Report of the 11th Session of the IOTC Working Party on Ecosystems and Bycatch

Olhão, Portugal 7–11 September 2015

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ACRONYMS

ACAP	Agreement on the Conservation of Albatrosses and Petrels
BSH	Blue shark
CITES	Convention on International Trade in Endangered Species
CMM	Conservation and Management Measure (of the IOTC; Resolutions and Recommendations)
CPCs	Contracting Parties and Cooperating Non-Contracting Parties
CPUE	Catch per unit of effort
current	Current period/time, i.e. $F_{current}$ means fishing mortality for the current assessment year.
EEZ	Exclusive Economic Zone
ERA	Ecological Risk Assessment
EU	European Union
F	Fishing mortality; F_{2010} is the fishing mortality estimated in the year 2010
FAD	Fish Aggregation Device
FAO	Food and Agriculture Organization of the United Nations
F_{MSY}	Fishing mortality at MSY
GLM	Generalised liner model
HBF	Hooks between floats
IO	Indian Ocean
IOTC	Indian Ocean Tuna Commission
IOSEA	Indian Ocean - South-East Asian Marine Turtle Memorandum
IO-ShYP	Indian Ocean Shark multi-Year Plan
IPOA	International Plan of Action
IUU	Illegal, Unreported and Unregulated, fishing
LL	Longline
LSTLV	Large-scale tuna longline vessel
MoU	Memorandum of Understanding
MPF	Meeting Participation Fund
MSY	Maximum sustainable yield
n.a.	Not applicable
NGO	Non-Governmental Organisation
NPOA	National Plan of Action
PSA	Productivity Susceptibility Analysis
ROS	Regional Observer Scheme
SC	Scientific Committee of the IOTC
SB	Spawning biomass (sometimes expressed as SSB)
SB_{MSY}	Spawning stock biomass which produces MSY
Taiwan,China	Taiwan, Province of China
UN	United Nations
WPDCS	Working Party on Data Collection and Statistics, of the IOTC
WPEB	Working Party on Ecosystems and Bycatch, of the IOTC

KEY DEFINITIONS

Bycatch	All species, other than the 16 species listed in Annex B of the IOTC Agreement, caught or interacted with by fisheries for tuna and tuna-like species in the IOTC area of competence.
Discards	Any species, whether an IOTC species or bycatch species, which is not retained onboard for sale or consumption.
Large-scale driftnets	Gillnets or other nets or a combination of nets that are more than 2.5 kilometers in length whose purpose is to enmesh, entrap, or entangle fish by drifting on the surface of, or in, the water column.

STANDARDISATION OF IOTC WORKING PARTY AND SCIENTIFIC COMMITTEE REPORT TERMINOLOGY

SC16.07 (para. 23) The SC **ADOPTED** the reporting terminology contained in Appendix IV and **RECOMMENDED** that the Commission considers adopting the standardised IOTC Report terminology, to further improve the clarity of information sharing from, and among its subsidiary bodies.

HOW TO INTERPRET TERMINOLOGY CONTAINED IN THIS REPORT

Level 1: ***From a subsidiary body of the Commission to the next level in the structure of the Commission:***
RECOMMENDED, RECOMMENDATION: Any conclusion or request for an action to be undertaken, from a subsidiary body of the Commission (Committee or Working Party), which is to be formally provided to the next level in the structure of the Commission for its consideration/endorsement (e.g. from a Working Party to the Scientific Committee; from a Committee to the Commission). The intention is that the higher body will consider the recommended action for endorsement under its own mandate, if the subsidiary body does not already have the required mandate. Ideally this should be task specific and contain a timeframe for completion.

Level 2: ***From a subsidiary body of the Commission to a CPC, the IOTC Secretariat, or other body (not the Commission) to carry out a specified task:***
REQUESTED: This term should only be used by a subsidiary body of the Commission if it does not wish to have the request formally adopted/endorsed by the next level in the structure of the Commission. For example, if a Committee wishes to seek additional input from a CPC on a particular topic, but does not wish to formalise the request beyond the mandate of the Committee, it may request that a set action be undertaken. Ideally this should be task specific and contain a timeframe for the completion.

Level 3: ***General terms to be used for consistency:***
AGREED: Any point of discussion from a meeting which the IOTC body considers to be an agreed course of action covered by its mandate, which has not already been dealt with under Level 1 or level 2 above; a general point of agreement among delegations/participants of a meeting which does not need to be considered/adopted by the next level in the Commission's structure.
NOTED/NOTING: Any point of discussion from a meeting which the IOTC body considers to be important enough to record in a meeting report for future reference.

Any other term: Any other term may be used in addition to the Level 3 terms to highlight to the reader of and IOTC report, the importance of the relevant paragraph. However, other terms used are considered for explanatory/informational purposes only and shall have no higher rating within the reporting terminology hierarchy than Level 3, described above (e.g. **CONSIDERED**; **URGED**; **ACKNOWLEDGED**).

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EXECUTIVE SUMMARY

The 11th Session of the Indian Ocean Tuna Commission's (IOTC) Working Party on Ecosystems and Bycatch (WPEB) was held in Olhão, Portugal from 7 to 11 September 2015. A total of 37 participants (37 in 2014, 32 in 2013) attended the Session. The meeting was opened by the Chairperson, Dr Rui Coelho from IPMA, Portugal, who welcomed participants to Portugal and formally opened the 11th Session of the IOTC Working Party on Ecosystems and Bycatch (WPEB11). The Chairperson also welcomed the Invited Expert for the meeting, Dr Humber Andrade (Brazil) and the stock assessment consultant Dr Joel Rice (USA).

Review of the statistical data available for ecosystems and bycatch species

WPEB11.04 (para. 26) **NOTING** the high level of uncertainty in the nominal catches of blue sharks and high proportion caught by Indonesia, the WPEB **RECOMMENDED** that the IOTC consultancy work that is currently taking place to improve the Indonesian nominal catch data series is extended in order to provide sufficient attention to sharks as well as tuna.

Revision of Resolution 11/04 *on a regional observer scheme*

WPEB11.07 (para. 48) **RECALLING** the objectives of Resolution 11/04 on a regional observer scheme as follows:

> "Para 1: *The objective of the IOTC Observer Scheme shall be to collect verified catch data and other scientific data related to the fisheries for tuna and tuna-like species in the IOTC area of competence*"

and **NOTING** that the objective of the ROS contained in Resolution 11/04, and the rules contained in Resolution 12/02 *On data confidentiality policy and procedures* makes no reference to the data collected not being used for compliance purposes, the WPEB reiterated its **RECOMMENDATION** that at the next revision of Resolution 11/04, it be clearly stated that the data collected shall not be used for compliance purposes.

Review of seabird mitigation measures in Resolution 12/06

WPEB11.10 (para. 235) The WPEB **RECOMMENDED** that CPCs bring data to the WPEB meeting in 2016, as the Commission via Resolution 12/06 required the WPEB and SC to undertake this task in 2015, which has not been possible due to insufficient data, and that a collaborative analysis of the impacts of Resolution 12/06 be undertaken during the WPEB meeting, if feasible. CPC review papers and datasets should include the following information/data from logbooks and/or observer schemes, where appropriate and should cover the period 2011 to 2015:

- Total effort south of 25°S by area and time, at the finest scale possible
- Observed effort south of 25°S by area and time, at the finest scale possible
- Observed seabird mortality rates south of 25°S by area and time, at the finest scale possible
- Descriptions of fleet structure /target species by time and area, and an indication of observer coverage per fleet/target species for effort south of 25°S
- Data on which seabird bycatch mitigation measures were used, on a set-by-set/cruise basis if possible or per vessel, or at the finest scale possible
- Descriptions of the specifications of seabird bycatch mitigation measures used according to the fields in the Regional Observer Scheme manual and in relation to the specifications given in Res 12/06

Revision of the WPEB Program of Work 2016–2020

WPEB11.12 (para. 258) The WPEB **RECOMMENDED** that the SC consider and endorse the WPEB Program of Work (2016–2020), as provided at Appendix XVIII.

Election of a Chairperson and Vice-Chairperson for the WPEB for the next biennium

WPEB11.13 (para. 270) The WPEB **RECOMMENDED** that the SC note that Dr Rui Coelho (EU,Portugal) was elected as Chairperson, and Mr Reza Shahifar (I.R. Iran) and Dr Ross Wanless (South Africa) were elected as Vice-Chairpersons of the WPEB for the next biennium, in accordance with the IOTC Rules of Procedure (2014).

Review of the draft, and adoption of the Report of the 11th Session of the Working Party on Ecosystems and Bycatch

WPEB11.14 (para. 274) The WPEB **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPEB11, provided at Appendix XIX, as well as the management advice provided in the draft resource stock status summary for each of the seven shark species, as well of those for marine turtles and seabirds:

Sharks

- Blue sharks (*Prionace glauca*) – Appendix IX
- Oceanic whitetip sharks (*Carcharhinus longimanus*) – Appendix X
- Scalloped hammerhead sharks (*Sphyrna lewini*) – Appendix XI
- Shortfin mako sharks (*Isurus oxyrinchus*) – Appendix XII
- Silky sharks (*Carcharhinus falciformis*) – Appendix XIII
- Bigeye thresher sharks (*Alopias superciliosus*) – Appendix XIV
- Pelagic thresher sharks (*Alopias pelagicus*) – Appendix XV

Other species/groups

- Marine turtles – Appendix XVI
- Seabirds – Appendix XVII

Stock status summary

A summary of the stock status for some of the most commonly caught shark species caught in association with IOTC fisheries for tuna and tuna-like species is provided in Table 1.

TABLE 1. Status summary for key shark species caught in association with IOTC fisheries for tuna and tuna-like species.

Stock	Indicators		Prev[1]	2010	2011	2012	2013	2014	2015	Advice to the Commission
Sharks: Although sharks are not part of the 16 species directly under the IOTC mandate, sharks are frequently caught in association with fisheries targeting IOTC species. Some fleets are known to actively target both sharks and IOTC species simultaneously. As such, IOTC Contracting Parties and Cooperating Non-Contracting Parties are required to report information at the same level of detail as for the 16 IOTC species. The following are the main species caught in IOTC fisheries, although the list is not exhaustive.										
Blue shark *Prionace glauca*	Reported catch 2014: Not elsewhere included (nei) sharks[2]: Average reported catch 2010–2014: Not elsewhere included (nei) sharks[2]: MSY (1,000 t) (80% CI): F_{MSY} (80% CI): SB_{MSY} (1,000 t) (80% CI): F_{2014}/F_{MSY} (80% CI): SB_{2014}/SB_{MSY} (80% CI): SB_{2014}/SB_0 (80% CI):	33,714 t 55,361 t 29,628 t 62,160 t Unknown Unknown Unknown (0.44–4.84) (0.83–1.75) Unknown								A precautionary approach to the management of blue shark should be considered by the Commission, by ensuring that future catches do not exceed current catches. The primary source of data that drive the assessment (total catches) is highly uncertain and should be investigated further as a priority. Click below for a full stock status summary: ○ Blue sharks – Appendix IX
Oceanic whitetip shark *Carcharhinus longimanus*	Reported catch 2014: Not elsewhere included (nei) sharks[2]: Average reported catch 2010–2014: Not elsewhere included (nei) sharks[2]:	5,389 t 55,361 t 2,400 t 62,160 t								There is a paucity of information available for these species and this situation is not expected to improve in the short to medium term. There is no quantitative stock assessment and limited basic fishery indicators currently available. Therefore the stock status is highly uncertain. The available evidence indicates considerable risk to the stock status at current effort levels. The primary source of data that drive the assessment (total catches) is highly uncertain and should be investigated further as a priority. Click below for a full stock status summary: ○ Oceanic whitetip sharks – Appendix X ○ Scalloped hammerhead sharks – Appendix XI ○ Shortfin mako sharks – Appendix XII ○ Silky sharks – Appendix XIII ○ Bigeye thresher sharks – Appendix XIV ○ Pelagic thresher sharks – Appendix XV
Scalloped hammerhead shark *Sphyrna lewini*	Reported catch 2014: Not elsewhere included (nei) sharks[2]: Average reported catch 2010–2014: Not elsewhere included (nei) sharks[2]:	42 t 55,361 t 89 t 62,160 t								
Shortfin mako *Isurus oxyrinchus*	Reported catch 2014: Not elsewhere included (nei) sharks[2]: Average reported catch 2010–2014: Not elsewhere included (nei) sharks[2]:	1,683 t 55,361 t 1,538 t 62,160 t								
Silky shark *Carcharhinus falciformis*	Reported catch 2014: Not elsewhere included (nei) sharks[2]: Average reported catch 2010–2014: Not elsewhere included (nei) sharks[2]:	2,782 t 55,361 t 4,064 t 62,160 t								
Bigeye thresher shark *Alopias superciliosus*	Reported catch 2014: Not elsewhere included (nei) sharks[2]: Average reported catch 2010–2014: Not elsewhere included (nei) sharks[2]:	0 t 55,361 t 159 t 62,160 t								
Pelagic thresher shark *Alopias pelagicus*	Reported catch 2014: Not elsewhere included (nei) sharks[2]: Average reported catch 2010–2014: Not elsewhere included (nei) sharks[2]:	0 t 55,361 t 122 t 62,160 t								

Colour key	Stock overfished($SB_{year}/SB_{MSY} < 1$)	Stock not overfished ($SB_{year}/SB_{MSY} \geq 1$)
Stock subject to overfishing($F_{year}/F_{MSY} > 1$)		
Stock not subject to overfishing ($F_{year}/F_{MSY} \leq 1$)		
Not assessed/Uncertain		

1. OPENING OF THE MEETING

1. The 11th Session of the Indian Ocean Tuna Commission's (IOTC) Working Party on Ecosystems and Bycatch (WPEB) was held in Olhão, Portugal from 7 to 11 September 2015. A total of 37 participants (37 in 2014, 32 in 2013) attended the Session. The list of participants is provided at Appendix I. The meeting was opened by the Chairperson, Dr Rui Coelho from IPMA, Portugal, who welcomed participants to Portugal and formally opened the 11th Session of the IOTC Working Party on Ecosystems and Bycatch (WPEB11). The Chairperson also welcomed the Invited Expert for the meeting, Dr Humber Andrade (Brazil) and the stock assessment consultant Dr Joel Rice (USA).

2. ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION

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

3. THE IOTC PROCESS: OUTCOMES, UPDATES AND PROGRESS

3.1 Outcomes of the 17th Session of the Scientific Committee

3. The WPEB **NOTED** paper IOTC–2015–WPEB11–03 which outlined the main outcomes of the 17th Session of the Scientific Committee (SC17), specifically related to the work of the WPEB and **AGREED** to consider how best to progress these issues at the present meeting.

4. **NOTING** paper IOTC–2015–WPEB11–INF01 which detailed the new '*Guidelines for the presentation of CPUE standardisations and stock assessment models'* which were updated and adopted by the Scientific Committee at its meeting in December 2014, the WPEB **REMINDED** all those delivering CPUE and Stock Assessment papers to adhere to the guidelines.

5. The WPEB **NOTED** that in 2014, the SC made a number of requests in relation to the WPEB10 report (noting that updates on Recommendations of the SC17 (and WPEB10) are dealt with under Agenda item 3.4. Those requests and the associated responses from the WPEB11 are provided below for reference.

Assessing the need for an NPOA

*The SC **NOTED** the difficulties faced by the IOTC Secretariat when summarising and standardising information on reported seabird and marine turtle interactions across all CPCs given the number of sources and range in type of information reported. Given the increasing amount of information being reported, the SC therefore **REQUESTED** the WPEB discuss and develop new ideas to update and improve how these data are presented and summarised in the future. (para. 64 of the SC17 report)*

IOTC NPOA portal

*The SC **REQUESTED** that all CPCs without an NPOA-Sharks and/or NPOA-Seabirds expedite the development and implementation of a NPOA, and to report progress to the WPEB and SC in 2015, **NOTING** that NPOAs are a framework that should facilitate estimation of shark catches, seabird interactions, and development and implementation of appropriate management measures, which should also enhance the collection of bycatch data and compliance with IOTC Resolutions. (para. 66 of the SC17 report)*

IOTC species identification cards: Marine turtles, seabirds and sharks

*The SC **REQUESTED** that the IOTC Secretariat facilitate the translation of the identification cards for marine turtles, seabirds and sharks into the following languages, in priority order: Farsi, Arabic, Spanish, Portuguese and Bahasa-Indonesian, and that the Commission allocate funds for this purpose. (para. 131 of the SC17 report)*

3.2 Outcomes of the 19th Session of the Commission

6. The WPEB **NOTED** paper IOTC–2015–WPEB11–04 which outlined the main outcomes of the 19th Session of the Commission, specifically related to the work of the WPEB and **AGREED** to consider how best to provide the Scientific Committee with the information it needs, in order to satisfy the Commission's requests, throughout the course of the current WPEB meeting.

7. The WPEB **NOTED** the 11 Conservation and Management Measures (CMMs) adopted at the 19th Session of the Commission (consisting of 11 Resolutions and 0 Recommendations) as listed below:

IOTC Resolutions

- Resolution 15/01 *On the recording of catch and effort data by fishing vessels in the IOTC area of competence*
- Resolution 15/02 *On mandatory statistical reporting requirements for IOTC Contracting Parties and Cooperating Non-Contracting Parties (CPCs)*
- Resolution 15/03 *On the vessel monitoring system (VMS) programme*
- Resolution 15/04 *Concerning the IOTC record of vessels authorised to operate in the IOTC area of competence*
- Resolution 15/05 *On conservation measures for striped marlin, black marlin and blue marlin*
- Resolution 15/06 *On a ban on discards of bigeye tuna, skipjack tuna, yellowfin tuna, and a recommendation for non-targeted species caught by purse seine vessels in the IOTC area of competence*
- Resolution 15/07 *On the use of artificial lights to attract fish to drifting fish aggregating devices*
- Resolution 15/08 *Procedures on a fish aggregating devices (FADs) management plan, including a limitation on the number of FADs, more detailed specifications of catch reporting from FAD sets, and the development of improved FAD designs to reduce the incidence of entanglement of non-target species*
- Resolution 15/09 *On a fish aggregating devices (FADs) working group*
- Resolution 15/10 *On target and limit reference points and a decision framework*
- Resolution 15/11 *On the implementation of a limitation of fishing capacity of Contracting Parties and Cooperating Non-Contracting Parties*

8. The WPEB **NOTED** that pursuant to Article IX.4 of the IOTC Agreement, the above mentioned Conservation and Management Measures shall become binding on Members, 120 days from the date of the notification communicated by the IOTC Secretariat in IOTC Circular 2015–049 (i.e. 10 September 2015).

9. **NOTING** that the Commission also made a number of general comments and requests on the recommendations made by the Scientific Committee in 2014, which have relevance for the WPEB (details as follows: paragraph numbers refer to the report of the Commission (IOTC–2015–S19–R): the WPEB **AGREED** that any advice to the Commission would be provided in the Management Advice section of each stock status summary for the bycatch species detailed in the relevant species sections of this report.

