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

Report of the Fifth Session of the IOTC Working Party on Ecosystems and Bycatch

Mombasa, Kenya 12 - 14 October 2009

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1. OPENING OF THE MEETING AND ADOPTION OF THE AGENDA

1. The Fifth Meeting of the Working Party on Ecosystems and Bycatch (WPEB) was opened on 12 October 2009 in Mombasa, Kenya, by the acting chair Dr Charles Anderson, who was elected to chair the meeting in the absence of the Chairperson Mr Riaz Aumeeruddy, who had tendered an apology.

2. Dr Anderson welcomed the participants (Appendix I), the agenda for the Meeting was adopted as presented in Appendix II, and rapporteurs were appointed. The list of documents presented to the meeting is given in Appendix III.

2. REVIEW OF THE DATA ON BYCATCH

2.1 STATUS OF IOTC DATABASES FOR NON-IOTC SPECIES

3. The Secretariat provided a report on the status of bycatch and ecosystem data in the IOTC databases (IOTC-2009-WPEB-09).

4. The document reviewed the different resolutions that have been taken so far by IOTC regarding those species (notably resolutions 05/05 and 08/01 on sharks, resolutions 05/09 and 08/03 on seabirds and resolution 09/06 on marine turtles). Regarding sharks, members should collect and report the same information as is collected and reported for tunas (catch, effort and size frequency). For seabirds and turtles, members should collect and report information on the numbers of animals caught. The information on retained catches and bycatches of sharks contained in the IOTC database is very incomplete; the Secretariat has received very few data on bycatch since the last session of the WPEB. Only two members reported detailed statistics, namely South Africa and EC (purse seine). No data or even aggregated summaries have been reported for other fleets catching large quantities of sharks (longline, gillnet). Also for all fleets, historical data series, necessary to undertake stock assessments, are missing. Size frequency data have been reported only by South Africa and South Korea and biological data, such as fin-body ratio by species, are still largely missing.

5. Regarding seabirds and turtles, bycatch data collected by observers have been reported in 2009 only by South Africa for the local and foreign vessels licensed to operate in the South African EEZ. In addition, the EC reported the catches of turtles by its purse seine fleet. The paucity of data held by the Secretariat on the different bycatch species groups makes any attempts to estimate levels of bycatch very difficult.

6. The WPEB recalled the existing data and information reporting requirements for members (Table 1) and noted that Resolution 08/01 adopted by the Commission in June 2008, requires CPC's to provide fisheries statistics for the major shark species. Given this, the working party expected that improvements in the amount and quality of data on sharks would be obtained over the coming years.

Table 1. IOTC data requirements for non-tuna species.

Sharks	
IOTC Resolution *05/05: Concerning the conservation of sharks caught in association with fisheries managed by IOTC*	Paragraph 1: CPCs shall annually report data for catches of sharks, in accordance with IOTC data reporting procedures, including available historical data.
IOTC Resolution *08/01: Mandatory statistical requirements for IOTC Members and Cooperating Non-Contracting Parties (CPC's)*	Paragraph 3: The provisions, applicable to tuna and tuna-like species, shall also be applicable to the most commonly caught shark species and, where possible, to the less common shark species.
Seabirds	
IOTC Recommendation *05/09: On incidental mortality of seabirds*	Paragraph 2: CPCs should be encouraged to collect and voluntarily provide the Scientific Committee with all available information on interactions with seabirds, including incidental catches in all fisheries under the purview of IOTC.
IOTC Resolution *08/03: On reducing the incidental bycatch of seabirds in longline fisheries*	Paragraph 7: CPCs shall provide to the Commission, as part of their annual reports, 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.
IOTC Resolution *08/01: Mandatory statistical requirements for IOTC Members and Cooperating Non-Contracting Parties (CPC's)*	Paragraph 3: The provisions, applicable to tuna and tuna-like species, shall also be applicable to the most commonly caught shark species and, where possible, to the less common shark species. CPC.s are also encouraged to record **and provide data on species other than sharks and tunas taken as bycatch.**
Sea turtles	
IOTC Resolution 09/06: *On Marine Turtles*	Paragraph 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.

	CPCs 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.
IOTC Resolution 08/01: *Mandatory statistical requirements for IOTC Members and Cooperating Non-Contracting Parties (CPC's)*	Paragraph 3: The provisions, applicable to tuna and tuna-like species, shall also be applicable to the most commonly caught shark species and, where possible, to the less common shark species. CPC.s are also encouraged to record **and provide data on species other than sharks and tunas taken as bycatch.**
Marine mammals	
IOTC Resolution 08/01: *Mandatory statistical requirements for IOTC Members and Cooperating Non-Contracting Parties (CPC's)*	Paragraph 3: The provisions, applicable to tuna and tuna-like species, shall also be applicable to the most commonly caught shark species and, where possible, to the less common shark species. CPC.s are also encouraged to record **and provide data on species other than sharks and tunas taken as bycatch.**

7. The Secretariat recalled that the practice of shark finning is prohibited by IOTC Resolution (05/05 adopted by the Commission in June 2005), but that there is still debate among all RFMOs regarding the best ways to handle this issue and to get agreement on the means to regulate shark landings.

8. The Secretariat recalled the difficulties in obtaining shark bycatch data by species, and noted that at present no approach for assessment can be prioritized.

9. The WPEB reiterated its disappointment and concern about the lack of reporting. The WPEB recalled the value of reporting to the Secretariat all information on tuna fisheries bycatch collected during national programs and encouraged contracting parties to initiate such programs. Bycatch estimates are valuable, but data as per IOTC standards are required. The WPEB emphasised the necessity of improvements in the amount and quality of data on sharks obtained over the coming years.

10. The WPEB recommended the following actions be taken to improve the standing of the data on non-tuna species currently available at the Secretariat (Table 2). In general, these recommendations are made over and above the existing obligations and technical specifications relating to the reporting of data.

Table 2a. 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, South Korea and India.
	Longliners targeting swordfish	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
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 how to identify shark species from fins and processed body parts.	All fleets	
Discard levels:		
Implementing levels of observer coverage that will produce acceptable levels of precision in estimates of discards.	All industrial fleets	
Estimating levels of discards for sharks, at least by large species groups or if possible, by species.	All fleets using sharks for their fins	
Estimates of historical discard levels for sharks by species and year	All industrial fleets	
Size frequency data:		
Collecting and reporting size frequency information for the main shark species caught by their fisheries, including all historical data available	All industrial fleets, notably longline fleets	Industrial fleets monitored through observers
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, 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 2b. Steps to improve the certainty of statistics on incidental catches of SEABIRDS

Data / information / work required	Fishery	Major fleets involved
Provision of historical data on incidental catches of seabirds, by species and fishing area, indicating the type of mitigation measure/s used in each case.	Industrial longline fisheries operating south of 25°S	Taiwan,China, Japan, Indonesia, Spain, Portugal and South Korea
Detailed estimation of seabird bycatch, by species and year, including the precision of such	Industrial longline fisheries operating south of 25°S	Taiwan,China, Japan, Indonesia and South Korea

estimates.		
Research on the effect of seabird bycatch mitigation measures.	Industrial longline fisheries operating south of 25°S	Taiwan,China, Japan, Indonesia and South Korea

Table 2c. Steps to improve the certainty of statistics on incidental catches of MARINE TURTLES

Data / information / work required	**Fishery**	**Major fleets involved**
Collect data on incidental catches of sea turtles, by species and fishing area, including the condition of the marine turtle at release	Countries having industrial longline fisheries	Taiwan,China, Indonesia and Japan
	Gillnet / gillnet-longline	Gillnet fisheries operating in the Arabian Sea (Pakistan, Sri Lanka and Iran) and the gillnet/longline fisheries of Sri Lanka, Yemen and Oman
	Industrial purse seine fleets	Spain, France, Seychelles, Iran, Japan and Thailand
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	Spain, France
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
Research on marine turtle bycatch monitoring and mitigation measures for gillnet fisheries	Countries having gillnet fisheries	Iran, Pakistan and Sri Lanka

11. The WPEB noted that similar recommendations for data collection and submission were made every year. Participants also noted that it was impossible for the WPEB to fulfil its mandate without appropriate data. The WPEB **strongly recommended** that the SC and the secretariat investigate means to encourage better data collection and submission.

2.2 REVIEW OF NEW INFORMATION AVAILABLE ON THE INCIDENTAL CATCH OF NON-TARGET SPECIES IN THE INDIAN OCEAN

Some issues on observer programs discussed at the 6th International Fisheries Observer and Monitoring Conference (Portland, ME, USA, July 2009) relevant to the IOTC WPEB. (IOTC-2009-WPEB-14)

12. The 6th International Fisheries Observer and Monitoring Conference held in Portland (Maine, USA) in July 2009 was organized by NMFS/NOAA and attracted around 300 participants from 37 countries (www.st.nmfs.noaa.gov/ifomc2009). This presentation summarized information from the Conference relating to the conduct and maintenance of observer programs, particularly in tuna fisheries. Among the different points discussed, it was emphasized that a paradigm shift is taking place at the global level in fisheries management and monitoring. This shift is clearly related to the growing number of stocks managed under ITQ (particularly in America); this has numerous consequences including the need for precise monitoring of catches at the individual boat level. But this shift is also correlated with a general growing need for better information and compliance in fisheries activities. The differences between science- and compliance-oriented observer programs are still present, but the distinctions are becoming less clear with the emergence of the monitoring issue. More and more frequently, monitoring systems based on observer programs are set in place in partnership with fishermen and this may help certification. Until recently no tuna fishery was certified by MSC (Marine Stewardship Council) as being a sustainable fishery. One explanation is that among the different principles and criteria used in the MSC certification process, fisheries management should be conducted at a regional level, *eg. at the level of the a tuna RFMO, and not at a national level*. A review of extrapolation methods used around the world for estimating bycatch and discards from limited observer data was also carried out and guidelines were suggested for achieving a common approach in the application of data extrapolation methodologies. Finally, this presentation summarized some current trends in fisheries observation technologies and particularly in electronic monitoring.

Maldives bycatch

13. The WPEB was briefly informed about bycatch issues in Maldives. Traditionally Maldives does not use purse seine, gillnets or trawl nets, and so many of the problems associated with by-catch elsewhere do not exist in Maldives. These prohibitions are now customary, with Maldivian fishermen continuing to use very selective gears. The most common gear is pole and line, plus more recently handline. Livebait pole and line fishing for tunas has been practiced for hundreds of years; there are good records of catch and effort data and almost no by-catch. Silky sharks, *Carcharinus falciformis*, are known to associate with tuna schools and so Maldivian tuna fishermen traditionally did not catch these sharks. There are also laws prohibiting the take of these sharks. Maldives also carries out hand lining, targeting large yellowfin; again, there is little or no bycatch. The tuna longline fishery is almost exclusively carried out by foreigners, under licence and in the outer EEZ; some data on bycatch have been collected and could be submitted. Maldives is applying to certify their pole and line fisheries under MSC (Marine Stewardship Council). Partly to facilitate this process Maldives is now in the process of applying to join IOTC, initially as a non-contracting cooperating party.

