and by area (Eastern and Western Indian Ocean, right. Data as of December 2010



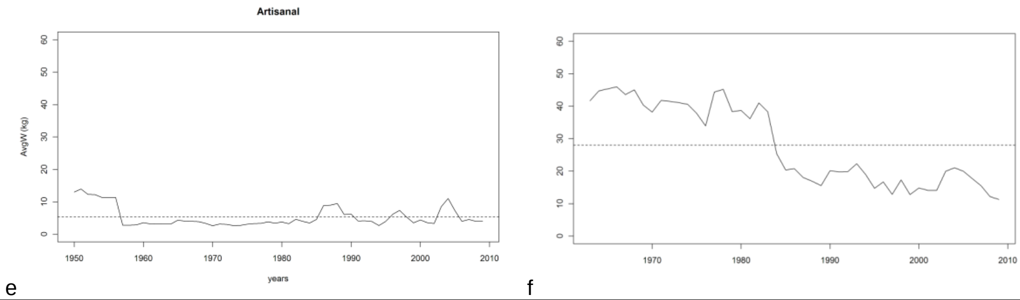


Figure 3. Temporal trend of average weight of bigeye (kg) for all fleets from 1950 to 2009: a) Purse-seine log school, b) Purse-seine free school, c) Longline Japan, d) Longline Taiwan,China, e) Artisanal, f) all fleets combined.

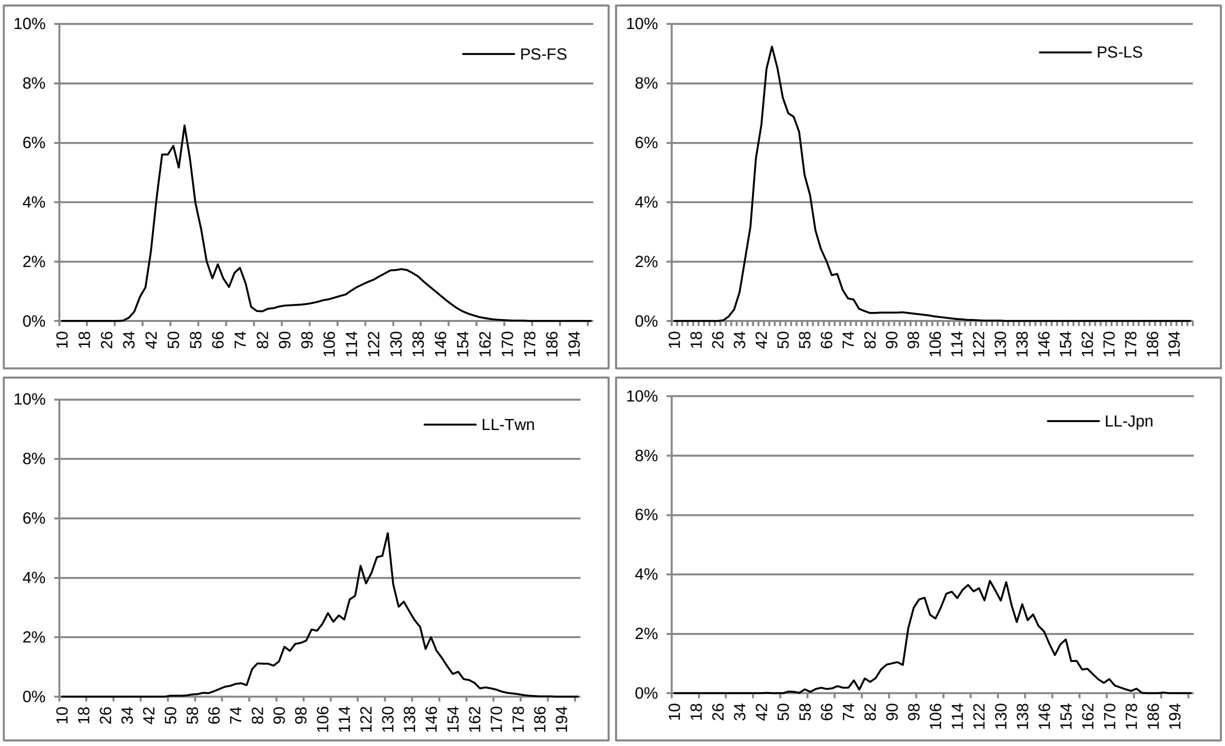


Figure 4. Proportion of catch at size of bigeye from purse seine and longline fisheries from 1999-2009.

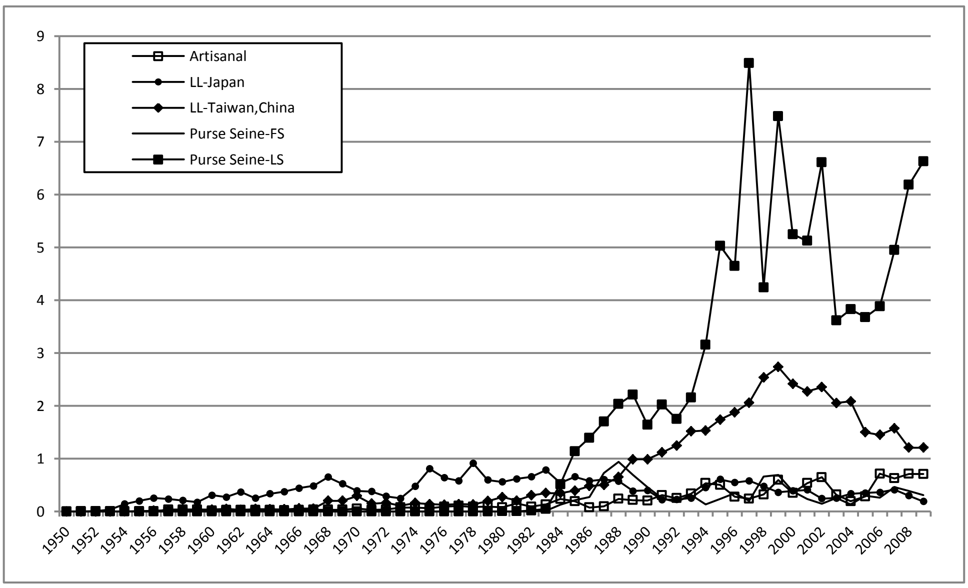


Figure 5. Catch in numbers of bigeye tuna by gear (purse seine-free school (FS), purse-seine log school (LS), longline-Japan, long-Taiwan,China and artisanal. Data as of December 2010

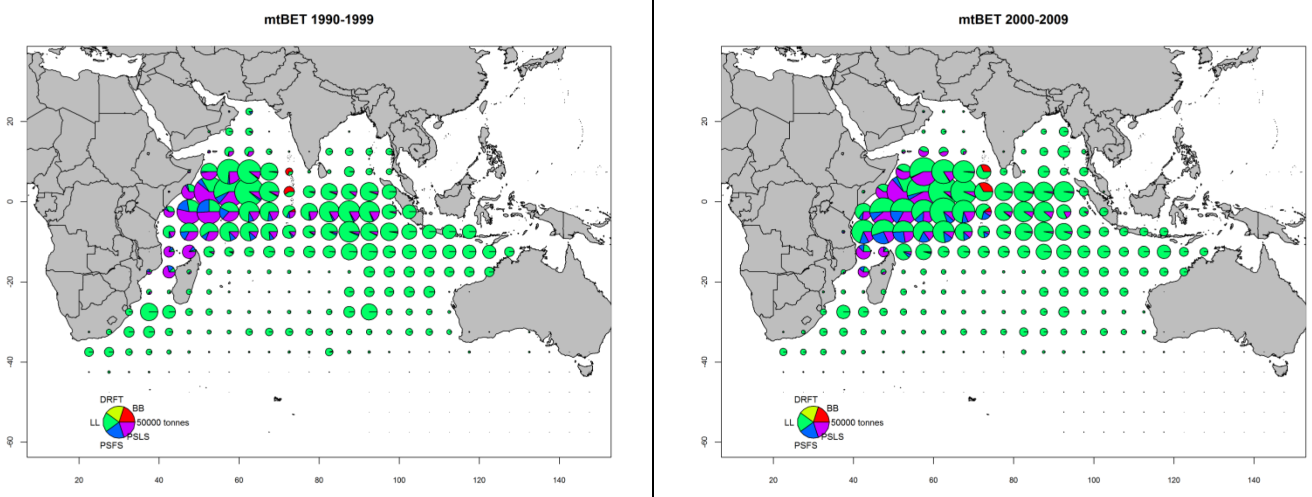


Figure 6. Total catches of bigeye tuna by gear (PSFS – purse-seine free school, PSLS – purse-seine log school, DRFT – driftnet, BB – bait boat, LL – longline) in the Indian Ocean over the periods 1990-1999 and 2000-2009. Data as of December 2010.

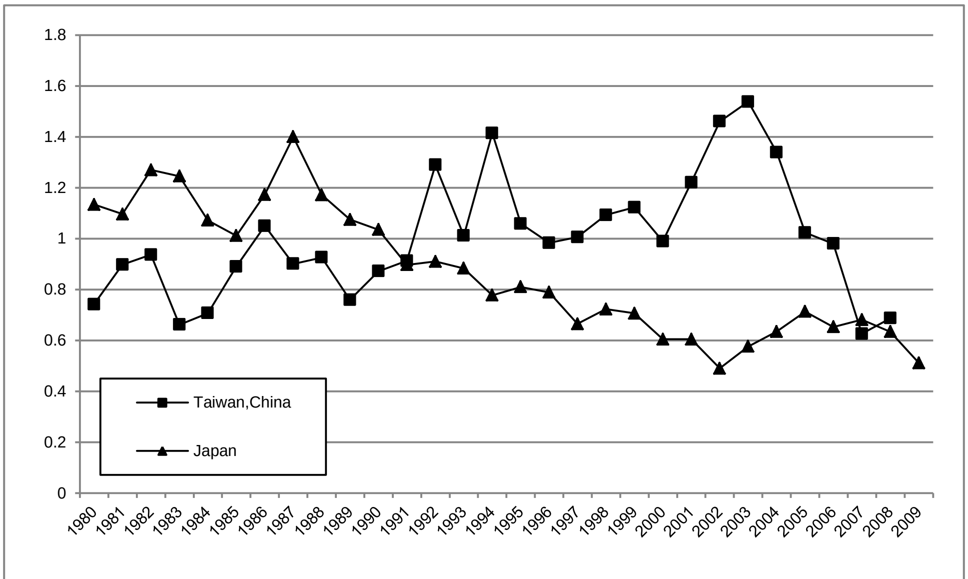


Figure 7. Relative Standardised CPUE indices of the longline fisheries of Japan (up to 2009) and Taiwan,China (up to 2008) in the tropical Indian Ocean.

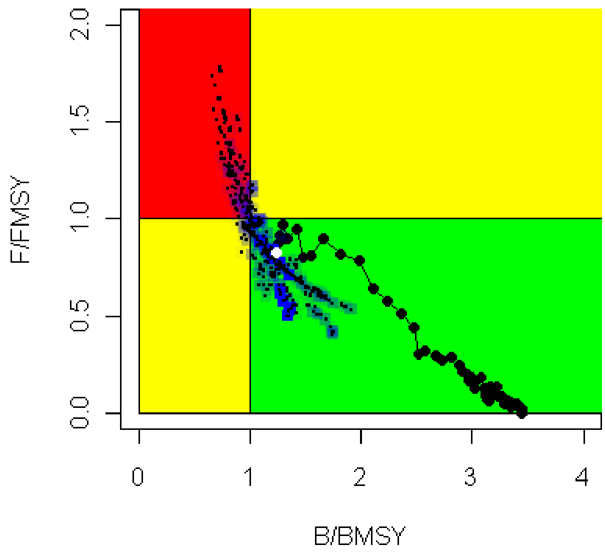


Figure 8. BET Kobe plot. Black circles represent the time series of annual median values from the weighted stock status grid (white circle is 2009). Blue squares indicate the MPD estimates for 2009 corresponding to each individual grid C model, with colour density proportional to the weighting (each model is also indicated by a small black point, as the squares from highly down weighted models are not otherwise visible).

EXECUTIVE SUMMARY OF THE STATUS OF THE SKIPJACK TUNA RESOURCE

(as adopted by the IOTC Scientific Committee in December 2010)

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 1990s, and peaked at 622,600t in 2006. Since then, catches have been declining rapidly to 440,600t in 2009, with an average annual catch for the period from 2005 to 2009 of 502,000t (Figure 2, 3 and Table 1). Preliminary catches for 2009 may have been the lowest reported during the last 10 years.

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), purse seine, baitboat and gillnets representing 95% of the total skipjack catches. 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). In 2009, 94 % (86% on average for the European/Seychelles during the last 10 years) of the skipjack tuna caught by purse-seine was taken in Log school.

The Maldivian fishery has increased its effective fishing effort with the mechanization of its pole-and-line fishery since 1974 and the use of anchored FADs since 1981. However, a strong decline in the catch has been observed during the last 3 years, from a catch of 136,700t in 2006 by more than 50% to 65,000 t in 2009. The reasons behind this drastic decline of the catch are not yet clear. It may be a result of reduction in fishing effort due to recent lower catch rates, but could also be linked to a substantial reduction in the proportion of large skipjack being caught in the Maldivian fishery. Catches of skipjack in the Maldives are strongly bimodal and reduction of the catch of large individuals will result in drastic reduction of total catches.

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. It was noted that the mean weight for purse seine catch exhibited a strong decrease since 2006 (3.1) until 2009 (2.4), for both free (3.8kg to 2.4kg) and log schools (3.0kg to 2.4kg).

Industrial purse seine fishery catch rates remained lower in 2007 (157,000t), 2008 (155,400t) and 2009(170,000t) when compared to the recent period of 1999-2006 during which catches exceeded 200,000t, but are still in the range of the previous period. While the activities of pirates off the coast of Somalia have meant that approximately ten purse-seine vessels have left the Indian Ocean and that the purse-seine fleet has avoided traditional skipjack fishing grounds where catch rates were high, no decline in catch rates has been observed in this fleet similar to that reported from the Maldives. This would indicate that the decline in catch rates in the Maldives fishery could be due to environmental causes such as higher than average sea surface temperatures, market considerations, like the marked increase of the fuel price, or other operational issues such as the availability of live bait .

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. New CPUE indices were presented in 2009, using purse seine nominal CPUE in the main fishing area north of equator.

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 2010.

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. After reaching a peak of 613,000 tons in 2006, total catches have strongly decreased, falling to 440,600 tons in 2009, the lowest observed since 1998. The low catches of the recent years is most probably largely due to the decrease on the number of purse seiners . a consequence of the piracy activities in the main skipjack fishing area.

2. **Purse-seine CPUE Trends**: In 2008, attempts to calculate standardized 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 since 2006. This index was updated in 2009, CPUEs being computed from two types of efforts (catch by positive set and by searching time). A base case and two cases with a 2% and 3% increase in fishing efficiency were applied on searching time to explore the effect on the CPUE trend. When considering the base case, catch per searching time fluctuate without trend while it is observed an overall decline in CPUE of 38% (2% increase in fishing efficiency) and 58% (3% increase in fishing efficiency). (fig 5bis).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. **Baitboat CPUE trends**: In 2010, an attempt was made to estimate a relative abundance index from the Maldivian skipjack tuna pole-and-line (PL) fishery catch and effort data. There are detailed records about many elements of the fishery which may be useful for quantifying changes in efficiency over time, however not all of these records are currently available in electronic format. Vessel-specific data were only available from a small number of observations (8% of the total PL catch) in the period 2004-2007 (*i.e.* monthly catches by atoll, with effort measured in boat-days). To estimate historical efficiency, a fleet composition model was employed in which the vessel registry provides the year of entry of different vessels into the fleet, and each vessel was assumed to remain active for a fixed number of years. The nominal CPUE (and GLM standardized series that excluded vessel effects) shows a strong increasing trend that parallels the fleet trend toward larger boats over the past two decades. The CPUE series that were standardized using historical estimates of fleet composition were either stable or decreasing over time. The most pessimistic model suggested that the standardized catch rates may have declined by about 60% between 1980 and 2000. No consistent decline was observed over the last 10 years (in which catches have been the highest on record) for any of the time series (but note that there is a drop between 2006 and 2007,

and that years 2008-9 were not included in the analysis). It is expected that considerably more data can be recovered to improve the analysis for next year. Additional vessel-specific data is accessible, including: alternative measures of effort (number of fishermen, number of poles), additional vessel characteristics (hull-type, horsepower), and the detailed time series should be extended to include 2004-2010. This may be informative even without the historical extrapolation. However, efforts should be made to recover the historical data as well. Assuming that catch rates can be standardized to account for vessel efficiency, there remain difficult questions of interpreting how these catch rates relate to abundance in the local fishery, and the broader Indian Ocean

4. **Average weight trends 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. However, a relatively strong decrease of the purse seine mean weight is observed since 2006 for both free and log schools, with the lower values observed since the beginning of this fishery. There is no clear explanation to this observation (changes in fishing zones, environment,etc). Such a decrease in mean weight has also been reported for the Maldivian baitboat fishery.
5. **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

No assessment was done on skipjack this year. In 2008, 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).

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 2008, and the causes of this decline should be examined; the reduction of the Somali fishing area due to the piracy is probably one of the reasons of the decline of the purse seine catches. Furthermore, the majority of the catch comes from fish that are sexually mature (greater than 40 cm) and therefore likely to have already reproduced.

MANAGEMENT ADVICE

Most tuna fleets operating in the Indian Ocean do not target or catch a single stock or species. The multi-species nature of the fishery, both industrial and artisanal, implies that management measures directed towards a single stock are very likely to have effect on other stocks as well. The direction and magnitude of these secondary effects cannot always be directly inferred given the adaptability of the various fleets

Current status

Skipjack tuna are widely regarded to be resilient to over-exploitation due to their life-history characteristics (*i.e.* rapid growth, early maturation and high reproductive potential). However, this does not exclude completely the possibility for skipjack to become overfished. Recent trends in certain fisheries suggest that the situation of the stock should be closely monitored and, thus, WPTT recommends that new attempts are made to assess the status of the stock during the next Session of the WPTT in 2011.

Outlook

Although there is no scientific basis for urgent concern about the status of the population of skipjack and the recent catches are considered to be sustainable, taking into account (i) the Precautionary Approach for fishery management, (ii) the rapid development of some artisanal and semi-industrial fleets and (ii) that the catches could not be increased continuously; the SC highlights that some management options should be considered. It is also noted that increasing catches of skipjack could lead to corresponding increase in fishing mortality for other species that are harvested in combination with skipjack in certain fisheries.

Recommendations

Given the limited nature of the work carried out on the skipjack in 2010, no management advice is provided for the stock.

SKIPJACK TUNA SUMMARY

Management quantity	**2009 (or most recent assessment)**	**2010 assessment**
Most recent catch	431,100 t(2008)	440,600 t (2009)*
Mean catch over the last 5 years (2005-2009)		502,200 t
Maximum Sustainable Yield		
$\mathbf{F_{Current}/F_{MSY}}$		
$\mathbf{B_{Current}/B_{MSY}}$		
$\mathbf{SB_{Current}/SB_{MSY}}$		
$\mathbf{B_{Current}/B_0}$		
$\mathbf{SB_{Current}/SB_0}$		
$\mathbf{B_{Current}/B_{Current,F=0}}$		
$\mathbf{SB_{Current}/SB_{Current,F=0}}$		

*preliminary catch estimate.

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 1960-2009 (in thousands of tonnes).Data as of November2010

Gear	Fleet	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	85	86
Purse seine	Spain																									6.4	18.6	19.1
	France																						0.2	1.0	9.4	27.3	29.8	36.1
	Indonesia	0.2	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.4	0.4	0.6	0.6	0.7	1.1	1.4	1.1	1.0	1.5	1.7	1.7	2.5	3.0	2.6	2.8	2.7
	NEI-Other																								0.4	8.2	8.4	6.4
	Japan																		0.1	0.9	0.6	0.4	0.1	0.5	0.6	0.7	0.3	0.6
	Other Fleets	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	3.2	4.5
	Total	*0.2*	*0.3*	*0.3*	*0.4*	*0.6*	*0.4*	*0.4*	*0.4*	*0.5*	*0.5*	*0.4*	*0.4*	*0.6*	*0.6*	*0.7*	*1.1*	*1.4*	*1.2*	*1.9*	*2.1*	*3.1*	*3.7*	*6.7*	*14.8*	*48.3*	*63.2*	*69.3*
Baitboat	Maldives	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	42.2	45.1
	Indonesia	0.4	0.6	0.6	0.6	0.6	0.7	0.8	0.7	0.8	0.8	0.6	0.7	1.0	1.1	1.2	1.9	2.5	1.9	1.8	2.7	3.0	3.0	4.5	5.3	4.5	4.9	4.7
	India	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	3.1	4.0
	Other Fleets	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	0.4	0.5
	Total	*9.9*	*9.2*	*8.8*	*9.0*	*8.9*	*15.1*	*17.9*	*20.0*	*18.6*	*20.7*	*28.8*	*29.3*	*19.4*	*28.3*	*35.3*	*19.9*	*23.0*	*17.4*	*17.5*	*22.7*	*27.9*	*24.6*	*22.7*	*27.6*	*40.4*	*50.6*	*54.3*
Gillnet	Sri Lanka	2.4	3.0	4.5	6.1	5.8	5.6	6.4	7.1	8.0	8.9	7.0	5.0	8.9	10.6	9.3	7.3	12.7	12.7	14.9	12.4	16.3	18.4	18.1	16.4	13.3	14.9	14.6
	Indonesia	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.7	0.7	0.8	0.6	0.6	0.9	1.0	1.1	1.7	2.3	1.7	1.7	2.5	2.8	2.8	4.2	4.9	4.2	4.6	4.4
	Pakistan	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	2.0	1.5
	Other Fleets	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	0.5	0.5
	Total	*4.6*	*5.3*	*6.9*	*9.5*	*10.1*	*10.2*	*12.2*	*12.9*	*13.9*	*14.3*	*11.8*	*9.6*	*14.4*	*17.8*	*15.6*	*14.8*	*21.9*	*19.7*	*20.8*	*21.5*	*21.1*	*24.3*	*26.2*	*22.7*	*19.2*	*22.0*	*21.0*
Line	Indonesia	0.4	0.5	0.5	0.5	0.6	0.6	0.7	0.7	0.7	0.8	0.6	0.6	0.9	1.0	1.1	1.7	2.2	1.7	1.6	2.4	2.7	2.7	4.0	4.7	4.0	4.4	4.2
	Madagascar	0.5	0.5	0.5	0.5	0.5	0.8	1.2	1.1	1.1	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	1.3	1.9	3.6	3.6	4.2
	Other Fleets	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	3.9	4.7	5.1	3.3	3.4	3.4	3.1	3.3
	Total	*1.5*	*1.8*	*2.0*	*2.4*	*2.4*	*2.7*	*3.3*	*3.3*	*3.6*	*3.3*	*4.2*	*3.9*	*4.6*	*5.4*	*5.2*	*5.8*	*7.6*	*6.5*	*6.5*	*6.9*	*8.0*	*8.4*	*8.5*	*10.0*	*10.9*	*11.1*	*11.6*
Other gears	*Total*	*0.5*	*0.5*	*0.6*	*0.4*	*0.5*	*0.5*	*0.7*	*0.6*	*0.8*	*0.6*	*0.3*	*0.3*	*0.5*	*0.3*	*0.4*	*0.6*	*0.7*	*0.5*	*0.5*	*0.8*	*0.8*	*0.9*	*1.3*	*1.5*	*1.3*	*1.4*	*1.3*
All	*Total*	*16.7*	*17.1*	*18.6*	*21.7*	*22.5*	*28.9*	*34.5*	*37.3*	*37.4*	*39.4*	*45.5*	*43.5*	*39.4*	*52.4*	*57.2*	*42.1*	*54.7*	*45.4*	*47.2*	*54.1*	*61.0*	*61.9*	*65.4*	*76.6*	*120.1*	*148.3*	*157.6*

Gear	Fleet	Av05/09	Av60/09	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09
Purse seine	Spain	82.0	31.2	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	65.1	66.6
	Seychelles	38.7	7.2					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	30.0	40.2
	France	36.1	20.4	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	29.7	29.3
	Indonesia	10.0	3.6	3.3	3.4	4.1	3.5	3.8	4.0	4.8	5.0	4.8	6.5	7.7	7.1	7.3	7.3	8.7	5.7	5.9	8.1	3.0	11.7	11.7	11.7	11.7
	Thailand	9.4	1.0														1.1	0.5				8.0	16.9	8.4	6.1	7.5
	NEI-Other	3.7	7.8	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	2.3	4.3	3.6
	Japan	3.2	3.8	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	4.4	3.2	3.4
	NEI-Ex-Soviet Union	2.8	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			
	Other Fleets	5.1	3.5	10.1	7.9	8.4	8.8	13.1	6.4	7.1	6.4	3.9	2.7	4.9	3.2	9.4	4.9	9.7	22.4	0.0	0.1	1.2	6.3	5.1	5.2	7.7
	Total	*191.0*	*82.4*	*82.5*	*96.3*	*130.9*	*111.8*	*126.6*	*155.3*	*168.7*	*184.1*	*183.7*	*155.7*	*154.0*	*157.1*	*204.9*	*207.1*	*197.3*	*244.3*	*217.5*	*164.6*	*214.1*	*258.6*	*157.0*	*155.4*	*170.0*
Baitboat	Maldives	102.7	47.2	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	85.6	65.0
	Indonesia	7.4	5.3	5.8	6.1	7.1	6.2	6.6	7.0	8.4	8.7	8.4	11.5	13.6	12.5	12.9	12.8	15.4	10.0	10.4	14.3	22.1	3.8	3.8	3.8	3.8
	India	6.3	3.3	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	6.9	8.8	8.0
	Other Fleets	0.0	0.6	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	0.0	0.0
	Total	*116.4*	*56.4*	*54.5*	*69.5*	*71.3*	*72.9*	*71.2*	*71.2*	*79.7*	*84.5*	*85.7*	*85.0*	*89.4*	*94.3*	*108.1*	*96.2*	*104.9*	*127.1*	*121.0*	*122.9*	*152.9*	*147.8*	*106.5*	*98.2*	*76.8*
Gillnet	Sri Lanka	73.3	29.9	15.3	15.9	17.4	20.5	23.2	27.1	31.6	38.9	40.7	47.4	56.2	57.0	72.6	79.4	74.8	72.9	83.1	83.3	48.0	60.2	80.5	86.9	90.9
	Iran, Islamic Republic	66.6	10.7			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	42.4	44.8
	Indonesia	15.8	5.9	5.4	5.6	6.6	5.8	6.2	6.5	7.8	8.1	7.8	10.7	12.6	11.6	12.0	11.9	14.3	9.3	9.7	13.3	5.8	18.3	18.3	18.3	18.3
	Pakistan	5.1	4.1	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	3.6	4.0	5.2	5.2	5.4	5.6
	Other Fleets	2.4	1.0	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	1.4	2.7	3.4	3.4
	Total	*163.1*	*51.6*	*25.0*	*27.7*	*32.8*	*35.7*	*38.6*	*44.7*	*51.8*	*63.7*	*58.2*	*66.1*	*83.5*	*78.5*	*104.0*	*115.3*	*117.0*	*109.2*	*132.7*	*154.5*	*138.3*	*183.8*	*174.3*	*156.3*	*163.0*
Line	Indonesia	12.3	5.3	5.2	5.4	6.3	5.5	5.9	6.2	7.4	7.8	7.5	10.2	12.0	11.1	11.4	11.4	13.7	8.9	9.2	12.7	10.2	12.8	12.8	12.8	12.8
	Madagascar	9.4	4.2	4.4	6.6	6.5	6.7	6.4	7.3	8.0	7.3	7.5	7.3	7.5	7.3	7.9	8.0	8.5	9.1	9.1	9.9	9.6	9.7	10.7	8.5	8.5
	Other Fleets	7.0	4.1	3.3	3.4	6.1	6.3	6.3	10.6	7.7	4.5	4.7	4.4	4.8	4.4	3.5	3.9	4.0	4.8	3.9	9.5	6.1	8.2	5.8	7.6	7.1
	Total	*28.6*	*13.7*	*12.9*	*15.4*	*18.9*	*18.5*	*18.6*	*24.2*	*23.2*	*19.6*	*19.6*	*21.9*	*24.3*	*22.9*	*22.9*	*23.3*	*26.1*	*22.8*	*22.3*	*32.1*	*25.9*	*30.7*	*29.3*	*28.8*	*28.4*
Other gears	*Total*	*3.0*	*1.7*	*1.6*	*1.7*	*2.1*	*1.8*	*1.9*	*2.0*	*2.5*	*2.5*	*2.5*	*3.2*	*3.8*	*3.5*	*3.6*	*3.6*	*4.2*	*2.9*	*4.1*	*4.4*	*6.5*	*1.8*	*2.2*	*2.4*	*2.4*
All	*Total*	*502.2*	*205.8*	*176.6*	*210.7*	*255.9*	*240.7*	*256.8*	*297.4*	*325.9*	*354.4*	*349.7*	*331.9*	*355.0*	*356.3*	*443.5*	*445.5*	*449.6*	*506.4*	*497.6*	*478.4*	*537.6*	*622.6*	*469.3*	*441.0*	*440.6*

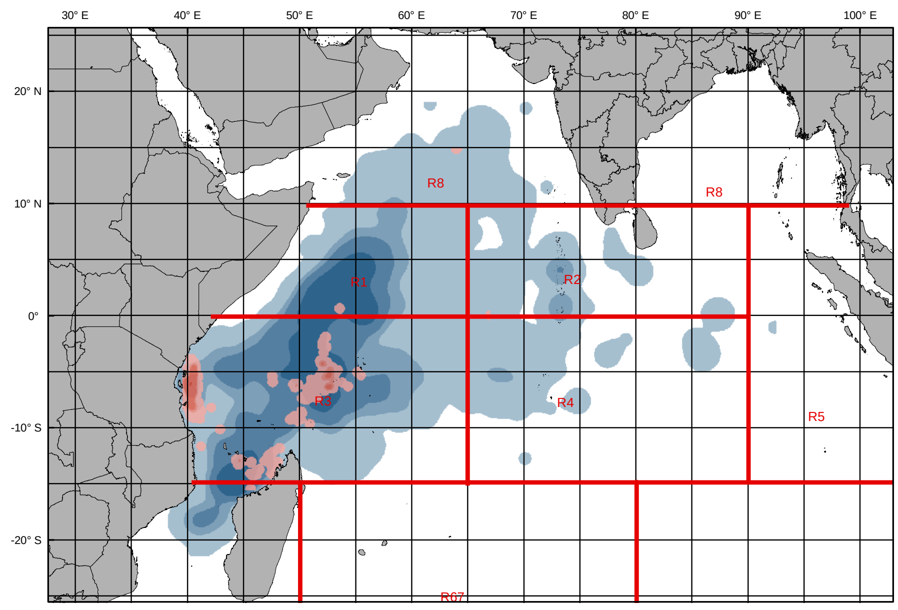


Figure 1. Tag recapture densities for skipjack tuna tagged in the south west Indian Ocean by the RTTP-IO. Data as of December 2010

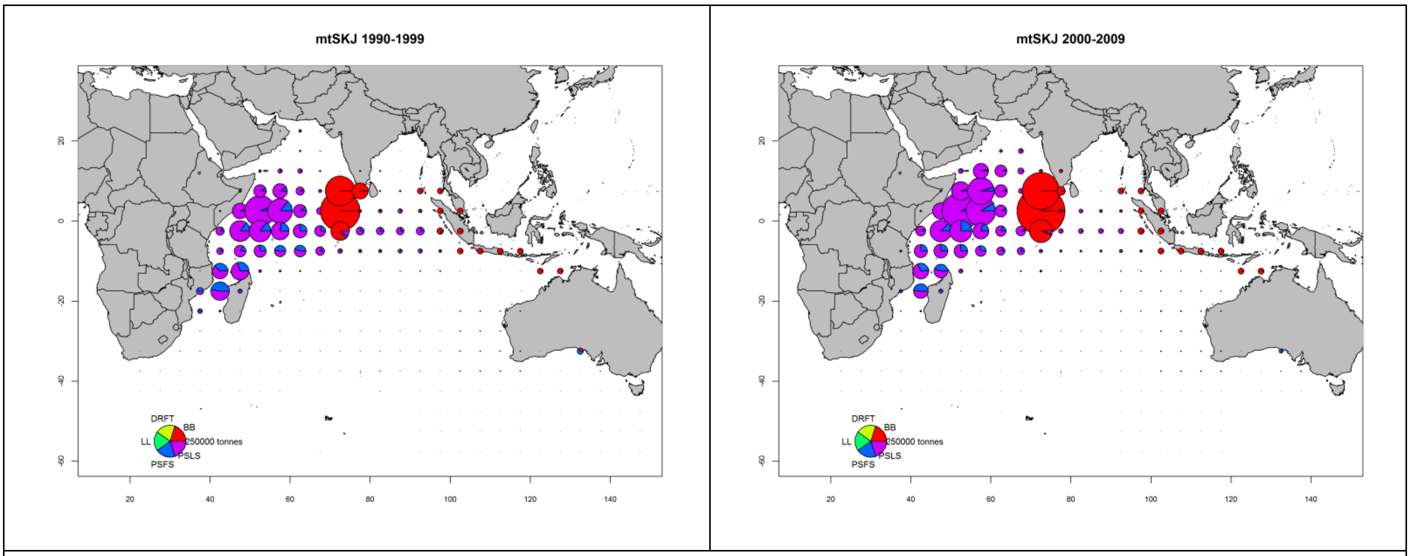


Figure 2. Total of annual total catches of skipjack tuna by gear (PSFS – purse-seine free school, PSLS – purse-seine log school, DRFT – driftnet, BB – bait boat, LL – longline) in the Indian Ocean over the period 1990-1999, 2000-2009. Data as of December 2010

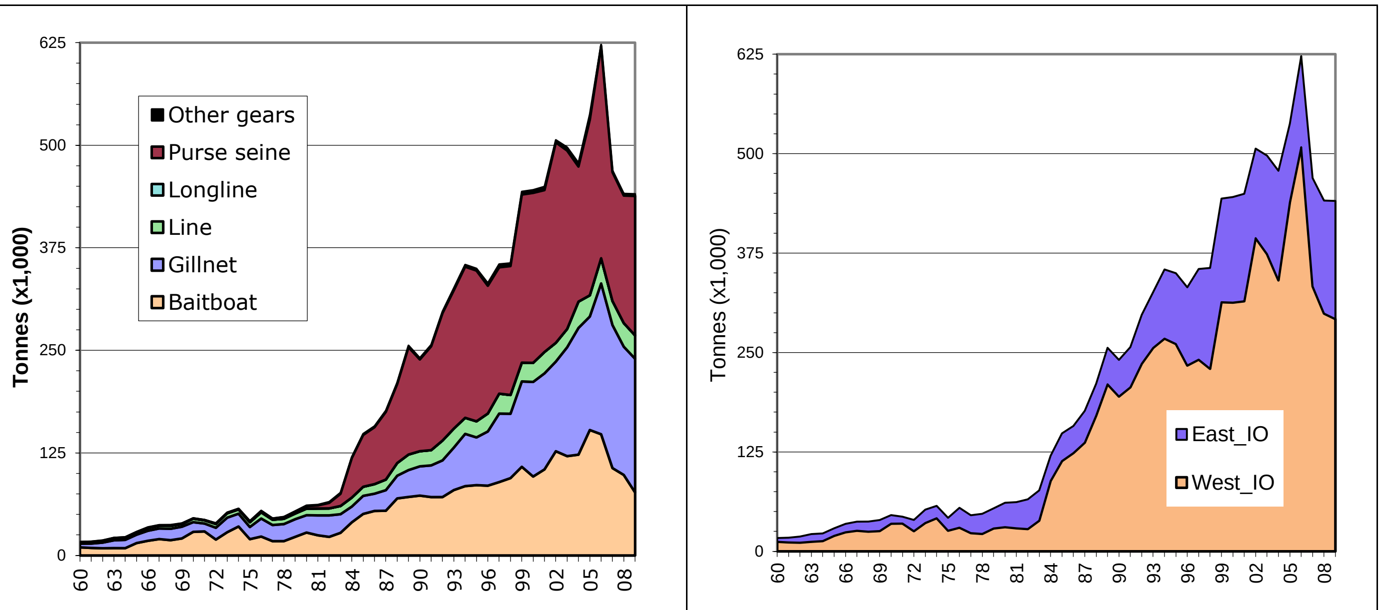


Figure 3. Yearly catches (thousand of metric tonnes) of skipjack tuna by gear (left) and by area (Eastern and Western Indian Ocean (right) from 1960 to 2009. Data as of November 2010

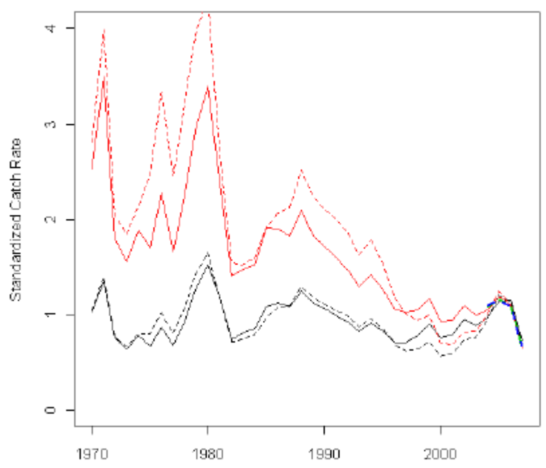


Figure 4. Comparison of the final relative abundance indices estimated by combining the fleet composition model with GLM-based vessel efficiency models.

Length-efficiency relationship derived from model A (which includes additional terms for month and atoll) in black, and from model B in red.

Solid lines indicate a vessel lifespan of 15 years, broken lines a vessel lifespan of 5 years.

The standardized CPUE series from models A (green) and B (blue) 2004-7 are also shown (largely overlapping with the other series).

Each series is scaled to have a mean of 1 over the last 4 years.

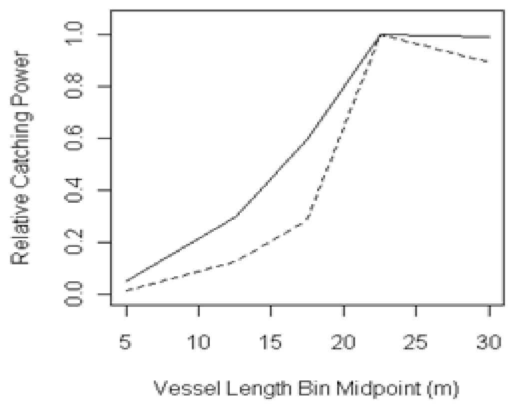


Figure 4. Effect of vessel length on efficiency as estimated by two simple GLM models using data from 2004-7.

Model A (solid line) includes Year, Month, Atoll and vessel length effects.

Model B (broken line) includes only Year and vessel length effects.

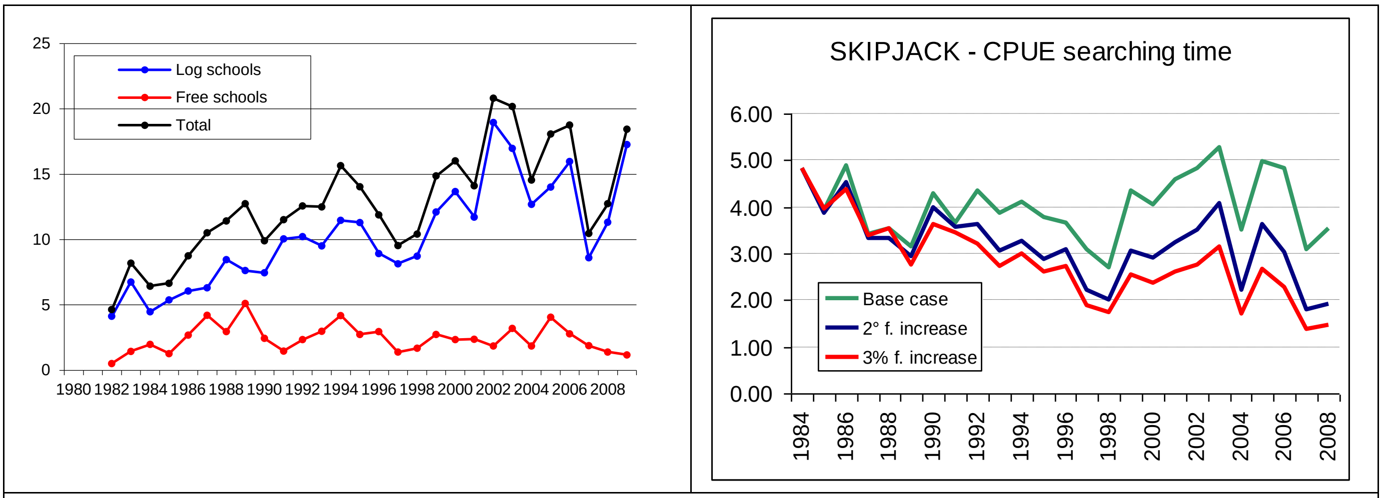


Figure5. Time series of CPUE of the purse seine fishery (raw, in tons per searching day), left and standardized (up to 2008) including an increase in fishing efficiency (0%, 2% and 3%), right.

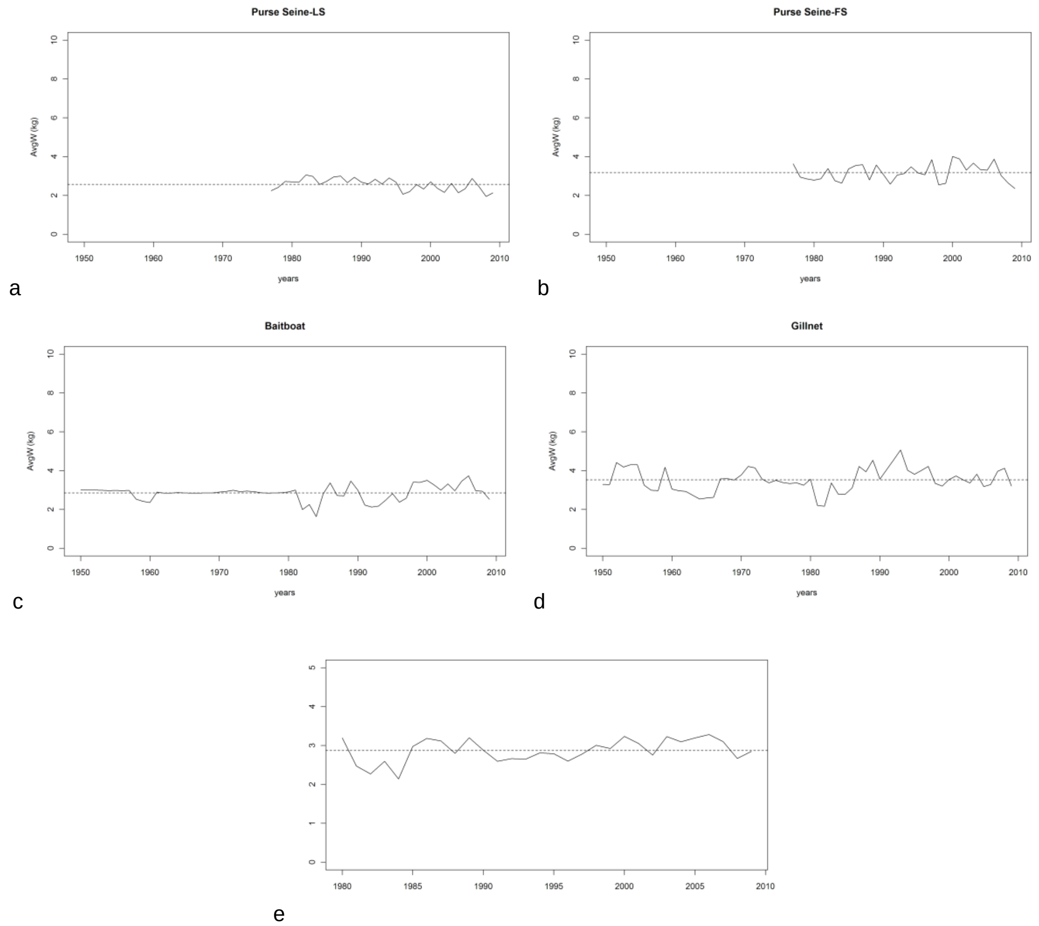


Figure 6. Temporal trend of average weight of skipjack (kg) for all fleets from 1950 to 2009: a) Purse-seine log school, b) Purse-seine free school, c) baitboat, d) gillnet, e) all fleets combined.

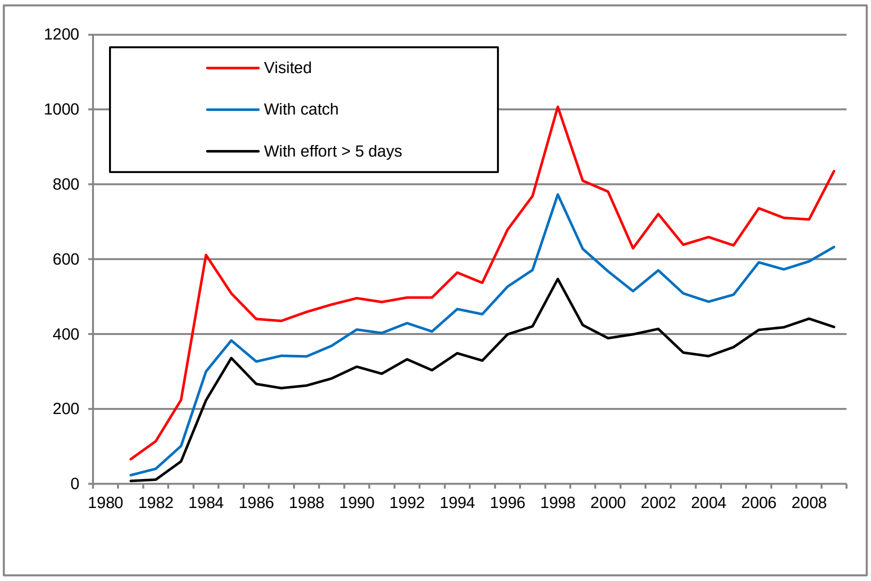


Figure 7. Number of one degree CWP squares explored by the purse seine fishery from 1980 to 2010.

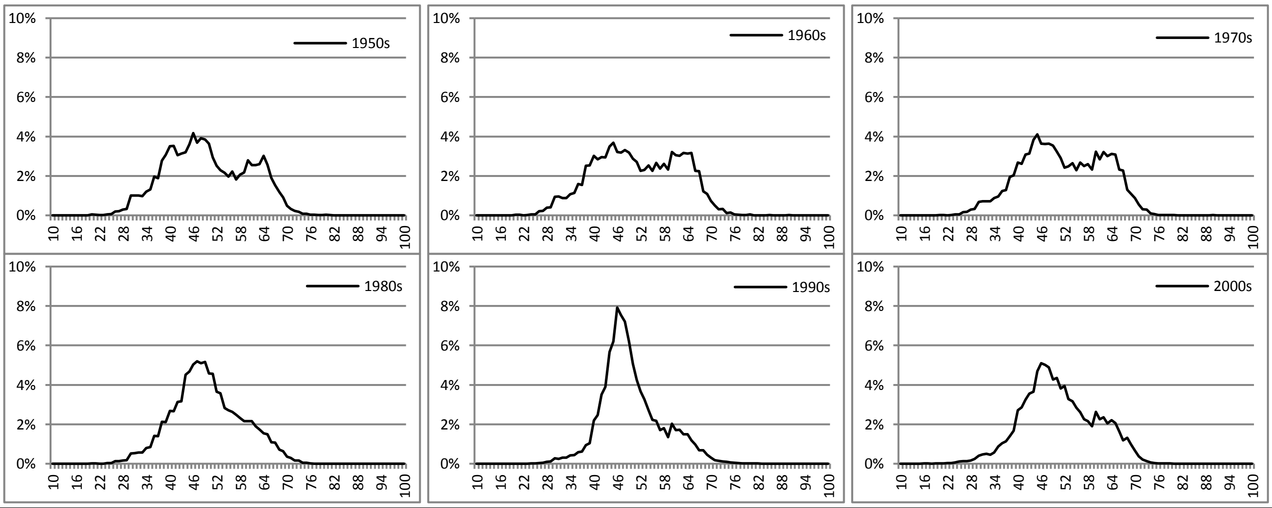


Figure 8. Proportion of the catch by size of skipjack tuna in numbers per decade from the 1950's to 2009.

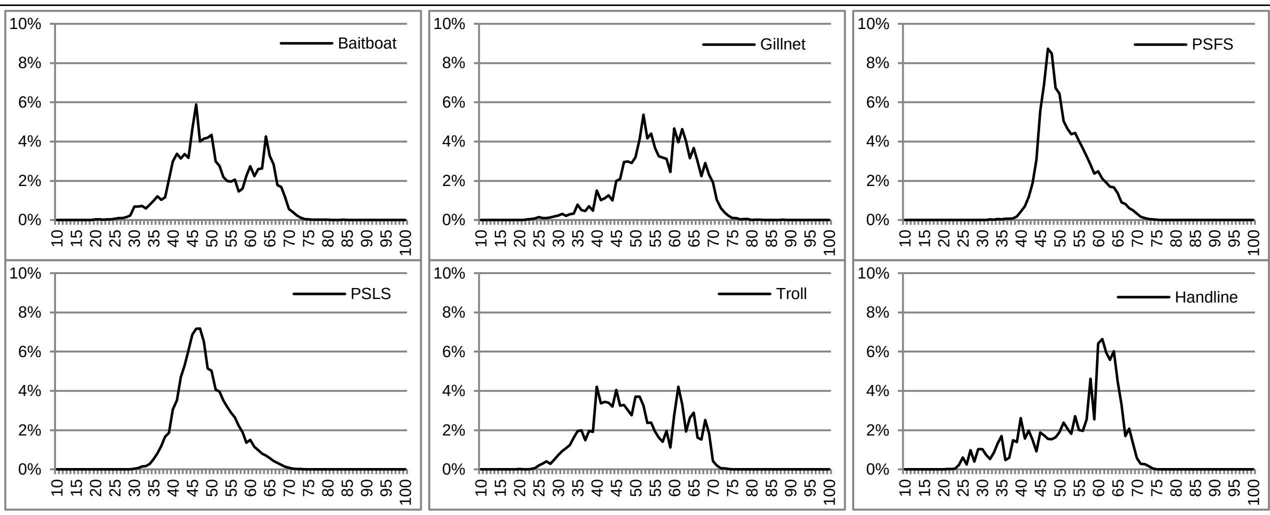


Figure 9. Proportion of the catch at size of skipjack tuna by gear for 1999-2009.

