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**Report of the Sixth Session of the IOTC  
Working Party on Ecosystems and Bycatch**

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**Victoria, Seychelles, 27 - 30 October 2010**

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**IOTC-2010-WPEB-R[E]**

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## 1. OPENING OF THE MEETING AND ADOPTION OF THE AGENDA

1. The Sixth Meeting of the Working Party on Ecosystems and Bycatch (WPEB) was opened on 27<sup>th</sup> October 2010 in Victoria, Seychelles, by the Chair Dr Charles Anderson.
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. INTERNATIONAL CONTEXT

3. The Chair of the Scientific Committee briefly described the outcomes of the 12<sup>th</sup> Session of the Scientific Committee and of the 14<sup>th</sup> Session of the Commission in relation to the subjects of ecosystem and bycatch. The group noted that three Resolutions (10/04, 10/06 and 10/12) and one Recommendation (10/13) relevant to the WPEB were adopted. The Chair also put emphasis on the requests of the Commission to the Scientific Committee and the WPEB. Finally, the group was informed on developments in the Kobe process, notably that a workshop on bycatch had been conducted in Brisbane, Australia (23-25 June 2010).
4. The Chair of the WPEB presented the report (IOTC-2010-WPEB-Inf06) of that workshop, which gathered participants from the five tuna Regional Fisheries Management Organizations (RFMOs), member countries and other interested parties. During the Kobe II bycatch workshop it was noted that many of the major bycatch species are declining and that there was a serious lack of data for those species. The importance of observers and of cooperation with fishers were emphasized as effective means to collect this missing information and to develop adequate mitigation measures. Finally, it was recommended that the RFMOs should form a joint Working Group on Bycatch, and that each should engage a dedicated staff member to address bycatch issue.
5. The WPEB endorsed all the recommendations of the Brisbane workshop, especially recommending that the joint Working Group is set up and that the IOTC Secretariat should engage a dedicated staff member to work on the bycatch issues as soon as practical.

## 3. REVIEW OF DATA ON BYCATCH AND ECOSYSTEMS

### 3.1 STATUS OF IOTC DATABASES FOR NON-IOTC SPECIES

6. The Secretariat provided a report on the status of bycatch and ecosystem data in the IOTC databases (IOTC-2010-WPEB-Press).
7. The document reviewed the different resolutions that have been taken so far by IOTC regarding bycatch species (notably Resolutions 05/05 and 10/02 on sharks, Resolution 10/06 on seabirds and Resolution 09/06 on marine turtles). Regarding sharks, members are required to 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, where possible by species.
8. The WPEB noted that some progress has been achieved since the meeting of the WPEB in 2009, including:
  - New reports from some countries concerning levels of bycatch for their fisheries:
    - Shark, marine turtle and seabird bycatch for longliners of South Africa in recent years
    - Shark and other bycatch for longliners of Australia in recent years
    - Shark, marine turtle and other bycatch for purse seiners under EU flags and France OT (2003-07)
    - Shark bycatch for some EU longline fleets (France, Portugal, Spain) and Seychelles in recent years
  - Preparation and dissemination of new Guidelines for the reporting of fisheries statistics to the IOTC including levels of bycatch of sharks, seabirds, marine turtles and other marine fauna, and sets of forms to facilitate the reporting of data on bycatch.
  - Reviews of historical datasets for some countries using new information reported or other alternative datasets
  - Coordination of activities in relation with the IOTC Regional Observer Programme, including Guidelines and minima data collection and reporting requirements.
9. The WPEB thanked the Secretariat and the countries that had provided data for the progress achieved in data collection and reporting.
10. However, the WPEB noted that the information on retained catches and bycatches of sharks contained in the IOTC database remains very incomplete. In particular, the WPEB noted that records of discards of sharks and catches by species are not available from most fleets. Also for all fleets, historical data series, necessary to undertake formal

stock assessments, are missing or highly incomplete. Size frequency data have been reported only by Australia, South Africa and South Korea in recent years and biological data, such as fin-body ratio by species, are still largely missing.

11. Regarding seabirds and marine turtles there is no information available from the main longline and gillnet fleets that operate in the Indian Ocean.

12. The paucity of data held by the Secretariat on the different bycatch species groups makes any attempts to estimate levels of bycatch very difficult.

13. The WPEB recalled the existing data and information reporting requirements for members (Table 1). It was noted that despite adoption of Resolution 08/01 by the Commission in June 2008, recently superseded by Resolution 10/02, levels of reporting of data on sharks and other bycatch species remains very poor.

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

<p><b>Sharks</b></p> <p>IOTC Resolution 05/05: <i>Concerning the conservation of sharks caught in association with fisheries managed by IOTC</i></p> <p>IOTC Resolution 10/02: <i>Mandatory statistical requirements for IOTC Members and Cooperating Non-Contracting Parties (CPC's)</i></p>	<p>Paragraph 1: CPCs shall annually report data for catches of sharks, in accordance with IOTC data reporting procedures, including available historical data.</p> <p>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.</p>
<p><b>Seabirds</b></p> <p>IOTC Resolution 10/06: <i>On reducing the incidental bycatch of seabirds in longline fisheries</i></p> <p>IOTC Resolution 10/02: <i>Mandatory statistical requirements for IOTC Members and Cooperating Non-Contracting Parties (CPC's)</i></p>	<p>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.</p> <p>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. CPCs are also encouraged to record <b>and provide data on species other than sharks and tunas taken as bycatch.</b></p>
<p><b>Sea turtles</b></p> <p>IOTC Resolution 09/06: <i>On Marine Turtles</i></p> <p>IOTC Resolution 10/02: <i>Mandatory statistical requirements for IOTC Members and Cooperating Non-Contracting Parties (CPC's)</i></p>	<p>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.</p> <p>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 <b>and provide data on species other than sharks and tunas taken as bycatch.</b></p>
<p><b>Marine mammals</b></p> <p>IOTC Resolution 10/02: <i>Mandatory statistical requirements for IOTC Members and Cooperating Non-Contracting Parties (CPC's)</i></p>	<p>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 <b>and provide data on species other than sharks and tunas taken as bycatch.</b></p>

14. The WPEB expressed strong concern that, to date, many countries have not reported bycatch data, and urged all countries to make the necessary arrangements for bycatch data to be collected and reported to the IOTC as soon as possible. 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. Summarised bycatch estimates are valuable, but original data as per IOTC standards are required. The WPEB particularly emphasised the necessity of improvements to both the quantity and quality of data on sharks to be collected and reported over the coming years.

15. 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, Table 3, Table 4 and Table 5). In general, these recommendations are made over and above the existing obligations and technical specifications relating to the reporting of data.

**Table 2.** Steps to improve the certainty of fisheries statistics for SHARKS

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

Data / information / work required	Fishery	Major fleets involved
Provision of historical data on incidental catches of seabirds, by species and fishing area, indicating the type of mitigation measure/s used in each case.	Industrial longline fisheries  All fisheries using gillnets on the high seas	Longline: Taiwan,China, Japan, Indonesia, Malaysia, Philippines, Spain, Portugal, Seychelles and South Korea  Iran, Pakistan, Sri Lanka
Provision of data collected through observer programmes, as specified by the Commission.		
Detailed estimation of seabird bycatch, by species and year, including the precision of such estimates.		
Research on the effect of seabird bycatch mitigation measures.		

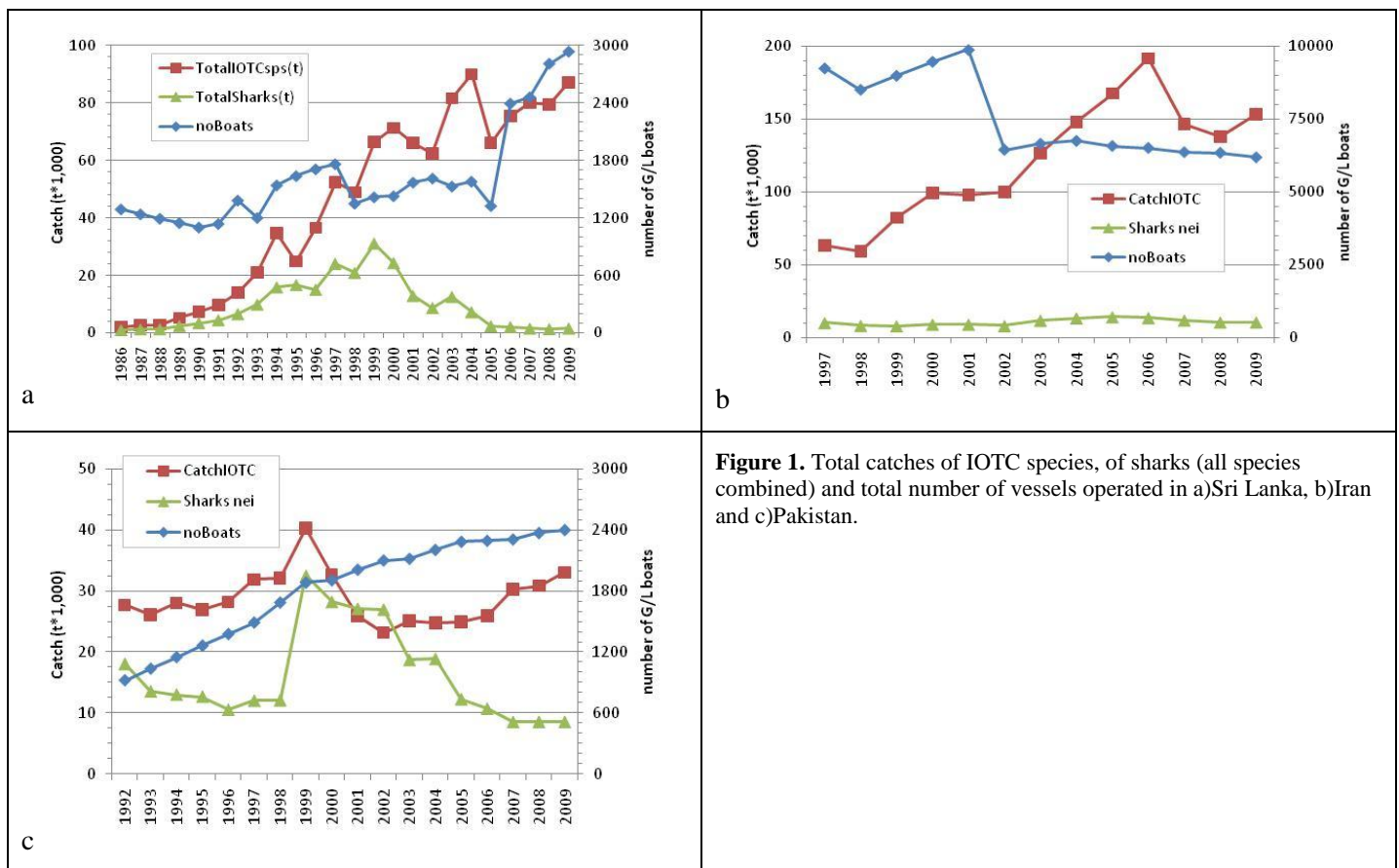
**Table 4.** Steps to improve the certainty of statistics on incidental catches of MARINE TURTLES

Data / information / work required	Fishery	Major fleets involved
Provision of data collected through observer programmes and estimates of total levels of bycatch of marine turtles, as specified by the Commission.	Countries having industrial longline fisheries	China, Taiwan,China, Indonesia and Japan
	Gillnet / gillnet-longline	Gillnet fisheries operating on the high seas (Pakistan and Iran)  Gillnet fisheries operating in coastal waters (India, Indonesia, Oman and Yemen)  Gillnet/longline fishery of Sri Lanka
	Industrial purse seine fleets	EU (before 2003), Seychelles, Iran, Japan and Thailand
Further research on interactions between Fish Aggregating Devices (FADs) and marine turtles, including mortality rates by species, area and type of FAD used	Industrial purse seine fleets	EU, Seychelles, Iran, Japan, Thailand
Further research on marine turtle bycatch mitigation measures for longline fisheries, <i>e.g.</i> examination of setting techniques and hook types.	Countries having industrial longline fisheries	Taiwan,China, Indonesia and Japan
Initiate research on marine turtle bycatch monitoring and mitigation measures for gillnet fisheries	Gillnet fisheries on the high seas	Iran, Pakistan and Sri Lanka
	Coastal gillnet fisheries	India, Indonesia, Oman and Yemen

**Table 5.** Steps to improve the certainty of statistics on incidental catches of MARINE MAMMALS

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

16. Figure 1 shows catch trends of shark and IOTC (tuna and tuna-like) species for some gillnet fisheries operating in the Indian Ocean, namely Sri Lanka, Iran and Pakistan. The WPEB noted that catches of sharks appear to be declining in recent years in the three fisheries and recommended that more research be carried out and presented at the next Session of the WPEB. It is important to note that the data, while informative, is thought to be of poor quality for Sri Lanka, Pakistan and Iran.