Digest of major information collected since 2008 until August 2009 in the frame of the longline observer program (SEALOR) based in La Réunion. (IOTC-2009-WPEB-10)

14. The La Réunion longline fishery targeting swordfish currently includes 45 vessels, including both small (LOA 10-17 m) and large vessels (to 24.9 m LOA). IRD is running an observer programme, monitoring the fishing operations of this fleet. Data are collected using several forms: longline fishing gear characteristics form; set and haul information form; catch event form; depredation events form; basket information form; and protected species observation or capture form. Instrumentation deployed on the longline also allows collection of fishing depth and temperature records and well as geolocation records of the longliner and the mainline. All data are stored in a database developed using MS Access software. Current observer coverage is 1 trip/month with operational coverage of 1.3% of hooks, 1.6% of sets and 1.9% of trips. Principal non-target species are tuna (YFT, ALB and BET), dolphinfish and sharks and rays (notably blue shark and pelagic stingray). Further plans are to extend observer coverage to 4% by

2010 (in terms of numbers of hooks), increase coverage of small vessels, and to improve sampling strategy and by-catch estimates.

Scientific catch estimations of bycatch species landed by the Spanish surface longline fleet targeting swordfish (Xiphias gladius) in the Indian Ocean with special reference to the years 2007 and 2008. (IOTC-2009-WPEB-03)

15. This document provided an overview of the bycatch levels by species landed by the Spanish surface longline fleet targeting swordfish (*Xiphias gladius*) in the Indian Ocean during the years 2007 and 2008. The three most prevalent species in the catch, swordfish, blue shark (*Prionace glauca*) and shortfin mako (*Isurus oxyrinchus*) represented 84.3% and 88.5% of the total landings in weight for this fishery during the last two years, respectively. During the years 2007-2008 the 'bycatch' species accounted for 56.0% of the total landings in weight: large pelagic sharks, 43.6%; tunas, 6.9%; billfish, 1.7%; and other species, 3.7%. Considering only the bycatch species, large pelagic sharks were the most prevalent, comprising an average of 78.0% of the total bycatch in weight, with tunas accounting for 12.3%, billfish 3.1% and other species 6.6%. The blue shark and the shortfin mako were the most important species within the group of large pelagic sharks, contributing 86.0% and 10.8%, respectively.

Quantitative estimates of the bycatches of the main species of the purse seine fleet in the Indian Ocean, 2003-2008. (IOTC–2009–WPEB–21)

16. Preliminary quantitative estimates of the main bycatch species and species groups (billfishes, sharks, rays and fin fishes) were made for the whole purse seine fishery since 2003. Data are from the French and Spanish observer programs from 2003 to 2007, representing a total of 1958 observed sets (4% of the total number of sets during this period). Annual raising factors by fishing mode based on tuna production (tons per 1000 tons of tuna landed) were estimated for each species group from logbooks and observer information stratified by quarter, fishing area and fishing mode (as described in WPEB-2008-12). According to these estimations, total bycatch was estimated at 9,585t, corresponding to 35.5t bycatch per 1000t of tuna landed. Tuna discards represents 54% of the total amount, followed by other fin fish (34%), sharks (10%), billfishes (1.5%) and rays (0.7%). The amounts estimated by fishing mode and species group are reported in the table below:

Table 3. Estimated bycatches of the purseseine fishery (tonnes bycatch per 1000t tuna).

Fishing mode	Tuna discards	Fishes	Sharks	Billfishes	Rays	Total	Total fishery (t)
FAD & sea mounts	26.46	19.70	5.99	0.68	0.25	53.08	160,454
Free schools	9.35	1.52	0.29	0.37	0.20	11.73	109,781
Total	19.16	11.96	3.57	0.55	0.24	35.47	270,235

17. These mean ratios were applied to the whole purse seine fishery annual catches from 2003 to 2008 to compute total bycatches by species groups, and then distributed within the groups according to the proportion in weight of the main species or families. Tuna discards were not estimated, and whale sharks (which are nearly always released alive) were not included in the sharks estimate. The main results are reported in the Table 4.

Table 4. Total bycatches estimated for the purse seine fisheries (in t)

Species group	Fishing mode	2003	2004	2005	2006	2007	2008	2003-2008 average
Billfishes	FAD & Seamounts	148	112	134	171	105	111	130
	Free schools	63	68	62	46	32	38	51
	Total	211	180	196	217	136	149	182
Sharks	FAD & Seamounts	1 402	1 060	1 270	1 618	990	1 053	1 232
	Free schools	49	53	49	36	25	30	40
	Total	1 452	1 113	1 318	1 654	1 014	1 082	1 272
Rays	FAD & Seamounts	30	32	32	25	17	34	28
	Free schools	34	28	33	43	26	17	30
	Total	64	60	65	68	43	50	58
Finfishes	FAD & Seamounts	2 408	2 574	2 515	1 964	1 352	2 662	2 246
	Free schools	255	206	246	321	195	124	224
	Total	2 662	2 780	2 761	2 285	1 547	2 785	2 470
TOTAL	**FAD & Seamounts**	**3 989**	**3 779**	**3 951**	**3 778**	**2 463**	**3 859**	**3 636**
	Free schools	**401**	**355**	**390**	**446**	**277**	**208**	**346**
	Total	**4 389**	**4 134**	**4 340**	**4 225**	**2 740**	**4 067**	**3 983**

18. The bulk of the bycatch consisted of tuna discards (average annual catch 6,700t; range 5,100-8,300t). These discards were not considered further in this presentation. The annual bycatch of all other groups averaged some 4,000t (range 2,750-4,400t). Of this the majority was made up of "fin fishes", with an annual mean catch close to 2,500t (range 1550-2,800t). The main species was rainbow runner (*Elagatis bipinnulatus*, 37% of the total), followed by triggerfishes (Balistidae, 24%), dolphinfishes (*Coryphaena* spp., 11%) and carangids (Carangidae, 7%), with the balance (21%) being made up of some 50 other species. Most were caught under FADs (95%). Fin fish species composition between FAD and log schools was rather similar, although there were more dolphinfishes on FADs, and the greatest diversity was from free schools. The next most important bycatch group was "sharks", with a total average annual catch close to 1,300t (range 1,000-1,650t). Shark bycatch was dominated by carcharhinids, the most important being the silky shark (*Carcharhinus falciformis*, 79%) followed by the oceanic whitetip shark (*C. longimanus*, 11%). 97% of sharks were caught on FADs. Shark species composition was quite similar between FAD and free schools sets. "Billfish" bycatch was relatively low, with an average annual catch of 180t (range 140-210t). The most important species were marlins (70%, mainly *M. indica* and *T. audax*) and sailfishes (27%). Most billfishes (72%) were caught on FADs. Billfish species composition was quite similar between FAD and log sets. "Rays" were caught in smaller quantities, with an average annual catch of 50t (range 40-70t). 65% of rays were caught on FADs. The most important species group was the Mobulidae (42%), followed by the giant manta (*Manta birostris*, 37%) and other and unidentified rays (20%). Ray species composition is rather similar between FAD and free schools, but with a larger diversity on free schools. Overall, discards by the purse seine fishery (excluding tuna discards) remains relatively low when compared to many other fisheries, with the large majority coming from FAD sets.

2.3 DISCUSSIONS AND RECOMMENDATIONS ON DATA

19. The WPEB noted that there are (in other regions) increasing numbers of monitoring programs involve high technology equipment especially for ITQ-regulated fisheries. Electronic monitoring (EM) systems can focus on several issues, including fishing locations, catch including discards, fishing methods, protected species interaction and mitigation measures. These systems are complementary to observer programs, can improve coverage and are useful for better data collection and compliance. Nevertheless, the WPEB expressed some concerns about the possible transfer and the implementation of EM in the context of the Indian Ocean fisheries considering the cost and also the high level of technological competence required.

20. The WPEB expressed concern regarding the increasing number of countries developing new industrial tuna fisheries, and also the growth of artisanal fisheries. These fisheries are often inadequately monitored and even basic information in lacking. There is clearly a need to improve bycatch reporting from such fisheries.

21. The WPEB noticed that the proportion of sharks caught by the Spanish longline fleet was particularly high compared to other fisheries operating in the same area, which could be due to a different fishing strategy.

22. The WPEB noted that much research is currently being conducted on manta rays within the Indian Ocean. It appears that there are two species of *Manta*, not just one as generally recognized, and that consequently improved species identification is required.

23. The WPEB requested that the same bycatch data analyses presented by EU (IOTC–2009–WPEB–21) should be expanded to include all available data for all available years. More generally, the WPEB recommended that, in light of relatively low by-catch when compared to many other fisheries, a report on the purse seine bycatch should be produced and made available. Moreover, the WPEB recommended that similar work is carried out for other fleets to be presented at the next Session of the WPEB.

24. IOTC Resolution 09/04 on development of a regional observer programme includes a mandate to produce three documents (relating to the role of the observer programme, species identification sheets and a training programme). The draft outlines should be ready by December 2009 to be presented at the Scientific Committee. The IOTC Secretariat requested WPEB participants to provide all available information concerning their national observer programmes in order to standardize the protocols and prioritize the types of data to be collected. More advanced versions of these documents should be completed by March 2010.

3. SHARKS

3.1 PAPERS PRESENTED

*Individual age and growth of blue shark (*Prionace glauca*) in the southwest Indian Ocean: preliminary results (IOTC-2009-WPEB-11)*

25. Age and growth rate estimates for 48 individual blue sharks were obtained by counting growth increments in vertebrae. Samples were collected in the southwestern Indian Ocean from dead individuals caught incidentally by commercial long-liners and during research cruises from the east of Madagascar, along the Mozambique Channel and the west of Reunion Island. Growth bands in central cones of both whole vertebrae and sectioned vertebrae were viewed using a binocular microscope with transmitted light. Size of sampled sharks ranged from 125 to 243 cm fork length (FL). Preliminary results indicated that the age estimates did not depend on the method of vertebral preparation: no statistical difference was found between age estimations from whole and sectioned vertebrae. Ages determined from whole vertebrae varied between 10 to 25 years, while age counts from sections ranged from 10 to 23 years. The von Bertalanffy growth model using empirical length at birth provided the biological and statistical fit to the data. This model gave parameter estimates of Linf = 258 cm FL and k = 0.18 y^{-1} for males, and Linf = 252cm FL and k = 0.13 y^{-1} for females. Males and females exhibited statistically significant differences in growth, indicating than females grow more slowly and are smaller than males. Our length-at-age estimates for blue shark are consistent with north Atlantic studies, but differ from results obtained from the south Atlantic. Therefore an age validation study is required before the hypothesis of annual growth band formation can be accepted.

Size distribution and length-weight relationships for some large pelagic sharks in the Indian Ocean (IOTC-2009-WPEB-6)

26. Size distribution and length-weight relationships for some large pelagic sharks caught in the Indian Ocean during Soviet Indian Ocean Tuna Longline Research Programme (SIOTLLRP) in 1961-1989 were presented. Shark species covered included: blue shark (*Prionace glauca*), oceanic whitetip shark (*Carcharhinus longimanus*), silky shark (*Carcharhinus falciformis*) and shortfin mako shark (*Isurus oxyrinchus*).

Sharks in Madagascar (IOTC-2009-WPEB-19)

27. Few pelagic shark data are available from Madagascar. Some data are available from observers on tuna longliners during 2004-2007, and there are also some data collected during the landing of scrap fish at Antsiranana. These data show that up to 2004, sharks contributed 76% of the total catch of 'tuna' longliners; sharks were a target, not a bycatch. In contrast, for purse seiners, shark catch did not exceed 1% of the total. Despite the lack of an NPOA-shark, from 2005-2006 sharks were relegated to a bycatch of the tuna longliners, due to the implementation of fishing agreement on the one hand and the control of the patrol vessel on the other.