EXECUTIVE SUMMARY OF THE STATUS OF THE YELLOWFIN TUNA RESOURCE

(FOR ADOPTION BY THE IOTC SCIENTIFIC COMMITTEE IN DECEMBER 2010)

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 distance travelled by yellowfin between their tagging and recovery positions is 710 nautical miles, and showing increasing distances as a function of time at sea (figure 10). 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.Unfortunately the comparative analysis of total catches and total yellowfin recoveries of tagged adult yellowfin (table 1) allows the WPTT to conclude that the real movement pattern and movement scale of yellowfin were probably widely biased by the lack of reporting by most longliners: in the hypothesis that these large yellowfin are equally available to longliners and purse-seiners in the western Indian Ocean or entire Indian Ocean area, it can be estimated that between 1448 and 2512 tagged yellowfin should have been reported by longline vessels, when only 41 recoveries have been identified on these fleets.

Table 1. Comparison of the numbers of large yellowfin (>1m) caught by purse-seine and by longline during recent years (2006-2008) in the Western Indian Ocean, and of the numbers of reported recoveries by each gear of the same categories (total ocean).

Gear and Area	PS West IO	LL West IO	LL total IO	Ratio of tag recovery (PS/LL)
Total number of large YFT > 1m caught	2,229,874	1,876,828	2,958,699	
Number of large YFT recovered at FL > 1m	2,984	46		
Number of tags reported / million YFT caught	1,338	25		55
Total number of tagged YFT caught by LL		2,512	3,959	

Longline catch data indicates that yellowfin are distributed continuously throughout the entire tropical Indian Ocean. 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 140 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 better used in stock assessments

Direct estimates of natural mortality at age (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 (and to levels assumed in other oceans), but it is consistent with the natural mortality at age estimated by the Lorenzen method.

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 1960 to 2009 are shown in Table 2 and illustrated in Figure 2. Contrary to the situation in other oceans, the artisanal fishery component in the Indian Ocean (mainly using pole and line, driftnet and hand line) is substantial, taking an estimated 37 % of the total YFT catches in weight, 48% in number, during recent years (2000-2009).

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 160 cm fork length (Figure 4) and smaller fish are more common in the catches taken north of the equator. Catches of yellowfin by purse seiners increased rapidly to around 128,000 t in 1993. Subsequently, they fluctuated around that level, until the period 2003 to 2006, when they were substantially higher, exceeding 150,000t with a maximum in 2004 of 228,600t.. The catch decline in recent years to reach 88,500t in 2009, the lowest level ever recorded since 1987. The amount of effort exerted by the EU purse seine vessels (fishing for yellowfin and other tunas) has been showing a decline of 24% in 2009 in comparison to 2008.

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 (average weight of approximately 5kg) 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). , . The proportion of log sets decreased steadily from 1997 (66%) to 2004 (41%), after which it started to increase, especially in 2009 where it reached a maximum of 73%, while it was 53% in 2008. This is mainly due to the piracy activities in the area.

The longline fishery started in 1952 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). Catches have typically fluctuated between 80,000 t and 123,000 t until 2007 but have drastically decreased in 2008 (59,400t) and 2009 (43,200t).

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 (an average catch of 466.000t) but have returned to a lower level since, reaching in 2009 288,100t, while bigeye catches remained at their average levels. Purse seiners currently take nearly 1/3 (32%) of total yellowfin catches, mostly from the western Indian Oceana around Seychelles. In 2003-2006, purse seine total catches made in this area were at an average level of 202.000 t, and declining to 88,500t in 2009. 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 centered in 2005. In 2008, purse seine catches increased of 20% despite of a decrease in nominal fishing effort.

Yellowfin catches in weight y gear (purse seine, longline and other methods) have been updated and current estimates of annual mean weights of yellowfin caught by the whole fishery are shown in Figure 8. After an initial decline, mean weights in the whole fishery remained quite stable from the 1970s to the late eighties. Since 1990, mean weights in the catches in the yellowfin fisheries have been quite stable. Prior to 2003, although total catch in biomass has been stable for several years, catches in numbers have been high but quite stable since 1995(Figure 11a), when catches of large YFT have been showing a peak during the 2003-2006 period (figure 11b).

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.

In 2008, new stock assessment areas were defined (figure 1) in order to obtain more homogeneous area being in better agreement with the fished ecosystems. New standardised CPUE were calculated for yellowfin tuna for Japanese (1960 to 2009) and Taiwanese longliners (1979-2009) in each of these areas. These CPUE are showing a quite different trend: Japanese CPUEs showing a marked steady decline, when the Taiwanese CPUEs have been quite stable during the last 30 years in most areas. However, the 2 CPUE trends show similar major decline in area 5 (Equatorial Esatern IO) and also in most areas since 2006 (figure 9).

These GLM CPUEs by area tend to be very similar to the observed trend in nominal CPUEs of the 2 fleets (a global decline for Japan and a global stability for Taiwan,China). However, it was noticed than in 1992 there was a sudden unexplained discrepancy between Japanese GLM and Nominal CPUEs: stable nominal CPUEs and GLM CPUEs showing a sudden major decline. This unexplained divergence between the nominal and GLM CPUEs may be due to an improper standardization in the present GLM of the effects on changes in HBF configuration and implementation of monofilament lines.

Since the early 1990's the fleet of Taiwan,China has concentrated part of its operation in the Arabian Sea area whereas the fleet of Japan has operated more in the central and south western Indian Ocean (when Taiwanese longliners have been seldom fishing in this area). It appears that the longline fisheries of Japan and Taiwan,China are now to some extent spatially distinct, but still showing a wide range of common fishing zones (areas 2 & 5).

STOCK ASSESSMENT

Assessing the status of the stock of yellowfin tuna in the Indian Ocean is presently complicated by the conflicting trends in the data: total yearly catches, length frequency data and abundance indices based on the longline CPUE. The observed trends in yellowfin catches and CPUEs are not mutually consistent. For any fished stock, the situation where yields keep increasing over the years without any substantial decline in abundance, cannot be explained easily. The trends observed in the Japanese LL CPUE series at the start of the fishery, 1950-1970, cannot be interpreted as reflecting the abundance of the stock, given the extreme discrepancy between observed total catches and CPUE, especially under the light of the subsequent observed dynamics of the fishery.

In 2010 a number of stock assessments for YFT were presented. Another iteration of the MFCL length and age-based model, incorporating tagging data, was carried out, with numerous improvements based on previous years analyses. An implementation of a similar model, SS3, incorporating tagging data was also carried out. Finally, they were complemented by a run of a simple surplus production model.

A number of serious uncertainties remain unsolved on the integrated assessments, most notably (1) those related to the spatial structure of the model, given the paucity of data informative on yellowfin movements across them, (2) the impact of the assumed vector of natural mortality, for which information is still scarce despite some advances due to the RTTP-IO programme, and (3) the influence of the indices of abundance derived from LL CPUE series, given the doubts on their accuracy at tracking abundance in the stock due to increases in efficiency not currently incorporated in their analysis.

Estimated values of stock biomass and fishing mortality are also influenced by the assumptions of selectivity of the main industrial fleets, PS and LL. Although some information on these parameters exists in the data, it remains an open issue how to treat the changes in the PS fishery and the effect of LL on older individuals from a selectivity perspective. Another structural assumption of great importance is the strength of the stock-recruitment relationship at low stock levels, the steepness parameter, so a number of runs with different credible levels were conducted.

The information obtained from the tagging and recoveries of the RTTP-IO and the various small-scale tagging projects, have provided the SC with much improved estimates of harvest rates for certain fleets, better definition of YFT growth patterns, important highlights on the possible ranges of movements across the Indian Ocean, and very promising first indications on the likely level of natural mortality.

Results

Estimates of stock status and values of relevant reference points were obtained from integrated statistical assessment models: SS3 and most notably MFCL. A number of scenarios related to major structural uncertainties in the model - steepness of the stock-recruitment relationship and spatial structure - were investigated but these fall short of the comprehensive exploration of structural, data and estimation uncertainty that would be required to be able to generate probabilistic statements on future trajectories under various fishing mortality scenarios, as required to generate a Kobe II matrix. The SC cannot at this stage yet provide this form of management advice given the results available, but intends to proceed in this direction in the near future.

Fit to the length frequency data was generally good, although the low sampling intensity in some strata might be introducing false signals that cannot be easily explained. The CPUE series by area appeared to be well explained by the model.

The precise status of the stock with reference to biomass and fishing mortality varies with the values of steepness and with the spatial structure used by the model (5 areas vs. a single area), but almost all of them indicate that the stock has gone into an overfished state ($B_{2009} < B_{MSY}$), except for those runs with the highest values of steepness (*i.e.* 0.8 and 0.9). Similarly, the stock appears to be in a overfished state, although the extent of this is highly dependent on the stock-recruitment assumptions.

The Kobe plot in figure 13 reflects the estimated biomass trajectories and final stock status obtained from the final runs of the 5-area configuration of MFCL. The modelled changes in selectivity of the purse seine fleets during the 2003-06 period, together with estimated peaks in recruitment in years before that period, allow the model to explain the 2003-06 high catches without the stock exceeding the F reference level. Catches in that period take the stock towards much higher levels of fishing mortality, and are clearly unsustainable in the medium and long term. The trajectories shown, for steepness values of 0.7 and 0.8, reflect the influence of this key parameter in the results. However, they both reflect that the stock is reaching or has reached its maximum level of exploitation, and that catches above the suggested limit are likely to take the stock further into an overexploited/overexploitation position

The effect of the high 2003-2006 catches on the stock biomass is now apparent, and the model appears to estimate lower than average recruitments for the last few years, which seems to stop its recovery despite the very recent decrease in effort on the purse-seine fishery. Although estimation of future recruitment is extremely difficult given the information currently available, a note of caution must be made regarding the dependence of future stock biomass trends to future recruitment levels. Analyses of environmental conditions in the Indian Ocean appear to provide with credible explanations for the lower recruitment estimated by the model.

MANAGEMENT ADVICE

Most tuna fleets operating in the Indian Ocean do not target or catch a single stock or species. The multi-species nature of the fishery, both industrial and artisanal, implies that management measures directed towards a single stock are very likely to have effect on other stocks as well. The direction and magnitude of these secondary effects cannot always be directly inferred given the adaptability of the various fleets

Current status

Estimates of total and spawning stock biomass show a marked decrease over the last decade, accelerated in recent years by the high catches of 2003-2006. It appears that the stock is currently overfished or approaching an overfished state, and overfishing has probably been occurring over recent years. The effect on the standing stock of the high catches of the 2003-2006 period is still noticeable as biomass appears to be decreasing despite catches returning to pre-2003 levels.

The estimates of MSY are between 250,000 t and 350,000 t in different stock assessment models and for different stock-recruitment relationships and spatial model structures. The mean catch over the 2007-2009 period of

310,000t is in the middle of that range while annual catches over the period 2003-2006 (averaging 464,000 t) were substantially higher than any of the MSY estimates.

The main mechanism that appears to be behind the very high catches in the 2003-2006 period is an increase in catchability by surface and longline fleets due to a high level of concentration across a reduced area and depth range. This was likely linked to the oceanographic conditions at the time generating high concentrations of suitable prey items that yellowfin exploited. A possible increase in recruitment in previous years, and thus in abundance, cannot be completely ruled out, but the signal estimated by the assessment models implies that the contribution of recruitment to the increase in catches is likely to be minor. This means that those catches probably resulted in substantial stock depletion.

Various indicators of catch rates for different fleets and areas appear to confirm this downward trend in abundance. Recruitment is estimated by the model to have been low over the course of the last five years.

Outlook

Catches in 2009 (288,000 t) were on the mid-range of MSY values. Improvements in the status of the stock, even with those lower catches, are dependent of future recruitments returning to the higher levels observed in the past.

The reduction in catches observed has been influenced by the reduction in effort and the decline of efficiency for most industrial fleets, consequence of the security situation in the Somali area. An improvement in this situation could rapidly reverse these changes in fleet activity and lead to an increase in effort that the stock might not be able to sustain in its current state, as catches would then be likely to exceed MSY levels.

Fishing mortality is likely to have exceeded the MSY-related levels in recent years, therefore some reduction in catch or fishing effort could be required to return exploitation rates to those related to MSY levels.

Recommendations

The SC considers that the stock of yellowfin has recently become overexploited or is very close to being overexploited so. Management measures should be continued that allow an appropriate control of fishing pressure to be implemented.

At this moment, the effect of time-area closures cannot be directly translated into management quantities of direct effect on the status of the stock, such as catches or fishing mortality, so their possible effect on the future evolution of the stock cannot be evaluated.

The SC recommends that catches of yellowfin tuna in the Indian Ocean should not increase beyond 300,000 t in order to bring the stock to biomass levels that could sustain catches at the MSY level in the long term. If recruitment continues to be lower than average, catches below 300,000 t would be needed to maintain stock levels.

The SC recommends that the situation of this stock is closely monitored.

YELLOWFIN TUNA SUMMARY

Management quantity	2009 Assessment	2010 Assessment
Most recent catch	318,400 t (2008)	288,100 t (2009)*
Mean catch over the last 5 years (2005-2009)		371,200 t
Maximum Sustainable Yield	300,000 t	320,000 t[(1)] range: (258,000 t – 347,000 t)
$F_{Current}/F_{MSY}$	1.16	0.994[(1)] range: (0.85 – 1.39)
$B_{Current}/B_{MSY}$	0.90	1.067[(1)] range: (0.91 – 1.17)
$SB_{Current}/SB_{MSY}$	1.12	1.112[(1)] range: (0.93 – 1.25)
$B_{Current}/B_0$	0.356	0.349[(1)] range: (0.34 – 0.35)
$SB_{Current}/SB_0$	0.342	0.332[(1)] range: (0.328 – 0.334)
$B_{Current}/B_{Current,F=0}$	0.400	0.462[(1)] range: (0.461 – 0.468)
$SB_{Current}/SB_{Current,F=0}$	0.340	0.438[(1)] range: (0.437 – 0.445)

*preliminary catch estimate.

[(1)] base case point estimates (5 areas, steepness fixed at 0.8), range of point estimates for 5 area models, with steepness fixed at 0.6, 0.7, 0.8 and 0.9.

Table 2. Best scientific estimates of the catches of yellowfin tuna (as adopted by the IOTC Scientific Committee) by gear and main fleets for the period 1960 to 2009. Data as of November 2010.

Gear	Fleet	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	85	86
Purse seine	Spain																									11.5	18.4	20.0
	France																						0.2	1.0	10.5	36.7	39.1	43.3
	NEI-Other																								0.7	8.4	9.4	6.3
	Other Fleets	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.1	0.2	0.5	0.4	0.3	0.1	0.3	1.6	1.8	2.1	4.2
	Total	*0.0*	*0.0*	*0.0*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.0*	*0.0*	*0.1*	*0.1*	*0.1*	*0.0*	*0.1*	*0.2*	*0.5*	*0.4*	*0.3*	*0.3*	*1.3*	*12.7*	*58.3*	*69.0*	*73.8*
Baitboat	Maldives	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	6.9	6.2
	Other Fleets	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	0.3	0.4	0.5	0.5	0.6	0.5	0.2	0.3	0.6	0.6
	Total	*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*	*4.9*	*4.9*	*6.1*	*5.0*	*7.9*	*8.5*	*7.6*	*6.8*
Longline	Taiwan,China	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*	*7.3*	*16.2*
	Japan	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	9.5	10.7
	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	0.8	0.7
	India																								0.0	0.1	0.2	0.6
	Korea, Republic of						0.1	0.1	0.4	5.3	9.2	5.3	7.5	10.3	10.8	13.2	13.6	13.9	33.2	26.7	18.1	13.3	12.5	19.4	16.3	10.2	12.5	15.5
	NEI-Deep-freezing																										0.1	1.1
	NEI-Indonesia Fresh Tuna																											0.1
	Other Fleets	0.0	0.0	0.0	0.0	*0.3*	0.5	0.5	0.1	2.5	0.6	2.0	1.7	1.6	1.2	0.7	0.3	1.1	0.9	0.2	0.4	0.5	0.4	0.4	0.7	0.8	0.2	0.4
	Total	*38.3*	*35.6*	*47.7*	*25.4*	*25.3*	*27.7*	*45.8*	*34.1*	*78.8*	*54.0*	*32.5*	*34.5*	*31.6*	*21.8*	*23.6*	*25.5*	*22.0*	*45.6*	*37.2*	*26.9*	*22.9*	*24.5*	*34.6*	*31.2*	*25.7*	*30.5*	*45.2*
Gillnet	Sri Lanka	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	6.9	7.1
	Oman	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	1.2	1.4
	Pakistan	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	1.5	2.6
	Other Fleets	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	1.1	0.6
	Total	*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*	*10.7*	*11.6*
Line	Yemen	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.2	0.3	0.3	0.3	0.8	1.0	1.1	1.1	1.2	1.2	1.3	1.0	0.9	1.6	2.5	3.3	4.1
	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	0.3	0.8	1.0	1.1	1.2	1.3	1.2	1.5	1.4	1.0	0.5	1.3	0.7	0.7
	Madagascar	0.4	0.4	0.4	0.4	0.4	0.7	0.9	0.9	0.9	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	1.6	2.9	2.9	3.4
	Comoros											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	0.2	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*	*0.2*	*0.2*
	India	0.3	0.4	0.1	0.2	0.4	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.2	0.9	0.2	0.3	0.4	0.3	0.4	0.6	0.8	0.5	0.7	0.3	0.5	1.0	0.4
	Other Fleets	0.7	0.8	1.1	1.3	1.3	1.3	1.4	1.6	1.7	1.9	1.5	1.5	2.1	2.2	2.1	1.5	2.4	5.9	5.4	5.2	4.5	3.4	4.3	3.6	2.9	4.1	5.4
	Total	*1.8*	*2.1*	*2.0*	*2.3*	*2.5*	*2.6*	*3.0*	*3.2*	*3.3*	*3.0*	*2.8*	*2.9*	*3.6*	*4.7*	*4.9*	*4.7*	*6.1*	*9.5*	*9.5*	*9.5*	*9.4*	*7.6*	*8.5*	*8.0*	*10.6*	*12.3*	*14.4*
Other gears	*Total*	*0.1*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.3*	*0.3*	*0.6*	*0.6*	*0.8*	*1.0*	*1.2*	*1.2*	*1.2*	*0.9*	*0.8*	*0.4*	*0.9*	*0.8*	*1.0*
All	*Total*	*44.1*	*42.5*	*55.6*	*35.3*	*36.0*	*38.1*	*58.3*	*47.3*	*92.6*	*67.9*	*45.3*	*44.8*	*46.2*	*43.2*	*45.1*	*45.1*	*47.2*	*73.1*	*63.9*	*56.1*	*51.8*	*54.1*	*65.0*	*71.5*	*114.3*	*130.9*	*152.8*

Gear	Fleet	Av05/09	Av60/09	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09
Purse seine	Spain	53.2	24.6	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	46.1	33.5
	France	38.9	21.4	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	37.5	22.6
	Seychelles	24.5	5.3					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	20.7	21.3
	Iran, Islamic Republic	4.4	1.4						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	2.1	1.7
	NEI-Other	3.1	6.6	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	3.2	1.8
	NEI-Ex-Soviet Union	1.6	2.7				0.8		5.2	8.6	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	5.9	3.0	5.7	6.1	5.9	7.0	11.1	14.3	13.7	7.4	6.6	4.8	3.7	3.3	2.3	1.5	5.5	6.6	0.8	0.5	3.9	4.1	6.5	7.5	7.5
	Total	*131.6*	*64.9*	*84.0*	*118.8*	*89.8*	*108.7*	*105.5*	*112.4*	*127.5*	*113.7*	*148.3*	*129.9*	*132.3*	*100.6*	*135.0*	*140.5*	*130.1*	*139.2*	*224.3*	*228.6*	*194.5*	*159.8*	*97.9*	*117.1*	*88.5*
Baitboat	Maldives	14.8	7.2	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	15.7	14.3
	Other Fleets	2.1	0.6	0.5	0.4	0.3	0.4	0.6	0.6	0.7	0.6	0.6	0.6	0.7	0.6	0.7	0.8	0.7	0.8	0.8	0.6	2.7	1.5	2.3	1.6	2.4
	Total	*16.9*	*7.8*	*7.9*	*6.3*	*5.8*	*5.3*	*7.6*	*8.6*	*9.9*	*13.0*	*12.4*	*12.1*	*12.9*	*13.6*	*13.3*	*10.9*	*11.8*	*17.1*	*16.9*	*15.1*	*17.6*	*17.3*	*15.6*	*17.3*	*16.6*
Longline	Taiwan,China	31.6	18.4	22.3	22.7	22.4	31.6	30.7	56.0	88.3	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	16.6	13.5
	Japan	15.5	14.2	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	22.3	18.6	10.4	4.9
	Indonesia	10.1	8.1	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	28.7	25.1	21.1	17.1	14.6	10.3	10.2	8.6	6.9
	NEI-Fresh Tuna	6.8	5.0			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	5.7	6.9	8.4	7.0	8.2	3.6
	Oman	5.2	0.7														1.4	1.7	1.8	1.5	3.1	6.7	3.3	4.0	5.3	6.6
	India	3.9	0.6	0.2	0.1	0.0	0.0	0.0	0.0	1.1	0.0	1.3	0.2	0.2	1.5	1.7	0.9	0.1	0.1	0.0	3.1	4.2	3.7	4.5	4.0	2.9
	Korea, Republic of	2.5	7.3	13.2	14.2	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	3.6	1.0	1.0
	NEI-Deep-freezing	2.4	2.9	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	2.9	1.2	0.6	0.6
	NEI-Indonesia Fresh Tuna	0.0	2.0		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	9.3	3.6	0.4	0.3	0.3	0.1	1.8	20.0	33.4	7.9	4.0	3.7	1.9	2.5	4.3	4.7	5.2	4.5	7.5	11.8	19.0	11.2	8.8	4.5	3.2
	Total	*87.5*	*62.8*	*47.0*	*54.9*	*65.3*	*86.1*	*78.8*	*136.7*	*196.5*	*120.4*	*88.6*	*113.6*	*109.1*	*109.3*	*103.7*	*91.3*	*83.3*	*87.6*	*87.0*	*117.5*	*150.8*	*100.3*	*83.6*	*59.4*	*43.2*
Gillnet	Sri Lanka	36.4	14.7	7.4	7.7	8.4	9.6	11.6	13.9	16.6	21.5	18.9	23.7	29.6	29.2	37.0	33.9	30.7	32.5	38.5	39.3	26.5	38.9	36.6	37.0	43.2
	Iran, Islamic Republic	23.8	8.1			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	17.1	20.6
	Oman	8.3	3.5	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	6.1	12.1	7.6	7.1	7.9	9.5	9.5
	Pakistan	4.1	3.1	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	4.0	3.5	3.7	3.4	2.2	1.7	5.2	5.4	6.0
	Other Fleets	4.0	0.9	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	5.1	4.8	4.8
	Total	*76.6*	*30.3*	*13.8*	*20.4*	*27.3*	*23.8*	*23.4*	*37.8*	*39.3*	*49.3*	*53.8*	*60.9*	*57.8*	*58.2*	*75.4*	*57.3*	*56.7*	*58.8*	*78.7*	*95.3*	*74.2*	*82.5*	*68.5*	*73.9*	*84.1*
Line	Yemen	18.1	7.8	4.8	5.5	6.3	7.1	7.9	8.6	7.7	8.5	13.4	15.2	17.2	19.3	21.4	23.4	25.5	27.5	25.7	31.6	26.7	19.6	16.2	13.9	13.9
	Oman	7.8	3.0	1.7	4.5	4.8	4.2	6.0	6.0	5.3	13.5	9.1	5.2	6.2	4.4	3.5	3.3	2.9	2.2	1.9	8.4	7.0	6.6	7.4	8.9	8.9
	Madagascar	7.6	3.4	3.6	5.4	5.2	5.4	5.2	5.9	6.5	5.9	6.1	5.9	6.1	5.9	6.4	6.5	6.9	7.4	7.4	8.0	7.8	7.9	8.6	6.8	6.8
	Comoros	7.1	2.5	0.2	0.2	3.7	3.7	3.7	5.0	5.0	5.9	5.9	5.8	5.6	5.6	5.4	5.9	5.4	5.8	6.1	6.2	6.2	6.2	6.3	8.4	8.4
	Maldives	6.2	1.2	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	6.9	5.3
	India	4.0	0.8	0.8	0.4	0.6	0.8	0.3	0.4	0.4	0.3	0.3	0.4	0.4	0.4	0.4	0.5	0.4	0.5	0.4	0.4	1.7	2.3	7.4	4.4	4.4
	Other Fleets	5.4	3.3	4.0	4.0	2.5	2.8	3.6	3.5	3.9	4.1	4.1	4.0	4.0	3.5	3.7	4.2	4.0	3.9	3.9	4.0	9.3	4.9	4.3	4.2	4.3
	Total	*56.2*	*22.0*	*15.4*	*20.3*	*23.4*	*24.3*	*27.0*	*29.7*	*29.2*	*38.4*	*39.0*	*36.8*	*39.8*	*39.6*	*41.5*	*45.4*	*47.6*	*51.5*	*47.9*	*65.4*	*64.2*	*53.3*	*57.7*	*53.6*	*52.0*
Other gears	*Total*	*2.4*	*1.0*	*1.4*	*3.1*	*3.0*	*2.7*	*0.4*	*0.7*	*0.6*	*1.2*	*3.2*	*2.1*	*0.5*	*1.0*	*0.5*	*0.5*	*0.4*	*0.4*	*1.2*	*1.6*	*2.3*	*1.1*	*1.5*	*3.6*	*3.7*
All	*Total*	*371.2*	*188.9*	*169.5*	*223.9*	*214.5*	*250.9*	*242.6*	*325.9*	*403.0*	*336.0*	*345.3*	*355.3*	*352.5*	*322.2*	*369.3*	*345.8*	*330.0*	*354.6*	*456.0*	*523.6*	*503.7*	*414.4*	*324.8*	*324.8*	*288.1*

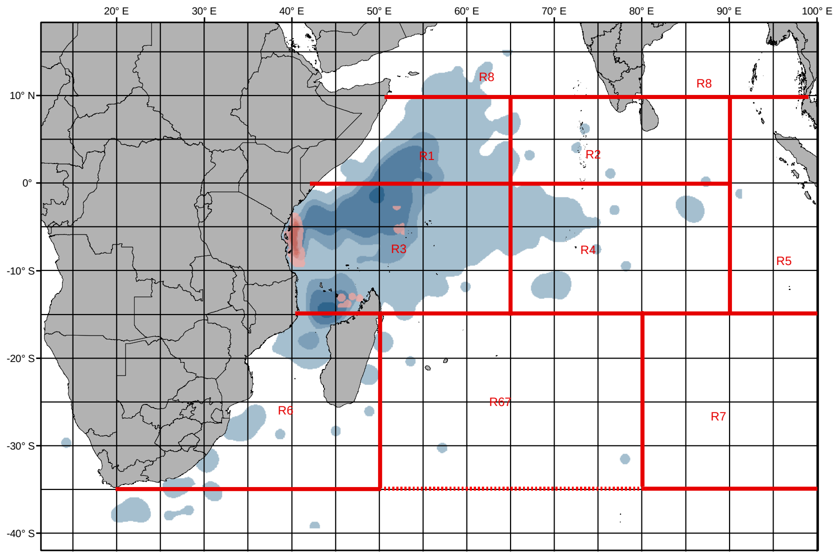


Figure 1. Tag recapture densities for yellowfin tuna tagged in the south west Indian Ocean by the RTTP-IO and limits between areas presently used in the MF-CL model(December 2010).

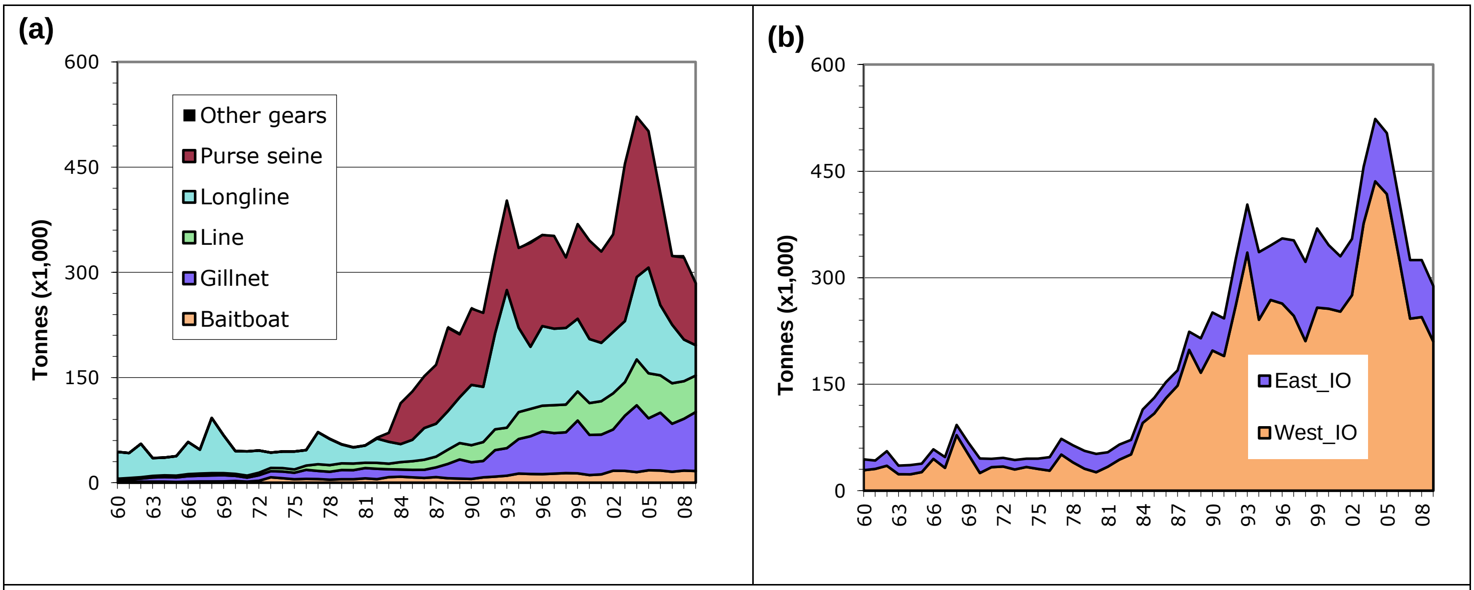


Figure 2. Yearly catches (tonnes x 1000) of yellowfin by (a) gear and (b) area (to be updated) from 1960 to 2009.Data as of November 2010

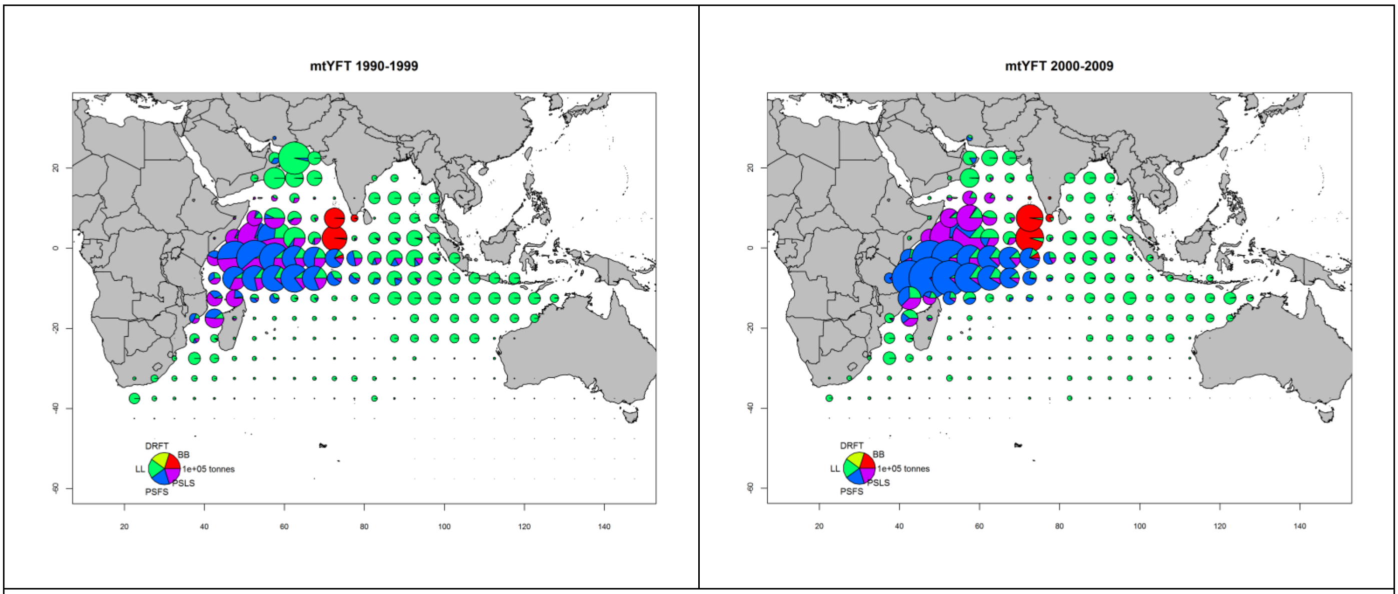


Figure 3. Total catches of yellowfin tuna by gear (PSFS – purse-seine free school, PSLS – purse-seine log school, DRFT – driftnet, BB – bait boat, LL – longline) in the Indian Ocean over the periods 1990-1999 and 2000-2009. Data as of December 2010

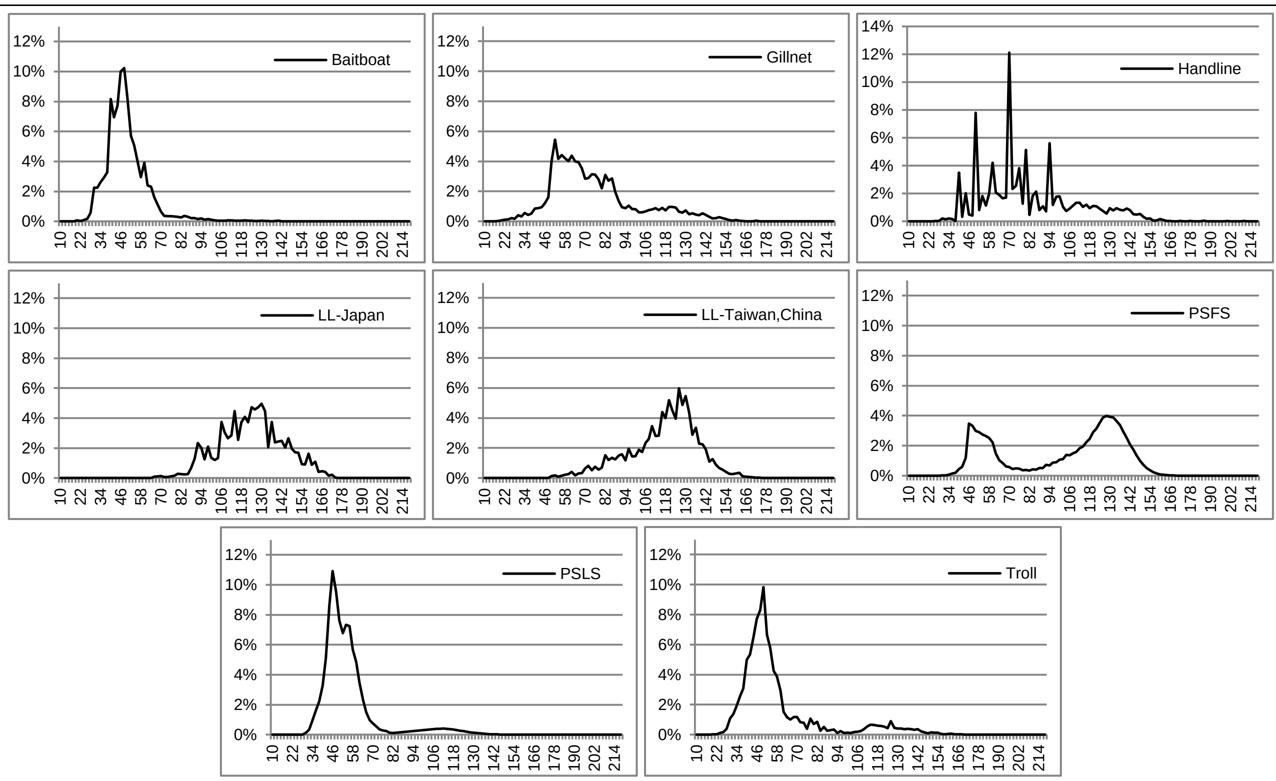


Figure 4. Proportion of the catch at size of yellowfin tuna by gear from 1999-2009.

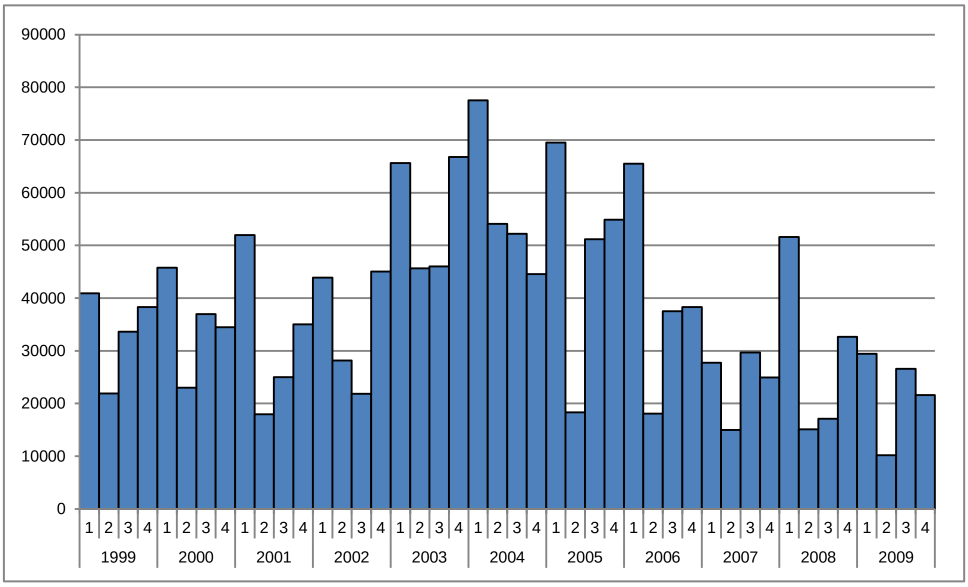


Figure 5. Yellowfin tuna quarterly catches by purse seiners in the Indian Ocean over the period 1999 to 2009

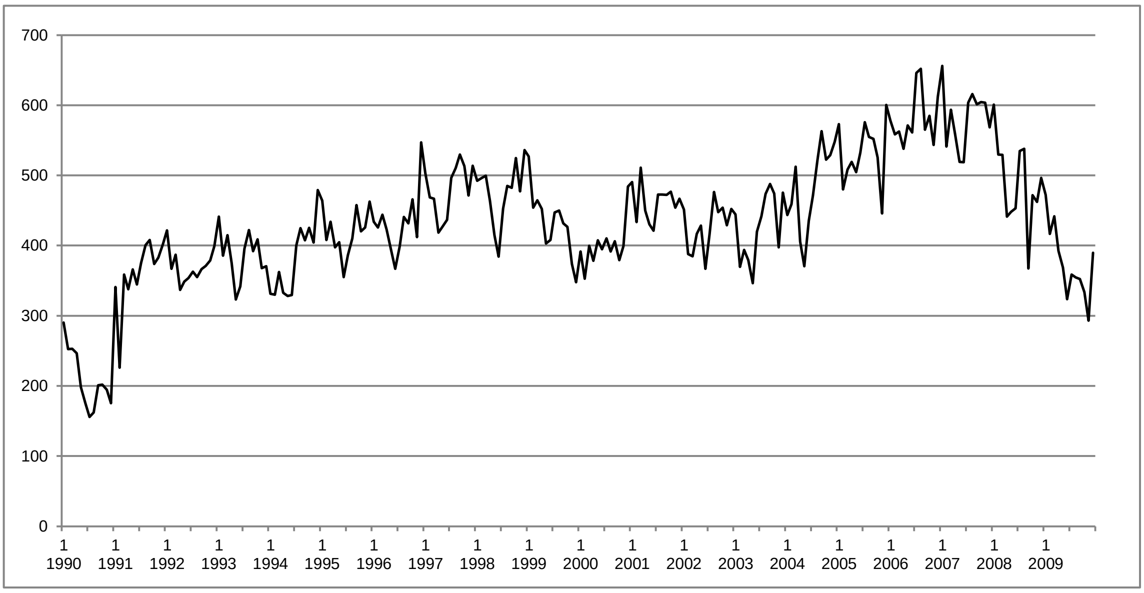


Figure 6. Monthly effort (days) exerted by the EU/Seychelles purse seine fleet in the Indian Ocean.

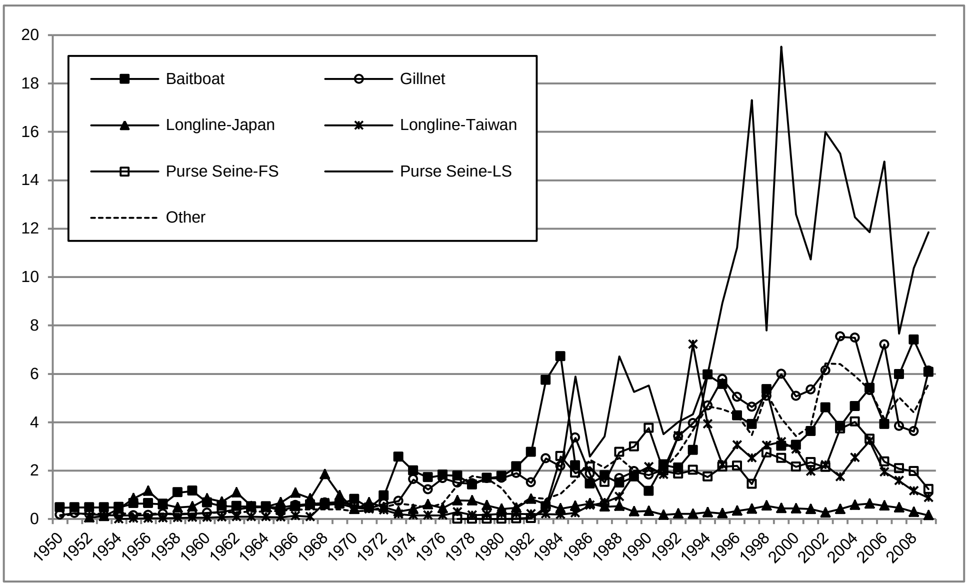


Figure 7. Numbers of yellowfin caught by gear-type.Data as of December 2010

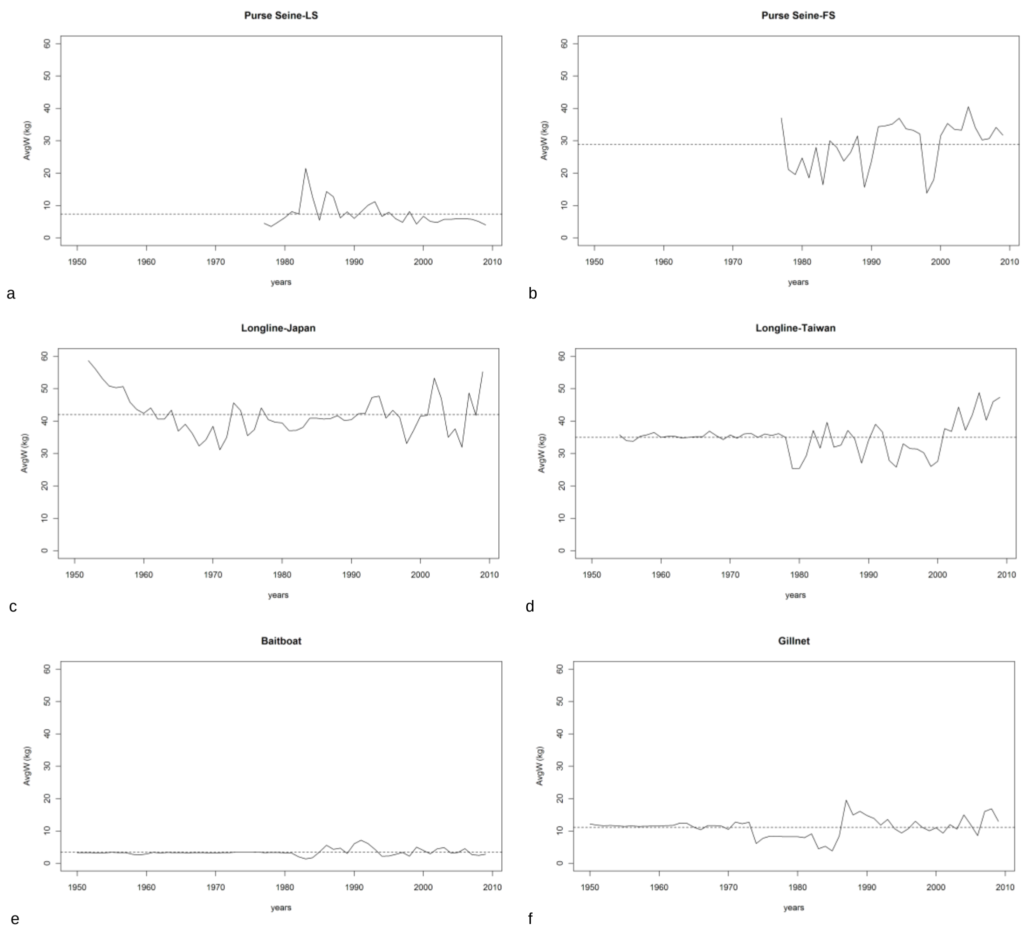


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Figure 8. Temporal trend of average weight of yellowfin (kg) for all fleets from 1950 to 2009: a) Purse-seine log school, b) Purse-seine free school, c) longline Japan, d) longline Taiwan,China, e)baitboat, f) gillnet, g) all fleets combined.. Data as of December 2010

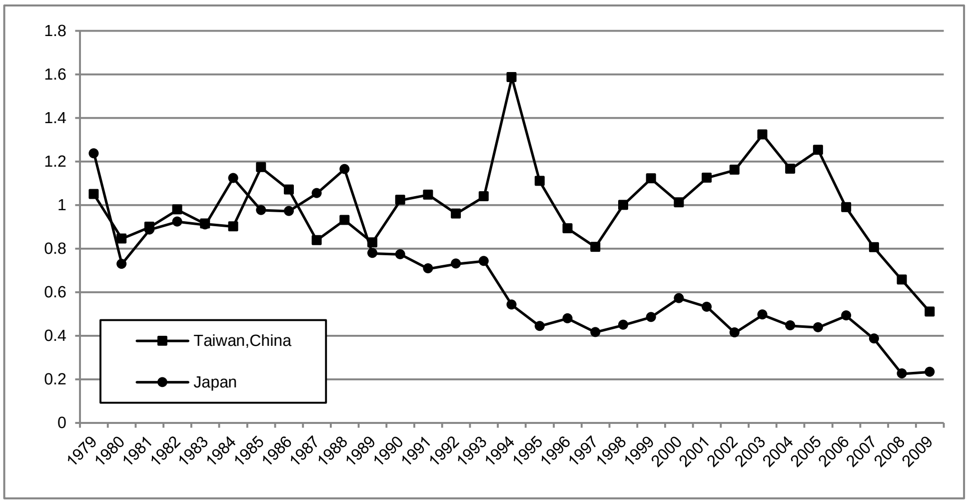

Figure 9. Comparison of the relative standardized yellowfin CPUEs for Japan and Taiwan,China for the period 1979-2009.

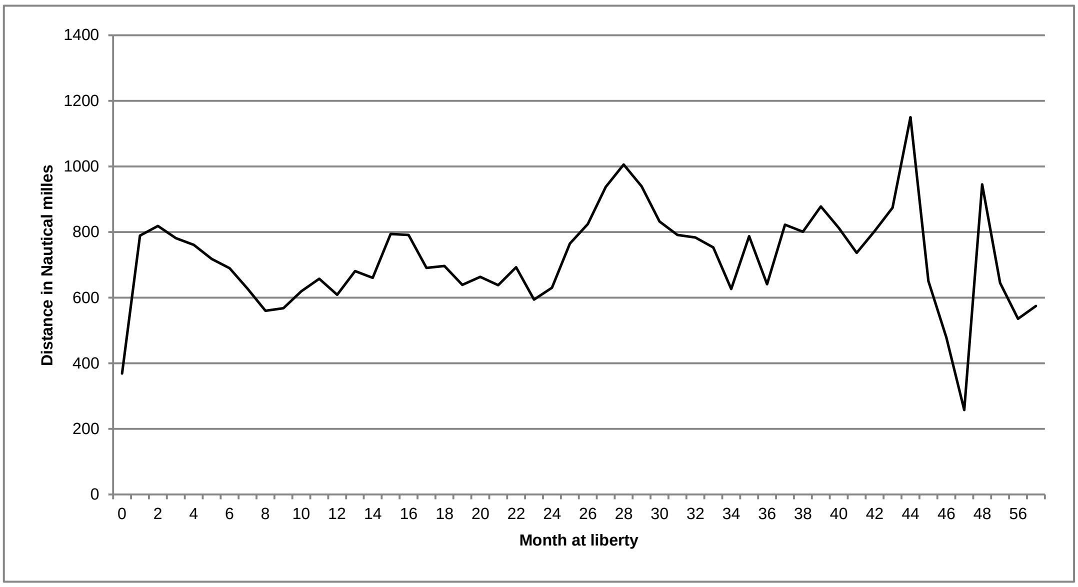

Figure 10: Average distance between tagging and recovery position of YFT as a function of duration at liberty. Data as of December 2010.