Para. 10. *The Commission **CONSIDERED** the list of recommendations made by the SC17 (Appendix VI) from its 2014 report (IOTC–2014–SC17–R) that related specifically to the Commission. The Commission **ENDORSED** the list of recommendations as its own, while taking into account the range of issues outlined in this Report (S19) and incorporated within Conservation and Management Measures adopted during the Session and as adopted for implementation as detailed in the approved annual budget and Program of Work. (para. 10 of the S19 report)*

Meeting Participation Fund

*The Commission **NOTED** that the MPF was used to fund the participation of a reduced number of national scientists to the Working Parties in 2014 (49 in 2014; 58 in 2013; 42 in 2012), all of which were required to submit and present a working paper at the meeting. (para. 37 of the S19 report)*

*The Commission **NOTED** that at its 2014 meeting, the Scientific Committee had recommended that the Meeting Participation fund be maintained into the future and increased back to its original allocation of $200,000 per year (see recommendations SC17.34, para. 119). As per the IOTC Rules of Procedure (2014), the SC had reminded the IOTC Secretariat that the MPF budget should be spent at the ratio of 75:25 (science: non-science meetings) which would equate to US$150,000 science: US$50,000 non-science meeting. (para. 38 of the S19 report)*

*The Commission **AGREED** that the MPF budget remains important and therefore provisions according to the estimated needs will be integrated into the budget. (para. 39 of the S19 report)*

Consultants

***NOTING** the Scientific Committee's attempts to prioritise the various projects and consultancies which it had requested funding for in 2016, in particular, that the High priority projects were those which it felt must be undertaken in 2016, the Commission **REQUESTED** that only those High priority projects listed in the*

Scientific Committee budget be funded by the Commission's regular budget, with exceptions detailed in other areas of the S19 report. (para. 40 of the S19 report)

Electronic monitoring

***NOTING** the recommendation from the Scientific Committee (SC17.43) that the Commission considers assigning the IOTC Secretariat, in consultation with interested IOTC scientists, to develop a project on electronic monitoring in the IOTC area of competence, the Commission **NOTED** that a concept note/proposal should be developed to allow an evaluation of the efficacy of electronic monitoring in the collection of information on catch, discards and fishing effort as a means to supplement scientific observer coverage for large-scale gillnet vessels. The concept note should include a detailed budget and be communicated to a range of potential funding organisations. (para. 41 of the S19 report)*

Meeting Participation Fund (MPF)

10. The WPEB **RECOMMENDED** that the IOTC Rules of Procedure (2014), for the administration of the Meeting Participation Fund be modified so that applications are due not later than 60 days (current deadline is 45 days), and that the full Draft paper be submitted no later than 45 days (current deadline is 15 days) before the start of the relevant meeting, so that the Selection Panel may review the full paper rather than just the abstract, and provide guidance on areas for improvement, as well as the suitability of the application to receive funding using the IOTC MPF. The earlier submission dates would also assist with Visa application procedures for candidates.

3.3 Review of Conservation and Management Measures relevant to Ecosystems and Bycatch

11. The WPEB **NOTED** paper IOTC–2015–WPEB11–05 which aimed to encourage participants at the WPEB10 to review some of the existing Conservation and Management Measures (CMM) relevant to relevant to ecosystems and bycatch, noting the CMMs contained in document IOTC–2015–WPEB11–04; and as necessary to 1) provide recommendations to the Scientific Committee on whether modifications may be required; and 2) recommend whether other CMMs may be required.

12. The WPEB **AGREED** that it would consider proposing modifications for improvement to the existing CMMs following discussions held throughout the current WPEB meeting.

3.4 Progress on the recommendations of WPEB10

13. The WPEB **NOTED** paper IOTC–2015–WPEB11–06 which provided an update on the progress made in implementing the recommendations from the previous WPEB meeting which were endorsed by the Scientific Committee, and **AGREED** to provide alternative recommendations for the consideration and potential endorsement by participants as appropriate given any progress.

14. The WPEB **RECALLED** that any recommendations developed during a Session, must be carefully constructed so that each contains the following elements:
    - a specific action to be undertaken (deliverable);
    - clear responsibility for the action to be undertaken (i.e. a specific CPC of the IOTC, the IOTC Secretariat, another subsidiary body of the Commission or the Commission itself);
    - a desired time frame for delivery of the action (i.e. by the next working party meeting, or other date);
    - if appropriate an approximate budget for the activity, so that the IOTC Secretariat may be able to use it as a starting point for developing a proposal for the Commission's consideration.

15. The WPEB **REQUESTED** that the IOTC Secretariat continue to prepare a paper on the progress of the recommendations arising from the previous WPEB, incorporating the final recommendations adopted by the Scientific Committee and endorsed by the Commission, as well as any updates and requests.

Identification cards for shark, seabirds and marine turtles

16. **NOTING** that the Commission has approved US$30,000 for the printing of the species identification cards in 2016, as confirmed by the IOTC Secretariat at the 19th Session of the Commission, the WPEB **RECOMMENDED** that the marine turtle, seabird and shark species identification cards already translated into languages other than English and French, be printed in the first quarter of 2016 for dissemination.

17. The WPEB **RECALLED** that electronic versions of the currently translated species identification cards are available at the following web link for download: http://iotc.org/science/species-identification-cards

18. The WPEB **REQUESTED** CPCs provide feedback on the usefulness of the printed card in improving species identification for all marine turtle and seabird interactions and shark catches in reported statistics, at each WPEB meeting.

19. The WPEB reiterated the **RECOMMENDATION** that the IOTC Secretariat ensure that hard copies of the identification cards continue to be printed as many CPCs scientific observers, both on board and port, still do not

have smart phone technology/hardware access and need to have hard copies on board. At this point in time, electronic formats, including 'applications or apps' are only suitable for larger scale vessels, and even in the case of EU purse seine vessels, the use of hard copies is relied upon due to on board fish processing and handling conditions, as well as weather conditions. Electronic versions may be developed as a complimentary tools.

4. REVIEW OF DATA AVAILABLE ON ECOSYSTEMS AND BYCATCH

4.1 Review of the statistical data available for ecosystems and bycatch species

4.1.1 IOTC database

20. The WPEB **NOTED** paper IOTC–2015–WPEB11–07 which provided an overview of the standing of a range of information received by the IOTC Secretariat for bycatch (including byproduct) species, in accordance with IOTC Resolution 15/02 *Mandatory statistical reporting requirements for IOTC Contracting Parties and Cooperating Non-Contracting Parties (CPC's)*, for the period 1950–2014. A summary for sharks is provided at Appendix IV.

21. The WPEB **NOTED** the main data issues that are considered to negatively affect the quality of the statistics for bycatch species available at the IOTC Secretariat, by species group, type of dataset and fishery, which are provided in Appendix V, and **REQUESTED** that the CPCs listed in the Appendix make efforts to remedy the data issues identified and to report back to the WPEB at its next meeting.

22. The WPEB **NOTED** the standing of catch statistics for the main species of sharks, by major fisheries (gears), for the period 1950–2014 (Appendix VI) and **EXPRESSED** strong concern as the information on retained catches and discards of sharks contained in the IOTC database remains very incomplete for most fleets despite their mandatory reporting status, and that catch-and-effort as well as size data are important for assessing the status of shark stocks.

23. **NOTING** that where there are serious issues with nominal catch data reported by CPCs the IOTC Secretariat provides estimates of total catches using alternative sources to obtain the best possible information to use for scientific advice, the WPEB **REQUESTED** the IOTC Secretariat describe these estimation processes (at a sufficient level of detail to allow reproduction of the results) prior to the next meeting in a reference document (Information Paper) to assist all scientists utilising the nominal catch series.

24. The WPEB **REQUESTED** that CPCs improve the reporting of spatial effort data by longline fleets to assist the assessment of which fleets are likely to have significant interaction with seabirds.

25. **NOTING** that Appendix III of paper IOTC–2015–WPEB11–07, which describes the availability of catch data for the main shark species by gear, also includes information for the combination of species and gear that do not interact, thus, providing a biased overview of the situation on reporting of fleets, the WPEB **REQUESTED** that table is revised again for the next WPEB, including only species which are expected to interact with particular gears.

26. **NOTING** the high level of uncertainty in the nominal catches of blue sharks and high proportion caught by Indonesia, the WPEB **RECOMMENDED** that the IOTC consultancy work that is currently taking place to improve the Indonesian nominal catch data series is extended in order to provide sufficient attention to sharks as well as tuna.

27. The WPEB **NOTED** the ad hoc nature of much bycatch information which is only provided in various working party papers and national reports in an unstandardised format, meaning it is of very limited use in any regional analyses.

28. The WPEB **RECALLED** that presenting data at a working party meeting does not constitute a formal submission to the IOTC Secretariat.

29. The WPEB **URGED** all CPCs to submit data to the IOTC Secretariat formally as required according to IOTC reporting procedures based on the requested fisheries statistics and data submission forms that can be found on the IOTC website: www.iotc.org/data/requested-statistics-and-submission-forms

4.1.2 Bycatch data exchange protocol

30. The WPEB **NOTED** paper IOTC–2015–WPEB11–41 which provided a proposal for a bycatch data exchange protocol, including the following abstract provided by the authors:

"A meeting of invited experts, convened in January 2015 in Keelung, Taiwan,China, to progress elements of the Work Plan agreed by the Joint Tuna RFMOs Technical Working Group-Bycatch, recommended that an existing data exchange format be used as the basis for summarizing data in each of the five tuna RFMOs. Compiling basic metadata across the tuna RFMOs aims at i) understanding and harmonizing tuna RFMO bycatch data holdings; ii) reviewing and improving bycatch data collection and reporting programmes ; and iii) planning for intra- and inter-RFMO analysis of bycatch rates and mitigation effectiveness. The proposed

t-RFMO bycatch data exchange protocol (BDEP) consists of i) a summary of the total fishing effort and total observed effort for each area by fishery and year; and ii) a summary for the same strata (area, fishery and year) of observed captures, mortalities and live releases of various taxa known to be vulnerable to interactions with tuna fisheries." – (see paper for full abstract).

31. The WPEB **ACKNOWLEDGED** the attempt to initiate the collation and harmonisation of global datasets for bycatch species and the importance of this work.

32. The WPEB **NOTED** that the provision of total, spatially disaggregated effort data is difficult due to the lack of reporting of total effort data by fleets.

33. The WPEB **REQUESTED** the IOTC Secretariat collate the observer data available, using the BDEP template as a trial format and aggregating data according to the guidelines in *Resolution 12/02 Data confidentiality policy and procedures* and present this for review at the next WPEB meeting.

4.2 Regional observer scheme – Update (Resolution 11/04 On a regional observer scheme)

34. The WPEB **NOTED** paper IOTC–2015–WPEB11–08 which provided an update on the national implementation of the IOTC regional observer scheme (ROS) for each IOTC CPC, noting that the ROS started on 1st July 2010 (Resolution 09/04 superseded by Resolution 10/04 and Resolution 11/04), including the following abstract provided by the authors:

"*As of 14th August 2015, fourteen CPCs (Australia, China (including Taiwan,China), Comoros, EU (France, Spain and Portugal), Indonesia, Japan, Kenya, Rep. of Korea, Madagascar, Maldives, Mauritius, Mozambique, Seychelles and South Africa) have submitted a list of observers and have been allocated an IOTC observer registration number. This makes a total of 259 IOTC registered observers. As of 14th August 2015, one hundred and eighty five (185) observer trip reports have been submitted to the IOTC Secretariat by Australia, China, EU(France and Portugal), Japan, Rep. of Korea, Madagascar, Mozambique and South Africa and two pilot trip reports have been submitted by Sri Lanka.*" – (see paper for full abstract).

35. **NOTING** the update of the implementation of the Regional Observer Scheme (Appendix VII), the WPEB again **EXPRESSED** its disappointment on the very low level of reporting to the IOTC Secretariat of both the observer trip reports and the list of accredited observers since the start of the ROS in July 2010. Such a low level of implementation and reporting is detrimental to the work of the WPEB and SC, in particular regarding the estimation of incidental catches of non-targeted species, as requested by the Commission.

36. **NOTING** that 14 CPCs have submitted a list of accredited observers and the IOTC registry now holds the names of 268 observers, the WPEB **AGREED** that the IOTC Secretariat will begin to make the details of contact points of the observer coordinating organisations available online in 2016 to facilitate the establishment of a regional pool of IOTC observers.

37. The WPEB **REQUESTED** CPCs to work with the IOTC Secretariat on the establishment of a set of regional training hubs for IOTC observers to be trained according to IOTC ROS standards, specialised by gear types, and **ENCOURAGED** offers from CPCs to host these centres.

38. **NOTING** the upcoming projects planned to support the ROS (including the development of an electronic reporting system, and a proposal for an electronic monitoring system), the WPEB **RECOMMENDED** that funding from the IOTC regular budget is allocated to support these activities over the next few years. The IOTC Secretariat has been tasked by the Commission to develop a proposal and budget for its consideration.

39. The WPEB **AGREED** that the priority languages for translation of the IOTC seabird identification cards should be (1) Indonesian, (2) Portuguese and (3) Spanish (updated in Table 2).

40. The WPEB **AGREED** that Sinhala and Tamil should be added as priority languages for translation of the shark and ray IOTC species identification cards (updated in Table 2).

Table 2. Languages for sequential translation of the IOTC species identification cards as identified by the SC16 and SC17 and adapted by the WPEB11.

Language	1. Tuna & like species	2. Billfish	3. Marine turtles	4. Sharks and rays	5. Seabirds
Farsi	2	1	1	1	5
Arabic	2	2	2	2	4
Urdu	4				
Bahasa Indonesian	1	3	5	6	1
Swahili		4			
Spanish		5	3	4	3

Portuguese		6	4	5	2
Thai		7			
Sinhala	3	8		3	
Tamil		8		3	
Bahasa Malaysia	1				
Hindi	3				

41. The WPEB **NOTED** the difficulty that developing countries may face in meeting the high observer data collection and reporting standards and the potential quality issues this might lead to.

42. The WPEB **AGREED** that a range of alternative solutions are necessary to begin making progress in data collection in developing country fleets such as electronic monitoring, extended port based sampling and fisher self-sampling/self-reporting (as is already being trialled in Pakistan and La Reunion (France)).

43. **NOTING** that there are issues with each of these alternatives, i.e. electronic monitoring can be demanding in terms of review time and expense, and port sampling can miss the fundamental issue of discarding, while fishers may lack the education and independence needed to collect data, the WPEB **AGREED** that these measures should therefore be used in combination as complementary approaches rather than being seen as alternatives.

44. The WPEB **AGREED** that extensive trialling and data validation exercises should be built into the electronic monitoring project proposal.

45. The WPEB **NOTED** the electronic monitoring trials planned for longline fisheries in the southern Indian Ocean through the Common Oceans programme and **AGREED** that BirdLife should also contribute to the IOTC proposal to share lessons learned.

46. The WPEB **REQUESTED** that all observer data be submitted to the IOTC Secretariat in electronic format, **NOTING** that this may be any electronic format as long as the data corresponds to the minimum reporting requirements.

47. The WPEB **RECOMMENDED** that capacity building activities continue to be supported via the Commission's annual budget, to improve the lack of compliance with the implementation of observer schemes by CPCs for their fleets and lack of reporting to the IOTC Secretariat as per the provisions contained within Resolution 11/04 *on a Regional Observer Scheme*.

Revision of Resolution 11/04 *on a regional observer scheme*

48. **RECALLING** the objectives of Resolution 11/04 on a regional observer scheme as follows:
"Para 1: *The objective of the IOTC Observer Scheme shall be to collect verified catch data and other scientific data related to the fisheries for tuna and tuna-like species in the IOTC area of competence*"
and **NOTING** that the objective of the ROS contained in Resolution 11/04, and the rules contained in Resolution 12/02 *On data confidentiality policy and procedures* makes no reference to the data collected not being used for compliance purposes, the WPEB reiterated its **RECOMMENDATION** that at the next revision of Resolution 11/04, it be clearly stated that the data collected shall not be used for compliance purposes.

5. REVIEW OF NATIONAL BYCATCH ISSUES IN IOTC MANAGED FISHERIES AND NATIONAL PLANS OF ACTION (SHARKS; SEABIRDS; MARINE TURTLES)

5.1 Review of applications for 'not applicable' NPOA status

49. The WPEB **RECALLED** that the IPOA-SHARKS is a voluntary instrument that applies to all States engaged in shark fisheries. The text sets out a set of activities which implementing States are expected to carry out, including an assessment of whether a problem exists with respect to sharks, adopting a National Plan of Action for the conservation and management of sharks (NPOA-SHARKS), as well as procedures for national reviews and reporting requirements. The calendar years by when these actions preferably should have been taken, are indicated.

50. The WPEB **RECALLED** that the IPOA-SEABIRDS is a voluntary instrument that applies to all States engaged in longline fisheries. The text sets out a set of activities which implementing States are expected to carry out, including an assessment of whether a problem exists with respect to the incidental catch of seabirds in its longline fishery, adopting a National Plan of Action for reducing the incidental catch of seabirds in longline fisheries (NPOA-SEABIRDS) as well as procedures for national reviews and reporting requirements. The calendar years by when these actions preferably should have been taken, are indicated.

51. The WPEB **NOTED** the process for assessing the need for an NPOA by CPCs, as adopted by the SC in 2014, detailed in Appendix VII of the SC17 Report. All CPCs are now required to follow that process when requesting

the IOTC Secretariat to apply a status of 'Not applicable (n.a.)' for an NPOA, in the 'Table of progress in implementing NPOA-sharks, NPOA-seabirds and the FAO guidelines to reduce sea turtle mortality in fishing operations'.

52. The WPEB **NOTED** that no requests were received by the IOTC Secretariat since the last SC meeting to apply a status of 'Not applicable (n.a.)' for an NPOA, in the 'Table of progress in implementing NPOA-sharks, NPOA-seabirds and the FAO guidelines to reduce sea turtle mortality in fishing operations'.

5.2 Updated status of development and implementation of National Plans of Action for seabirds and sharks, and the implementation of the FAO guidelines to reduce marine turtle mortality in fishing operations (CPCs)

5.2.1 NPOA implementation overview

53. The WPEB **NOTED** paper IOTC–2015–WPEB11–09 which provided an update on the current status of development and implementation of National Plans of Action for seabirds and sharks, and implementation of the FAO guidelines to reduce marine turtle mortality in fishing operations, by IOTC CPCs, including the following abstract provided by the authors:

"At its 19th Session, the Commission NOTED the updated status of development and implementation of National Plans of Action for seabirds and sharks, and the implementation of the FAO guidelines to reduce marine turtle mortality in fishing operations, by each CPC, as provided in the Scientific Committee report. (para 35 of the S19 Report); The Commission also NOTED the request from the Scientific Committee that all CPCs without an NPOA-Sharks and/or NPOA-Seabirds expedite the development and implementation of a NPOA, and to report progress to the WPEB and SC in 2015, recalling that NPOA-Sharks are a framework that should facilitate estimation of shark catches, and development and implementation of appropriate management measures, which should also enhance the collection of bycatch data and compliance with IOTC Resolutions. (para. 36 of the S19 Report)"

54. The WPEB **NOTED** the current status of development and implementation of National Plans of Action (NPOAs) for sharks and seabirds, by each CPC, recalling that the IPOA-Seabirds and IPOA-Sharks were adopted by the FAO in 1999 and 2000, respectively, and required the development of NPOAs. Despite the time that has elapsed since then, very few CPCs have developed NPOAs, or even carried out assessments to ascertain if the development of a Plan is warranted. Currently only 12 of the 37 IOTC CPCs (32 Contracting Parties and 5 CNCPs in 2015) have an NPOA-Sharks (8 more in development), while only 6 CPCs have an NPOA-Seabirds (2 in development). A single CPC has determined than an NPOA-Sharks is not needed, and 5 have similarly determined than an NPOA-Seabirds is not needed.