**Figure 1.** Total catches of IOTC species, of sharks (all species combined) and total number of vessels operated in a) Sri Lanka, b) Iran and c) Pakistan.

### 3.2 DATA FROM OTHER SOURCES

#### Ecology and bycatch of tuna with respect to the conservation and management measures taken by the government of Pakistan (IOTC-2010-WPEB-22)

17. Pakistan marine fisheries, including those for tuna, are an important contributor to the country's GDP and export earnings. Little is known about the levels of catches and bycatches of the tuna fishing fleets in Pakistan, although some data are collected by the Department of Fisheries. The fleet includes a large number of vessels using drifting gillnets of more than 8km in length. Pakistan recently revised its deep sea fishing policy, and aims to develop fishing activities in its EEZ beyond territorial waters.

18. The WPEB acknowledged the information provided and requested that better communication be developed between Pakistan and the IOTC in order to implement IOTC Resolutions.

#### Catch and bycatch in the pelagic longline fishery around Mayotte (NE Mozambique Channel), July 2009-September 2010 (IOTC-2010-WPEB-19)

19. Bycatch in the pelagic longline fishery around Mayotte was investigated from July 2009 to September 2010. As the longline fishery is expanding around Mayotte, the Shark Research Group (French NGO) in collaboration with the "Exploited Marine Ecosystems" team of IRD (Institut de Recherche pour le Développement) based in La Réunion, set up an observer program to assess catch characteristics in the pelagic longline fishery around Mayotte, from 2009 to 2010. Data were collected on "Mtwaro I", an 8-m longline fishing boat based in Mayotte and operating over the insular slope around the island. The vessel undertakes short cruises of one day and deploys 500 hooks per set, during night-time. Data were collected for 29 longline sets. A total of 818 individuals belonging to 23 different species were recorded. The largest proportion of catches was of targeted species, primarily swordfish (37.5%) and tunas (31.3%).

Sharks represented 20.3% of catches. Four loggerhead turtles (*Caretta caretta*) and one false killer whale (*Pseudorca crassidens*) were caught alive and released.

20. The WPEB noted that even with a small dataset some interesting and valuable information could be gathered. It welcomed this study and recommended that the deployment of observers around Mayotte on the domestic longline fleet should continue.

#### **How much sampling coverage affects bycatch estimate in the purse-seine fishery? (IOTC-2010-WPEB-20)**

21. The results of a simulation evaluating the biases and uncertainties associated with bycatch sampling in tropical tuna purse seine (PS) fisheries was presented to the WPEB. Simulations were based on a set of observer data collected in the Eastern Pacific Ocean by IATTC in 2000. This study focused on fishing sets made on floating objects and on four major bycatch species: mahi mahi (*Coryphaena hippurus*), silky shark (*Carcharhinus falciformis*), swordfish (*Xiphias gladius*) and blue marlin (*Makaira nigricans*). Results showed that biases and uncertainties were strongly dependent on both the percentage of coverage and the fish species considered. The results suggest that the current 10% sampling coverage rate of the European PS fishery of the Indian Ocean may lead to positive biases (< 5%) and large uncertainties (> 20%) in bycatch estimates for these four species when caught in log-associated sets. The size of the fishery, *i.e.* total number of trips, was also shown to affect bycatch estimates for a specific level of sampling coverage. The use of unbiased ratio estimators was found to be particularly useful when sampling coverage is low (< 10%).

22. The WPEB noted that the 5-10 % coverage recommended within the IOTC Regional Observer Scheme was a minimum level, even for frequently encountered bycatch species like mahi mahi and silky shark. At these low levels of coverage, uncertainty is high and it is necessary to use bias correction to compensate for likely overestimation of bycatch. While more observer coverage is highly desirable, it was noted that achieving even 5-10% coverage (which should be considered a minimum) is subject to many difficulties. These include both practical (lack of space on small boats) and security constraints.

#### **Diversity of marine animals in bycatch of tuna longlining in Pakistan (IOTC-2010-WPEB-23)**

23. Foreign tuna longliners, mainly from Taiwan, China, have been licenced to fish for tuna in the Pakistani EEZ for several years. Data gathered in the early 1990s, suggested bycatch represented only 5% of the total catch, and comprised, mainly billfishes, dolphin fish and blue sharks. The bulk of the catch was of the target species, *i. e.* yellowfin tuna. Total catches of yellowfin are currently of the order of 40 000 t annually, mainly caught by gillnetters.

24. The WPEB noted that the gillnets used in Pakistan were more than 2.5km in length, which did not comply with the IOTC Resolution 09/05. The WPEB recommended that this issue be addressed by Pakistan. The WPEB further noted that the level of bycatch was not assessed but probably very important, and strongly recommended that this also be addressed.

### **3.3 STATUS OF THE IOTC REGIONAL OBSERVER SCHEME**

25. The need for a Regional Observer Scheme (ROS) is well recognized. IOTC Resolutions 09/04 and 10/04 set the principle for the development of a scientific ROS based on national implementation of observer projects by IOTC CPCs, starting on 1st July 2010. The main goals of this scheme are to use observers to sample catches in order to quantify catch composition, discards and, bycatches, and to collect size frequency and other biological data.

26. The targets set out in the Resolutions are to have coverage of 5% of fishing operations for vessels larger than 24m from 1st July 2010, to gradually increase towards a 5% coverage for vessels smaller than 24m fishing outside their EEZ, and to develop sampling programmes to monitor artisanal fisheries at landings.

27. It was noted with appreciation that funds have been identified by the Commission to develop these sampling programmes for artisanal fisheries.

28. In May 2010, a workshop was organized in Seychelles in order :

- To define minimum data sets to be collected by the ROS and develop a set of forms to be used as guidelines by the Members in their national projects
- To develop an IOTC Observer Manual to be used as guideline by the Members in their national projects
- To develop an Observer Trip Report format for submission of observer data to the IOTC Secretariat



29. These documents were presented to the WPEB (IOTC-2010-WPEB-Inf02, Inf03) and were provided to the CPCs as guidelines for the implementation of the ROS.

30. The WPEB was informed that observers have been deployed by Japan, China, South Africa and by France (La Réunion and TAAF) and that national projects had been initiated in India, Kenya and Seychelles. It was noted that piracy is a serious impediment to the deployment of observers in the WIO.

31. The WPEB acknowledged the progress made by the Secretariat in developing the materials needed to start the ROS. It was noted, however, that although the ROS started on 1<sup>st</sup> July 2010, to date, no observer trip reports had been sent to the Secretariat.

### 3.4 DISCUSSIONS ON DATA

32. The WPEB noted that despite its annual recommendations regarding data collection and submission, the lack of data on bycatch remains an issue.

33. At its first Session in 2005, the WPEB called for data on bycatch to be reported: *“Acknowledging that there was likely to be more information available on bycatch than is held by the IOTC Secretariat, the Secretariat sent out a call for any information on data on non-tuna catches in the Indian Ocean tuna fisheries”* (IOTC-2005-WPBy-R)

34. Since then, there was annual recommendation from the group in that direction:

- *“The WPBy acknowledged the paucity of information on bycatch available in the IOTC databases but were optimistic that, given the recent management measures relating to bycatch species implemented by the Commission that both the quality and quantity of data would start to improve in the near future. The WPBy reiterated the Commissions strong reminder made at its Tenth Session about the obligations of Members and national scientists to collect and provide relevant information.”* (IOTC-2006-WPBy-R)
- *“The WPEB strongly encouraged CPC’s to submit all relevant data on bycatch to IOTC Secretariat.”* (IOTC-2007-WPEB-R)
- *“The WPEB expressed its disappointment about the little progress made by IOTC CPC’s concerning the implementation of recommendations outstanding from previous WPEB meetings. The WPEB stressed the need for IOTC CPC’s to implement the recommendations from the WPEB as soon as possible.”* (IOTC-2008-WPEB-R)
- *“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. The Secretariat was 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”* (IOTC-2009-WPEB-R)

35. The WPEB noted that some CPCs are collecting data, sometimes for several years and that this data should be made available to the Secretariat.

### 3.5 ADVICE AND RECOMMENDATIONS

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

## 4. SHARKS

### 4.1 REVIEW OF ANY NATIONAL PLAN OF ACTION (NPOA) RELATING TO REDUCTION OF SHARK BYCATCH IN TUNA FISHERIES

36. The WPEB was informed that India has started the process of establishing an NPOA-sharks, including a special chapter on sharks as bycatch in tuna fisheries.

37. The Seychelles NPOA-sharks is entering in its third year. An important recent development was the agreement between the association of shark fishers and the recreational diving community, the two main stakeholder groups concerned with sharks. In addition, research on migration, behaviour and critical habitat of coastal sharks has commenced under the SEYSHA project funded by IRD, with a first tagging cruise scheduled for November 2010.

38. Maldives has plans for an NPOA-sharks. All shark fishing has been already banned in this country to protect reef sharks, which are of great economic importance to the tourism industry.

39. The Secretariat identified several NPOA-sharks on the FAO website, noting a new NPOA-shark for Japan from March 2009.

40. The WPEB noted that little progress has been made with the development of NPOA-sharks among the IOTC CPCs. It recalled that NPOA-sharks are a framework that should facilitate estimation of shark catches and development of appropriate management measures. The development and implementation of NPOA-sharks should also enhance the collection of bycatch data and compliance with IOTC Resolutions. Some projects and initiatives in the Indian Ocean (*e.g.* BOBLME and other GEF projects) can offer assistance to countries in the region to develop and implement their NPOA-sharks. The WPEB recommended that all CPCs develop NPOA-sharks as soon as possible and that progress should be reported to the next session of the WPEB.

### 4.2 RESEARCH PROGRAMMES ON SHARKS

#### **Indian Ocean-scale predictions of seasonal whale shark distribution from opportunistic fisheries-based sightings (IOTC-2010-WPEB-18)**

41. Despite being the largest marine fish, little is known about the whale shark's (*Rhincodon typus*) pelagic distribution. The extent to which ocean-wide and seasonal patterns in whale shark distribution correlate with remotely sensed environmental conditions was explored. A 17-year time series of whale shark sightings in the Indian Ocean collected by the tuna purse-seine fishery was analysed relative to concurrent data describing chlorophyll a concentration and sea surface temperature (SST) extracted from composite satellite images. Different sets of pseudo-absences were generated to account for spatio-temporal variations in sampling effort and probability of detection, and to test for model sensitivity to spatial variation. Spatial generalized linear mixed-effect (GLMM) and Maximum Entropy (MaxEnt) models were applied to project whale sharks habitat suitability and its seasonal variation, and to produce maps of predicted seasonal distribution probability. The GLMM including bathymetric slope, depth, distance to shore, mean SST, SST<sup>2</sup> (quadratic term), SST and chlorophyll a had the highest relative statistical support, with the highest percent deviance explained when using random pseudo-absences: (57% in austral autumn, 35% in winter, 35% in spring and 20% in summer). The MaxEnt suggested that whale sharks respond mainly to variation in primary productivity and temperature in all seasons. Distance to shore and bathymetric slope had only minor influence on presence. Prediction maps showed that within the sampled area, habitat use varies between seasons and follows a clockwise directional shift from autumn through to summer. In terms of habitat suitability, whale sharks move between different aggregations sites in the Indian Ocean. This supports the hypothesis that whale sharks in this region comprise a single population at this oceanic scale. By assessing the importance of temperature and productivity cues, a basis is provided for predicting pelagic distribution of the world's largest fish and provide a baseline for temperature-dependent predictions of future distributional changes.

42. The WPEB noted that older data from the European fleet (for both Indian and Atlantic oceans) are available and could be made available to the authors for further analysis, recommending that data from other RMFOs should also be used.