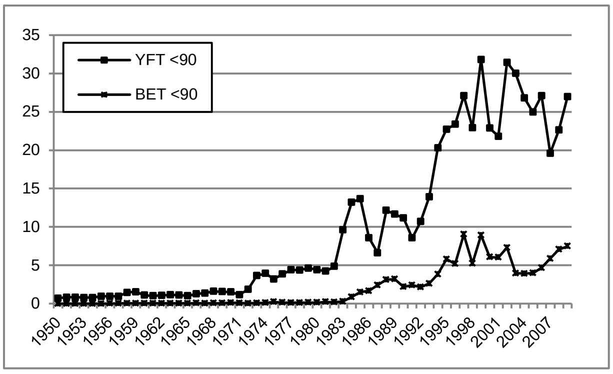

Figure 11: Total yearly catches of small YFT and BET <90 cm (in millions) taken by the whole fisheries. Data as of December 2010.

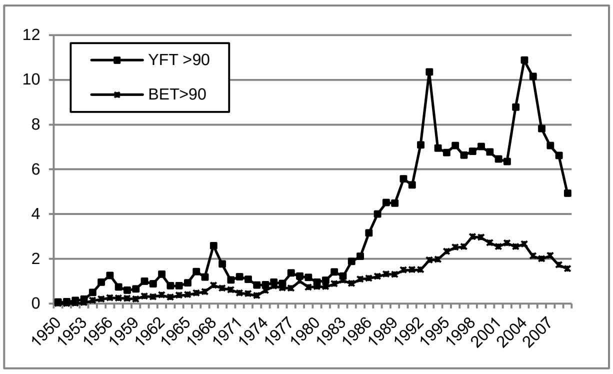

Figure 11: Total yearly catches of large YFT and BET >90 cm (in millions) taken by the whole fisheries. Data as of December 2010.

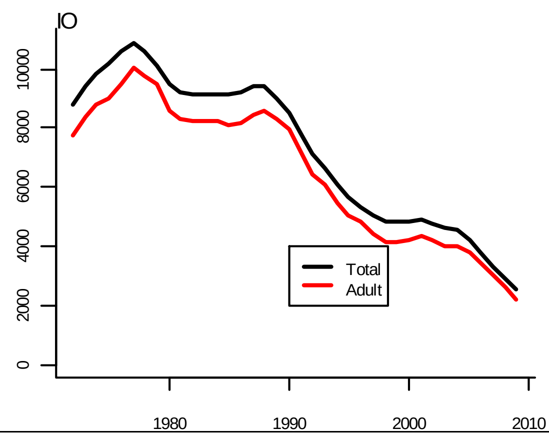

Figure 12. Temporal trend in total and adult biomass (1000s mt) for the whole Indian Ocean. (IOTC-2010-WPTT-R)

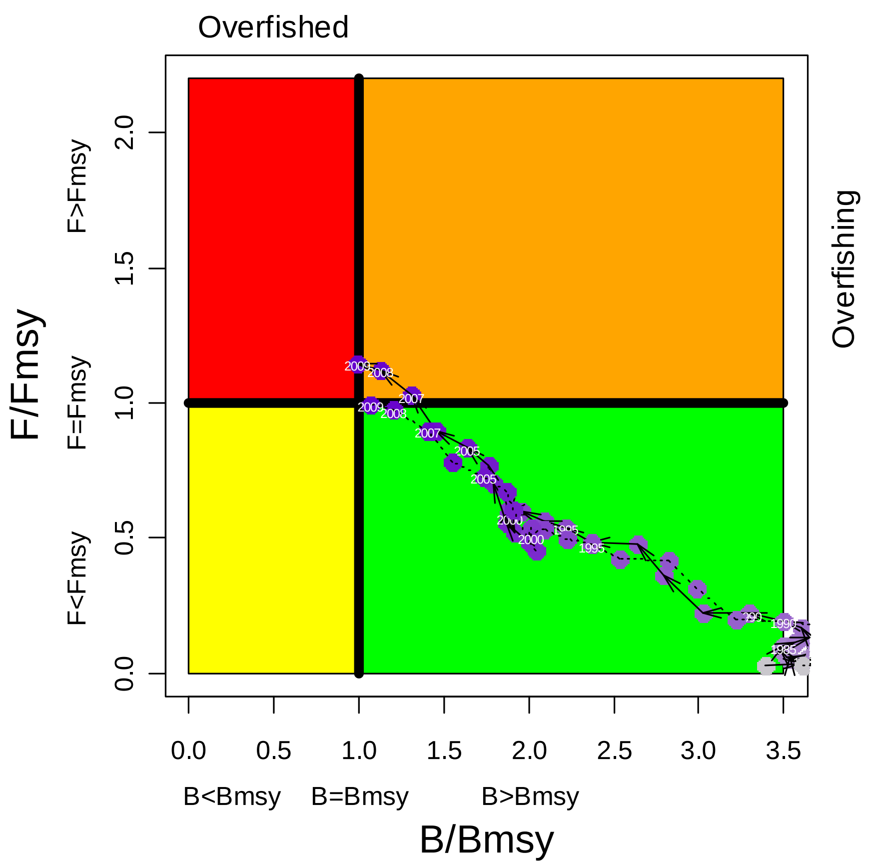

Figure 13. Temporal trends in annual stock status, relative to SBMSY (x-axis) and FMSY (y-axis) reference points for the final 5 area run (steepness 0.7 and 0.8 - dashline). The colour of the points is graduated from mauve (1960) to dark purple (2009).

EXECUTIVE SUMMARY OF THE STATUS OF THE INDIAN OCEAN SWORDFISH RESOURCE

(as adopted by the IOTC Scientific Committee in December 2010)

BIOLOGY

Swordfish (*Xiphias 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 are 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.

Preliminary genetic studies of the stock structure of swordfish in the western Indian Ocean have suggested that there may be spatial heterogeneity, and research is ongoing to resolve this question. For the purposes of stock assessments, one pan-ocean stock has traditionally been assumed. However, spatial heterogeneity in stock indicators (CPUE trends) indicates the potential for localised depletion of swordfish in the Indian Ocean, and efforts were made to admit this possibility in the stock assessment.

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 (however, there is considerable uncertainty in the appropriate methods for age estimation in swordfish, and direct validation studies are still needed).

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 swordfish 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 (Table 1). The average annual catch for the period from 2005 to 2009 was 27,100 t and it was 22,300 t in 2008 and 22,100t in 2009. 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 Taiwan,China 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 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 1990s.

Total catches have declined substantially in the last few years, largely due to the declining number of Taiwanese longliners.

STOCK ASSESSMENT

A stock assessment for swordfish was undertaken in 2010, including a range of models and stock structure assumptions. ASPIC and ASIA models assumed a single homogenous Indian Ocean population. The SS3 model assumed a single spawning population, with the potential for differential depletion in each of 4 areas. The SCAM model examined only the SW region, because it is generally perceived to be the most highly depleted region, and may represent a discrete population. The stock status reference points obtained from the range of models varies considerably, but a number of general consistencies were evident. This summary attempts a qualitative summary across models and data-based indicators.

In 2010, the aggregate Indian Ocean standardized Japanese and Taiwanese CPUE series demonstrate similar declining trends over the period of overlap (1995-2008). However, when examined by the assessment sub-areas, the Japanese and Taiwanese CPUE series show some important conflicts (particularly in the south-west Indian Ocean).

The annual average sizes of swordfish in the respective Indian Ocean fisheries are variable but show no trend (Figure 6). It was considered encouraging that there are not 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.

RESULTS FOR THE AGGREGATE INDIAN OCEAN

The stock status reference points from the range of models for the aggregate Indian Ocean were generally consistent, in that the point estimates suggested $B>B_{MSY}$ and $F<F_{MSY}$ for all models, although there was a large range in the uncertainty estimates. The central tendency of the depletion and MSY estimates are very similar, and the variability is mostly in the degree of uncertainty expressed. All of the models suggest that depletion is moderate, within the range 0.39 – 0.56 (B_{2008}/B_0). MSY estimates varied from 19,000 t to 46,000 t, with many models having point estimates of ~30,000 tonnes. The WPTT considered that the Kobe plot for the ASPIC model (figure 8) provided a useful descriptive summary of the general trends of the Indian Ocean models for recent years (although the uncertainty is understated relative to the full range of results and B/B_{MSY} is on the pessimistic end of the range).

In 2010, the WP undertook projections in stock status under a range of management scenarios for the first time, following recommendation by the Kobe II meeting in Barcelona in June 2010 to harmonise technical advice to managers across RFMOs. The executive summary presents the K2SM for the ASPIC model projections (table 1). These tables attempt to quantify the future outcomes from a range of management options. The tables describe the probability of the fishery being in an undesirable state at some point in the future, where 'undesirable' was assigned the default definitions of $F>F_{MSY}$ or $B<B_{MSY}$. The timeframes represent 3 and 10 year projections (from the last data in the model), which corresponds to predictions for 2011 and 2018. The management options represent three different levels of constant catch projection: catches 20% less than 2008, equal to 2008 and 20% greater than 2008. It is recognised at this time that the K2SM does not represent the full range of uncertainty from the assessments. The inclusion of the K2SM at this time is primarily intended to familiarise the Commission with the format and method of presenting management advice

MODEL RESULTS FOR THE SOUTH-WEST INDIAN OCEAN

The apparent fidelity of swordfish to particular areas is a potential concern, as this can lead to localised depletion of sub-populations. This seems to be the greatest concern in the south-west (SW) region, where CPUE series of the fleets of Japan, Taiwan, Spain and La Reunion have all shown substantial declines at some point during the past 20 years (the timing and magnitude of the declines is not entirely consistent). The spatially-disaggregated SS3 model could not adequately fit the steep CPUE declines in the SW at the same time as the relatively stable CPUE in the other regions. The SCAM models (which only examined the SW) suggested that this sub-population is highly depleted (B_{2008}/B_{MSY} = 0.27-0.88, B_{2008}/B_0 = 0.024- 0.07). Kobe plots from two representative SCAM models (fig. 9) illustrate consistent overfishing and population decline for most of the past 15 years. However, there are reasons for not being overly alarmist in the interpretation of these preliminary results, *i.e.* stock structure and movement rates are not known, the results may not be consistent with the size composition data (selectivity was not estimated and size composition was not fit in the model), the CPUE series conflict (especially in the last 5 years), and the CPUE series are sensitive to assumptions about spatial/targeting preferences. Furthermore, even if these pessimistic models are correct, then fishing mortality has decreased substantially in recent years, such that the point estimates suggest that overfishing is probably not occurring at present, $F_{2008}/F_{MSY} = 0.64 – 0.98$). However, until there is further evidence to reduce the uncertainty in the SW assessment (particularly the CPUE series), it would be prudent to proceed under the assumption that this sub-population is heavily depleted, and may not be rebuilding.

MANAGEMENT ADVICE

Current Stock status

The WPB considers that MSY-related reference points are probably not being exceeded for the Indian Ocean population as a whole, and the overall level of depletion probably does not represent a conservation risk.

The potentially high levels of depletion in the south-west remain a special concern. The preliminary assessment for this sub-region confirms that the pessimistic indicators are consistent with a sub-population that has experienced overfishing for several recent years ($F>F_{MSY}$) and remains currently overfished ($B<B_{MSY}$). Recent declines in catch and effort have probably brought the fishing mortality level down to sustainable levels (point estimates suggest that $F_{2008} < F_{MSY}$). However, there are a number of unresolved problems with the model and data, including inconsistencies among different CPUE series and the size composition data.

Outlook

The continued decrease in longline catch and effort in recent years has substantially lowered the pressure on the Indian Ocean stock as a whole, and fishing probably does not represent a high conservation risk at present. However, catches still exceed some of the more pessimistic MSY estimates.

If the pessimistic stock assessments for the SW are accurate (and if this region does represent a distinct sub-population), then the decreased catch and effort have greatly reduced the pressure on this sub-population. However, further reductions would be required to be certain that rebuilding was initiated.

Recommendations

If the recent declines in effort continue, and catch remains substantially below the estimated MSY of 29,000 t, then there is probably no urgent need to introduce restrictive management actions to the Indian Ocean as a whole. However, continued monitoring is required to manage the uncertainty.

It is recommended that catches in the SW should be maintained at levels at or below those observed in 2008 (6,426 t), until either i) there is clear evidence that substantial rebuilding is occurring (through recruitment or immigration), or ii) further analyses indicate that the current assessment is inappropriate.

SWORDFISH SUMMARY FOR THE WHOLE INDIAN OCEAN

Management quantity	2009 Assessment	2010 Assessment
Most recent catch	22,335 t (2008)	22,100 t (2009)
Mean catch over the last 5 years (2005-2009)		27,100 t
Maximum Sustainable Yield	33,000 t Range: 32,000 – 34,000 t	29,000 t[1] Range[1]: 19,000 – 46,000 t
F_{2008}/F_{MSY}	0.79 Range: 0.58 – 0.84	0.70[1] Range[1]: 0.32 – 0.94
B_{2008}/B_{MSY}	1.31 Range: 1.13 – 1.46	1.13[1] Range[1]: 0.93 – 3.29
SB_{2008}/SB_{MSY}		
B_{2008}/B_0	0.48 (0.19-0.87)	0.42[1] Range[1]: 0.39 – 0.55
SB_{2008}/SB_0		
$B_{2008}/B_{2008,F=0}$		
$SB_{2008}/SB_{2008,F=0}$		

[1]Central point estimate is adopted from the ASPIC model, the range represents the most extreme value from the ASPIC bootstrap results and the MPD estimates from the ASIA and SS3 models.

SWORDFISH SUMMARY FOR THE SOUTHWEST INDIAN OCEAN ONLY

Management quantity	2010 Assessment
Most recent catch	6,426 t (2008)
Mean catch over the last 5 years (2005-2009)	8,081 t
Maximum Sustainable Yield	6,200 – 6,300 t[1]
F_{2008}/F_{MSY}	0.64 – 0.98[1]
B_{2008}/B_{MSY}	
SB_{2008}/SB_{MSY}	0.269 – 0.88[1]
B_{2008}/B_0	
SB_{2008}/SB_0	0.0241 – 0.070[1]
$B_{2008}/B_{2008,F=0}$	
$SB_{2008}/SB_{2008,F=0}$	

[1]The range represents the MPD values from the two SCAM models that were judged to be the most plausible.

Table 1. Kobe 2 Strategy Matrix for comparing management options based on ASPIC. Table entries are the probability of violating the MSY-related reference points for three constant catch projections, i.e. current catch level (2008; i.e. 0% change), catches 20% less than current and catches 20% above current catch, reported for 3 year and 10 years in the future. The catch levels are provided in brackets.

Stock status Reference Point	Projection Time frame	Alternative Catch Projections			Data Rich/Data Poor
		C(2008) -20% (17,866 t)	C(2008) (22,333 t)	C(2008)+20% (26,800 t)	
P(Ft>Fmsy)	In 3 years	0.001	0.004	0.22	Moderate
	In 10 years	0.001	0.004	0.14	Moderate

Stock status Reference Point	Projection Time frame	Alternative Catch Projections			Data Rich/ Data Poor
		C(2008) -20% (17,866 t)	C(2008) (22,333 t)	C(2008)+20% (26,800 t)	
P(Sbt<SBmsy)	In 3 years	0.158	0.194	0.260	Moderate
	In 10 years	0.028	0.050	0.160	Moderate

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 1960-2009 (in thousands of tonnes). Data as of December 2010)

Gear	Fleet	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	85	86
Longline	China																											
	Taiwan,China	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	1.7	2.0	3.2
	NEI-Deep-freezing																										0.0	0.2
	Japan	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	1.3	2.2	1.3
	Indonesia															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
	India																								0.0	0.0	0.0	0.0
	Korea, Republic of						0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.1	0.2	0.3	0.6	0.6	0.8	0.9	0.6	0.4	0.4	0.3	0.3	0.1	0.0	0.0
	Other Fleets	0.0	0.0	0.0	0.0	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	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	*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*	*2.0*	*2.4*	*2.3*	*2.3*	*2.3*	*2.8*	*3.4*	*3.2*	*4.3*	*4.9*
Gillnet	Sri Lanka																											0.0
	India																					0.1	0.1	0.4	0.1	0.2	0.1	0.1
	Pakistan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	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*	*0.1*	*0.1*	*0.4*	*0.1*	*0.2*	*0.2*	*0.2*
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*	*0.1*	*0.0*	*0.0*	*0.0*	*0.0*
All	*Total*	*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*	*2.0*	*2.4*	*2.3*	*2.4*	*2.4*	*3.2*	*3.6*	*3.5*	*4.4*	*5.1*

Gear	Fleet	Av05/09	Av60/09	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09
	China	0.5	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	0.4	0.4	0.2
Longline	Taiwan,China	6.3	5.4	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	6.0	4.7	6.3
	Spain	4.5	0.9							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	4.8	3.9	3.4
	NEI-Deep-freezing	1.8	1.5	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	1.9	1.2	0.3	0.3
	Japan	1.6	1.2	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	2.2	1.6	1.0
	Indonesia	1.5	0.5	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	1.0	1.6	3.0	2.8	2.0	1.7	1.6	1.1	1.1
	Portugal	1.2	0.2												0.1	0.2	0.2	0.6	0.8	0.9	0.9	1.1	2.2	2.0	0.5	0.5
	India	1.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.3	0.4	0.1	0.0	0.0	0.0	0.8	0.5	0.9	1.2	1.3	1.6
	France-Reunion	1.0	0.4					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	1.1	0.9	0.9
	Seychelles	0.9	0.2									0.0	0.1	0.2	0.2	0.3	0.5	0.7	0.6	1.4	1.4	1.3	0.9	1.0	0.7	0.8
	United Kingdom	0.9	0.1																		0.4	0.6	1.1	1.0	0.9	0.8
	Guinea	0.6	0.1															0.0	0.4	0.3	1.0	0.8	0.6	0.6	0.5	0.5
	Tanzania	0.5	0.1																			0.5	0.6	0.6	0.5	0.5
	Mauritius	0.5	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	0.5	0.4	0.4
	Senegal	0.4	0.1																	0.2	0.1	0.1	0.6	0.6	0.5	0.5
	Korea, Republic of	0.2	0.2	0.1	0.1	0.1	0.1	0.0	0.1	0.1	1.1	0.7	1.1	0.7	0.3	0.0	0.1	0.1	0.0	0.1	0.3	0.3	0.3	0.1	0.0	0.1
	Australia	0.2	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			0.1	0.3
	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	0.1	0.2	0.2
	Other Fleets	1.0	0.3	0.1	0.1	0.3	0.4	0.4	0.5	0.4	0.5	0.3	0.1	0.2	1.2	0.5	0.1	1.5	1.8	1.4	0.5	1.0	1.0	1.1	1.3	0.9
	Total	*24.9*	*11.9*	*5.6*	*7.9*	*6.7*	*7.0*	*7.8*	*13.8*	*23.2*	*23.4*	*28.8*	*32.3*	*31.3*	*34.5*	*32.1*	*30.2*	*27.6*	*29.4*	*33.8*	*34.6*	*30.3*	*28.0*	*26.0*	*20.1*	*20.3*
Gillnet	Sri Lanka	1.0	0.5	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	0.9	0.8	0.9
	India	0.6	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.2	0.1	0.1	0.3	0.4	0.3	0.2	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.9	0.7	0.7
	Pakistan	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0					0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.1	0.5	0.5	0.5	0.5	
	Other Fleets	0.1	0.0	0.1	0.3	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0
	Total	*2.0*	*0.7*	*0.3*	*0.5*	*0.4*	*0.4*	*0.3*	*0.5*	*2.1*	*1.0*	*1.0*	*1.3*	*1.7*	*1.2*	*1.4*	*3.2*	*2.5*	*2.6*	*2.8*	*2.6*	*1.7*	*2.4*	*2.3*	*2.1*	*1.7*
Other gears	*Total*	*0.1*	*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*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.2*	*0.2*
All	*Total*	*27.1*	*12.7*	*5.9*	*8.4*	*7.1*	*7.5*	*8.1*	*14.3*	*25.3*	*24.5*	*29.8*	*33.7*	*33.2*	*35.8*	*33.6*	*33.4*	*30.2*	*32.1*	*36.7*	*37.3*	*32.1*	*30.5*	*28.5*	*22.4*	*22.1*

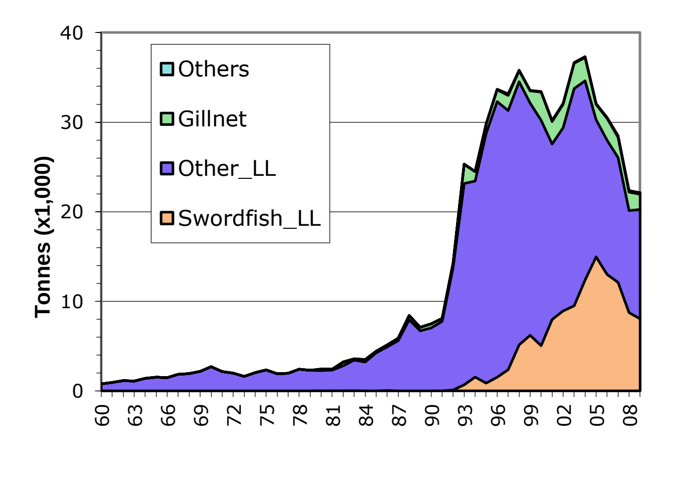

Figure 1. Catches of Swordfish per gear and year recorded in the IOTC Database (1960-2009). Data as of November 2010

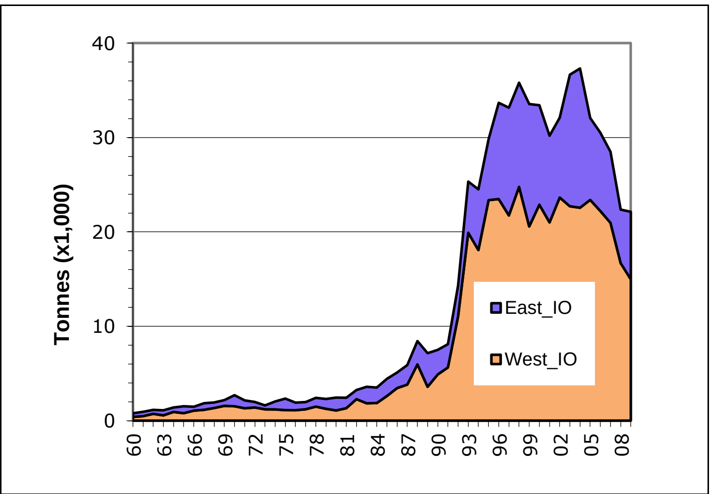

Figure 2. Trends of the swordfish catches in the western and the eastern area of the Indian Ocean from 1960 – 2009. Data as of November 2010

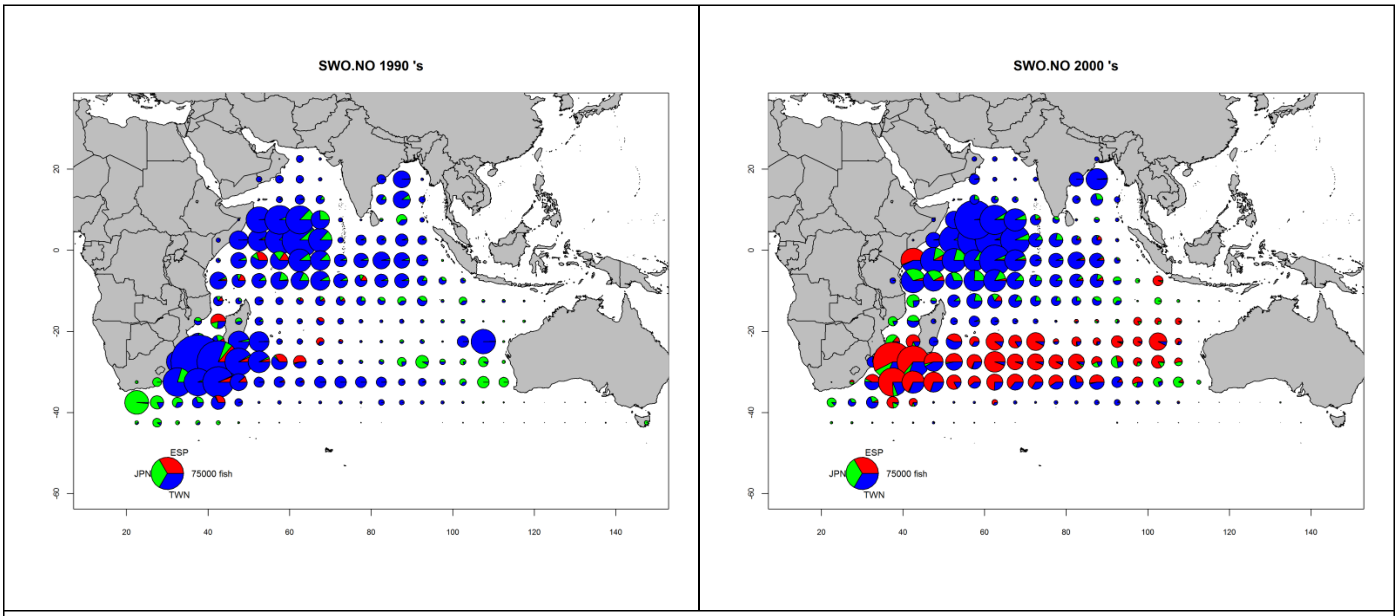

Figure 4. Mean annual catches of swordfish (t) for the periods 1990 to 1999 and 2000 to 2008 for longline, gillnet and other fisheries in the Indian Ocean.

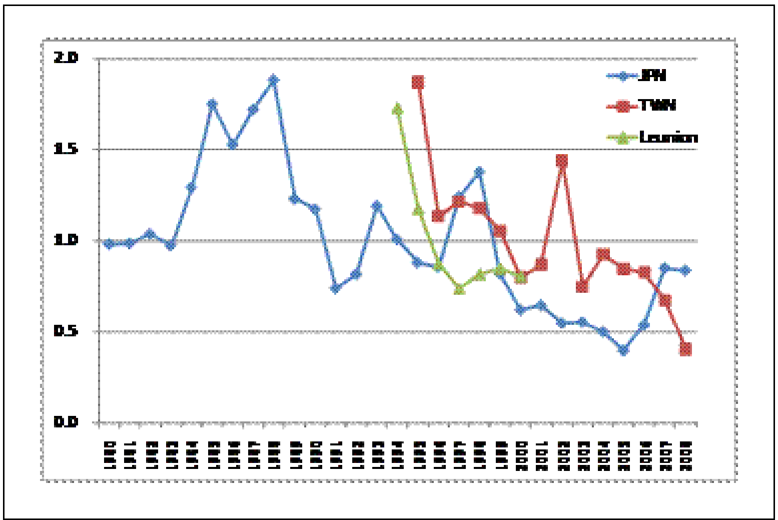

Figure 5: Standardised CPUE index for the longline fleets of Japan and Taiwan,China 1980 to 2008

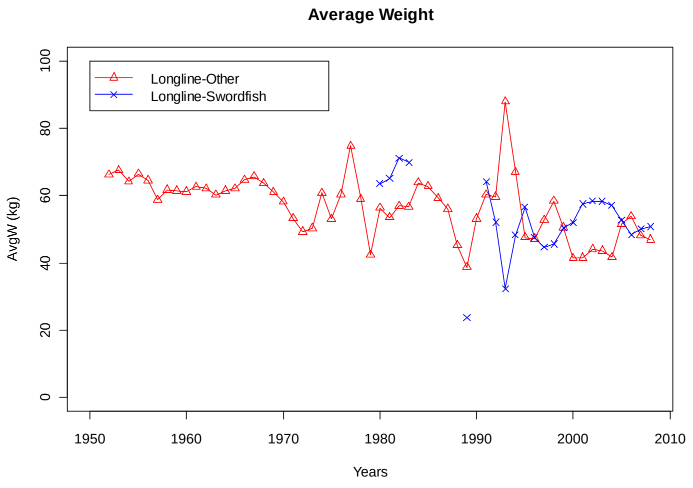

Figure 7. Trends in average size of swordfish per gear in the Indian Ocean from 1952 to 2008.

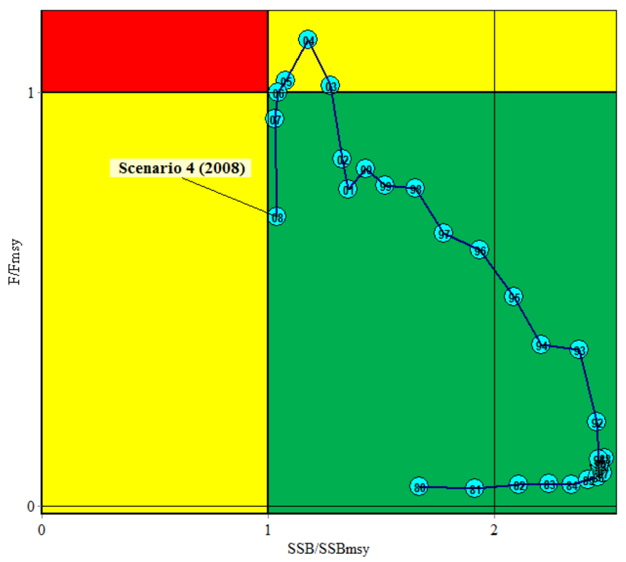

Figure 8. Kobe plot illustrated the result of the ASPIC model

EXECUTIVE SUMMARY OF THE STATUS OF BLACK MARLIN

(as adopted by the IOTC Scientific Committee in December 2010)

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 2005 to 2009 is around 5,069 t. The distribution of black 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), Indonesia (gillnets) 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 3, 4 and 5). 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. However, aspects of the biology, productivity and fisheries for this species combined with the lack of data on which to base a more formal assessment is a cause for considerable concern. Research emphasis on improving indicators and exploration of stock assessment approaches for data poor fisheries are warranted.

BLACK MARLIN SUMMARY

Management quantity	2009 Assessment	2010 assessment
Most recent catch	5,883 t (2008)	5,410 t (2009)
Mean catch over the last 5 years (2005-2009)		5,069 t
Maximum Sustainable Yield		
$F_{Current}/F_{MSY}$		
$B_{Current}/B_{MSY}$		
$SB_{Current}/SB_{MSY}$		
$B_{Current}/B_0$		
$SB_{Current}/SB_0$		
$B_{Current}/B_{Current,F=0}$		
$SB_{Current}/SB_{Current,F=0}$		

Table 1. Best scientific estimates of the catches of black marlin (as adopted by the IOTC Scientific Committee) by gear and main fleets for the period 1960-2009 (in thousands of tonnes). Data as of November 2010

Gear	Fleet	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	85	86
Longline	China																											
	Taiwan,China	0.3	0.5	0.3	0.4	0.4	0.3	0.2	0.2	0.6	0.9	1.2	0.9	0.9	0.5	0.9	0.7	0.3	0.3	0.2	0.2	0.5	0.4	0.3	0.7	0.5	0.7	0.8
	Indonesia														0.0	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
	Japan	1.4	1.2	1.5	0.9	1.1	1.0	1.0	1.2	1.5	1.2	1.1	0.7	0.3	0.2	0.4	0.4	0.2	0.1	0.4	0.2	0.2	0.3	0.3	0.4	0.6	0.5	0.3
	India																								0.0	0.0	0.0	0.0
	Korea, Republic of						0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.3	0.4	0.3	0.3	0.4	0.4	0.5	0.4	0.3	0.4	0.3	0.3	0.3
	NEI-Deep-freezing																										0.0	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	*1.7*	*1.7*	*1.9*	*1.3*	*1.6*	*1.3*	*1.2*	*1.5*	*2.1*	*2.1*	*2.4*	*1.8*	*1.4*	*0.9*	*1.6*	*1.5*	*0.8*	*0.7*	*1.0*	*0.8*	*1.2*	*1.0*	*1.0*	*1.5*	*1.4*	*1.4*	*1.5*
Gillnet	Sri Lanka																											0.1
	India																					0.1	0.1	0.3	0.1	0.2	0.1	0.1
	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
	Pakistan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	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	0.0	0.0	0.0	0.0	0.2	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*	*0.2*	*0.3*	*0.1*	*0.4*	*0.2*	*0.3*	*0.4*	*0.3*
Other gears	India																					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
	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	0.0	0.0	0.0	0.2	0.2	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*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.1*	*0.1*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*
All	*Total*	*1.7*	*1.7*	*1.9*	*1.3*	*1.6*	*1.4*	*1.3*	*1.5*	*2.1*	*2.1*	*2.4*	*1.8*	*1.4*	*0.9*	*1.6*	*1.5*	*0.8*	*0.8*	*1.0*	*1.1*	*1.5*	*1.2*	*1.6*	*1.9*	*1.9*	*2.0*	*2.0*

Gear	Fleet	Av05/09	Av60/09	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09
Longline	China																									
	Taiwan,China	0.9	0.6	1.0	0.8	0.7	0.3	0.5	1.1	0.4	0.5	0.6	0.4	0.4	0.5	0.4	0.6	0.6	0.6	0.9	0.7	0.9	1.0	0.7	0.8	1.1
	NEI-Fresh Tuna	0.3	0.1			0.1	0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.3	0.3	0.2	0.2	0.0	0.1	0.1	0.1	0.2	0.2	0.4	0.5	0.3
	Indonesia	0.3	0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.4	0.5	0.4	0.5	0.3	0.3	0.5	1.0	0.7	0.5	0.3	0.2	0.2	0.2
	Oman	0.2	0.0														0.1	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.2
	Japan	0.1	0.4	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1
	India	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	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.2
	Korea, Republic of	0.0	0.1	0.3	0.3	0.3	0.2	0.1	0.1	0.2	0.1	0.1	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
	NEI-Deep-freezing	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.2	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
	Other Fleets	0.1	0.1	0.0	0.1	0.2	0.2	0.2	0.3	0.2	0.3	0.1	0.1	0.1	0.0	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2
	Total	*2.2*	*1.5*	*1.7*	*1.5*	*1.5*	*1.1*	*1.1*	*2.0*	*1.2*	*1.5*	*1.5*	*1.5*	*1.6*	*1.8*	*1.7*	*1.7*	*1.2*	*1.5*	*2.3*	*2.0*	*2.0*	*2.1*	*1.9*	*2.3*	*2.4*
Gillnet	Sri Lanka	0.8	0.3	0.1	0.1	0.1	0.2	0.2	0.4	0.5	1.3	0.9	1.1	1.4	1.0	1.0	1.2	1.6	0.7	0.7	0.6	1.1	1.2	0.6	0.6	0.7
	India	0.7	0.2	0.1	0.1	0.2	0.2	0.1	0.2	0.2	0.2	0.1	0.4	0.5	0.3	0.3	0.4	0.5	0.4	0.5	0.4	0.4	0.8	0.8	0.7	0.7
	Indonesia	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.3	0.2	0.3	0.3	0.3	0.3	0.3	0.2	0.3	0.3	0.1	0.7	0.7	0.7	0.7
	Pakistan	0.4	0.1	0.1	0.1	0.3	0.3	0.2	0.3	0.3	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.2	0.1	0.1	0.1	0.4	0.4	0.4	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	*2.5*	*0.8*	*0.3*	*0.3*	*0.6*	*0.7*	*0.6*	*1.0*	*1.2*	*2.1*	*1.7*	*2.1*	*2.5*	*2.0*	*1.9*	*2.2*	*2.5*	*1.5*	*1.6*	*1.5*	*1.9*	*3.1*	*2.6*	*2.5*	*2.6*
Other gears	India	0.2	0.1	0.0	0.0	0.0	0.0	0.0	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	0.3	0.3	0.2	0.2
	Indonesia	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	0.1	0.1	0.0	0.0	0.0		0.1	0.1	0.1	0.1
	Sri Lanka	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	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
	Other Fleets	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	0.0	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.1
	Total	*0.4*	*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*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.5*	*0.5*	*0.4*	*0.4*
All	*Total*	*5.1*	*2.5*	*2.2*	*1.9*	*2.3*	*2.0*	*2.0*	*3.2*	*2.7*	*4.0*	*3.5*	*3.9*	*4.4*	*4.0*	*3.8*	*4.0*	*4.0*	*3.2*	*4.1*	*3.7*	*4.1*	*5.7*	*5.0*	*5.1*	*5.4*

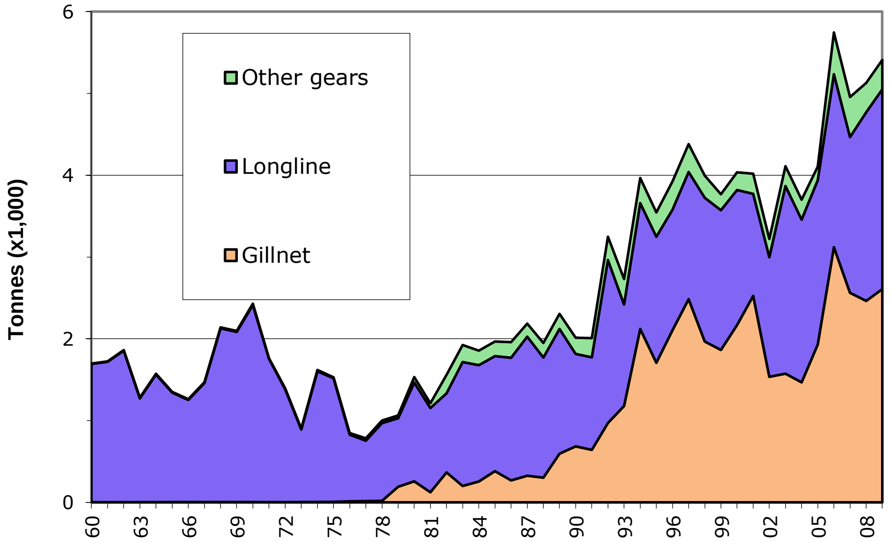

Figure 1: Estimated catches of black marlin by gear recorded in the IOTC Database (1960-2009). Note, these are minimum catch estimates as they are derived from IOTC fleets only and the levels of catch by other fleets are unknown.

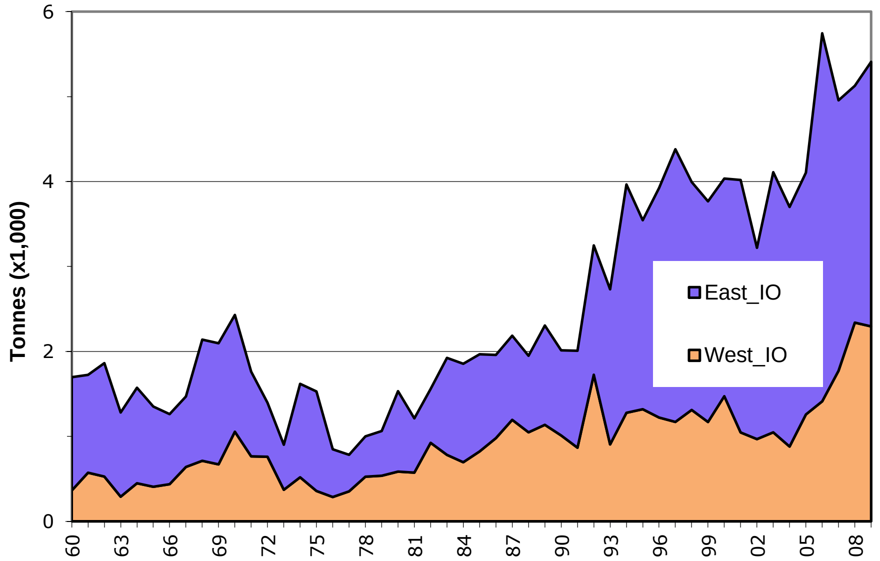

Figure 2. Trends of the black marlin catches in the western and the eastern area of the Indian Ocean from 1960 – 2009. Data as of November 2010

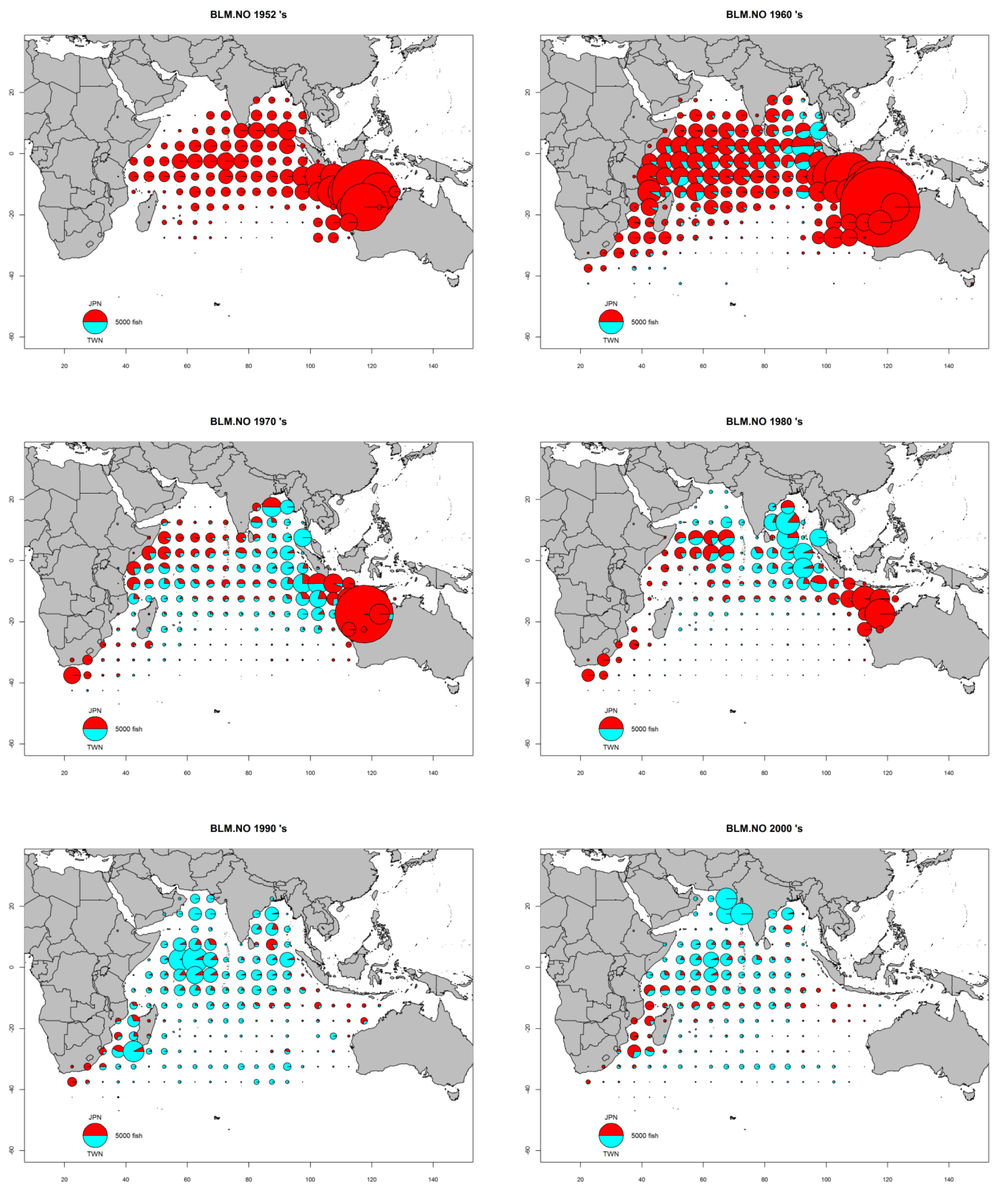

Figure 3: Total catches of black marlin (number) by longline vessels from Japan and Taiwan,China operating in the Indian Ocean over the periods 1952 to 2008 per decade

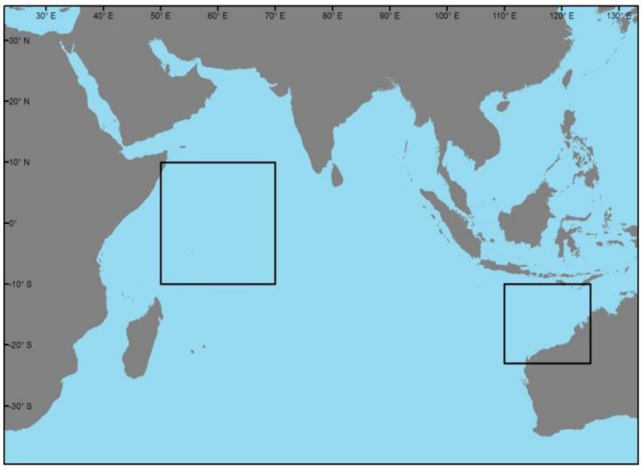

Figure 4. Major marlin fishing areas (framed): Seychelles and NW Australia.

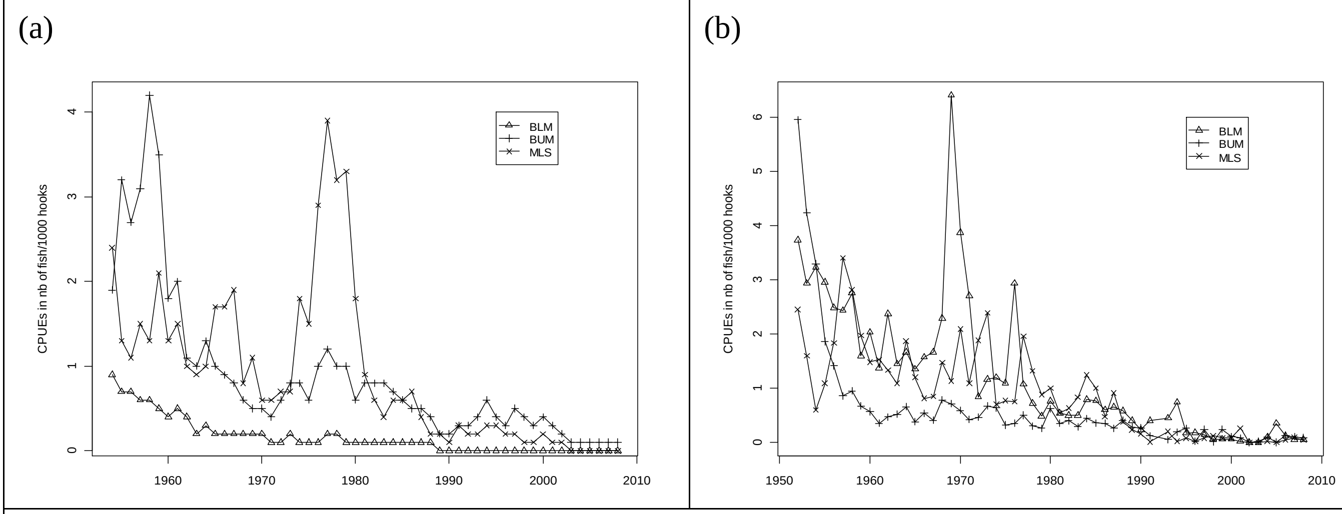

Figure 5. (a) nominal yearly CPUE (in numbers of fishes / 1000 hooks) of Japanese longliners in the North West Australia area (10-20°S,110-120°E) for blue marlin (BUM), striped marlin (MLS) and black marlin (BLM) (b) nominal yearly CPUE (in numbers of fishes / 1000 hooks) of Japanese longliners in the area around Seychelles Islands (10°N-10°S,50-70°E) for the period 1952 to 2008.

EXECUTIVE SUMMARY OF THE STATUS OF THE BLUE MARLIN

(as adopted by the IOTC Scientific Committee in December 2010)

BIOLOGY

Blue marlin[11] (*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 2004 to 2008 is around 9500 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

[11] 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.

fishing grounds (West Equatorial and north-west Australia) and the catches in the initial fishing grounds areas also decreased substantially (Figures 3, 4 and 5). 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 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. However, aspects of the biology, productivity and fisheries for this species combined with the lack of data on which to base a more formal assessment is a cause for considerable concern. Research emphasis on improving indicators and exploration of stock assessment approaches for data poor fisheries are warranted.