55. The WPEB **NOTED** the current status of development and implementation of the FAO guidelines to reduce marine turtle mortality in fishing operations. Currently only 6 of the 37 IOTC CPCs have implemented the AO guidelines (2 more in progress), and one CPC (France (OT)) will implement a full NPOA in 2015. The IOTC and IOSEA Secretariats should continue to work collaboratively with any CPC requesting assistance to develop their national management plans for the reduction of marine turtle bycatch in tuna fisheries.

56. The WPEB **REQUESTED** that all CPCs without an NPOA-Sharks and/or NPOA-Seabirds expedite the development and implementation of a NPOA, and to report progress to the WPEB and SC in 2016, **NOTING** that NPOAs are a framework that should facilitate estimation of shark catches, seabird interactions, and development and implementation of appropriate management measures, which should also enhance the collection of bycatch data and compliance with IOTC Resolutions.

57. The WPEB **REQUESTED** that the IOTC Secretariat continue to periodically revise the table summarising progress towards the development of NPOA-Sharks, NPOA-Seabirds, and the implementation of the FAO guidelines to reduce marine turtle mortality in fishing operations, by each CPC for the consideration at each WPEB and the SC meeting. The current version is provided at Appendix VIII.

5.2.2 Seychelles NPOA-Sharks

58. The WPEB **NOTED** paper IOTC–2015–WPEB11–11 which describes the Seychelles NPOA sharks for the period 2007 to 2010, including the following abstract provided by the authors:

"*The Seychelles National Plan of Action for the Conservation and Management of Sharks 2007-2010 (NPOA) was formulated by the Seychelles Fishing Authority in 2006 to provide a national basis for the implementation of UNFAO international plan of the same name (IPOA). The NPOA was developed through a comprehensive and iterative process of stakeholder consultation and following the criteria as set out in the IPOA. The NPOA was adopted in 2007 and set out a four-year action plan that addressed the 10 goals of the IPOA-Sharks as they related to local circumstances. The NPOA contains two missions statement for attainment within its first four year-phase and set as its ultimate vision "That shark stocks in the Seychelles EEZ are effectively conserved and managed so as to enable their optimal long-term sustainable use. The NPOA has so far engendered considerable progress in laying the foundations for viable conservation and sustainable use of*

sharks through the development of capacity and understanding amongst stakeholder." *– (see paper for full abstract)*

59. The WPEB **NOTED** that the Seychelles has contracted the service of a Shark Fishery Expert to review its shark NPOA-Sharks for 2007–2010 and to develop a new plan of action for 2016–2019.

60. The WPEB **NOTED** that the implementation of the Seychelles' current NPOA-Sharks and development of the new NPOA-Sharks is undertaken by a steering committee involving different stakeholders from both the government and private sectors.

5.2.3 Maldives NPOA-Sharks

61. The WPEB **NOTED** paper IOTC–2015–WPEB11–12 Rev_1 which describes the status of the shark fishery ban in the Maldives and the implementation of the National Plan of Action on Sharks, with an update on marine turtles and seabirds, including the following abstract provided by the authors:

"*Up until 1970s, the shark fishery of the Maldives was a traditional one, where large sharks were caught in need of shark liver oil. This traditional shark fishery evolved to more export oriented fisheries in 1970s, when highly targeted fisheries for sharks developed in the Maldives. These were the deepwater gulper shark fishery, reef-associated shark fishery and oceanic shark fishery. Shark fisheries were undertaken by a minor community, and had always been in conflict with important stakeholders such as the pole and line tuna fishery and the booming dive tourism industry. The declining status of shark fisheries, exacerbated by unresolved conflicts with other stakeholders led to declaration of total shark fishing ban in 2010. With the shark fishing ban in place, sharks are now caught as bycatch in the Maldivian fisheries. Larger part of shark catch, 99.9% of total shark catch is now from tuna longline fishery. Shark bycatch from pole and line and handline tuna fisheries are virtually nil; contributing 0.06% and 0.08% respectively to total shark bycatch." – (see paper for full abstract)*

62. The WPEB **NOTED** that an NPOA-Sharks for the Maldives was finalised in April 2015 (provided as IOTC–2015–WPEB11–INF12).

63. The WPEB **NOTED** that the Maldives has in place, a complete ban on targeted shark fishing in waters of the Maldives (atoll basins and surrounding coral reefs and in the EEZ) requiring all longliners targeting tunas to record the condition and fate of the shark bycatch in the logbooks and to release all live sharks where possible. In addition, any dead shark bycatch retained has to be declared to an observer for confiscation as required under national regulation. As there are no designated observers at this point in time, vessels are required to discard all sharks caught and record the discards in logbooks. Although no explicit ban on trade exists, any sharks fished from the Maldives EEZ cannot be exported in principle, as there is a fishery ban on sharks in place.

64. The WPEB **NOTED** that the Maldives is the only CPC observing a full fishery ban on sharks that prohibits retention of sharks and therefore the provision to prevent shark finning contained in Res 05/05 (para 2) calling for full utilisation of shark catches would not applicable. Since the sharks are not retained the Maldives may also not be in a position to provide size data for dead sharks as required under Res 10/02.

65. The WPEB **NOTED** that in the Maldivian fisheries the bycatch of marine turtles, based on logbook data, is extremely low and for sea birds it is negligible.

5.2.4 India NPOA-Sharks

66. The WPEB **NOTED** paper IOTC–2015–WPEB11–INF10 which detailed the status of development of an NPOA-Sharks by India, with an update on marine turtles and seabirds, including the following abstract provided by the authors:

"*India is one of the major shark fishing nations in the world and currently stands at the second position, next only to Indonesia. According to FAO statistics, India's contribution to the global catch of sharks during 2006-2009 was 9%. Targeted shark* fishing in India started when market demand for this commodity increased in recent years. Today, an increase in the number and efficiency of fishing boats, directed fishing and expansion of fishing areas, and multi-day, deep water shark fishing have become a prevalent practice in Indian waters. An initial rise in shark catches along the coast, followed by a subsequent consistent decline in catch and catch rate in the last one decade has raised serious concern over the resource and the long-term viability of its fishery.*" *– (see paper for full abstract)*

67. The WPEB **NOTED** the excellent work undertaken by India to develop the preparatory NPOA-Sharks document, which will facilitate an informed process to develop an NPOA-Sharks in the near future.

5.2.5 NPOA *IOTC website portal*

68. The WPEB **NOTED** that the NPOA portal on the IOTC website (http://iotc.org/science/status-of-national-plans-of-action-and-fao-guidelines) provides details of the most recent updated table of progress in implementing

NPOA-Sharks, NPOA-Seabirds and the FAO Guidelines to Reduce Sea Turtle Mortality in Fishing Operations. It also provides other information in support of CPCs wishing to develop their own NPOAs, such as the guidelines and NPOA documents from all CPCs who have submitted their NPOAs.

6. NEW INFORMATION ON BIOLOGY, ECOLOGY, FISHERIES AND ENVIRONMENTAL DATA RELATING TO ECOSYSTEMS AND BYCATCH SPECIES

6.1 Review new information on environment and ecosystem interactions and modelling, including climate change issues affecting pelagic ecosystems in the IOTC area of responsibility

6.1.1 Bycatch from I.R. Iran fleets

69. The WPEB **NOTED** paper IOTC–2015–WPEB11–13 Rev_1 which detailed the bycatch from I.R. Iran fishing vessels operating in the Indian Ocean in 2014, including the following abstract provided by the authors:

"*In order to assess the level of Iranian tuna fishing vessels By-catch in the IOTC competence of area, we used 2014 data which they collected through the Iran Fishery Organization data Collection system. Base on the system outputs, about 25 different species of Tuna, Tuna-like and some other species are caught by Iranian fishermen through the Tuna fishing activities. Base on 2014 information in total, 266948 tons of different species including, 227193 tons Tuna and Tuna-like species (target species 85.1%), 21470 tons Billfish (8.1%), 7551 tons different species of Sharks (2.8%) and 10734 tons 0f the other species (4%) are caught by Iranian fishing vessels in the IOTC competence of area."*

70. The WPEB **ENCOURAGED** further development in data collection to improve compliance with IOTC data collection and reporting requirements detailed in Resolutions 15/1 and 15/02.

71. **NOTING** that data were provided by I.R. Iran in aggregated form for all types of fisheries, the WPEB **REQUESTED** I.R. Iran to present bycatch data by gear and by species. In addition, papers of this nature should be for the entire history of the fishery available and not simply a single year's data.

72. The WPEB **REQUESTED** I.R. Iran to provide information on fishing effort distribution, as well as details on data sampling system and strategy, at the next WPEB meeting.

6.1.2 Bycatch: Thailand fleets

73. The WPEB **NOTED** paper IOTC–2015–WPEB11–14 which detailed the landing bycatch by tuna Thailand longline fishery landed at Phuket Province, including the following abstract provided by the authors:

"*Study on landing catch of tuna longline fishery in the Indian Ocean by collecting data from foreign vessels landing at fishing ports in Phuket Province, Thailand during January to December, 2011. The length of the vessels were 19-40 m and the fish storage capacity were 15-20 tons. There were two types of vessel structure, wood and wood-fiberglass. The number of employed hooks per vessel were 1,300-1,500. The radio bouys were used to identify the position of longline, and the hydraulic winchs were used for hauling the longline. The tuna baits were round scads and/or the lived milkfish. Fishing grounds were in the latitudes of 2° S to 12° N and longtitude of 77° to 95° 40´ E. The high fishing effort were found in the beginning and ending of the year or during off Southwest monsoon. The total catch were 5,543,244 kg with the value of 766.79 million baht. They included 4,318,743 kg of tuna with the value of 690.99 million baht, 92,351 kg of billfishes with the value of 5.73 million baht and 1,132,150 kg of bycatch with the value of 70.07 baht.*" *– (see paper for full abstract)*

74. The WPEB **NOTED** the port sampling efforts carried out by Thailand on foreign vessels landing in Phuket, Thailand.

75. The WPEB **NOTED** the low proportion of precise fishing positions extracted from logbook data and that Thailand had indicated it would like to increase logbook coverage to better depict fishing grounds where foreign longliners operate.

6.1.3 Bycatch mitigation methods: Fishing time

76. The WPEB **NOTED** paper IOTC–2015–WPEB11–15 which detailed the optimal fishing time window approach to mitigate bycatch in longline fisheries, including the following abstract provided by the authors:

"*One of the main concerns of the ecosystem approach to fisheries is the mitigation of bycatch, especially in pelagic longline fisheries. Bycatch represent unmarketable species and protected species for some of them. Various mitigation measures already exist to reduce bycatch in longline fisheries, notably concerning the equipment used and the strategy of fishing gear deployment. However, measures that concern the hours of gear deployment remain poorly studied. Using hook-timer data collected during scientific longline fishing campaigns between 2004 and 2014 in the South West Indian Ocean, we developed a method to identify optimal fishing practice that maximizes bycatch reduction and swordfish yield (in number). Here we found*

that hourly capture patterns of swordfish and bycatch (sharks, turtles) are different and allow to identify an optimal fishing practice that consists in fishing between 18pm and 9am. This methodology certainly provides a relevant bycatch mitigation approach that benefits to fishermen but also allow to mitigate the impact of longline fisheries on the ecosystem."

77. The WPEB **ENCOURAGED** the authors to further develop their study and adjust optimal window to local seasonal crepuscular time and assess the influence of moon phases on the hooking time. An updated paper would be useful for the next WPEB meeting.

6.1.4 ObServe database and software

78. The WPEB **NOTED** paper IOTC–2015–WPEB11–16 which detailed the ObServe: Database and operational software for longline and purse seine fishery data, including the following abstract provided by the authors:

"Observation data collected aboard fishing vessels are essential to describe the impact of fisheries on fish community. The Institut de Recherche pour le Développement (IRD, France) has been sending observers aboard tropical purse-seiners since 1995 in the Atlantic and Indian Oceans, and longliners since 2007 in the Indian Ocean. Since 2005, IRD is appointed by the European Union (EU) and the French Direction des Pêches Maritimes et de l'Aquaculture (DPMA, French government) to conduct scientific observations aboard French vessels to monitor tropical fisheries in the framework of EU Data Collection Framework (DCF). To monitor this program, the Observatoire Thonier (OT) from IRD has been developing since 2010 an information system named ObServe that is intended to manage data collected in the framework of DCF. ObServe consists of (i) a central database based on PostgreSQL, (ii) a Java-based software used for data acquisition and management, and (iii) data synchronization features between these two modules." – *(see paper for full abstract)*

79. The WPEB **AGREED** that ObServe is useful tool to store and manage scientific, observer and logbook tuna fisheries data by observers on board both purse seine and longline vessels.

80. The WPEB **ENCOURAGED** participants of the WPEB to contact the authors directly to explore software functions and database functionality.

81. The WPEB **ENCOURAGED** IRD to develop training modules on ObServe utilisation, for potential incorporation within the broader IOTC Regional Observer Scheme training program.

6.1.5 Beached drifting fish aggregating devices: Seychelles

82. The WPEB **NOTED** paper IOTC–2015–WPEB11–39 which detailed environmental impacts and causation of 'beached' Drifting Fish Aggregating Devices around Seychelles Islands: a preliminary report on data collected by Island Conservation Society, including the following abstract provided by the authors:

"*In the past decade the number of Drifting Fish Aggregating Devices (DFADs) deployed by tuna purse seine vessels has risen sharply. The increased number of deployments has seen an increased number of lost DFADs. These lost DFADs continue to drift with ocean currents and a large number eventually come into contact with land and 'beach', becoming stuck in a wide range of habitats. Here we detail the first attempt to assess the environmental impact and causation of lost DFADs that have become beached on and around Seychelles islands. The data presented shows that vessels owned by Spanish companies are responsible for 76% of the DFADs found beached in the study area. The data also shows that there has been a move by the fishing industry towards 'non-entangling' DFADs that make use of 'sausage nets' to reduce the entanglement of sharks and turtles in the open ocean but that these devices still pose an entanglement risk when they come into contact with coral reefs.*" – *(see paper for full abstract)*

83. The WPEB **NOTED** that ~40% of FADs found during the survey did not have any satellite buoy with identification marking, thereby making it impossible to track FAD ownership.

84. The WPEB **NOTED** the lack of temporal information included in the study which analysed the aggregated information collected for the period 2011 to 2015, however, the group was informed of the recent changes and improvements in the construction of non-entangling DFADs since 2012 as requested by IOTC Resolution 13/08 (IOTC–2015–WPEB11–INF09) and **ENCOURAGED** the authors to present more detailed information including temporal aspects to investigate changes in the material used to construct DFADs over time.

85. The WPEB **NOTED** that similar work is ongoing in the Maldives, focusing on ghost nets found in the waters of the Maldives originating from different countries.

86. WPEB **NOTED** that in many RFMOs (e.g. IOTC (Resolution 15/08) and NAFO) the marking of all fishing gears used in a RFMO area of responsibility is a mandatory requirement and that marking requirements are also recommended by FAO Code of Conduct for Responsible Fisheries and implementation of methods to facilitate the retrieval of derelict fishing gear and other marine debris is encouraged in the FAO guidelines to reduce sea turtle mortality in fishing operations.

87. The WPEB **NOTED** the authors recommendations which can be found in the paper.

88. **RECALLING** paragraphs 1 and 2 of IOTC Resolution 15/09 *On a fish aggregating devices (FADs) working group* (see below), the WPEB **AGREED** that the authors should present the study and the recommendations of the study to be considered during the proposed working group meeting, currently being planned in the first half of 2016:

> Para 1. "*An ad hoc working group on FADs (**Annex I**), drifting and anchored, is created to assess the consequences of the increasing number and technological developments of FADs in tuna fisheries and their ecosystems, in order to inform and advise on future FAD-related management options. This ad hoc working group would be of multi-sectorial nature, involving various stakeholders such as scientists, fishery managers, fishing industry representatives, administrators and fishers. The working group shall deliver its findings in time for the 2017 IOTC Scientific Committee to examine them*."
>
> Para. 2. "*The IOTC Secretariat should liaise with the ICCAT Secretariat to determine if their FAD working group could work in conjunction with the IOTC working group*."

6.1.6 System of verification of the code of good practices in purse seine fisheries

89. The WPEB **NOTED** paper IOTC–2015–WPEB11–INF09 which described a system of verification of the code of good practices on board ANABAC and OPAGAC tuna purse seiners and preliminary results for the Atlantic Ocean, including the following abstract provided by the authors:

> "*Spanish tuna purse-seiner organizations ANABAC and OPAGAC established in 2012 a common agreement or the application of good practices for responsible tuna purse-seine fisheries. The aim of this agreement is to reduce the mortality by entangling or by incidental catch of FAD-associated sensible species (sharks, rays/mantas whale sharks and sea turtles). The good practices defined in this agreement comprise the use of non-entangling FADs as well as the application of release operations for FAD-associated sensible fauna. In order to monitorize and assess the actual level of application of these good practices, a system of verification is being implanted in all the vessels of the ANABAC and OPAGAC fleets – i.e. 59 purse seiners and 19 supply vessels in April 2015, including both Spanish flags and other flags – operating in the 3 Oceans, in areas corresponding to 4 tuna RFMOs (ICCAT, IOTC, WCPFC and IATTC). This verification is based on in-situ registration of the good practices by observers. This document presents the initial situation (October 2014) in terms of application of good practices*" – (see paper for full abstract)

90. The WPEB **NOTED** the paper indicates that since December 2014, 100% observer coverage is available for the Indian Ocean EU,Spain purse seine fleet to monitor the use of non-entangling DFADs and the use of bycatch release operations.

91. The WPEB **NOTED** the indication from the authors that based on preliminary information from the Atlantic, non-conformities in the use of non-entangling DFADs and in the application of safe-release protocols are mostly due to partial information of skippers which are solved through personal communication and training workshops. Progress is being made on the use of non-entangling FADs and safe-release practices in consecutive fishing trips.

92. The WPEB **NOTED** that this does not yet include methods to mitigate against FAD loss and that a project is in progress to develop and promote the use of biodegradable material to construct FADs.

93. The WPEB **REQUESTED** the authors to present the first results for the Indian Ocean during next session of the WPEB in 2016, as a Working Paper for consideration.

6.1.7 Ecosystem based fisheries management: tRFMO progress

94. The WPEB **NOTED** paper IOTC–2015–WPEB11–40 which detailed the preliminary review of ICCAT, WCPFC, IOTC and IATTC progress in applying ecosystem based fisheries management, including the following abstract provided by the authors:

> "*Oceanic tuna, billfish and shark species, the structure of their communities and food webs they form provide and sustain important high-sea ecosystem services for human wellbeing. International instruments of fisheries governance such as the UN Fish Stock Agreement have changed slowly the expectations and roles of Regional Fisheries Management Organizations (RFMOs) in accounting for ecosystem considerations in their decision-making when managing tuna and tuna-like species and associated ecosystems. Our main objective is to evaluate the progress of tuna RFMOs in applying Ecosystem Based Fisheries Management (EBFM). We first develop a framework of a Conceptual Ecological Model for what could be considered a "role model" tuna RFMO. Second, we develop a criteria to evaluate the progress in applying EBFM against this idealized role model RFMO. In our criteria, we assess progress in the following four ecological components separately: (1) targeted species (2) bycatch species, (3) ecosystem properties and trophic interactions and (4) habitats.*" – *(see paper for full abstract)*

95. The WPEB **THANKED** the authors for the useful review and **ACKNOWLEDGED** the issues highlighted for IOTC in the comparative tables. Indicators of the impact of tuna fisheries on non-target species is needed.