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**First descriptions of the behaviour of silky sharks (*Carcharhinus falciformis*) around drifting FADs, in the Indian Ocean, using acoustic telemetry (IOTC-2010-WPEB-12)**

43. The silky shark (*Carcharhinus falciformis*), is the primary elasmobranch bycatch species in industrial tuna purse seine fisheries throughout the world's major oceans. Juvenile silky sharks commonly associate with drifting fish aggregating devices (FADs) deployed as a strategy to enhance tuna catches in these fisheries. Despite their regular incidental capture around drifting FADs, no research has been conducted into the role that these floating objects play in the biology and ecology of these juvenile pelagic sharks. The results from the first investigations into the behaviour of juvenile silky sharks associated with drifting FADs in the western Indian Ocean using acoustic telemetry are presented in this document. A total of 10 silky sharks were equipped with coded acoustic transmitters (Vemco V13 and V16P – pressure sensor tags), tagged around four drifting FADs to which acoustic receivers were attached (Vemco VR2 and VR3-ARGOS). Eight sharks were detected around the FADs, all performing an initial excursion (from 0.10 to 3.50 d) away from the FAD after release, likely corresponding to stress after capture and tagging. Continuous residence periods (without day-scale absences) averaged 5.19 d (SD = 3.15 d). Detailed analysis showed that excursions away from FADs were made at night, lasting a few hours. During periods of association, silky sharks typically occupied the upper 35 m of the water column for the majority of the observation period. These results, as well as perspectives on future research, were discussed in the context of ecosystem-based management of tuna fisheries.

**Double tagging of juvenile silky sharks to improve our understanding of their behavioural ecology: preliminary results (IOTC-2010-WPEB-10)**

44. The behaviour of two juvenile silky sharks (*Carcharhinus falciformis*), both while they were associated with drifting FADs and while not associated, was investigated through double tagging with acoustic transmitters and miniaturized PAT tags. Sharks were caught and tagged around drifting FADs in the Mozambique Channel. Drifting FADs were equipped with satellite-linked acoustic receivers, to monitor the fine scale behaviour of sharks while at the FADs. Both sharks remained associated with the drifting FADs for several days (7.8 and 10.0 d). During their association both sharks undertook nocturnal excursions away from the FAD, during which deep dives were often observed. Vertical behaviour was found to change once the sharks were believed to have left the FAD, with the depth of the nocturnal dives increasing considerably.

**Summary of PATs deployed on pelagic sharks in the Western Indian Ocean under the MADE program (IOTC-2010-WPEB-09)**

45. Within the framework of the MADE project (see paragraph 50), three dedicated research cruises were conducted in 2010 on board longline vessels (one of the cruises was carried out in conjunction with SWIOFP). A total of 14 PATs and one miniPAT were deployed on three species of pelagic sharks. During another research cruise in 2010 to tag sharks around drifting FADs, two miniPATs were deployed on silky sharks. 24% of deployed tags remained on sharks for their full planned duration, with only one premature release attributed to mortality from the capture and tagging operation. Two tags never reported. So far, a total of 516 days at liberty were recorded for silky sharks (8 individuals), 19 days for oceanic white tip sharks (1 individual, 1 individual not reported) and 293 days for blue sharks (6 individuals, 1 individual not reported). More tagging is planned and analysis will start in the coming year.

**International Seafood Sustainable Foundation initiatives to develop and test bycatch mitigation options for tropical tuna purse seine fisheries (IOTC-2010-WPEB-13)**

46. The International Seafood Sustainability Foundation (ISSF) has initiated a research program to develop and test technical options to reduce bycatch by industrial tuna fisheries. The initial emphasis will address ways to reduce the incidental mortality of bigeye tuna of undesirable size, oceanic sharks and marine turtles in tropical purse seine fisheries. The ISSF will implement field studies through the full charter of a dedicated purse seine vessel or vessels operating in the Pacific, Atlantic and Indian Oceans over a 24-month schedule, spread over 3 years. Overall project guidance will be provided by the ISSF Scientific Advisory Committee. A Purse Seine Research Vessel Steering Committee is developing the specific projects to be conducted while considering practical input from skippers and industry representatives gained from regional workshops convened by the ISSF. The first research cruise will be in the eastern Pacific Ocean early in 2011, with plans for 2011 cruises in the Indian and Western Pacific Oceans.

47. The WPEB recognized the importance of this initiative. A request was made to take advantage of sea time in the Indian Ocean to collect data on seabirds and cetaceans if spaces were available for additional scientists. Similarly, it was noted that the platform could be used to test automated sampling system (video) for bycatch and discards.

#### **Mitigating ADverse Ecological impacts of open ocean fisheries (MADE project)**

48. A general update of activities of the EU MADE project in the Indian Ocean was given to the WPEB.

49. The group acknowledged the work by the MADE project noting that the majority of the papers presented in the shark section of this meeting were fully or partially facilitated under this project.

50. The WPEB recorded its support for all such international efforts, including the new initiative by the ISSF. However, the group also recognised the need for smaller scale research activities to develop much needed baseline information from all regional countries. This could include basic information from landing sites, and could include fishers' knowledge.

#### **Niche partitioning between blue and silky sharks in the south-west Indian Ocean (IOTC-2010-WPEB-15)**

51. The blue shark (*Prionace glauca*) and the silky shark (*Carcharhinus falciformis*) are oceanic pelagic predators caught as bycatch by open ocean fisheries. They do show differences in their biology, but the situation in the western Indian Ocean is poorly known because of a worrying lack of data. Analyses of the stable isotope ratios of carbon ( $^{13}\text{C}/^{12}\text{C}$ ) and nitrogen ( $^{15}\text{N}/^{14}\text{N}$ ) in tissues have a broad array of applications in ecology. For example, stable isotope ratios in predator tissues are directly related to those of their prey. Such analyses in pelagic sharks can therefore improve knowledge of their trophic ecology and should provide a greater understanding of their role in the pelagic realm.

52. Dorsal muscle of individuals of blue shark ( $n = 90$ ; 110-267cm FL) and silky shark ( $n = 70$ ; 61-197cm FL) from the south-western Indian Ocean were analysed. Stable isotope analyses in soft tissues such as muscle provide insights on diet over the previous several months to one year, depending on species. This study gave preliminary results on the trophic positions values of blue shark and silky shark individuals according to size, season and latitude. Ontogenic patterns and trophic level at size were compared both within and between species.

53. The group noted the information provided by this contribution and suggested some added effort in the analyses and interpretation of data presented.

#### **Pelagic elasmobranch diversity and abundance in the Western Indian Ocean: an analysis of long-term trends from research and fisheries longline data (IOTC-2010-WPEB-16)**

54. Increasing fishing pressure in the open ocean worldwide over recent decades has affected the abundance level of large pelagic fishes. This impact concerns not only the target species such as tuna and swordfish, but also bycatch species. Among these bycatch species suffering the impact of sophisticated open ocean fisheries (purse seine and longline), pelagic shark populations have likely declined. The decline level is difficult to quantify due poor quality of data available. Pessimistic analyses are sometimes published to increase concerns for their conservation. Shark data reported in fishermen's logbooks and observer reports are frequently characterised by under-reporting, while there is also over-reporting of some shark species and widespread misidentification and mis-recording.

55. In this study, shark capture (by taxa or group of taxa) data collected in the Indian Ocean during 1961 to 2009 from both longline scientific cruises and the longline observer program based in La Réunion were analysed. The temporal trend of pelagic elasmobranch (shark and ray) diversity was analysed according to a spatial stratification with respect to biogeographic province, distance from the coast and vertical habitat. The data demonstrate decreased species richness during recent decades; however probable misidentifications for some taxa during early years of research could introduce biases in the observed pattern. Decrease in nominal CPUE and mean weight of individuals are also demonstrated for major pelagic shark taxa. The current status of the shark community in the region is discussed.

#### **4.3 IMPROVEMENT ON SHARK IDENTIFICATION**

56. The WPEB recalled that mis-identification of sharks is a major factor affecting the quality of the available shark catch data. In both 2008 and 2009 the WPEB recommended that guidelines on sharks identification and data collection should be developed. The WPEB acknowledged the progress made by the Secretariat on this issue.

57. Collaboration has been established between the IOTC Secretariat and the SPC on this issue, and shark identification cards are currently being developed and adapted for the Indian Ocean by the Secretariat. The WPEB strongly recommended that this task be completed before its next meeting. The WPEB was informed that other initiatives were and are developing ID cards for sharks, and recommended that the Secretariat should collaborate with them in order to have standard ID cards for the Indian Ocean, and maximize their distribution to observers and samplers.

58. An information paper (IOTC-WPEB-2010-Inf01) provided details of identification of manta and mobula rays, which are important components of bycatch in some Indian Ocean fisheries. The WPEB congratulated the author on this contribution.

59. The WPEB reiterated its recommendation from last year that CPCs which are conducting research cruises and observer projects, 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.

#### 4.4 STOCK ASSESSMENT AND ECOLOGICAL RISK ASSESSMENT ON SHARKS (IOTC-2010-WPEB-04)

60. Document IOTC-2010-WPEB-04 on shark assessment for the Australian National Plan of Action for the conservation and management of sharks was presented to the group. Australia's NPOA-sharks is due for review. The report identified changes occurring in fisheries since the release of the 2001 shark assessment report and identified new and on-going issues. Improvements have been made in species identification, catch and effort data collection, and shark-specific management measures to address issues of concern. Further improvements required in the short term include data verification, implementation of robust management methods and precautionary measures to prevent any further declines in shark species. In the longer term there is a need to:

- ensure further and more consistent application of risk-based approaches to shark conservation and management
- assess the significance of cumulative fisheries and other impacts on high-risk species
- review the need for and, where necessary, the methods to obtain accurate market and trade data
- examine the need for improved management measures to reduce or restrict the targeting of sharks for the purpose of supplying shark fin to export markets
  - support the development of more effective shark bycatch mitigation methods
  - conduct assessments of the risk non-commercial fisheries pose to sharks
  - continue to encourage the effective monitoring and management of the harvest and bycatch of pelagic shark species on the high seas
  - assess the sustainability of imported shark products.

61. The group was informed about several broad-scale genetic studies on pelagic sharks, which should be encouraged for determining population structure for stock assessment and management purposes.

62. The WPEB reiterated its recommendation to improve shark catch and effort data for stock assessment. The planned Regional Observer Scheme and national observer projects were considered essential to address this issue. However, in the immediate future, the use of simple indicators (*e.g.* catch, catch rates, length, condition and fate, diversity, local knowledge of fishermen, *etc.*) to identify trends in populations was strongly recommended. Indicators that are already available which suggest that Indian Ocean pelagic shark stocks are in decline include:

- Decline in catch rate of silky sharks reported by Maldivian fishermen (IOTC-2009-WPEB-08)
- Decline in catch rate of sharks in standard Indian longline research surveys (IOTC-2009-WPEB-17)
- Decline in catch rate and mean weight of oceanic whitetip shark in WIO longline catches (IOTC-2008-WPEB-10)
- Decline in total catches of sharks in the Sri-Lankan and Pakistani fisheries in recent years (Figure 1)
- Loss of elasmobranch diversity in WIO longline catches over four decades (IOTC-2010-WPEB-16)

63. The biological characteristics of sharks (*e.g.* slow growth, late maturity, small numbers of young, *etc.*) make them particularly vulnerable to population depletion. It is therefore not surprising that, following decades of tuna fishing by longliners, purse-seiners and other gears, that pelagic shark abundance should have declined in the tropical Indian Ocean. However, the apparent magnitude of declines across such a wide variety of species and fisheries are a cause for concern.

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#### 4.5 CONSERVATION OF SHARKS CAUGHT IN ASSOCIATION WITH FISHERIES MANAGED BY IOTC.

64. 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 on-board 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.”

65. In 2008 and 2009, 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. In the last Scientific Committee no consensus was reached to re-present this recommendation to the Commission. 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 reached on this matter and the *status quo* remained 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.

66. The information was given to the group that some studies have shown that the fin to body mass ratio ranges between 4 and 21% depending on species and sex. The current level (5%) is towards the lower limit of this range. However, it was noted that there remains some uncertainty among shark experts about what percentage level is the most suitable.

67. It was noted that landing sharks with fins attached would tend to reduce the wasteful practice of finning (*i.e.* removing the fins and discarding the carcass). It might also tend to reduce fishing effort, particularly on sharks, since vessels might need to return to port more frequently to unload. In addition, landing sharks with fins attached would allow the estimation of catch statistics by species, and the collection of biological information and samples, thus providing the information required for stock assessment.

68. Therefore, a majority of members of the WPEB reiterated its recommendation from last year, *i.e.* to land sharks with fins naturally attached. However, a number of scientists expressed some reservation on the practicality on-board fishing vessels of this recommendation.

69. As in 2009, amendments to the IOTC Resolution 08/04 “Concerning the recording of the catch by longline fishing vessels in the IOTC area” were suggested in order to improve collection of data on depredation and shark bycatch in the Indian Ocean. It was proposed 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 are easily identifiable by most fishermen (and which in some 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.