Opinions count: decline in abundance of Silky Sharks in the central Indian Ocean reported by Maldivian fishermen. (IOTC-2009-WPEB-8)

28. The silky shark *Carcharhinus falciformis* is probably the most important species of oceanic shark in terms of catch weight taken in fisheries in the Arabian Sea and tropical Indian Ocean. However, both catch and biological data are scarce, while catch per unit effort time series are almost completely lacking. It is therefore difficult to make informed judgements about the status of this species in this ocean. Nevertheless, it is clear that silky sharks have been heavily exploited in other oceans, where populations appear to have been reduced to a fraction of their former abundance. There is no reason to suppose that the same is not happening in the Indian Ocean. In the Maldives there is a small, directed fishery for silky sharks but no published catch data. We conducted a series of five small surveys of Maldive islanders and fishermen, recording their opinions of the status of the local shark longline fishery and of the silky shark resource. Remarkably consistent results were obtained: islanders and shark fishermen reported a decline in the shark longline fishery; all fishermen reported declines in the abundance and average size of silky sharks. It is difficult to quantify these declines, but the available information is consistent with silky shark abundance currently being less than 50% and perhaps just 10% of what it was 20 years ago. Since silky sharks are highly migratory, this implies that they have been grossly overexploited on an oceanic scale.

Decline in CPUE of oceanic sharks in the Indian EEZ: urgent need for precautionary approach. (IOTC-2009-WPEB-17)

29. Catch per unit effort (CPUE) and its variability observed in resource surveys can provide a measure of the standing stock of a resource and the changes in its stock density. Data on the CPUE of sharks obtained in tuna longline survey in the Indian EEZ by Govt. of India survey vessels during 1984-2006 were considered in this study. A total effort of 3.092 million hooks yielded 20,884 sharks. 23 species belonging to five families were recorded. Average hooking rate was 0.68 per hundred hooks, and showed a high degree of spatio-temporal variability. Over the survey period, a sharp decline was observed in the hooking rate from all regions. The trend in the CPUE is a clear indication of the decline in the abundance of sharks in the different regions of the EEZ, the most alarming scenario being on the west coast as well as the east coast, where the average hooking rate recorded during the last five years was less than 0.1 per hundred hooks. It is evident from the results of the survey that the standing stock of several species of sharks in the Indian seas has declined to such levels that the sustainability of the resource is in doubt, requiring urgent conservation and management measures.

Depredation: Improvement of the information flow within IOTC. On the IOTC resolution 08/04 "Concerning the recording of the catch by longline fishing vessels in the IOTC area": how to incorporate depredation information and improve shark catch statistics? (IOTC-2009-WPEB-5)

30. Amendments to IOTC Resolution 08/04 "Concerning the recording of the catch by longline fishing vessels in the IOTC area" were suggested. These aimed to improve collection of data on depredation and shark bycatch in the IOTC regulation area. Summaries on occurrence, vulnerability and identification features of several shark species / groups were given. It was suggested to modify the minimum requirement list of shark species in order to include those shark species / groups which commonly occur in tropical Indian Ocean longline catches and which can easily be identified by fishermen (and which in several cases are of conservation concern, being listed by IUCN as 'Vulnerable' or 'Endangered'). The shark list presented in Resolution 08/04 and the new recommendations were reviewed. Although the potential difficulties of correct identification and reporting by fishermen were acknowledged, **the WPEB recommended an amendment to the list of species proposed under Resolution 08/04.**

Table 5. Shark species to be reported to IOTC

Under resolution 08/04	Under new proposal
Blue Shark	Blue Shark, *Prionace glauca*
Mako Shark	Mako Sharks, *Isurus* spp.
Porbeagle	Great White Shark, *Carcharodon carcharias*
	Crocodile Shark, *Pseudocarcharias kamoharai*
	Thresher Sharks, *Alopias* spp.
	Tiger Shark, *Galeocerdo cuvier*
	Requiem Sharks, *Carcharhinus* spp.
	Hammerhead Sharks, *Sphyrna* spp.
Other Sharks	Other Sharks
	Pelagic Stingray, *Dasyatis violacea*

3.2 UPDATES ON NPOA-SHARKS

31. The WPEB noted that few National Plans of Action – Sharks were provided from IOTC members at this meeting. The WPEB urged IOTC CPC's that have an NPOA-Sharks to present it during the next meetings of the WPEB (In appendix IV list of the countries that developed NPOAs-Sharks; Secretariat to provide if possible).

Seychelles: Progress on the implementation of the Seychelles National Plan of Action for the Conservation and Management of Sharks – 2007. (IOTC-2009-WPEB-18)

32. The status of shark stocks of Seychelles has been the subject of increasing conjecture in recent years with concerns as to the sustainability of current exploitation. There is particular concern about the common practice of "finning". With the increase the demand for shark fins on the Asian market the targeting of sharks and the practice of finning by local fishers has increased dramatically in recent years, whereas previously sharks were mostly taken as by-catch, with many being released. The Ministry of Environment and Natural Resources (MENR) and the Seychelles Fishing Authority (SFA) developed a National Plan of Action for the Conservation and Management of Sharks (NPOA-sharks) in accordance with FAO guidelines under its International Plan of Action (IPOA-sharks). The Seychelles NPOA-sharks was produced in April 2007. The NPOA-sharks sets out a four-year action plan with 11 work programmes that seek to address the 10 goals of the IPOA-sharks. The mission of the first 4-year phase of this NPOA is twofold:

- To establish the necessary capacity, systems and databases to enable the informed adaptive management of shark stocks in Seychelles
- To implement an active and progressive precautionary approach to the management of targeted and non-targeted shark fishing effort that takes into account the transitional needs of stakeholders.

33. The implementation of the Seychelles NPOA-shark has progressed relatively slowly since it was produced in April 2007. However with the setting up of a Scientific Committee, things are picking up. Funds are being secured by both NGOs and the Government (SFA) to address many of the work programme activities. The BEMA-SEYSHA research project will address many of the research gaps, particularly regarding biology, ecology and behaviour of coastal sharks in the Seychelles. The objective is to improve knowledge on the behavioural ecology of some coastal shark species in the Seychelles, and use this knowledge to inform management decisions. The consultative approach adopted in the implementation of the NPOA-sharks is proving positive and effective: stakeholders are already implementing some actions even in the absence of legislation or formal agreements. It is anticipated that more activities will be completed in 2010.

Maldives

34. Sharks are important for the Maldives. Watching sharks in their natural environment by tourist divers generates considerable revenue, and so there is much interest in the Maldives to protect sharks. Reef-associated sharks have been heavily fished and stocks are depleted. Oceanic sharks also appear to have declined significantly in abundance over recent years. Shark fishing is now banned within 12 miles of atoll rim. Effective from March 2010, the

Government of Maldives has decided to ban all forms of shark fishing as well as the import and export of shark products from Maldives. In addition to these developments, Maldives is working on the shark management issue with the support from the Bay of Bengal Programme Inter-Governmental Organization (BOBP-IGO), the member states of which are India, Maldives, Sri Lanka and Bangladesh. As part of implementation of FAO's Code on Conduct on Responsible Fishing, Maldives is developing a National Plan of Action - Sharks. The plan is currently in a draft form. The NPOA-sharks will include elements relating to socio-economic impact reduction, data collection and handling, research and development, education and awareness raising and improving coordination and consultation.

Japan

35. An identification guide for sharks is being distributed to observers, along with a training programme to help them with shark identification.

3.3 CONSERVATION OF SHARKS CAUGHT IN ASSOCIATION WITH FISHERIES MANAGED BY IOTC (DISCUSSION ON RECOMMENDATIONS FOR LANDING SHARK FINS).

36. Sharks are taken as bycatch in several Indian Ocean tuna fisheries. IOTC Resolution 05/05, paragraph 4 states that: "CPCs shall require their vessels to not have onboard fins that total more than 5% of the weight of sharks onboard, up to the first point of landing. CPCs that currently do not require fins and carcasses to be offloaded together at the point of first landing shall take the necessary measures to ensure compliance with the 5% ratio through certification, monitoring by an observer, or other appropriate measures."

37. In 2008, the WPEB recommended that, since the percentage of fins to body weight ratio requirement has no clear scientific basis, sharks should be landed with their fins naturally attached. This is required for the collection of reliable landing data, which would allow stock assessments. The Secretariat explained that, during last meeting of the IOTC Commission held in Bali in March-April 2009, several proposals were tabled in relation to conservation measures of sharks caught in association with fisheries managed by IOTC. These included the recommendation of WPEB, and others relating to the methods by which shark fins might be landed. However, a consensus was not reach on this matter and the status quo recommendation is still in place. In response to a request from the Commission for more information on the technical aspects of this issue, it was again discussed by the WPEB.

38. It was noted that the 5% ratio of fins to body weight has no clear scientific basis. There is a wide range of reported fin to body weight ratios both within and between species. Factors contributing to this variability include: differences in fin sizes between species; ontogenetic changes in fin sizes within species; and also methodological differences (*eg.* in fin cutting practices; in the number and type of fins used in the calculations; the type of carcass weight used; and the kind of processing for dressed carcasses). It was noted that there is currently considerable uncertainty among RFMOs and shark experts about what percentage level is appropriate.

39. It was noted that the 5% criterion, if enforced, would tend to reduce the wasteful practice of finning (*ie.* removing the fins and discarding the carcass). It might also tend to reduce fishing effort, particularly on sharks, since vessels would need to return to port more frequently to unload. However, the 5% criterion would not be valid to collect correct catch statistics and to improve the collection of biological sample. The WPEB further noted that the suggestion that fins could be detached and then re-attached to the carcass in a plastic bag was ecologically unacceptable. Rather, fins might be partially sliced through and folded over, thus minimizing storage space while remaining attached.

40. Therefore, the WPEB reiterated its previous recommendation (i.e. to land sharks with fins naturally attached) because that is the best way to ensure correct catch statistics, and to facilitate collection of biological information, as required to assess shark populations. The WPEB also considered that the landing of sharks with fins naturally attached was the best way to reduce or avoid the practice of finning.

41. In summary, **the WPEB recommended that all sharks be landed with fins naturally attached to the body**.

3.4 RESEARCH PROGRAMMES ON SHARKS

42. The WPEB was informed about the MADE (Mitigating ADverse Ecological impacts of open ocean fisheries) project, funded by the EU. The main objective of MADE is to develop measures to mitigate adverse impacts of fisheries targeting large pelagic fish in the open ocean, through application of appropriate knowledge on the biology and ecology of species and of the fisheries. Within this project, the silky shark is considered a priority species and various research activities are planned to study its biology, stock structure and migration. At the same time, technical

measures relating to different gears (circle vs. J-hooks) are being investigated in order to propose mitigation actions for silky shark within the Indian Ocean. Under MADE, an ecological FAD is also being developed to reduce the passive entanglement of various species of sharks and turtles (see also Turtle section).

3.5 IMPROVEMENT ON SHARK IDENTIFICATION

43. The WPEB recalled that mis-identification of sharks is a major factor affecting the quality of the available shark catch data. In 2008 the WPEB it recommended that guidelines on sharks identification and data collection should be developed. The WPEB noted that there was no progress on this and **recommended that the Secretariat should have a consultancy to develop these guidelines.**

44. The WPEB was informed that the Secretariat of the Pacific Community has produced a book (individual sheets) to assist fishers to identify sharks. IATTC has similar identification sheets. Such aids could be useful for observers and/or national administrations to improve the quality of information of data transmitted to IOTC. The WPEB requested the Secretariat to follow up, and use the existing sheets as a basis for the production of shark identification materials for the Indian Ocean.

45. **The WPEB also reiterated its recommendation from last year that CPCs**, which are conducting research cruises and observer programs, **develop digital photo archives of shark species and make these available to IOTC for wider use**. The WPEB was informed that Japan is producing some identification guides for shark identification.