96. The WPEB **NOTED** that the ERA conducted for marine turtles in the IOTC area of competence was qualitative (level 1) and so was allocated the lowest progress score.

97. The WPEB **NOTED** the level of subjectivity in the criteria that was moderated by restricting the analysis to items within the reports of each other tRFMO Scientific Committees.

98. **NOTING** the Seapodym ecosystem model presented at WPEB10 which was not presented at the following Scientific Committee and so was not considered in the evaluation.

99. The WPEB **AGREED** to support the initiative to hold a joint tRFMO meeting to discuss the issues and progress.

6.1.8 Shark tagging programs: Indian Ocean

100. The WPEB **NOTED** paper IOTC–2015–WPEB11–42 which provided a summary of the Indian Ocean elasmobranch tagging programs, including the following abstract provided by the authors:

"*A summary of shark tagging experiments conducted by various research organizations in the Indian Ocean is developed as a reference documents for further considerations of WPEB and IOTC Secretariat. Research programmes are grouped in alphabetical order of names of respective institutions.*"

101. The WPEB **ACKNOWLEDGED** the willingness of Australia (N.S.W.) to provide tagging data from their shark tagging studies for consideration at the WPEB meetings.

102. The WPEB **NOTED** that a study on whale shark post-release survival following interaction with purse seine vessels is already being undertaken by AZTI and IRD.

103. The WPEB **NOTED** paper IOTC–2015–WPEB11–INF11, which provided a concept note on an IOTC shark tagging program with pop-up satellite archival tags (PSAT) in response to Indian Ocean Shark Year Programme (ShYP) priorities, and those endorsed by the Scientific Committee and Commission.

104. The WPEB **NOTED** the estimated costs for a tagging program as a response to priorities identified in the shark year program and **ACKNOWLEDGED** that it responds to Recommendation SC17.10, as it focuses on an identified priority species.

105. The WPEB **ACKNOWLEDGED** the importance of PSAT tagging for sharks to study post-release mortality of species currently banned for retention in IOTC area of competence, and **REQUESTED** that the authors submit the revised Concept note for the consideration of the Scientific Committee and potential funding bodies.

106. **NOTING** that while there are cheaper tags (US$2,000) available, they are developed only for survivorship analysis, and as such, the WPEB **AGREED** that the US$4,000 PSAT tags provide more data that allows the estimation of precise mortality cases and operate for longer periods, and collect information on habitat use and migratory behaviour.

107. The WPEB **AGREED** that purse seine fisheries and not only longline fisheries should be considered for the deployment on electronic tags on oceanic whitetip sharks.

6.1.9 UK(OT) illegal fishing catch composition

108. The WPEB **NOTED** paper IOTC–2015–WPEB11–48 which provided an update on the catch and bycatch composition of illegal fishing in the United Kingdom(OT) and a summary of abandoned and lost fishing gear, including the following abstract provided by the authors:

"*IOTC-2013-WPEB09-56 Rev_1 presented the results of analysis on the catch taken from vessels detailed for illegal fishing with the British Indian Ocean (BIOT) between 2007 and 2013. It included catch data from 37 vessels based on measurements and estimates made by the Senior Fisheries Protection Officer (SFPO). This paper gives a brief update based on catches from a further 15 vessels, detained on suspicion of fishing illegally in BIOT waters during 2014 and 2015. The amount of information collected will vary between vessels depending on the time available to the SFPO, priority is given to identifying and estimating the weight of key species and if time allows length measurements can also be taken. A summary of the length measurements taken from shark species was given in the previous paper, no new measurements have been taken and this has not been updated.*" *– (see paper for full abstract)*

109. The WPEB **AGREED** that information on gillnet length collected from lost or stranded gear may provide important information to estimate current compliance of gillnet fishing countries with IOTC (Resolution 12/12) and UN regulations that prohibit the use of large-scale driftnets on the high seas.

Resolution 12/12: *"Large-scale driftnets" are defined as gillnets or other nets or a combination of nets that are more than 2.5 kilometers in length whose purpose is to enmesh, entrap, or entangle fish by drifting on the surface of, or in, the water column*.

7. GILLNET FISHERIES: PROBLEMS AND NEEDS *(INCLUDING CAPACITY BUILDING)*

7.1 Regional review of the current and historical data available for gillnet fleets operating in the Indian Ocean

110. The WPEB **AGREED RECALLED** the recommendation from the SC16 for a consultancy to provide a Regional review of the current and historical data available for gillnet fleets operating in the Indian Ocean and **NOTED** that this was not funded by the Commission.

111. **NOTING** that the IOTC Secretariat developed a template which was sent to CPCs of the major gillnet fisheries in the Indian Ocean in early 2015 to facilitate standardised data collection for collation and review, and the lack of information provided, it was **AGREED** that the Secretariat should develop Terms of Reference for a consultancy and seek external funding for this work.

7.1.1 Pakistan shark bycatch in gillnet fisheries

112. The WPEB **NOTED** papers IOTC–2015–WPEB11–46, which provide an update on the shark bycatch of tuna gillnet fisheries of Pakistan, including the following abstract provided by the authors:

"T*here are about 500 tuna gillnet vessels targeting tuna and tuna like species off Pakistan. In order to assess the shark bycatch in tuna gillnet fisheries of Pakistan, skippers trained by WWF were charged to record catch and bycatch data on four gillnet vessels from a period of January 2013 to June 2015. This report provides information on shark bycatch. A total of 4,537 sharks with a catch rate of 33.31 per km 2 of net over the study period was recorded.. The most common species was Rhizoprionodon acutus (41.3%, capture rate 15.99 per km 2 of net), Carcharhinus falciformis (25.08%, capture rate 6.15 per km 2 of net), and Isurus oxyrinchus (25.03%, capture rate 8.17 per km 2 of net) were found in four boats. Other species caught included Carcharhinus amblyrhynchos (n=136), Alopias pelagicus (n=112), Carcharhinus sorrah (n=83), S. phyrna spp. (n=27), oceanic whitetip (n=19), whale shark (n=1) and 1 unidentified species (n=7).*" *– (see paper for full abstract)*

113. **NOTING** that gillnets are regularly being used in excess of 4,000 m (and up to 7,000 m) within and occasionally beyond the EEZ of Pakistan and other IOTC CPCs in the region, and that those used within the EEZ may sometimes drift onto the high seas in contravention of Resolution 12/12, the WPEB **RECOMMENDED** that the Commission should consider if a ban on large scale gillnets should also apply within IOTC CPC EEZ. This would be especially important given the negative ecological impacts of large scale drifting gillnets in areas frequented by marine mammals and turtles.

7.1.2 Pakistan gillnet fishery: Information paper

114. The WPEB **NOTED** papers IOTC–2015–WPEB11–INF05, which provide a review of bycatch by the tuna gillnet fisheries of Pakistan, including the following abstract provided by the authors:

"*Tuna gillnet fishery of Pakistan employs more than 500 fishing boats that operate in offshore waters. In addition to tuna, gillnet also catches large quantities of by-catch fish species including billfishes, pelagic sharks, dolphin fishes as well as marine turtles and cetaceans, which are protected species. High by-catch of these non-target animals affects their population in the area. The paper provides information on by-catch and suggests measures that can be adopted as alternate fishing methods to minimize mortality of endangered and threatened cetaceans and turtles."*

115. The WPEB **RECALLED** that the Common Oceans (ABNJ) Tuna Project contains an element to examine bycatch in gillnet fisheries in the northwest Indian Ocean, which is being managed by WWF-Pakistan.

7.2 Update on training conducted for CPCs having gillnet fleets on species identification, bycatch mitigation and data collection methods

116. The WPEB **NOTED** that Item 7.2 is now covered under the Regional Observer Scheme section of the WPEB Report, and as such, is not detailed here.

7.3 Development of plans of action for future training on species identification, bycatch mitigation and data collection for gillnet fleets and also to identify other potential sources of assistance

117. The WPEB **NOTED** that Item 7.3 is now covered under the Regional Observer Scheme section of the WPEB Report, and as such, is not detailed here.

8. BLUE SHARK

8.1 Review new information on blue shark biology, stock structure, bycatch mitigation measures, fisheries and associated environmental data

8.1.1 Blue shark size and sex-ratios

118. The WPEB **NOTED** paper IOTC–2015–WPEB11–22 which describes the distribution patterns of sizes and sex-ratios of blue shark in the Indian Ocean, including the following abstract provided by the authors:

"*The blue shark is the most captured shark in pelagic longline fisheries targeting tunas and swordfish. As part of an ongoing cooperative research between several institutes and national scientists, information on blue shark catch-at-size was collected, compiled and analyzed for the Indian Ocean. This included information from fishery observers, logbooks, scientific projects and scientific surveys from several fishing nations, specifically EU.Portugal, EU.France, Japan, Taiwan,China, South Africa and the USSR (data from historical surveys). Datasets included information on catch location and date, and specimen size and sex. A total of 77,396 blue shark records collected between 1966 and 2014 were compiled, with the sizes ranging from 41 to 369 cm FL (fork length). Considerable variability was observed in the size distribution by region and season, with larger sizes tending to occur in equatorial and tropical regions and smaller sizes in southern latitudes in more temperate waters. Some fleets/surveys showed bimodal size distributions, which may be related with the fact that those fleets/surveys operate in several locations throughout the Indian Ocean.*" – *(see paper for full abstract)*

119. The WPEB **NOTED** that this paper provides a broad overview of the main patterns of blue shark size distributions along the Indian Ocean, but some finer scale patterns might still be going on at specific locations that may not be reflected in this general overview. As such, continuing with finer scale studies is also important.

120. The WPEB **NOTED** and discussed the issue of the stock structure of blue shark in the Indian Ocean, specifically that given the present biological knowledge, it is considered to be a single stock. However, this issue will need to be further examined, via the IOTC Stock Structure genetics project.

121. The WPEB **NOTED** that the sex-ratio identified is dependent on the fishing operation strategy/seasonality and discussed how to address area dependent sex ratios in integrated models such as stock synthesis. This is an important issue that is difficult to put into the integrated model. Seasonal changes of catch at size data in south east and south west areas should also be examined.

8.1.2 Blue shark length composition: Indonesia longline

122. The WPEB **NOTED** paper IOTC–2015–WPEB11–23 which describes blue shark length composition from the Indonesian longline fleet in the Indian Ocean: period 2005–2014, including the following abstract provided by the authors:

"*Blue sharks (Prionace glauca) are large, highly migratory, pelagic carcharhinids found throughout the oceans in all tropical and temperate waters. In Indonesian longline fleet in the Indian Ocean, blue sharks are the single most common bycatch species caught in the tuna surface longline fishery. The aims of this paper were to presents the information about length composition, spatiotemporal distribution and relative abundance (No. fish/100 hooks) obtained from data base Research Instituted for Tuna Fisheries scientific observer program. Data from tuna longline fishery in the Indian Ocean has collected by scientific observers from Research Institute for Tuna Fisheries during 2005 – 2014, comprising of a total of 93 trips with an average of 24 days/trip. Mean length of the blue shark Showed little variation between years (147.66 - 194.30 cmFL. Geographical distribution of blue shark CPUE (# fish / 100 hooks) more caught during Southeast monsoon than Northwest monsoon.*"

123. The WPEB **NOTED** only two individual catches in 2011 and questioned the reason for this. The authors clarified that in 2011 the Indonesian fleets changed the area of operations (near coastal) and used deep-set longline.

124. **NOTING** the changes in fishing strategy that have been taking place in Indonesia fisheries, the WPEB **REQUESTED** that Indonesia provides in the future a document with a review of the Indonesian longline fleet operation mode and changes, including details on the use of shark lines attached directly to buoys.

125. The WPEB **REQUESTED** Indonesia to investigate the possibility of providing a standardised blue shark CPUE series for use in the next stock assessment, as Indonesia is the fleet currently reporting the most blue shark catches in the Indian Ocean and operates mainly in the southeast Indian Ocean, an area for which very little information in currently available.

126. The WPEB **ACKNOWLEDED** the efforts made by Indonesia to improve its observer scheme, and to improve shark species identification by its data recorders by developing and implementing a system of observer training and data validation.

8.1.3 Blue shark reporting ratio: Japan longline

127. The WPEB **NOTED** paper IOTC–2015–WPEB11–51 which provides an estimation of appropriate reporting ratio for the blue shark caught by Japanese longliner in the Indian Ocean, including the following abstract provided by the authors:

"*This document paper presents an appropriate reporting rate for the blue shark caught by Japanese longline fishery in the Indian Ocean. New statistical approach was applied to choose the best available reporting rate (RR) for blue shark through comparisons of the catch rate between observer data and logbook data. The most appropriate reporting rate was chosen by AIC from the simulation study with the filtering data by the different RR, and the value was 54 %. The value is largely different from the previous study in the ICCAT (80 %). However, this result seems to be reasonable because extreme higher RR can lose the useful information on the logbook data for the CPUE standardization, by contrast, lower RR can include a large number of unreported catch data.*"

128. The WPEB **NOTED** that in the Pacific Ocean the fleets targeting bigeye tuna tend to catch the highest proportion of blue shark, while in the Indian Ocean the fleets targeting southern bluefin tuna tend to catch the most blue shark in comparison to other fleets. The reason for the differences are thought to be that the main fishing area for southern bluefin tuna in the Indian Ocean overlaps with blue shark distribution more than other fleets.

129. The WPEB **NOTED** that the proportion of sets with zero blue shark catch in the Japanese observer dataset is very high (~46%) relative to observer data from Japanese tuna longline fisheries in the Atlantic (20%). The paper (IOTC–2015–WPEB11–51) mentions that this may be due to fishing on krill aggregations resulting in no shark bycatch.

130. The WPEB **AGREED** that for the stock assessment models data from all periods available can be used. An investigation of the use of fine scale vessel or cruise effects should also be examined for the next WPEB meeting.

8.1.4 Shark fin trade data: Historical catch reconstruction

131. The WPEB **NOTED** paper IOTC–2015–WPEB11–24 which provided a historical catch estimate reconstruction for the Indian Ocean based on shark fin trade data, including the following abstract provided by the authors:

"*This paper presents alternative estimates of catches of blue and oceanic whitetip sharks in the Indian Ocean based on shark fin trade data. This method was previously applied to the Atlantic Ocean for use in blue and shortfin mako shark assessments, as well as to the Western and Central Pacific Ocean for use in oceanic whitetip and silky shark assessments. The method involves multiple assumptions and is best utilized as an alternative (i.e. for comparison) to catch estimates prepared from more traditional data sources. Estimates were constructed using four steps. First, estimates by species (in number and biomass based on Hong Kong shark fin auction data and extrapolated to the global trade) in 2000 were reconstructed using triangular distributions in a Bayesian model and Markov chain Monte Carlo (MCMC) methods. These estimates were then adjusted using annual imports into Hong Kong for 1980-2011. Figures were then further adjusted based on the diminishing share of Hong Kong's shark fin trade as compared to the total global trade in recent years.*" *– (see paper for full abstract)*

132. The WPEB **NOTED** that the shark catch estimations from the method detailed in the paper end at 2011 and do not include the period 2012-14, because of changing conditions in the markets.

133. The WPEB **AGREED** that data provided with this method could be used in the blue shark stock assessments.

134. **NOTING** that the reliability of using the effort-based proportioning method to partition the global estimate to an Indian Ocean catch estimate may be questionable, given that effort is not very well reported for the Indian Ocean and some other Oceans, the WPEB **AGREED** that it would be better to use one of the other proportioning methods such as target tuna catch.

135. The WPEB **NOTED** that the weight differential between wet and dry fins in the trade data had been accounted for, in the original Hong Kong-based trade estimates and was possible because Hong Kong, unlike many countries, separates quantities dried and frozen fins under different customs codes.

8.2 Review of new information on the status of blue shark

8.2.1 **Nominal and standardised CPUE indices**

EU,Spain blue shark longline standardised CPUE

136. The WPEB **NOTED** paper IOTC–2015–WPEB11–25 which provided standardised catch rates for blue shark caught by the EU,Spain surface longline fleet in the Indian Ocean during the period 2001 to 2013, including the following abstract provided by the authors:

"*Standardized catch per unit of effort (CPUE) were obtained for the blue shark stock (Prionace glauca) of the Indian Ocean using General Lineal Models (GLM) from a total of 1838 trips of the Spanish surface*

longline fleet fishing swordfish during the 2001-2013 period. A base-case and two sensibility runs were conducted. The main factors considered into the base-case were year, area, quarter, gear and ratio between swordfish and blue shark catches. The significant base-case model explained the 82% of the CPUE variability of the blue shark. A major part of this variability was explained by the proxy of the targeting criteria defined as the ratio between the two more prevalent species caught during the trip, the swordfish and the blue shark. Other factors were also significant but less important. The standardized CPUE trend obtained in the base-case suggests a stable trend over time of the Indian Ocean blue shark stock." *– (see paper for full abstract)*

137. The WPEB **NOTED** the following:
    - The main area of operation of the EU,Spain fleet in the Indian Ocean is in the southwest region, similar to the EU,Portugal fleet. The EU,Spain and EU,Portugal fleets use similar operations, fleet dynamics, and both target mainly swordfish. However, the EU,Spain fleet is much larger (22 active EU,Spain vessels versus 6 for EU,Portugal in 2014), and operates in a much wider region. This may be the reason why the EU,Spain and EU,Portugal signals for the blue shark CPUE are different.
    - Alternative area stratifications (based on SST or other areas) makes very little difference on the CPUE standardisation process.
    - That targeting was accounted for using swordfish and blue shark ratios.

EU,Portugal blue shark longline standardise CPUE

138. The WPEB **NOTED** paper IOTC–2015–WPEB11–26 which provided an update of blue shark catches and standardised CPUE for the Portuguese pelagic longline fleet in the Indian Ocean, including the following abstract provided by the authors:

    "*The Portuguese pelagic longline fishery in the Indian Ocean started in the late 1990's, targeting mainly swordfish in the southwest region. A effort has been made by the Portuguese Institute for the Ocean and Atmosphere (IPMA) over the last years to collect of historical catch and effort data on this fishery since it started in the late 1990's to the present date, as well as vessel monitoring system (VMS) data. This working document analyses the catch, effort, nominal and standardized CPUE trends for blue shark captured by this fishery, and explores the use of targeting effects in the CPUE standardization process. Nominal annual CPUEs were calculated in biomass (kg/1000 hooks), and were standardized with Generalized Linear Mixed Models (GLMMs) using year, quarter, season, targeting, and area:season interactions as fixed effects, and vessel as random effects. Model goodness-of-fit and comparison was carried out with the Akaike Information Criteria (AIC), and model validation with residual analysis.*" *– (see paper for full abstract)*

139. The WPEB **NOTED** the following:
    - Most effort was concentrated in the southwest Indian Ocean, and the Indian Ocean stratification was much larger, and may not be representative for other areas in the North and East.
    - The authors produced a CPUE standardisation only for the southwest Indian Ocean core area of operation of this fleet. This was carried out by the authors during the meeting and the results were shared. Using only the core area produced little differences in the final standardised blue shark CPUE for the EU,Portugal fleet.
    - It is possible to compare number versus weight based CPUEs based on observer data, available for this fleet since 2011.
    - It is possible to compare nominal CPUE trend between EU,Spain and EU,Portugal by areas, as both fleets operate in similar ways. Nominal patterns could be examined and submitted at subsequent WPEB meetings.
    - Annual change of monthly CPUE pattern based on change of operational data/fishing ground by year is not accounted for. Selection of data using seasonality is important as well, and should be further explored.
    - Is may be useful to present nominal CPUE pattern of EU,Portugal fleet by area.
    - The sensitivity analysis presented on targeting effects using ratios and cluster analysis, demonstrated that in this case, where most catches are composed by only 2 species (blue shark and swordfish), the final clusters are similar to the ratios and as such there is almost no differences in using ratios or cluster. In some other cases (namely Taiwan,China) PCA analysis have also been used and explained the targeting effects better in the standardisation process, and this could be explored in the future.