70. Although some scientists expressed their reservation because of the potential difficulties of correct identification and reporting by fishermen, the majority of the scientists of the WPEB suggested an amendment to the list of species for which reporting is required under Resolution 08/04 (Table 6).

**Table 6.** Shark species to be reported to IOTC

Under resolution 08/04	Under new proposal
Blue Shark	Blue Shark, <i>Prionace glauca</i>
Mako Shark	Mako Sharks, <i>Isurus</i> spp.
Porbeagle	Porbeagle, <i>Lamna nasus</i>
	Great White Shark, <i>Carcharodon carcharias</i>
	Crocodile Shark, <i>Pseudocarcharias kamoharai</i>
	Thresher Sharks, <i>Alopias</i> spp <sup>1</sup> .
	Tiger Shark, <i>Galeocerdo cuvier</i>
	Oceanic Whitetip shark, <i>Carcharhinus longimanus</i>
	Other Requiem Sharks, <i>Carcharhinus</i> spp.
	Hammerhead Sharks, <i>Sphyrna</i> spp.
Other Sharks	Other Sharks
	Pelagic Stingray, <i>Pteroplatytrygon violacea</i>

#### 4.6 ADVICE, RECOMMENDATIONS AND PROPOSALS

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

<sup>1</sup> As per IOTC Resolution 2010/12, catch of Thresher sharks have to be reported but not kept (*i.e.* released if alive or discarded if dead)

16. The WPEB recommended that the IOTC should continue to collaborate with Kobe process and with the CMS MoU on sharks.

17. The WPEB recommended that the IOTC Secretariat should engage a staff member for bycatch issues (with draft TORs to be developed for the SC)

## 5. SEABIRDS

### 5.1 REVIEW OF ANY NATIONAL PLAN OF ACTION FOR REDUCING INCIDENTAL CATCHES OF SEABIRDS IN LONGLINE FISHERIES

71. 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 seabird bycatch. These should 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 NPOA-seabirds. The WPEB once again 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. This could be in the form of a negative list, indicating which countries have still to produce NPOAs.

### 5.2 UPDATE FORM BIRDLIFE INTERNATIONAL

72. BirdLife presented an outline of a Global Environment Facility (GEF) project proposal that is being developed and requested an expression of support from the WPEB for the project. The project will focus on developing bycatch mitigation technologies and mainstreaming the advice about and use of these, via the FAO's Best Practice Technical Guidelines for bycatch, to tuna RFMOs. There were no questions or comments, and the chair concluded that there was general support for this work and expressed the opinion that this was a worthy project that could deliver substantial benefits to the work of the WPEB and the IOTC more generally.

### 5.3 RESEARCH ON INTERACTIONS BETWEEN SEABIRDS AND TUNA FISHERIES IN THE INDIAN OCEAN

#### **Experimental determinations of factors affecting the sink rates of baited hooks to minimize seabird mortality in pelagic longline fisheries" (IOTC-2010-WPEB-06)**

73. Although line weighting and other mitigation measures are required in the pelagic longline fishery off Australia's east coast, some seabirds are still caught, suggesting that mitigation measures are not fully effective in all conditions. An experiment was conducted in that fishery to establish a scientific basis for potential changes to reduce seabird mortality; in particular, different combinations of line weighting and other variables affecting line sink rates were evaluated. The experiment examined the effects of different bait species (blue mackerel, yellow-tail mackerel and squid), bait life status (dead or alive), weight of leaded swivels (60 g, 100 g and 160 g) and leader length (distance between leaded swivel and hooks: 2 m, 3 m and 4 m) on the sink rates of baited hooks from 0-6 m deep.

74. On average, live bait sank much slower than dead bait, greatly increasing the exposure of baited hooks to seabirds. Sink rates of individual live bait were highly variable. Many were < 2 m underwater 18 seconds after deployment, including some on the heaviest swivels, and some were < 10 m deep after 120 seconds. With dead bait, gear with 60 g and 100 g swivels on the same leader length sank at similar rates, as did all three swivel weights on 4 m leaders. The 160 g x 2 m combination sank the fastest, averaging 0.27 m/s and 0.74 m/s from 0-2 m and 4-6 m, respectively. The 60 g x 4 m combination sank the slowest, averaging 0.16 m/s to 2 m depth and failing to attain 6 m depth after 18 seconds. Initial sink rates (0-2 m) were increased by placing leaded swivels close to hooks and final sink rates (> 4 m) by increasing the weight of the swivels.

75. The results indicate that the small (incremental) changes to the weight of leaded swivels and the length of leaders typically preferred by the fishing industry are unlikely to make an appreciable reduction in seabird mortality because resultant increases in sink rates will be insubstantial.

76. Changing line weighting regimes to reduce seabird mortality requires consideration of sink rates close to the surface (*i.e.* 0-2 m) in addition to cumulative rates to the deeper depths. It is suggested that to substantially reduce



seabird mortality compared to that associated with 60 g swivels and ~3.5 m leaders (the preferred option by industry in Australia) may require branch lines be configured with swivels  $\geq 120$  g  $\leq 2$  m from hooks. An alternative to the latter regime would be to place a smaller amount of weight at or very close to the hook. The exact amount of weight would have to be determined experimentally. The WPEB agreed that the Resolution 10/06 should be revised to reflect this advice.

#### **Effect of line shooter and mainline tension on the sink rates of pelagic longlines, and implications for seabird interactions (IOTC-2010-WPEB-07)**

77. The likelihood that seabirds will be hooked and drowned in longline fisheries increases when baited hooks sink slowly. IOTC-2010-WPEB-07 reported on an experiment conducted in Australia's pelagic longline fishery to test the hypothesis of no difference in sink rates of baited hooks attached to mainline set under varying degrees of tension. Fishermen target different fishing depths by setting mainline through a line shooter which controls the tension (or slackness) in the line. Mainline was set in three configurations typically used in the fishery: a) surface set tight with no slackness astern; b) surface set loose with two seconds of slack astern and; c) deep set loose with seven seconds of slack astern. Sink rates of baited hooks were measured using time depth recorders. Tension on the mainline had a powerful effect on sink rates. Baited hooks on branch lines attached to tight mainlines reached 2 m depth nearly twice as fast as those on the two loose mainline tensions, averaging 5.8 s (0.35 m/s) compared to 9.9 s (0.20 m/s) and 11.0 s (0.18 m/s) for surface set loose and deep set loose tensions, respectively. The likely reason for the difference is propeller turbulence. Tight mainline entered the water aft of the area affected by turbulence whereas the two loose mainlines and the clip ends of branch lines were set directly into it about 1 m astern of the vessel. The turbulence presumably slowed the sink rates of baited hooks at the other end of the branch lines.

78. The results suggest that mainline deployed with a line shooter (as in deep setting) into propeller turbulence at the vessel's stern slows the sink rates of baited hooks, potentially increasing their availability to seabirds. Unless mainline can be set to avoid propeller turbulence the use of line shooters for deep setting should not be accepted as an effective deterrent to seabirds. There was complete agreement with the scientific findings at this time (see para.101).

#### **Progress in development and testing of an underwater bait setter for pelagic longline fisheries (IOTC-2010-WPEB-08)**

79. This paper described updated information on the development of an underwater bait setter for pelagic longline gear, which has the potential to:

- eliminate mortality of surface-seizing seabirds (*e.g.* albatrosses)
- reduce or eliminate mortality of diving seabirds (*e.g.* petrels, shearwaters)
- eliminate bait loss to seabirds
- allow fishing at any time day/night, potentially without tori line
- remove threat of seasonal closures
- allow use of line weighting options more acceptable to fishers
- undertake tamper-resistant data gathering on SD cards
- reduce need for observers to monitor mitigation measures

80. Preliminary trials are underway and are encouraging, compared to hand setting. There is slightly improved bait retention, and similar setting speed. The device is currently being tested in a bird "hot spot" in a pelagic longline fishery in Uruguay, with further work planned in Australia later in 2010 and early 2011. ACAP undertook to report progress to the WPEB in 2011.

#### **Review of Seabird Bycatch Mitigation Measures for Pelagic Longline Fishing Operations (IOTC-2010-WPEB-17)**

81. IOTC-2010-WPEB-17 reported on a review of recent research on seabird mitigation measures for pelagic longline gear conducted by ACAP's Seabird Bycatch Working Group (SBWG) in 2010. That working group advises ACAP on actions that will assist in assessment, mitigation and reduction of negative interactions between fishing operations and seabirds, and comprises representatives from ACAP's 13 Parties, together with invited experts with relevant technical or other expertise. The review is considered to represent the current best scientific advice for pelagic longline gear, and is available at <http://www.acap.aq/english/english/advisory-committee/ac5/ac5-outcomes>.

82. Since the last meeting of the WPEB a considerable amount of research has been undertaken on seabird bycatch mitigation measures in pelagic longline fisheries. Evidence is emerging that the use of appropriate configurations of weights on branchlines is currently the most effective means of reducing seabird access to baits, although it still needs to be used in conjunction with other measures, such as bird scaring lines (BSL) and night setting.

83. A summary of key findings was provided to assist IOTC in its consideration of the efficacy of the mitigation measures currently in use within the IOTC convention area, as required by IOTC Resolution 10/06. These related specifically to line weighting, use of line shooters, and offal management.

#### ***Line weighting of branchlines***

84. Particularly relevant were two papers, which were highlighted: “Shrink and defend: A comparison of two streamer line designs in the 2009 South Africa tuna fishery” (Melvin, E.F., Guy, T.J. and Read, L.B. 2010. SBWG-3\_Doc\_13, <http://www.acap.aq>), and “Effect of line shooter and mainline tension on the sink rates of pelagic longlines and implications for seabird interactions” (IOTC-2010-WPEB-07).

85. The Melvin research, conducted with the support of the Japan Tuna Fisheries Cooperative Association, found that in order to defend baited hooks with streamer lines from bird depredation (and in particular white-chinned petrels), the distance from the vessel at which baits sink beyond the birds’ reach (10 m) must be within the aerial extent of the streamer line (100 m). Achieving this rate of sink could only be achieved if adequate line weighting was applied. The need to modify IOTC Resolution 10/06 to focus on combinations of measures that can achieve this was emphasized.

86. Results from Robertson et al (IOTC-2010-WPEB-06) indicate that in order to achieve sink rates sufficient to ensure that dead baits reach depths of 10 m within 100 m of their deployment (and therefore under protection of the bird scaring lines) would require one of the following line weighting regimes: 40 g weight attached at the hook; 60 g weight attached within 1m of the hook; or 98 g weight attached within 2m of the hook. It was stressed that these are minimum specifications, and increasing weight or decreasing distance from the hook would further improve sink rates. The meeting agreed that IOTC Resolution 10/06 should be revised to reflect these specifications.

#### ***Use of line shooters***

87. IOTC-2010-WPEB-06, reported upon in more detail above, found that initial sink rates of branch lines on mainline ‘set deep’ was actually slower than when mainline was set ‘tight’, contrary to what is generally thought to occur by most fishers. As a result, line shooters should not be considered as a mitigation measure because they do not improve initial sink rates, although they will continue to be used on many vessels because they are considered to improve fishing efficiency. ACAP recommended that line shooters should be deleted from the list of accepted seabird bycatch mitigation measures in Table 1 of Resolution 10/06.

#### ***Offal management***

88. Offal management is generally of little importance to minimising seabird interactions in pelagic fisheries as there are much smaller quantities of fish waste derived from fishing operations, in direct contrast to the situation in demersal fisheries. The inclusion of offal management as a mitigation measure in Resolution 10/06 most likely has been taken from use of this measure in CCAMLR and other demersal longline fisheries, where it is much more important. Good offal management should be encouraged in IOTC fisheries as good practice, but the measure should be deleted from the list of accepted seabird bycatch mitigation measures in Table 1 of Resolution 10/06, as there is no scientific information to support its mitigation effectiveness in pelagic fisheries. There was complete agreement with the scientific findings at this time (see para.101).