46. The 6th Scientific Symposium of the Western Indian Ocean Marine Science Association (WIOMSA) was held in August 2009 at Université de La Réunion, St. Denis, Réunion. Shark issues were discussed at a workshop on "Sharks in the Western Indian Ocean: Current Knowledge and Research Needs for Conservation". The production of a field identification guide of sharks and rays of the western Indian Ocean has been identified as a high priority. Save Our Seas Foundation and WIOMSA will explore funding possibilities to develop such a guide.

3.6 STOCK ASSESSMENT ON SHARKS

47. The WPEB noted that several papers on shark biology and fisheries were presented during the meeting. In addition, an Ecological Risk Assessment for 5 fleets fishing in Indian Ocean was presented to the group; this was considered a particularly useful means of identifying the most vulnerable species of sharks, on which assessment efforts should be focussed. The WPEB agreed that the information presented, and the data currently available with IOTC, were insufficient to carry out a rigorous assessment for any shark species. Nevertheless, there was general agreement that various indicators could be used to illuminate shark population trends and to provide first indicators of stock status.

48. **WPEB recommended that such preliminary assessments should be initiated for sharks in the Indian Ocean to the extent possible**. In particular (taking into account their importance to fisheries and apparent declines in their catch rates) the WPEB considered that immediate research and assessment efforts should be directed to the following species: blue shark (*Prionace glauca*), oceanic whitetip shark (*Carcharhinus longimanus*) and silky shark (*Carcharhinus falciformis*).

49. The WPEB noted that whale sharks (*Rhincodon typus*) frequently associate with tuna schools, and that they are accorded iconic conservation status. **It recommended that information of potential value for stock assessment of whale sharks should be compiled for this species.**

3.7 ADVICE ON INTERACTIONS BETWEEN SHARKS AND TUNA FISHERIES IN THE INDIAN OCEAN

50. This section is covered within the Depredation section.

3.8 EXECUTIVE SUMMARIES ON SHARK SPECIES

51. Executive summaries on shark species prepared for 2008 Scientific Committee were reviewed. The WPEB considered the necessity to update these executive summaries in advance of 2009 Scientific Committee in December.

3.9 RECOMMENDATIONS RELATING TO SHARKS

52. The WPEB recommends that:

The 5% fin to body weight ratio measure be replaced with a resolution requiring sharks to be landed with fins naturally attached to the body.
CPCs that are conducting research cruises and observer programs, develop digital photo archives of shark species

and make them available to IOTC for wider use.
The status of Indian Ocean shark stocks be assessed, to the extent possible, using available information on various fishery indicators.
Particular attention and immediate research and assessment effort should be directed to the following species: blue shark (*Prionace glauca*), oceanic whitetip shark (*Carcharhinus longimanus*) and silky shark (*Carcharhinus falciformis*).
IOTC resolution 08/04 "Concerning the recording of the catch by longline fishing vessels in the IOTC area" be amended to: (a) add the following species to the minimum requirement list: great white shark crocodile shark, thresher sharks, tiger shark, requiem sharks, hammerhead sharks and pelagic stingray; (b) replace 'mako shark' with 'mako sharks'; and (c) delete porbeagle shark.
Priority be given to reviewing the status of pelagic sharks at the next meeting of the WPEB.
Information of potential value for stock assessment of whale sharks should be compliled

4. SEABIRDS

4.1 PAPERS PRESENTED

New information on the distribution of southern seabirds and their overlap with the IOTC zone (IOTC-2009-WPEB-13)

53. Recent information on the distribution of albatrosses and petrels in the IOTC convention area was presented. Albatrosses and petrels are part of the marine ecosystems, relying entirely on marine resources. They breed on oceanic islands, notably on several islands of the Indian Ocean south of the IOTC zone. The populations of several species have been declining over the past 30 years, and one species, the Amsterdam Albatross, is critically endangered. This decline has been related to bycatch mortality in longline fisheries. The problem of bycatch in the CCAMLR zone in waters surrounding the breeding grounds has been relatively well studied, and measures have been taken in the demersal toothfish fisheries to reduce seabird bycatch. In addition, previous studies have shown that breeding birds of several species fly to subtropical waters 1000-2000 km to the north, where their ranges overlap extensively with the fishing areas of tuna longliners. Demographic models suggest that the decline of all populations, through increased mortality of adults, is related to longline effort in the IOTC/CCSBT areas. Until now, however, little information was available on the distribution of the non-breeding part of the population, especially juvenile and immature birds that represent half of the total population. Recently, juveniles and immatures of eight species of albatrosses and petrels from Crozet, Kerguelen and Amsterdam Islands were tracked. A surprising result from these studies was that these naïve birds, believed to be very susceptible to bycatch, range much further north than do adult birds. Juvenile and immature ranges overlap completely with the southern part of the IOTC Convention area, as far north as latitude 25°S. This extends markedly the northern range of overlap previously considered (30°S), most importantly it shows that a significant part of these populations rely entirely on the IOTC Convention area during critical parts of their life cycle (Figure 1). An example was presented of a tracked Wandering Albatross that was caught by an Asian longliner. These results underline the need for observer programmes onboard longliners, and for more collaboration between seabird scientists working in the southern Indian Ocean. They also highlight the need for IOTC to develop an ecological risk assessment for IOTC fisheries that considers seabird interactions and the vulnerability of birds to the effects of longline fishing.

Table 6. Summary for the species of albatrosses and large petrels breeding in the southern Indian Ocean susceptible to longline fisheries

Species	IUCN Criteria	Trend over 30 years	Population size (breeding pairs/year)	Overlap of foraging range of breeding adults with IOTC zone	Overlap of foraging range non-breeding adults with IOTC zone	Priority for gathering information on bycatch in IOTC zone
Amsterdam albatross	CR	+	28	Complete	Complete	+++
Wandering albatross	VU	-	8,500	Moderate	High	++
Sooty albatross	EN	-	4,900	High	Complete	+++
Light mantled sooty albatross	NT	Stable	7,100	No	Low	+
Indian yellow nosed albatross	EN	-	41,500	High	?	+++
Black-browed albatross	EN	Stable	4,780	No	High	+
Grey-headed albatross	VU	+	24,140	Low	?	+
Northern giant petrel	NT	-	3,080	No	High	+++
Southern giant petrels	NT	+	6,900	No	Low	+
White-chinned petrel	VU	-	~250,000	Moderate	High	++
Grey petrel	NT	-	c. 7,000	Moderate	High	+++

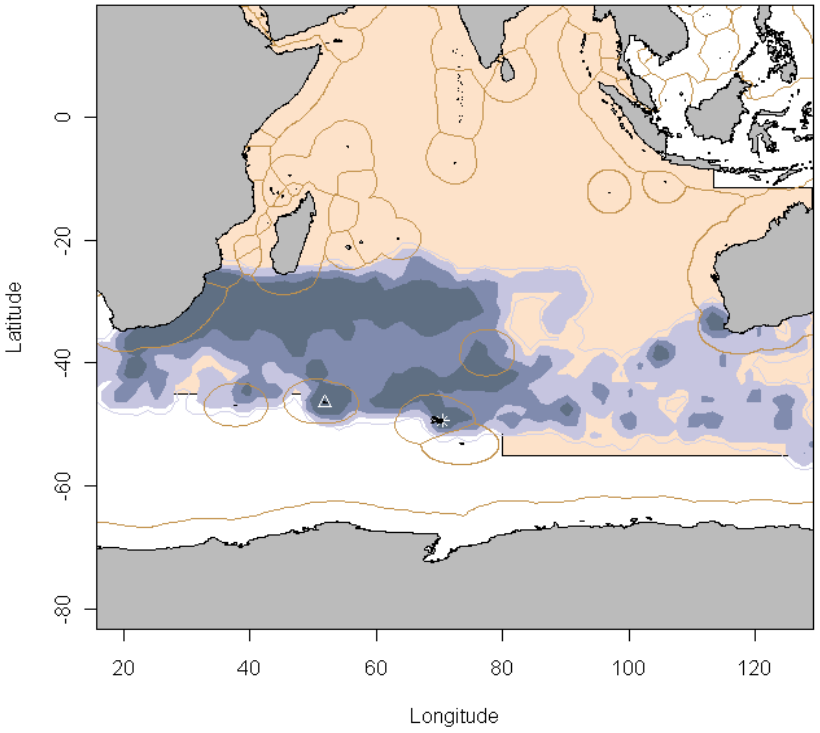

Figure 1. Combined density distribution of juvenile Sooty Albatross, White-chinned Petrel and Northern Giant-Petrel (blue-grey shading) tracked from the Crozet, Kerguelen and Amsterdam Islands during January-September 2009, showing extensive overlap with the southern sector of the IOTC convention area (pink shading).

54. During subsequent discussion WPEB members expressed a need for summary information about seabird biology, movements and population trends. It was noted that the website of the Agreement on the Conservation of Albatrosses and Petrels, ACAP (www.acap.aq) hosts detailed fact sheets covering many seabird species that interact with IOTC fisheries, and that these are freely available.

55. It was also mentioned that a seabird Executive Summary is due and should be ready for comment in time for the 2009 Scientific Committee meeting. This follows the format of previous Executive Summaries for other taxa. However, recognizing that the majority of threats, standards of data, biological and life-history details and other factors do not vary as widely between seabird species as they do for other taxa, e.g. sharks, this summary takes a more general approach. The summary includes a brief description of seabird life-history characters that predispose them to vulnerability to additional mortality. It focuses on longline fishing impacts because these are better understood, but details knowledge gaps and suggests priorities for further research for purse-seine and gillnet fisheries. It details

management concerns and the IOTC response to bycatch problems, as well as highlighting issues relating to data availability.

56. There was discussion about the fact that the distribution of some seabird species covers several ocean basins and RFMO areas, and that to protect them effectively there is a need for harmonized actions. Particularly relevant here are the CCSBT and the WCPFC. ACAP considered that the IOTC currently has the strongest mitigation measures of all tuna RFMOs. Bycatch was considered to be a serious concern for conservation of seabirds, but it was recognized that fishers are also trying to reduce incidental capture. The meeting emphasized the need for effective monitoring of the mitigation measures, which would require wide-ranging efforts to track effectiveness. Pivotal to this was the establishment of a good observer programme with dedicated bycatch observation duties, and an active specialist working group that meets regularly, reviews current levels of fishing effort and bycatch rates, undertakes a regular Ecological Risk Assessment process, and develops recommendations for management that are referred to the Commission. The model adopted by CCAMLR is widely acknowledged as extremely effective, but recently other tuna RFMOs (WCPFC, ICCAT) have also made progress in this respect, particularly in developing an ERA process.

57. It was pointed out that although CCAMLR currently has in place 100% observer coverage for many of its fisheries, the ERA process initially adopted was based on very poor information. Nevertheless, this process had yielded unequivocal, strong results that were used to implement effective seabird conservation measures.

4.2 SEABIRD MITIGATION MEASURES

58. The advice previously provided to the Commission in IOTC-2007-WPEB-21 is considered to represent the current best scientific advice for pelagic longline gear. However, there is much research currently underway that is likely to see changes in recommended approaches to mitigation in the next couple of years. A report on several research initiatives currently underway for pelagic longlining was provided.

59. ACAP pointed out that although several seabird avoidance measures have been trialled to varying degrees in pelagic fisheries, seabird avoidance measures require substantial improvement before they can be fully proven and accepted. Many of the mitigation measures currently adopted have little empirical support as to their efficacy. This applies to measures such as side-setting, bird-scaring lines, bait casting machines, blue-dyed bait and also line-shooter effect on mainline tension. ACAP has concluded that thorough comparative experimental assessment of many mitigation measures needs to be undertaken against Southern Ocean assemblages of diving seabirds (e.g. *Procellaria* petrels and *Puffinus* shearwaters) and albatrosses, with research based on larger sample sizes and more transparent methodologies before many measures could be applied with any confidence.