Japan blue shark longline standardised CPUE: observer data

140. The WPEB **NOTED** paper IOTC–2015–WPEB11–30 Rev_1 which provided an update of standardised CPUE of blue shark in the Indian Ocean estimated from observer data in the period between 1992 and 2014, including the following abstract provided by the authors:

    "*This document provided the update of standardized CPUE (catch number per 1000 hooks) of blue shark caught by Japanese longline fishery in the Indian Ocean, based on Japanese observer data conducted between 1992 and 2014. As the operation observed in 2013 strongly biased to certain area, the*

standardization was conducted without the data of 2013. The model selection based on information criteria and statistical test suggested the zero-inflated negative binomial GLM was the best model among three type of GLM (Poisson FLM, zero-inflated Poisson GLM and zero-inflated negative binomial GLM). Throughout the period analyzed, the standardized CPUE indicated relatively stable trend except fluctuation between 1998 and 2000. The estimate of 2013 was not obtained in this study, however, neither continuously increasing nor decreasing trend of abundance was suggested in this analysis."

141. The WPEB **NOTED** the following:
    - This analysis was based on coverage by area (SE and SW from southern bluefin tuna targeting sets). The difference between fisheries operating here and the entire Indian Ocean needs to be examined. The spatial extent and coverage of fleet activities has reduced substantially from the historic period.
    - The percentage of positive sets should be reported in subsequent years.

Japan blue shark longline standardised CPUE: logbook data

142. The WPEB **NOTED** paper IOTC–2015–WPEB11–50 which provided an update of CPUE and catch for blue shark caught by Japanese longliner during 1971 to 1993 in the Indian Ocean, including the following abstract provided by the authors:

    "*This document paper presents the estimates of catch-per-unit-of-effort (CPUE) and catch of the blue shark caught by Japanese longline fishery in the Indian Ocean during 1971-1993 with the improvement of standardization methods. CPUE was standardized using zero-inflated negative binomial model after the data filtering on the basis of more than 54 % reporting rate (RR; number of sets with "sharks" recorded/total number of sets). A stepwise approach is used to choose the preferred explanatory variables and the best model is selected based on the AIC. Annual changes in the CPUE suggested that the historical population trend of blue shark during 1971-1993 were relatively stable with annual fluctuations. Annual changes in total catch number had increased until mids 1980s and then decreased until 1990.*"

143. The WPEB **CONGRATULATED** the authors on the improvements made to the standardisation of blue shark CPUE for the Japanese longline fleet operating in the Indian Ocean.

144. The WPEB **NOTED** the following:
    - The filtered data produced using approaches presented in paper IOTC–2015–WPEB11–51 (see below) were analysed using stepwise regressions.
    - The flat trend was quite different from what was reported at the previous Working Party (IOTC–2014–WPEB10–26) (see Fig. 1).
    - All fleet operations were used (not only southern bluefin tuna areas). Northern and Southern areas were covered in fishing effort prior to 1993 As such, the analysis may not be representative of the entire Indian Ocean.

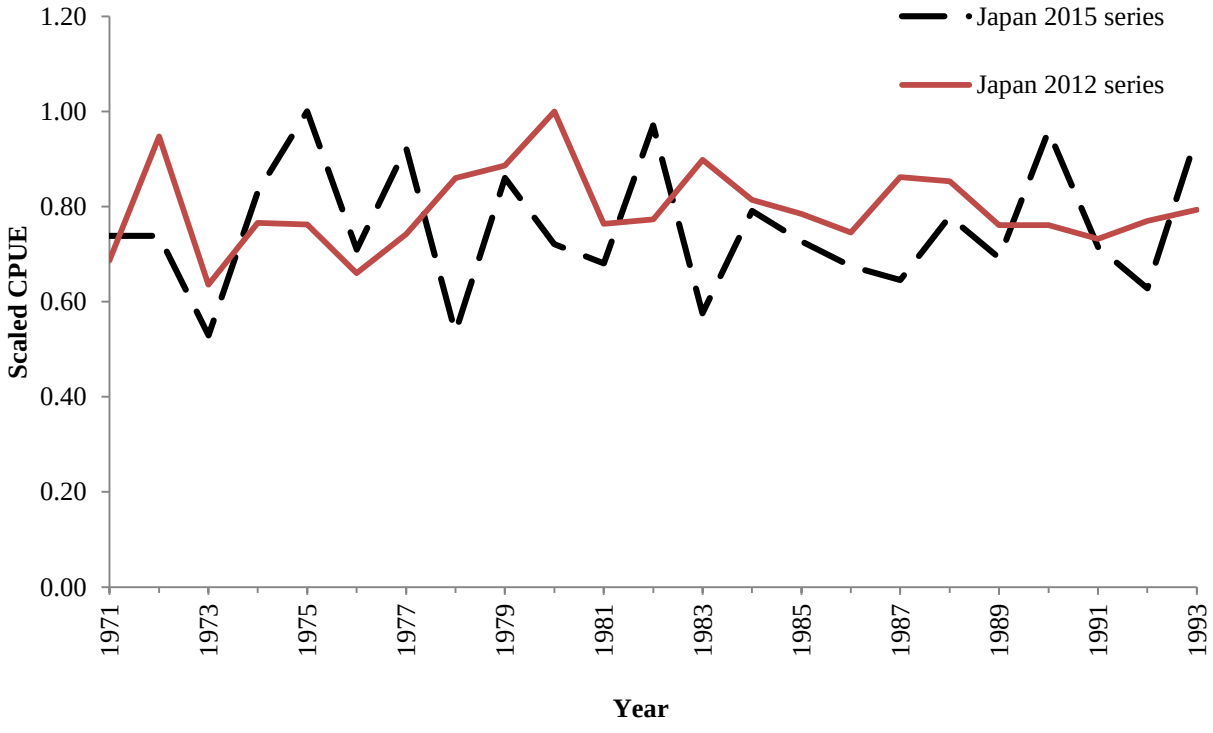

Fig. 1. Differences in the approaches presented between the 2012 and 2015 WPEB meetings. The 2015 analysis uses a filtered data set with sets of a reporting rate of 54% on set by set operations, versus the 2012 analysis which used vessels where reporting rates were exceeding 80% (based on an ICCAT study).

Taiwan,China blue shark standardise CPUE

145. The WPEB **NOTED** paper IOTC–2015–WPEB11–52 Rev_1 which provided an updated and revised standardised catch rate of blue sharks caught by the Taiwan,China longline fishery in the Indian Ocean, including the following abstract provided by the authors:

"*The blue shark catch and effort data from observers' records of Taiwanese large longline fishing vessels operating in the Indian Ocean from 2004-2013 were analyzed. Based on the fishing grounds of the target species, three areas, namely, A (north of 10ºN), B (10ºN-10ºS), and C (south of 10ºS), were categorized. To cope with the large percentage of zero shark catch, the catch per unit effort (CPUE) of blue shark, as the number of fish caught per 1,000 hooks, was standardized using a two-step delta-lognormal model that treats the proportion of positive sets and the CPUE of positive catches separately. Standardized indices with 95% bootstrapping confidence intervals were reported. The standardized CPUE showed a stable trend for blue sharks from 2004 to 2008 and increased steadily thereafter with peaks in 2012 and 2013. The sharply increase of CPUE in this period might be because most observers' data were collected in area C where high blue shark catch rate and low zero-catch of blue shark occurred in that year. The results obtained in this study can be improved if longer time series observers' data are available.*"

146. The WPEB **NOTED** the following:
    - Area C was driving the CPUE up if effort shifted to southern bluefin tuna area where blue shark density higher than other areas.
    - reconsideration of model structure of CPUE standardisation should be undertaken, as Area A has almost no information, Area B was primarily driven by bigeye tuna tropical areas and Area C contains sets targeting two different species (southern bluefin tuna and albacore).
    - unrealistic sudden large increases in CPUE in Area C would be due to the change of operational pattern such as shift of targeting or fishing ground, and thus this increase should not reflect actual dynamics of population in Area A. Using a target cluster or some other factor to explain these changes in targeting needs to be considered further.
    - to use larger number of categories for HPB explanatory variables as Taiwan,China longline vessels actually targets 4 or more species in the period analysed.
    - the authors recalculated standardised CPUE of blue shark caught by Taiwan,China longline vessels.

147. The WPEB **NOTED** that based on these advises, CPUE of Taiwan,China longline vessels was recalculated using a revised model. First, data of vessels believed to target shark (apparently lower zero catch ratio than others) recorded in 2012 and 2013 was eliminated from the analysis. Area stratification were re-designed for four areas (A (north of 10ºS, east to 70ºE), B (north of 10ºS, 70ºE-120ºE), C (south of 10ºS, 20ºE-60ºE), D (south of 10ºS, 60ºE-120ºE)) and the effect of gear configuration (HPB) was categorised into the four classes of 1-9, 10-12, 13-14, and >=15 to adjust the change of CPUE by different target species. With these modifications, unrealistic sudden decrease was disappeared (Fig. 2) and the model seems adequately adjusted the effect of target species, operational area and season. The new Taiwan,China CPUE was subsequently used for the input of stock assessment models of blue shark.

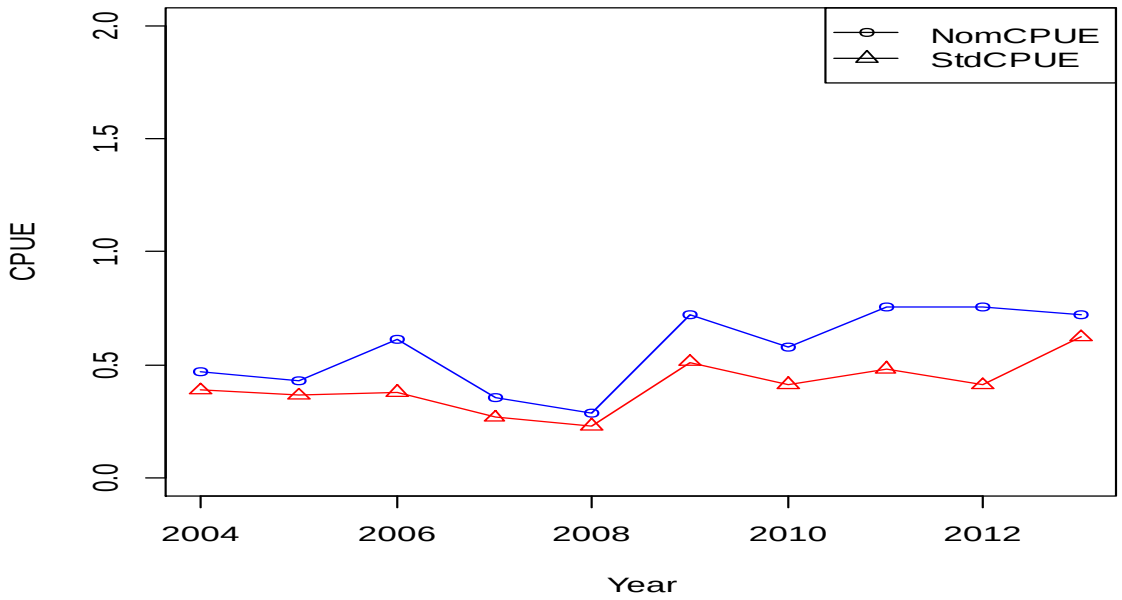

Fig. 2. Blue Shark. Taiwan,China revised blue shark CPUE, nominal and standardised.

8.2.2 CPUE *discussion summary*

148. The WPEB **NOTED** that possible interactions of year with other covariates could be explored.

149. The WPEB **REQUESTED** that any future CPUE analysis papers include model comparisons and residual diagnostics, as per the '*Guidelines for the presentation of CPUE standardisations and stock assessment* models' adopted by the SC in 2014 (IOTC–2015–WPEB11–INF01). Comparison of catch to derived CPUE should be examined and detailed in the meeting paper.

150. The WPEB **NOTED** a broader issue of using number or weights for standardisation, and what may be a better way to standardise. The issue was examined in ICCAT and found not to be problematic if the same sizes were targeted, but could produce bias the analysis if different size categories are caught and used in the standardisation.

151. The WPEB **NOTED** the following regarding the state of CPUE analysis for fleets with important catches of blue shark in the IOTC area of competence:
    - Uncertainty remains on the representativeness of the spatial coverage and appropriate spatial units for the CPUE standardisation for some fleets.
    - Trends in standardised CPUE differ among fleets that operate in the same area, and efforts should be made to understand why there are these differences for the main longline fleets operating in similar areas.
    - Fleet effects should be examined in subsequent years, and appropriate methods of dealing with zero catches using alternative methods, like the hurdle models (e.g. Delta approach), and zero inflated models should be explored.
    - In general the methods to deal with bycatch species in longline fisheries have improved substantially.

152. The WPEB **AGREED** that study of environmental data (e.g. climate index and/or factors affecting catchability) in relation with CPUE changes should be encouraged as an important tool in understanding short-term CPUE spikes.

153. The WPEB **NOTED** that of the blue shark CPUE series available for assessment purposes, the EU,Portugal, EU,Spain, Japan and Taiwan,China series are to be used in the final stock assessment models in 2015, for the reasons discussed above (Fig. 3).
    - EU,Spain (2001–2013) from document IOTC–2015–WPEB11–25.
    - EU,Portugal (2000–2014) from document IOTC–2015–WPEB11–26.
    - Japan (early 1975–1993; late 1992–2014) from documents IOTC–2015–WPEB11–30 Rev_1, IOTC–2015–WPEB11–51.
    - Taiwan,China (2004–2012) from document IOTC–2015–WPEB11–52 Rev_1.

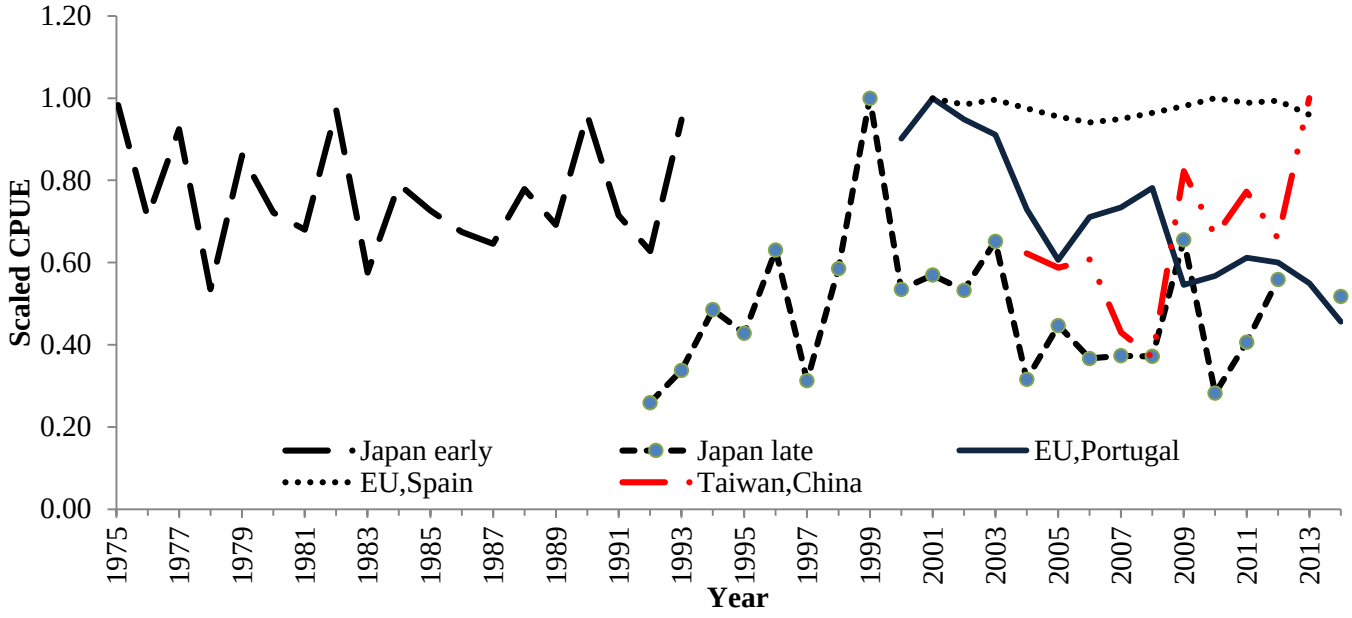

Fig. 3. Blue shark: Comparison of the blue shark standardised CPUE series for the longline fleets of Japan (early, 1975–1993), Japan (late, 1992–2014), EU,Portugal (2000–2014), EU,Spain (2001–2013), and Taiwan,China (2004–2012).

8.2.3 Stock assessments (including data poor approaches)

Blue shark: Summary of stock assessment models in 2015

154. The WPEB **NOTED** Table 3 which provide an overview of the key features of each of the stock assessments presented in 2015 for the Indian Ocean-wide assessments (3 model types). Similarly, Table 4 (IOTC Data) and Table 5 (Trade Data) provides a summary of the assessment results.

Table 3. Blue shark: **Indian Ocean-wide** assessments. Summary of final stock assessment model features as applied to the Indian Ocean blue shark resource in 2015.

Model feature	**BSSPM (Doc# 27)**	**SRA (Doc# 49)**	**SS3 (Doc# 28 Rev_1)**
Software availability	Private	Martell and Froese 2012	NMFS toolbox
Population spatial structure / areas	1	1	1
Number CPUE Series	4	No	5
Uses Catch-at-length/age	No	No	Yes
Age-structured	No	No	Yes
Sex-structured	No	No	Yes
Number of Fleets	1	1	8
Stochastic Recruitment	No	No	Yes

Table 4. Blue shark: **Indian Ocean-wide** summary of key management quantities from the assessments undertaken in 2015, using IOTC data, as the basis for historical catch estimates. Point estimates are the median values across all models.