BLUE MARLIN SUMMARY

Management quantity	**2008 Assessment**	**2009 assessment**
Most recent catch	7,100 t (2008)	8,583t (2009)
Mean catch over the last 5 years (2005-2009)		9,350 t
Maximum Sustainable Yield		
$\mathbf{F_{Current}/F_{MSY}}$		
$\mathbf{B_{Current}/B_{MSY}}$		
$\mathbf{SB_{Current}/SB_{MSY}}$		
$\mathbf{B_{Current}/B_0}$		
$\mathbf{SB_{Current}/SB_0}$		
$\mathbf{B_{Current}/B_{Current,F=0}}$		
$\mathbf{SB_{Current}/SB_{Current,F=0}}$		

Table 1. Best scientific estimates of the catches of blue marlin (as adopted by the IOTC Scientific Committee) by gear and main fleets for the period 1960-2009 (in thousands of tonnes). Data as of November 2010

Gear	Fleet	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	85	86
Longline	China																											
	Taiwan,China	0.3	0.3	0.4	0.6	0.7	0.4	0.3	0.7	1.6	1.7	2.8	2.3	2.3	1.3	1.3	1.6	1.0	1.0	1.3	1.5	1.4	1.3	1.4	1.7	2.3	2.1	3.7
	Indonesia														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	0.0
	Japan	3.6	3.1	2.9	1.7	2.8	3.2	3.2	3.3	2.1	1.7	1.3	1.0	0.9	0.6	0.9	0.7	0.3	0.3	0.9	0.4	0.6	0.8	1.1	1.6	1.5	1.5	1.2
	India																								0.0	0.0	0.0	0.0
	NEI-Deep-freezing																										0.0	0.2
	Korea, Republic of						0.0	0.0	0.0	0.0	0.1	0.4	0.4	0.6	0.8	1.4	1.4	1.3	1.3	1.6	1.7	1.3	1.2	1.2	1.1	0.9	1.0	1.3
	Seychelles																								0.0	0.0	0.0	
	NEI-Indonesia Fresh Tuna																											0.0
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	*3.9*	*3.4*	*3.3*	*2.2*	*3.5*	*3.7*	*3.6*	*4.1*	*3.8*	*3.5*	*4.4*	*3.6*	*3.8*	*2.7*	*3.7*	*3.7*	*2.6*	*2.6*	*3.9*	*3.6*	*3.5*	*3.5*	*3.8*	*4.5*	*4.8*	*4.7*	*6.6*
Gillnet	Sri Lanka																											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	0.0
	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*	*0.2*
Other gears	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	0.1	0.1	0.1	0.1	0.5	0.4	0.3	0.3	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	0.0	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*	*0.1*	*0.1*	*0.1*	*0.1*	*0.5*	*0.4*	*0.3*	*0.3*	*0.3*
All	*Total*	*3.9*	*3.5*	*3.3*	*2.3*	*3.5*	*3.8*	*3.6*	*4.1*	*3.8*	*3.5*	*4.4*	*3.7*	*3.8*	*2.7*	*3.8*	*3.7*	*2.7*	*2.7*	*4.0*	*3.7*	*3.6*	*3.5*	*4.3*	*5.0*	*5.1*	*5.1*	*7.1*

Gear	Fleet	Av05/09	Av60/09	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09
Longline	China																									
	Taiwan,China	3.0	2.1	4.3	2.9	2.7	1.3	2.0	3.2	3.8	1.7	2.4	2.3	3.4	4.1	3.1	3.6	3.0	3.3	4.4	3.6	3.2	3.3	2.5	2.3	3.4
	Indonesia	1.3	0.6	0.1	0.2	0.3	0.3	0.3	0.6	0.6	0.9	1.0	1.9	2.3	2.1	2.5	1.4	1.3	2.4	2.6	2.9	1.9	1.6	1.1	1.1	0.9
	NEI-Fresh Tuna	0.7	0.2			0.3	0.5	0.4	0.5	0.5	0.7	0.6	0.6	0.7	0.6	0.6	0.5	0.1	0.4	0.6	0.6	0.7	0.8	0.7	0.9	0.3
	Japan	0.6	1.1	0.9	0.8	0.4	0.3	0.2	0.3	0.3	0.6	0.4	0.6	1.2	1.2	0.8	1.0	0.4	0.5	0.4	0.5	0.5	0.7	0.8	0.6	0.4
	India	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.2	0.2	0.4	0.5	0.6	0.8
	NEI-Deep-freezing	0.2	0.3	0.2	0.4	0.4	0.3	0.4	0.5	1.0	0.5	0.7	1.0	1.1	1.8	1.4	1.2	0.6	0.5	0.4	0.2	0.3	0.2	0.1	0.1	0.1
	Korea, Republic of	0.1	0.6	1.2	1.2	1.0	0.9	0.3	0.5	0.4	0.5	0.3	0.5	0.4	0.2	0.0	0.1	0.1	0.0	0.1	0.2	0.2	0.1	0.2	0.2	0.0
	Seychelles	0.1	0.0									0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1
	NEI-Indonesia Fresh	0.0	0.1		0.2	0.6	0.8	0.8	0.9	0.8	1.0	0.5	0.2	0.2	0.0	0.0										
	Other Fleets	0.3	0.1	0.0	0.0	0.1	0.0	0.2	0.3	0.1	0.1	0.0	0.1	0.0	0.1	0.2	0.3	0.4	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.2
	Total	*6.7*	*5.3*	*6.8*	*5.7*	*5.7*	*4.4*	*4.7*	*6.8*	*7.5*	*6.0*	*6.0*	*7.2*	*9.4*	*10.3*	*8.9*	*8.2*	*5.9*	*7.4*	*8.8*	*8.4*	*7.4*	*7.5*	*6.1*	*6.1*	*6.3*
Gillnet	Sri Lanka	2.6	1.0	0.2	0.3	0.3	0.6	0.7	1.0	1.4	3.9	2.7	3.1	4.2	3.0	2.8	3.4	4.6	2.1	2.0	1.9	3.1	3.8	2.0	1.8	2.2
	Other Fleets	0.1	0.0	0.6	0.0	0.1	0.0	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	0.1	0.1	0.1	0.1
	Total	*2.6*	*1.1*	*0.9*	*0.3*	*0.3*	*0.6*	*0.8*	*1.1*	*1.5*	*3.9*	*2.7*	*3.1*	*4.2*	*3.0*	*2.8*	*3.5*	*4.7*	*2.2*	*2.1*	*1.9*	*3.1*	*3.9*	*2.1*	*1.9*	*2.3*
Other gears	Sri Lanka	0.0	0.1	0.4	0.4	0.4	0.4	0.4	0.5	0.4	0.4	0.4	0.3	0.3	0.2	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
	Total	*0.0*	*0.1*	*0.4*	*0.4*	*0.4*	*0.4*	*0.4*	*0.5*	*0.4*	*0.4*	*0.4*	*0.3*	*0.3*	*0.2*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
All	*Total*	*9.3*	*6.5*	*8.0*	*6.3*	*6.4*	*5.3*	*5.9*	*8.3*	*9.4*	*10.4*	*9.1*	*10.7*	*13.9*	*13.5*	*11.7*	*11.7*	*10.7*	*9.6*	*10.9*	*10.4*	*10.5*	*11.4*	*8.2*	*8.1*	*8.6*

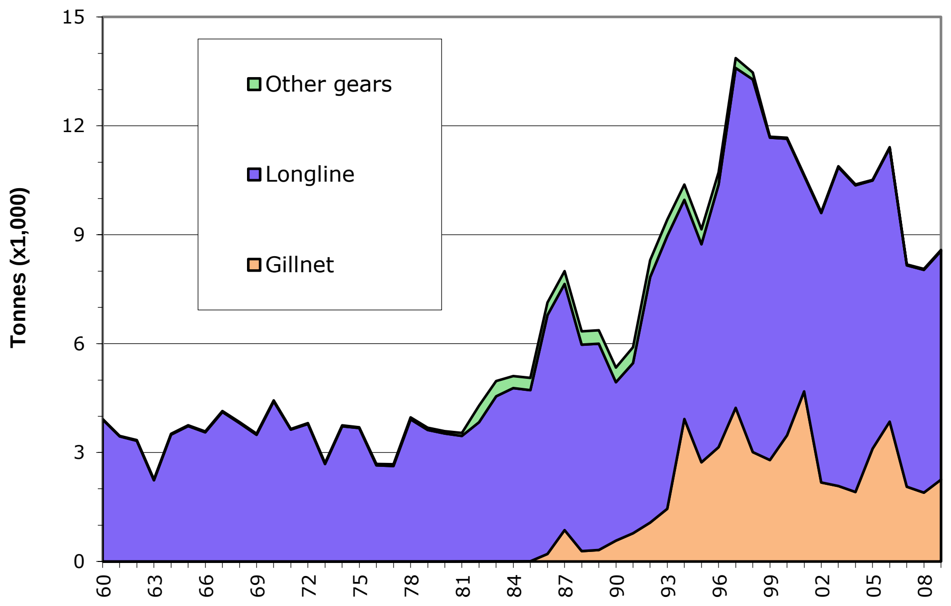

Figure 1: Estimated catches of blue marlin by gear recorded in the IOTC Database (1960-2009). Note, these are minimum catch estimates as they are derived from IOTC fleets only and the levels of catch by other fleets are unknown

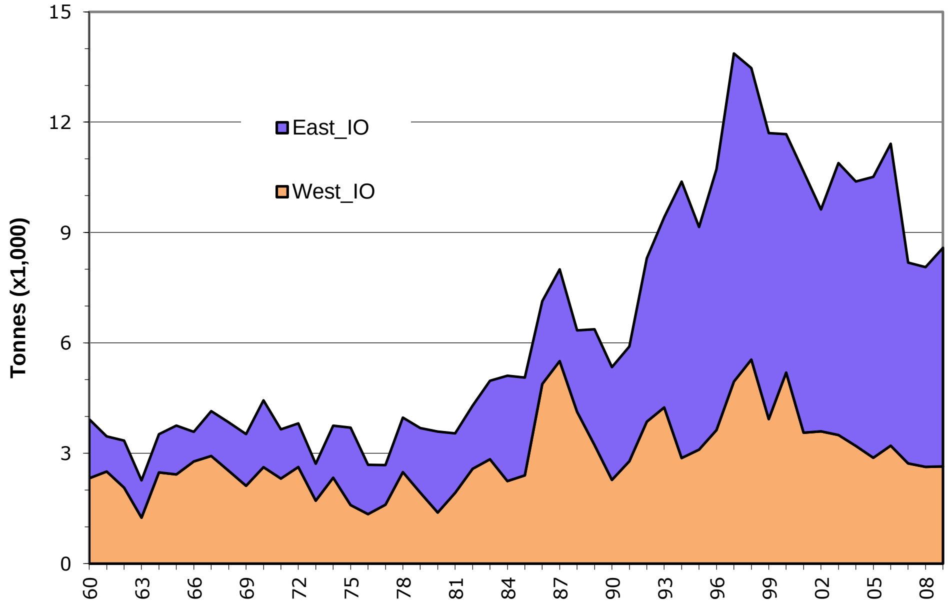

Figure 2. Trends of the blue marlin catches in the western and the eastern area of the Indian Ocean from 1960 – 2009. Data as of November 2010

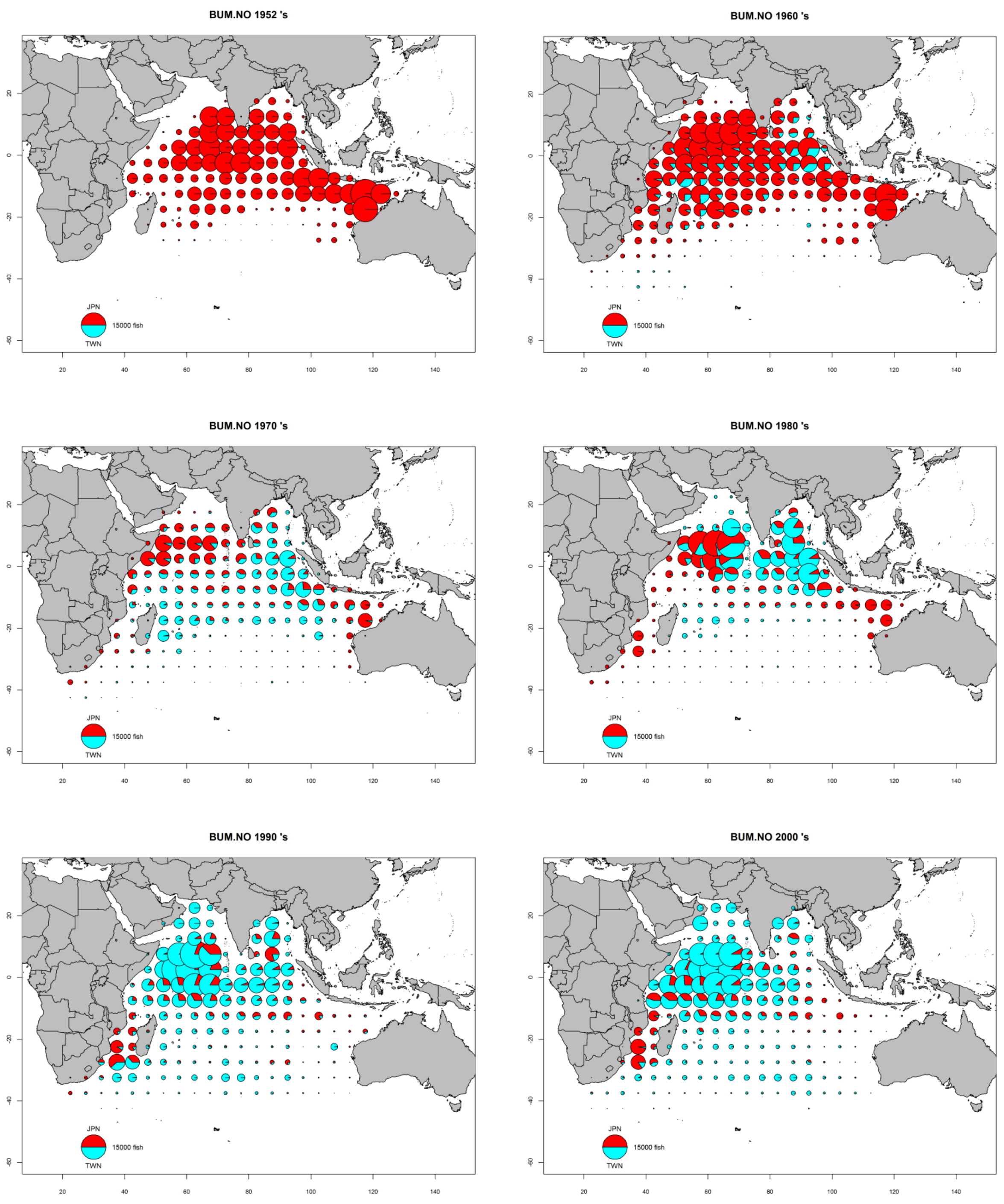

Figure 3: Total catches of blue marlin (number) by longline vessels of Japan and Taiwan,China operating in the Indian Ocean over the periods 1952 to 2008per decade.

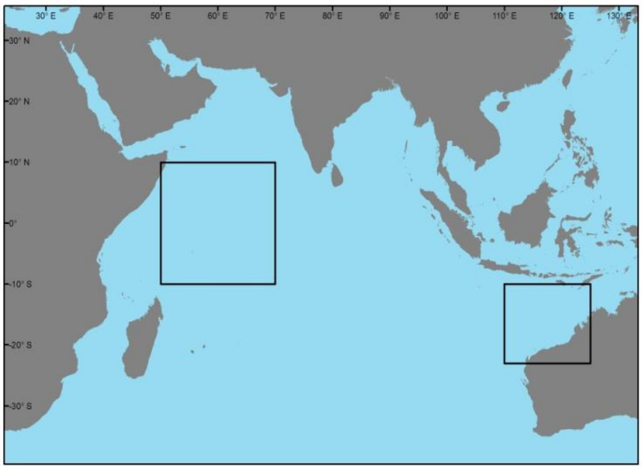

Figure 4. Major marlin fishing areas (framed): Seychelles and NW Australia.

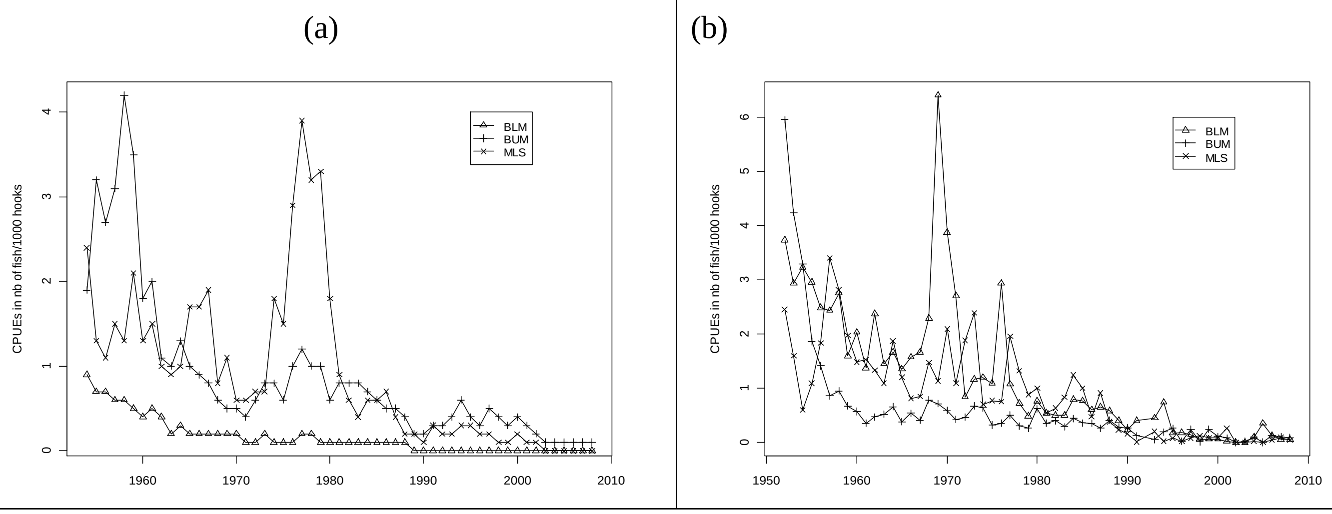

Figure 5. (a) nominal yearly CPUE (in numbers of fishes / 1000 hooks) of Japanese longliners in the North West Australia area (10-20°S,110-120°E) for blue marlin (BUM), striped marlin (MLS) and black marlin (BLM) (b) nominal yearly CPUE (in numbers of fishes / 1000 hooks) of Japanese longliners in the area around Seychelles Islands (10°N-10°S,50-70°E) for the period 1952 to 2008.

EXECUTIVE SUMMARY OF THE STATUS OF THE STRIPED MARLIN

(as adopted by the IOTC Scientific Committee in December 2010)

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 2004 to 2008 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 3, 4 and 5). 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. However, aspects of the biology, productivity and fisheries for this species combined with the lack of data on which to base a more formal assessment is a cause for considerable concern. Research emphasis on improving indicators and exploration of stock assessment approaches for data poor fisheries are warranted.

STRIPED MARLIN SUMMARY

Management quantity	**2009 Assessment**	**2010 assessment**
Most recent catch	2,500 t (2008)	2,22800 t (2009)
Mean catch over the last 5 years (2005-2009)		2,779 t
Maximum Sustainable Yield		
$\mathbf{F_{Current}/F_{MSY}}$		
$\mathbf{B_{Current}/B_{MSY}}$		
$\mathbf{SB_{Current}/SB_{MSY}}$		
$\mathbf{B_{Current}/B_0}$		
$\mathbf{SB_{Current}/SB_0}$		
$\mathbf{B_{Current}/B_{Current,F=0}}$		
$\mathbf{SB_{Current}/SB_{Current,F=0}}$		

Table 1. Best scientific estimates of the catches of striped marlin (as adopted by the IOTC Scientific Committee) by gear and main fleets for the period 1960-2009 (in thousands of tonnes). Data as of November 2010

Gear	Fleet	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	85	86
Longline	China																											
	Taiwan,China	0.3	0.3	0.2	0.6	0.7	0.4	0.3	0.3	1.0	1.9	2.0	1.1	1.1	0.7	1.3	1.3	2.1	3.2	4.0	2.4	3.9	4.4	1.9	2.6	2.1	3.1	4.8
	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
	India																								0.0	0.0	0.0	0.0
	NEI-Deep-freezing																										0.0	0.3
	Japan	2.0	2.4	1.8	1.3	1.4	3.0	3.9	4.2	2.3	2.2	1.6	1.0	0.8	0.5	1.4	0.9	0.5	0.5	1.8	1.1	1.1	0.9	0.6	0.6	1.0	1.0	1.0
	Seychelles																								0.0	0.0	0.0	
	Korea, Republic of						0.0	0.0	0.0	0.0	0.1	0.3	0.3	0.4	0.5	1.0	0.6	0.6	0.8	1.0	0.9	0.8	0.7	0.7	0.7	0.7	0.7	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	0.0	0.0
	Total	*2.3*	*2.7*	*2.0*	*1.8*	*2.1*	*3.5*	*4.2*	*4.6*	*3.4*	*4.2*	*3.9*	*2.4*	*2.3*	*1.8*	*3.6*	*2.9*	*3.3*	*4.6*	*6.9*	*4.5*	*5.9*	*6.0*	*3.2*	*3.9*	*3.8*	*4.8*	*7.2*
Other gears	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*	*2.3*	*2.7*	*2.0*	*1.8*	*2.1*	*3.5*	*4.2*	*4.6*	*3.4*	*4.2*	*3.9*	*2.4*	*2.3*	*1.8*	*3.6*	*2.9*	*3.3*	*4.6*	*6.9*	*4.5*	*5.9*	*6.0*	*3.2*	*3.9*	*3.8*	*4.8*	*7.2*

Gear	Fleet	Av05/09	Av60/09	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09
Longline	China	0.1	0.0									0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.1
	Taiwan,China	1.5	2.1	4.4	3.0	2.7	1.0	2.3	2.1	5.2	3.1	3.8	3.0	2.4	2.5	2.0	1.8	2.1	2.0	2.2	2.5	1.8	1.8	1.4	1.2	1.2
	Indonesia	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.2	0.2	0.3	0.3	0.3	0.3	0.4	0.3	0.2	0.2
	India	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	0.2	0.2	0.0	0.0	0.0	0.0	0.2	0.1	0.2	0.3	0.3	0.3
	NEI-Fresh Tuna	0.2	0.1			0.3	0.5	0.4	0.5	0.5	0.7	0.5	0.6	0.7	0.6	0.5	0.5	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.1
	NEI-Deep-freezing	0.1	0.2	0.2	0.4	0.4	0.2	0.4	0.3	1.4	0.9	1.1	1.3	0.8	1.2	0.9	0.7	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1
	Japan	0.1	0.9	0.7	0.3	0.1	0.1	0.2	0.2	0.1	0.2	0.2	0.3	0.4	0.3	0.3	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1
	Seychelles	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	0.1	0.1	0.1
	Korea, Republic of	0.0	0.4	1.0	1.0	0.8	0.7	0.2	0.4	0.4	0.4	0.4	0.6	0.2	0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.0
	France-Reunion	0.0	0.0					0.0	0.0	0.0	0.0	0.0	0.0	0.0	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	0.1	0.1	0.0	0.0	0.2	0.1	0.3	0.3	0.1	0.2	0.1	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
	Total	*2.7*	*4.0*	*6.3*	*4.7*	*4.6*	*2.6*	*3.8*	*3.8*	*7.8*	*5.5*	*6.3*	*6.1*	*4.8*	*5.3*	*4.3*	*3.9*	*3.1*	*3.1*	*3.1*	*3.7*	*3.0*	*3.2*	*2.6*	*2.5*	*2.1*
Other gears	Indonesia	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	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
	Other Fleets	0.1	0.0	0.1	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	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Total	*0.1*	*0.0*	*0.1*	*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*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
All	*Total*	*2.8*	*4.0*	*6.4*	*4.8*	*4.6*	*2.7*	*3.9*	*3.8*	*7.9*	*5.6*	*6.4*	*6.2*	*4.9*	*5.3*	*4.4*	*4.0*	*3.2*	*3.2*	*3.2*	*3.8*	*3.1*	*3.3*	*2.7*	*2.6*	*2.2*

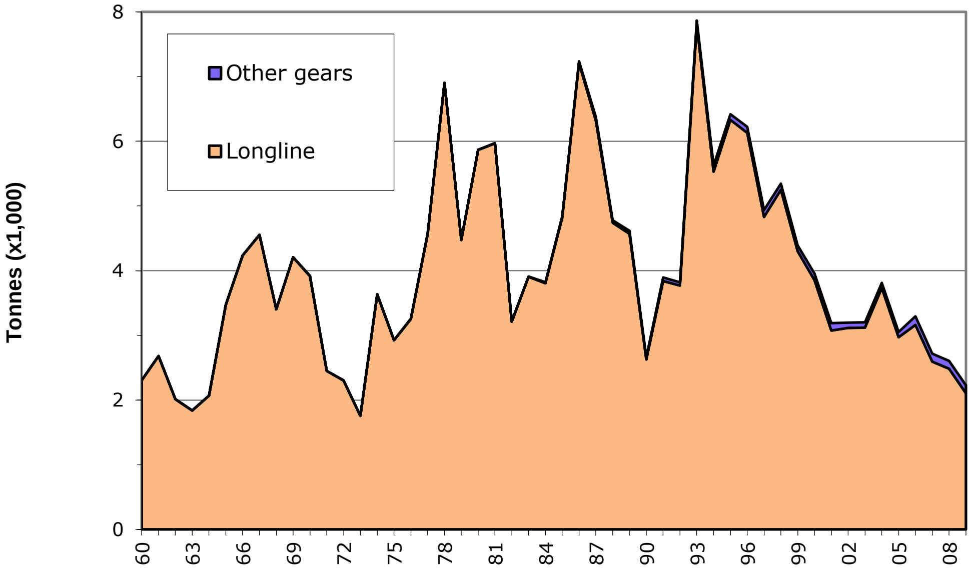

Figure 1: Estimated catches of striped marlin by gear recorded in the IOTC Database (1960-2009). Note, these are minimum catch estimates as they are derived from IOTC fleets only and the levels of catch by other fleets are unknown**.**

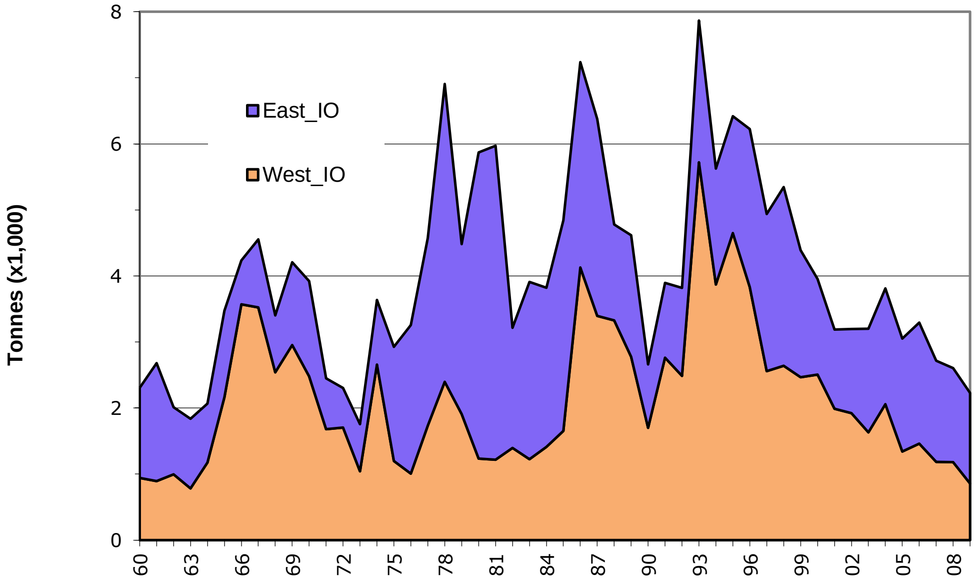

Figure 2. Trends of the Striped marlin catches in the western and the eastern area of the Indian Ocean from 1960 – 2009. Data as of November 2010

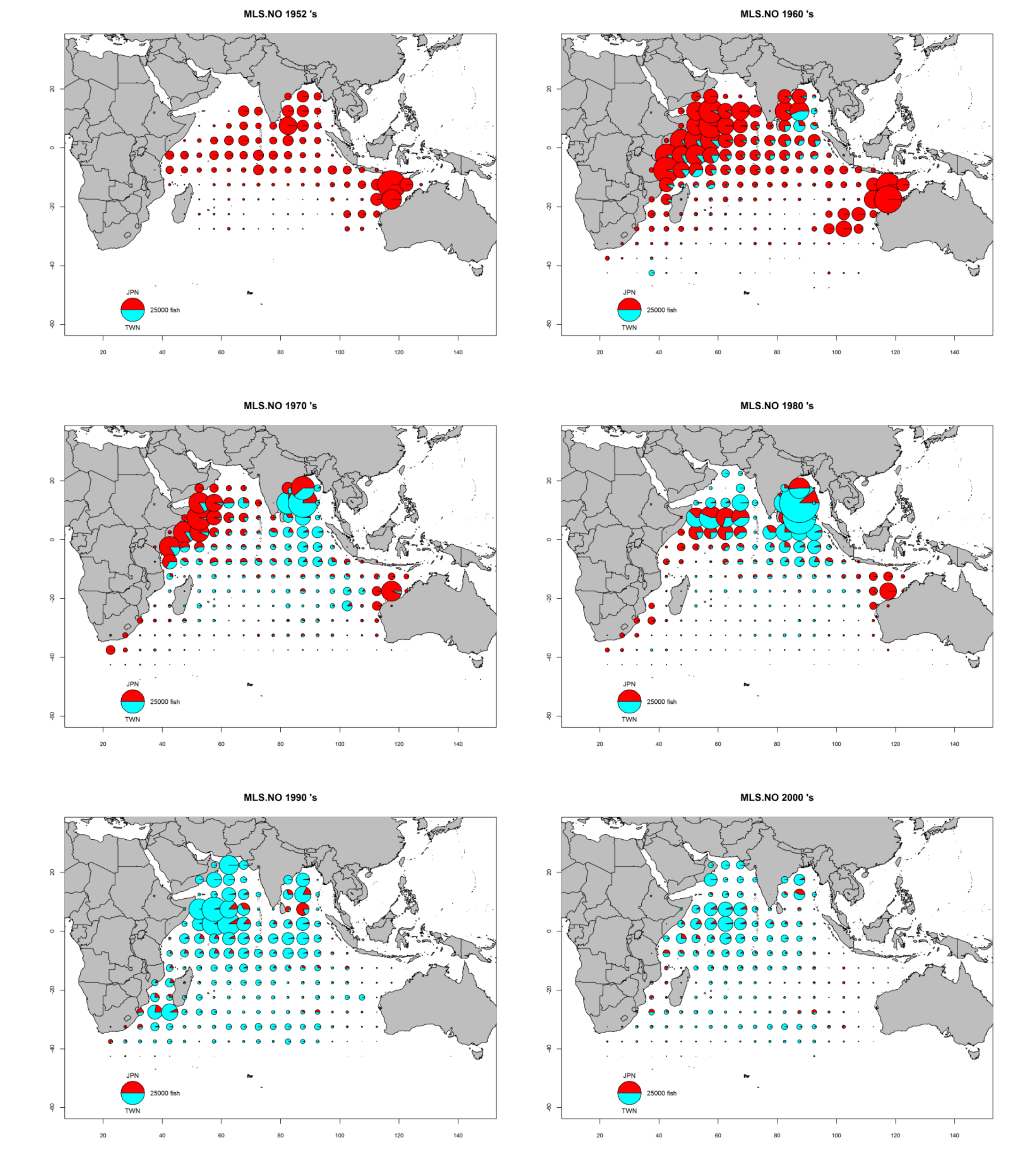

Figure 3: Total catches of striped marlin (number) by longline vessels from Japan and Taiwan,China operating in the Indian Ocean over the periods 1952 to 2008 per decade.

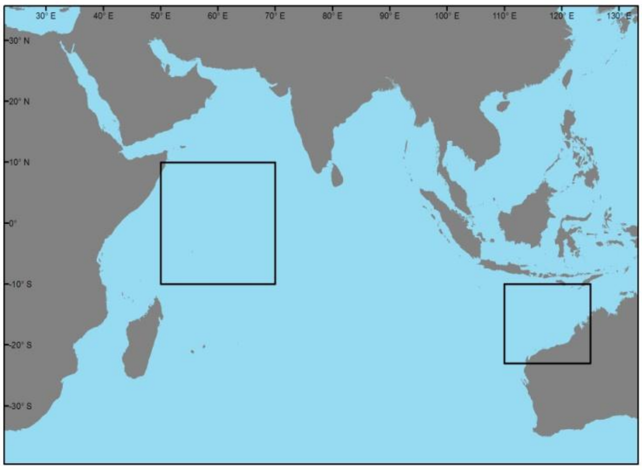

Figure 4. Major marlin fishing areas (framed): Seychelles and NW Australia.

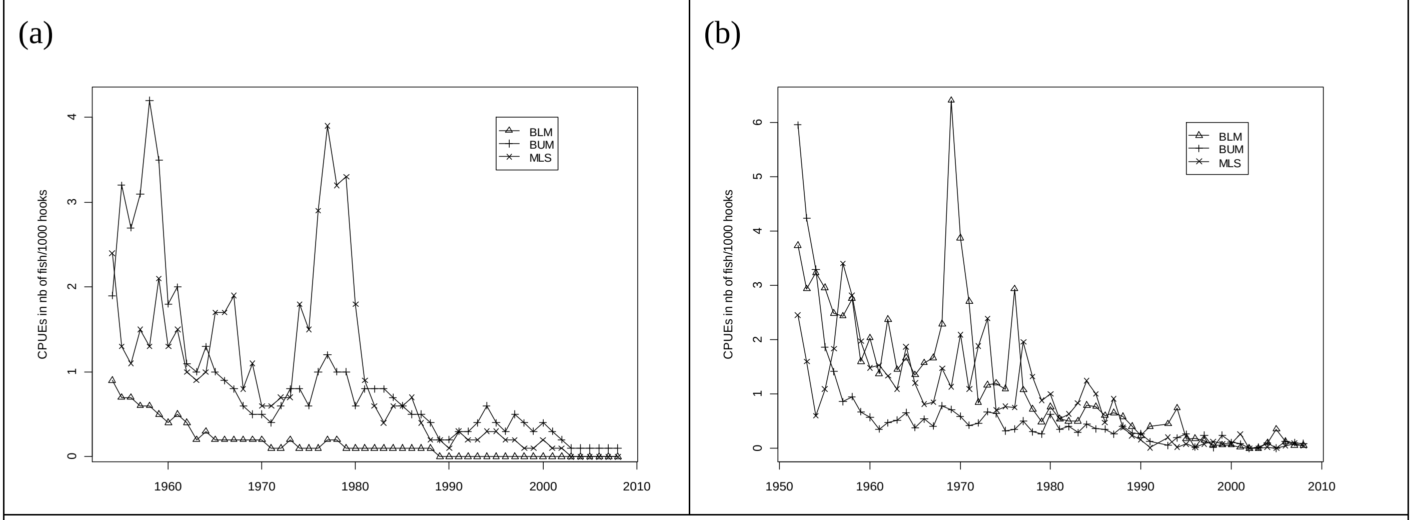

Figure 3. (a) nominal yearly CPUE (in numbers of fishes / 1000 hooks) of Japanese longliners in the North West Australia area (10-20°S,110-120°E) for blue marlin (BUM), striped marlin (MLS) and black marlin (BLM) (b) nominal yearly CPUE (in numbers of fishes / 1000 hooks) of Japanese longliners in the area around Seychelles Islands (10°N-10°S,50-70°E) for the period 1952 to 2008.

EXECUTIVE SUMMARY OF THE STATUS OF THE INDO-PACIFIC SAILFISH

(as adopted by the IOTC Scientific Committee in December 2010)

BIOLOGY

Indo-Pacific sailfish[12] (*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 2005 to 2009 is around 24,768 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.

[12] 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*.

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. However, aspects of the biology, productivity and fisheries for this species combined with the lack of data on which to base a more formal assessment is a cause for considerable concern. Research emphasis on improving indicators and exploration of stock assessment approaches for data poor fisheries are warranted.

INDO-PACIFIC SAILFISH SUMMARY

Management quantity	**2009 Assessment**	**2010 assessment**
Most recent catch	20,100 t (2008)	23,220 t (2009)
Mean catch over the last 5 years (2005-2009)		24,768 t
Maximum Sustainable Yield		
$F_{Current}/F_{MSY}$		
$B_{Current}/B_{MSY}$		
$SB_{Current}/SB_{MSY}$		
$B_{Current}/B_0$		
$SB_{Current}/SB_0$		
$B_{Current}/B_{Current,F=0}$		
$SB_{Current}/SB_{Current,F=0}$		

Table 1. Best scientific estimates of the catches of Indo-Pacific Sailfish (as adopted by the IOTC Scientific Committee) by gear and main fleets for the period 1960-2009 (in thousands of tonnes). Data as of November 2010

Gear	Fleet	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	85	86
Longline	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
	Japan	1.0	0.9	0.8	0.7	0.7	0.7	0.8	0.9	0.9	0.7	0.4	0.6	0.4	0.2	0.2	0.1	0.1	0.0	0.1	0.1	0.0	0.0	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	0.1	0.1	0.1	0.1	0.2	0.3	0.4	0.2	0.3	0.3	0.3	0.2	0.2	0.2	0.1	0.2	0.3
	Total	*1.0*	*0.9*	*0.8*	*0.7*	*0.7*	*0.7*	*0.8*	*0.9*	*1.0*	*0.7*	*0.5*	*0.7*	*0.5*	*0.3*	*0.4*	*0.5*	*0.5*	*0.3*	*0.3*	*0.3*	*0.4*	*0.3*	*0.3*	*0.3*	*0.2*	*0.3*	*0.4*
Gillnet	Iran, Islamic Republic																						0.0				0.0	0.0
	India																					0.5	0.3	1.0	0.5	0.6	0.4	0.5
	Sri Lanka																											0.1
	Pakistan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	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	0.8	0.1	0.2	0.2	0.1	1.4	0.6
	Tanzania											0.1		0.0		0.1	0.1	0.1	0.1	0.1	0.2	0.0	0.2	0.5	0.2	0.2	0.2	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	0.0	0.0	0.0	0.0
	United Arab Emirates																								0.1	0.1	0.1	0.2
	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	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2	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	0.2	0.2	0.2	0.1	0.1	0.1
	Total	*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*	*0.0*	*0.2*	*0.2*	*0.3*	*0.4*	*0.3*	*1.6*	*1.6*	*1.0*	*2.0*	*1.3*	*1.4*	*2.5*	*1.9*
Line	Madagascar	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	0.0	0.1	0.1	0.2	0.2	0.2
	India																					0.2	0.1	0.2	0.2	0.2	0.1	0.2
	Mauritius																									0.0	0.1	0.1
	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	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1
	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	0.1	0.1	0.1	0.1	0.1	0.5	0.5	0.4	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	0.1	0.1	0.1	0.2	0.2
	Total	*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*	*0.2*	*0.2*	*0.2*	*0.4*	*0.4*	*1.0*	*0.9*	*1.0*	*1.0*	*1.1*
Other gears	*Total*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.1*	*0.0*	*0.0*	*0.0*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.1*	*0.1*	*0.1*	*0.0*	*0.1*	*0.1*	*0.1*
All	*Total*	*1.1*	*1.0*	*0.9*	*0.8*	*0.8*	*0.8*	*1.0*	*1.1*	*1.2*	*0.9*	*0.8*	*0.8*	*0.8*	*0.5*	*0.9*	*1.0*	*1.1*	*1.0*	*1.1*	*2.4*	*2.6*	*1.7*	*3.4*	*2.5*	*2.8*	*3.9*	*3.4*

Gear	Fleet	Av05/09	Av60/09	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09
Longline	NEI-Fresh Tuna	0.4	0.2	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.5	0.6	0.6	0.7	0.4	0.3	0.5	1.3	0.2	0.3	0.1	0.6	0.5	0.4
	Indonesia	0.4	0.1			0.1	0.2	0.2	0.2	0.2	0.3	0.2	0.3	0.3	0.3	0.2	0.2	0.0	0.2	0.3	0.3	0.4	0.4	0.4	0.5	0.2
	Japan	0.3	0.3	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	0.2	0.1	0.1	0.1	0.1	0.2	0.4	0.5	0.4	0.2
	Korea, Republic of	0.0	0.1					0.7	1.0	0.7	0.9	0.9	1.0	0.0	0.0	0.0										
	Pakistan	0.5	0.2	0.2	0.2	0.5	0.4	0.4	0.4	0.3	0.3	0.2	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.3	0.5	0.4	0.5	0.6	0.5
	Other Fleets	1.6	0.9	0.3	0.3	0.7	0.7	1.4	1.8	1.5	1.8	1.7	1.9	1.3	1.2	1.2	0.9	0.8	1.1	2.0	0.9	1.4	1.4	2.0	2.0	1.2
	Total	*8.6*	*1.8*	*0.0*				*0.2*	*0.2*	*0.7*	*1.1*	*3.6*	*2.3*	*2.3*	*1.8*	*3.2*	*3.1*	*3.2*	*4.3*	*7.3*	*12.1*	*12.6*	*10.6*	*6.2*	*5.6*	*8.0*
Gillnet	Iran, Islamic Republic	3.3	1.0	0.4	0.4	0.5	0.5	0.7	1.1	1.3	1.1	0.9	2.5	2.8	2.1	1.9	2.3	2.8	2.6	2.9	2.7	2.3	5.0	2.4	3.4	3.4
	Sri Lanka	3.0	1.2	0.1	0.1	0.1	0.2	0.3	0.4	0.7	1.8	1.3	2.0	2.7	1.9	3.6	5.7	3.9	4.6	4.8	9.0	4.0	4.3	2.3	2.1	2.5
	India	2.4	0.9	0.6	1.1	1.9	1.7	2.0	1.7	1.9	2.4	2.3	2.3	1.9	2.0	2.1	2.0	1.0	0.7	0.7	0.7	2.3	2.3	2.4	2.5	2.6
	Pakistan	0.5	0.3	0.1	0.3	0.3	0.4	0.2	0.2	0.4	0.6	0.4	0.5	0.5	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.7	0.7	0.7	0.3	0.3
	Tanzania	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.5	0.5	0.5	0.5
	Indonesia	0.3	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.1	0.1	0.6	0.4	0.2	0.2
	Oman	0.2	0.2	0.4	0.8	0.4	0.4	0.1	0.4	0.3	0.1	0.3	0.4	0.6	0.4	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.3
	United Arab Emirates	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	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Other Fleets	18.9	5.6	1.8	2.9	3.5	3.5	3.9	4.5	5.8	7.6	9.4	10.5	11.4	9.4	12.2	14.4	12.2	13.3	16.9	25.6	22.5	24.2	15.1	14.9	17.8
	Total	*1.5*	*0.5*	*0.4*	*0.0*	*0.8*	*0.7*	*0.7*	*0.6*	*0.7*	*0.8*	*0.8*	*0.8*	*1.4*	*1.1*	*1.2*	*1.4*	*1.5*	*1.6*	*1.4*	*1.5*	*1.6*	*1.5*	*1.3*	*1.5*	*1.5*
Line	India	1.0	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.2	0.2	0.5	0.6	0.4	0.4	0.5	0.6	0.6	0.6	0.6	0.6	1.3	1.2	0.9	0.9
	Yemen	0.5	0.2			0.7	0.7	0.7	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.3	0.4	0.3	0.3	0.4	0.4	0.4	0.4	0.5	0.6	0.6
	Comoros	0.5	0.0																			0.6	0.6	0.6	0.3	0.3
	Mauritius	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.6	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	Oman	0.1	0.1	0.2	0.4	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.1	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2
	Sri Lanka	0.0	0.2	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.4	0.4	0.3	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other Fleets	0.4	0.2	0.2	0.3	0.2	0.2	0.3	0.2	0.3	0.3	0.3	0.4	0.3	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.5	0.5	0.3	0.3
	Total	*4.2*	*1.5*	*1.3*	*1.3*	*2.5*	*2.5*	*2.5*	*2.3*	*2.4*	*2.5*	*2.5*	*2.7*	*3.9*	*2.9*	*2.7*	*3.1*	*3.2*	*3.1*	*3.1*	*3.3*	*3.9*	*4.7*	*4.3*	*4.1*	*4.1*
Other gears	*Total*	*0.0*	*0.1*	*0.1*	*0.3*	*0.1*	*0.1*	*0.0*	*0.0*	*0.0*	*0.0*	*0.1*	*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*
All	*Total*	*24.8*	*8.1*	*3.6*	*4.8*	*6.8*	*6.8*	*7.7*	*8.5*	*9.7*	*11.9*	*13.6*	*15.2*	*16.7*	*13.5*	*16.2*	*18.4*	*16.2*	*17.6*	*22.1*	*29.8*	*27.8*	*30.3*	*21.5*	*21.1*	*23.2*

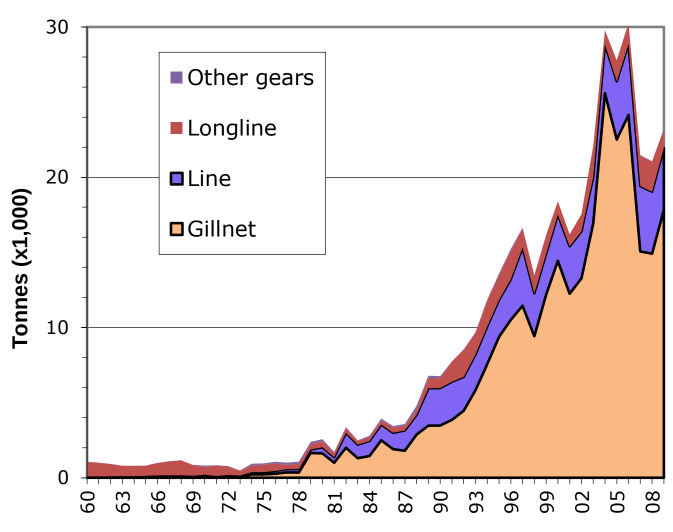

Figure 1. Estimated catches of Indo-Pacific sailfish by gear recorded in the IOTC Database (1960-2009).

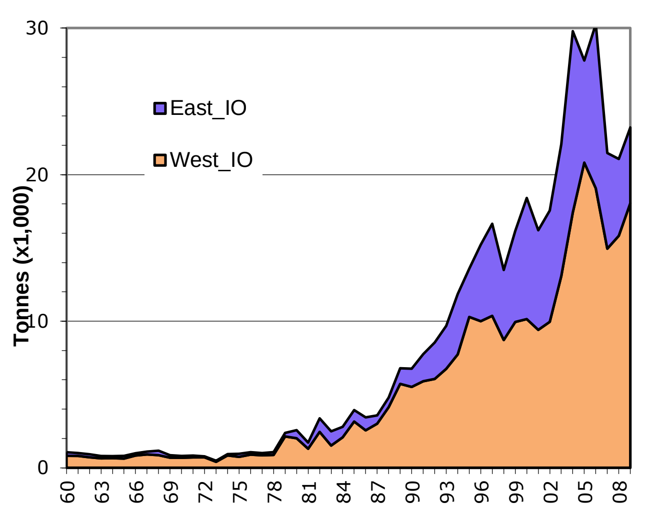

Figure 2. Trends of the Indo-Pacific sailfish catches in the western and the eastern area of the Indian Ocean from 1960 – 2009. Data as of November 2010.

EXECUTIVE SUMMARY OF THE STATUS OF THE BULLET TUNA RESOURCE

(as adopted by the IOTC Scientific Committee in December 2010)

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 and are 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 uncertain13 (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 have been increasing since then up to a peak of 7,000t in 2007. The average annual catch estimated for the period 2005 to 2009 is 4,300 t. However, the high catches of bullet tuna recorded since 2006 are throught to be unrealistic in comparison with previous years. In recent years, the countries attributed with the highest catches of bullet tuna are Indiaand Sri Lanka (Table 1).

Length frequency data for bullet tuna is only available for the Sri Lankan fisheries, catching mainly bullet tuna ranging between 15 and 35 cm.

AVAILABILITY OF INFORMATION FOR STOCK ASSESSMENT

Retained catches are highly uncertain for all fisheries (Figure 2) due to:

- Aggregation: Bullet tunas are usually not reported by species being aggregated with frigate tunas or, less frequently, other small tuna species.
- Mislabelling: Bullet tunas are usually mislabelled as frigate tuna, their catches reported under the latter species.
- Underreporting: the catches of bullet tuna by industrial purse seiners are rarely, if ever, reported.

It is for the above reasons that the catches of bullet tunas in the IOTC database are thought to represent only a small fraction of the total catches of this species in the Indian Ocean. In particular, catches reported by India in recent years are unreliable and need to be verified.

Discard levels are moderate for industrial purse seine fisheries. The EC recently reported discard levels of bullet tuna for its purse seine fleet, for 2003-08, estimated using observer data. The Secretariat will use this data to estimate discards for other purse seine fleets during the same period.

[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.

Changes to the catch series: Overall, there have not been significant changes to the catches of bullet tuna since the SC in 2009. However, the catches reported by India for 2007 are significantly higher than those previously estimated.

CPUE Series: Catch-and-effort series are not available for most fisheries and, when available, they are usually considered to be of poor quality for the fisheries having reasonably long catch-and-effort data series, as it is the case with the gillnet fisheries of Sri Lanka (Figure 3).

Trends in average weight cannot be assessed for most fisheries. Reasonable long series of length frequency data are only available for Sri Lankan gillnets and lines but the amount of specimens measured has been very low in recent years.

Catch-at-Size(Age) table: Catch-at-Size data are not available for the bullet tuna due to the paucity of size data available from most fleets and the uncertain status of the catches for this species. Length distributions derived from the data available for some selected fisheries are shown in Figure 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 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.

The SC recommended that bullet tuna be reviewed at the first meeting of the IOTC Working Party on NeriticTunas.