#### ***Management advice on line shooters and offal management***

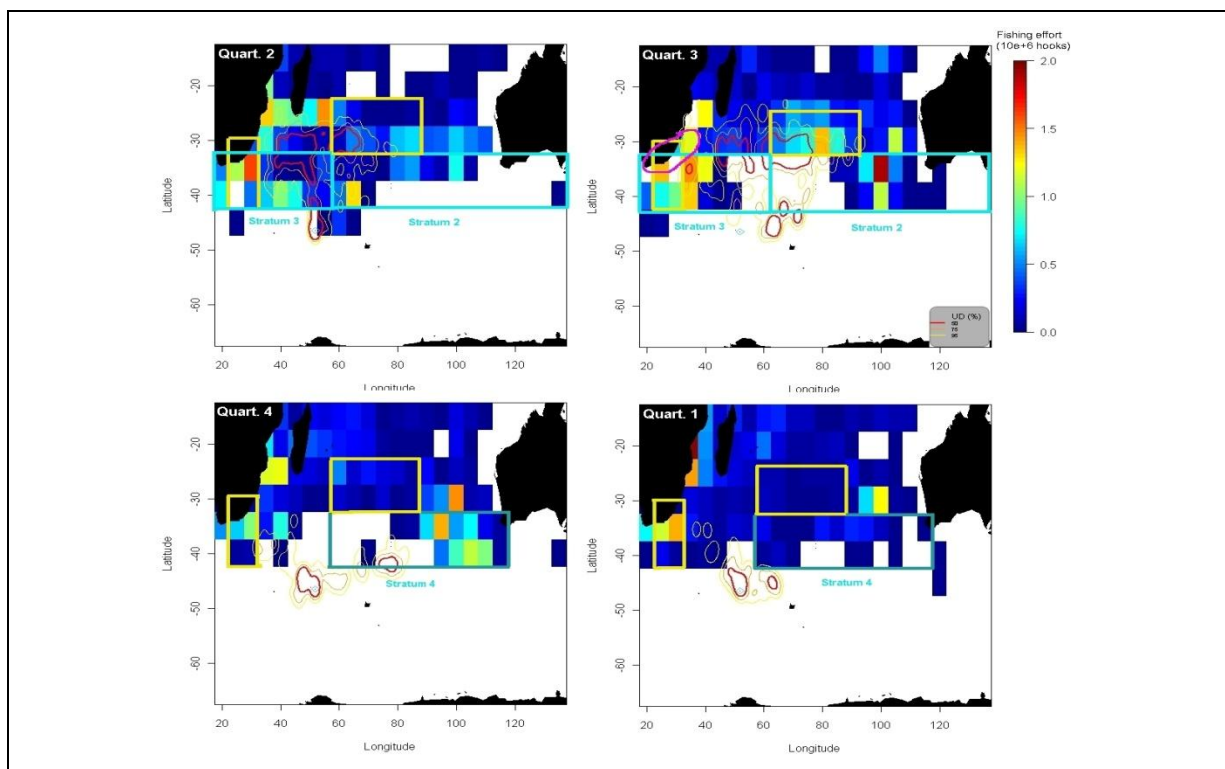
89. The meeting agreed that IOTC Resolution 10/06 should be revised to reflect the advice that the use of line shooters and offal management be removed from the list of accepted seabird bycatch mitigation measures in table 1 of the Res, noting the advice in para.101 that new information on the efficacy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

#### ***New information from the Arabian sea***

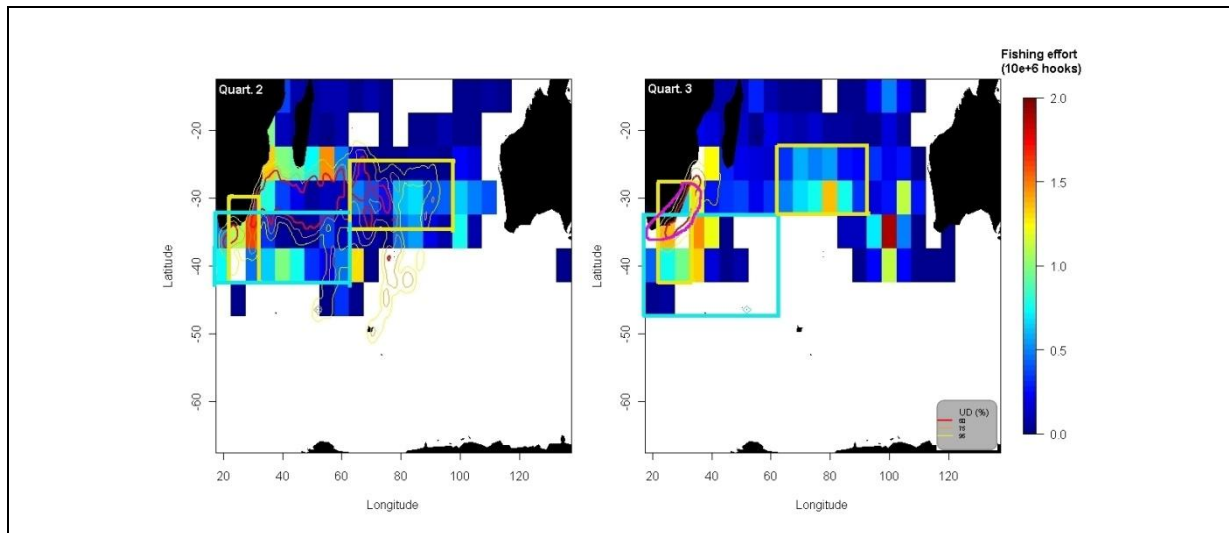
90. Pakistan, Sri Lanka and Iran reported on their substantial drifting gillnet fisheries (including fishing on the high seas). Pakistan reported bycatch of a storm petrel on-board a gillnet vessel. The meeting noted that flesh-footed shearwaters and other species are known to migrate to areas where some of these fisheries operate and could be at risk.

**New information on the distribution of southern seabirds and their overlap with the IOTC zone: Seasonal changes in distribution and the importance of the non-breeders and juveniles in assessing overlap between seabirds and longliners (IOTC-2010-WPEB-14)**

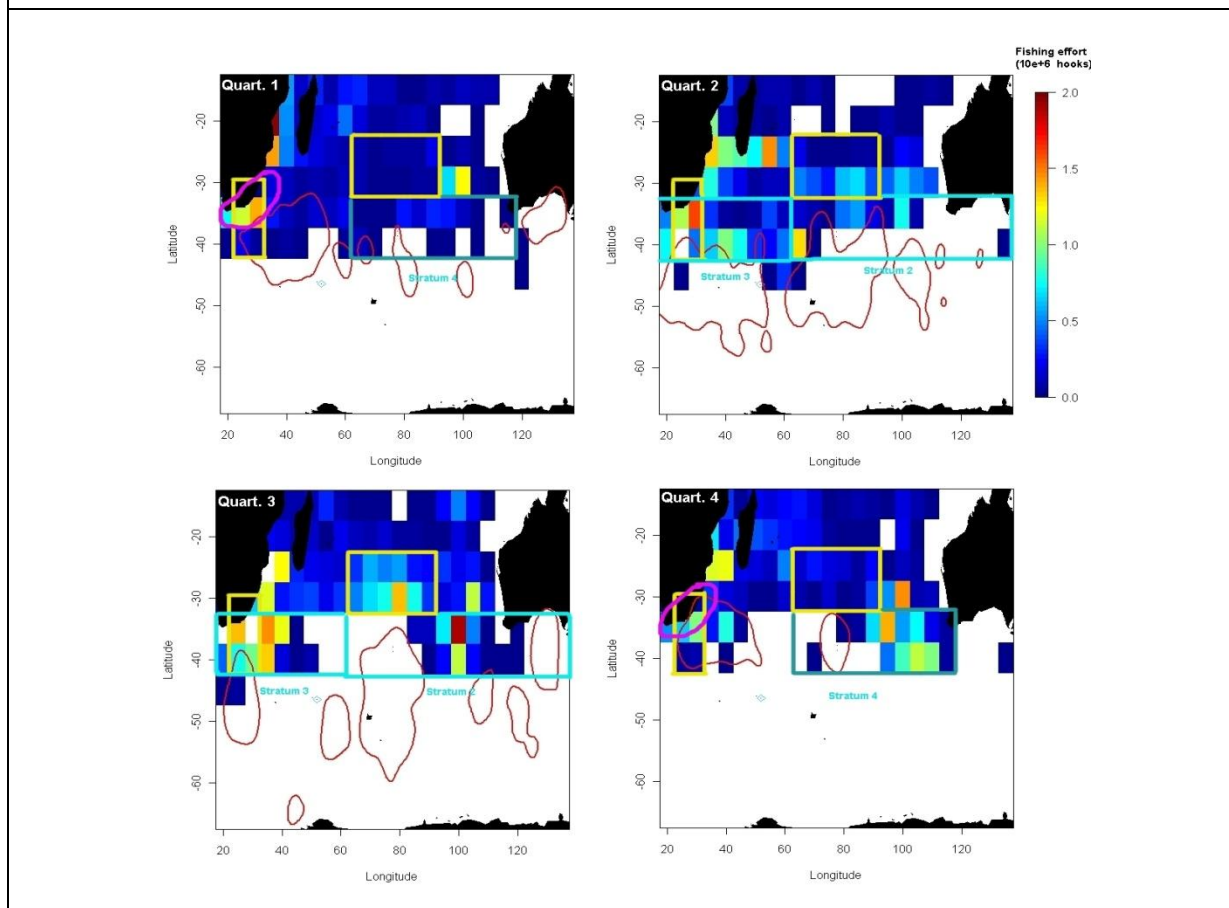
91. Up-to-date information on the distribution of albatrosses and petrels in the IOTC area was presented. The populations of several species have been decreasing over several decades, and one species, the Amsterdam Albatross, is critically endangered. This decrease has been related to bycatch mortality in longline fisheries. IOTC-2009-WPEB-13 demonstrated that several species forage in subtropical waters 1000-2000 km to the north of the breeding islands, where their ranges overlap extensively with tuna longline fishing effort. Demographic models suggest that the decrease 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, although for some species, decreases of population are due to reduced recruitment, *i.e.* to high mortality during the juvenile and immature phase. To investigate the degree of overlap of the juvenile and immature part of populations with longline fishing, 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 young and native birds (Figure 2 and Figure 3), believed to be very susceptible to bycatch, range much further north than do adult birds (Figure 4). In particular, juveniles range widely in the southern part of the IOTC area, as far north as latitude 25°S, where they encounter a high density of fishing effort (Figure 2 and Figure 3). These results show that a significant part of these populations rely entirely on the IOTC area during critical parts of their life cycle. Data were presented for Sooty Albatross and White-chinned Petrel tracked during breeding, non-breeding or juvenile periods. These results highlight the high overlap that exists with longliners (high fishing effort), and more specifically with the area of highest estimated bycatch (for Taiwanese, Japanese or South-African fleets, the only IOTC fleets for which any bycatch data exist). Importantly, the overlap varies by season due to variability in seabird and longliner distribution



**Figure 2.** Overlap of IOTC longline fishing effort (maximum value of fishing effort - in millions of hooks - reported during 2005-2008 period) and utilization distribution (Utility Distributions (UD) of 50, 75 and 95%) or Kernel density ( $h=1$ ) of satellite locations for juvenile Sooty Albatross after fledging from Crozet Island during 2nd quarter (a), 3<sup>rd</sup> quarter (b), 4<sup>th</sup> quarter (c) and 1<sup>st</sup> quarter of the following year (d). The areas of highest estimated bycatch reported of seabirds are shaded (Taiwanese fleet: yellow; Japanese: blue; South-African: pink). (ask KD for original maps)



**Figure 3.** Overlap of IOTC longline fishing effort (maximum value of fishing effort - in millions of hooks -reported during 2005-2008 period) and utilization distribution (UDs of 50, 75 and 95% or Kernel density ( $h=1$ ) of satellite locations for juvenile White-chinned Petrel after fledging from Crozet Island during 2<sup>nd</sup> (a) and 3<sup>rd</sup>(b)quarters. The areas of highest estimated bycatch reported of seabirds are shaded (Taiwanese fleet: yellow; Japanese: blue; South-African: pink). (ask KD for original maps)



**Figure 4.** Overlap of IOTC longline fishing effort (maximum value of fishing effort - in millions of hooks -reported during 2005-2008 period) and utilization distribution (UD of 50%) or Kernel density ( $h=2$ ) of satellite locations for Sooty Albatross from Crozet Island during non-breeding period on a quarterly basis. The areas of highest estimated bycatch reported of seabirds are shaded (Taiwanese fleet: yellow; Japanese: blue; South-African: pink). (ask KD for original maps)

92. These results highlight the crucial need to have access to reliable recent data on fishing effort and bycatch estimates (by fleet, area and species composition, and also bird legband recovery data) in order to better understand the potential impact on seabirds and enable effective management of fisheries and seabird populations.