60. Bird scaring lines (BSL) are the most commonly prescribed seabird bycatch mitigation measures for longline fisheries, although peer reviewed publications of streamer line trials in pelagic fisheries are few and limited in scope. Most designs commonly used have no empirical support. Mr Ed Melvin (USA) has recently undertaken a series of trials on at least two Japanese longliners operating off South Africa to test three BSL designs. The results of this work should be available for the next meeting of the WPEB.

61. Research has recently been concluded by Dr Graham Robertson (Australia) on the effectiveness of line-shooters in increasing sink rate of baited hooks in pelagic longline fisheries. The research showed that setting the mainline loose with a line shooter resulted in slower sink rates in surface waters when compared with baited hooks set with a line shooter setting the mainline tight. This was contrary to what was expected, and most likely because propeller turbulence slowed the sink rates of loose mainlines and baited hooks, whereas hooks on lines set tight entered the water well clear of the propeller wash. Although tests against seabirds are required, this result suggests that mainlines set loose with a line shooter are likely to increase (not decrease) the risk to seabirds during line setting operations. Best practice recommendations will need to be revised in the light of this information. However, at this stage it would appear that unless mainlines can be set to avoid propeller turbulence, the use of line setters for deep setting should not be promoted as an effective mitigation measure. This advice is particularly relevant as line-shooters are one of the measures recommended as effective in Resolution 08/03 "On reducing the incidental bycatch of seabirds in longline fisheries" (Table 1, column B).

62. Other mitigation gear and approaches currently being studied include bait pods, smart hooks (http://www.ausindustry.gov.au/CustomerStories/Documents/Smart%20Hook.pdf), line-weighting regimes, safe leads and an underwater setting capsule that shows great promise, and which recently won the International Smart Gear Award for 2009 (www.smartgear.org). The results of these research programmes are likely to enter the public domain within the next year. For this reason the WPEB felt it would be premature to recommend changes to the current seabird conservation measures, but preferred to wait until the studies currently under way can be brought into consideration. Therefore **the WPEB recommends that there be no changes to the current advice, but that the WPEB should consider recommendations based on new, rigorous scientific evidence at their 2010 meeting.** At that time the

WPEB would consider, amongst other things, if the current mitigation measures were sufficient to reduce seabird bycatch to sustainable levels. **The WPEB further recommends that, in light of new information on the distribution of juvenile albatrosses and petrels, that the area in which longliners are required to use mitigation measures should be extended further north to latitude 25˚S**.

63. It was again emphasized that there is a clear need for good observer data to assess the efficacy of mitigation measures while they are being trialled. This is an essential component to improving mitigation measures. **The WPEB recommends that bycatch issues be given appropriate consideration in the development of observer data collection forms, standards and reporting procedures to the commission. Furthermore, any data previously collected by CPCs on bycatch of seabirds should be made available for preliminary assessment on the extent of bycatch and species composition.**

4.3 REVIEW OF NPOAS

64. No new NPOA-seabirds were presented at the meeting. BirdLife had initiated a process with FAO that resulted in the publication (in 2009) of Best Practice Technical Guidelines for IPOA/NPOA Seabirds. These would greatly facilitate the development of effective, strong NPOA-seabirds. ACAP undertook to present a review of NPOA-Seabirds at next year's WPEB meeting. It was felt that countries should be assessed for progress in developing NPOAs for sharks, seabirds and turtles. **The WPEB recommends that the Commission encourage CPCs to fulfil their FAO obligations and develop their NPOA-seabirds.** The Secretariat agreed to collect information from CPCs and prepare a table summarising progress towards the development of NPOAs for consideration at the SC in December.

4.4 UPDATE FROM BIRDLIFE INTERNATIONAL

65. There was a description of the outcome of the ERA process at ICCAT, which has recently been concluded and will be considered by the ICCAT Commission in November 2009. The recommendations from this process included expanding the area of application for seabird measures, based on concerns that complete lack of data (no systematic observer programme) for vast areas of the ICCAT Convention area required a precautionary approach. There was also a strong recommendation to establish a regional observer programme.

66. BirdLife also reported on the publication of a series of seabird bycatch mitigation fact-sheets. The fact-sheets present current best practice for mitigation measures currently endorsed by BirdLife International. The fact-sheets represent the collective input from many entities, including fishery managers, national fishing authorities and research institutes, fishermen and bycatch research scientists. It was noted that these documents will undergo regular review and updating as research refines designs and informs understanding of the practical implementation and value of different mitigation measures. These were available electronically to the meeting (IOTC-2009-WPEB-Inf08 BirdLife mitigation factsheets). Hard copies will be distributed at the SC 2009 meeting.

4.5 DISCUSSIONS AND RECOMMENDATIONS RELATING TO SEABIRDS

67. The WPEB discussed the value of the ERA process for seabirds, and recommended that one be commenced with work carried out inter-sessionally and at the next meeting of the WPEB.

68. The WPEB recommends that:

An ERA process be commenced for seabirds, with work carried out inter-sessionally and at the next meeting of the WPEB.
No changes be made to the seabird conservation measures in Resolution 08/03 at this time, but that the WPEB should consider new recommendations based on rigorous scientific evidence at the next meeting in 2010.
In light of new information on the distribution of juvenile albatrosses and petrels, consideration be given to extend the area in which longliners are required to use mitigation measures further north to latitude 25˚S.
Bycatch issues be given appropriate consideration in the development of observer data collection forms, standards and reporting procedures to the Commission.
Any data previously collected by CPCs on bycatch of seabirds should be made available for preliminary assessment by the WPEB on the extent of bycatch and species composition.

The Commission should encourage CPCs to fulfil their FAO obligations to assess the need for NPOAs Seabirds and develop plans if appropriate.
Seabird Executive Summaries should be produced in time for the 2009 Scientific Committee meeting, and updated regularly.
Priority be given to updating seabird recommendations at the next meeting of the WPEB.

5. TURTLES

5.1 PAPERS PRESENTED

Entanglement of Olive Ridley Turtles Lepidochelys olivacea *in ghost nets in the equatorial Indian Ocean (IOTC-2009-WPEB-07)*

69. Records of olive ridley turtles, *Lepidochelys olivacea*, in the Maldives (n = 45) were compiled, as were records of turtles entangled in nets from elsewhere in the topical Indian Ocean. With just two exceptions, all individuals for which measurements are available (n=37) were 61cm carapace length or less, i.e. immature. Most individuals were recorded in oceanic waters, which are believed to be an important habitat for juvenile olive ridley turtles. Most Maldivian records (84%) occurred during the northeast monsoon season and subsequent intermonsoon (December to April) when currents are predominantly from the east. This partly reflects the distribution of recording effort, but also suggests that many olive ridleys enter Maldivian waters from the east, possibly originating from the nesting beaches of eastern India. 71% of our recent records (n=34) were of olive ridley turtles entangled in pieces of fishing net (ghost nets), suggesting that this is an important cause of juvenile mortality. Since most forms of net fishing (including trawling, pelagic gillnetting and purse seining) are not used in the Maldives, the origins of these ghost nets must be international. During the northeast monsoon, when currents are from the east, the main sources of ghost nets appear to be Indian and Sri Lankan gillnet fisheries. During the southwest monsoon, when currents are from the west, an important source of ghost netting arriving in the Maldives is the western Indian Ocean tuna purse seine fishery, which uses very large numbers of net-festooned, drifting fish aggregating devices (FADs).

Design of ecological FADs (IOTC-2009-WPEB-16)

70. Purse seiners deploy thousands of Drifting Fish Aggregating Devices (DFADs) in all tropical oceans to catch tropical tunas. Although different designs of DFADs exist, fishers all over the world mainly use bamboo rafts with black netting hanging underneath. However, this type of FAD causes incidental mortality of sea turtles and sharks through entanglement. It is now urgent that fishers use "Ecological FADs" that reduce such ghost fishing in order to move towards sustainable and responsible purse seine fisheries. This study identified the criteria for Ecological FADs and proposed various possible designs for Ecological FADs taking into account ecological considerations as well as fishers' considerations.

5.2 BYCATCH OF MARINE TURTLES IN TUNA LONGLINES

71. IOTC Resolution 09/06 On Marine Turtles requires the WPEB to develop recommendations for mitigation measures, release guidelines and data collection for by-caught turtles. More specifically, the WPEB is asked to consider the effects of circle hooks on target species catch rates, marine turtle mortalities and other bycatch species. There are several studies in the literature that demonstrate that circle hooks do reduce sea turtle mortality, although some variation occurs in terms of ecological benefit across regions and fisheries. There was some concern that the use of circle hooks would increase catch rates of some shark species. However, sample sizes in some studies showing such an effect are small. **The WPEB recommended that, wherever possible, experiments of every fishing combination with longlines be conducted to assess the relative effects of hook type, bait and target depth in order to propose practical mitigation measures within the IOTC area**. It further **recommended that studies into the effectiveness of circle hooks adopt a multi-species approach, so as to avoid, as far as possible, promoting a mitigation measure for one bycatch taxon that might exacerbate bycatch problems for other taxa.**

72. While acknowledging some uncertainty regarding the impact of circle hook use on other species, the WPEB recognised that the use of circle hooks reduces turtle mortality, and considered that conservative action must be taken without delay according to the endangered status of several sea turtle species. Therefore, the **WPEB recommended that the use of circle hooks be extended in particular to shallow-set tuna longlines in the Indian Ocean.**

73. The WPEB acknowledged that fishermen are usually keen to release turtles caught by pelagic longline alive. However lack of proper experience, turtle release equipment and manuals often result in the unsatisfactory release of turtles by cutting the branch line. **The WPEB recommended the urgent development of IOTC guidelines on releasing sea turtles, and that these be made freely available to fishers.** These guidelines could be based on sea turtle handling guidebooks that have already been published by other organizations. A Sea Turtle handling Guidebook for fishermen (in different languages) is available at: http://www.medasset.org/cms/images/stories/FishermanGuide/Fisherman-guidebook_EN.pdf.

74. The WPEB further **recommended equipping all longline vessels with the necessary tools to remove hooks from the turtles to ensure safe release and minimize post-release mortality**. It was noted that dedicated de-hooking devices designed to remove hooks safely are already available on the market.

5.3 OTHER DISCUSSIONS ON MARINE TURTLES

75. With regard to FADs and turtle entanglements, the WPEB noted encouraging results from both scientists and industry in improving FAD design to reduce incidental mortality of species such as sea turtles. The WPEB reiterated its concerns regarding the use of pieces of net hung below FADs since they are a cause of mortality of sea turtles. **The WPEB recommended complete conversion to the use ecological FADs as soon as possible, and that they be constructed from biodegradable materials.**

76. The WPEB was informed of the 30th Sea Turtle Symposium to be held in Goa, India, in April 2010 (www.seaturtle.org).

77. The WPEB noted that no turtle experts attended the meeting and encouraged members to solicit participation at future WPEB meetings from colleagues with appropriate expertise.

78. The following problems related to sea turtles have been identified in previous years and are ongoing:

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

5.4 RECOMMENDATIONS RELATING TO MARINE TURTLES

79. The WPEB recommends that:

Complete conversion to the use ecological FADs be completed as soon as possible
Purse seine FADs be constructed from biodegradable materials
The use of circle hooks be extended to shallow-set tuna longlines in particular
Experiments of every fishing combination with longlines be conducted to assess the relative effects of hook type, bait and target depth in order to propose practical mitigation measures
IOTC guidelines on releasing sea turtles be developed, and that these be made freely available to fishers
All longline vessels to be equipped with the necessary tools to remove hooks from turtles to ensure safe release and minimize post-release mortality.