BULLET TUNA SUMMARY

Management quantity	2009 assessment	2010 assessment
Most recent catch	3,700 t (2008)	4,317 t (2009)*
Mean catch over the last 5 years (2005-2009)		4,302 t
Maximum Sustainable Yield		
$F_{Current}/F_{MSY}$		
$B_{Current}/B_{MSY}$ (1)		
$SB_{Current}/SB_{MSY}$ (2)		
$B_{Current}/B_0$ (1)		
$SB_{Current}/SB_0$ (2)		
$B_{Current}/B_{Current,F=0}$		
$SB_{Current}/SB_{Current,F=0}$		

* Preliminary catch estimates

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 1960-2009 (in thousands of tonnes). Data as of November 2010

Gear	Fleet	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	85	86
Gillnet	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	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
	India																											
	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	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
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	0.1	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Madagascar																											
	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	0.1	0.0	0.0	0.1	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
	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	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.2	0.2	0.2	0.3

Gear	Fleet	Av05/09	Av60/09	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09
Gillnet	Sri Lanka	0.8	0.2	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	1.2	0.8	1.1
	India	0.4	0.1	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	0.6	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
	Total	1.3	0.4	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	1.8	0.9	1.2
Line	India	2.5	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	4.5	2.6	2.6
	Madagascar	0.3	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	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.4	0.3	0.3
	Other Fleets	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	0.0	0.0	0.0	0.0	0.0	0.0
	Total	2.8	0.5	0.2	0.3	0.3	0.3	0.3	0.5	0.3	0.6	0.4	0.7	0.6	0.6	0.5	0.5	0.6	0.6	0.9	0.6	1.3	1.9	4.9	2.9	2.9
Other gears	India	0.2	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	0.1	0.2	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
	Total	0.2	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	0.1	0.2	0.2
All	*Total*	4.3	0.9	0.4	0.5	0.6	0.6	0.7	0.9	0.6	1.5	1.1	1.9	2.2	2.1	1.2	1.3	1.1	2.0	1.7	1.5	2.8	3.5	6.9	4.0	4.3

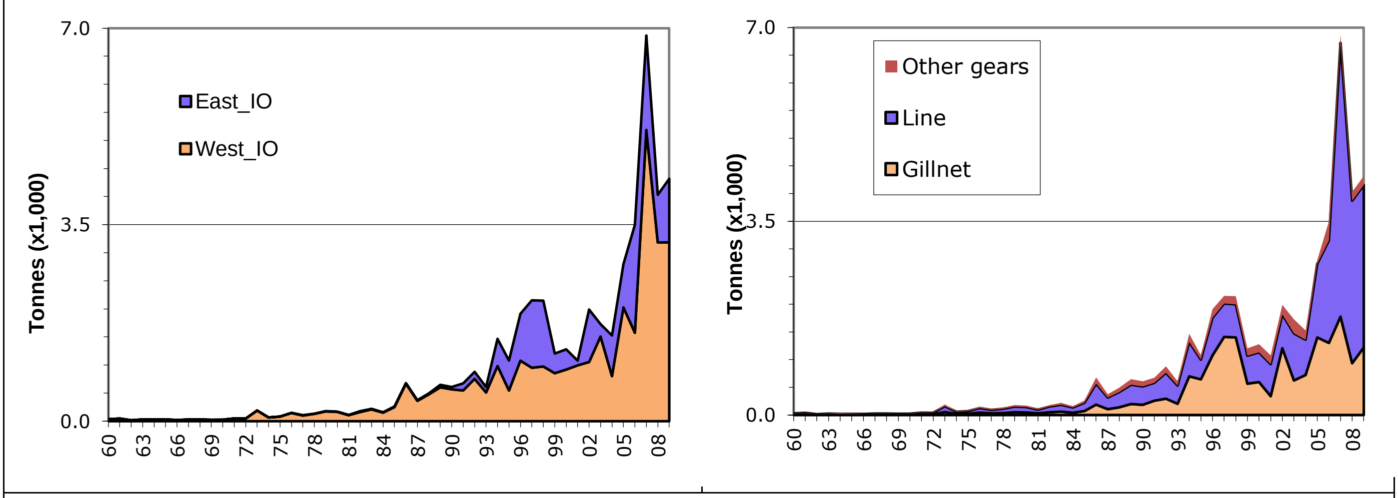

Figure 1. Bullet tuna: annual catches from 1960 to 2009 by area (left) and gear (right). Data as per November 2010

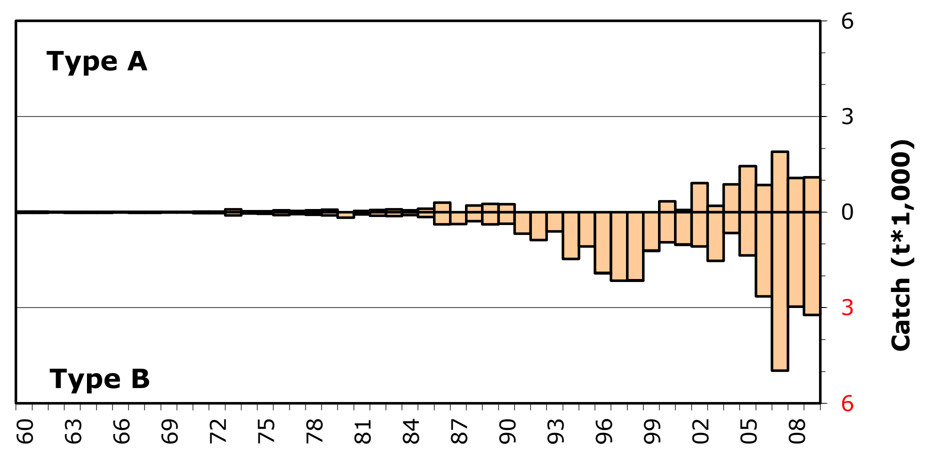

Figure 2. Bullet tuna: uncertainty of annual catch estimates. The amount of the catch below the zero-line has been categorised as uncertain according to the criteria given in the text.

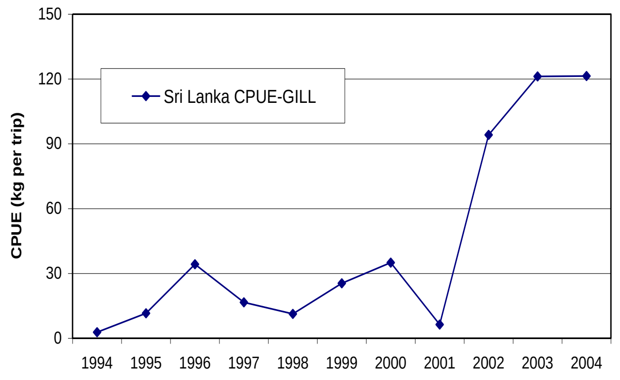

Figure 3: Bullet tuna: Nominal CPUE series for the gillnet fishery of Sri Lanka derived from the available catches and effort data (1994-2004)

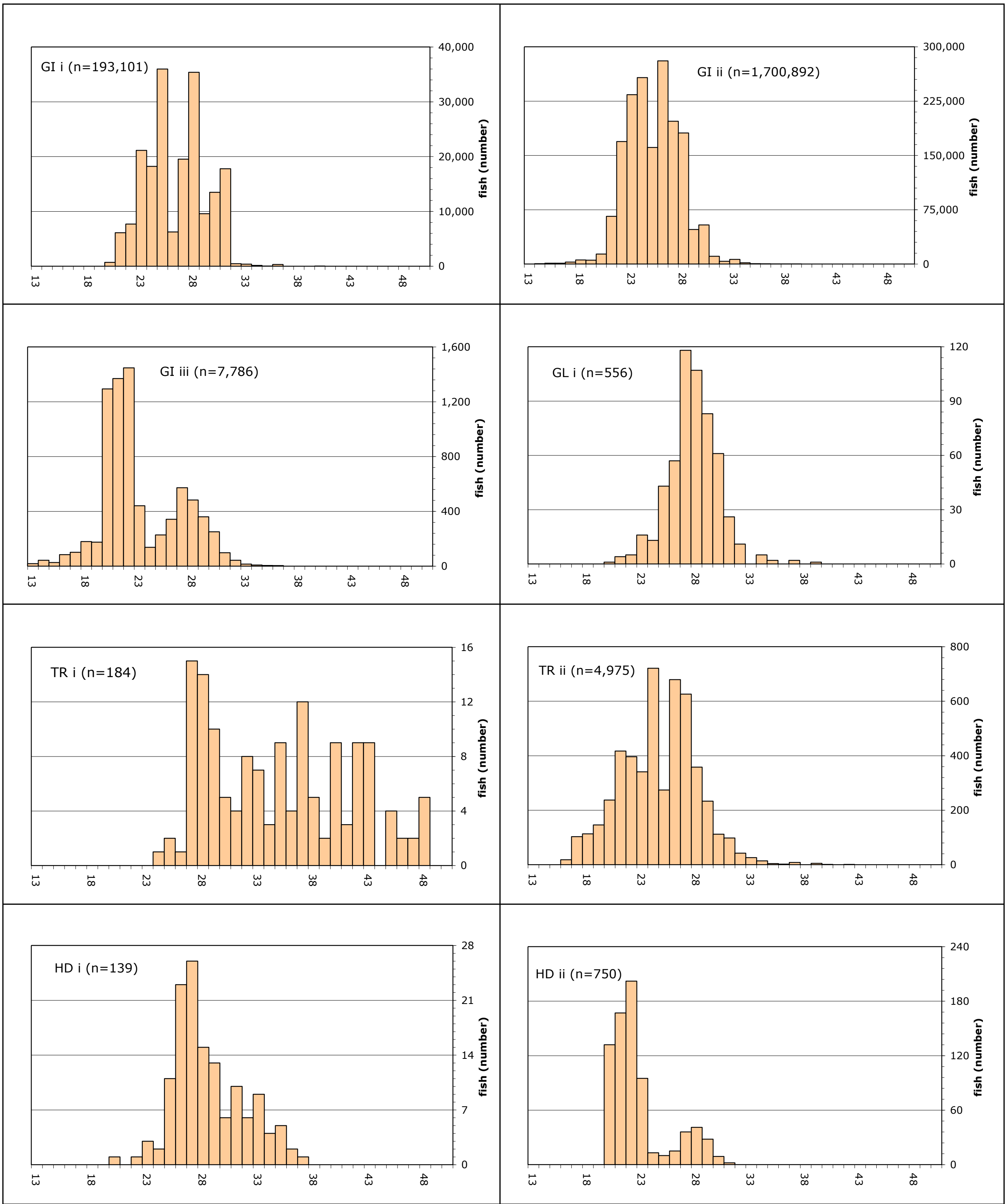

Figure 4. Bullet tuna: Length frequency distributions (total amount of fish measured by 1cm length class by decade) derived from the data available at the IOTC Secretariat for selected fisheries and periods
GI: Gillnet fisheries: i. Sri Lanka 1980-89, ii. Sri Lanka 1990-99, iii. Sri Lanka 2000-06
GL: Gillnet and longline combination: i. Sri Lanka 2000-06
TR: Troll line fisheries: i. Sri Lanka 1980-89, ii. Sri Lanka 1990-99
HD: Hand line fisheries: i. Sri Lanka 1990-99, ii. Sri Lanka 2000-06

EXECUTIVE SUMMARY OF THE STATUS OF THE FRIGATE TUNA RESOURCE

(as adopted by the IOTC Scientific Committee in December 2010)

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[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. 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 2005 to 2009 is 33,240 t with the highest catches for the species of 39,000 t recorded in 2006. In recent years, the countries attributed with the highest catches are India, Indonesia, Maldives and Iran and Sri Lanka (Table 1).

The size of frigate tunas taken by the Indian Ocean fisheries typically ranges between 25 and 50 cm depending on the type of gear used, season and location.

AVAILABILITY OF INFORMATION FOR STOCK ASSESSMENT

Retained catches are highly uncertain (Figure 2) notably for the following fisheries:

- Artisanal fisheries of India: Although India reports catches of frigate tuna they are not always reported by gear. The Secretariat has allocated the catches of frigate tuna by gear for years in which this information was not available. In recent years, the catches of frigate tuna in India have represented 34% of the total catches of this species in the Indian Ocean. Furthermore, the amounts of frigate tuna reported by India in recent years are considered uncertain (2004-09 catches).
- Artisanal fisheries of Indonesia: Indonesia did not report catches of frigate tuna by species or by gear for 1950-2004; catches of frigate tuna, bullet tuna and other species were reported aggregated for this period. The Secretariat used the catches reported since 2005 to break the aggregates for 1950-2004 by gear and species. The catches estimated for the frigate tuna represent more than 27% of the total catches of this species in the Indian Ocean in recent years.
- Artisanal fisheries of Mozambique, Myanmar (and Somalia): None of these countries have ever reported catches to the Secretariat. Catch levels are unknown.

[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.

- Other artisanal fisheries: The catches of frigate tuna and bullet tuna are seldom reported by species and, when reported by species, they usually refer to both species (due to mislabelling, with all catches assigned to the frigate tuna).
- Industrial fisheries: The catches of frigate tuna recorded for industrial purse seiners are thought to be a fraction of those retained on board. Due to this species being a bycatch, its catches are seldom recorded in the logbooks, nor can they be monitored in port. The EC recently reported catch levels of frigate tuna for its purse seine fleet, for 2003-08, estimated using observer data. The Secretariat will use this data to estimate retained catches for other purse seine fleets during the same period.

Discard levels are moderate for industrial purse seine fisheries. The EC recently reported discard levels of frigate tuna for its purse seine fleet, for 2003-08, estimated using observer data. The Secretariat will use this data to estimate discards for other purse seine fleets during the same period.

Changes to the catch series: Overall, there have not been significant changes to the catches of frigate tuna since the SC in 2008.

CPUE Series: Catch-and-effort series are available from some fisheries but they are considered highly incomplete. In most cases catch-and-effort data are only available for short periods. Reasonably long catch-and-effort series (extending for more than 10 years) are only available for Maldives baitboats and troll lines (Figure 3) and Sri Lanka gillnets. The catches and effort recorded for Sri Lankan gillnets are, however, thought to be inaccurate due to the dramatic changes in CPUE recorded between consecutive years.

Trends in average weight can only be assessed for Sri Lankan gillnets and Maldivian pole and lines but the amount of specimens measured has been very low in recent years. The length frequency data available from the mid-eighties to the early nineties was obtained with the support of the IPTP (Indo-Pacific Tuna Programme). Unfortunately, data collection did not continue after the end of the IPTP activities.

Catch-at-Size(Age) table: Catch-at-Size data are not available for the frigate tuna due to the paucity of size data available from most fleets (Figure 17) and the uncertain status of the catches for this species. Length distributions derived from the data available for some selected fisheries are shown in Figure 4.

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.

The SC **recommended** that frigate tuna be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

FRIGATE TUNA SUMMARY

Management quantity	2009 assessment	2010 assessment
Most recent catch	33,900 t (2008)	33,550 t (2009)*
Mean catch over the last 5 years (2004-2008)		33.240 t
Maximum Sustainable Yield		
$F_{Current}/F_{MSY}$		
$B_{Current}/B_{MSY}$ (1)		
$SB_{Current}/SB_{MSY}$ (2)		
$B_{Current}/B_0$ (1)		
$SB_{Current}/SB_0$ (2)		
$B_{Current}/B_{Current,F=0}$		
$SB_{Current}/SB_{Current,F=0}$		

* Preliminary catch estimates

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 1960-2009 (in thousands of tonnes). (Data as of November 2010)

Gear	Fleet	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	85	86
Baitboat	Maldives	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	1.3	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	0.1	0.0	0.0	0.0	0.0
	Total	*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*	*1.3*	*0.9*
Gillnet	Iran, Islamic																											0.3
	India	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	1.7	4.8
	Sri Lanka																											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	0.1	0.2	0.1	0.1	0.1	0.1	0.3	0.1	0.0	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	0.4	0.5
	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	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.1	0.3	0.3	0.2
	Total	*0.4*	*0.5*	*0.2*	*0.3*	*0.4*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.2*	*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*	*2.5*	*5.8*
Line	India	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	0.9	2.4
	Madagascar	0.0	0.0	0.0	0.0	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	0.1	0.1	0.2	0.3	0.3	0.3
	Maldives	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	0.3	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	0.1	0.1	0.1	0.1	0.2	0.7	0.7	0.5	0.6	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	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	Total	*0.4*	*0.5*	*0.3*	*0.4*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.3*	*0.3*	*0.4*	*1.1*	*0.5*	*0.6*	*0.9*	*0.8*	*0.9*	*1.1*	*1.1*	*0.9*	*1.7*	*2.0*	*1.8*	*2.4*	*3.8*
Other gears	Indonesia	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.3	0.3	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	1.8	0.4
	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	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.6
	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	1.7	0.8
	Other Fleets	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.2	0.3	0.2	0.1	0.2	0.3	0.4	0.4
	Total	*0.2*	*0.2*	*0.2*	*0.2*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.6*	*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*	*4.1*	*2.2*
All	*Total*	*1.8*	*2.6*	*2.1*	*2.3*	*2.6*	*3.3*	*3.8*	*3.9*	*3.8*	*3.8*	*2.9*	*3.2*	*3.4*	*7.8*	*5.7*	*5.6*	*5.7*	*6.8*	*4.9*	*5.5*	*5.1*	*4.9*	*10.3*	*8.4*	*6.9*	*10.3*	*12.7*

Gear	Fleet	Av05/09	Av60/09	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09
Baitboat	Maldives	4.0	2.5	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	3.8	4.7
	Other Fleets	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	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
	Total	*4.0*	*2.6*	*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*	*3.9*	*4.8*
Gillnet	Iran, Islamic R.	4.3	0.7	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	7.2	5.2
	India	3.7	2.8	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	1.8	2.5	2.5
	Sri Lanka	0.9	0.6	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	1.0	0.7	0.9
	Indonesia	0.8	0.3	0.1	0.2	0.1	0.2	0.3	0.4	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.5	0.6	0.6	0.6	0.9	0.8	0.8	0.8	0.8
	UAE	0.1	0.3	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	0.1	0.1	0.1
	Other Fleets	0.4	0.3	0.4	0.5	0.7	0.5	0.2	0.3	0.3	0.3	0.6	0.6	0.8	0.6	0.6	0.5	0.6	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.5
	Total	*10.3*	*4.9*	*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*	*13.6*	*9.4*	*11.6*	*9.9*
Line	India	1.7	1.4	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	0.5	0.3	0.3
	Madagascar	0.5	0.4	0.6	0.0	0.2	0.9	0.7	0.7	1.0	1.0	0.8	1.2	0.9	1.1	0.9	0.9	1.0	1.0	0.6	1.2	0.8	0.6	0.3	0.3	0.3
	Maldives	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	0.2	0.5
	Sri Lanka	0.0	0.3	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	0.0	0.0
	Other Fleets	0.4	0.3	0.2	0.4	0.5	0.4	0.4	0.4	0.5	0.7	0.7	0.5	0.7	0.6	0.7	0.7	0.6	0.5	0.5	0.5	1.1	0.3	0.3	0.2	0.2
	Total	*3.0*	*2.6*	*3.0*	*3.1*	*3.8*	*4.6*	*4.4*	*5.1*	*4.8*	*6.1*	*4.5*	*6.4*	*5.4*	*5.7*	*4.7*	*5.0*	*5.4*	*5.5*	*6.2*	*6.4*	*3.0*	*8.0*	*1.4*	*1.1*	*1.3*
Other gears	Indonesia	11.1	3.6	0.8	2.7	1.6	2.7	4.4	4.6	6.0	7.3	7.1	7.6	7.8	7.5	8.1	8.6	7.0	7.6	7.8	7.8	10.1	11.4	11.4	11.4	11.4
	India	2.2	0.5	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	3.6	3.5	3.5
	Thailand	1.5	0.9	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	1.5	1.4	1.7	1.6
	Sri Lanka	0.8	0.3	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	0.9	1.0
	Other Fleets	0.4	0.2	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	0.2	0.1
	Total	*16.0*	*5.5*	*8.9*	*4.7*	*3.7*	*4.4*	*6.0*	*6.8*	*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*	*14.4*	*17.5*	*17.7*	*17.5*
All	*Total*	*33.2*	*15.6*	*16.8*	*14.2*	*15.5*	*17.6*	*18.4*	*21.9*	*24.0*	*28.9*	*29.0*	*35.5*	*30.2*	*31.5*	*28.0*	*30.1*	*29.2*	*32.4*	*36.4*	*33.1*	*27.2*	*39.3*	*31.8*	*34.3*	*33.6*

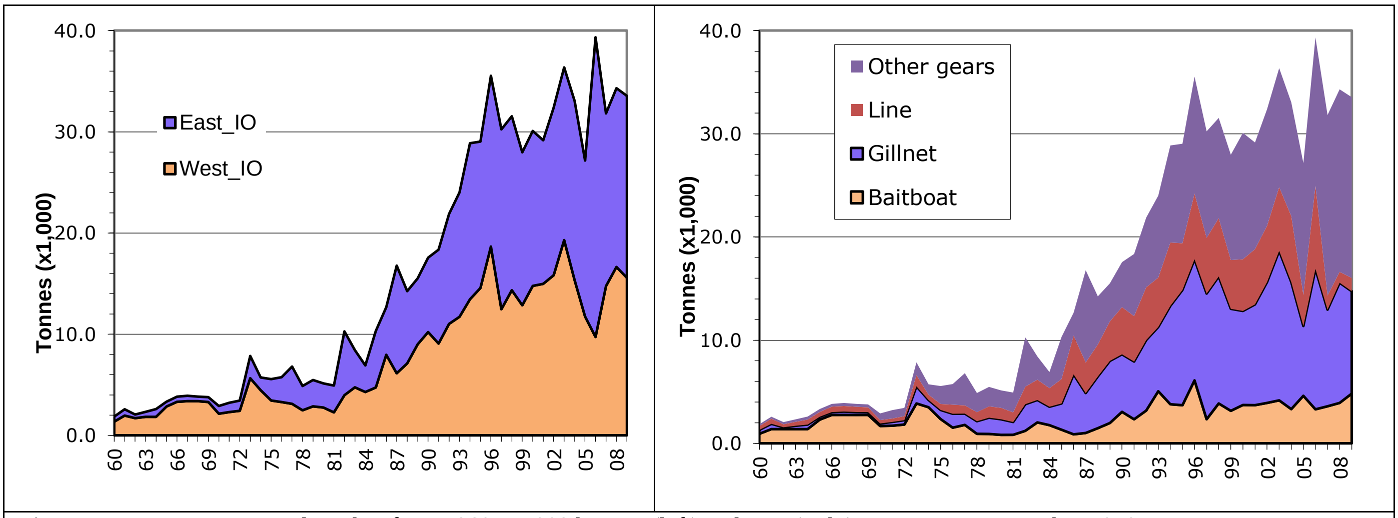

Figure 1. Frigate tuna: annual catches from 1960 to 2009 by area (left) and gear (right). Data as per November 2010

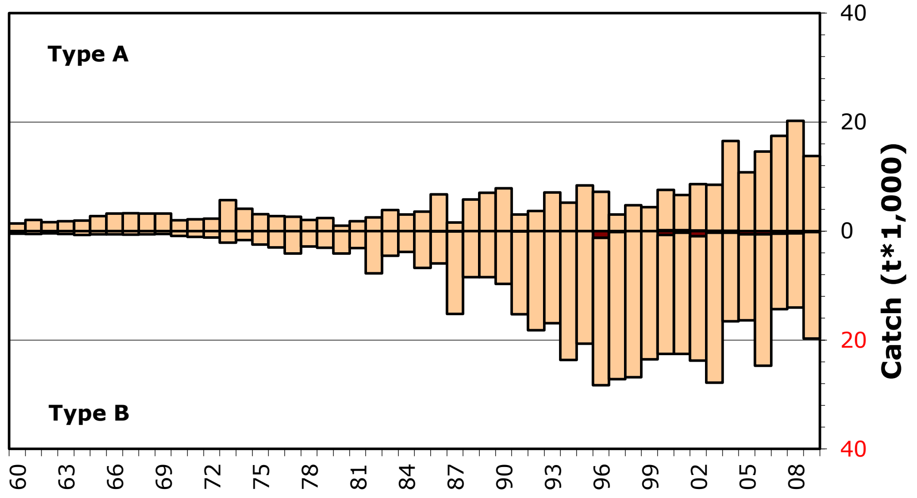

Figure 2. Frigate tuna: uncertainty of annual catch estimates. The amount of the catch below the zero-line has been categorised as uncertain according to the criteria given in the text. Dark sections represent estimates of catches by industrial fleets.

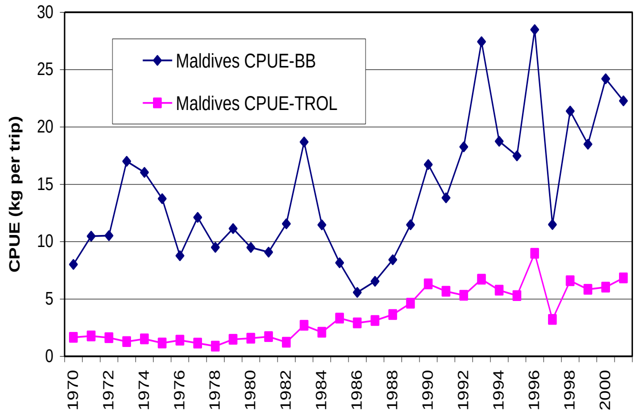

Figure 3: Frigate tuna: Nominal CPUE series for the baitboat (BB) and line (LINE) fisheries of Maldives derived from the available catches and effort data (1970-2001)

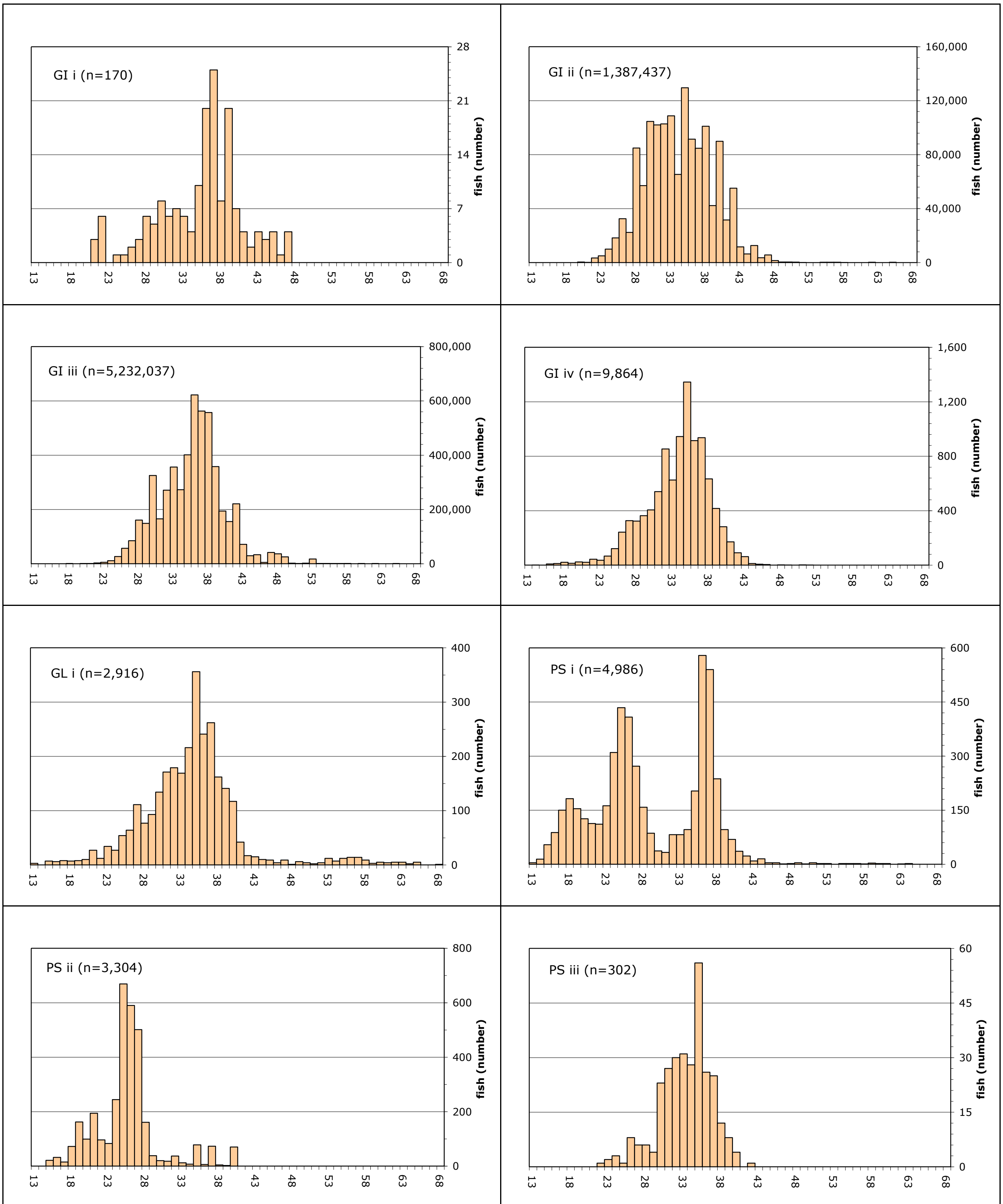

Figure 4. Frigate tuna: Length frequency distributions (total amount of fish measured by 1 cm length class by decade) derived from the data available at the IOTC Secretariat for selected fisheries and periods
GI: Gillnet fisheries: i. Indonesia 1980-89, ii. Sri Lanka 1980-89, iii. Sri Lanka 2000-06, iv. Sri Lanka 2000-06
GL: Gillnet and longline combination: i. Sri Lanka 2000-06
PS: Coastal purse seine fisheries: i. Indonesia 1980-89, ii. Malaysia 1980-89, iii. Sri Lanka 2000-06 (ring net)

EXECUTIVE SUMMARY OF THE STATUS OF THE INDO-PACIFIC KING MACKEREL RESOURCE

(as adopted by the IOTC Scientific Committee in December 2010)

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 by 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[15] (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, and peaking in recent years at around 43,000 t. The average annual catch estimated for the period 2005 to 2009 is 36,200 t. In recent years, the countries attributed with the highest catches are Indonesia, India and Iran (Table 1).

AVAILABILITY OF INFORMATION FOR STOCK ASSESSMENT

Retained catches are highly uncertain for all fisheries (Figure 2) due to:

- Aggregation: King mackerels are usually not reported by species being aggregated with Spanish mackerels or, less frequently, other small tuna species.
- Mislabelling: King mackerels are usually mislabelled as Spanish mackerel, their catches reported under the latter species.
- Underreporting: the catches of King mackerel may be not reported for some fisheries catching them as a bycatch.

It is for the above reasons that the catches of king mackerel in the IOTC database are thought to represent only a small fraction of the total catches of this species in the Indian Ocean.

Discard levels are believed to be low although they are unknown for most fisheries.

Changes to the catch series: There have not been significant changes to the catches of king mackerel since the SC in 2009.

CPUE Series: Catch-and-effort series are not available for most fisheries and, when available, they refer to very short periods. This makes it impossible to derive any meaningful CPUE from the existing data**.**

[15] 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.

Trends in average weight can not be assessed for most fisheries. Samples of king mackerel are only available for the coastal purse seiners of Thailand and gillnets of Sri Lanka but they refer to very short periods and the numbers sampled are very small.

Catch-at-Size(Age) table: Catch-at-Size data are not available for the king mackerel due to the paucity of size data available from most fleets and the uncertain status of the catches for this species.

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 **recommended** that Indo-Pacific king mackerel be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

INDO-PACIFIC KING MACKEREL SUMMARY

Management quantity	**2009 assessment**	**2010 assessment**
Most recent catch	43,200 t (2008)	42,330 t (2009)*
Mean catch over the last 5 years (2005-2009)		38,000 t
Maximum Sustainable Yield		
$F_{Current}/F_{MSY}$		
$B_{Current}/B_{MSY}$ (1)		
$SB_{Current}/SB_{MSY}$ (2)		
$B_{Current}/B_0$ (1)		
$SB_{Current}/SB_0$ (2)		
$B_{Current}/B_{Current,F=0}$		
$SB_{Current}/SB_{Current,F=0}$		

* Preliminary catch estimates

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 1960-2009 (in thousands of tonnes). Data November 2010

Gear	Fleet	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	85	86
Gillnet	India	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	9.8	5.5
	Indonesia	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	0.7	0.7
	Iran, Islamic																							1.4	1.6	0.9	0.5	0.5
	Bangladesh																										0.0	0.0
	Saudi Arabia																						0.0	0.0	0.0	0.0	0.0	0.0
	Malaysia	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	1.2	1.5
	Thailand											0.0		0.0	0.2	0.1	0.1	0.2	0.5	0.3	0.6	0.5	0.6	0.2	0.1	0.1	0.3	0.2
	Pakistan	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.2	0.4	0.3	0.3	0.2	0.2	0.3	0.3	0.5	0.1	0.4	0.4	0.4	0.4	0.4	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	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0
	Total	*2.7*	*3.5*	*3.5*	*3.0*	*4.1*	*3.7*	*4.2*	*4.0*	*4.7*	*4.3*	*4.3*	*5.3*	*6.8*	*4.7*	*7.7*	*7.0*	*7.6*	*7.6*	*7.1*	*10.5*	*10.2*	*10.5*	*12.2*	*12.0*	*14.0*	*13.0*	*9.1*
Line	Indonesia	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	0.7	0.7
	India	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	1.4	0.8
	Yemen	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	0.6	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	0.0	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	*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*	*2.1*	*2.0*	*2.2*	*1.8*	*2.9*	*2.8*	*2.2*
Other gears	India	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	6.0	3.4
	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	0.0	0.0
	Malaysia																			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	0.1	0.1	0.0	0.0
	Total	*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*	*6.0*	*3.4*
All	*Total*	*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*	*13.9*	*12.8*	*13.7*	*12.4*	*11.7*	*17.1*	*17.4*	*17.1*	*19.1*	*18.7*	*23.9*	*21.7*	*14.7*

Gear	Fleet	Av05/09	Av60/09	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09
Gillnet	India	13.4	7.5	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	17.1	19.0	19.0
	Indonesia	4.9	2.4	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	4.9	4.9
	Iran, Islamic	3.5	1.5	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	4.0	2.6
	Bangladesh	0.9	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	0.2	0.5	0.7	0.9	0.5	1.3	1.1	0.7	0.7
	Saudi Arabia	0.8	0.1	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	0.5	0.4	0.3	0.6	1.0	0.8	0.9	0.9
	Malaysia	0.4	0.8	1.7	1.4	1.1	1.2	1.3	1.6	1.2	1.2	0.8	0.9	1.0	1.4	0.3	0.4	0.5	0.8	0.7	0.6	0.4	0.5	0.4	0.4	0.4
	Thailand	0.1	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	0.1	0.2	0.2	0.2
	Pakistan	0.0	0.2	0.6	0.7	0.0	0.1	1.0	0.0					0.1	0.1	0.4	0.3	0.2								
	Other Fleets	0.1	0.1	0.1	0.0	0.1	0.1	0.0	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	0.1	0.1	0.1	0.1	0.1
	Total	*24.2*	*12.9*	*11.6*	*16.7*	*19.5*	*14.3*	*18.9*	*15.2*	*20.2*	*15.6*	*22.3*	*20.3*	*18.7*	*25.4*	*19.1*	*19.5*	*19.5*	*20.5*	*20.1*	*20.9*	*15.8*	*17.8*	*28.3*	*30.2*	*28.8*
Line	Indonesia	4.6	2.3	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	4.6	4.6
	India	0.7	1.0	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	0.6	0.4	0.4
	Yemen	0.2	0.4	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	0.1	0.1
	Other Fleets	0.2	0.1	0.1	0.0	0.1	0.1	0.1	0.2	0.2	0.3	0.2	0.2	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.3
	Total	*5.7*	*3.7*	*2.4*	*6.3*	*7.7*	*4.3*	*4.5*	*3.0*	*6.8*	*5.0*	*7.3*	*8.4*	*7.7*	*8.3*	*7.2*	*7.3*	*8.1*	*6.4*	*6.7*	*8.4*	*6.2*	*5.8*	*5.6*	*5.4*	*5.4*
Other gears	India	4.3	4.2	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	3.7	4.4	4.4
	Thailand	3.0	0.6	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1	1.8	1.8	2.0	0.1	1.3	1.6	1.9	1.9	2.5	3.0	3.4	2.6	3.0	2.9
	Malaysia	0.6	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	1.1	1.2	0.8	0.7	0.7	0.7	0.6	0.7	0.7	0.6	0.6
	Other Fleets	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	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.3
	Total	*8.1*	*5.0*	*4.4*	*5.3*	*6.4*	*4.6*	*7.1*	*6.1*	*7.4*	*5.7*	*6.1*	*6.2*	*6.8*	*9.9*	*5.9*	*7.4*	*7.6*	*8.4*	*8.0*	*7.8*	*8.7*	*8.2*	*7.3*	*8.2*	*8.2*
All	*Total*	*38.0*	*21.6*	*18.4*	*28.2*	*33.5*	*23.2*	*30.5*	*24.4*	*34.5*	*26.3*	*35.7*	*34.8*	*33.2*	*43.6*	*32.2*	*34.2*	*35.2*	*35.4*	*34.8*	*37.0*	*30.8*	*31.9*	*41.2*	*43.8*	*42.3*

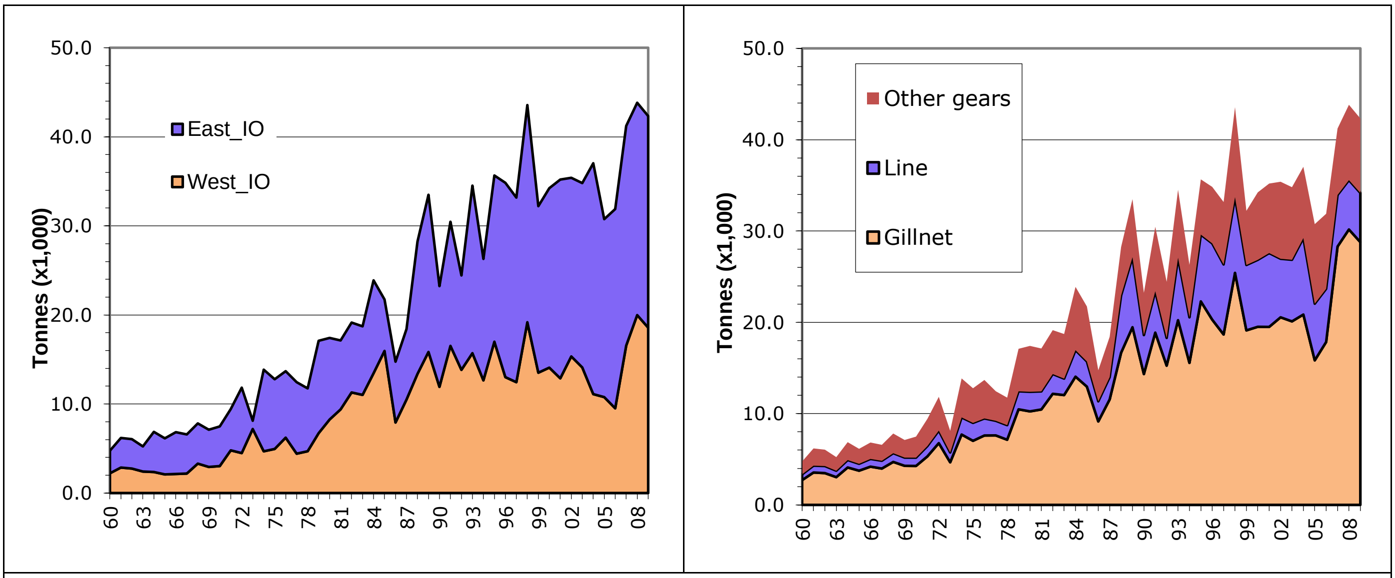

Figure 1. Indo-Pacific king mackerel: annual catches from 1960 to 2009 by area (left) and gear (right). Data as of November 2010

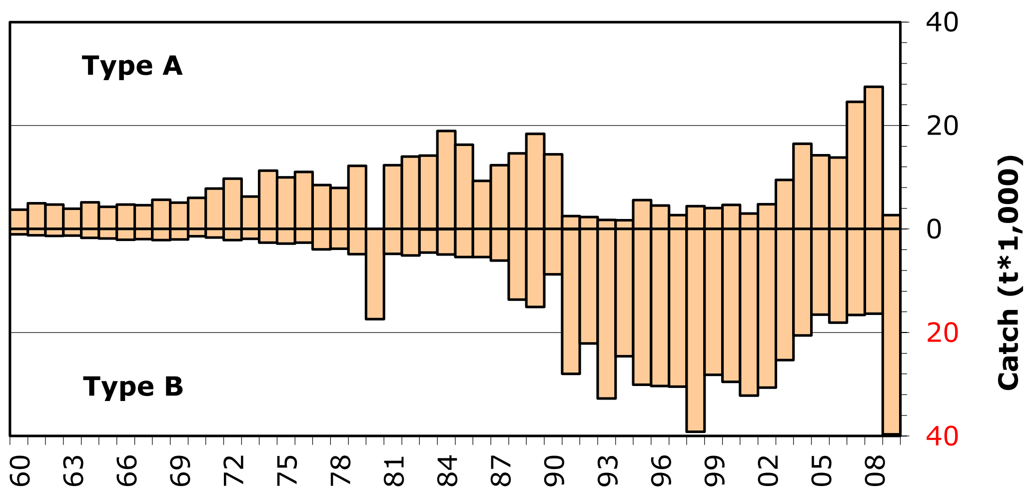

Figure 2. Indo-Pacific king mackerel: uncertainty of annual catch estimates. The amount of the catch below the zero-line has been categorised as uncertain according to the criteria given in the text.

EXECUTIVE SUMMARY OF THE STATUS OF THE KAWAKAWA RESOURCE

(as adopted by the IOTC Scientific Committee in December 2010)

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[16] (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 2005 to 2009 is 120,000 t, 70% of the catches being done in the Eastern Indian Ocean). In recent years, the countries attributed with the highest catches are Indonesia, India, Iran and Malaysia (Table 1).

A high percentage of the kawakawa captured by Thai purse seiners in the Andaman sea is comprised of fish 15 to 30 cm long.

AVAILABILITY OF INFORMATION FOR STOCK ASSESSMENT

Retained catches are uncertain (Figure 31) notably for the following fisheries:

- Artisanal fisheries of Indonesia: Indonesia did not report catches of kawakawa by species or by gear for 1950-2004; catches of kawakawa, longtail tuna and, to a lesser extent, other species were reported aggregated for this period. The Secretariat used the catches reported since 2005 to break the aggregates for 1950-2004 by gear and species. The catches of kawakawa estimated for this component represent more than 39% of the total catches of this species in recent years.
- Artisanal fisheries of India: Although India reports catches of kawakawa they are not always reported by gear. The Secretariat has allocated the catches of kawakawa by gear for years in which this information was not available. The catches of kawakawa have represented 20% of the total catches of this species in the Indian Ocean in recent years.

[16] 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.

- Artisanal fisheries of Mozambique, Myanmar (and Somalia): None of these countries have ever reported catches to the Secretariat. Catch levels are unknown.
- Other artisanal fisheries: The catches of kawakawa are usually not reported by species, being combined with catches of other small tuna species like skipjack tuna and frigate tuna (coastal purse seiners of Malaysia and Thailand).
- Industrial fisheries: The catches of kawakawa recorded for industrial purse seiners are thought to be a fraction of those retained on board. Due to this species being a bycatch, its catches are seldom recorded in the logbooks, nor are they monitored in port. The EC recently reported catch levels of frigate tuna for its purse seine fleet, for 2003-08, estimated using observer data. The Secretariat will use this data to estimate retained catches for other purse seine fleets during the same period.

Discard levels are moderate for industrial purse seine fisheries. The EU recently reported discard levels of kawakawa for its purse seine fleet, for 2003-08, estimated using observer data. The Secretariat will use this data to estimate discards for other purse seine fleets during the same period.

Changes to the catch series: There have not been significant changes to the catches of kawakawa since the SC in 2009. The changes in the catch series followed a review of the catches of coastal fisheries in Madagascar, conducted by the IOTC Secretariat. It was assumed that Madagascar combines the catches of several species under the name narrow-barred Spanish mackerel, including kawakawa.

CPUE Series: Catch-and-effort series are available from some fisheries but they are considered highly incomplete. In most cases catch-and-effort data are only available for short periods. Reasonably long catch-and-effort data series (extending for more than 10 years) are only available for Maldives baitboats and troll lines and Sri Lanka gillnets (Figure 3). The catch-and-effort data recorded for Sri Lankan gillnets are, however, thought to be inaccurate due to the dramatic changes in CPUE recorded between consecutive years.

Trends in average weight can only be assessed for Sri Lankan gillnets but the amount of specimens measured has been very low in recent years. The length frequency data available from the mid-eighties to the early nineties was obtained with the support of the IPTP (Indo-Pacific Tuna Programme). Unfortunately, data collection did not continue after the end of the IPTP activities.

Catch-at-Size(Age) table: Catch-at-Size data are not available for the kawakawa due to the paucity of size data available from most fleets (Figure 35) and the uncertain status of the catches for this species. Length distributions derived from the data available for some selected fisheries are shown in Figure 36.

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.

The SC **recommended** that Kawakawa be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

KAWAKAWA SUMMARY

Management quantity	2008 assessment	2009 assessment
Most recent catch	126,700 t (2007)	129,850 t (2008)*
Mean catch over the last 5 years (2005-2009)		119,900 t
Maximum Sustainable Yield		
$F_{Current}/F_{MSY}$		
$B_{Current}/B_{MSY}$ (1)		
$SB_{Current}/SB_{MSY}$ (2)		
$B_{Current}/B_0$ (1)		
$SB_{Current}/SB_0$ (2)		
$B_{Current}/B_{Current,F=0}$		
$SB_{Current}/SB_{Current,F=0}$		

* Preliminary catch estimates

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 1960-2009 (in thousands of tonnes). Data as of November 2010.