## Level 1 Risk Assessment of Indian Ocean Seabirds Susceptible to Bycatch in Longline Fishing Operations (IOTC-2010-WPEB-24)

93. This paper represents a preliminary risk assessment for seabirds occurring in the Indian Ocean, which has been carried out intersessionally by the Agreement on the Conservation of Albatrosses and Petrels (ACAP) and BirdLife International (BirdLife). The methodology adopted for the assessment closely follows that used recently by the International Commission for the Conservation of Atlantic Tuna (ICCAT). The assessment examines characteristics that would put seabirds at risk from bycatch in longline fisheries operation and combined these characteristics in algorithms to calculate relative risk.

94. Forty seabird populations were identified as High Priority under all three of the risk algorithms used, relative to the other species considered in the assessment. These included 10 species of albatrosses, together with grey and white-chinned petrels, and the Flesh-footed Shearwater. The Amsterdam Albatross is critically endangered, and might also be potentially susceptible to disease<sup>2</sup>. In some cases, a high risk score was the result of a precautionary approach given a lack of available data, particularly on population trend *e.g.* sooty, grey-headed and Indian yellow-nosed albatrosses.

95. The presence of a large number of seabird species that are known to interact with pelagic longline gear, many of which have an unfavourable conservation status, lends support to the proactive approach taken by the IOTC in implementing bycatch mitigation measures within the Indian Ocean. It also highlights the need to ensure that Resolution 10-06 is regularly updated to ensure best-practice mitigation measures are applied in areas of highest risk to seabird species and populations, and high levels of compliance are achieved by fishers. Currently, this measure is broadly applied to waters south of 25 degrees South, but the risk to seabirds may not be evenly spread across such a large area, and it may be appropriate to further refine the area of application to ensure risk to seabirds is adequately addressed through appropriate management. For example, applying more rigorous measures in areas adjacent to important seabird breeding sites during critical times of the breeding cycle.

96. The WPEB recommended the adoption of such an approach by initially undertaking a Level 2 Risk Assessment for those species identified as High Priority in the Level 1 assessment, or a Level 3 assessment for a smaller number of species where data are available to permit a highly quantified model-based analysis. However, it noted that resources to facilitate such further work should be provided, and that high-quality fishery observer data will need to be collected and made available for analysis.

97. 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.

### 5.4 IDENTIFICATION SHEETS FOR OBSERVERS

98. BirdLife has facilitated the provision, at no cost, of copyrighted seabird images for an identification guide. The Secretariat will produce and print the ID sheets for use in the Regional Observer Scheme, and possibly for fishermen if more funding is available.

99. The WPEB recommended that the ID sheets for seabirds be finalized for the next meeting of the WPEB.

### 5.5 REVIEW OF RESOLUTION 10/06

100. In light of the new scientific assessments of various aspects of mitigation measures, that leave only 4 recommended mitigation measures, it was suggested that the two-column approach would no longer be appropriate. The proposal was to greatly simplify the resolution by requiring that fishers choose two of the four options from a list.

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

101. There is a need to adjust some of the specifications in 10/06. Line weighting be changed as per the recommendations in IOTC-2010-WPEB-17. It was pointed out that several lines of research in South Africa have

<sup>2</sup> Miccol, T. 2010. *Les poules mangent les limaces* : the impact of chickens on invertebrate diversity on Amsterdam Island. *Polar Poultry* 1: 29-34.



shown great promise in demonstrating that weights can be added safely to lines (without risk to crew safety) and the initial indications from several studies are that heavier weights make no difference to target catch rates. It was agreed that this is a field of very active research and new information should be reviewed by the WPEB on an annual basis.

102. Point 8 in Resolution 10/06 calls for a review from SC presented at the 2011 Commission meeting, of the impact of resolution on seabird bycatch rates. However, there are no data, so it is unlikely that the WPEB or SC will be able to provide the commission with any details. However, South Africa is probably in a position to provide some information, as an example. BirdLife to follow this up with the South African government for presentation at SC in December

103. The following proposed changes to Resolution 10/06 reflect the recommendations of the WPEB, with some reservations expressed by a few scientists.

Paragraph 3.

*CPCs shall ~~as soon as possible and, at the latest before 1 November 2010~~, ensure that all longline vessels fishing south of 25°S use at least two of the mitigation measures in Table 1 below, including at least one from Column A. Vessels shall not use the same measure from Column A and Column B. Until 31 October 2010, CPCs shall ensure that all longline vessels fishing south of 30°S use at least two of the mitigation measures in Table 1 below, including at least one from Column A. Vessels shall not use the same measure from Column A and Column B*

Paragraph 7.

*CPCs shall provide to the Commission, as part of their annual reports, information on how they are implementing this measure and all available information on interactions with seabirds, including bycatch by fishing vessels carrying their flag or authorised to fish by them. This is to include details of species where available to enable the Scientific Committee to annually estimate seabird mortality in all fisheries within the IOTC area of competence. CPCs are encouraged to develop systems, such as retention of carcasses for later identification, or establish photo identification processes, to improve identification of seabirds to species level.*

Table 1. Seabird mitigation measures

Weighted branch lines
Night setting with minimum deck lighting
Bird-scaring lines (Tori Lines)
Blue-dyed squid bait

The specification of the weighted branch line measure in Annex 1 should be replaced by the following scheme:

- 40 grams weight attached at the hook; or
- 60 grams weight within 1 metre of the hook; or
- 98 grams weight within 2 metres of the hook.

## 5.6 ADVICE AND RECOMMENDATIONS

18. The WPEB recommended that following the Level 1 Risk Assessment, work commence on a Level 2 or possibly Level 3 Risk Assessment to highlight areas of elevated risk to the high priority species. A highly quantified model-based Level 3 analysis would require the provision of additional resources.

19. The WPEB recommended that the Secretariat finalize the production of seabird identification sheets.

20. The WPEB proposed a revision to Resolution 10/06 to take into account the new scientific information on the negative impacts of line shooters on sink rates, and consequent risk that this poses to seabird bycatch, on the effectiveness of line weighting regimes and the absence of any scientific information on the effectiveness of offal discard management in reducing incidental mortality of seabirds, noting that more scientific information may be provided during the Scientific Committee

21. The WPEB recommended that the National Action Plan for Amsterdam Albatross, currently being finalized by France, be submitted to the WPEB for review in 2011

22. The WPEB encouraged CPCs to develop systems, such as retention of carcasses for later identification, or establish photo identification processes, to improve identification of seabirds to species level.

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

findings relevant to IOTC fisheries.

24. The WPEB recommended that CPCs fulfil their FAO obligation to assess the need for NPOA-seabird and develop plans if appropriate. To assist in this the Secretariat should prepare a table summarising progress towards the development of NPOA-Seabirds by CPCs for the next Scientific Committee.

## 6. TURTLES

### 6.1 REVIEW OF ANY NATIONAL PLANS FOR THE REDUCTION OF SEA TURTLE BYCATCH IN TUNA FISHERIES

104. There is, as yet, no formal requirement for sea turtle NPOAs within the framework of FAO; however the WPEB was informed that at least a dozen IOSEA Marine Turtle MoU Signatory States had been developing national plans or management strategies for sea turtles, which were in various stages of completion. The extent to which they incorporated measures for reducing sea turtle bycatch was unknown.

105. The document IOTC-2010-WPEB-25 was presented to the WPEB . It compiled information from the IOSEA Online Reporting Facility (<http://ioseaturtles.org/report.php>) on fisheries-turtle interactions and mitigation measures reported by 19 IOSEA Signatory States that are also IOTC members or co-operating non-members.

106. Among other things, the report describes fisheries potentially interacting with marine turtles (including a subjective indication of fishing effort and perceived impacts); illegal fishing occurring in territorial waters; and national measures and programmes to minimise incidental capture and mortality of marine turtles. While IOSEA did not have the capacity to compile or process raw data from Signatory States, it does maintain a number of useful region-wide metadatabases, such as one on satellite tracking projects. It was noted that the IOSEA reports were incomplete in many respects and not necessarily up-to-date; and that they would benefit from additional inputs, particularly from fisheries agencies.

107. The group acknowledged the work and the effort of the IOSEA. Information compiled by IOSEA is useful for the deliberations of the WPEB, and it was recommended that the respective Secretariats should collaborate to try to supplement the existing information, with a view to preparing analyses that could help to guide decision-making.

108. However, it was noted that when multiple agencies with different perspectives were involved in providing information, there were likely to be contradictions. Information on sea turtles during the pelagic phase of their life history was scant, and observer data could be very useful to fill in gaps.

109. The WPEB was informed that France was in the process of compiling a much more comprehensive national report; and an offer was made to provide information from the French purse seine fishery. The WPEB recommended that distant water fishing nations should join the MoU, which had initially been directed toward Indian Ocean coastal countries.

### 6.2 RESEARCH ON INTERACTIONS BETWEEN TURTLES AND TUNA FISHERIES IN THE INDIAN OCEAN

110. The WPEB was given an update on the Southwest Indian Ocean Fisheries Project (SWIOFP) which has a biodiversity component that provided for research on sea turtles. Among other things, this nine-country project will attempt to identify turtle 'hotspots' and migration routes, and combine this information with environmental parameters and fisheries data to identify areas of risk. Substantial funding was available from a range of sources for new satellite tracking work; and a 3-day training workshop had recently been held for 14 participants from 8 countries of the South-West Indian Ocean.

111. It was noted that relatively few turtles were caught during purse seine setting operations, and most were released alive. However, turtles were being entangled and dying on the FADs themselves, in numbers that have been recorded but not yet analysed. The WPEB recommended that such analysis be conducted for its next session.

112. The Convention on Migratory Species (CMS) is undertaking a major project which will pull together information on the impacts of gillnetting on a range of migratory species worldwide. It is expected that a draft report, including recommendations, will be available in time for the next WPEB meeting. The IOSEA also described a comprehensive assessment of Indian Ocean leatherback conservation status that includes recommendations for additional work.

113. It was noted that it was important to consider stranding data, which could be indicative of a bycatch problem; and proposed that observer programmes retain samples of juveniles caught in purse seines for analyses by turtle experts.

### 6.3 TASKS REQUESTED BY THE SCIENTIFIC COMMITTEE TO THE WPEB:

114. It was proposed that two of the tasks (to develop recommendations on appropriate mitigation measures and to develop guidelines for appropriate handling and release) would benefit from a review of material already developed in other regions. To that end, it was suggested that the IOTC Secretariat examine whether modest funding could be allocated for a short desk study that would synthesise available information.

115. The development of regional standards for data collection, exchange and training could benefit from related standardisation initiatives undertaken or foreseen in the framework of the SWIOFP and the IOSEA Western Indian Ocean – Marine Turtle Task Force.

116. The IOTC Secretariat had initiated a cost-effective collaboration with SPC that will result in the production of a marine turtle identification guide, adapted for the Indian Ocean region. The WPEB recommended that these ID sheets are finalized before its next meeting, and that the Secretariat cooperate with other initiatives developing the same kind of material.

### 6.4 REVIEW OF RESOLUTION 09/06

117. The WPEB did not recommend any changes to Resolution 09/06, however, it urged the CPCs to comply with the existing Resolution.

### 6.5 RESEARCH ON EFFECT OF SEA TURTLES MITIGATION MEASURES

#### *Ecological FADs*

118. The WPEB was informed that following results of the MADE project the French, Spanish and Seychelles purse seine fleets were making progress towards the conversion to ecological FADs. France is already deploying non-biodegradable FADs that eliminate the possibility of turtles becoming entrapped in both the Atlantic and Indian oceans; while Spain will conduct experiments in the Atlantic Ocean with many different ecological, biodegradable FAD designs before recommending a particular design. Additional experimentation on FADs would occur under the global ISSF project

119. Since the EU and Seychelles fleets accounted for more than 90% of the total purse-seine effort in the Indian Ocean, it is likely that turtle interactions with this gear type had a good chance of being minimized.

120. However, the WPEB encouraged other countries using drifting or anchored FADs (including Iran, Comoros, Maldives, Seychelles and Thailand), where necessary, to move towards the adoption of ecological FADs and update the relevant information in their IOSEA national reports.

#### *The use of circle hooks*

121. The WPEB was informed that a growing proportion of circle hooks is being utilized in the longline fishery of La Réunion. In addition, in Indonesia, there is strong industry interest to take up circle hooks, but availability of suitable locally-produced hooks was problematic.

122. The OFCF is funding a project in Central and South America to promote the use of circle hooks, and some progress should be reported at the next Session of the WPEB.