6. MARINE MAMMALS

80. There were no papers presented on bycatch of marine mammals. A presentation from WWF included evidence of marine mammal bycatch in the coastal fisheries of East Africa. Recalling the IOTC-WPEB 2008 meeting report, the WPEB reiterated the need to better understand the interactions between marine mammals and tuna fisheries. The WPEB was reminded that a MOU (under the CMS) now exists for the conservation of dugongs within the Indian Ocean.

81. An Indian Ocean Cetacean Symposium was held in Maldives in July 2009 (www.mrc.gov.mv). Some 60 delegates attended from 22 countries. A peer-reviewed proceedings volume is under preparation. The issue of marine mammal bycatch was noted as being of particular concern.

82. The significance of pelagic gillnets as a source of morality for marine mammals was reiterated. The WPEB stressed the need for national scientists from countries with major gillnet fisheries for tunas to document marine mammal mortality, as a first step towards mitigation.

83. The following problems issues marine mammals have been identified in previous years and are ongoing:

- Analysis of purse-seine fishery log-books in order to update the original information on marine mammal diversity and distribution within the Indian Ocean whale sanctuary as compiled for baleen whales by Robineau (1991) using data from the period 1982 to 1985
- Review of existing marine mammal data in the IOTC databases
- Encouragement of national scientists to make reports on the sightings made by observers of all marine mammals observed in tuna fishing operations within the IOTC

7. OTHER SPECIES

7.1 PAPERS PRESENTED

Fate of the fish caught on longline gears and potential mitigation measures (IOTC-2009-WPEB-15)

84. This document summarises some major results obtained during experiments conducted in collaboration with the Reunion Island (France) fishing industry. These studies may aid fishermen in modifying fishing operations and selecting a fishing strategy to increase economic benefits and also to reduce the impact on bycatch mortality. Firstly, we investigated the behaviour of the fishes when caught on the longline gear and the survivorship of fish hooked, using longline gears instrumented with hook time recorders (HT) and temperature depth recorders (TDR). We showed that the percentages of fish recovered alive at hauling varied among species. The percentages of fish recovered alive up to 8 h after capture provides a rough idea of the resistance of each species to the capture process; these rates were recorded for the blue shark (*Prionace glauca*), the oceanic whitetip shark (*Carcharhinus longimanus*) and for the bigeye tuna (*Thunnus obesus*) and were respectively 29%, 23 % and 27% while this rate was lower for the swordfish (8%). Moreover, we demonstrated that shortening the soaking time during the fishing operation could be beneficial in many ways for fishermen. A second study on the reproduction dynamic of the swordfish in the vicinity of Reunion Island showed that the Big Old Fat Fecund Female Fish (BOFFFF) hypothesis could effectively apply to this species. Consequently, the removal of the larger, older individuals could be detrimental for the stock and the current results may be used, in the future, to support new policies preserving population age structure. One management method available to conserve older fish would be to institute slot size limits for retention (minimum and maximum size) but this potential measure to be successful individuals must survive their release back to the water. The last study aimed at investigating the possibility of developing a method to reduce the stress of the fishes caught with hooks. Prototypes of "sleeping hook" were developed and tested, using rod and reel, around moored fish aggregating devices (FADs). During the fishing experiments a total of 162 fish comprising 3 main species were caught including: yellowfin tuna (*Thunnus albacares*), skipjack tuna (*Katsuwonus pelamis*) and dolphinfish (*Coryphaena hippurus*). Analyses of blood chemistry stress indicators revealed the "sleeping hook" method to be successful in reducing the fish stress. Additional research should be conducted to evaluate the feasibility of reducing the soaking period in the current fishing strategy. However, the "sleeping hook" could contribute to the development of alternative fishing technology enabling also to reduce the side effect of protracted soaking times e.g. by reducing post hooking mortality and increasing the post release survivorship of species of conservation concern and unwanted sized target species.

7.2 DISCUSSIONS AND RECOMMENDATIONS RELATING TO OTHER SPECIES

85. The importance of large fecund individuals for maintaining the spawning potential of the stocks were discussed. Although widely mentioned in the other fisheries literature this has not been well document in the pelagic fisheries. This important line of thinking should be considered in the stock conservation and management of the pelagic resources.

8. DEPREDATION

8.1 PAPERS PRESENTED

Progress made on mitigation of depredation in the Seychelles semi-industrial longline fishery (IOTC-2009-WPEB-18)

86. A semi-industrial longline fishery targeting swordfish and tuna started in Seychelles in 1995. An analysis of depredation data collected by the Seychelles Fishing Authority since that time revealed an overall depredation rate of 21%, representing 4.2 fish lost/1000 hooks, which is one of the highest depredation rates in the world. Given this, and the significant economic loss that results, an action plan to mitigate depredation by cetaceans on the Seychelles semi-industrial longline fishery was drawn up in 2006. Three research cruises were conducted onboard commercial semi-industrial fishing vessels between 2006 and 2008 with the following objectives: (a) to understand the fishing operation in order to design suitable mitigation devices; (b) to identify the marine mammals involved in depredation; and (c) to identify and record acoustic signals generated by the vessel which may attract predators. The study shows that several species of cetaceans are likely to be involved in depredation on the semi-industrial longline fishery. Spinner dolphins, Risso's dolphins, pygmy killer whales and rough-toothed dolphins were identified in the vicinity of the fishing gears, and were considered to be potential predators. Trials with 'SPIDER' mitigating devices were not successful as they failed to deter depredation and the protection provided was inadequate (especially in the case of hooked swordfish): in many cases when the device had been triggered, the captured fish was still depredated. To date there has been no further work to improve the SPIDER depredation mitigation device due to lack of funds. Further research is anticipated once funds are secured.

Assessment of the efficiency of the physical protection of fish as mitigation measure to depredation by marine mammals in pelagic longlining. (IOTC-2009-WPEB-12)

87. The results of the experimental field trials of depredation mitigation devices (DMD) was presented. Two types of DMD, called "spider" and "sock" were designed and tested respectively in November 2007 and November 2008 onboard the same vessel. Both surveys aimed at checking the efficiency of each DMD and assessing whether they fit the fishing gear and fishing technique parameters and constraints. Final results show low operational performance of both devices in term of handling usability, and protection of the catch.

Depredation: improvement of the information flow within IOTC. 1. Draft IOTC information sheet, reporting form and webpage. (IOTC-2009-WPEB-04)

88. An information sheet aimed at improving knowledge of the non-scientific community in the IOTC region on depredation on pelagic longline gears was presented. An approach to increase information flow between local fishermen and IOTC through the Commission's website was discussed. A draft voluntary depredation reporting form for small-scale fisherman was proposed (Appendix V).

Depredation: improvement of the information flow within IOTC. 2. On IOTC Resolution 08/04 "Concerning the recording of the catch by longline fishing vessels in the IOTC area". How to incorporate depredation information and improve shark catch statistics? (IOTC-2009-WPEB-04)

89. Amendments to IOTC resolution 08/04 "Concerning the recording of the catch by longline fishing vessels in the IOTC area" aimed to improve collection of the data on depredation and shark bycatch in the IOTC regulation area are presented. Two amendments to the resolution aimed to include depredation information in the longline logbooks were presented. (These are covered under Section 2 on Sharks).

8.2 DISCUSSIONS AND RECOMMENDATIONS RELATING TO DEPREDATION

90. The WPEB noted that there was much research being carried out elsewhere in the world, and that it would be highly advantageous for regional scientists to keep abreast of all developments. At the same time it was recognised that there may be regional differences, which make it highly desirable to continue research on depredation within the Indian Ocean.

91. The WPEB noted that sharks as well as cetaceans were a cause of depredation on longlines. It was also noted that spinner dolphins feed mainly on small prey (*eg.* mesopelagic fishes) and were unlikely to be involved in depredation.

92. The WPEB discussed the need for improved collection and reporting of statistics relating to depredation. This was previously noted by the Workshop on Depredation held by IOTC in Seychelles in 2007. Depredation is recognized as a source of both economic losses and unreported fishing mortality in small-scale and industrial longline fisheries. Lack of data not only prevents quantification of these impacts, but also hinders identification of depredation hotspots and development of mitigation measures. The WPEB acknowledged that IOTC Resolution 08/04 "Concerning the recording of catch by longline fishing vessels in the IOTC area" was an important step towards the adoption of standard longline logbooks. However, that Resolution did not include mandatory measures on the collection of data on depredation. It was suggested that this could be rectified with only minor modification to the logbooks. Two amendments were proposed:

- **Amendment 1** to Resolution 08/04: Appendix II, Section 2-2 CATCH/CAPTURES. It is recommended that the following text be added: " 2) For each species, number of individuals damaged by sharks or cetaceans should be given in brackets after the number of individual caught. Numbers of damaged fish should not to be included with the number of individuals caught, which are considered as non-damaged individuals."
- **Amendment 2** to Resolution 08/04: Appendix II, Section 2-4 REMARKS/REMARQUES. It is recommended that the following text be added: " 3) Each depredation event (damage of the catch by sharks or cetaceans) should be carefully documented in the remarks. The cause of damage may be identified by sighting of predators in the vicinity of the vessel/gear or by post-mortem traces on damaged fish; this should be indicated in the remarks. Sightings information should include the number of individual predators seen in the vicinity of the gear/vessel."

8.3 RECOMMENDATION RELATING TO DEPREDATION

93. The WPEB recommends that:

An amendment be made to Resolution 08/04: Appendix II, Section 2-2 CATCH/CAPTURES, with the addition of the following text: " 2) For each species, number of individuals damaged by sharks or cetaceans should be given in brackets after the number of individual caught. Numbers of damaged fish should not to be included with the number of individuals caught, which are considered as non-damaged individuals."
A second amendment be made to Resolution 08/04: Appendix II, Section 2-4 REMARKS/REMARQUES, with the addition of the following text: " 3) Each depredation event (damage of the catch by sharks or cetaceans) should be carefully documented in the remarks. The cause of damage may be identified by sighting of predators in the vicinity of the vessel/gear or by post-mortem traces on damaged fish; this should be indicated in the remarks. Sightings information should include the number of individual predators seen in the vicinity of the gear/vessel."
There is a need to continue research on monitoring and mitigation of depredation within the Indian Ocean.

9. ECOSYSTEM APPROACHES

9.1 PAPERS PRESENTED

Some recent trends in the Indian Ocean pelagic ecosystem traced from historical and recent data.

94. Preliminary results of an analysis of abundance trends of several elasmobranch and teleost fish in the Indian Ocean pelagic ecosystem were presented, based on data from research longline cruises. A widespread decline in the abundance of top predators such as large pelagic sharks and tunas was demonstrated, as was the emergence of the

several mid-sized, lower-trophic-level species such as crocodile shark and lancetfish. The relative abundances of lancetfish and tuna showed a dramatic shift between 1960-1990 and 2000-2008, with tuna being replaced by lancetfish. During 1960-1990 there were 5 tuna to 1 lancetfish, now there is 1 tuna to 5 lancetfishes.

Ecological Risk Analysis (IOTC-2009-WPEB-20)

95. A Productivity Susceptibility Analysis (PSA) was carried out using data from five Indian Ocean tropical tuna fisheries: EU purse seine (2003-20007), Soviet Union purse seine (1983-1995), Soviet Union longline (1961-1989), Taiwanese longline (2002-2008) and Reunion longline. The PSA showed somewhat similar results for all fleets. Overall, two high risk species groups were identified. One included sharks (both coastal and pelagic) and was characterized by low productivity and high susceptibility values to different fishing gears. The second group included teleosts (both IOTC and non-IOTC species), characterized by higher productivities but high susceptibility to purse seine and longline gear.