Gear	Fleet	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	85	86
Purse seine	Indonesia	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	17.7	18.4
	Malaysia	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	1.3	0.8	0.9	1.7	1.1	2.5	1.1	0.8	1.4	1.7	2.6	2.2
	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	1.5	0.7
	India	0.2	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.2	1.1	0.3	0.4	0.8	0.5	0.7	0.9	1.6	0.9	0.9	0.7	0.9	1.3	1.4
	Other Fleets	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	0.0	0.0
	Total	1.4	1.5	1.6	1.9	2.6	2.3	2.2	2.5	2.3	2.3	3.6	2.9	3.0	4.4	3.9	6.5	10.0	11.7	15.1	10.8	13.9	16.0	19.7	17.8	22.0	23.0	22.8
Gillnet	India	1.9	2.6	0.8	1.5	1.4	1.2	1.0	1.4	1.4	1.2	1.2	2.4	2.2	10.4	3.1	3.9	7.1	4.9	6.6	8.9	14.1	8.6	8.8	6.9	8.6	12.1	13.3
	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	1.7	1.9
	Pakistan	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	0.8	1.6
	Sri Lanka																											0.0
	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	0.4	0.4	0.5	0.5	0.6	0.5	0.7	0.6	0.5	0.2	0.6	0.5	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	0.8	1.2
	Other Fleets	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	0.6	0.6
	Total	2.4	3.1	1.5	2.5	2.8	2.7	3.0	3.4	3.3	2.9	3.1	3.9	4.2	12.1	5.5	6.7	10.3	7.6	8.4	11.4	16.1	11.6	14.0	11.4	15.2	16.5	19.2
Line	India	0.5	0.8	0.2	0.4	0.5	0.3	0.3	0.4	0.4	0.3	0.3	0.6	0.6	2.8	0.8	1.1	1.9	1.3	1.7	2.3	3.5	2.1	2.4	1.8	2.3	3.2	3.5
	Yemen	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	0.6	0.6	0.7	0.6	1.8	0.9	0.9	0.8	1.1	2.1	1.4
	Madagascar	0.2	0.2	0.1	0.2	0.2	0.3	0.4	0.3	0.3	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	0.4	0.6	1.1	1.1	0.9
	Indonesia	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	1.9	1.9
	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	1.4	0.7
	Other Fleets	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.3	0.3	0.4	0.6	0.5	0.5	0.5	0.6	0.7	0.9	0.9	1.3	1.1	1.4	1.2	1.3
	Total	1.3	1.5	1.0	1.2	1.2	1.3	1.3	1.8	1.8	1.6	1.8	1.9	2.1	4.8	2.8	3.0	4.9	4.4	5.2	5.3	8.4	6.6	7.9	7.2	8.7	10.9	9.7
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	1.0	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	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.4	0.2	0.2
	Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.3	0.3	0.3	0.3	0.7	0.6	0.3	0.4	0.4	0.3	0.4	0.6	0.7	1.1	1.3	1.2	1.1	0.8
All	Total	5.1	6.1	4.1	5.6	6.6	6.3	6.6	7.9	7.6	7.1	8.8	9.0	9.6	21.9	12.8	16.5	25.5	24.1	29.0	27.9	38.9	34.9	42.8	37.7	47.1	51.6	52.4

Gear	Fleet	Av05/09	Av60/09	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09
Purse seine	Indonesia	34.8	17.7	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	37.4	37.4	37.4
	Malaysia	10.3	3.2	1.4	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	10.0	10.0
	Thailand	8.8	3.1	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	9.0	7.0	9.1	9.0
	India	6.7	1.5	1.0	1.2	2.1	2.6	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	8.5	11.8	11.8
	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	0.1
	Total	60.6	25.5	24.3	24.7	28.7	26.8	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	58.9	65.4	68.4	68.3
Gillnet	India	15.9	9.8	10.1	11.1	19.3	24.0	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	11.0	15.1	15.1
	Iran, Islamic R.	15.6	4.1	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	20.4	17.8
	Pakistan	3.2	1.8	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	3.3	3.5
	Sri Lanka	2.3	0.5	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	3.0	2.0	2.8
	Oman	1.3	0.7	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	1.4	1.3	1.2	1.2
	UAE	0.2	0.8	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	0.1	0.1	0.1	0.1
	Other Fleets	2.3	0.9	0.7	1.0	0.8	1.0	1.2	1.3	1.1	1.2	1.4	1.2	1.7	1.9	1.4	1.4	1.1	1.3	2.2	1.6	1.2	2.6	2.8	2.5	2.5
	Total	40.9	18.5	16.8	22.2	25.6	31.2	20.0	24.1	18.8	18.7	23.3	26.1	33.8	32.6	38.4	38.7	35.1	40.5	39.9	31.5	36.7	42.8	36.9	44.8	43.1
Line	India	5.2	2.9	2.8	3.0	4.9	6.1	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	4.4	4.3	4.3
	Yemen	3.8	1.4	1.3	1.7	1.3	1.6	1.7	1.7	0.6	1.2	1.3	1.5	1.7	1.9	2.1	2.2	2.4	2.6	1.5	3.0	2.9	2.5	2.8	5.3	5.3
	Madagascar	2.0	1.2	2.4	0.1	1.1	3.1	2.3	2.8	3.8	2.7	3.1	3.0	2.6	3.3	2.4	2.1	2.0	2.2	1.8	2.3	2.3	1.9	1.9	1.9	1.9
	Indonesia	1.5	1.6	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	0.3	0.3	0.3
	Maldives	0.6	0.6	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	0.4	0.9
	Other Fleets	1.8	1.1	3.3	2.2	1.8	1.8	2.3	2.1	1.7	2.3	2.1	1.6	2.0	1.5	1.4	1.1	1.3	1.0	1.3	1.4	1.7	1.9	1.7	1.8	1.8
	Total	14.9	8.9	12.6	9.6	12.2	15.5	13.5	15.0	15.2	13.8	14.7	14.4	15.4	16.0	15.8	15.9	14.5	15.7	14.3	15.5	18.1	15.6	12.1	14.0	14.5
Other gears	Maldives	1.8	0.9	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	1.7	2.1
	India	1.2	0.1															0.0		0.0				3.7	1.2	1.2
	Other Fleets	0.6	0.2	0.5	0.6	0.3	0.4	0.0	0.1	0.0	0.1	0.3	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.2	0.2	0.4	0.8	0.7	0.7
	Total	3.6	1.2	1.0	1.2	0.9	1.3	0.9	1.4	1.7	1.8	2.1	3.1	1.6	2.4	1.3	1.5	1.8	1.9	2.2	2.1	2.4	1.7	6.4	3.6	4.0
All	Total	119.9	54.1	54.6	57.8	67.4	74.8	66.6	72.2	75.2	76.4	85.2	90.0	98.2	97.2	102.6	110.6	97.7	109.7	109.9	105.1	99.3	119.1	120.7	130.7	129.9

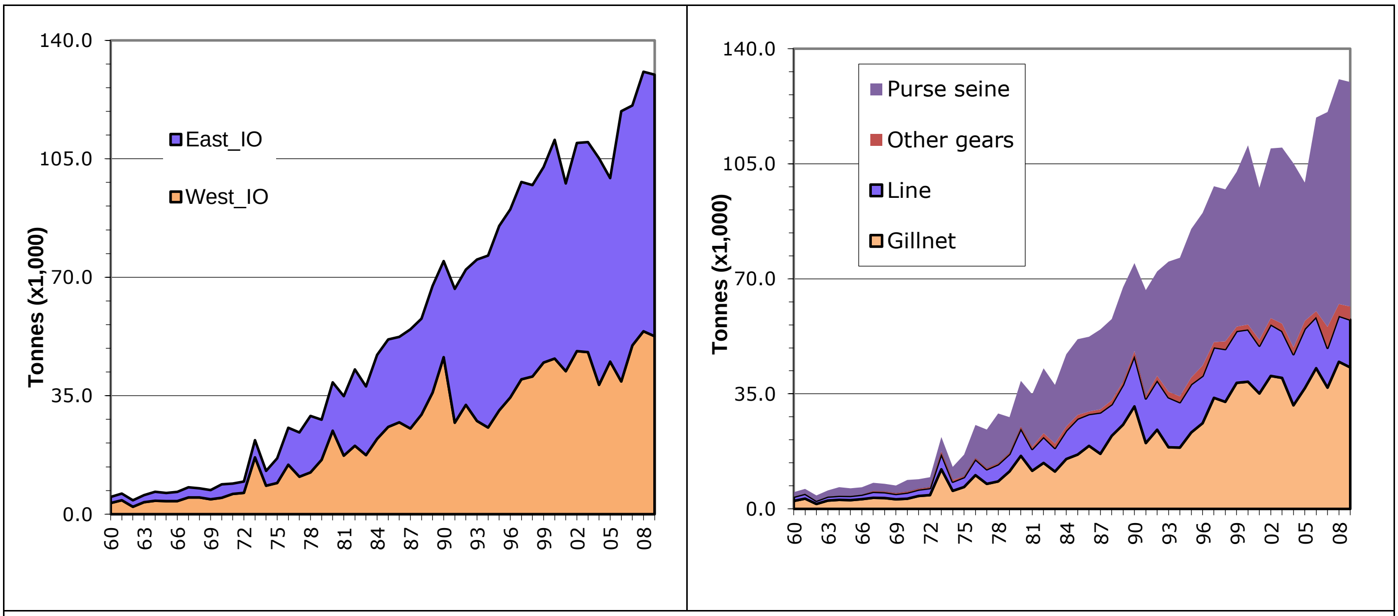

Figure 1. Kawakawa: (a) annual catches from 1960 to 2009 by (on the left) area *i.e.* Eastern and Western Indian Ocean and (on the right) gear. Data as of November 2010

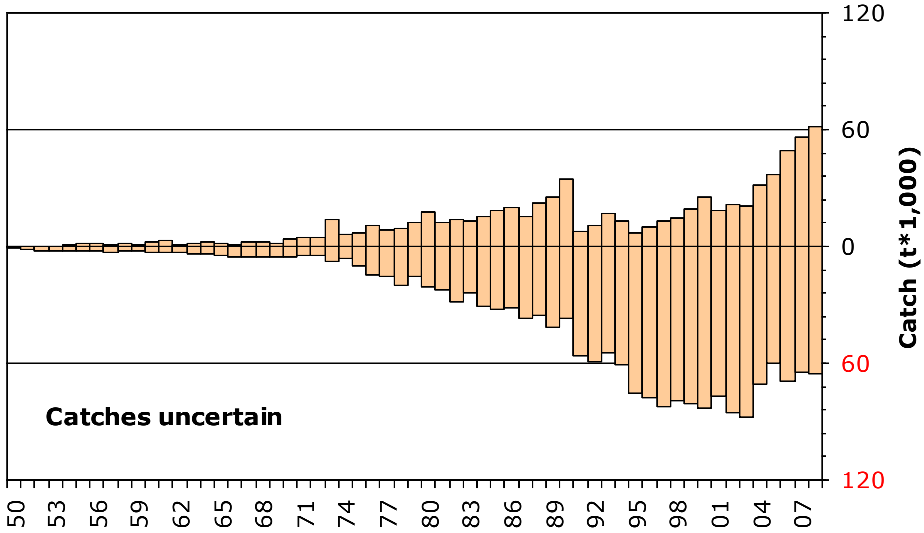

Figure 2. Kawakawa: uncertainty of annual catch estimates. The amount of the catch below the zero-line has been categorised as uncertain according to the criteria given in the text.

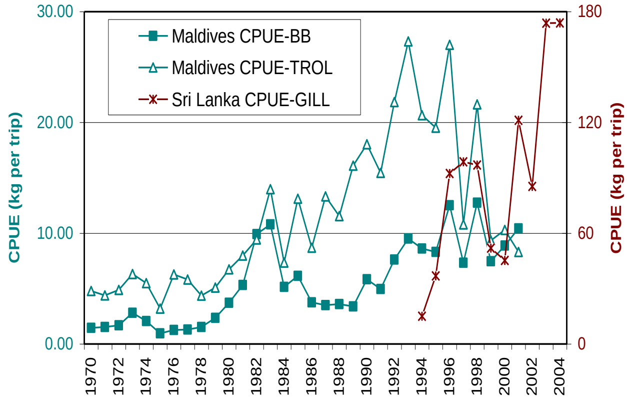

Figure 3. Kawakawa: Nominal CPUE series for the baitboat (BB) and troll line (TROL) fisheries of Maldives (left axis; 1970-2001) and the gillnet fishery of Sri Lanka (right axis; 1994-2004) derived from the available catches and effort data

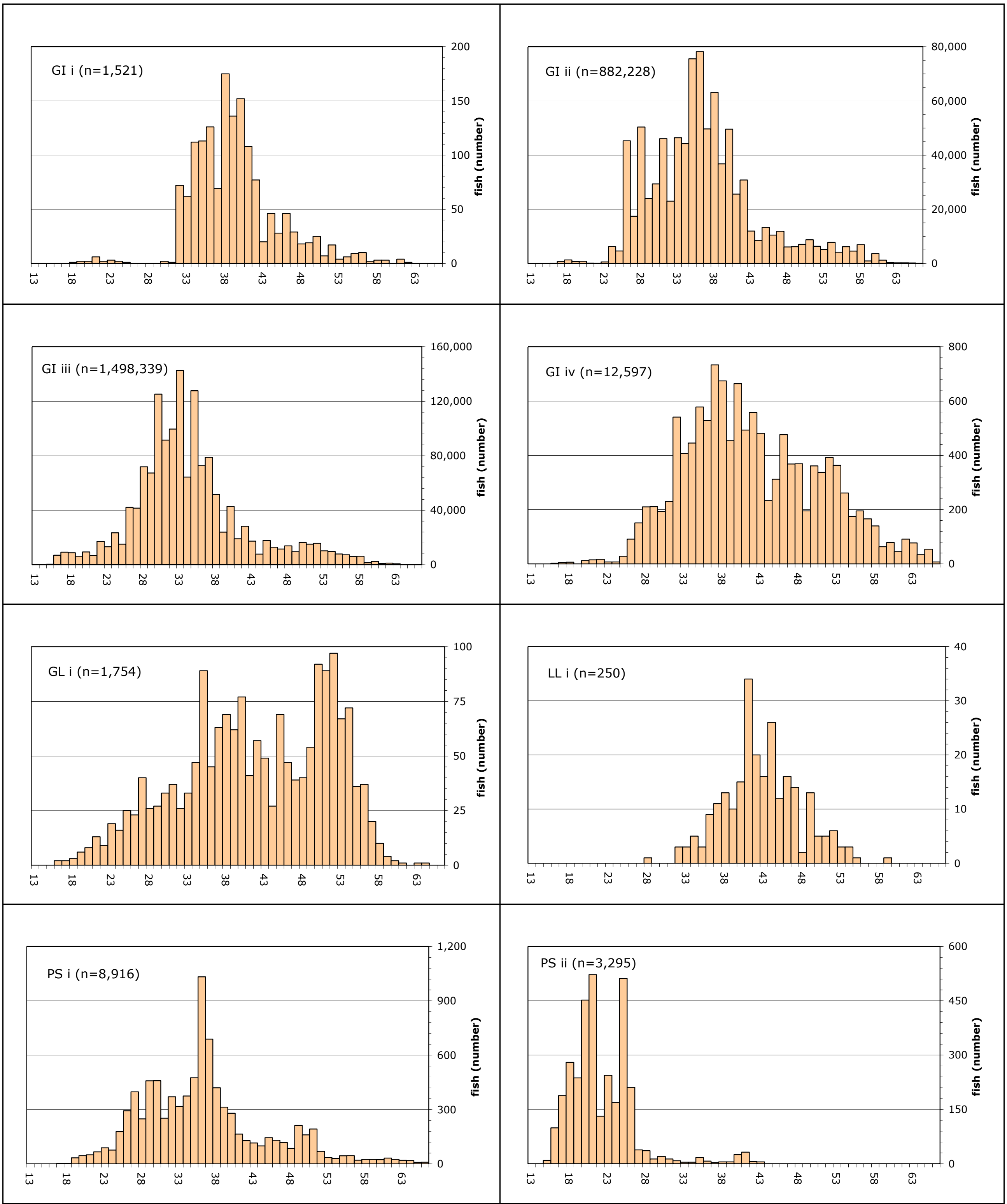

Figure 4. Kawakawa: Length frequency distributions (total amount of fish measured by 1cm length class by decade) derived from the data available at the IOTC Secretariat for selected fisheries and periods
GI: Gillnet fisheries: i. Indonesia 1980-89, ii. Sri Lanka 1980-89, iii. Sri Lanka 1990-99, iv. Sri Lanka 2000-06
GL: Gillnet and longline combination: i. Sri Lanka 2000-06
LL: Coastal longline fisheries: i. Sri Lanka 1990-99
PS: Coastal purse seine fisheries: i. Indonesia 1980-89, ii. Malaysia 1980-89

EXECUTIVE SUMMARY OF THE STATUS OF THE LONGTAIL TUNA RESOURCE

(as adopted by the IOTC Scientific Committee in December 2010)

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[17] (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 122,000t t in 2009. The average annual catch estimated for the period 2005 to 2009 is 103,800 t . In recent years, the countries attributed with the highest catches of longtail tuna are Indonesia and Iran, and to a lesser extent, , Oman, Yemen and Pakistan (Table 1).

The size of longtail tunas taken by the Indian Ocean fisheries typically ranges between 15 cm and 120 cm depending on the type of gear used, season and location. The fisheries operating in the Andaman Sea (coastal purse seines and troll lines) tend to catch longtail tuna of small size (15cm-55cm) while the gillnet fisheries operating in the Arabian Sea catch larger specimens (40cm-100cm).

AVAILABILITY OF INFORMATION FOR STOCK ASSESSMENT

Retained catches are uncertain, notably for the following fisheries:

- Artisanal fisheries of Indonesia: Indonesia did not report catches of longtail tuna by species or by gear for 1950-2004; catches of longtail tuna, kawakawa and other species were reported aggregated for this period. The Secretariat used the catches reported since 2005 to break the aggregates for 1950-2004 by gear and species. The catches estimated for the longtail tuna represent more than 30% of the total catches of this species in the Indian Ocean in recent years.
- Artisanal fisheries of India and Oman: Although these countries report catches of longtail tuna, until recently the catches have not been reported by gear. The Secretariat used alternative information to assigning the catches reported by species. The catches of longtail tuna that had to be allocated by gear represented 13% of the total catches of this species in recent years.
- Artisanal fisheries of Mozambique, Myanmar (and Somalia): None of these countries have ever reported catches to the Secretariat. Catch levels are unknown.

[17] 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.

- Other artisanal fisheries: The Secretariat had to estimate catches of longtail tuna for the artisanal fisheries of Yemen (no data reported to the Secretariat) and Malaysia (catches not reported by species). The catches estimated for the longtail tuna represent more than 8% of the total catches of this species in recent years.

Discard levels are believed to be low although they are unknown for most fisheries.

Changes to the catch series: There have not been significant changes to the catches of longtail tuna since the SC in 2009. The increase in the catches in 2007 originates from a review of the catches of Thai coastal purse seiners, conducted by the Directorate of Fisheries of Thailand.

CPUE Series: Catch-and-effort series are available from some fisheries but they are considered highly incomplete. In most cases catch-and-effort data are only available for short periods. Reasonably long catches and effort series (extending for more than 10 years) are only available for Thailand small purse seines and gillnets (Figure 3).

Trends in average weight can only be assessed for Iranian gillnets but the amount of specimens measured has been very low in recent years. The length frequency data available from the mid-eighties to the early nineties was obtained with the support of the IPTP (Indo-Pacific Tuna Programme). Unfortunately, data collection did not continue after the end of the IPTP activities.

Catch-at-Size(Age) table: Catches-at-Size are not available for the longtail tuna due to the paucity of size data available from most fleets and the uncertain status of the catches for this species. Length distributions derived from the data available for some selected fisheries are shown in Figure 4.

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 longtail tuna in the Indian Ocean, therefore the stock status is uncertain. The SC notes the catches of longtail tuna are increasing.

The SC recommended that longtail tuna be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

LONGTAIL TUNA SUMMARY

Management quantity	**2009 assessment**	**2010 assessment**
Most recent catch	104,400 t (2008)	122,400 t (2009)*
Mean catch over the last 5 years (2005-2009)		103,800 t
Maximum Sustainable Yield		
$F_{Current}/F_{MSY}$		
$B_{Current}/B_{MSY}$ (1)		
$SB_{Current}/SB_{MSY}$ (2)		
$B_{Current}/B_0$ (1)		
$SB_{Current}/SB_0$ (2)		
$B_{Current}/B_{Current,F=0}$		
$SB_{Current}/SB_{Current,F=0}$		

* Preliminary catch estimates

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 1960-2009 (in thousands of tonnes). Data as of November 2010

Gear	Fleet	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	85	86
Purse seine	Malaysia	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.4	0.3	0.2	0.7	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	1.5	1.2
	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	2.2	1.5
	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	0.2	0.2	0.3	0.5	0.7	0.8	0.6	0.7	1.0	1.2	1.1	1.3	1.2	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*	*0.2*	*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*	*1.5*	*2.1*	*3.0*	*2.7*	*2.6*	*8.5*	*8.6*	*8.2*	*4.9*	*4.1*
Gillnet	Iran, Islamic											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	11.8	11.7
	Indonesia	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	15.8	16.5
	Pakistan	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	2.1	4.4
	India	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	4.5	1.6
	Oman	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	3.6	4.0
	United Arab	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	2.4	3.4
	Other Fleets	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	0.7	0.9
	Total	*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*	*41.0*	*42.5*
Line	Yemen	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	0.3	1.0	1.0	0.5
	Oman	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	1.9	2.1
	Madagascar	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	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	0.3	0.6	0.6	0.5
	India	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	1.2	0.4
	Other Fleets	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	0.7	0.8
	Total	*0.9*	*1.0*	*0.9*	*0.9*	*0.9*	*1.1*	*1.1*	*1.2*	*1.2*	*1.1*	*0.8*	*0.9*	*1.0*	*1.5*	*2.5*	*2.9*	*3.4*	*3.4*	*3.8*	*3.7*	*4.4*	*3.8*	*3.5*	*2.1*	*4.4*	*5.3*	*4.3*
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	0.2	0.5	0.6	0.7	0.5	0.6	0.9	1.1	1.0	1.2	1.1	1.2
	Oman	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	1.2	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	0.3	0.4	0.0	0.0
	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*	*0.3*	*0.3*	*0.8*	*1.0*	*1.4*	*1.6*	*1.8*	*1.5*	*1.8*	*2.0*	*1.9*	*1.6*	*2.6*	*2.3*	*2.5*
All	*Total*	*5.9*	*6.1*	*6.5*	*7.7*	*9.3*	*9.5*	*11.0*	*11.5*	*11.2*	*10.6*	*10.5*	*8.6*	*10.4*	*13.1*	*15.9*	*19.8*	*25.3*	*26.5*	*27.1*	*27.5*	*28.8*	*32.7*	*45.4*	*38.0*	*47.4*	*53.5*	*53.4*

Gear	Fleet	Av05/09	Av60/09	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09
Purse seine	Malaysia	4.4	1.5	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	4.3	4.3
	Thailand	3.7	2.1	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	2.6	6.2	4.1	4.1
	Indonesia	3.0	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	3.5	3.5	3.5
	Iran, Islamic R.	2.1	0.7						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	2.7	2.2
	Other Fleets	0.8	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	1.2	0.0	0.0	0.3	0.1	0.1	0.1	1.3	1.4	1.4
	Total	*14.1*	*5.7*	*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*	*7.3*	*13.4*	*18.6*	*16.0*	*15.4*
Gillnet	Iran, Islamic R.	28.9	10.8	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	31.2	47.1
	Indonesia	27.6	15.5	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	27.7	27.7	27.7
	Pakistan	5.8	4.4	6.0	6.3	4.9	6.2	6.1	5.8	4.5	5.8	5.0	4.7	5.6	5.5	6.3	6.0	5.2	5.1	6.1	5.3	5.2	5.6	5.7	5.7	7.0
	India	5.2	2.5	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	6.7	4.8	4.8
	Oman	4.1	2.8	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	4.1	4.3	4.2	4.0	4.0
	UAE	3.0	2.3	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	4.0	3.4	2.8	2.8
	Other Fleets	0.7	0.7	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	0.5	0.6	0.6	1.0	1.0
	Total	*75.3*	*39.0*	*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*	*78.0*	*67.5*	*59.8*	*71.0*	*74.2*	*77.2*	*94.5*
Line	Yemen	5.4	1.9	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	3.1	3.1
	Oman	3.3	1.6	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	3.2	3.3	3.3	3.2	3.2
	Madagascar	1.2	0.6	1.0	0.1	1.3	1.1	0.9	0.8	1.0	1.2	1.8	1.6	1.2	1.2	1.4	0.8	0.8	1.0	1.1	1.0	0.9	0.8	1.6	1.3	1.3
	India	0.3	0.7	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	0.2	0.2
	Other Fleets	1.1	0.6	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	0.7	0.7	0.8	0.8	0.5	1.2	1.5	1.3	1.3
	Total	*11.3*	*5.3*	*9.5*	*6.6*	*5.8*	*6.1*	*6.3*	*5.5*	*7.2*	*9.6*	*8.2*	*7.3*	*7.7*	*7.8*	*10.2*	*10.2*	*10.4*	*10.4*	*8.5*	*10.2*	*12.0*	*12.9*	*13.4*	*9.0*	*9.0*
Other gears	Indonesia	1.5	1.0	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	1.2	1.2	1.2
	Oman	0.4	0.6	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	0.4	0.4	0.4	0.4
	Other Fleets	1.2	0.1	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	0.1	0.2	1.9	1.8	1.8
	Total	*3.0*	*1.8*	*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*	*1.8*	*3.5*	*3.4*	*3.4*
All	*Total*	*103.8*	*51.8*	*67.9*	*70.1*	*68.8*	*59.2*	*63.2*	*53.0*	*65.8*	*74.8*	*92.9*	*85.3*	*86.4*	*92.9*	*100.5*	*120.4*	*100.7*	*101.0*	*102.7*	*91.6*	*82.2*	*99.1*	*109.7*	*105.6*	*122.4*

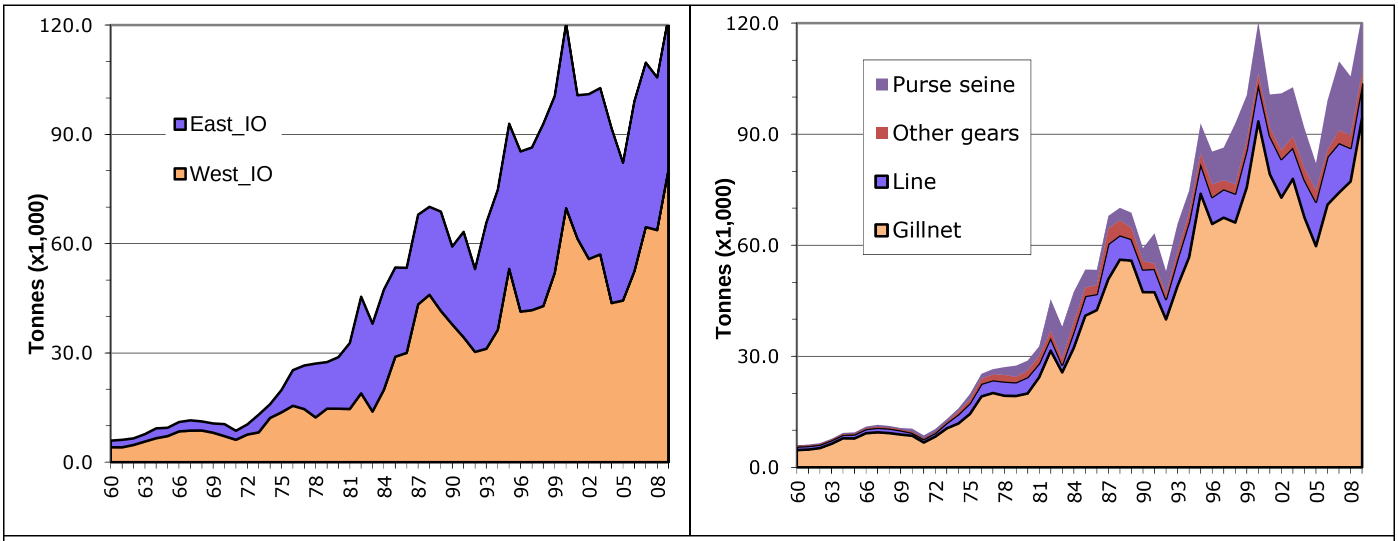

Figure 1. Longtail tuna: annual catches from 1960 to 2009 by area (left) and gear (right). Data as per November 2010

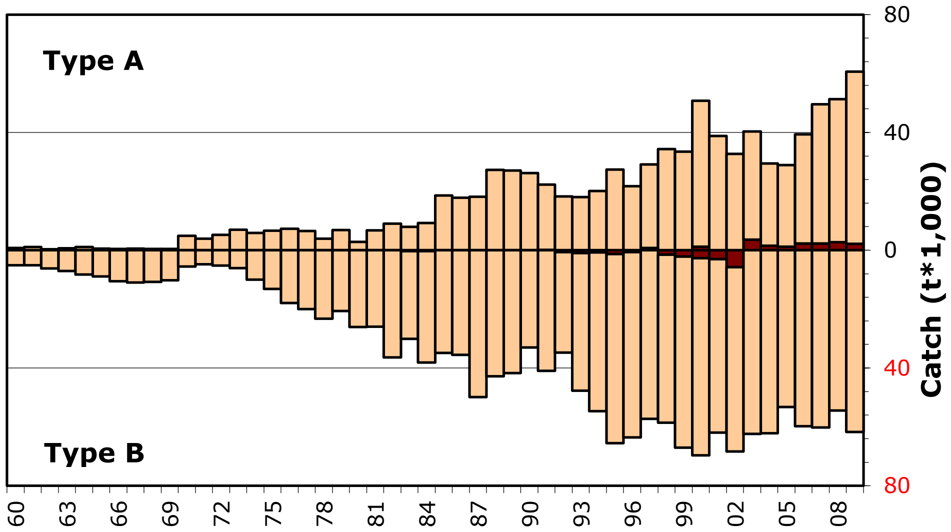

Figure 2. Longtail tuna: uncertainty of annual catch estimates (1960-2009). The amount of the catch below the zero-line has been categorised as uncertain according to the criteria given in the text. Dark sections represent estimates of catches by industrial fleets

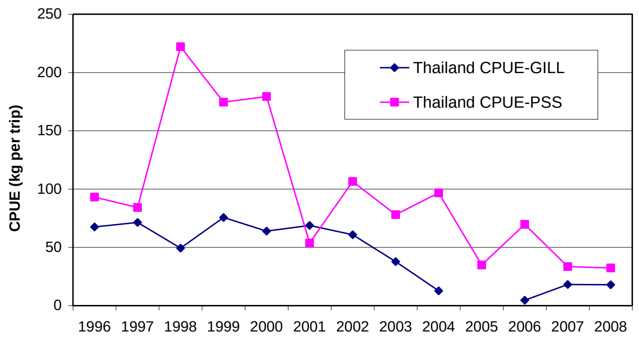

Figure 3. Longtail tuna: Nominal CPUE series for the gillnet (GILL) and coastal purse seine (PSS) fisheries of Thailand derived from the available catches and effort data (1996-2008)

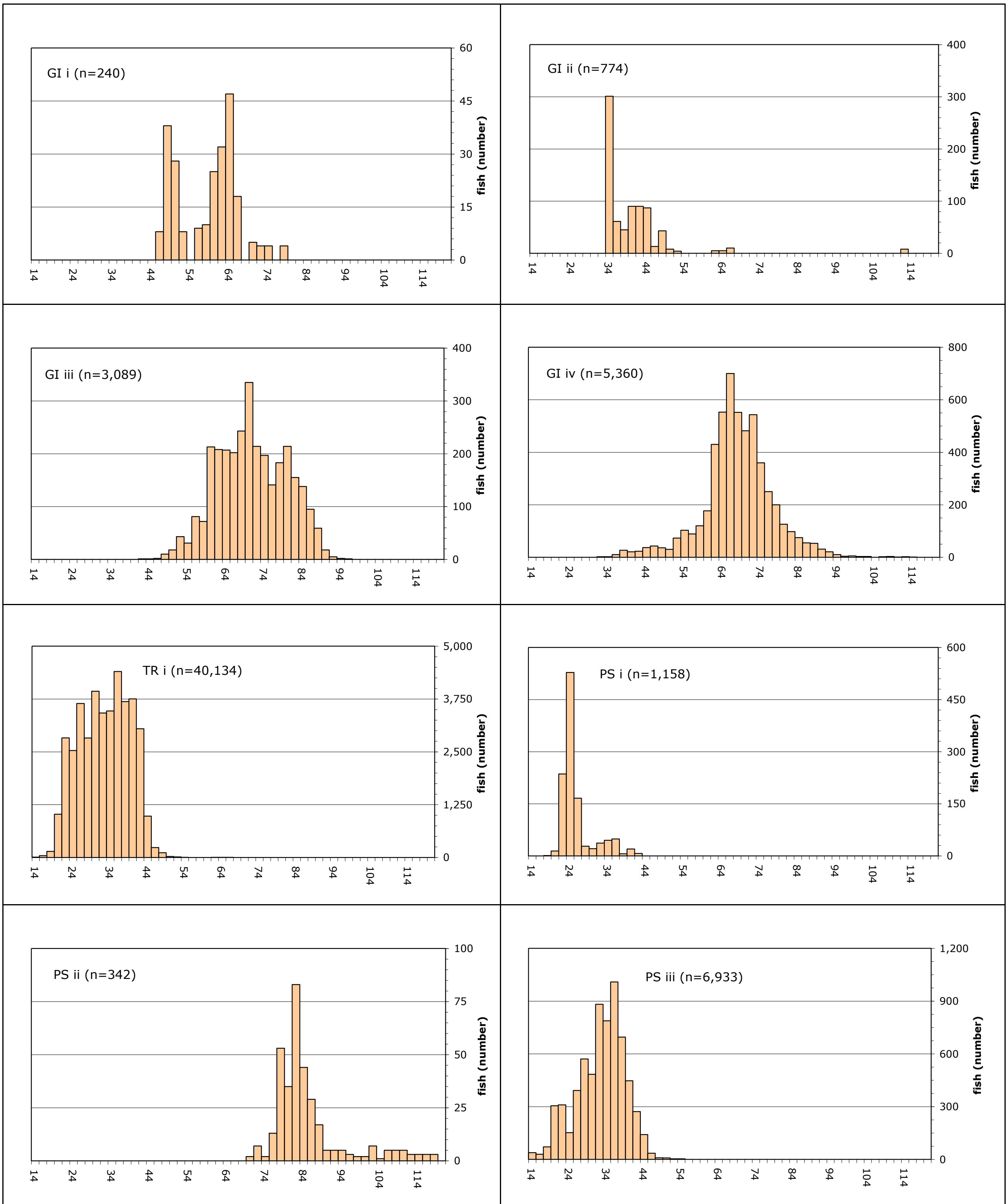

Figure 4. Longtail tuna: Length frequency distributions (total amount of fish measured by 2cm length class by decade) derived from the data available at the IOTC Secretariat for selected fisheries and periods

GI: Gillnet fisheries: i. Sri Lanka 1980-89, ii. Sri Lanka 1990-99, iii. Pakistan 1990-99, iv. Iran 2000-06

TR: Troll line fisheries: i. Malaysia 1980-89

PS: Coastal purse seine fisheries: i. Malaysia 1980-89, ii. Iran 2000-06, iii. Thailand 2000-06

EXECUTIVE SUMMARY OF THE STATUS OF THE NARROW-BARRED SPANISH MACKEREL RESOURCE

(as adopted by the IOTC Scientific Committee in December 2010)

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 trolling.

The catch estimates for Spanish mackerel were derived from very small amounts of information and are therefore highly uncertain[18] (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-1990s, peaking at 118,000t in 2006. The current average annual catch is around 110,800 t (for the period 2005 to 2009), with most of the catch obtained taken from the west Indian Ocean area. (Figures 1, and Table 1). In recent years, the countries attributed with the highest catches of Spanish mackerel are India, Indonesia, Madagascar, Pakistan, Iran, UAE 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

Retained catches are uncertain (Figure 40) notably for the following fisheries:

- Artisanal fisheries of India and Indonesia: India and Indonesia have only recently reported catches of Spanish mackerel by gear, including catches by gear for the years 2005-08 and 2007-08, respectively. In both cases, the Secretariat used the catches reported by gear to break previous catches of this species by gear. The catches of Spanish mackerel estimated for this component represent more than 22% of the total catches of this species in recent years.
- Artisanal fisheries of Madagascar: Madagascar has never reported catches of Spanish mackerel to the IOTC. During 2010 the Secretariat conducted a review aiming to break the catches recorded in the FAO

[18] 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.

database as Spanish mackerel by species, on the assumption that all catches of nertitic tunas had been combined under this name. The new catches estimated are thought to be very uncertain.

- Artisanal fisheries of Mozambique, Myanmar (and Somalia): None of these countries have ever reported catches to the Secretariat. Catch levels are unknown.
- Other artisanal fisheries: Oman and the UAE do not report catches of Spanish mackerel by gear. Although most of the catches are believed to be taken by gillnets, some Spanish mackerel may be also caught by using small surrounding nets, lines or other artisanal gears. Thailand and Malaysia report catches of Spanish mackerel and Indo-Pacific king mackerel aggregated.
- All fisheries: In some cases the catches of seerfish species are mislabelled, the catches of Indo-Pacific king mackerel and, to a lesser extent, other seerfish species, labelled as Spanish mackerel. Similarly, the catches of wahoo in some longline fisheries are thought to be mislabelled as Spanish mackerel. This mislabelling is thought to have little impact in the case of the Spanish mackerel but may be important for other seerfish species.

Discard levels are believed to be low although they are unknown for most fisheries.

Changes to the catch series: The latest catch series produced shows lower catches than previous series used by the SC. The changes in the catch series followed a review of the catches of coastal fisheries in Madagascar, conducted by the IOTC Secretariat. It was assumed that Madagascar combines the catches of several species under the name narrow-barred Spanish mackerel, including kawakawa.

CPUE Series: Catch-and-effort series are available from some fisheries but they are considered highly incomplete. In most cases catch-and-effort data are only available for short periods. Reasonably long catch-and-effort data series (extending for more than 10 years) are only available for Sri Lanka gillnets (Figure 3). The catches and effort recorded are, however, thought to be unrealistic due to the dramatic changes in CPUE recorded in 2003 and 2004.

Trends in average weight can only be assessed for Sri Lankan gillnets but the amount of specimens measured has been very low in recent years. The length frequency data available from the mid-eighties to the early nineties was obtained with the support of the IPTP (Indo-Pacific Tuna Programme). Unfortunately, data collection did not continue after the IPTP activities came to an end.

Catch-at-Size(Age) table: Catch-at-Size data are not available for the Spanish mackerel due to the paucity of size data available from most fleets and the uncertain status of the catches for this species. Length distributions derived from the data available for some selected fisheries are shown in Figure 4.

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.

The SC recommended that narrow-barred Spanish mackerel be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas.

NARROW-BARRED SPANISH MACKEREL SUMMARY

Management quantity	2009 assessment	2010 assessment
Most recent catch	118,200 t (2008)	108,600 t (2009)*
Mean catch over the last 5 years (2004-2008)		110,800 t
Maximum Sustainable Yield		
$F_{Current}/F_{MSY}$		
$B_{Current}/B_{MSY}$ (1)		
$SB_{Current}/SB_{MSY}$ (2)		
$B_{Current}/B_0$ (1)		
$SB_{Current}/SB_0$ (2)		
$B_{Current}/B_{Current,F=0}$		
$SB_{Current}/SB_{Current,F=0}$		

* Preliminary catch estimates

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 1960-2009 (in thousands of tonnes). Data as of November 2010

Gear	Fleet	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	85	86
Gillnet	India	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	9.3	13.3
	Indonesia	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	3.4	4.2
	Iran, Islamic																							0.1	1.4	0.6	0.7	0.7
	Pakistan	1.3	1.2	1.8	2.7	3.7	4.0	5.4	5.2	5.3	4.8	4.3	3.4	7.5	4.8	4.4	3.1	3.7	5.4	5.8	9.1	1.9	7.2	7.3	7.9	6.8	7.3	7.5
	Sri Lanka	1.2	1.3	2.1	3.0	2.6	2.2	3.8	5.3	5.3	5.2	3.9	2.5	2.9	3.3	3.2	3.1	3.9	3.8	3.8	4.4	6.1	4.9	4.4	3.9	3.7	3.8	3.9
	Saudi Arabia																						0.6	0.5	0.7	0.8	7.1	7.7
	Qatar																							0.2	0.2	0.3	0.3	0.1
	Oman	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	10.9	7.7
	United Arab	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	4.2	6.7
	Malaysia	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	2.8	3.6
	Other Fleets	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	0.9	0.8	1.0	1.6	2.7	1.9	2.3	1.8	3.3	2.8	2.7	1.8	2.6	2.8
	Total	*9.5*	*10.4*	*12.6*	*13.8*	*15.5*	*15.9*	*19.5*	*20.8*	*21.8*	*20.7*	*18.2*	*18.6*	*24.2*	*22.2*	*26.9*	*27.8*	*27.1*	*31.8*	*31.6*	*38.3*	*35.5*	*39.5*	*44.7*	*41.9*	*41.5*	*52.4*	*58.3*
Line	Madagascar	0.3	0.3	0.3	0.3	0.3	0.5	0.7	0.6	0.6	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.7	1.1	2.0	2.0	1.9
	India	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	1.4	1.9
	Indonesia	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	2.5	3.1
	Saudi Arabia																						0.2	0.2	0.3	0.4	1.2	1.4
	Yemen	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	3.5	3.8
	Oman	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	5.7	4.1
	Other Fleets	0.6	0.6	0.8	1.1	1.0	1.0	1.4	1.7	1.8	1.7	1.2	0.9	0.9	1.0	1.1	1.1	1.3	1.5	1.5	1.6	2.7	2.1	1.5	2.4	2.2	2.0	2.4
	Total	*3.8*	*3.9*	*4.5*	*4.8*	*4.7*	*5.0*	*6.0*	*6.5*	*6.6*	*6.2*	*5.1*	*5.7*	*6.3*	*6.6*	*10.3*	*12.5*	*10.4*	*11.1*	*11.4*	*11.2*	*14.5*	*12.2*	*11.8*	*10.3*	*16.2*	*18.3*	*18.7*
Other gears	India	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	5.7	8.1
	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	0.9	1.4
	Indonesia	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	0.6	0.7
	Oman	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	3.6	2.5
	Other Fleets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.9	0.5	0.3	0.5	0.4	0.6	0.8	0.6	0.6	0.4	0.0	0.6	0.1	0.1	0.0	0.4
	Total	*2.1*	*2.6*	*2.6*	*2.3*	*2.5*	*2.3*	*2.5*	*2.5*	*3.1*	*2.9*	*3.8*	*5.5*	*5.5*	*5.1*	*6.5*	*6.8*	*7.7*	*6.4*	*6.2*	*7.5*	*9.2*	*7.7*	*10.7*	*9.0*	*9.7*	*10.8*	*13.2*
All	*Total*	*15.4*	*16.9*	*19.7*	*20.9*	*22.7*	*23.2*	*27.9*	*29.7*	*31.5*	*29.8*	*27.1*	*29.8*	*36.0*	*33.9*	*43.6*	*47.1*	*45.2*	*49.3*	*49.2*	*56.9*	*59.3*	*59.4*	*67.2*	*61.3*	*67.5*	*81.5*	*90.2*

Gear	Fleet	Av05/09	Av60/09	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09
Gillnet	India	20.3	10.6	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	25.9	20.3	20.3
	Indonesia	19.6	6.5	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	24.1	24.1	24.1
	Iran, Islamic	8.1	2.6	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	10.0	7.3
	Pakistan	7.3	6.7	7.7	10.1	6.8	6.2	10.0	8.4	8.4	7.2	8.6	10.1	12.5	12.7	13.1	10.6	9.3	7.9	8.5	8.8	7.2	7.0	7.4	7.4	7.6
	Sri Lanka	3.9	3.9	4.1	4.2	4.3	4.3	4.1	4.0	4.1	4.1	4.7	3.8	4.1	4.5	4.8	4.9	4.7	4.7	4.6	4.2	1.9	3.8	4.1	4.5	4.9
	Saudi Arabia	2.9	2.7	7.0	7.1	6.7	7.6	7.8	7.9	8.2	8.5	6.0	5.0	3.6	4.7	3.7	3.5	4.8	3.9	3.1	2.9	3.0	2.9	2.7	2.8	2.8
	Qatar	2.2	0.5	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	1.8	2.6	2.6
	Oman	1.7	3.2	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	1.8	1.6	1.7	1.6	1.6
	United Arab	1.5	4.2	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	1.9	1.1	0.3	0.3
	Malaysia	1.0	1.8	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	1.0	1.0
	Other Fleets	4.2	2.3	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	3.6	3.9	4.1	3.8	3.2	4.6	4.7	4.2	4.3
	Total	*72.6*	*45.0*	*61.2*	*67.1*	*55.8*	*52.8*	*55.2*	*60.0*	*57.9*	*58.1*	*69.7*	*61.5*	*65.1*	*71.6*	*69.0*	*71.1*	*68.7*	*66.5*	*68.2*	*64.2*	*45.1*	*78.8*	*83.4*	*78.8*	*76.7*
Line	Madagascar	6.5	2.6	3.5	0.2	5.1	4.0	3.4	2.8	3.3	4.0	3.2	3.1	3.5	4.9	5.9	6.7	6.5	6.1	7.1	5.8	6.3	7.0	6.2	6.6	6.6
	India	4.2	1.7	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	5.3	4.7	4.7
	Indonesia	3.9	3.7	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	0.1	0.1	0.1
	Saudi Arabia	2.2	1.1	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	2.3	2.2	2.1	2.1	2.1
	Yemen	2.1	2.2	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	2.8	2.8
	Oman	1.3	1.7	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	1.4	1.2	1.3	1.3	1.3
	Other Fleets	2.1	1.9	3.5	2.5	2.6	3.0	2.9	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	2.1	2.2	2.0	2.0	2.0
	Total	*22.2*	*14.9*	*24.4*	*21.3*	*21.5*	*18.5*	*18.9*	*17.9*	*19.8*	*22.6*	*19.3*	*18.1*	*20.5*	*22.1*	*23.0*	*24.6*	*25.1*	*22.6*	*24.3*	*24.4*	*35.4*	*17.6*	*18.7*	*19.6*	*19.7*
Other gears	India	9.4	6.2	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	7.6	7.1	7.1
	Thailand	3.8	1.4	1.4	0.7	1.6	1.8	1.8	2.4	2.3	1.8	2.8	3.5	3.4	3.1	2.2	2.1	2.1	2.9	2.9	3.3	3.8	4.3	3.3	3.8	3.7
	Indonesia	1.0	0.8	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	0.2	0.2	0.2
	Oman	0.1	0.9	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	0.2	0.1	0.1	0.1	0.1
	Other Fleets	1.7	0.6	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	1.2	1.8	1.5	1.1	1.7	3.3	1.2	1.1	1.1
	Total	*16.0*	*9.9*	*13.6*	*14.1*	*12.3*	*9.7*	*9.2*	*12.6*	*11.3*	*12.3*	*15.1*	*14.8*	*14.3*	*16.6*	*16.2*	*18.3*	*14.9*	*18.9*	*18.1*	*16.8*	*21.4*	*21.6*	*12.5*	*12.4*	*12.2*
All	*Total*	*110.8*	*69.8*	*99.3*	*102.5*	*89.6*	*81.1*	*83.3*	*90.4*	*89.1*	*93.0*	*104.0*	*94.5*	*100.0*	*110.4*	*108.2*	*114.0*	*108.6*	*108.0*	*110.7*	*105.4*	*102.0*	*118.1*	*114.6*	*110.8*	*108.6*

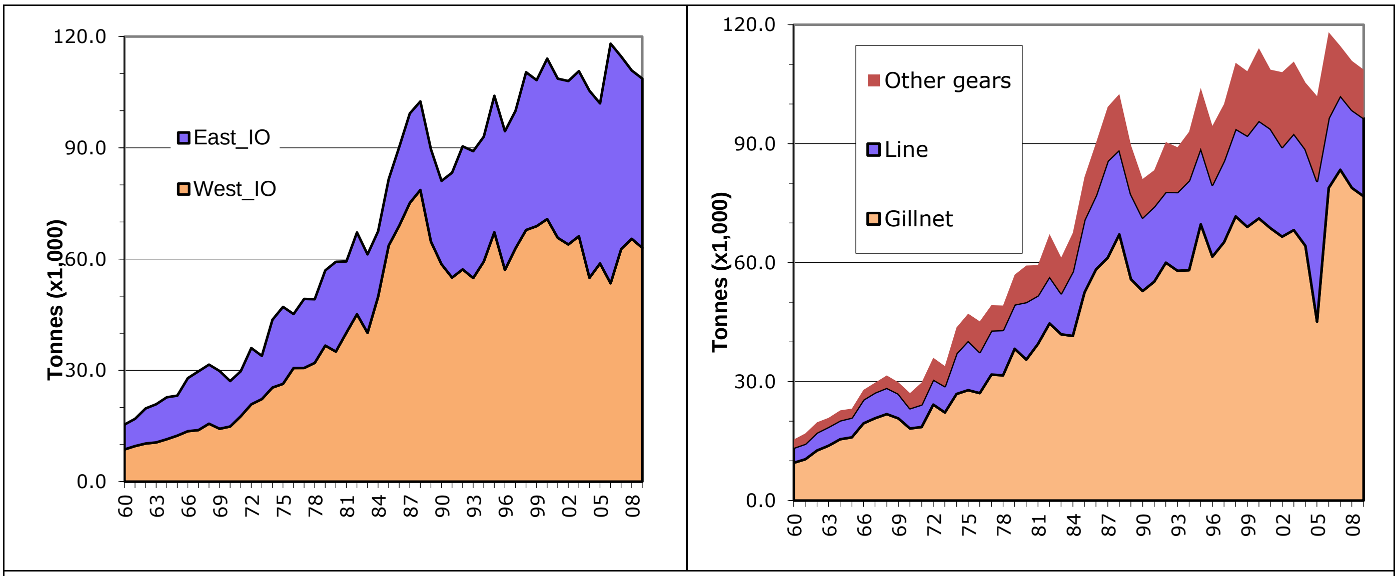

Figure 1. Narrow-barred Spanish mackerel: (a) annual catches from 1960 to 2009 by (on the left) area *i.e.* Eastern and Western Indian Ocean and (on the right) gear. Data as of November 2010

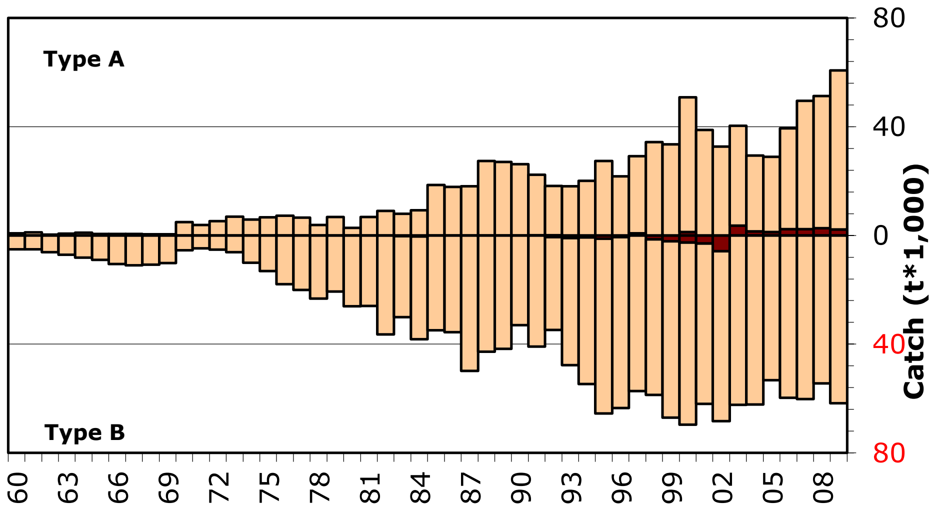

Figure 2. Narrow-barred Spanish mackerel: uncertainty of annual catch estimates. The amount of the catch below the zero-line has been categorised as uncertain according to the criteria given in the text.