#### *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*

123. The WPEB was informed that in the framework of the PROSPER project a range of experiment was going to be conducted in La Réunion.



*IOTC guidelines on releasing sea turtles be developed, and that these be made freely available to fishers*

124. The IOTC Secretariat will include instructions on safe release of turtles in the identification guides currently being developed.

*All longline vessels to be equipped with the necessary tools to remove hooks from turtles to ensure safe release and minimize post-release mortality.*

125. No information on progress was available.

## 6.6 ADVICE AND RECOMMENDATIONS

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

## 7. MARINE MAMMALS

### 7.1 RESEARCH PROGRAMMES ON MARINE MAMMALS

126. The WPEB was informed of several relevant developments concerning marine mammals in the Indian Ocean. The peer-reviewed proceedings volume of the Indian Ocean Cetacean Symposium, held in Maldives in 2009, is to be published by the International Whaling Commission (IWC) in 2011. A marine mammal stranding workshop sponsored by CMFRI, Cochin and NOAA (USA) was held in Cochin, India in January 2010. Also in India, a cetacean distribution and bycatch from local fisheries monitoring project is currently executed by the CMFRI. The WPEB strongly supported further such marine mammal initiatives within the region.

127. The WPEB was also informed of a regional marine mammal project being started under the auspices of the South West Indian Ocean Fisheries Project (SWIOFP). This marine mammal project will run from 2010-12. Its objectives include study of: the population structure of the spinner dolphin; high seas distribution of large cetaceans; cetacean (and other) bycatch in coastal gillnet fisheries.

128. The occurrence of major gillnet tuna fisheries in the Arabian Sea was highlighted as a likely source of significant cetacean bycatch. While cetacean bycatch has been recorded from Sri Lanka, Indian and to some extent Omani fisheries, it is barely documented from Pakistani, Iranian and Yemeni fisheries. It was reported that, all cetaceans in Indian waters are protected under the Wildlife (Protection) Act, 1972. However, there are sporadic reports of incidental capture in gillnets. In some rare occasions, fishermen use the dead cetaceans as shark bait or used for human consumption. A forthcoming CMS global study of the impacts of gillnetting on migratory species may shed some light on the extent of cetacean (and other) bycatch in this region. Nevertheless, there is clearly a need for these fisheries to be monitored, for which foreign assistance may be required in some cases. It was reported that driftnets in excess of 2.5 km length are regularly used in both Pakistani and Iranian fisheries, in contravention of IOTC Resolution 09/05.

129. From the EU purse seine fishery, there are logbook records of large whales. It was noted that an analysis of such records would provide a useful update and expansion of the original baleen whale compilation of Robineau (1991)<sup>3</sup>.

## 7.2 ADVICE AND RECOMMENDATIONS

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

34. The WPEB recommended that available whale data from the European purse-seine fishery to be reviewed and analysed.

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

## 8. OTHER SPECIES

### 8.1 RESEARCH PROGRAMMES ON OTHER SPECIES

#### Remote discrimination of By-catch in purse seine fishery using fisher's echo-sounder buoys

130. Within the European MADE programme (Mitigating ADverse Ecological Impacts of open ocean fisheries), a new observational instrument is being tested to remotely discriminate by-catch around drifting FADs. Nowadays Spanish fishers are using echo-sounder buoys to monitor and relocate DFADs. These echo-sounder buoys provide fishing masters with remotely monitored estimates of biomass beneath their DFADs. However, biomass estimates are given for all the species and sizes together without identifying the contribution of the different species and sizes to the acoustic signal. If remote discrimination of tuna species and/or sizes could be improved, this might allow fishers to avoid long trips to areas with high percentages of by-catch species and making sets that perhaps would have better not been made. Although this paper presents preliminary results and further studies are needed to improve the tool, echo-sounder buoys do show great potential to be used to minimize by-catch.

131. The WPEB recognized that the use of echo-sounder buoys could potentially allow purse-seine skippers to remotely estimate the abundance of bycatch under drifting FADs. However, the results are preliminary and the research should be continued.

#### Behaviour of two major bycatch species of tuna purse-seiners at FADs: oceanic triggerfish (*Canthidermis maculatus*) and rainbow runner (*Elagatis bipinnulata*)

132. Rainbow runners (*Elagatis bipinnulata*) and oceanic triggerfish (*Canthidermis maculatus*) are both widely distributed and major bycatch species of tuna purse-seine fisheries. But to date, very little information is available on their biology and behaviour. The increasing importance of Fish Aggregating Devices (FADs) within the fishery has raised concerns over the impacts of these devices on pelagic ecology and populations of these bycatch species. In this study, acoustic telemetry was used to investigate the behavioural ecology of these two species around FADs. Three

<sup>3</sup> Robineau, D., 1991. Balaenopterid sightings in the western tropical Indian Ocean (Seychelles area), 1982-1986. In: S. Leatherwood & G.P. Donovan (eds.). *Cetaceans and cetacean research in the Indian Ocean Sanctuary*. Marine Mammal Technical Report N°3. UNEP, Nairobi, Kenya, pp.171-178.

tuna purse seine FADs in the northern Mozambique channel were equipped with satellite linked acoustic receivers. Two *E. bipinnulata* and thirteen *C. maculatus* were equipped with coded acoustic tags some of which had pressure sensors. The average Total Time of Association (TTA) with the FAD was 67 days for *E. bipinnulata* and 21.5 days for *C. maculatus*. No departures lasting more than 24 hours were observed for either species. The diel pattern of vertical distribution of *E. bipinnulata* and *C. maculatus* were similar, averaging 9.9 m (SD  $\pm$  11.7m) and 5.1 m (SD  $\pm$  9.2 m) during the night and 19.7 m (SD  $\pm$  14.1 m) and 10.1 m (SD  $\pm$  12.5 m) during the day, respectively. The high fidelity and limited vertical distribution of the two bycatch species studied confirms their high catchability by the FAD based purse-seine fishery

133. The WPEB noted with interest the results of the study and recommended that such research is pursued.

## 8.2 ADVICE AND RECOMMENDATIONS

36. The WPEB encouraged further work on other fish species commonly caught as bycatch in the purse-seine fisheries, *i.e.* oceanic triggerfish, rainbow runners, dolphin fish, *etc.*

37. The WPEB encouraged research on anchored FADs and their effect on bycatch.

38. The WPEB recommended that any data collected in Maldives on anchored FADs is made available to researchers.

## 9. DEPREDATION

### 9.1 REVIEW OF AVAILABLE DATA ON DEPREDATION

134. A review of a study published in the SPC newsletter was presented to the WPEB (IOTC-2010-WPEB-Inf17) In this paper the evolution of mitigation methods for depredation-by toothed whales in tuna longline fisheries over a half century from industrial fisheries operations was reviewed. There have been five major mitigation approaches used over the past 60 years, *i.e.* (1) self-reliant efforts (boat and line handling and other techniques); (2) chemical methods (use of powders and others); (3) population control; (4) physical methods (nets, covers, etc) and (5) acoustics methods (active and passive approaches). The historical progress and evolution of these methods was discussed and the methods which are logistically effective within industrial tuna longline fisheries were evaluated. Current work includes acoustical studies using depredation mitigation pingers, and also development of special streamers with light alloy balls having strongly disturbing echolocation properties, based on longline industry experience. Future prospects are discussed.

135. The WPEB recognized that depredation is a serious issue and could result in important economic loss for fishers. It recommended continued research on the subject and especially on the new pingers that are currently being developed. However, the WPEB recommended that measures to reduce depredation should not interfere with other measures used to mitigate bycatch, *i.e.* weighting branch line regime.

### 9.2 RECOMMENDATIONS RELATING TO DEPREDATION

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

## 10. ECOSYSTEM APPROACHES

### 10.1 ECOLOGICAL RISK ASSESSMENT FOR BYCATCH MONITORING, ANALYSIS AND MANAGEMENT IN AN RMFO CONTEXT

#### Ecological Risk Management in Australian tuna and billfish fisheries (IOTC-2010-WPEB-05)

136. This paper provided an overview of the Australian Ecological Risk Management (ERM) process and the outcomes for Australia's tuna and billfish fisheries. The principal Australian tuna fisheries covered by IOTC are the Western Tuna and Billfish Fishery (WTBF) and Western Skipjack Fishery (WSF). However, this paper also covered the ERM strategies for Eastern Tuna and Billfish Fishery (ETBF), the Eastern Skipjack Fishery (ESF) and Southern

Bluefin Tuna Fishery to provide a more comprehensive overview. Through the ERM process, Australia aims to minimise impacts of fishing on all aspects of the marine ecosystem including bycatch species, protected (TEP) species, habitats, and communities. The ERM process works through conducting Ecological Risk Assessments (ERA) for each fishery to identify species, habitats or communities that are at high risk from fishing practises and then developing targeted management measures for species identified to be at high risk. The principal environmental risks identified for the tuna and billfish fisheries relate to incidental capture or entanglement of seabirds, sharks, turtles and marine mammals. Under the ERM strategy Australia has developed a range of management measures to minimise impacts on these species groups that are outlined in the Bycatch and Discards workplan, Threat Abatement Plan (TAP) for seabirds and the Turtle mitigation strategy.

137. The WPEB noted that this paper provided good guidance on the direction to follow in the future and recommended that a coordinator should take the lead in order to identify and gather the information need to undertake such an assessment at the level of the IOTC. It was suggested that the WPEB could have a special session on Ecological Risk Assessment next year. The WPEB recommended that the ERA undertaken last year on bycatch of sharks in the purse-seine fishery should be updated for next year and recommended that as priority an ERA should be undertaken on sea turtle bycatch within the purse-seine fishery.

### **Trophic ecology of tunas, sharks, billfishes and allied species in the eastern Arabian Sea (IOTC-2010-WPEB-21)**

138. The diet of seventeen species of large pelagic predatory fishes caught during a tuna longline survey in the western Indian EEZ (Eastern Arabian Sea) were analysed to study the trophic interactions among these predators and prey species. The predators studied included two species of tunas, four billfishes, six pelagic sharks, two dolphinfishes and one species each of ray, lancetfish and barracuda. Sex-wise, seasonal and ontogenetic variations in the diet of major species were analysed. Importance of *Sthenoteuthis oualaniensis*, *Charybdis smithii*, *Cubiceps pauciradiatus*, flyingfishes and neritic tunas in the diets of large pelagic predatory fishes of the Arabian Sea was highlighted. Estimated trophic levels of large pelagic predators of Arabian Sea in the present study were in the range of 4.13 to 4.36. Cluster analysis of the diet of all species revealed four distinct trophic guilds among the large pelagic predatory fishes of the Arabian Sea. Diet overlap and feeding niche partitioning analysis revealed that many of the large pelagic predatory fishes are sharing common food species in the Arabian Sea. The maximum index of dietary overlap was between *A. ferox* and *C. melanopterus* as both these species were found to consume large quantities of *C. smithii*. However, the most significant dietary overlap, from the point of view of longline fishery was that between *I. platypterus* and *T. albacares*. This study further revealed that, although large predators including tunas, billfishes and lancetfishes consume a variety of food items, reflecting their opportunistic nature, the dominance of a few selected species was noteworthy. There is potential to develop fisheries for prey of large predatory fishes, to be used as bait in longlining as well as for human consumption.

139. The WPEB acknowledged the work undertaken, however it was surprised by the report of catches of *C. melanopterus* on pelagic longlines. This shark is normally associated with reefs and coastal waters, and its presence offshore requires confirmation.

## **10.2 ADVICE AND RECOMMENDATIONS**

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

## **11. RESEARCH RECOMMENDATIONS AND PRIORITIES**

140. 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 2009 recommendations are provided below as underlined text. The references to report paragraphs refer to paragraphs in the WPEB-5 Report (2009).

**DATA**

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.

- *Achieved with the presentation of a document on identification of manta and mobula rays*

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

- *Little progress*

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.

- *Significant progress with the production of an observer manual, an observer trip report template and development of id cards for sharks, seabirds and turtles.*

**SHARKS (paragraph 52)**

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.

- *Proposal rejected by Scientific Committee*

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.

- *Little progress*

The status of Indian Ocean shark stocks be assessed, to the extent possible, using available information on various fishery indicators.

- *Some progress, more required*

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*).

- *Some progress, with several reports on blue and silky species this year. However, the lack of research on oceanic whitetip sharks was noted with concern, as this in part reflects the current scarcity of this species*

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.