96. The WPEB considered this kind of analysis to be a very useful means of rapidly assessing large numbers of taxa, and identifying potentially vulnerable species that can then be subject to more detailed and rigorous analyses. The importance of both widening and refining the scope of such analyses to include improved estimates of biological parameters, additional species (*i.e.* marine turtles and seabirds), and information from other fisheries (such as gillnet fisheries) was noted.

WWF - Eastern African Marine Ecoregion (EAME) bycatch reduction and mitigation strategy: key issues, challenges and opportunities. (IOTC-2009-WPEB-22)

97. The WWF-EAME is working closely with partners, including the international community in coastal East Africa (Kenya, Tanzania and Mozambique) to implement bycatch reduction and mitigation measures in tuna and shrimp fisheries. These measures include: promoting ecosystem-based approaches to fisheries management; supporting trials and testing of bycatch reduction devices, including turtle excluder devices (TEDs) in the shrimp fisheries and circle hooks in tuna longlining; encouraging and promoting innovative fishing gears through the international smart gear competition; raising consumer awareness about sustainably caught fish and fishery products; documenting bycatch related information to inform policy and decision making; strengthening policy and legislation on bycatch; and integrating science into conservation. WWF has assisted with the establishment and supports the effective management of Marine Protected Areas (MPAs) and priority seascapes in the region. WWF and partners are also promoting stepwise marine fisheries certification as a market-based approach to address bycatch issues. The lobster, octopus and shrimp fisheries in Kenya, Tanzania and Mozambique, respectively are currently undergoing pre-assessments. Further work was required on: systematic collection of bycatch data; assessment of mortality from bycatch; impacts on populations for both target and non-target species; mitigation measure research; compliance with bycatch norms; observer programme implementation; institutional, legal and policy framework strengthening; and mobilization of funding to support the implementation and enforcement of existing bycatch measures. WWF's commitment to collaborate with relevant partners, including IOTC and its Working Parties to address tuna fishery issues, including bycatch reduction and mitigation, was expressed.

9.2 DISCUSSIONS AND RECOMMENDATIONS RELATING TO ECOSYSTEM APPROACHES

98. The WPEB noted the occurrence of population explosions of mantis shrimp and swimming crabs within the western Indian Ocean. They were often associated with remarkably increased tuna catches, particularly of yellowfin tuna. It was agreed that observations on such events are important and the **WPEB recommended that such events should be well documented for a better understanding of ecosystem variability and its implications for abundance and catchability of pelagic species.**

99. **The WPEB encouraged further work on ecological risk assessment (ERA).** It was clear that there is lack of data for many Indian Ocean bycatch species. This makes quantitative stock assessment impossible, and thus increases the value of ERAs. Nevertheless, the collection of biological information for all bycatch and ecologically significant species is important within the region.

100. The WPEB noted with interest and concern the apparent replacement of tunas with lancetfish in some longline catches. This development requires further investigation.

9.3 RECOMMENDATIONS RELATING TO ECOSYSTEM APPROACHES

101. The WPEB recommends that:

Further work on Ecological Risk Assessments and that ERA analysis is expanded to other fisheries and taxa.
Population explosions of mantis shrimps and swimming crabs within the western Indian Ocean should be properly documented.

10. RESEARCH RECOMMENDATIONS AND PRIORITIES

102. In order to evaluate the efficiency and effectiveness of the working party, the Commission requested the WPEB to review its previous recommendations annually. Comments on the status of the 2008 recommendations are provided below as underlined text. The references to report paragraphs refer to paragraphs in the WPEB-4 Report (2008).

DATA
1. That the actions in Table 2 be taken to improve the standing of the data on non-tuna species currently available at the Secretariat (Paragraph 9). • *Little progress has been made*
2. That IOTC member countries with major fisheries send trained and knowledgeable scientists to WPEB meetings in the future (Paragraph 14). • *Recommendation partially implemented with good representation by fisheries and seabird biologists in 2009. However, not all CPCs represented and no marine turtle experts present in 2009. Greater representation of shark biologists in future would be helpful, particularly given the importance of both directed catch and bycatch of this group within the IOTC Area. Continued representation of seabird biologists also considered necessary given need to review Resolution 08/03, as well as better attendance by other specialists.*
3. That IOTC Recommendation 05/07 Concerning a management standard for the tuna fishing vessels, to deploy if appropriate, scientific observers on-board the vessels according to the Commission's Resolution (Appendix I-ii), become binding on members (Paragraph 17). • *Resolution 09/04 has addressed this recommendation.*
4. That the Commission mandate the WPEB (though the Scientific Committee) to develop regional standards covering data collection, data exchange, training and the development of guidelines for the operational aspects of such programmes and use these to assist members, especially those with major bycatch issues, improve their bycatch data collection and reporting (Paragraph 19). • *Resolution 09/04 has addressed this recommendation.*
SHARKS
5. In response to a request from the Commissions for more information on the technical aspects of IOTC Resolution 05/05 "Concerning the conservation of sharks caught in association with fisheries managed by IOTC", the WPEB recommended the advice relating to Paragraph 34 be put forward to the Scientific Committee for its consideration (Paragraph 35). • *The WPEB reiterates its position stated during its last session. For scientific reasons the WPEB recommends that the 5% fin to body weight ratio measure be replaced with a resolution requiring sharks to be landed with fins naturally attached to the body.*
6. That CPCs that are conducting research cruises and observer programs, develop digital photo archives of shark species and make it available to IOTC for wider use (Paragraph 40). • *No progress made*
7. That stock assessments be initiated for sharks in the Indian Ocean to the extent possible, given the current data

limitations (Paragraph 42).

- *Little progress made. While full stock assessments may not be possible because of data limitations, it is still essential that some of stock evaluation be carried out for impacted species. Priority species have been identified (silky shark, oceanic whitetip shark and blue shark) and this has been identified as a priority for work both intersessionally and at the WPEB meeting in 2010.*

SEA TURTLES

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

- *SPC has provided a booklet and agreed to its use by IOTC. Funds will be sourced from the Commission for production and distribution to fishers and fisheries managers.*

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

- *Implemented but needs to be updated on regular basis.*

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

- *Some progress made with development of an ecological FAD and at-sea trials conducted by fishers. The WPEB recommended complete conversion to the use of ecological FADs as soon as possible and that these FADs are made of biodegradable materials.*

ECOSYSTEM APPROACHES

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

- *A preliminary ERA has been undertaken, including observers data for sharks, turtles and teleosts from five fisheries. The WPEB encourages further work on ERAs and that ERA analysis is expanded to other fisheries and taxa.*

12. That close collaboration and collaborative work should be pursued with WCPFC, ICCAT and IATTC with respect to ERA (Paragraph 84).

- *A close collaboration is being carried out between researchers from different Tuna RFMOs to share knowledge, methods and data in order to carry out ERA analysis for different tuna and tuna-like species fisheries.*

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

- *Good progress made, with several WPEB members actively participating in CLIOTOP activities.*

11. OTHER BUSINESS

103. Dr Charles Anderson was nominated by the Working Party as the new Chair, following advice that the current Chairperson Mr Riaz Aumeeruddy had indicated an inability to continue in the position.

104. The WPEB acknowledged the many contributions and expressed its deep appreciation of the work of the previous Chair, Mr Riaz Aumeeruddy.

12. ADOPTION OF THE REPORT

105. The Report of the Fifth Session of the Working Party on Ecosystems and Bycatch was adopted by correspondence on the 20th November 2009.

APPENDIX I

WORKING PARTY ON ECOSYSTEMS AND BYCATCH
12/10/2009 – 14/10/2009
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APPENDIX II

DRAFT AGENDA FOR THE 5TH SESSION OF THE WORKING PARTY ON ECOSYSTEMS & BYCATCH, 12-14 OCTOBER 2009

1. OPENING REMARKS

2. REVIEW OF THE DATA ON BYCATCH

- Review of the data available in the IOTC database (Secretariat)
- Data from other sources
- Status of observer programmes

3. SHARKS

- Papers as provided by participants
- Review of any National Plans of Action for the reduction of shark bycatch in tuna fisheries
- Conservation of sharks caught in association with fisheries managed by IOTC (*discussion on way forward as the Commission rejected the recommendation of the WPEB/SC*).
- Research programmes on sharks
- Improvement on shark identification
- Stock assessment on sharks
- Advice on interactions between sharks and tuna fisheries in the Indian Ocean
- Executive summaries on shark species

4. SEABIRDS

- Papers provided by participants
- Review of any National Plans of Action for Reducing Incidental Catches of Seabirds in Longline Fisheries
- Update from Birdlife International
- Advice on interactions between seabirds and tuna fisheries in the Indian Ocean

5. TURTLES

- Papers provided by participants
- Review of any National Plans of Action for the reduction of sea turtle bycatch in tuna fisheries
- Research on effect of sea turtles mitigating measures (circle hooks)
- Draft Executive Summary on sea turtles
- Advice on interactions between sea turtles and tuna fisheries in the Indian Ocean

6. MAMMALS

- Papers provided by participants
- Research programmes on marine mammals

7. OTHER SPECIES

- Papers provided by participants
- Research programmes on other species

8. DEPREDATION

- Review of available data on depredation

- Requirement for improvement of the data on depredation
- Stock assessment and depredation

9. ECOSYSTEM APPROACHES

- Ecological Risk Assessment for bycatch monitoring, analysis and management, in an RFMO context
- Papers presented by participants