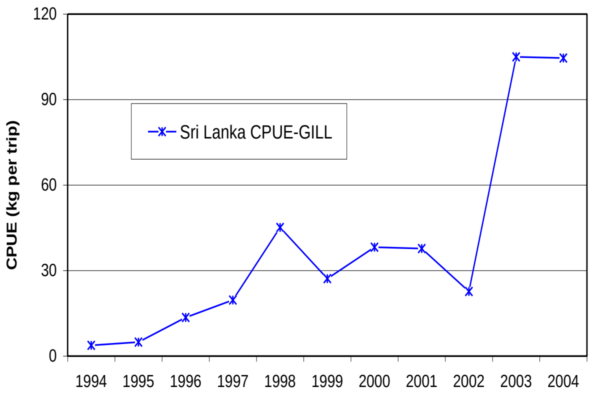

Figure 3. Narrow-barred Spanish mackerel: Nominal CPUE series for the gillnet fishery of Sri Lanka derived from the available catches and effort data (1994-2004)

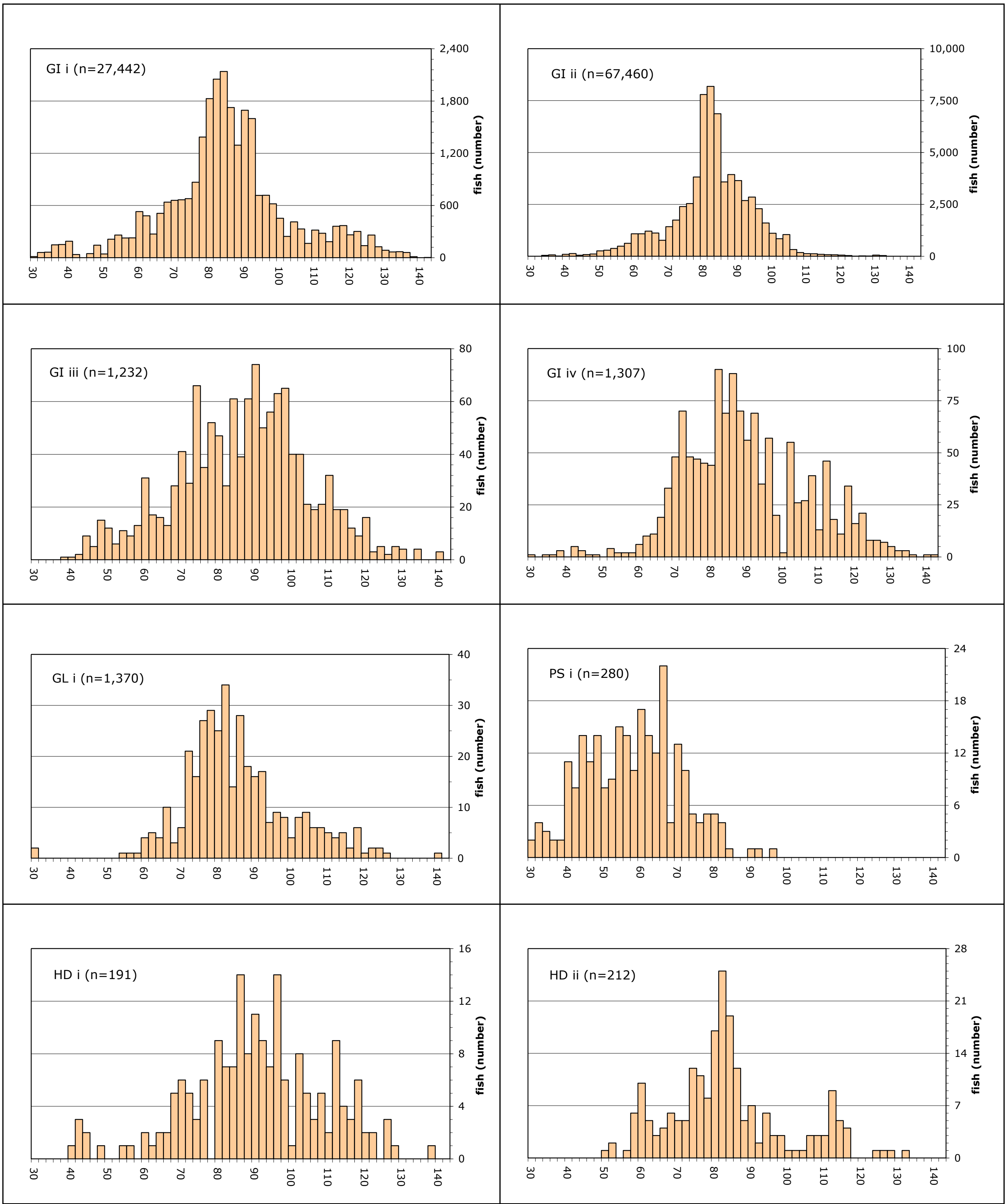

Figure 4: Narrow-barred Spanish mackerel: Length frequency distributions (total amount of fish measured by 2cm length class by decade) derived from the data available at the IOTC Secretariat for selected fisheries and periods.
GI: Gillnet fisheries: i. Sri Lanka 1980-89, ii. Sri Lanka 1990-99, iii. Pakistan 1990-99, iv. Sri Lanka 2000-06
GL: Gillnet and longline combination: i. Sri Lanka 2000-06
PS: Coastal purse seine fisheries: i. Thailand 2000-06
HD: Hand line fisheries: i. Sri Lanka 1990-99, ii. Sri Lanka 2000-06

EXECUTIVE SUMMARIES ON SHARKS

EXECUTIVE SUMMARY OF THE STATUS OF BLUE SHARKS

(as adopted by the IOTC Scientific Committee in December 2010)

FAO code: **BSH**

International Union for Conservation of Nature (IUCN) Vulnerability and conservation status in the Western Indian Ocean (WIO) and the Easter Indian Ocean (EIO)

Species	IUCN status [1, 27]		
	Global status	WIO	EIO
Prionace glauca	Near Threatened	-	-

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. 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.

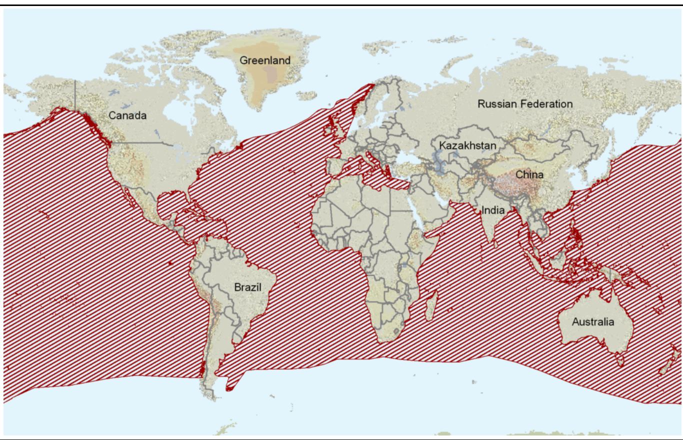

Figure 1. The worldwide distribution of the blue shark (source: www.iucnredlist.org)

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 15 year old female [20]. Longevity is estimated to be between 20-26 years of age and maximum size is around 3.8 m FL. Preliminary data for Indian Ocean shows that male may reach 25 and females 21 years old [17]. Length–weight relationship for both sexes combined in the Indian Ocean is $TW=0.159*10^{-4} * FL^{2.84554}$ [18].

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.

- Fecundity: relatively high (25-50)
- Generation time: 8.1 years
- Gestation Period: 9-12 months

Biological parameters in the Indian Ocean

Parameters	Status	Area	References
Reproduction cycle	Partially known	Equator	[13]
		SWIO	[14]
Size at first maturity	Partially known	Maldives	[15]
	Study in progress	SWIO	
Nursery ground	Partially known	South from 20°S	[16]
Growth	*Studies in progress*	SWIO	[17, 18]
Migration pattern	*Study in progress*	Ocean wide	[19]

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 occasionally in the 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 to organise shark fishing competitions where blue sharks and mako sharks are targeted. Sport fisheries for oceanic 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 fewer 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.

Table 1. Estimated frequency of occurrence [2, 3, 4, 5, 6] and by-catch mortality [7, 8, 9, 10] in the Indian Ocean pelagic fisheries.

Gears	PS	LL		BB/TROL/HAND	GILL	UNCL
		SWO	TUNA			
Frequency	rare	abundant		rare	unknown	unknown
Fishing Mortality		13 to 51 %	0 to 31%			
Post release mortality		19%				

- Finning practice: often (and increasing) [11, 12]
- Area overlap with IOTC management area: high (map to be updated)

AVAILABILITY OF INFORMATION FOR STOCK ASSESSMENT

There is little information on blue shark biology from the Indian Ocean and no information is available on stock structure.

Possible fishery indicators:

1. **Trends in catches**: The catch estimates for blue shark are highly uncertain as is their utility in terms of minimum catch estimates.
2. **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). Historical research data shows overall decline in CPUE while mean weight of blue shark in this time series are relatively stable [4]
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

Current status

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 and few basic fishery indicators currently available for blue shark in the Indian Ocean While the blue shark stocks status is highly uncertain, it is likely to be poor.

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.

Recommendations

The SC recommended that mechanisms are developed by the Commission to encourage CPCs to comply with their reporting requirement on sharks.

The SC agreed that three options should be considered for amendment of Resolution 08/04 *concerning the recording of the catch by longline fishing vessels in the IOTC area* in order to improve data collection and statistics on sharks that would allow the development of stock status indicators.

BLUE SHARK SUMMARY

Note that the catches recorded for sharks are thought incomplete. The catches of sharks are usually not reported and when they are they might not represent the total catches of this species but simply those retained on board. It is also likely that the amounts recorded refer to weights of processed specimens, not to live weights.

<table>
<tr><td></td><td></td><td>2008</td><td>2009</td></tr>
<tr><td rowspan="2">Most recent catch</td><td>Blue shark</td><td>8,101 t</td><td>9,842 t</td></tr>
<tr><td>nei-sharks</td><td>65,225 t</td><td>64,642 t</td></tr>
<tr><td rowspan="2">Mean catch over the last 5 years (2005-2009)</td><td>Blue shark</td><td colspan="2">9,466 t</td></tr>
<tr><td>nei-sharks</td><td colspan="2">66,507 t</td></tr>
</table>

Four CPCs have reported detailed data on sharks (*i.e.* Australia, EU (Spain, Portugal and United Kingdom), South Africa, and Sri-Lanka) while nine CPCs have reported partial data or data aggregated for all species (*i.e.* Belize, China, Japan, Korea, Malaysia, Oman, Seychelles, Mauritius, UK-territories).

For CPCs reporting longline data by species *(i.e.* Australia, Spain, Portugal, United Kingdom and South Africa), 74% of the catch of sharks by longliners, all targeting swordfish, were blue sharks.

EXECUTIVE SUMMARY OF THE STATUS OF SILKY SHARKS

(as adopted by the IOTC Scientific Committee in December 2010)

FAO code: **FAL**

International Union for Conservation of Nature (IUCN) Vulnerability and conservation status in the Western Indian Ocean (WIO) and the Easter Indian Ocean (EIO)

Species	IUCN status [1, 27]]		
	Global status	WIO	EIO
Carcharhinus falciformis	Near Threatened	Near Threatened	Near Threatened

BIOLOGY

The silky shark (*Carcharhinus falciformis*) is one of the most abundant large sharks inhabiting warm tropical and subtropical waters throughout the world.

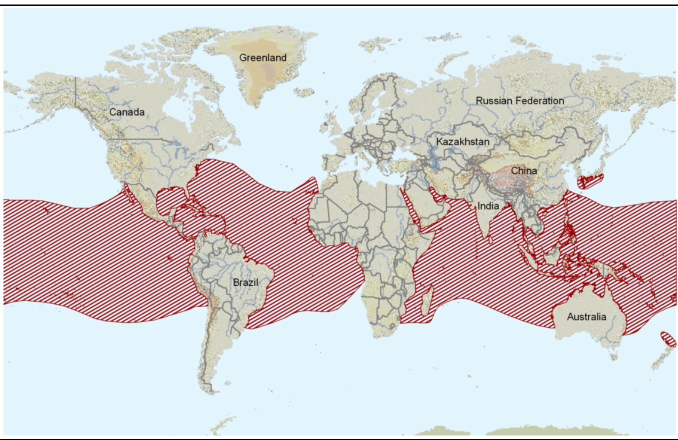

Figure 1. The worldwide distribution of the silky shark (source: www.iucnredlist.org)

Essentially pelagic, the silky shark is distributed from slopes to the open ocean. It also ranges to inshore areas and near the edges of continental shelves and over deepwater reefs. It also demonstrates strong fidelity to seamounts and natural or man-made objects (like FADs) floating at the sea surface. Silky sharks live down to 500 m but have 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, particularly under floating objects. Large silky sharks associate with free-swimming tuna schools

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 or less at birth. Generation time is estimated to be 8 years. Length–weight relationship for both sexes combined in the Indian Ocean is $TW=0.160*10^{-4} * FL^{2.91497}$ [18].

- Fecundity: medium (<20 pups)
- Generation time: 8 years
- Gestation Period: 12 months

Biological parameters in Indian Ocean

Parameters	Status	Area	References
Reproduction cycle	Study in progress	SWIO	
Size at first maturity	Partially known	Maldives	[15]
	Study in progress	SWIO	
Nursery ground	Partially known	Maldives	[15]
Growth	Unknown		
Migration pattern	Study in progress	Ocean wide	[19]

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 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.

Table 1. Estimated frequency of occurrence and by-catch mortality in the Indian Ocean pelagic fisheries [2, 3, 4, 5, 6]

Gears	PS	LL		BB/TROL/HAND	GILL	UNCL
		SWO	TUNA			
Frequency	common	abundant		common	abundant	unknown
Fishing Mortality	Study in progress	Study in progress	Study in progress			
Post release mortality	Study in progress					

- Finning practice: often [11, 12]
- Area overlap with IOTC management area: high (Fig.)

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. However, Maldivian shark fishermen report significant declines in silky shark abundance over past 20 years [25]. In addition, Indian longline research surveys, in which silky sharks contributed 7% of catch, demonstrate declining catch rates over the period 1984-2006 [26].
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

Current status

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 and few basic fishery indicators currently available for silky shark in the Indian Ocean. While the silky shark stock status is highly uncertain, it is likely to be poor.

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.

Despite the lack of data, it is clear from the information that is available that silky shark abundance has declined significantly over recent decades. Options for management should be formulated.

Recommendations

The SC recommended that mechanisms are developed by the Commission to encourage CPCs to comply with their reporting requirement on sharks.

The SC agreed that three options should be considered for amendment of Resolution 08/04 *concerning the recording of the catch by longline fishing vessels in the IOTC area* in order to improve data collection and statistics on sharks that would allow the development of stock status indicators.

SILKY SHARKS SUMMARY

Note that the catches recorded for sharks are thought incomplete. The catches of sharks are usually not reported and when they are they might not represent the total catches of this species but simply those retained on board. It is also likely that the amounts recorded refer to weights of processed specimens, not to live weights.

		2008	2009
Most recent catch	Silky shark	452 t	537 t
	nei-sharks	65,225 t	64,642 t
Mean catch over the last 5 years (2005-2009)	Silky shark	574 t	
	nei-sharks	66,507 t	

Four CPCs have reported detailed data on sharks (*i.e.* Australia, EU (Spain, Portugal and United Kingdom), South Africa, and Sri-Lanka while nine CPCs have reported partial data or data aggregated for all species (*i.e.* Belize, China, Japan, Korea, Malaysia, Oman, Seychelles, , Mauritius, UK-territories).

For CPCs reporting longline data by species (*i.e.* Australia, Spain, Portugal, United Kingdom and South Africa), 1.5% of the catch of sharks by longliners, all targeting swordfish, were silky sharks, and for CPCs reporting gillnet data by species (*i.e.* Sri Lanka), 22% of the catches of shark were silky sharks.

EXECUTIVE SUMMARY OF THE STATUS OF OCEANIC WHITETIP SHARKS

(as adopted by the IOTC Scientific Committee in December 2010)

FAO code: **OCS**

International Union for Conservation of Nature (IUCN) Vulnerability and conservation status in the Western Indian Ocean (WIO) and the Easter Indian Ocean (EIO).

Species	IUCN status [1, 27]		
	Global status	WIO	EIO
Carcharhinus longimanus	Vulnerable	-	-

BIOLOGY

The oceanic whitetip shark (*Carcharhinus longimanus*) is one of the most common large sharks in warm oceanic waters. It is typically found in the open ocean but also close to reefs and near oceanic islands.

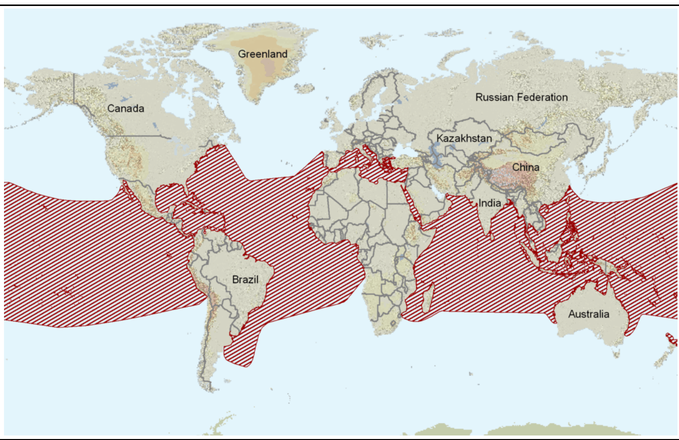

Figure 1. The worldwide distribution of the oceanic whitetip shark (source: www.iucnredlist.org)

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. Length–weight relationship for both sexes combined in the Indian Ocean is $TW=0.386*10^{-4} * FL^{2.75586}$ [18]

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.

- Fecundity: **medium** (<20 pups)
- Gestation Period: 12 months

Biological parameters in Indian Ocean

Parameters	Status	Area	References
Reproduction cycle	Study in progress	SWIO	
Size at first maturity	Study in progress	SWIO	
Nursery ground	Unknown		
Growth	Study in progress	SWIO	
Migration pattern	Trans-equatorial	SWIO	[19]

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.

Table 1. Estimated frequency of occurrence and by-catch mortality in the Indian Ocean pelagic fisheries [2, 3, 4, 5, 6, 8]

Gears	PS	LL		BB/TROL/HAND	GILL	UNCL
		SWO	TUNA			
Occurrence	common	common		common	common	unknown
Fishing Mortality	Study in progress	58%				
Post release mortality	Study in progress					

- Finning practice: often [11, 12]
- By-catch/release injury rate: unknown but probably high
- Area overlap with IOTC management area: high (Fig.)

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 oceanic whitetip shark are highly uncertain as is their utility in terms of minimum catch estimates.
2. **Nominal CPUE Trends:** data not available. Historical research data shows overall decline in CPUE and mean weight of oceanic whitetip shark [4]. Anecdotal reports suggest that oceanic white tips have become rare throughout much of the Indian Ocean during the past 20 years. Indian longline research surveys reported zero catches from the Arabia Sea during 2004-09[26].
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

Current status

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 and few basic fishery indicators currently available for oceanic whitetip shark in the Indian Ocean. While the oceanic whitetip shark stock status is highly uncertain, it is likely to be poor.

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.

Despite the lack of data, it is apparent from the information that is available that oceanic whitetip shark abundance has declined significantly over recent decades. Options for management should be considered based on research and potential mitigations measures (*e.g.* wire trace…).

Recommendations

The SC recommended that mechanisms are developed by the Commission to encourage CPCs to comply with their reporting requirement on sharks.

The SC agreed that three options should be considered for amendment of Resolution 08/04 *concerning the recording of the catch by longline fishing vessels in the IOTC area* in order to improve data collection and statistics on sharks that would allow the development of stock status indicators.

SUMMARY

Note that the catches recorded for sharks are thought incomplete. The catches of sharks are usually not reported and when they are they might not represent the total catches of this species but simply those retained on board. It is also likely that the amounts recorded refer to weights of processed specimens, not to live weights.

		2008	2009
Most recent catch	Oceanic white tip shark	180 t	245 t
	nei-sharks	65,225 t	64,642 t
Mean catch over the last 5 years (2005-2009)	Oceanic white tip shark	231 t	
	nei-sharks	66,507 t	

Four CPCs have reported detailed data on sharks (*i.e.* Australia, EU (Spain, Portugal and United Kingdom), South Africa, and Sri-Lanka while nine CPCs have reported partial data or data aggregated for all species (*i.e.* Belize, China, Japan, Korea, Malaysia, Oman, Seychelles, , Mauritius, UK-territories).

For CPCs reporting longline data by species *(i.e.* Australia, Spain, Portugal, United Kingdom and South Africa), 0.6% of the catch of sharks by longliners, all targeting swordfish, were oceanic whitetip sharks, and for CPCs reporting gillnet data by species (*i.e.* Sri Lanka), 7% of the catches of shark were oceanic whitetip sharks.

EXECUTIVE SUMMARY OF THE STATUS OF SHORTFIN MAKO SHARKS

(as adopted by the IOTC Scientific Committee in December 2010)

FAO code: **SMA**

International Union for Conservation of Nature (IUCN) Vulnerability and conservation status in the Western Indian Ocean (WIO) and the Easter Indian Ocean (EIO)

Species	IUCN status [1, 27]		
	Global status	WIO	EIO
Isurus oxyrinchus	Vulnerable	-	-

BIOLOGY

The shortfin mako shark (*Isurus oxyrinchus*) is widely distributed in tropical and temperate waters warmer than 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

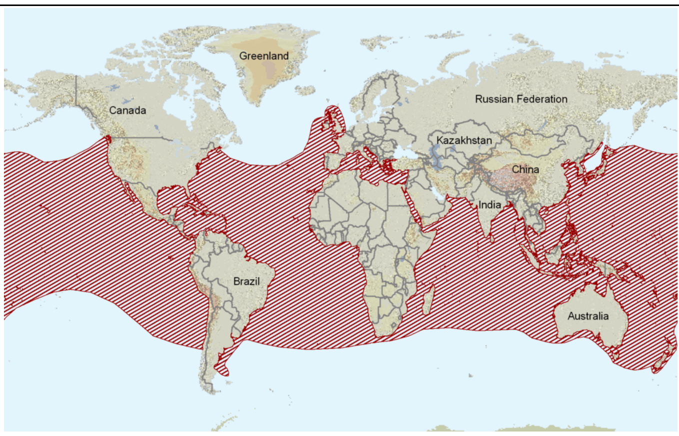

Figure 1. The worldwide distribution of the shortfin mako shark (source: www.iucnredlist.org)

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. Length–weight relationship for both sexes combined in the Indian Ocean is $TW=0.349*10^{-4} * FL^{2.76544}$ [18].

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. Size at birth is about 70 cm (TL). The length of the reproductive cycle is around three years. Generation time is estimated to be 14 years.

- Fecundity: medium (<30 pups)
- Generation time: 14 years
- Gestation Period: 15-18 months

Biological parameters in Indian Ocean

Parameters	Status	Area	References
Reproduction cycle	Partially known	off KwaZulu-Natal	[20]
Size at first maturity	Partially known	off KwaZulu-Natal	[20]
Nursery ground	Unknown		
Growth	Unknown		
Migration pattern	Study in progress	Ocean wide	[19]

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 anecdotally by the 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.

Table 1. Estimated frequency of occurrence and by-catch mortality in the Indian Ocean pelagic fisheries [2, 3, 4, 5, 6, 23]

Gears	PS	LL		BB/TROL/HAND	GILL	UNCL
		SWO	TUNA			
Occurence	rare	common		rare-common	rare-common	unknown

- Finning practice: often [11, 12]
- By-catch/release injury rate: unknown but probably high
- Area overlap with IOTC management area: high (Fig)

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. Historical research data shows overall decline in CPUE and mean weight of mako sharks [4].
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

Current status

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 and few basic fishery indicators currently available for shortfin mako shark in the Indian Ocean. While the shortfin mako stock status is highly uncertain, it is likely to be poor.

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.

Recommendations

The SC recommended that mechanisms are developed by the Commission to encourage CPCs to comply with their reporting requirement on sharks.

The SC agreed that three options should be considered for amendment of Resolution 08/04 *concerning the recording of the catch by longline fishing vessels in the IOTC area* in order to improve data collection and statistics on sharks that would allow the development of stock status indicators.

SHORTFIN MAKO SHARK SUMMARY

Note that the catches recorded for sharks are thought incomplete. The catches of sharks are usually not reported and when they are they might not represent the total catches of this species but simply those retained on board. It is also likely that the amounts recorded refer to weights of processed specimens, not to live weights.

		2008	2009
Most recent catch	Shortfin mako shark	1,113 t	1,019 t
	nei-sharks	65,225 t	64,642 t
Mean catch over the last 5 years (2005-2009)	Shortfin mako shark	1,376 t	
	nei-sharks	66,507 t	

Four CPCs have reported detailed data on sharks (*i.e.* Australia, EU (Spain, Portugal and United Kingdom), South Africa, and Sri-Lanka while nine CPCs have reported partial data or data aggregated for all species (*i.e.* Belize, China, Japan, Korea, Malaysia, Oman, Seychelles, Mauritius, UK-territories).

For CPCs reporting longline data by species *(i.e.* Australia, Spain, Portugal, United Kingdom and South Africa), 12% of the catch of sharks by longliners, all targeting swordfish, were shortfin mako sharks.

EXECUTIVE SUMMARY OF THE STATUS OF SCALLOPED HAMMERHEAD SHARKS

(as adopted by the IOTC Scientific Committee in December 2010)

FAO code: **SPL**

International Union for Conservation of Nature (IUCN) Vulnerability and conservation status in the Western Indian Ocean (WIO) and the Easter Indian Ocean (EIO)

Species	IUCN status [1, 27]		
	Global status	WIO	EIO
Sphyrna lewini	Endangered	Endangered	Least concern

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.

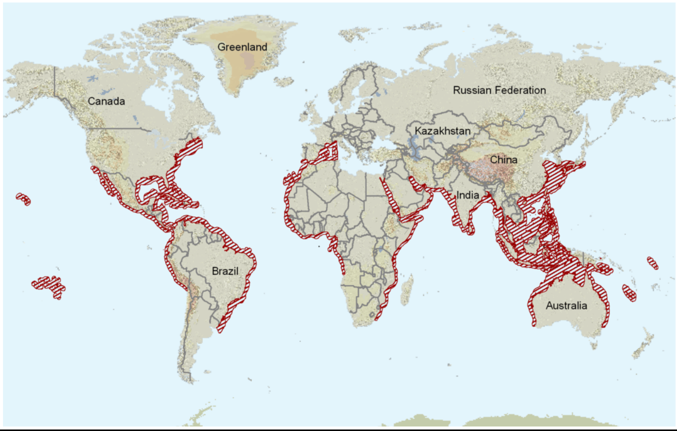

Figure 1. The worldwide distribution of the scalloped hammerhead shark (source: www.iucnredlist.org)

In some areas, the scalloped hammerhead shark forms large resident populations. In other areas, large schools of small-sized sharks are known to migrate polewards 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.

- Fecundity: **medium** (<31 pups)
- Gestation Period: 9-10 months

Biological parameters in Indian Ocean

Parameters	Status	Area	References
Reproduction cycle	Unknown		
Size at first maturity	Partially known	east coast of southern Africa	[20]
Nursery ground	Unknown		
Growth	Unknown		
Migration pattern	Unknown		

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.

Table 1. Estimated frequency of occurrence and by-catch mortality in the Indian Ocean pelagic fisheries [2, 3, 4, 23]

Gears	PS	LL		BB/TROL/HAND	GILL	UNCL
		SWO	TUNA			
Occurrence	rare	common		absent	common	unknown

- Finning practice: very often [11, 12, 22]
- By-catch/release injury rate: unknown but probably high
- Area overlap with IOTC management area: high (map to be updated)

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. However, Indian longline research surveys, in which scalloped hammerhead sharks contributed up to 6% of regional catch, demonstrate declining catch rates over the period 1984-2006 [26].
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

Current status

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 and few basic fishery indicators currently available for scalloped hammerhead shark in the Indian Ocean. While the scalloped hammerhead shark stock status is highly uncertain, it is likely to be poor.

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.

Recommendations

The SC recommended that mechanisms are developed by the Commission to encourage CPCs to comply with their reporting requirement on sharks.

The SC agreed that three options should be considered for amendment of Resolution 08/04 *concerning the recording of the catch by longline fishing vessels in the IOTC area* in order to improve data collection and statistics on sharks that would allow the development of stock status indicators.

SCALLOPED HAMMERHEAD SHARK SUMMARY

Note that the catches recorded for sharks are thought incomplete. The catches of sharks are usually not reported and when they are they might not represent the total catches of this species but simply those retained on board. It is also likely that the amounts recorded refer to weights of processed specimens, not to live weights.

		2008	2009
Most recent catch	Scalloped hammerhead shark	13 t	11 t
	nei-sharks	65,225 t	64,642 t
Mean catch over the last 5 years (2005-2009)	Scalloped hammerhead shark	11 t	
	nei-sharks	66,507 t	

Four CPCs have reported detailed data on sharks (*i.e.* Australia, EU (Spain, Portugal and United Kingdom), South Africa, and Sri-Lanka while nine CPCs have reported partial data or data aggregated for all species (*i.e.* Belize, China, Japan, Korea, Malaysia, Oman, Seychelles, Mauritius, UK-territories).

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EXECUTIVE SUMMARY OF THE STATUS OF MARINE TURTLES IN THE INDIAN OCEAN

(as adopted by the IOTC Scientific Committee in December 2010)

OVERVIEW OF THE MARINE TURTLE SPECIES IN THE INDIAN OCEAN

Six species of marine turtles 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 marine turtles, growing up to one meter long and weighing 130-160 kg. Adult green turtles are unique among marine 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. Adults 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 offshore, where they are believed to caught up in major oceanic current systems and 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 South East 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.

During the 19th and 20th centuries intense exploitation of green turtles provided onboard red meat for sustained cruises of sailing vessels before the time of refrigeration, as well as meat and calipee (*i.e.* yellow glutinous/cartilage part of the turtle found next to the lower shell) for an international market. Several nesting populations in the Indian Ocean were devastated as a result.

Hawksbill turtle

The hawksbill turtle (*Eretmochelys imbricata*) is small to medium-sized compared to other marine 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. Their narrow, pointed beaks allow them to prey selectively on soft-bodied animals like sponges and soft corals

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 generally shorter 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 at several beaches in the Indian Ocean, have resulted in population recovery. Hawksbills – although generally not found in large concentrations, are widely distributed in the Indian Ocean. The largest nesting populations of hawksbills in or around the Indian Ocean (which are among the largest in the world) occur in the Seychelles, Indonesia and Australia.

The keratinous (horn-like) scutes of the hawksbill are known as “tortoise shell,” and they were sought after for manufacture of diverse articles in both the Orient and Europe. From before the time of Christ tortoise shell was one of the most important trade commodities in a well-developed trade network in the Indian Ocean.

Leatherback turtle

The leatherback turtle (*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 turtle is the only marine turtle that lacks a hard shell: there are no large external keratinous scutes and the underlying bony shell is composed of a mosaic of hundreds of tiny bones. Adults are capable of tolerating water temperatures well below tropical and subtropical conditions, and special physiological adaptations allow them to maintain body temperature above cool water temperatures. They specialise on soft bodied invertebrates found in the water column, particularly jelly fish and other sorts of “jellies.” The leatherback turtle 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 in certain areas. The distribution and developmental habitats of juvenile leatherback turtles are poorly understood. While the leatherback turtle 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 over one meter long and weigh around 110 kg or more. It reaches sexual maturity at around 35 years of age. Loggerhead turtles are circumglobal, occurring throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans.

Loggerhead turtles 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 turtles 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 loggerhead turtles can spend decades living on the high seas, crossing from one side of an ocean basin to another before taking up residence on benthic coastal waters. Their enormous heads and powerful jaws enable them to crush large marine molluscs, on which they specialise.

Olive ridley turtle

The olive ridley turtle (*Lepidochelys olivacea*) is considered the most abundant marine turtle in the world, with an estimated 800,000 nesting females annually. Adults are relatively small, weighing on average around 45 kg. As with other species of marine turtles, their size and morphology varies from region to region.

The olive ridley turtle 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 ridley turtles 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 ridley turtles reach sexual maturity in around 15 years, a young age compared to some other marine turtle species. Many females nest every year, once or twice a season, laying clutches of approximately 100 eggs.

The olive ridley turtle 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 Orissa, India.

Gahirmatha 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 ridley turtles 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 ridley turtles 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 turtle 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 turtle 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 marine turtle species, though they do make long reproductive migrations of up to 1300 km. This restricted range means that the flatback turtle is vulnerable to habitat loss, especially breeding sites.

AVAILABILITY OF INFORMATION ON THE INTERACTIONS BETWEEN MARINE 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 marine turtle interactions. The IOSEA database covers information from a wider range of fisheries and gears than IOTC does.

The IOSEA Online Reporting Facility[19] compiles information through IOSEA National Reports on potential marine 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 marine 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, Taiwan,China , 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 using onboard observers to better understand the nature and extent of the interactions between fisheries for tuna and tuna-like species in the Indian Ocean and marine turtles.

IOTC members have implemented a number of national observer programmes that are providing information on the levels of marine 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.

CPCs are also required, through Resolution 09/06, to collect (through logbooks and observer programs) and report all interactions with marine turtles to the Scientific Committee (see below). Furthermore, Resolution 10/04 *on an Regional Observer Scheme* requires data on marine turtle interactions to be recorded by observers and reported to the IOTC within 90 days. The requirement under Resolution 10/04 in conjunction with the reporting requirements

19 (www.ioseaturtles.org/report.php)

under Resolution 09/06, means that all CPCs should be reporting marine turtle interactions as part of their annual report to the Scientific Committee.

RESOLUTION 09/06 ON MARINE TURTLES

2. CPCs shall collect (including through logbooks and observer programs) and provide to the Scientific Committee all data on their vessels‟ interactions with marine turtles in fisheries targeting the species covered by the IOTC Agreement. CPC shall also furnish available information to the Scientific Committee on successful mitigation measures and other impacts on marine turtles in the IOTC Area, such as the deterioration of nesting sites and swallowing of marine debris.

RESOLUTION 10/04 ON A REGIONAL OBSERVER SCHEME

10. Observers shall:

b) Observe and estimate catches as far as possible with a view to identifying catch composition and monitoring discards, by-catches and size frequency;

Limited data on marine turtle bycatch in IOTC longline and purse seine fisheries have been reported to the IOTC with 2 of the 32 CPCs (28 Members and 4 Cooperating non-Contracting Parties) reporting marine turtle interactions to date (Table 7). However, data from other sources and in other regions are showing that threats to marine turtles can be ranked, high to low, as gillnet, longline and purse-seine fisheries.

Table 7. Members and Cooperating non-Contracting Parties reporting of marine turtle interactions for 2009 to the IOTC (updated December 2010)

CPC's reporting marine turtle interactions	CPC's not reporting marine turtle interactions
Australia	Belize
South Africa*	Comoros
	European Union**
	Eritrea
	France
	Guinea
	India
	Indonesia
	Iran, Islamic Republic of
	Japan
	Kenya
	Korea, Republic of
	Madagascar
	Malaysia
	Mauritius
	Oman, Sultanate of
	Pakistan
	Philippines
	Seychelles
	Sierra Leone
	Sri Lanka
	Sudan
	Taiwan,China
	Tanzania
	Thailand
	Vanuatu
	Maldives*
	Senegal*
	Uruguay*

*Cooperating non-Contracting Party

**Observer data was reported for the French purse-seine fleet for 2009 as well as for the La Réunion longline fleet. Moreover, the observer programme on-board the EU Purse-seine fleet has been discontinued because of piracy activities.

Purse seine

European Union observers (covering on average 5 % of the operations annually) reported 74 marine turtles were caught by French and Spanish purse seiners over the period 2003 to 2007[20]. The most common bycatch species reported are olive ridley, green and hawksbill turtles, and these were mostly caught on log sets and returned to the sea alive (although there is no systematic information on survivorship after release).Mortality levels of marine turtles due to entanglement in the drifting FADs set by the fishery are still unknown and need to be assessed. The EU purse-seine fleet is making progress towards the conversion to ecological FADs. France is already deploying FADs that eliminate the possibility of turtles to be entangled in both the Atlantic and Indian Oceans, while Spain will conducts experiments in the Atlantic Ocean on several ecological FADs design before recommending and deploying a particular one.

Long line

While information on most of the major longline fleets in the IOTC is currently not available, in the South African longline fisheries the marine turtle bycatch mainly comprises leatherback turtles, with lesser amounts of loggerhead, hawksbill and green turtles[21]. Estimated average catch rates of marine 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 former *Soviet Union Indian Ocean Tuna Longline Research Programme* undertaken in the western Indian Ocean from 1964 to 1988 reported catching 2 marine turtles from a total of 1346 sets (around 660,00 hooks)[22]. However, it is not known if there was systematic recording of marine turtle captures.

Over the period 1997 to 2000, the Programme Palangre Réunionnais[23] examined marine 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 and 25 unidentified marine turtles. This equated to an average catch rate of less than 0.02 marine turtles per 1000 hooks over the 4 years.

Four longline vessels of the Fishery Survey of India (FSI) carried out survey in the whole Indian EEZ between 2005-2009. During this period around 800 000 hooks were deployed in the Arabian Sea, in the Bay of Bengal and in the waters of Andaman and Nicobar. In total 87 marine turtles (79 olive ridley, 4 green and 2 hawksbill turtles) were caught. Catch rates were of 0.302 turtles per 1000 hooks in the Bay of Bengal area, 0.068 turtles per 1000 hooks in the Arabian sea and 0.008 turtles per 1000 hooks in the Andaman and Nicobar waters. The highest occurrence of incidental catches in the Bay of Bengal area is probably due to the large abundance of olive ridleys whose main nesting ground in the Indian Ocean is on the east coast of India, in the Orissa region.

Nonetheless, information on longline interactions with marine turtles in the Indian Ocean is at a very preliminary stage, and it is not known if this fishing activity represents a serious threat to marine turtles, as is the case in most other fisheries regions of the world.

Gillnets

Due to the nature of this gear, incidental catch of marine turtles in gillnets is thought to be relatively high compared to that of purse-seine and longline fisheries, however, quantified data for this gear type are almost non-existent.. While the IOTC currently has virtually no information on marine turtle-"gillnet" interactions, the IOSEA database indicates that the coastal mesh net fisheries occur in about 90% of IOSEA Signatory States in the Indian Ocean, and the fishery is considered to have moderate to relatively high impact on marine turtles in about half of these

[20] IOTC-2008-WPEB-08
[21] IOTC-2006-WPBy-15
[22] IOTC-2008-WPEB-10
[23] 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

IOSEA member States. Given the widespread abundance of mesh net fisheries in the Indian Ocean, there is clearly an urgent need for careful, systematic information on this fishery and its impacts on marine turtles.

IOTC'S APPROACH TO ENHANCE THE CONSERVATION OF MARINE TURTLES

The IOTC is strengthening its collaboration with IOSEA, one of the results being the production of this executive summary. With 32 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 adopted the Resolution 09/06 to mitigate the impact of fishing operations on sea turtles:

A. In general

i. CPCs shall implement as appropriate the FAO Guidelines.

ii. CPCs shall collect all data on their vessels' interaction s with marine turtles in fisheries targeting the species covered by the IOTC Agreement

iii. CPC shall also furnish available information to the Scientific Committee on successful mitigation measures and other impacts on marine turtles in the IOTC Area, such as the deterioration of nesting sites and swallowing of marine debris.

iv. CPCs shall require fishermen on vessels targeting species covered by the IOTC Agreement to bring aboard, if practicable, any captured hard shelled turtle that is comatose or inactive as soon as possible and foster its recovery, including aiding in its resuscitation, before safely returning it to the water. CPCs shall ensure that fishermen are aware of and use proper mitigation and handling techniques and keep on board all necessary equipment for the release of turtles, in accordance with guidelines to be adopted by the IOTC.

v. CPCs shall undertake research trials of circle hooks, use of whole finfish for bait, alternative FAD designs, alternative handling techniques, gillnet design and fishing practices and other mitigation methods which may improve the mitigation of adverse effects on turtles, and report the results of these trials to the Scientific Committee (SC), at least (60 days) in advance of the annual meetings of the SC.

B. For purse seine fisheries

i. Ensure that operators of such vessels, while fishing in the IOTC Area:

a) To the extent practicable, avoid encirclement of marine turtles, and if a marine turtle is encircled or entangled, take practicable measures to safely release the turtle.

b) To the extent practicable, release all marine turtles observed entangled in fish aggregating devices (FADs) or other fishing gear.

c) If a marine turtle is entangled in the net, stop net roll as soon as the turtle comes out of the water; disentangle the turtle without injuring it before resuming the net roll; and to the extent practicable, assist the recovery of the turtle before returning it to the water.

d) Carry and employ dip nets, when appropriate, to handle turtles.

ii. Encourage such vessel to adopt FAD designs which reduce the incidence of entanglement of turtles;

iii. Require that operators of such vessels record all incidents involving marine turtles during fishing operations in their logbooks24 and report such incidents to the appropriate authorities of the CPC;

iv. Provide the results of the reporting under paragraph 7(c) to the Commission as part of the reporting requirement of paragraph 2.

[24] This information should include, where possible, details on species, location of capture, conditions, actions taken on board and location of release

C. For longline fisheries

i. Ensure that the operators of all longline vessels carry line cutters and de-hookers in order to facilitate the appropriate handling and prompt release of marine turtles caught or entangled, and that they do so in accordance with IOTC Guidelines to be developed. CPCs shall also ensure that operators of such vessels are required to carry and use, where appropriate, dip-nets, in accordance with guidelines to be adopted by the IOTC;

ii. Encourage the use of whole finfish bait where appropriate;

iii. Require that operators of such vessels record all incidents involving marine turtles during fishing operations in their logbooks[25] and report such incidents to the appropriate authorities of the CPC;

iv. Provide the results of the reporting under paragraph 6(c) to the Commission as part of the reporting requirement of paragraph 2.

D. For gillnet fisheries

i. Require that operators of such vessels record all incidents involving marine turtles during fishing operations in their logbooks[26] and report such incidents to the appropriate authorities of the CPC;

ii. Provide the results of the reporting under paragraph 5(a) to the Commission as part of the reporting requirement of paragraph 2.

In an effort to better understand the situation regarding marine turtle interactions, 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.

The IOTC Regional Observer Scheme (ROS) started on 1st July 2010, as per Resolution 10/04, which aims to collect scientific observer data on catch and bycatch on, at least, 5% of the fishing operations of vessel over 24m and vessel under 24m fishing outside their EEZ. In addition, the IOTC Secretariat is developing some identification cards on marine turtles for the observers in collaboration with the Secretariat of the Pacific Community.

IOSEA has also been collecting information on progress made towards the completion of national plans of action for marine turtles. According to information available as at November 2008, seven Indian Ocean IOSEA Signatory States (Australia, Comoros, Kenya, Myanmar, Saudi Arabia, Seychelles, United Kingdom) already have national action plans in place while another nine (Bangladesh, Eritrea, Indonesia, Madagascar, Pakistan, South Africa, Sri Lanka, Thailand, United Republic of Tanzania) are working towards this end.

MANAGEMENT ADVICE

The SC noted that the International Union for Conservation of Nature (IUCN) has classified the olive ridley turtle as vulnerable, the green and loggerhead turtles as endangered and the hawksbill and leatherback turtles as critically endangered. It is important to point out that a number of international global environmental accords (*e.g.* CMS, CBD), as well as numerous fisheries agreements obligate States to provide protection for these species.

While the status of marine 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 marine turtles due to capture by gillnets and to a lesser extent purse seine fishing (*i.e.* entanglement on FADs) and longline is not known. Notwithstanding this, it is acknowledged that the impact on marine turtle populations from fishing for tuna and tuna-like species may increase if fishing pressure increases, or if the status of the marine turtle populations worsens due to other factors such as an increase in fishing pressure from other fisheries or anthropological or climatic impacts.

[25] This information should include, where possible, details on species, location of capture, conditions, actions taken on board and location of release
[26] This information should include, where possible, details on species, location of capture, conditions, actions taken on board and location of release

Current status

No assessment has been undertaken by the IOTC WPEB for marine turtles due to the lack of data from CPCs. However, a number of comprehensive assessments of the status of Indian Ocean marine turtles are available from other sources, among them:

- Hawksbill turtle – Marine Turtle Specialist Group 2008 IUCN Red List status assessment[27].
- Loggerhead turtle – 2009 status review under the U.S. endangered species act[28].
- Leatherback turtle - Assessment of the conservation status of the leatherback turtle in the Indian Ocean and South-East Asia (IOSEA Marine Turtle MoU, 2006)[29].

The current IUCN threat status for each of the marine turtle species reported as caught in IOTC fisheries to date is provided in Table 8:

Table 8. IUCN treat status for all marine turtle species reported as caught in fisheries within IOTC Convention area.

Species	Latin name	IUCN threat status
Flatback turtle	*Natator depressus*	Data deficient
Green turtle	*Chelonia mydas*	Endangered
Hawksbill turtle	*Eretmochelys imbricata*	Critically Endangered
Leatherback turtle	*Dermochelys coriacea*	Critically Endangered
Loggerhead turtle	*Caretta caretta*	Endangered
Olive ridley turtle	*Lepidochelys olivacea*	Vulnerable

Outlook

Resolution 09/06 *on marine turtles* includes an evaluation requirement (para.9) by the Scientific Committee in time for the 2011 meeting of the Commission (para.10). However, given the lack of reporting of marine turtle interactions by CPCs to date, such an evaluation cannot be undertaken at this stage.

Recommendations

The SC recommended that mechanisms are developed by the Commission to encourage CPCs to comply with their reporting requirement on marine turtles. The SC also recalled its recommendation from 2009 that Resolution 09/06 does apply to leatherback turtles in its entirety, and that the term 'hard-shelled' should be removed from Resolution 09/06 when the resolution is revised.

[27] http://www.iucnredlist.org/documents/attach/8005.pdf
[28] http://www.nmfs.noaa.gov/pr/pdfs/statusreviews/loggerheadturtle2009.pdf
[29] http://www.ioseaturtles.org/content.php?page=Leatherback%20Assessment

EXECUTIVE SUMMARY OF THE STATUS OF SEABIRDS

(as adopted by the IOTC Scientific Committee in December 2010)

OVERVIEW OF SEABIRD SPECIES IN THE IOTC KNOWN OR LIKELY TO BE VULNERABLE TO MORTALITY FROM FISHING OPERATIONS

Seabirds are species that derive their sustenance primarily from the ocean and which spend the bulk of their time (when not on land at breeding sites) at sea. Seabirds are characterised as being late to mature and slow to reproduce; some do not start to breed before they are ten years old. Most lay a single egg each year, with some albatross species only breeding every second year. To compensate for this, seabirds are long-lived, with natural adult mortality typically very low. These traits make any increase in human-induced adult mortality potentially damaging for population viability, as even small increases in mortality can result in population decreases.

Eight seabird families occur within the convention area of the Indian Ocean Tuna Commission, either regularly or as breeding species. They are commonly referred to as penguins, albatrosses and petrels, tropicbirds, gannets and boobies, cormorants, frigatebirds, and skuas, gulls and terns. Of these, the procellariiformes (albatrosses and petrels) are the species most susceptible to being caught as bycatch in longline fisheries (Wooller *et al.* 1992, Brothers *et al.* 1999), and therefore are most susceptible to direct interactions with IOTC fisheries.

Worldwide, 18 of the 22 species of albatross are listed by the IUCN as globally threatened, with bycatch in fisheries identified as the key threat to the majority of these species (Robertson & Gales 1998). Impacts of longline fisheries on seabird populations have been demonstrated (*e.g.* Weimerskirch & Jouventin 1987, Weimerskirch *et al.* 1997, Croxall *et al.* 1990, Tuck *et al.* 2001, Nel *et al.* 2003). In general, other IOTC gear types (including purse seine, bait boats, troll lines, and gillnets) are considered to have low incidental catch of seabirds, however data remain limited.

The southern Indian Ocean is of global importance in relation to albatross distribution: seven of the 18 species of southern hemisphere albatrosses have breeding colonies on Indian Ocean islands[30]. In addition, all but one[31] of the 18 southern hemisphere albatrosses forage in the Indian Ocean at some stage in their life cycle. The Indian Ocean is particularly important for Amsterdam albatross (*Diomedea amsterdamensis* – Critically Endangered) and Indian yellow-nosed albatross (*Thalassarche carteri* – Endangered), which are endemic to the southern Indian Ocean, white-capped albatross (*Thalassarche steadi* – endemic to New Zealand), shy albatross (*T. cauta* – endemic to Tasmania, and which forage in the area of overlap between IOTC and WCPFC), wandering albatross (*D. exulans* – 74% global breeding pairs), sooty albatross (*Phoebetria fusca* – 39% global breeding pairs), light-mantled sooty albatross (*P. palpebrata* – 32% global breeding pairs), grey-headed albatross (*T. chrysotoma* – 20% global breeding pairs) and northern and southern giant-petrel (*Macronectes halli and M. giganteus* – 26% and 30% global breeding pairs, respectively).

AVAILABILITY OF INFORMATION ON THE INTERACTIONS BETWEEN SEABIRDS AND FISHERIES FOR TUNA AND TUNA-LIKE SPECIES

Currently, there is no mandatory requirement for CPCs to report seabird interactions while fishing for tuna and tuna-like species in the IOTC area. Resolution 10/02 encourages CPCs to record and report data on seabird interactions (see below). However, if a CPC chooses not to record data on seabird interactions, as permitted under Resolution 10/02, then the requirements of Resolution 10/06 become void, as the wording of Resolution 10/06 only requires reporting of data where it is available. However, Resolution 10/04 (commenced on 1 July 2010) requires data on seabird interactions to be recorded by observers and reported to the IOTC within 90 days. The requirement under Resolution 10/04 in conjunction with the annual reporting requirements under Resolution 10/06, means that all CPCs should be reporting observed seabird interactions as part of their annual report to the Scientific Committee.

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[30] Amsterdam, black-browed, grey-headed, Indian yellow-nosed, light-mantled, sooty and wandering albatrosses

[31] Atlantic yellow-nosed albatross (*Thalassarche chlororhynchos)*

RESOLUTION 10/02 MANDATORY STATISTICAL REQUIREMENTS FOR IOTC MEMBERS AND COOPERATING NON-CONTRACTING PARTIES (CPC'S):

3. Catch and effort data:

(…)CPC's are also encouraged to record and provide data on species other than sharks and tunas taken as bycatch.

RESOLUTION 10/04 ON A REGIONAL OBSERVER SCHEME

10. Observers shall:

b) Observe and estimate catches as far as possible with a view to identifying catch composition and monitoring discards, by-catches and size frequency;

RESOLUTION 10/06 ON REDUCING THE INCIDENTAL BYCATCH OF SEABIRDS IN LONGLINE FISHERIES:

7. CPCs shall provide to the Commission, as part of their annual reports, information on how they are implementing this measure and all available information on interactions with seabirds, including bycatch by fishing vessels carrying their flag or authorised to fish by them. This is to include details of species where available to enable the Scientific Committee to annually estimate seabird mortality in all fisheries within the IOTC area of competence.

Limited data on seabird bycatch in IOTC longline fisheries have been reported to the IOTC for 2009with only 2 of the 32 CPCs (28 Members and 4 Cooperating non-Contracting Parties) reporting seabird interactions to date (Table 9).