Management quantity	**BSSPM (Doc# 27)**	**SRA (Doc# 49)**	**SS3 (Doc# 28 Rev_1)**
2014 catch estimate (t)	33,714		
Mean catch from 2010–2014 (t)	29,629		
h (steepness) (base case)	n.a.	n.a.	0.5
MSY (1,000 t) (80% CI; range*)	33.20 (17.14–62.78)*	19.47 (12.1–28.2)	9.53 (4.61–15.64)*
Data period (catch)	1950–2014	1950–2014	1971-2014
CPUE series	LL: Japan; EU,Portugal; EU,Spain; Taiwan,China	n.a.	LL: Japan, EU,Portugal, EU,Spain, Taiwan,China

CPUE period	Japan (1992-2014); EU,Portugal (2000-2014); EU,Spain (2001-2013); Taiwan,China (2004-2014)	n.a.	Japan, early (1971-1992) Japan late (1992-2014) (2013 n.a.) EU,Portugal (2000-2014) EU,Spain (2001-2013) Taiwan,China (2004-2013)
F_{MSY} (80% CI; range*)	0.15 (0.10–0.24)*	0.12 (0.05–0.21)	0.14 (0.06–0.23)*
SB_{MSY} or $*B_{MSY}$ (1,000 t) (80% CI; range*)	226.15 (117.71–331.79)*	n.a.	16.50 (13.30–27.00)*
F_{2014}/F_{MSY} (80% CI; range*)	0.87 (0.30–2.48)*	1.53 (0.51–3.10)	3.53 (1.13–15.68)*
B_{2014}/B_{MSY} (80% CI; range*)	1.31 (0.70–2.15)*	1.09 (0.84–1.36)	n.a.
SB_{2014}/SB_{MSY} (80% CI; range*)	n.a.	n.a.	0.98 (0.58–1.66)*
B_{2014}/B_{1950} (80% CI; range*)	0.66 (0.35–1.08)*	0.55 (0.42–0.68)	n.a.
SB_{2014}/SB_{1971} (80% CI; range*)	n.a.	n.a.	0.42 (0.28–0.65)*
$B_{2014}/B_{1950, F=0}$ (80% CI; range*)	n.a.	n.a.	n.a.
$SB_{2014}/SB_{current, F=0}$ (80% CI; range*)	n.a.	n.a.	n.a.

* 'range' is a minimum and maximum value of models examined. LL = longline; n.a. = not available

Table 5. Blue shark: **Indian Ocean-wide** summary of key management quantities from the assessments undertaken in 2015, using Trade data, as the basis for historical catch estimates. Point estimates are the median values across all models.

Management quantity	**BSSPM (Doc# 27)**	**SRA (Doc# 49)**	**SS3 (Doc# 28 Rev_1)**
2014 catch estimate (t)	141,571		
Mean catch from 2010–2014 (t)	129,126		
h (steepness) (base case)	n.a.	n.a.	0.5
MSY (1,000 t) (80% CI; range*)	149.38 (83.39–269.78)*	95.05 (71.60–156.90)	56.89 (28.24–84.86)*
Data period (catch)	1980–2014	1950–2014	1971–2014
CPUE series	LL: Japan; EU,Portugal; EU,Spain; Taiwan,China	n.a.	LL: Japan, EU,Portugal, EU,Spain, Taiwan,China
CPUE period	Japan (1992-2014); EU,Portugal (2000-2014); EU,Spain (2001-2013); Taiwan,China (2004-2014)	n.a.	Japan, early (1971-1992) Japan late (1992-2014) (2013 n.a.) EU,Portugal (2000-2014) EU,Spain (2001-2013) Taiwan,China (2004-2013)
F_{MSY} (80% CI; range*)	0.16 (0.10–0.24)*	0.11 (0.05–0.21)	0.14 (0.06–0.23)*
SB_{MSY} or $*B_{MSY}$ (1,000 t) (80% CI; range*)	995.93 (559.51–	n.a.	92.6 (77.7–147.00)*

	1,391.51)*		
F_{2014}/F_{MSY} (80% CI; range*)	0.90 (0.30–2.55)*	1.38 (0.38–2.02)	2.52 (0.96–10.48)*
B_{2014}/B_{MSY} (80% CI; range*)	1.25 (0.57–2.13)*	1.05 (0.97–1.50)	n.a.
SB_{2014}/SB_{MSY} (80% CI; range*)	n.a.	n.a.	1.01 (0.57–1.52)*
B_{2014}/B_{1950} (80% CI; range*)	0.62 (0.28–1.06)*	0.53 (0.49–0.75)	n.a.
SB_{2014}/SB_{1971} (80% CI; range*)	n.a.	n.a.	0.42 (0.27–0.59)*
$B_{2014}/B_{1950, F=0}$ (80% CI; range*)	n.a.	n.a.	n.a.
$SB_{2014}/SB_{current, F=0}$ (80% CI; range*)	n.a.	n.a.	n.a.

* 'range' is a minimum and maximum value of models examined. LL = longline; n.a. = not available

Bayesian State-Space Production Model (BSSPM): Blue shark

155. The WPB **NOTED** paper IOTC–2015–WPEB11–27 which provided a preliminary stock assessment of blue shark caught in Indian Ocean using a Bayesian State-Space Production Model (BSSPM), including the following abstract provided by the authors:

"*Bayesian state-space models were fitted to four standardized catch rates of blue shark (Prionace glauca) caught in the Indian Ocean. Estimations of catches as reported in the IOTC databases were the base case, though alternative estimation of catches was considered in the sensitivity analyses. Uncertain is high as indicated by the wide posteriors of parameters. The preliminary estimations showed in this paper indicate that biomass of blue shark population is above the biomass at MSY, but the harvest rate is close or above the harvest rate at MSY.*"

156. The WPB **NOTED** the key assessment results for the BSSPM as shown below (Tables 6 and 7a and b; Fig. 4). Note that K2MSM projections were not run due to large uncertainty in catch estimates.

Table 6. Blue shark: Key management quantities from the BSSPM assessment, for the Indian Ocean. Point estimates are medians across all models.

Management Quantity	**Aggregate Indian Ocean (IOTC-DB)**	**Aggregate Indian Ocean (TRADE-DB)**
2014 catch estimate (t)	33,714	141,571
Mean catch from 2010–2014 (t)	29,629	129,126
MSY (1000 t) (range across all models)	(17.14–62.78)	(83.39–26.98)
Data period (catch)	1950–2014	1980–2014
F_{MSY} (range*)	0.15 (0.10–0.24)	0.16 (0.10–0.24)
SB_{MSY} or $*B_{MSY}$ (1,000 t) (range*)	226.15 (117.71–331.79)*	995.93 (559.51–1,391.51)*
F_{2014}/F_{MSY} (range*)	0.87 (0.30–2.48)*	0.90 (0.30–2.55)*
B_{2014}/B_{MSY} (range*)	1.31 (0.70–2.15)*	1.25 (0.57–2.13)*
SB_{2014}/SB_{MSY} (range*)	n.a.	n.a.
B_{2014}/B_{1950} (range*)	0.66 (0.35–1.08)*	0.62 (0.28–1.06)*
SB_{2014}/SB_{1971} (range*)	n.a.	n.a.
$B_{2014}/B_{1950, F=0}$ (range*)	n.a.	n.a.
$SB_{2014}/SB_{current, F=0}$ (range*)	n.a.	n.a.

* 'range' is a minimum and maximum value of models examined. n.a.: not available

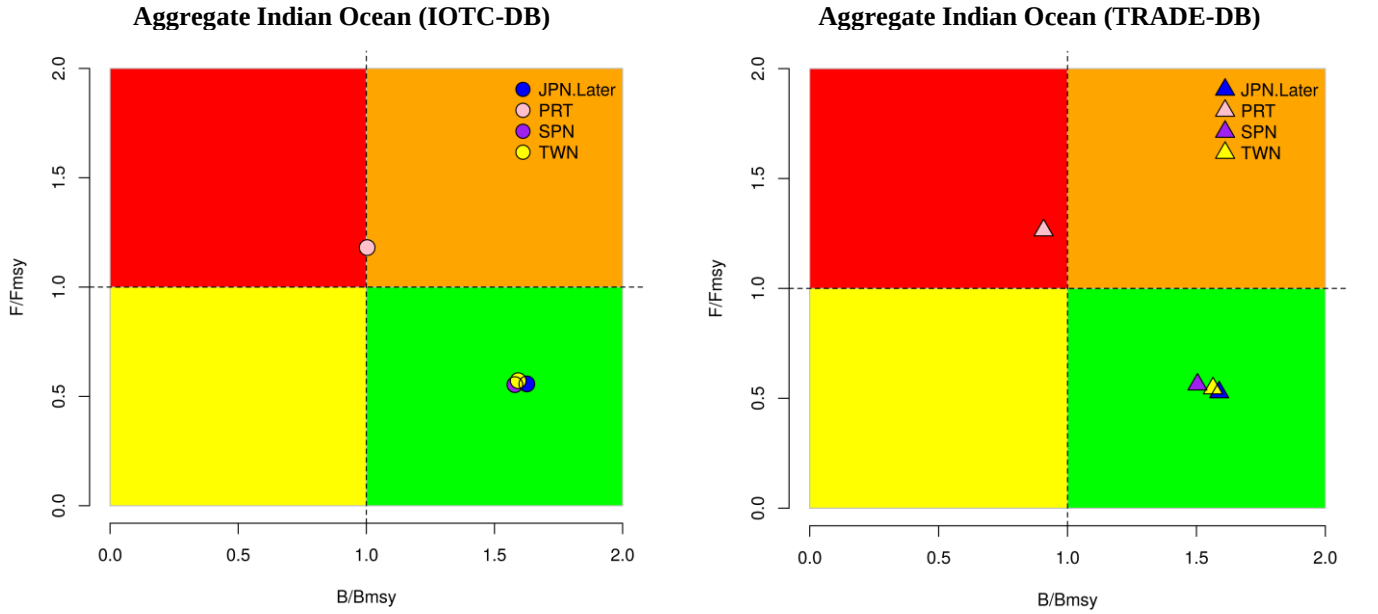

Fig. 4. Blue shark: BSSPM aggregated Indian Ocean assessment Kobe plot for the median values of the last point. Circles stand for the calculations based on IOTC estimations of catches, while triangles stand for the calculations based on estimations of catches based on trade markets. CPUE series: Japan 1992–2014 (JPN.Later); EU,Portugal 2000–14 (PRT); EU,Spain 2001–13 (SPN); and Taiwan,China 2004–14 (TWN).

Table 7a. Blue shark: BSSPM aggregated Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of violating the MSY-based reference points for nine constant catch projections using IOTC DB (average catch level from 2012–14 (31,759 t), ± 10%, ± 20%, ± 30% and ± 40%) projected for 3 and 10 years. **Note: K2MSM projections were not run due to large uncertainty in catch estimates.**

Reference point and projection timeframe	**Alternative catch projections (relative to the average catch level from 2012–2014, 31,759 t) and probability (%) of violating MSY-based target reference points ($B_{targ} = B_{MSY}$; $F_{targ} = F_{MSY}$)**								
	60% (19,055t)	**70%** (22,231 t)	**80%** (25,407 t)	**90%** (28,583 t)	**100%** (31,759 t)	**110%** (34,935 t)	**120%** (38,110 t)	**130%** (41,286 t)	**140%** (44,462 t)
$B_{2017} < B_{MSY}$									
$F_{2017} > F_{MSY}$									
$B_{2024} < B_{MSY}$									
$F_{2024} > F_{MSY}$									

Table 7b. Blue shark: BSSPM aggregated Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of violating the MSY-based reference points for nine constant catch projections using TRADE DB (average catch level from 2012–14 (134,212 t), ± 10%, ± 20%, ± 30% and ± 40%) projected for 3 and 10 years. **Note: K2MSM projections were not run due to large uncertainty in catch estimates.**

Reference point and projection timeframe	**Alternative catch projections (relative to the average catch level from 2012–2014, 134,212 t) and probability (%) of violating MSY-based target reference points ($B_{targ} = B_{MSY}$; $F_{targ} = F_{MSY}$)**								
	60% (80,527 t)	**70%** (93,948 t)	**80%** (107,369 t)	**90%** (120,790 t)	**100%** (134,212 t)	**110%** (147,663 t)	**120%** (161,054 t)	**130%** (174,475 t)	**140%** (187,896 t)
$B_{2017} < B_{MSY}$									
$F_{2017} > F_{MSY}$									
$B_{2024} < B_{MSY}$									
$F_{2024} > F_{MSY}$									

157. The WPEB **NOTED** the following with respect to the BSSPM modelling approach presented at the meeting:

- Models fitted using the catches estimations of IOTC converged fast, but the convergence of models fitted to catches estimated based on trade were more difficult to achieve.
- Most of the datasets do not convey information about the parameters of the models.
- Priors of r strongly affects the posterior distributions of MSY and current stock status.
- Uncertainties on the estimations of parameters and of the benchmarks were high as indicated by the wide credibility intervals as calculated based on the posterior distributions.

- CPUE series were conflictive. Calculations based on the Portuguese time series indicate that the stock is probably overfished or subject to overfishing, while the calculations based on the other series indicate the stock have been not overfished in the last few years. Estimations of benchmarks (e.g. F_{msy}) as calculated using IOTC catches or Trade catches were very different due to the large differences of the scales of the catch estimations. However, the time trends of the F/F_{msy} and B/B_{msy} ratios were similar.
- Estimations of MSY were close to the recent catches, which is an indication that the catches should not increase in the future.
- K2MSM projections were not run due to large uncertainty in catch estimates.

Stock Reduction Analysis (SRA): Blue shark

158. The WPB **NOTED** paper IOTC–2015–WPEB11–49 Rev_1 which provided a stock assessment of blue shark in the Indian Ocean using a Stock Reduction Analysis (SRA), including the following abstract provided by the authors:

"*We conduct stock assessments for Indian Ocean blue shark using data poor approaches. We used a catch-based stock reduction analysis method. The method is based on a classical biomass dynamics model, requires only catch history but not fishing effort or CPUE. Known population growth rate will improve the assessment result. In this paper, we assume that the species analysed, in the whole Indian Ocean belong to a single stock and the population size in 1950 is the virgin biomass, and is also equal to their carrying capacities. We use recently updated catch data in the analysis. For blueshark the geometric mean virgin biomass was about 173.3 to 559.7 thousand tonnes, and the intrinsic population growth rate is about 0.245 (0.08-0.73 95% CI). The entire stock can support a MSY of nearly 19.1 thousand tonnes. Catch levels in recent year may have been too high, and likely overfishing is occurring on the stock. Using Trade based data indicated that the yield targets were higher, 95K though relative reference points on both F and B were between 1.38 and 1.53 (F_{2014}/FMSY) and 1.05-1.09 (B_{2014}/BMSY). Estimates for B0 also differed substantially when trade based catches were used (1.1-2.6 Mt), but more plausible for an area like the Indian Ocean.*"

159. The WPB **NOTED** the key assessment results for the SRA as shown below (Tables 8 and 9a, b; Fig. 5).

Table 8. Blue shark: Key management quantities from the SRA assessment, for the Indian Ocean. Point estimates are the geometric means. Point estimates are the median values across all models.

Management Quantity	**Aggregate Indian Ocean (IOTC-DB)**	**Aggregate Indian Ocean (TRADE-DB)**
2014 catch estimate (t)	33,714	141,571
Mean catch from 2010–2014 (t)	29,629	129,126
MSY (1000 t) (80% CI)	19.47 (12.10–28.20)	95.05 (71.60–156.90)
Data period (catch)	1950–2014	1950–2014
F_{MSY} (80% CI)	0.12 (0.05–0.21)	0.11 (0.05–0.21)
SB_{MSY} or $*B_{MSY}$ (1,000 t) (80% CI)	n.a.	n.a.
F_{2014}/F_{MSY} (80% CI)	1.53 (0.51–3.10)	1.38 (0.38–2.02)
B_{2014}/B_{MSY} (80% CI)	1.09 (0.84–1.36)	1.05 (0.97–1.50)
SB_{2014}/SB_{MSY} (80% CI)	n.a.	n.a
B_{2014}/B_{1950} (80% CI)	0.55 (0.42–0.68)	0.53 (0.49–0.75)
SB_{2014}/SB_{1950} (80% CI)	n.a.	n.a.
$B_{2014}/B_{1950, F=0}$ (80% CI)	n.a.	n.a
$SB_{2014}/SB_{1950, F=0}$ (80% CI)	n.a.	n.a

n.a.: not available

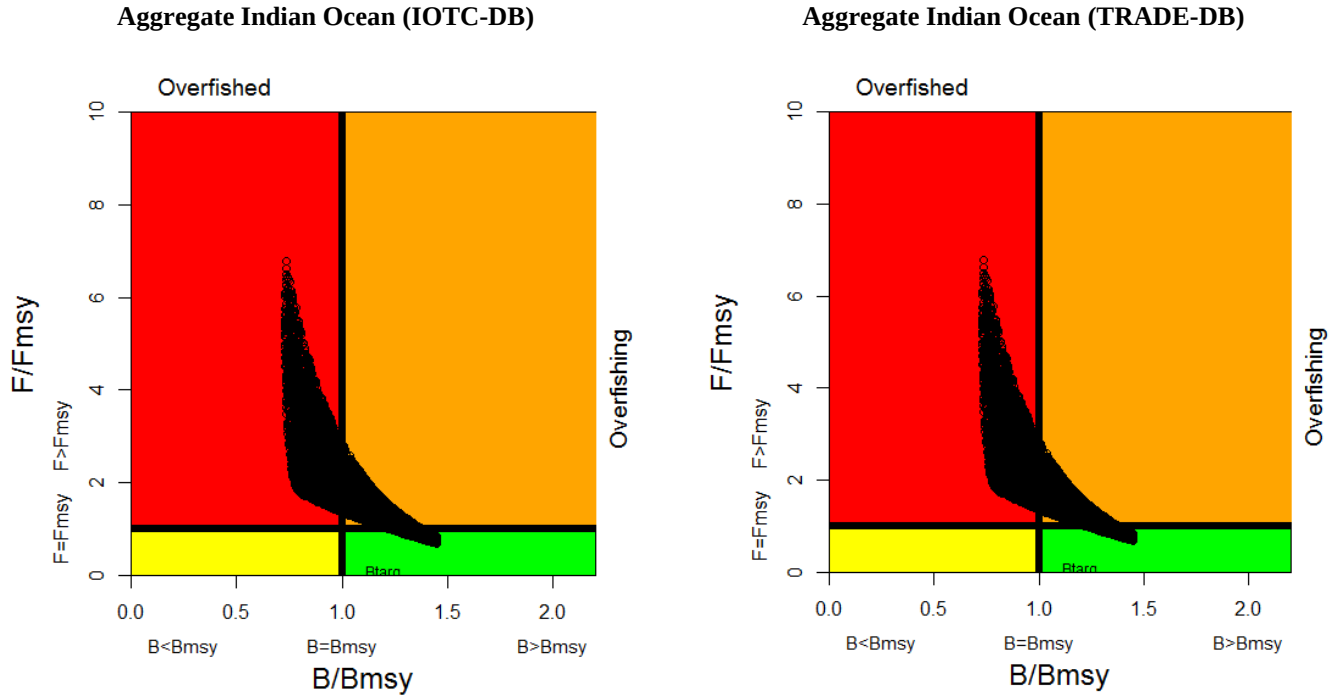

Fig. 5. Blue shark: SRA aggregated Indian Ocean assessment Kobe plot showing stock status indicator for the last point (2014) across all feasible (~14,000) options for the IOTC DB (left panel) and TRADE based datasets (right panel).