10. RESEARCH RECOMMENDATIONS AND PRIORITIES

- Mortality caused by non-degradable waste

11. OTHER BUSINESS

APPENDIX III

LIST OF DOCUMENTS

Document	Title	Availability
IOTC-2009-WPEB-01	Draft agenda of the Working Party on Ecosystems and Bycatch	✓
IOTC-2009- WPEB-02	WPTEB List of documents	✓
IOTC-2009-WPEB-03	Scientific catches estimations of bycatch species landed by the Spanish surface longline fleet targeting swordfish (*Xiphias* gladius) in the Indian Ocean with special reference to the years 20077 and 2008. *A. Ramos-Cartelle, B. García-Cortés, J. Fernández, J. Mejuto*.	✓
IOTC-2009-WPEB-04	Depredation. Improvement of the information flow within IOTC. 1. Draft IOTC information sheet, reporting form, and webpage. *E.V. Romanov*	✓
IOTC-2009-WPEB-05	Depredation. Improvement of the information flow within IOTC. 2. On the IOTC resolution 08/04 "Concerning the recording of the catch by longline fishing vessels in the IOTC area": how to incorporate depredation information and improve shark catch statistics?. *E.V. Romanov*	✓
IOTC-2009-WPEB-06	Size distribution and length-weight relationships for some large pelagic sharks in the Indian Ocean. *E.V. Romanov, N.V. Romanova*	✓
IOTC-2009-WPEB-07	Entanglement of Olive Ridley Turtles *Lepidochelys olivacea* in ghost nets in the equatorial Indian Ocean. *R.C. Anderson, H. Zahir, R. Jauharee, T. Sakamoto, I. Sakamoto and G. Johnson*	✓
IOTC-2009-WPEB-08	Opinions count: decline in abundance of Silky Sharks in the central Indian Ocean reported by Maldivian fishermen. *R.C. Anderson and R. Jauharee*	✓
IOTC-2009-WPEB-09	Status of IOTC databases for NON-IOTC SPECIES. *M.Herrera, L. Pierre, IOTC Secretariat*	✓
IOTC-2009-WPEB-10 (pres)	Papier sur SEALOR (le point sur la base données observateurs LL Réunion). *P. Bach*	
IOTC-2009-WPEB-11	Papier sur Age et croissance requin Peau bleue. *N. Rabehagasoa*	✓
IOTC-2009-WPEB-12	Assessment of the efficiency of the physical protection of fish as mitigation measure to depredation by marine mammals in pelagic longlining. *N. Rabearisoa, P. Bach, V. Lucas, F. Giroux, M. Vely, E. Romanov, P. Tixier, C. Guinet*	✓
IOTC-2009-WPEB-13 (pres)	New information on the distribution of southern seabirds and their overlap with the IOTC zone. *K Delord and H. Weimerskirch*	
IOTC-2009-WPEB-14	Some issues on observer programs discussed at the 6th International Fisheries Observer and monitoring conference (Portland, ME, USA, July 2009) relevant for IOTC WPEB working group. *P. Chavance, J. Amande and P. Cauquil*	✓
IOTC-2009-WPEB-15	Fate of the fish caught on longline gears and potential mitigation measures. *F. Poisson*	✓
IOTC-2009-WPEB-16	Design of ecological FADs. *J. Franco, L. Dagorn, I. Sancristobal, G. Moreno*	✓
IOTC-2009-WPEB-17	Decline in CPUE of Oceanic Sharks in the Indian EEZ : Urgent Need for Precautionary Approach. *M.E. John and B.C. Varghese*	✓
IOTC-2009-WPEB-18	Implementation of the Seychelles National Plan of Action for the Conservation and Management of Sharks – 2007. *V. Lucas, C. Assan, J. Dorizo*	✓
IOTC-2009-WPEB-19	Sharks Madagascar – *T. Randriambola*	✓
IOTC-2009-WPEB-20 (pres)	Ecological Risk Assessment for species caught in IOTC fisheries. *H. Murua, H. Arrizabalaga, J. Julia Hsiang-Wen Huang, E. Romanov, P. Bach, P. Chavance, A. Delgado de Molina, R. Pianed, J. Ariz, J. Ruiz*	
IOTC-2009-WPEB-21 (pres)	Quantitative estimates of the by-catches of the main species of the purse seine fleet in the Indian ocean, 2003-2008. *R. Pianet, P. Chavance, H. Murua, A. Delgado de Molina*	
IOTC-2009-WPEB-22 (pres)	Fisheries Sustainability in Eastern African Marine Ecoregion (EAME). By-catch: Key Issues, Challenges and opportunities. *E.Kimakwa*	
IOTC-2009-WPEB-Inf01	Crocodile shark (*Pseudocarcharias kamoharai*) distribution and abundance trends in pelagic longline fisheries. *E.V. Romanov, J.C. Levesque*	✓
IOTC-2009-WPEB-Inf02	Depredation on pelagic longlines in the Indian Ocean: an analysis of historical trends, severity, implications. *E.V. Romanov, D. Gaertner, P. Bach, N.V. Romanova, V. Lucas, N. Rabearisoa*	✓
IOTC-2009-WPEB-Inf03	Diversity and assemblage of micronekton in the Mozambique Channel using pelagic trawls and stomach contents of top predators. *M. Potier, F. Menard, E. Romanov, D. Benivary,M. Mwale.*	✓
IOTC-2009-WPEB-Inf04	Trophic positions of micronektonic organisms in the Mozambique Channel: new information from stable isotopes. *F. Menard, N. Coffineau, D. Benivary, F. Le Loc'h, N. Bodin, M .Potier*	✓
IOTC-2009-WPEB-Inf05	Circle Hooks and Longline Catches. *P. Ward and S. Hall*	✓
IOTC-2009-WPEB-Inf06	Do circle hooks reduce the mortality of sea turtles in pelagic longlines? A review of recent experiments. A.J. Read	✓
IOTC-2009-WPEB-Inf07	NGO letter for WPEB	✓
IOTC-2009-WPEB-Inf08	Birdlife Mitigation Factsheets	✓
IOTC-2009-WPEB-Inf09	Bycatch WCPFC09	✓
IOTC-2009-WPEB-Inf10	WPEB Recommendations 2008	✓
IOTC-2009-WPEB-Inf11	Sharks Turtles Executive Summaries	✓

APPENDIX IV

List of countries with NPOA Sharks and NPOA Seabirds

	NPOA Sharks	NPOA Seabirds
Australia	X	
European Community	X	
Japan	X	
Kenya	X	
Korea	X	
La Réunion (France)	X	
Malaysia	X	
Philippines	X	
Seychelles	X	
South Africa	X	
Taiwan,China	X	

APPENDIX V

Depredation information sheet and Draft 'voluntary depredation reporting form

Depredation in pelagic fisheries

1. What is a depredation?

Depredation is a common term for removal or damage of the catch (bait) from fishing gear or cultured animals in stocking facilities. Depredation is a particular manifestation of the interaction between fisheries or aquaculture and non-target species such as marine mammals, elasmobranch and teleost fish, birds, molluscs or crustaceans.

2. How to identify depredation?

Damage of the catch or damage of the bait (LL)

3. Which fishing gears affected in IOTC area?

- Pelagic longlines – often,
- Driftnet – no data, probably often,
- Purse seine – rarely,
- Pole and line – no data, probably rarely.

4. How to identify causes of depredation (species responsible)?

Direct observations of depredation events are rare. Predators responsible for damage are usually identified on the basis of traces left on bitten fish remains and on the basis of the depredation pattern

CHARACTER/PATTERN OF THE DAMAGE AND TRACES OF PREDATOR

Damage pattern:

- **Heavy damage** (high percentage **of the catch** or **all fish caught** are damaged) usually corresponds to ***cetacean*** damage
- **Heavy damage of individual fish** (heads only or even maxillary parts with operculums only) usually corresponds to ***cetacean*** damage. Single crushing and tearing off bite.
- **Sporadic damage** with **several visible bites** on the fish body fish usually corresponds to sharks or other non-cetacean predators.

If you have signs of shark depredation most probably one of the next fish caught will be shark.

Traces on fish caught or on bait:

Clear crescent-like cuts are sign of the large pelagic **shark** depredation. All **pelagic shark** species **involved in depredation** have blade-like, very sharp teeth, situated in several rows in jaws forming crescent-like mouth. Such teeth morphology and mouth shape allow them to make clear cuts of fish flesh. Even mako sharks, with incomplete cutting edges on jaws (Compagno, 2001) can clearly bite piece of fish caught.

Shark left crescent-shaped cuts in the body of fish with sharply cut edges of wounds and overall damage to the fish caught very often represented by one or several single bites (see also Chapman *et al.*, 2006, Gilman *et al.*, 2008).

Ragged wounds, tear off (instead of cut) pieces of flesh, traces of conical teeth are signs of **cetacean** depredation.

Cetaceans involved in depredation (toothed whales) have sparsely-settled conical teeth. Jaws shape is rather conical or oval than crescent-like.

Edges of wounds left by toothed whales on fish usually ragged, with traces of conical widely spaced teeth. Toothed whales often eat fish completely up to the position of the hook in the fish body. In many cases toothed whales left only jaws and operculums of mouth-caught tuna. Predation pattern of cetaceans suggest that toothed whales are able to identify position of metallic hooks inside fish body by their organs of sonic location (Romanov *et al.*, 2007).

Small (up to 5-8 cm in length) oval or circular clean cuts are depredation by **cookie-cutter shark**.

(Chapman *et al.*, 2006)(Chapman *et al.*, 2006).

Squid or birds damage occurred more rarely than other types of depredation.

5. How to avoid depredation?

- ***Do not feed cetaceans;***
- ***Do not discard fish or offal in the presence of cetaceans; same measures are useful to avoid shark attraction to fishing gears;***
- ***Do not set or haul gear when cetaceans are around;***
- ***Change fishing are;***
- ***Set you longline deep:*** deep setting decrease longline interactions with sharks and bring additional benefits: decrease interaction with endangered species like sea turtles and increase catch of highly valuable species like bigeye tuna;
- ***Avoid depredation hotspots:*** avoid setting in the hotspots of sharks: seamounts, oceanic shoals, and shelf edge;
- ***Control soaking time:*** do not increase soaking time. Decrease soaking time if you faced depredation***;***
- ***Report depredation:*** mitigation of depredation need joint effort of fishers, researchers and managers. Report depredation will help to monitor depredation in your region and to develop mitigation measures; Take a photographs if it possible.

6. How to report depredation?

If your vessel is over 24 m long record in the vessel logbook all fish individuals depredated, specifying to the extend possible fish species and identification of predator. You can report also depredation visiting **IOTC website (www.iotc.org/xxx/xxx)**.

If your vessel is smaller than 24 m long, please report depredation in special form available at **IOTC website** or your local fisheries office.

Do not forget: Indian Ocean is international cetacean sanctuary (established by International Whaling Commission IWC): do not make any harm to cetaceans even if they do harm to you.

Useful references:

Chapman, L., P. Sharples, D. Brogan, A. Desurmont, S. Beverly, and W. Sokimi. 2006. Marine species identification manual for horizontal longline fishermen/Manuel d'identification des especes marines destine aux pecheurs a la palangre horizontale. SPC, Noumea (New Caledonia) 152 p.

Gilman, E., S. Clarke, N. Brothers, J. Alfaro-Shigueto, J. Mandelman, J. Mangel, S. Petersen, S. Piovano, N. Thomson, P. Dalzell, M. Donoso, M. Goren, and T. Werner. 2008. Shark interactions in pelagic longline fisheries. Marine Policy 32:1-18.

Romanov E., Gaertner, D., Bach, P., Romanova, N. 2008. Depredation on pelagic longlines in the Indian Ocean: an analysis of the Soviet historical database (1961-1989) on tuna research. Proceedings of the international workshop on the depredation in the tuna longline fisheries in the Indian Ocean, Seychelles, 9-10 July 2007.

DRAFT voluntary reporting form for depredation

Confidential data
For statistical purposes only
None of the fields are obligatory

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

Tuna Statistics in the Indian Ocean

IOTC Form 99:
Voluntary reporting form for depredation and other non-target species for small-scale fisheries

Page ____ of ____

Vessel name	
Vessel length, m	
Fishing area	
Landing site	
Country/flag	

Observation type	
Single operation	☐
Several operations	☐
No of operations	

Position/area	
Lat DD°MM' S/N	Long DDD°MM' E

Type of Gear			Effort				Operation details			
							Fishing type		Bait	
Longline	Pelagic drifting	☐		Hooks			Night fishing	☐	Fish whole	☐
	Pelagic statinary	☐		Hooks			Day fishing	☐	Fish parts	☐
	Bottom	☐		Hooks			Soaking time, h		Squid	☐
Gillnet	Pelagic drifting	☐		Sections of		m length				
	Pelagic statinary	☐		Sections		m length	Target species		Attractant used	
	Bottom	☐		Sections		m length	Tuna	☐		
Purse seine		☐		Sets	Length/height	/	Swordfish	☐	Lightsteaks	☐
Ring net		☐		Sets	Length/height	/	Sharks	☐	Fish/fish blood	☐

Catch details		
Catch, no	Non-damaged	Damaged
Total		
Tuna		
Swordfish		
Other billfish		
Sharks		
Other fish		

Damage details				Sightings								Catch/bycatch species involved in depredation			
				Along the gear				Along the vessel							
Damage done by	Damage of			Numbers				Numbers				Numbers			
	Catch	Bait	Gear	n/a	1-5	5-50	>50	n/a	1-5	5-50	>50	n/a	1-5	5-50	>50
Cetaceans	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Big sharks	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Cookiecutter shark	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Squid	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Seabirds	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Seaturtles	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Crustaceans	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