- *Proposal rejected by Scientific Committee*

Priority be given to reviewing the status of pelagic sharks at the next meeting of the WPEB

- *Limited progress, due to lack of data and limited participation by pelagic shark specialists.*

Information of potential value for stock assessment of whale sharks should be compiled

- *Significant progress, with several peer-reviewed papers published or in press*

**SEABIRDS (paragraph 68)**

An ERA process be commenced for seabirds, with work carried out inter-sessionally and at the next meeting of the WPEB

- *Level-1 ERA for IO seabirds completed and presented to WPEB-6*

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.



- *New evidence discussed at WPEB-6, and proposals made for changes to Resolution*

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

- *Proposal adopted by Commission in March 2010*

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.

- *Limited progress*

The Commission should encourage CPCs to fulfil their FAO obligations to assess the need for NPOAs Seabirds and develop plans if appropriate.

- *Limited progress*

Seabird Executive Summaries should be produced in time for the 2009 Scientific Committee meeting, and updated regularly.

- *Achieved*

Priority be given to updating seabird recommendations at the next meeting of the WPEB.

- *Achieved*

### **SEA TURTLES (paragraph 79)**

Complete conversion to the use ecological FADs be completed as soon as possible

- *French fleet has started adoption of new design, while Spanish fleet is investigating new designs*

Purse seine FADs be constructed from biodegradable materials

- *Spanish fleet investigating new designs*

The use of circle hooks be extended to shallow-set tuna longlines in particular

- *No progress reported*

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

- *No progress reported*

IOTC guidelines on releasing sea turtles be developed, and that these be made freely available to fishers

- *IOTC Secretariat working on guidelines, to be printed with identification sheets, which should be available in 2011*

All longline vessels to be equipped with the necessary tools to remove hooks from turtles to ensure safe release and minimize post-release mortality.

- *Limited progress*

### **DEPREDAATION (paragraph 93)**

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.”

- *No consensus at the Scientific Committee. However, a form to voluntarily report depredation event was endorsed by the SC.*

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.”

- *No consensus at the Scientific Committee. However, a form to voluntarily report depredation event was endorsed by the SC.*

There is a need to continue research on monitoring and mitigation of depredation within the Indian Ocean.

- *Limited progress*

**ECOSYSTEM APPROACHES (paragraph 101)**

Further work on Ecological Risk Assessments and that ERA analysis is expanded to other fisheries and taxa

- *Limited progress*

Population explosions of mantis shrimps and swimming crabs within the western Indian Ocean should be properly documented.

- *Some intersessional work, but not yet ready for publication*

**12. OTHER BUSINESS**

141. The WPEB acknowledged the work of the Chair in running the meeting.

**13. ADOPTION OF THE REPORT**

142. The Report of the Sixth Session of the Working Party on Ecosystems and Bycatch was finalized in the main on the 30th October 2010 and adopted by correspondence on the 12 November 2010.

## APPENDIX I

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**APPENDIX II**  
**AGENDA OF THE 6<sup>TH</sup> SESSION OF THE WORKING PARTY ON TROPICAL TUNAS**

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**I. OPENING**

1. Adoption of agenda and opening remarks

**II. INTERNATIONAL CONTEXT**

1. Update on the Kobe process

**III. REVIEW OF THE DATA ON BYCATCH AND ECOSYSTEMS**

1. Update on the data available in the IOTC database (Secretariat)
2. Data from other sources
3. Status of the IOTC Regional Observer Scheme
4. Advice and recommendations

**IV. SHARKS**

1. Review of any National Plans of Action relating to reduction of shark bycatch in tuna fisheries
2. Research programmes on sharks
3. Improvement on shark identification
4. Stock assessment / ERA on sharks
5. Conservation of sharks caught in association with fisheries managed by IOTC (*Discussion on way forward following Commission's rejection of WPEB/SC recommendation to land sharks with fins attached*).
6. Review of Resolution 05/05
7. Advice and recommendations

**V. SEABIRDS**

1. Review of any National Plans of Action for reducing incidental catches of seabirds in longline fisheries
2. Update from Birdlife International
3. Research on interaction between seabirds and tuna fisheries in the Indian Ocean
4. Identification sheets for observers
5. Review of Resolution 10/06
6. Advice and recommendations

**VI. TURTLES**

1. Review of any National Plans of Action for the reduction of sea turtle bycatch in tuna fisheries
2. Research on interaction between turtles and tuna fisheries in the Indian Ocean
3. Tasks requested by the Scientific Committee to the WPEB:
  - To develop recommendation on appropriate mitigation measures
  - To develop guidelines for appropriate handling and release
  - To develop regional standards for data collection, exchange and training
  - To produce a marine turtle Id Guide
4. Review of Resolution 09/06
5. Research on effect of sea turtles mitigating measures (eg. circle hooks)
6. Advice and recommendations

**VII. MAMMALS**

1. Research programmes on marine mammals
2. Advice and recommendations

**VIII. OTHER SPECIES**

1. Research programmes on other species
2. Advice and recommendations

**IX. DEPREDATION**

1. Review of available data on depredation
2. Requirement for improvement of the data on depredation
3. Possible consequences of depredation on stock assessment
4. Advice and recommendations

**X. ECOSYSTEM APPROACHES**

1. Ecological Risk Assessment (ERA) for bycatch monitoring, analysis and management, in an RFMO context
2. Advice and recommendations

**XI. OTHER BUSINESS**

### APPENDIX III

#### LIST OF DOCUMENTS

Document	Title	Availability
IOTC-2010-WPEB-01	Draft agenda of the Working Party on Ecosystems and Bycatch	✓
IOTC-2010-WPEB-02	WPEB List of documents	✓
IOTC-2010-WPEB-03	Remote discrimination of By-catch in purse seine fishery using fisher's echo-sounder buoys. <i>Lopez, J., Moreno, G., Soria, M., Cotel, P. and Dagorn, L.</i>	✓
IOTC-2010-WPEB-04	2009 Shark Assessment Report for the Australian National Plan of Action for the Conservation and Management of Sharks. <i>Benseley, N., Woodhams J., Patterson H.M., Rodgers M., McLoughlin K., Stobutzki I. and Begg G.A.</i>	✓
IOTC-2010-WPEB-05	Ecological Risk Management in Australian tuna and billfish fisheries. <i>Australian Fisheries Management Authority</i>	✓
IOTC-2010-WPEB-06	Line weighting and other factors affecting sink rates - Australia. <i>Robertson, G., Candy, S.G., Wienecke, B. and Lawton, K.</i>	✓
IOTC-2010-WPEB-07	Effect of line shooter on pelagic mainline tension. <i>Robertson G., Candy, S.G. and Wienecke, B.</i>	✓
IOTC-2010-WPEB-08	Development of an Underwater Bait Setter. <i>Robertson, G. and Ashworth, P.</i>	✓
IOTC-2010-WPEB-09	Summary of PATs deployed on pelagic sharks in the Western Indian Ocean under the MADE program. <i>Filmalter, J.D., Dagorn, L. and Bach, P.</i>	✓
IOTC-2010-WPEB-10	Double tagging of juvenile silky sharks to improve our understanding of their behavioral ecology : preliminary results. <i>Filmalter J.D., Dagorn, L. and Soria, M.</i>	✓
IOTC-2010-WPEB-11	Behaviour of two major bycatch species of tuna purse seiners at FADs: oceanic triggerfish and rainbow runner. <i>Forget, F., Dagorn, L., Filmalter, J.D., Soria, M., Govinden, R.</i>	✓
IOTC-2010-WPEB-12	First descriptions of the behaviour of silky sharks ( <i>Carcharhinus falciformis</i> ) around drifting FADs, in the Indian Ocean, using acoustic telemetry. <i>Filmalter, J.D., Dagorn, L., Cowley, P. and Taquet, M.</i>	✓
IOTC-2010-WPEB-13	International Seafood Sustainability Foundation initiatives to develop and test bycatch mitigation options for tropical purse seine fisheries. <i>Restrepo V.R. and Dagorn, L.</i>	✓
IOTC-2010-WPEB-14	New information on the distribution of southern seabirds and their overlap with the IOTC zone: Seasonal changes in distribution and the importance of the non-breeders and juveniles in assessing overlap between seabirds and longliners. <i>Delord, K. and Weimerskirch, H.</i>	✓
IOTC-2010-WPEB-15	Niche partitioning between blue and silky sharks in the south-west Indian Ocean. <i>Rabehagasoa, N., Lorrain, A., Ménard, F., Potier, M., Richard, P. and Bach, P.</i>	✓
IOTC-2010-WPEB-16	Pelagic elasmobranch diversity and abundance in the western Indian Ocean: an analysis of long-term trends from research and fisheries longline data. <i>Romanov, E., Bach, P., Rabearisoa, N., Rabehagasoa, N., Filippi, T. and Romanova, N.</i>	✓
IOTC-2010-WPEB-17	Review of Seabird Bycatch Mitigation Measures for Pelagic Longline Fishing Operations. <i>ACAP</i>	✓
IOTC-2010-WPEB-18	Indian Ocean-scale predictions of seasonal whale shark distribution from opportunistic fisheries-based sightings. <i>Sequeira, A., Mellina, C., Rowat, D., Meekan, M.G., Bradshaw, C.J.A.</i>	✓
IOTC-2010-WPEB-19	Catch and bycatch in the pelagic longline fishery around Mayotte (NE Mozambique Channel), July 2009-September 2010. <i>Kiszka, J., Bein, A., Bach, P., Jamon, A., Layssac, K., Labart, S. and Wickel, J.</i>	✓
IOTC-2010-WPEB-20	How much sampling coverage affects bycatch estimate in the Purse-seine fishery? <i>Amandé, M.J., Lennert-Cody, C.E., Bez, N., Hall, M.A., Chassot, E.</i>	✓
IOTC-2010-WPEB-21	Trophic ecology of Tunas, bill fishes and sharks in the Western Indian EEZ. <i>Varghese, S.P.</i>	✓
IOTC-2010-WPEB-22	Ecology and By-catch tuna with respect to the conservation and management measures. <i>Riaz, M.A.</i>	✓
IOTC-2010-WPEB-23	Diversity on marine animals in bycatch tuna longlining in Pakistan. <i>Akbar, K.M.S.</i>	✓
IOTC-2010-WPEB-24	Level 1 Risk Assessment of Indian Ocean Seabirds Susceptible to Bycatch in Longline Fishing Operations. <i>Baker, G.B. and Wanless, R.M.</i>	✓
IOTC-2010-WPEB-25	Extracts from the IOSEA marine turtle MoU 'online reporting facility' concerning fisheries-turtle interactions in IOTC member states. <i>Hykle, D.</i>	✓
IOTC-2010-WPEB-26 (pres)	Marine Mammals project in the Southwest Indian Ocean Fisheries Project (SWIOFP) Ecology, interaction with fisheries and conservation. <i>Marsac, F.</i>	✓
IOTC-2010-WPEB-Inf01	Mobulidae of the Indian Ocean: an identification hints for field sampling. <i>Romanov, E.</i>	✓
IOTC-2010-WPEB-Inf02	Regional Observer Scheme manual	✓

Document	Title	Availability
IOTC-2010-WPEB-Inf03	IOTC Regional Observer Scheme Forms	✓
IOTC-2010-WPEB-Inf04	Status of IOTC databases (2009)	✓
IOTC-2010-WPEB-Inf05	WCPFC Research Plan to determine status of Key Shark Species	✓
IOTC-2010-WPEB-Inf06	Report of the International Workshop on tuna RFMO management of issues relating to bycatch.	✓
IOTC-2010-WPEB-Inf07	IOTC Resolution05/05	✓
IOTC-2010-WPEB-Inf08	IOTC Resolution09/06	✓
IOTC-2010-WPEB-Inf09	IOTC Resolution10/06	✓
IOTC-2010-WPEB-Inf10	IOTC Resolution10/4	✓
IOTC-2010-WPEB-Inf11	Kobe II Bycatch Workshop Background Paper Sea Turtles	✓
IOTC-2010-WPEB-Inf12	DRAFT - Kobe II Bycatch Workshop Background Paper Non-target finfish species and small target species	✓
IOTC-2010-WPEB-Inf13	Kobe II Bycatch Workshop Background Paper Marine Mammals	✓
IOTC-2010-WPEB-Inf14	Kobe II Bycatch Workshop Background Paper Seabirds	✓
IOTC-2010-WPEB-Inf15	SPC Sharks Identification cards	✓
IOTC-2010-WPEB-Inf16	SPC Turtle Identification cards	✓
IOTC-2010-WPEB-Inf17	An overview of toothed whale depredation mitigation efforts in the Indo-Pacific region (SPC newsletter)	✓