Table 9. Members and Cooperating Non-Contracting Parties reporting of seabird interactions for 2009 to the IOTC (updated December 2010).

CPC's reporting seabirds interactions	CPC's not reporting seabirds interactions
Australia	Belize
South Africa*	Comoros
	European Union**
	Eritrea
	France
	Guinea
	India
	Indonesia
	Iran, Islamic Republic of
	Japan
	Kenya
	Korea, Republic of
	Madagascar
	Malaysia
	Mauritius
	Oman, Sultanate of
	Pakistan
	Philippines
	Seychelles
	Sierra Leone
	Sri Lanka
	Sudan
	Taiwan,China
	Tanzania
	Thailand
	Vanuatu
	Maldives*
	Senegal*
	Uruguay*

*Cooperating Non-Contracting Party

** Data was received only for the longline fishery of La Réunion

A list of the seabird species reported as caught in IOTC longline fisheries is shown in Table 10. However, not all reports identify birds to species level and, overall, information on seabird bycatch in the IOTC area remains very limited (Gauffier, 2007).

Table 10. List of seabird species recorded as caught in longline fisheries within IOTC area of competence.

Species	Latin name
Albatross	
Atlantic Yellow-nosed Albatross	*Thalassarche chlororynchos*
Black-browed albatross	*Thalassarche melanophrys*
Indian yellow-nosed albatross	*Thalassarche carteri*
Shy albatross	*Thalassarche cauta*
Sooty albatross	*Phoebetria fusca*
Tristan albatross	*Diomedea dabbenena*
Wandering albatross	*Diomedia exulans*
White-capped albatross	*Thalassarche steadi*
Petrels	
Cape/Pintado petrel	*Daption capense*
Great-winged petrel	*Pterodroma macroptera*
Grey petrel	*Procellaria cinerea*
Northern giant-petrel	*Macronectes halli*
White-chinned petrel	*Procellaria aequinoctialis*
Others	
Cape gannet	*Morus capensis*
Flesh-footed shearwater	*Puffinus carneipes*

In the absence of data from observer programs reporting seabird bycatch, risk of bycatch has been identified through analysis of the overlap between albatross and petrel distribution and IOTC longline fishing effort, based on data from the Global Procellariiform Tracking Database (ACAP 2007). The overlap between seabird distribution and IOTC longline fishing effort is shown in Table 3. A summary map indicating distribution is shown in Figure 1. The 2007 analysis of tracking data indicated that albatrosses breeding on Southern Indian Ocean islands spent 70–100% of their foraging time within areas overlapping with IOTC longline fishing effort. The analysis identified the proximity of the Critically Endangered Amsterdam albatross and Endangered Indian yellow-nosed albatross to high levels of pelagic longline effort. Wandering, shy, grey-headed and sooty albatrosses and white-chinned petrels showed a high overlap with IOTC longline effort. Data on distribution during the non-breeding season was lacking for many species, including black-browed albatrosses and white-capped albatrosses (known from bycatch data to be amongst the species most frequently caught).

In 2009 and 2010, new tracking data were presented to the Working Party on Ecosystems and Bycatch (WPEB) which filled a number of gaps from the 2007 analysis, particularly for sooty albatross, and for distributions of juveniles of wandering, sooty and Amsterdam albatrosses, white-chinned and northern giant petrels (Delord & Weimerskirch 2009, 2010). This analysis indicated substantial overlap with IOTC longline fisheries.

Due to remaining gaps in tracking and observer data, it is likely that there are other species at risk of bycatch which are not identified in Tables 2 and 3.

Table 11. Overlap between the distribution of (a) breeding and (b) non-breeding albatrosses, petrels and shearwaters and IOTC fishing effort. Distributions were derived from tracking data held in the Global Procellariiform Tracking Database. Fishing data are based on the average annual number of hooks set per 5° grid square from 2002 to 2005. Overlap is expressed as the percentage of time spent in grid squares with longline effort, and is given for each breeding site as well the species' global population where sufficient data exists. Shaded squares represent species/colonies for which no tracking data were available.

Species/Population (a) Breeding	Global Population (%)	Overlap (%)
Amsterdam albatross (Amsterdam)	100	100
Antipodean (Gibson's) albatross		
Auckland Islands	59	1
Black-browed albatross		1
Iles Kerguelen	1	88
Macquarie Island	<1	1
Heard & McDonald	<1	
Iles Crozet	<1	
Buller's Albatross		2
Solander Islands	15	1
Snares Islands	27	2
Grey-headed albatross		7
Prince Edward Islands	7	70
Iles Crozet	6	
Iles Kerguelen	7	

Indian yellow-nosed albatross		
Ile Amsterdam	70	100
Ile St. Paul	<1	
Iles Crozet	12	
Iles Kerguelen	<1	
Prince Edward Island	17	
Light-mantled albatross	39	
Shy albatross		
Tasmania	100	67
Sooty albatross		
Iles Crozet	17	87
Ile Amsterdam	3	
Ile St. Paul	<1	
Iles Kerguelen	<1	
Prince Edward Island	21	
Wandering albatross		75
Iles Crozet	26	93
Iles Kerguelen	14	96
Prince Edward Islands	34	95
Northern giant petrel	26	
Southern giant petrel	9	
White-chinned Petrel		
Iles Crozet	?	60
Iles Kerguelen	?	
Prince Edward Island	?	
Short-tailed shearwater		
Australia	?	3
Species/Population (b) Non-breeding	**Global Population (%)**	**Overlap (%)**
Amsterdam albatross (Amsterdam)	100	98
Antipodean (Gibson's) albatross		9
Antipodes Islands	41	3
Auckland Islands	59	13
Black-browed albatross		
South Georgia (GLS data)	16	3
Heard & McDonald Islands	<1	
Iles Crozet	<1	
Iles Kerguelen	1	
Buller's albatross		13
Solander Islands	15	9
Snares Islands	27	15
Grey-headed albatross		
South Georgia (GLS data)	58	16
Iles Crozet	6	
Iles Kerguelen	7	
Prince Edward Island	7	
Indian yellow-nosed albatross		
Light-mantled albatross		
Northern royal albatross		3
Chatham Islands	99	3
Taiaroa Head	1	1
Shy albatross		
Tasmania	100	72
Sooty albatross		
Southern royal albatross		
Wandering albatross		59
White-capped albatross		
Northern giant petrel		
Southern giant petrel		
White-chinned petrel		
Westland petrel		
Short-tailed shearwater		

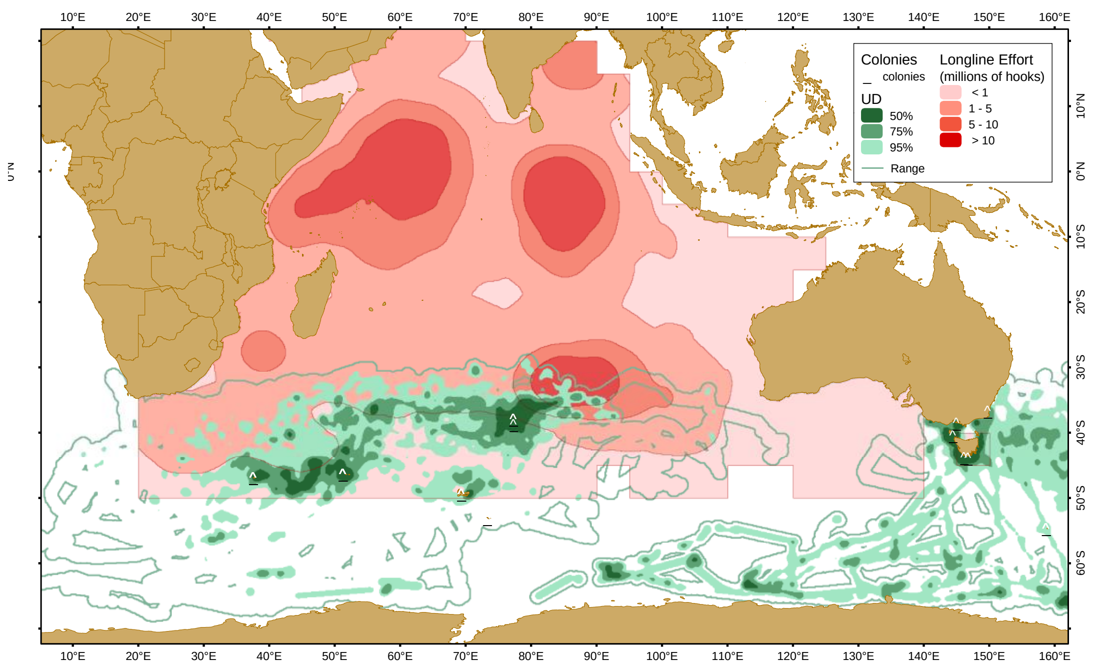

Figure 4. Distribution of breeding albatrosses, petrels and shearwaters in the Indian Ocean (see Table 3 for list of species included), and overlap with IOTC longline fishing effort for all gear types and fleets (average annual number of hooks set per 5° grid square from 2002 to 2005).

MANAGEMENT CONCERNS

Several solutions have been developed that can reduce seabird bycatch in longline fisheries. Evidence from areas where seabird bycatch was formerly high but has been reduced (*e.g.* Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) and South Africa) has shown that it is important to employ, simultaneously, a suite of mitigation measures. Research conducted in South Africa by Japanese and US researchers (Melvin *et al*. 2010) showed that bird scaring lines (BSL, also known as tori or streamer lines) displace seabird attacks on baits, but only as far astern as the BSL extends. If baits are sufficiently close to the surface behind the aerial extent of the BSL, the rate of attack by seabirds on baited hooks, and hence risk of bycatch, remains high. This research shows clearly that appropriate sink rates must be used in tandem with BSLs and that unweighted branch lines or those with small weights placed well away from the hook pose the highest risks to seabirds. The research also suggests no negative effect of line-weighting on target catches, but limited sample sizes preclude definitive analysis (Melvin *et al*. 2010). In addition, experience from CCAMLR and elsewhere has indicated a number of additional factors contribute to successful reduction of seabird bycatch (FAO 2008; Waugh et al. 2008). These include research to optimise the effectiveness of mitigation measures and their ease of implementation, the use of onboard observer programs to collect seabird bycatch data and evaluate the effectiveness of bycatch mitigation measures, training of both fishermen and observers in relation to the problem and its solutions, and ongoing review of the effectiveness of these activities. Mitigation measures recommended by ACAP (Agreement on the Conservation of Albatrosses and Petrels) as effective include weighted branch lines that ensure that baits quickly sink below the reach of diving seabirds, night setting, and appropriate deployment of well designed BSLs.

Seabird bycatch mitigation is an area of very active research. The SC suggested a revision of the current Resolution 10/06 once its impact will be fully assessed and more scientific observations will be compiled and duly analysed with appropriate technical measures.

Reduction of seabird bycatch may even bring benefits to fishing operations, for example by reducing the loss of bait to seabirds. Recent research in Brazil showed a reduction of 60% of the capture of seabirds and higher catch rates (20-30%) of target species when effective mitigation measures were applied (Mancini et al. 2009). However, more detailed economic assessments across a diversity of regions, fishing gears and seasons are required to get a fuller picture of economic benefits.

IOTC'S APPROACH TO ENHANCE THE CONSERVATION OF SEABIRDS

Since 2005, IOTC has adopted three measures to address seabird bycatch. The current measure (Resolution 10/06) requires that all longline vessels fishing south of 25°S use at least two seabird bycatch mitigation measures selected from a table, including at least one measure from Column A (Table 4). In addition, CPCs are required to provide to the Commission all available information on interactions with seabirds.

Table 12. Seabird bycatch mitigation measures in IOTC Resolution 10/06

Column A	**Column B**
Night setting with minimum deck lighting	Night setting with minimum deck lighting
Bird-scaring lines (Tori Lines)	Bird-scaring lines (Tori Lines)
Weighted branch lines	Weighted branch lines
	Blue-dyed squid bait
	Offal discharge control
	Line shooting device

Resolution 10/06 *on reducing the incidental bycatch of seabirds in longline fisheries* includes an evaluation requirement (para 8 – see below) by the Scientific Committee in time for the 2011 meeting of the Commission.

RESOLUTION 10/06 ON REDUCING THE INCIDENTAL BYCATCH OF SEABIRDS IN LONGLINE FISHERIES:

8. The Scientific Committee, based notably on the work of the WPEB and information from CPCs, will analyse the impact of this Resolution on seabird bycatch no later than for the 2011 meeting of the Commission. It shall advise the Commission on any modifications that are required, based on experience to date of the operation of the Resolution and/or further international studies or research on the issue, in order to make the Resolution more effective.

IOTC Resolution 10/04 set out procedures to establish a regional observer programme within the convention area, with a required level of coverage of at least 5% of operations/sets observed. This programme will increase data available to IOTC on bycatch, including bycatch of seabirds.

GAPS IN THE KNOWLEDGE OF FISHERY IMPACTS ON SEABIRDS

While Table 10indicates several species known to have been caught in IOTC longline fisheries and an analysis of tracking data has highlighted species likely to be at risk (Table 3), many data gaps remain and it is likely that the number of species taken as bycatch and the extent of that bycatch are significantly under-reported.

Bycatch data from onboard observer programs

Data on seabird bycatch within IOTC fisheries is generally very sparse. Reports on observer data on seabird bycatch have been submitted to WPEB by two CPCs as well as for the longline fleet of La Réunion (Table 1) for 2009. Globally it is recognized that onboard observer programs are vital for collecting data on catches of non-target species, particularly those species which are discarded at sea. More specifically, observers need to observe hooks during setting and monitor hooks during the hauling process to adequately assess seabird bycatch and evaluate the effectiveness of mitigation measures in use. Levels of observer coverage significantly in excess of 5% are likely to be needed if IOTC is to accurately monitor seabird bycatch levels in its fisheries.

Bycatch data from longline fisheries in tropical areas

Observer data from longline fisheries occurring north of 20˚S is very sparse (Gauffier 2007). While seabird bycatch rates in tropical areas are generally assumed to be low, a number of threatened seabirds forage in these northern waters. Due to their small population sizes, bycatch at significant levels could be occurring but not, or almost never being observed.

Impacts of fishing gears other than longline

The impact of purse-seine fishing on tropical seabird species, including larids (gulls, terns and skimmers) and sulids (gannets and boobies), is generally considered to be low, but data remain sparse and there are anecdotal observations which suggest that these interactions might merit closer investigation. However, no observation of incidental catch of seabird in the purse-seine fishery has been made in the Indian Ocean since the beginning of the fishery 25 years ago. The scale and impacts of gillnet fishing impacts on seabirds in the IOTC convention area is unknown. Outside the convention area, gillnet fishing has been recorded as catching high numbers of diving seabird species, including shearwaters and cormorants (*e.g.* Berkenbusch and Abraham 2007). The large coastal gillnet fisheries in the northern part of the IOTC clearly merit closer investigation, and should be considered a priority, as should the impact of lost or discarded gillnets (ghost fishing) on seabirds.

Indirect impacts of fisheries on seabirds

Many tropical seabird species forage in association with tunas, which drive prey to the surface and thereby bring them within reach of the seabirds. The depletion of tuna stocks could therefore have impacts on these dependent species. More widely, the potential 'cascade' effects of reduced shark and tuna abundances on the ecosystem is largely unknown. Although these kinds of impacts are difficult to predict, there are some examples that suggest meso-predator release has occurred in the Convention area (*e.g.* Romanov and Levesque 2009)

MANAGEMENT ADVICE

Current status

No assessment has been undertaken by the IOTC WPEB for seabirds due to the lack of data from CPCs. The current IUCN threat status for each of the seabird species reported as caught in IOTC longline fisheries to date is provided in Table 5:

Table 5. IUCN treat status for all seabird species reported as caught in longline fisheries within IOTC area of competence.

Species	Latin name	IUCN threat status
Albatross		
Atlantic Yellow-nosed Albatross	*Thalassarche chlororynchos*	Endangered
Black-browed albatross	*Thalassarche melanophrys*	Endangered
Indian yellow-nosed albatross	*Thalassarche carteri*	Endangered
Shy albatross	*Thalassarche cauta*	Near Threatened
Sooty albatross	*Phoebetria fusca*	Endangered
Tristan albatross	*Diomedea dabbenena*	Critically Endangered
Wandering albatross	*Diomedia exulans*	Vulnerable
White-capped albatross	*Thalassarche steadi*	Near Threatened
Petrels		
Cape/Pintado petrel	*Daption capense*	Least Concern
Great-winged petrel	*Pterodroma macroptera*	Least Concern
Grey petrel	*Procellaria cinerea*	Near Threatened
Northern giant-petrel	*Macronectes halli*	Least Concern
White-chinned petrel	*Procellaria aequinoctialis*	Vulnerable
Others		
Cape gannet	*Morus capensis*	Vulnerable
Flesh-footed shearwater	*Puffinus carneipes*	Least Concern

Outlook

Resolution 10/06 *on reducing the incidental bycatch of seabirds in longline fisheries* includes an evaluation requirement (para 8) by the Scientific Committee in time for the 2011 meeting of the Commission. However, given the lack of reporting of seabird interactions by CPCs to date, such an evaluation cannot be undertaken at this stage.

Recommendations

The SC recommended that mechanisms are developed by the Commission to encourage CPCs to comply with their reporting requirement on seabirds.

The SC recommended that a major revision of the Resolution 10/06 on reducing the incidental bycatch of seabirds in longline fisheries should be considered, in the near future, once its impact is examined. Such revision may include the removal of the use of line shooters and offal management from the list of seabird mitigation measures.

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APPENDIX VIII
STATUS OF THE DEVELOPMENT OF NPOA-SHARKS AND NPOA-SEABIRDS IN CPCS

		NPOA-Sharks PAN-Requins	Date	NPOA-Seabirds PAN-Oiseaux de mer	Date	Comments / Commentaires
MEMBERS / MEMBRES						
Australia	**Australie**	**Yes /Oui**	**16/04/2004**	**Yes / Oui**	**2006**	Sharks : review released in 2010 and 2nd NPOA-sharks to be released in 2011. / Requins: revue realise en 2010 et 2ième PLAN prévu pour 2011. Seabirds: Threat Abatement Plan – Review in 2011. / Oiseaux de mer: Plan de Réduction des Menaces – Revue en 2011.
Belize	**Belize**					
China	**Chine**	**No / Non**		**No / Non**		
Taiwan,China	**Taiwan,Chine**	**Yes / Oui**	**2004**	**Yes / Oui**	**2007**	
Comoros	**Comores**	**No / Non**		**No/ Non**		
Eritrea	**Erythrée**					
European Union	**Union Européenne**	Drafted / Rédigé				Approved on 05/02/2009 but not implemented yet / Approuvé le 05/02/2009 mais pas encore mise en œuvre.
France (territories)	**France (territoire)**	Idem EU / UE				
Guinea	**Guinée**					
India	**Inde**	Being drafted/ En préparation				Assistance from BOBP-IGO / Support du projet BOBP-IGO
Indonesia	**Indonésie**	Drafted / Rédigé				
Iran, IR	**Iran, RI**					
Japan	**Japon**	**Yes / Oui**	**03/12/2010**	**Yes / Oui**	**03/12/2010**	Implementation report will be submitted in February or March 2011 / Un rapport d'activités sera soumis en février ou mars 2011
Kenya	**Kenya**	No / Non		No / Non		
Korea, R	**Corée, R**	Drafted / Rédigé		Drafted / Rédigé		Implementation in 2011 / Mise en œuvre en 2011.
Madagascar	**Madagascar**	**No / Non**		**No / Non**		Fisheries Monitoring system in place in order to ensure compliance of vessel with rules and convention for the protection of seabirds and sharks / Surveillance active des pêches pour faire respecter les différentes conventions sur les requins et les oiseaux marins.
Malaysia	**Malaisie**	**Yes / Oui**	**2006**			
Mauritius	**Maurice**	Being drafted / En préparation		**No / Non**		
Oman, Sult.	**Oman, Sult.**					

Pakistan	**Pakistan**					
Seychelles	**Seychelles**	Yes / Oui	2007	No / Non		NPOA-sharks to be reviewed in 2011 / PAN-requins doit être révisé en 2011
Sierra Leone	**Sierra Leone**					
Sri Lanka	**Sri Lanka**					
Sudan	**Soudan**					
Tanzania	**Tanzanie**	No / Non		No / Non		
Thailand	**Thaïlande**	Yes / Oui		No / Non		NPOA-sharks implemented since 23/11/2005 / PAN-requins mise en œuvre depuis le 23/11/2005.
United Kingdom	**Royaume Uni**	No / Non		No / Non		Before 2010, terms and conditions related to sharks in the license to foreign vessels. No more relevant today as Chagos is an MPA / Avant 2010, termes et conditions concernant les requins inclus dans la licence de pêche accordée aux bateaux étrangers. N'est plus nécessaire maintenant que les Chagos sont une AMP.
Vanuatu	**Vanuatu**					
COOPERATING NON-CONTRACTING PARTIES / PARTIES COOPERANTE NON-CONTRACTANTES						
Maldives	**Maldives**	Drafted / Rédigé		No / Non		Shark fishing banned in Maldives since 2010. NPOA to be discussed with stakeholders in 2011 / Pêche aux requins prohibée depuis mars 2010. Le PAN-requins sera sera discuté par les acteurs de la filière en 2011
Senegal	**Sénégal**					
South Africa	**Afrique du Sud**	Being drafted / En préparation		Yes	2008	
Uruguay	**Uruguay**	Yes / Oui	2008			

APPENDIX IX
PROGRESS ON RECOMMENDATIONS FROM THE 5 T-RFMO JOINT WORKSHOPS AND FROM THE IOTC PERFORMANCE REVIEW PANEL

RECOMMENDATIONS	PROGRESS
WORKSHOP ON THE PROVISION OF SCIENTIFIC ADVICE	
Routine data collected by year: catch, effort and size data	
1. All members of Tuna-RFMOs are called upon to give a top priority to the provision of data of good quality in a timely manner, according to the existing mandatory data requirements of tuna RFMOs, in order to facilitate the work of tuna RFMOs scientific bodies in the provision of scientific advice based on the most recent information.	*Priority given as shown by the adoption of mandatory data requirements, the monitoring of data reporting by various subsidiary bodies, including the Compliance Committee, the re-establishment of a WP on data collection and the emphasis of the Secretariat activities in support of data collection.*
2. Lags in the submission of fishery data should be reduced making a full use of communication technologies (*e.g.* web based) and efforts should be undertaken that basic data formats are harmonized.	*IOTC has adopted standard forms for PS, LL and now BB and GN fisheries. Secretariat works with members to standardize and facilitate data reporting.*
3. Efforts should be undertaken so that basic data used in stock assessment (catch, effort and sizes by flag and time/area strata) provided by members should be made available via the websites of tuna RFMOs or by other means.	*Basic catch data, and SF data available at website. CE also available, but not detailed at a level that would allow members to replicate CPUE analyses.*
4. Fine scale operational data should be made available in a timely manner to support stock assessment work, and confidentiality concerns should be addressed through RFMOs rules and procedures for access protection and security of data.	*Some fleets have made available operational data, but no direct access to the data to date, even under IOTC confidentiality provisions.*
5. Tuna RFMOs should ensure adequate sampling for catch, effort and size composition across all fleets and especially distant water longliners for which this information is becoming limited.	*Size-frequency sampling effort is inadequate for some distant water longline fleets.*
6. Tuna RFMOs should cooperate to improve the quality of data, in particular for methods to estimate: (1) species and size composition of tunas caught by purse seiners and by artisanal fisheries and (2) catch and size of farmed tunas	*There have been recent meetings on methodological issues concerning point 1, incorporating scientists from the IOTC and other RFMOs. Point is not applicable here.*
7. Tuna RFMOs should use alternative sources of data, notably observer and cannery data, to both validate the information routinely reported by Parties and estimate catches from non-reporting fleets.	*IOTC has received data from cannery sources (through ISSF). A Regional Observer Scheme started on July 1st 2010, mandatory for IOTC members, with the objective to obtain data to improve catch estimates of all fleets*
Biological data	
8. Regular large scale tagging programs should be developed, along with appropriate reporting systems, to estimate natural mortality growth and movement patterns by sex, and other fundamental parameters for stock assessments.	*IOTC completed recently the Indian Ocean Tuna Tagging Programme (IOTTP), a combination of large-scale and small-scale tagging projects around the IO, targeting tropical tunas. The combined number of releases reached close to 200,000 fish, with about 20% recovery rate.*
9. Archival tagging should be an ongoing activity of tagging programs as it provides additional insights into tuna behaviour and vulnerability.	*Some archival tagging was conducted in the context of the IOTTP*
10. Spatial aspects of assessment should be encouraged within all tuna RFMOs in order to substantiate spatial management measures.	*Stock assessment techniques used for the major stocks incorporate spatial structure. Separate analyses have been conducted to assess potential benefits of spatial management measures (time-area closures)*
11. The use of high-resolution spatial ecosystem modelling frameworks should be encouraged in all tuna RFMOs since they offer the opportunity to better integrate	*Not yet fully developed in the IOTC context.*

biological features of tuna stocks and their environment.	
Stock assessment	
12. Tuna RFMOs should promote peer reviews of their stock assessment works.	*No formal peer-review process has been implemented. Invited experts attend meetings of the Working Parties providing an independent source of expertise.*
13. Tuna RFMOs should use more than one stock assessment model and avoid the use of assumption-rich models in data-poor situations.	*For the major stocks, IOTC scientists have been utilizing several stock assessment models, and the results are contrasted to better understand the situation of the stock. For*
14. Chairs of Scientific Committees should jointly develop checklists and minimum standards for stock assessments.	*IOTC SC has adopted guidelines for the presentation of SA results, including the provision to archive all input, output and executable files with the Secretariat. Joint work with Chairs from other SCs to be developed.*
Communications by tuna RFMOs	
15. Standardized executive summaries should be developed for consideration by all tuna RFMOs to summarize stock status and management recommendations. These summaries should be discussed and proposed by the chairs of the Scientific Committees at Kobe III.	*IOTC has had standardized species executive summaries for several years. Joint work with Chairs from other SCs to be developed.*
16. The application of the Kobe II strategy matrix should be expanded and applied primarily to stocks for which sufficient information is available	*The application of the Kobe-II strategy matrix is progressing, by the WPB and WPTT on two stocks in 2010.*
17. Tuna RFMOs should develop mechanisms to deliver timely and adequate information on their scientific outcomes to the public	*Report of the SC, including executive summaries and stock status summary table are public domain. Development of factsheets, oriented to a more general audience, being considered.*
18. All documents, data and assumptions related to past assessments undertaken by tuna RFMOs should be made available in order to allow evaluation by any interested stakeholder	*All data (input and output) as well as the computer programmes actually utilized are archived with the Secretariat, and available to interested parties.*
Enhanced cooperation between RFMOs	
19. Chairs of Scientific Committees should establish an annotated list of common issues that could be addressed jointly by tuna RFMOs and prioritize them for discussion at the Kobe III meeting	*Joint work with Chairs from other SCs to be developed.*
20. Tuna RFMOs should actively cooperate with programs integrating ecosystem and socio-economic approaches such as CLIOTOP to support the conservation of multi-species resources	*To be developed*
Capacity building	
21. Where determined by a Tuna RFMO, a review of the effectiveness of capacity-building assistance already provided should be undertaken. Reviews of tuna scientific management capacity in developing countries, within the framework of the respective RFMO may also be conducted at their request	*Secretariat has begun participating in capacity building on management only very recently, with a goal in facilitating a better participation of members. Capacity building on data collection since 2002, and reviews of this available. Effectiveness of bilateral arrangements between members is not routinely assessed or reported.*
22. Developed countries should strengthen in a sustained manner their financial and technical support for capacity-building in developing countries, notably small island developing States, on the basis of adequate institutional arrangements in those countries and making full use of local, sub-regional and regional synergies	*IOTC developed member states contribute to initiatives that strengthen the ability of developing states to discharge their duties. For example, IOTC-OFCF Project, RTTP, Regional Fisheries Strategy under 10th EDF.*
23. Tuna RFMOs should have assistance funds that cover various forms of capacity-building (*e.g.* training of technicians and scientists, scholarships and fellowships, attendance to meetings, institutional building, and development of fisheries).	*Resolution 10/05 provides for a funding mechanism to facilitate scientists and representatives from IOTC Members and Cooperating non-Contracting Parties (CPCs) who are developing States to attend and/or contribute to the work of the Commission, the*

	Scientific Committee and its Working Parties. Assistance funds directly for capacity building have been limited to the IOTC-OFCF project since 2002. IOTC cooperates with other initiatives in the region such as SWIOFP, or COI.
24. Tuna RFMOs, if necessary, should ensure regular training of technicians for collecting and processing of data for developing states, notably those where tuna is landed	*Again, implemented mostly through IOTC-OFCF Project.*
25. The structural weaknesses in the receiving mechanism for capacity building within a country should be improved by working closely with Tuna RFMOs	*This is the implementation model of the IOTC-OFCF Project.*
WORKSHOP ON BYCATCH	
Improving assessments of bycatch within tuna RFMOs	
1. RFMOs should assess the impact of fisheries for tuna, tuna like and other species covered by the conventions on bycatch by taxon using the best available data.	*Impact on seabird bycatch relatively well assessed. Impact on other bycatch taxa poorly known (due largely to lack of data), but in the case of sharks believed to be high.*
2. RFMOs should consider adopting standards for bycatch data collection which, at a minimum, allows the data to contribute to the assessment of bycatch species population status and evaluation of the effectiveness of bycatch measures. The data should allow the RFMOs to assess the level of interaction of the fisheries with bycatch species.	*Minimum data requirements under the Regional Observer Scheme have been agreed by all members. It is too early to assess the effectiveness of these actions.*
3. Encourage the participation of appropriate scientists in relevant T-RFMO working groups to conduct and evaluate bycatch assessments and proposed mitigation strategies;	*IOTC has invited repeatedly relevant experts to the meetings of the WPEB. Preliminary estimates of bycatch have been conducted for some fleets on the basis of data from national observer programmes. Mitigation strategies relatively well developed for seabirds caught in longline fisheries; less well developed, or non-existent, for other taxa and fisheries.*
4. Implement/enhance observer and port sampling programs with sufficient coverage to quantify/estimate bycatch and require timely reporting to inform mitigation needs and support conservation and management objectives, addressing practical and financial constraints	*The Regional Observer Scheme (Resolution 10/04), in place since July 2010, aims at addressing this issue with national observers and field samplers required to collect scientific information about catches of all species, including bycatch species.*
Improving ways to mitigate/reduce bycatch within tuna RFMOs	
5. RFMO measures should reflect adopted international agreements, tools and guidelines to reduce bycatch, including the relevant provisions of the FAO Code of Conduct, the IPOAs for Seabirds and Sharks, the FAO guidelines on sea turtles, the best practice guidelines for IPOAS for seabirds, and the precautionary approach and ecosystem approaches.	*Mitigation of seabird bycatch is relatively well addressed, although there remains scope for further improvement. Mitigation of turtle bycatch in drifting FADs deployed by the purse seine fishery is being addressed through the development of 'ecological FADs', while turtle bycatch in the longline fishery is being addressed by the increasing adoption of circle hooks and the development of best practice release guidelines. Bycatch of turtles in other fisheries and of sharks in all fisheries are not well mitigated. Ecosystem approaches are not well developed.*
6. For populations of concern including those evaluated as depleted, RFMOs should develop and adopt immediate, effective management measures, for example, prohibition as appropriate on retention of such species where alternative effective sustainability measures are not in place.	*IOTC adopted in 2010 a ban on retaining thresher sharks.*
7. Evaluate the effectiveness of current bycatch mitigation measures, and their impact on target species catch and management, and identify priorities for action and gaps in implementation, including enforcement of current measures and capacity building needs in developing states	*Seabird bycatch mitigation measures in the South African longline fishery have been evaluated and found to be effective. Other fisheries and taxa have not been evaluated.*

8. Seek binding measures or strengthen existing mitigation measures, including the development of mandatory reporting requirements for bycatch of all five taxa across all gear types and fishing methods where bycatch is a concern; and	*Some mitigation and reporting measures have been adopted, but these could be improved in some cases. Furthermore, compliance remains low.*
9. Identify research priorities, including potential pilot projects to further develop and evaluate the effectiveness of current or proposed bycatch mitigation measures, working with fishers, fishing industry, IGOs and NGOs, universities and others as appropriate, and facilitate a full compendium of information regarding mitigation techniques or tools currently in use, *e.g.* building on the WCPFC Bycatch Mitigation Information System.	*The WPEB has identified research priorities. The active involvement of IGOs, NGOs and other organisations is regularly solicited.*
10. Due to the conservation status of certain populations and in accordance with priorities in the RFMO areas, expedite action on reducing bycatch of threatened and endangered species.	*Threatened and endangered species have been, or are being, identified and prioritised through ecological risk assessment processes.*
11. Adopt the following principles as the basis for developing best practice on bycatch avoidance and mitigation measures and on bycatch conservation and management measure. • binding, • clear and direct, • measureable, • science-based, • ecosystem-based, • ecologically efficient (reduces the mortality of bycatch), • practical and safe, • economically efficient, • holistic, • collaboratively developed with industry and stakeholders, and • fully implemented.	*Development of best practice for bycatch avoidance and mitigation is still at an early stage in the IOTC area.*
Improving cooperation and coordination across RFMOs	
12. As a matter of priority, establish a joint T-RFMO technical working group to promote greater cooperation and coordination among RFMOs with the attached Terms of Reference. The RFMOs are encouraged to expedite the formation of the joint working group.	[To be decided by the SC]
13. Actively develop collaborations between relevant fishing industry, IGOs and NGOs, universities and others as appropriate, and RFMOs to assess the impact of bycatch on the five taxa, study the effectiveness of bycatch mitigation measures, and further the understanding of population dynamics of species of conservation concern;	
14. Develop the long-term capacity of T-RFMOs to coordinate and cooperate for data collection, assessment of bycatch, outreach, education, and observer training, including establishing a process to share information on current bycatch initiatives and potential capacity building activities.	The joint-WG mentioned in paragraph 12 could constitute the process for sharing information.
15. RFMOs are encouraged to report progress to Kobe III on the formation and on progress against the recommendations in part I and II of this workshop report.	

Capacity building for developing countries	
16. Acknowledging the additional or new requirements of bycatch mitigation and the need to build further capacity for implementation, in carrying out the recommendations in I, II, and III above, consider capacity building programs for developing countries to assist in their implementation. Establish a list of existing capacity building programs related to bycatch issues (see attached Appendix 2 for example) to avoid duplication where possible and facilitate coordination of new capacity building programs.	[List of capacity building initiative to be completed)

RELEVANT RECOMMENDATIONS OF THE PERFORMANCE REVIEW PANEL

ON CONSERVATION AND MANAGEMENT	
Data collection and sharing	
The Panel identified a poor level of compliance by many IOTC Members. with their obligations, notably those related to the statistical requirements on artisanal fisheries and sharks, and recommends that:	
1. The timing of data reporting be modified to ensure that the most recent data are available to the working parties and the Scientific Committee.	*The timing of the WP on Tropical Tunas and the WP on Billfish is nearly optimal to provide assessments on the most recently available data, and have the results reported to the Scientific Committee*
2. The deadline to provide data on active vessels be modified to a reasonable time in advance of the meeting of the Compliance Committee. This deadline is to be defined by the Compliance Committee.	*Resolution 10/08 establishes February 15th as the new deadline for submission of the list of active vessels for the previous year.*
3. The scheduling of meetings of the working parties and Scientific Committee be investigated based on the experience of other RFMOs. This should bear in mind the optimal delivery of scientific advice to the Commission.	*Given the large number of meetings of other RFMOs, it is becoming increasingly difficult to find a schedule of meetings that would be better than the one currently in practice.*
4. The Commission task the Scientific Committee with exploring alternative means of communicating data to improve timeliness of data provision.	*The Secretariat encourages members to utilize electronic means to expedite reporting. A study commissioned for 2011 to determine the feasibility to report in near real-time for various fleets will produce findings relevant to this item.*
5. Non-compliance be adequately monitored and identified at individual Member level, including data reporting.	*Reports on compliance with data reporting requirements have been regularly reviewed to the Compliance Committee, as well as discussed at the species WPs, WP on Data Collection and Statistics and the Scientific Committee.*
6. The causes of non-compliance be identified in cooperation with the Member concerned.	*The Secretariat maintains contacts with national officers to determine the reasons for non-compliance, in particular, concerning data –reporting.*
7. When the causes of non-compliance are identified and all reasonable efforts to improve the situation are exhausted, any Member or non-Member continuing to not -comply be adequately sanctioned (such as market related measures).	*Actions to be taken by the Compliance Committee*
8. There is a need to improve the quality and quantity of the data collected and reported by the Members, including the information necessary for implementing the ecosystem approach. The most immediate emphasis should be placed on catch, effort and size frequency. The Panel also recommends that:	*See below.*
9. Support for capacity building be provided to developing States - the Commission should	*Currently, the only funding available continues to be through the externally-funded IOTC-*

enhance funding mechanisms to build developing country CPCs' capacity for data collection, processing and reporting infrastructures, in accordance with the Commission requirements.	*OFCF programme. Other sources and cooperative arrangements might be available in the future (e.g. SWIOFP, COI, etc.)*
10. A regional scientific observer programme to enhance data collection (also for non-target species) and ensure a unified approach be established, building on the experience of other RFMOs, Regional standards on data collection, data exchanged and training should be developed.	*Resolution 10/04 implements the Regional Observers Scheme, starting from July 1st 2010, based on national implementation. The Secretariat coordinated the preparation of standards for data requirements, training and forms.*
11. Actions be taken so that fishing fleets, especially Maldives, Taiwan, Province of China and Yemen participate in data collection and reporting.	*The fleets of Maldives and Taiwan,China comply with most of the IOTC mandatory data requirements. The security situation in Yemen continues to prevent a more direct joint work with national scientists on data collection issues.*
12. A relationship with Taiwan, Province of China be developed in order to have data access when needed, to all its fleet data as well as historical series, and address the problems deriving from the current legal framework.	*Access is routinely given to data from Taiwan, Province of China, including access to its historical data.*
13. The Secretariat's capacity for data dissemination and quality assurance be enhanced, including through the employment of a fisheries statistician.	*The existing post of Data Analyst is being converted to a Fisheries Statistician to join the Data Section of the Secretariat.*
14. A statistical working party be established to provide a more efficient way to identify and solve the technical statistical questions.	*The WP on Data Collection and Statistics has resumed its meeting since 2009.*
15. The obligation incumbent to a flag State to report data for its vessels be included in a separate Resolution from the obligation incumbent on Members to report data on the vessels of third countries they licence to fish in their exclusive economic zones (EEZs).	*Resolutions 10/07 and 10/08 implement this recommendation*
In relation to non-target species, the panel recommends that: 16. The list of shark species for which data collection is required in Recommendation 08/04 be expanded to include the five species identified by the Scientific Committee (blue shark, shortfin mako, silky shark, scalloped hammerhead, oceanic whitetip), and apply to all gear types.	*In 2010, the majority of the WPEB recommended a longer list of eleven species or species-groups (plus thresher sharks, which should not be retained). All of these species or groups are easily recognised by fishermen. (It is noted here that although silky shark is perhaps the most important shark bycatch species in tropical tuna fisheries, it is not easily identified by fishermen, since it is readily confused with similar species).*
17. The Secretariat's capacity to provide support to developing States' Members should be enhanced.	*See Recommendation 15.*
18. Cooperative capacity building efforts amongst Members and, as appropriate external organisations, should be encouraged.	*See Recommendation 11 and 21.*
19. Innovative or alternative means of data collection (*e.g.* port sampling) should be explored and, as appropriate, implemented.	*The IOTC-OFCF Programme has been supporting sampling programme and other means of data collection since 2002.*
20. Avenues to collect data from non-Members should be explored.	*The activities of the IOTC-OFCF Project have not been limited to IOTC members, and, in the past, have extended to important non-member fishing countries such as Yemen and Maldives.*
Quality and provision of scientific advice	
21. For species with little data available, the Scientific Committee should be tasked with making use of more qualitative scientific methods that are less data intensive.	*The species WPs have been using informal analyses of stock status indicators when data were considered insufficient to conduct full assessments.*
22. More emphasis should be given to adherence to data collection requirements.	*The WP on Data Collection and Statistics and the species WPs evaluate the availability and quality of data available. The Compliance Committee receives a report on the timeliness and completeness of the reporting of the data required.*
23. Confidentiality provisions and issues of accessibility to data by the scientists concerned	*Input, output and executable files for the stock assessment of major stocks are archived*

needs to be clearly delineated, and/or amended, so that analysis can be replicated.	*with the Secretariat to allow replication of analyses. Access to operational data under cooperative arrangements, and subject to confidentiality rules is still limited.*
24. The resources of the IOTC Secretariat should be increased. Even though some progress will be made with recruitment of the stock analysis expert, some additional professional staffing is required.	*The Commission declined the request for additional staff in 2010, the Secretariat will propose a budget for the 2011-12 biennium that includes additional professional staff.*
25. To enhance the quality of scientific advice and the technical soundness of the papers being considered by the Scientific Committee and its working parties, and to encourage publication of IOTC scientific papers in relevant journals, future consideration should be given to the establishment of a scientific editorial board within the Scientific Committee	*Not discussed by the SC yet*
26. An online IOTC Data Summary should be established	*Not completed yet. Budgetary provisions to be renewed for 2011.*
27. Ongoing peer review by external experts should be incorporated as standard business practice of working parties and the Scientific Committee.	*External experts are regularly invited to provide additional expertise, although this does not constitute, strictly speaking, a formal process of peer review.*
28. New guidelines for the presentation of more user friendly scientific reports in terms of stock assessments should be developed. In this respect, Kobe plots are considered to be the most desirable method of graphical presentation, especially to non-technical audience.	*All recent stock assessment results have been presented using the Kobe plot, and the species WPs are progressing in presenting potential benefits*
29. A special fund to support the participation of scientists from developing States should be established.	*Completed, through the adoption of the special Meeting Participation Fund in 2010 (Resolution 10/05) to support participation of representatives, including scientists, from developing states in meetings of the Commission. The fund is financed, initially, by accumulated funds, with no provisions for long-term support yet agreed.*
30. The Commission should renew efforts to convene meetings of the Working Party on Neritic Tunas	*Programmed for 2011.*

APPENDIX X
GUIDELINES FOR THE PRESENTATION OF STOCK ASSESSMENT MODELS

A set of guidelines for the presentation of stock assessment models and results was agreed by the SC. These guidelines attempt to ensure greater transparency and facilitate peer-review of models employed in the provision of advice on the status of the stocks. Scientists presenting model runs should provide to the Secretariat a copy of all input and output files and of the executable file or files used. These will be archived for future testing and replication. Scientists are encouraged to freely share the source code of the methods used.

Documents should describe the available data and mention, if necessary, data sources or observations not included in the analysis. When referring to datasets provided by the Secretariat, the date, coverage and precise database should be mentioned. Data sources not previously seen by a Working Party might need their own document presenting them. This includes standardized CPUE series or other data sources processed prior to use.

The population dynamics that are modelled and the techniques used should be clearly presented including a description of the partition, annual cycle, and other relevant population processes.

Alternative scenarios and retrospective analyses should ideally be carried and, if included, a description of the motivation for the selection of base and alternative cases should be added, giving detail of how the alternative case assumptions differ from those of the base case. The description of any retrospective analyses should cover the assumptions involved and results obtained. Projections should be similarly documented.

Documentation guidelines

Software inspection and archival

- Input and output files of all alternative runs or scenarios presented should be made available during the meeting for inspection by interested members and for later archiving by the Secretariat. Ideally, these should be stored together with a copy of the software used in the analysis. When this is not possible due to licensing issues, a complete reference of the versions of both software and operating system employed should be made. Similarly, confidential inputs need not be provided but they should be documented and identified.
- Software used should ideally be open sourced using an appropriate license, or at least be made available to interested parties for inspection under a limited license. If closed source software is used, this should be clearly justified and sufficient tests as to its validity and reliability, under similar circumstances as those under which it will be used in IOTC-related work, should be carried out and its results made available.
- Comprehensive testing, including regression testing and testing of the influence of various assumptions, is greatly encouraged in all cases.

Observations

- Describe the available data and mention, if necessary, data sources or observations not included in the analysis. When referring to datasets provided by the Secretariat, indicate the date, coverage (years, fleets, areas), and precise database (*e.g.*NC, CE).
- Data sources not previously seen by a Working Party might need their own document presenting them. This includes standardized CPUE series or other data sources processed prior to use.

Standardized CPUE indices of abundance

- Description of data pre-processing (*e.g.* treatment of outliers, selection of core areas if applicable)
- Efforts should be made to describe temporal and spatial patterns in the data, identifying gaps or sudden operational changes that that lead to an unbalanced design.
- Software and specific function calls
- Standard diagnostic plots (residuals, leverage plots, etc)
- Parameter values, including error estimates
- For complicated models, a stepwise progression from simpler models should be documented to help identify confounding, and a distinction between statistical significance and practical significance.
- Efforts should be made to circulate these analyses well in advance of the relevant working party to allow discussion, and timely implementation in the stock assessment analyses.

Population dynamics

- Describe the population dynamics that are modelled and the techniques used including a description of the partition (age/length/sex groups, maturity, spatial structure, movement dynamics, if necessary), annual cycle (time steps, growth assumptions, natural and fishing mortality functions, recruitment, and sequence of those), and relevant population processes. Fixed parameters should be identified and documented. Emphasis should be placed in describing the formal statistical methods applied, including modelling methods, and form, limits and assumptions of both free and derived parameters.

Statistical methods

- Describe of the formal statistical methods, including
    1. Software name, version number, bibliographic references and source
    2. Maximum likelihood or objective function
    3. Bootstrap assumptions and McMC algorithm, if used.
- Describe the free parameters used by the model, including
    1. Name and description of the parameter
    2. Details of the estimation bounds/functional relationships with other parameters
    3. Details of the prior assumed (if any), and source of the prior
    4. Weightings for likelihood terms
    5. Adjustment of variance by scaling/adding process error
    6. Penalties
- Describe the derived parameters used by the model, including
    1. Name, description and definitions of derived parameters (be precise with those that have alternative definitions, *e.g.*, B0, MSY, BMSY)
    2. Details of any bounds/functional relationships with other parameters.
    3. Details of any priors assumed (including source).

Scenarios and retrospective analyses

- Alternative scenarios and retrospective analyses should be carried when possible and, if included, a description of the motivation for the selection of base and alternative cases should be added, giving detail of how the alternative case assumptions differ from those of the base case. Description of any retrospective analyses, should cover the assumptions involved and results obtained. Projections should be similarly documented.

APPENDIX XI
TERMS OF REFERENCE FOR A BYCATCH OFFICER

Within the Indian Ocean there are major tuna fisheries, some of which catch non-target (or bycatch) species, including pelagic sharks, marine turtles, seabirds, marine mammals, and others. Some of these species are threatened, endangered or protected. Many appear to be declining in abundance, raising concerns for the sustainability of these fisheries and the livelihoods and food security of fishers (notably from developing coastal countries) who depend upon these resources. However, there is an acute lack of information for almost all of these species, which hampers development mitigation and other management measures.

The Kobe-II Workshop on Bycatch (Brisbane, June 2010) recommended the creation of a Bycatch Joint Technical Working Group covering the five Tuna-RFMOS. For IOTC to maximise its input into this working group and also to ensure significant progress into bycatch monitoring and mitigation in its own area of competence, the Scientific Committee recommended that a Bycatch Officer be recruited at the Secretariat to develop the long-term capacity of IOTC to deal with all bycatch issues. The following terms of reference are proposed:

1. Assist with capacity building of developing countries for bycatch monitoring and mitigation

2. Take an active part in appropriate scientific and technical meetings (including the IOTC's Working Party on Ecosystems and Bycatch; the proposed t-RFMO Joint Working Group on Bycatch; the Kobe process bycatch meetings; *etc*)

3. Develop and maintain network of bycatch species specialists to assist IOTC WPEB.

4. Assist development and oversight of the Regional Observer Scheme.

5. Assist with updating Executive Summaries of bycatch species.

6. Assist with producing reviews of bycatch issues relevant to the work of IOTC.

7. Assist with development of Ecological Risk Assessments for bycatch species.

8. Assist with distribution of information on bycatch issues to all stakeholders (industry, government agencies, NGOs, research groups, *etc*).

9. Assist with maintenance and updating bycatch database.

10. Assist with documentation of bycatch use and with development of best practice guidelines for bycatch utilization, especially in relation to food security and in developing coastal countries.

APPENDIX XII
STATEMENTS OF THE REPUBLIC OF MAURITIUS AND THE UNITED KINGDOM; WITH REGARDS TO THE DECLARATION OF A MARINE PROTECTED AREA IN THE CHAGOS ARCHIPELAGO

Statement of the Republic of Mauritius

The Republic of Mauritius does not recognize the Marine Protected Area (MPA) as announced by UK. Mauritius strongly objects to the creation of the MPA in the waters of Chagos Archipelago. The UK government has been informed of the objection of Mauritius in a correspondence dated 2 April 2010. The Chagos Archipelago including Diego Garcia forms an integral part of the sovereign territory of the Republic of Mauritius under national and international law and we do not recognize BIOT.

Statement of the United Kingdom

The UK has no doubt about its sovereignty over the British Indian Ocean Territory which was ceded to Britain in 1814 and has been a British dependency ever since.

As the UK Government has reiterated on many occasions, we have undertaken to cede the Territory to Mauritius when it is no longer needed for defense purposes.

The BIOT Administration is continuing to work on the implementation of the Marine Protected Area. This includes preparing implementing legislation in BIOT law, enforcement arrangements, establishing administrative and scientific research frameworks, funding, dialogue with interested parties and exploring the opportunities for involving representatives of the Chagossian community in environmental work in the Territory.