Table 9a. Blue shark: SRA aggregated Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of violating the MSY-based reference points for nine constant catch projections using IOTC DB (average catch level from 2012–14 (31,759 t), ± 10%, ± 20%, ± 30% and ± 40%) projected for 3 and 10 years

Reference point and projection timeframe	**Alternative catch projections (relative to the average catch level from 2012–2014, 31,759 t) and probability (%) of violating MSY-based target reference points ($B_{targ} = B_{MSY}$; $F_{targ} = F_{MSY}$)**								
	60% (19,055t)	**70%** (22,231 t)	**80%** (25,407 t)	**90%** (28,583 t)	**100%** (31,759 t)	**110%** (34,935 t)	**120%** (38,110 t)	**130%** (41,286 t)	**140%** (44,462 t)
$B_{2017} < B_{MSY}$	19	23	27	31	35	39	42	46	50
$F_{2017} > F_{MSY}$	48	58	68	76	84	91	97	100	100
$B_{2024} < B_{MSY}$	31	41	52	61	70	78	85	92	96
$F_{2024} > F_{MSY}$	46	59	72	82	91	98	100	100	100

Table 9b. Blue shark: SRA aggregated Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of violating the MSY-based reference points for nine constant catch projections using TRADE DB (average catch level from 2012–14 (134,212 t), ± 10%, ± 20%, ± 30% and ± 40%) projected for 3 and 10 years.

Reference point and projection timeframe	**Alternative catch projections (relative to the average catch level from 2012–2014, 134,212 t) and probability (%) of violating MSY-based target reference points ($B_{targ} = B_{MSY}$; $F_{targ} = F_{MSY}$)**								
	60% (80,527 t)	**70%** (93,948 t)	**80%** (107,369 t)	**90%** (120,790 t)	**100%** (134,212 t)	**110%** (147,663 t)	**120%** (161,054 t)	**130%** (174,475 t)	**140%** (187,896 t)
$B_{2017} < B_{MSY}$	3	5	6	8	10	12	14	16	18
$F_{2017} > F_{MSY}$	19	26	34	43	52	60	68	76	82
$B_{2024} < B_{MSY}$	0	6	16	25	34	42	50	58	65
$F_{2024} > F_{MSY}$	19	26	37	48	59	70	80	88	95

160. The WPEB **NOTED** the following with respect to the SRA modelling approach presented at the meeting:

- The data was highly uncertain and given it relies only on catch data this method is probably not appropriate.
- As there is a high degree of uncertainty in the Indonesian catch, and this fishery needs to be examined carefully as it accounts for close to 60% of the catch.

- The results were consistent with a much more complex approach. Even though it's driven by the catch the relative values of current biomass to optimal levels remain consistent across approaches.
- Trade based estimates provided more plausible results on B_0 versus the IOTC DB, and was consistent with values estimated in the Pacific Ocean and Atlantic Ocean.

Stock Synthesis III (SS3)

161. The WPB **NOTED** paper IOTC–2015–WPEB11–28 Rev_2 which provided a stock assessment for blue shark in the Indian Ocean using Stock Synthesis III (SS3), including the following abstract provided by the authors:

"*This paper presents the first stock assessment of blue shark in the Indian Ocean. The assessment uses the stock assessment model and computer software known as Stock Synthesis (version 3.24f http://nft.nefsc.noaa.gov/Download.html). The blue shark assessment model is an age structured (30 years), spatially aggregated (1 region) and two sex model. The catch, effort, and size composition of catch, are grouped into 8 fisheries covering the time period from 1971 through 2014. Data collected previous to 1971 are not considered in this analysis. Blue sharks are most often caught as bycatch in the Indian Ocean tuna fisheries, though some directed mixed species (sharks and tunas/billfish) fisheries do exist. Commercial reporting of landings has been minimal, as has information regarding the targeting and fate of blue sharks encountered in the fisheries. Useful data on catch and effort is mostly limited to recent years, a time series of historical catch has been estimated based on reported effort and observed catch rates. Multiple data gaps relating to the true state of nature with respect to catch and abundance trends were overcome through the use of integrated stock assessment techniques and the inclusion of alternative data.*"

162. The WPB **NOTED** the key assessment results for the SS3 as shown below (Tables 10 and 11a, b; Fig. 6).

Table 10. Blue shark: Key management quantities from the SS3 assessment, for the Indian Ocean. Point estimates are the median values across all models.

Management Quantity	**Aggregate Indian Ocean (IOTC Catch)**	**Aggregate Indian Ocean (Trade Catch)**
2014 catch estimate (t)	33,714	141,571
Mean catch from 2010–2014 (t)	29,628	129,199
MSY (1000 t) (80% CI)	9.53 (4.61–15.64)	56.89 (28.24–84.86)
Data period (catch)	1971–2014	1971–2014
F_{MSY} (range*)	0.14* (0.06–0.23)	0.14* (0.06–0.23)
SB_{MSY} or $*B_{MSY}$ (1,000 t) (range*)	16.50 (13.30–27.00)	92.6 (77.7–147.00)
F_{2014}/F_{MSY} (range*)	3.52 (1.13–15.68)	2.52 (0.96–10.48)
B_{2014}/B_{MSY} (range*)	n.a.	n.a.
SB_{2014}/SB_{MSY} (range*)	0.98 (0.58–1.66)	1.01 (0.57–1.52)
B_{2014}/B_{1950} (range*)	n.a.	n.a.
SB_{2014}/SB_{1971} (range*)	0.42 (0.28–0.65)	0.42 (0.27–0.59)
$B_{2014}/B_{1950,\ F=0}$ (range*)	n.a.	n.a.
$SB_{2014}/SB_{current,\ F=0}$ (range*)	n.a.	n.a.

* 'range' is a minimum and maximum value of models examined. n.a.: not available

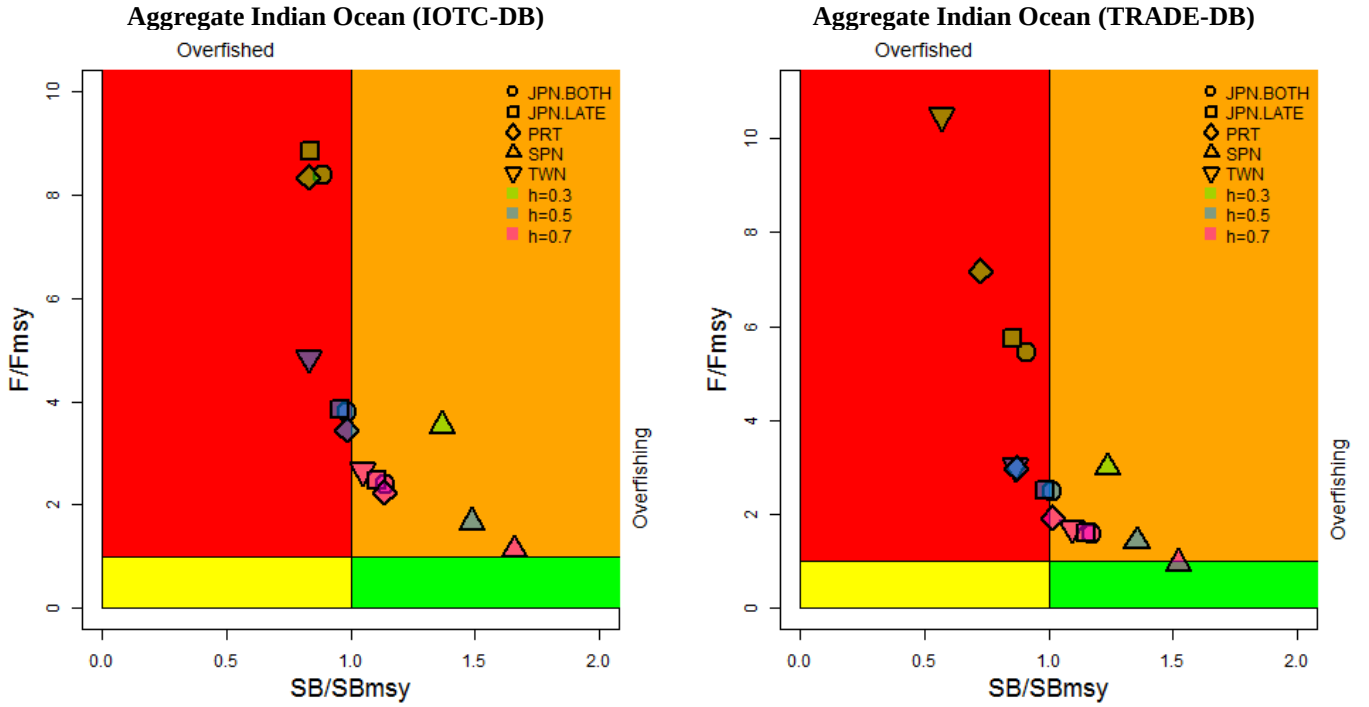

Fig. 6. Blue shark: SS3 aggregated Indian Ocean assessment Kobe plot for the 2014 estimate based on a range of models explored with varying steepness, and fits to CPUE series. Note that these are for different dataset, namely the IOTC DB and Trade based datasets (IOTC DB: left panel and TRADE DB: right panel). Note that one point is not shown on the left panel due to an extreme F_{2014}/F_{msy} value of 15.6.

Table 11a. Blue shark: SS3 aggregated Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of violating the MSY-based reference points for nine constant catch projections using IOTC DB (average catch level from 2012–14 (31,759 t), ± 10%, ± 20%, ± 30% and ± 40%) projected for 3 and 10 years. **Note**: K2MSM projections were not run due to large uncertainty in catch estimates.

Reference point and projection timeframe	**Alternative catch projections (relative to the average catch level from 2012–2014, 31,759 t) and probability (%) of violating MSY-based target reference points ($B_{targ} = B_{MSY}$; $F_{targ} = F_{MSY}$)**								
	60% (19,055t)	**70%** (22,231 t)	**80%** (25,407 t)	**90%** (28,583 t)	**100%** (31,759 t)	**110%** (34,935 t)	**120%** (38,110 t)	**130%** (41,286 t)	**140%** (44,462 t)
$B_{2017} < B_{MSY}$									
$F_{2017} > F_{MSY}$									
$B_{2024} < B_{MSY}$									
$F_{2024} > F_{MSY}$									

Table 11b. Blue shark: SS3 aggregated Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of violating the MSY-based reference points for nine constant catch projections using TRADE DB (average catch level from 2012–14 (134,212 t), ± 10%, ± 20%, ± 30% and ± 40%) projected for 3 and 10 years. **Note: K2MSM projections were not run due to large uncertainty in catch estimates.**

Reference point and projection timeframe	**Alternative catch projections (relative to the average catch level from 2012–2014, 134,212 t) and probability (%) of violating MSY-based target reference points ($B_{targ} = B_{MSY}$; $F_{targ} = F_{MSY}$)**								
	60% (80,527 t)	**70%** (93,948 t)	**80%** (107,369 t)	**90%** (120,790 t)	**100%** (134,212 t)	**110%** (147,663 t)	**120%** (161,054 t)	**130%** (174,475 t)	**140%** (187,896 t)
$B_{2017} < B_{MSY}$									
$F_{2017} > F_{MSY}$									
$B_{2024} < B_{MSY}$									
$F_{2024} > F_{MSY}$									

163. The WPEB **NOTED** the following with respect to the SS3 modelling approach presented at the meeting:
- The growth parameters used were from other oceans. Region-specific growth parameters should be used in future assessments.
- CPUE series does not run the entire length of the catch and could be problematic in the model fitting.

- Length composition catch size changes seasonally and yearly, and a yearly model cannot address this. Quarterly models are possible only if data were available at that step. Seasonality should be examined in future models.
- The initial values of steepness used were lower than those used for the north Atlantic (Steepness of 0.73, adopted for the north Atlantic blue shark), and subsequent runs included the range 0.3–0.7.
- There were critical data issues. Alternative catch series should be examined if available. A lot of time was spent on adjusting the final three years of the trade based estimates using the target species catch data from the IOTC database which are likely to be severe underestimates. The trade base estimates provided more plausible estimates of virgin biomass given that they were on a scale more similar to the north Atlantic and Pacific oceans.

- No K2MSM matrices were generated as there was a large uncertainty in the catch series.

8.2.4 Selection of Stock Status indicators for blue shark

164. **NOTING** that the standardised CPUE series produced in 2015 were often conflicting, and that the catch series from the IOTC database were not considered realistic, the WPEB **AGREED** that using a range of model runs should be used in developing relative stock status advice, but not for absolute measures of biomass or yield.

165. **NOTING** the large advance in the current state of knowledge of blue shark in the Indian Ocean, and that the assessments carried out in 2015 were essentially giving the same outlook on the stock, the WPEB **AGREED** that the ensemble of information from the assessments should be used for developing stock status advice.

Parameters for future analyses: CPUE standardisation and stock assessments

166. The WPEB **AGREED** that in order to obtain comparable CPUE standardisations for shark species, the set of parameters detailed in Table 12, if available, could be used for the standardisation of CPUE analysis in 2016, which could then be used as indices of abundance for the stock assessments for blue shark (and other species if available).

Table 12. A selection of the possible parameters for the standardisation of blue shark CPUE series.

CPUE standardisation parameters/approach	Value for CPUE standardisation
Model	*ZIP Models, Delta-Log Normal/Poisson/Log-Normal/Tweedie*
Area	As appropriate for each series
CE Resolution	Operational data on a one by one spatial resolution
GLM Factors	Year, Quarter, Area, HBF, environmental indicators, species ratios + interactions

167. The WPEB **NOTED** that the model parameters contained in Table 13 were used fully or partially in the range of assessment models undertaken in 2015, and that for continuity purposes should be used for preliminary base case analysis, with appropriate sensitivity runs. Revision of the parameters should be undertaken prior to assessments being undertaken to ensure the most up to date, and region specific parameters are used.

Table 13. Blue shark: Model parameters for potential use in future base case and sensitivity stock assessment runs.

Biological parameters	Value for assessments
Sex ratio	1:1
Age (longevity)	30+ years
Natural mortality	Sex specific and age specific, Age specific rates for 1 to 30 (Fe Males) are 0.366, 0.245, 0.195, 0.168, 0.151, 0.139, 0.130, 0.124, 0.119, 0.115, 0.112, 0.110, 0.108, 0.106, 0.1 (age 15+) Males (1-30) are 0.359, 0.245, 0.195, 0.166, 0.147, 0.134, 0.125, 0.118, 0.112, 0.108, 0.104, 0.101, 0.099, 0.097, 0.095, 0.09 (15+)
Growth formula	VB Curves from Pacific used (Nakano 1995) k=0.15, linf= 234 for females. For males k=0.138, linf=274.
Weight-length allometry	Allometric, a=3.293e-006, b=3.225
Maturity	50% mature at age 5, length-based logistic curve
Fecundity	25 pups/female
Stock-recruitment	Bev-Holt, h=0.3,0.5, 0.7
Other parameters	
Fisheries	LL specific, and MISC category should be split into shark-line, GN and others
Abundance indices	Japan CPUE, Portugal CPUE, Spain CPUE and Taiwan,China CPUE
Selectivity	Double Normal, Logistic

Review of data needs and way forward for the evaluation of shark stocks - catch data reconstruction

168. **NOTING** that reconstructing catch data is very important and will have a great impact in the models and projections, the WPEB **AGREED** that this issue be examined thoroughly in the upcoming years for assessment purposes.

169. The WPEB **REQUESTED** that the WPEB Chairperson work with CPCs individually or jointly if possible, to develop and refine data which can be used in catch reconstruction. In doing so, full account should be taken of data quality with respect to deficiencies in accurate reporting, as well as for the estimation of catch and discards. This would be done in collaboration with the IOTC Secretariat inter-sessionally. CPCs should facilitate the sharing of information for this task, including information coming from national observer schemes, guaranteeing that it will be used under strict confidentiality rules.

170. The WPEB **AGREED** that a short inter-sessional meeting is conducted with a small group of scientists to work mainly on blue shark catch data reconstruction to be used for stock assessment in subsequent years. The Chairperson and IOTC Secretariat shall work intersessional to develop a budget and seek funding for the meeting.

171. The WPEB **NOTED** potential alternatives for catch estimates that could be used for comparative purposes, including estimating shark catches based on target species catches, generating catch estimates from shark fin trade data, from transhipment data and from shark catch rates and effort. These alternative catch estimates should be presented at future sessions of the WPEB for review and incorporation within the IOTC DB. In addition methods to estimate catches after 2011 need to be developed as the trade data is only reliable to 2011.

172. The WPEB **NOTED** that in the Indian Ocean there are more uncertainties than in other Oceans as there is less information on the fishery and biology. This information gap needs to be addressed with studies that address these critical uncertainties.

8.3 Development of management advice for blue shark and update of the Executive Summary for the consideration of the Scientific Committee

173. The WPEB **ADOPTED** the management advice developed for blue shark in IOTC fisheries for tuna and tuna-like species, as provided in the draft resource stock status summary and **REQUESTED** that the IOTC Secretariat update the draft stock status summary for blue shark with the latest 2014 catch data (if applicable), and for the summary to be provided to the SC as part of the draft Executive Summary, for its consideration:
    - Blue sharks (*Prionace glauca*) – Appendix IX

9. OTHERS SHARKS AND RAYS

9.1 Review new information on other shark and ray biology, stock structure, bycatch mitigation measures, fisheries and associated environmental data

9.1.1 Value chain analysis: Madagascar shark fisheries

174. The WPEB **NOTED** paper IOTC–2015–WPEB11–17 which provided a preliminary value chain analysis of shark fisheries in Madagascar, including the following abstract provided by the authors:
"*Madagascar's extensive (~6,500 km) coastline comprises the most diverse and extensive shallow marine habitats in the Western Indian Ocean, supporting an estimated 123 shark and ray species. Sharks have featured in Madagascar's fisheries for at least 100 years, with exports recorded as early as the 1920's. Globally, shark fins are one of the most highly valued seafood items and represent a critical and significant source of cash for some of Madagascar's isolated fishing communities. The global shark fin trade is estimated to be worth between US$400-500 million a year. Increases in the shark trade over the last two decades is closely linked to economic growth in China, where the market is concentrated, and the ripple effects of this increase in demand have been felt worldwide. Scientific estimates for the number of sharks killed annually can be up to 100 million individuals and sharks are on the whole overexploited. Today, thirty percent of all shark and ray species are now classified as Threatened' or 'Near Threatened' with extinction according to the IUCN Red List, although this number is likely to be higher given that the status of almost half (47%) of shark species cannot be scientifically assessed due to a lack of data.*" *– (see paper for full abstract)*

175. The WPEB **AGREED** that the value chain analysis undertaken by the authors, was a useful addition to the work of the WPEB, especially as socio-economic studies have largely been neglected in the past.

176. The WPEB **WELCOMED** the work on the reconstruction of shark catches in the Madagascar waters and **ENCOURAGED** further effort focused on historical shark catch reconstruction.

177. The WPEB **NOTED** that:
    - There is a substantial amount of sharks estimated to be caught by IUU vessels in Madagascar waters.

- Gillnets of a length from 2.5 to 7 kms are frequently used within the Madagascar EEZ, and more specifically in the Mozambique channel.

178. The WPEB **REQUESTED** that once the shark catch history reconstruction is complete, that the authors share it with the IOTC Secretariat and WPEB for addition to the overall IOTC database for shark catches. Similarly, the WPEB **ENCOURAGED** all IOTC CPCs to undertake similar shark catch reconstructions and report to the IOTC Secretariat in 2016.

9.1.2 Sri Lanka shark fisheries

179. The WPEB **NOTED** paper IOTC–2015–WPEB11–18 Rev_1 which examined the impact of policies on the conservation of sharks in the large pelagic fishery, including the following abstract provided by the authors:

"*Sharks are of great commercial importance in the marine fisheries sector in Sri Lanka. They are taken in large quantities for human consumption, especially to obtain shark fins, which is an export oriented product and to a lesser extent for the extraction of liver oil. Though pelagic shark catches are incidental to or a by-catch of fisheries mainly targeting tuna in Sri Lanka, sharks are mostly harvested for their fins.*

The annual shark production has been estimated at 4392, 3177, 1828 and 1611 MT respectively in 2011, 2012, 2013 and 2014." *– (see paper for full abstract)*

180. The WPEB **NOTED** that the paper provided information on landings so the discarded quantities are unknown.

181. The WPEB **NOTED** the difficulties with the identification of landed sharks which are not whole and **ACKNOWLEDGED** the usefulness of shark identification cards in their sampling programme.

9.1.3 Common thresher shark: Presence in the Indian Ocean

182. The WPEB **NOTED** paper IOTC–2015–WPEB11–19 which examined whether the common thresher shark (*Alopias vulpinus*) occur in the tropical Indian Ocean, including the following abstract provided by the authors:

"*Presence of common thresher shark Alopias vulpinus in the tropical Indian Ocean is questioned referring to absence of validated recent occurrences and doubtful observations in the past. Collection of georeferenced morphological data with simultaneous photo documentation and genetic sampling is suggested as a solution to resolve uncertainties in Alopiid species distribution, occurrence and abundance.*"

183. **NOTING** that *Alopias vulpinus* is unlikely to occur in tropical regions of the Indian Ocean, but is yet to be confirmed, the WPEB **ENCOURAGED** cooperation among CPCs for genetic and photo sampling in order to document any occurrence of *Alopias vulpinus* in these areas.

184. The WPEB **RECALLED** that any sampling program of thresher sharks must first be received and then approved by either the WPEB or by the Scientific Committee, as detailed paragraph 7 of IOTC Resolution 12/09 which states:

Para. 7. "*Scientific observers shall be allowed to collect biological samples (vertebrae, tissues, reproductive tracts, stomachs, skin samples, spiral valves, jaws, whole and skeletonised specimens for taxonomic works and museum collections) from thresher sharks that are dead at haulback, provided that the samples are part of the research project approved by the IOTC Scientific Committee (or IOTC Working Party on Ecosystems and Bycatch (WPEB)). In order to obtain the approval, a detailed document outlining the purpose of the work, number and type of samples intended to be collected and the spatio-temporal distribution of the sampling work must be included in the proposal. Annual progress of the work and a final report on completion of the project shall be presented to the IOTC WPEB and the IOTC Scientific Committee*."

9.1.4 Madagascar shark fisheries

185. The WPEB **NOTED** paper IOTC–2015–WPEB11–21 Rev_1 which detailed shark catch characteristics for Malagasy longliners from 2010 to 2014, including the following abstract provided by the authors:

"*From 2010 to 2014, Malagasy national fleet deployed on average 7 longliners less than 24 meters operating in the eastern part of Madagascar's EEZ. They deploy 800 to 1300 hooks per set and do short cruises of 4 to 7 days to maintain their catch fresh. The main targeted species are tuna and swordfish but some billfish species and sharks are taken as bycatch. The evolution of shark catch by these longliners in recent years (from 2010 to 2014) is presented in this paper. The data have been collected from the catch declarations by the fishing companies. The total fish catch of the longliners is estimated at 1772 tons since 2010 with an average of 443 tons per year. The largest proportion of catches concerns the targeted species, primarily tunas (45%), then billfish (20%). Sharks represented 13% of catches. Note that the trend of total catch is decreasing since 2010, the same for sharks from 85 tons in 2010 to 45 tons in 2014. However, during the last for years, the catch per unit effort (CPUE) has been globally increased.*" *– (see paper for full abstract)*

186. The WPEB **REQUESTED** that the authors provide additional information on targeting, and tuna and billfish species catch composition in future analysis in order to better understand shark catch levels reported as bycatch.

187. The WPEB **NOTED** that Madagascar currently does not collect information on shark species at landing sites. However there are plans to improve port sampling activities in the coming year with one aim of improving the quality of species identification and catch data.

188. The WPEB **ENCOURAGED** Madagascar to incorporate data collected by observers in their analysis to extend the assessment of impacts on the local longline fishery on bycatch species.

9.1.5 Oceanic whitetip shark purse seine catches

189. The WPEB **NOTED** paper IOTC–2015–WPEB11–29 which detailed interactions of oceanic whitetip sharks with the tuna purse seine fisheries in the Indian Ocean, including the following abstract provided by the authors:
"*The interaction between Oceanic whitetip sharks (OCS) and the purse seine fishery in the western Indian Ocean was analyzed, in order to investigate the potential of using this fishery's database to derive abundance indexes and determine population trends for the species. Observer data from the French purse seine fleet combined with a historic database from the Soviet Union were used in the analyses. The combined time series spanned from 1986 to 2014. A well-marked change on the proportion of Fishing Aggregating Devices (FADs) with the presence of oceanic whitetip sharks was observed, fluctuating around 20% from mid 80's to mid 90's and dropping to less than 10% as from 2005.*" *– (see paper for full abstract)*

190. The WPEB **ENCOURAGED** the authors to continue this study, in particular to make attempts to include numbers of sharks into modelling approaches, and to make an attempt to develop indicators of oceanic whitetip shark population abundance that could be useful for the assessment purposes in the future.

9.2 Review of new information on the status of other sharks

9.2.1 Nominal and standardised CPUE indices

191. The WPEB **NOTED** that as no new CPUE indices for other sharks were presented in 2015, in accordance with the Program of Work.

9.2.2 Selection of Stock Status indicators for other sharks

192. The WPEB **AGREED** that as no new information was presented for other shark species in 2015, that previous indicators (if any), as well as the most recent catch estimates would be used to update the management advice from last year.

9.3 Development of management advice on the status of other shark stocks and update of other shark species Executive Summaries for the consideration of the Scientific Committee

193. The WPEB **ADOPTED** the management advice developed for a subset of other shark species commonly caught in IOTC fisheries for tuna and tuna-like species, as provided in the draft resource stock status summaries and **REQUESTED** that the IOTC Secretariat update the draft stock status summary for sharks with the latest 2014 catch data (if applicable), and for the summary to be provided to the SC as part of the draft Executive Summary, for its consideration:
    - Oceanic whitetip sharks (*Carcharhinus longimanus*) – Appendix X
    - Scalloped hammerhead sharks (*Sphyrna lewini*) – Appendix XI
    - Shortfin mako sharks (*Isurus oxyrinchus*) – Appendix XII
    - Silky sharks (*Carcharhinus falciformis*) – Appendix XIII
    - Bigeye thresher sharks (*Alopias superciliosus*) – Appendix XIV
    - Pelagic thresher sharks (*Alopias pelagicus*) – Appendix XV

10. OTHER BYCATCH AND BYPRODUCT SPECIES INTERACTIONS

10.1 Review new information on other bycatch and byproduct, in terms of biology, ecology, fisheries interactions and bycatch mitigation measures

10.1.1 Data and reporting requirements

194. The WPEB **RECALLED** the IOTC Resolutions relevant to marine turtle species (notably Resolutions 15/01, 15/02 and 12/04), including the data recording and reporting (Table 14) requirements by which Contracting Parties and Cooperating Non-Contracting Parties (CPCs) are required to collect and report all marine turtle interaction data.

TABLE 14. IOTC data collection and reporting requirements for marine turtles.

Resolution	Paragraph
IOTC Resolution 12/04: *On Marine Turtles*	Paragraph 3: CPCs shall collect (including through logbooks[1] and observer programs[*schemes*]) and provide to the IOTC Secretariat no later than 30 June of the following year in accordance with Resolution 10/02 [*superseded by 15/02*] (or any subsequent revision), all data on their vessels' interactions with marine turtles. The data shall include the level of logbook or observer coverage and an estimation of total mortality of marine turtles incidentally caught in their fisheries.

[1]Discard data from logbooks should be submitted to the IOTC Secretariat formally as required according to IOTC reporting procedures based on the requested fisheries statistics and data submission forms that can be found on the IOTC website: www.iotc.org/data/requested-statistics-and-submission-forms

195. The WPEB **AGREED** that the lack of data from CPCs on interactions and mortalities of marine turtles in the Indian Ocean is a substantial concern, resulting in an inability of the WPEB to estimate levels of marine turtle bycatch. There is an urgent need to quantify the effects of fisheries for tuna and tuna-like species in the Indian Ocean on marine turtle species, as required by Resolution 12/04, and it is clear that little progress on obtaining and reporting data on interactions with marine turtles has been made. This data is necessary to allow the IOTC to respond and manage the adverse effects on marine turtles, and other bycatch species.

196. The WPEB **RECALLED** that, in accordance with Resolution 12/04, paragraph 6, CPCs are obliged to ensure that fishers are aware of and use proper mitigation, identification, handling and de-hooking techniques. Furthermore, it is mandatory that vessels keep onboard all necessary equipment for the release of marine turtles, in accordance with handling guidelines in the *IOTC Marine Turtle Identification Cards*. Appropriate equipment for longliners includes line cutters, dehooking devices and dipnets for safely bringing marine turtles onboard.

197. The WPEB **AGREED** that for future sessions of the WPEB where marine turtles are a focus species, the Chairperson, Vice-Chairperson and IOTC Secretariat should solicit more papers on marine turtle catch mitigation techniques for gillnets (i.e. concerning bycatch mitigation measures under investigation or use in the Indian Ocean and other regions), with a view to developing further technical advice for the SC.

10.2 Review of new information on the proposed retention of non-target species by various gears

198. The WPEB **NOTED** that no progress was made on this item. For progress to be made. For progress to be made, funds allocated from the Commission's regular budget or sourced externally will be needed.

10.3 Marine turtles

10.3.1 Review new information on marine turtle biology, ecology, fisheries interactions and bycatch mitigation measures

Proceedings of the regional symposium on sea turtle conservation in Asia

199. The WPEB **NOTED** paper IOTC–2015–WPEB11–31, the proceedings of the regional symposium on sea turtle conservation in Asia, including the following abstract provided by the authors:

"*There are a number of threats being faced by a dwindling population of marine turtles in Pakistan, of which entanglement in various fishing gears is considered to be the most serious threat. In order to enumerate the extent of mortality and to devise a strategy to reduce interaction of turtles with fishing operations, a study was initiated in October 2012. Monitoring of fishing operations was done in coastal and offshore areas of Pakistan which revealed that in the pelagic gillnet operations in the offshore water maximum numbers of turtles get enmeshed resulting in mortality in some cases. It is heartening that the majority of such turtles survived enmeshment. Mortality was observed only in 3 % cases which is mainly because of the poor heaving process and improper handling onboard fishing vessels. A study on seasonal variation of entanglement in the offshore gillnets fisheries revealed a bimodal pattern. A major peak of entanglement was noticed during October-December with the maximum in November.*" *– (see paper for full abstract)*

Marine turtle mitigation measure effectiveness in tuna longline fisheries

200. The WPEB **NOTED** paper IOTC–2015–WPEB11–32 which described a planned workshop for joint analysis of marine turtle mitigation options for longline fisheries, including the following abstract provided by the authors:

"*An analysis of mitigation options for tuna longline bycatch of marine turtles will be launched in late 2015 by the Secretariat of the Pacific Community (SPC) with funding provided by the ABNJ (Common Oceans) Tuna Project. IOTC members are invited to contribute relevant data on a voluntary basis in order to construct a comprehensive, and if possible multi-ocean, dataset for analysis. Similar to the shark mitigation analysis conducted by SPC in 2014-2015, this analysis will quantitatively assess the potential for a variety of mitigation measures (e.g. changes in gear designs and fishing methods) to reduce mortality and injury, either singly or in combination. The first stage of the analysis will focus on characterizing baseline marine turtle*

interaction and mortality rates under existing fishing operations. A data preparatory workshop is planned to facilitate compilation and interpretation of national datasets, with special procedures developed for sharing of data for which there may be confidentiality concerns." – *(see paper for full abstract)*

201. The WPEB **NOTED** that an analysis of mitigation options for tuna longline bycatch of marine turtles will be launched in late 2015 by the Secretariat of the Pacific Community (SPC) with funding provided by the Common Oceans (ABNJ) Tuna Project. IOTC members are invited to contribute relevant data on a voluntary basis in order to construct a comprehensive, and if possible multi-ocean, dataset for analysis. Similar to the shark mitigation analysis conducted by SPC in 2014–15, this analysis will quantitatively assess the potential for a variety of mitigation measures (e.g. changes in gear designs and fishing methods) to reduce mortality and injury, either singly or in combination.

202. The WPEB **NOTED** that:
    - the first stage of the analysis will focus on characterising baseline sea turtle interaction and mortality rates under existing fishing operations. A data preparatory workshop is planned to facilitate compilation and interpretation of national datasets, with special procedures developed for sharing of data for which there may be confidentiality concerns;
    - the second stage of analysis, to be finalised in a second workshop, will alter the baseline scenario to explore various mitigation options, and if possible, combine these with estimates of absolute impacts, to determine whether any of the simulated mitigation schemes would be able to reduce any unacceptable impacts to marine turtle populations to acceptable levels;
    - the analysis will be coordinated with an ongoing NOAA study of marine turtle mitigation in Pacific and Atlantic fisheries in order to broaden the geographic scope of the findings. This study will inform Pacific bycatch management discussions as well as demonstrate methods and indicative results for other regions.

203. **NOTING** the invitation to all IOTC CPCs to consider participating in the workshop and contributing relevant data on sea turtle interaction and mortality rates, the WPEB **ENCOURAGED** all CPCs interested to contact the authors directly to discuss participation and contributions accordingly. SPC expects to announce further details of the first workshop, planned for February 2016, in the last quarter of 2015 at which time participants in the workshop will be confirmed and available funding for developing country representatives will be allocated.

Marine turtle bycatch in the tuna gillnet fisheries of Pakistan

204. The WPEB **NOTED** paper IOTC–2015–WPEB11–47 which provided an assessment of marine turtle bycatch in the tuna gillnet fisheries of Pakistan, including the following abstract provided by the authors:
"*Gillnets are commonly used to capture tuna in the continental shelf and oceanic waters off Pakistan. The tuna gillnet fleet consists of about 500 vessels that operate in the offshore waters of Pakistan and beyond its EEZ. Limited information was previously available on the incidence of sea turtle bycatch in the tuna gillnet fishery in this region. In order to assess the magnitude of sea turtle bycatch off Pakistan, four skippers were trained by WWF as observers on four tuna gillnet vessels to document sea turtle bycatch over 30 consecutive months from January 2013 to June 2015. Over the course of the sampling, 600 sea turtle bycatch events were recorded at a rate of 8.44 per km 2 of net over the study duration. Observed mortality (i.e. dead turtles upon hauling) accounted for 10% of the total caught turtles in the four vessels in the reported period. 90% of the turtles were released alive in apparent good condition. The olive ridley sea turtle (Lepidochelys olivacea) accounted for 68.8% of captures (n = 178), followed by the green turtle (Chelonia mydas, 29.6%, n = 178), and the hawksbill turtle (Eretmochelys imbricata, 1.5%, n=9).*"

205. The WPEB **NOTED** that the study provided useful information and although the authors were not present, asked that the work continue and an update be presented at the WPEB in 2016.

10.3.2 Review of mitigation measures in Resolution 12/04

206. The WPEB **NOTED** paragraph 11 of IOTC Resolution 12/04 states:
(para. 11) The IOTC Scientific Committee shall request the IOTC Working Party on Ecosystems and Bycatch to:
    a) Develop recommendations on appropriate mitigation measures for gillnet, longline and purse seine fisheries in the IOTC area;
    b) Develop regional standards covering data collection, data exchange and training;
    c) Develop improved FAD designs to reduce the incidence of entanglement of marine turtles, including the use of biodegradable materials.

10.3.3 Development of management advice on the status of marine turtle species

207. The WPEB **ADOPTED** the management advice developed for marine turtles, as provided in the draft status summary and **REQUESTED** that the IOTC Secretariat update the draft stock status summary with the latest 2014

interaction data, and for the summary to be provided to the SC as part of the draft Executive Summary, for its consideration:

- Marine turtles (Appendix XVI).

10.4 Seabirds

10.4.1 Review new information on seabird biology, ecology, fisheries interactions and bycatch mitigation measures

Reporting of seabird bycatch in longline fisheries

208. The WPEB **NOTED** paper IOTC–2015–WPEB11–33 Rev_1 which highlighted a need for improved reporting on seabird bycatch in the longline fishery, including the following abstract provided by the authors:
"*The National Reports produced by CPCs between 2011 and 2014 were reviewed to determine if the reporting requirements by CPCs reflect the objectives of relevant resolutions. Resolution 10/06 is the relevant resolution against which CPCs reported; this was superseded in 2012 by Resolution 12/06, but mandatory implementation of 12/06 only came into force on 1 July 2014. Specifically we tested if National Reports allow the assessment of seabird bycatch levels. CPCs were generally compliant, with compliance in reporting improving between 2011 and 2014, with the exception of three CPCs that had very poor reporting for seabird interactions. The lack of a structured reporting format resulted in information provided by CPCs being non-standardised, the effect of which is that the objectives of Resolution 12/06 are met inadequately. We propose an approach based on that currently used within the CCSBT, where CPCs are required to report on fishing effort, observer coverage, and seabird bycatch and interactions south of 25°S in their national reports.*" – *(see paper for full abstract)*

209. **NOTING** the need to improve the provision of seabird bycatch and associated information in IOTC National Reports to the Scientific Committee, the WPEB **AGREED** that it would be useful to trial the use of a slightly modified summary table, as proposed in paper IOTC–2015–WPEB11–33 Rev_1 with information from some CPCs fishing south of 25°S.

210. The WPEB **NOTED** that the following countries have reported longline fishing activities in the area of 25S; EU-France, EU,Portugal EU,Spain, EU,UK, Malaysia, Mauritius, South Africa, Seychelles, China, Australia, Rep. of Korea, Taiwan,China and Japan.

211. The WPEB **REQUESTED** that BirdLife International should work intersessionally with interested CPCs and the IOTC Secretariat to prepare a summary table (example below) that can be presented to the next meeting of the SC for their consideration and discussion. Completing such a summary table would not replace the need for CPCs to formally submit data to the IOTC Secretariat as required by IOTC Resolutions.
Example table: Summary seabird bycatch

Fishery	**Observed**				
Year					
Area[1]	Total effort[2] (#hooks/sets)	Total hooks[2] /sets observed hauled	Captures (number)[3]	Mortalities (number)	Live releases (number)
Total					

[1]Spatial stratification (following CCSBT statistical areas)
[2]Effort should preferentially be provided in number of hooks, or sets where this is not possible
[3]By species/groups wherever possible

New approaches for better understanding seabird bycatch in tuna longline fisheries

212. The WPEB **NOTED** paper IOTC–2015–WPEB11–34 which outlined new approaches for better understanding seabird bycatch in tuna longline fisheries, including the following abstract provided by the authors:
"*BirdLife International, through its local partner BirdLife South Africa, is implementing the seabird bycatch component of the FAO's GEF-funded Common Oceans Programme for tuna fisheries. Through this project, BirdLife proposes to hold a joint tuna RFMO meeting, under the banner of the Kobe Process, which would use a collaborative approach to undertake a global assessment of the impact of tuna RFMO seabird bycatch conservation measures. In addition, through the Common Ocean programme, BirdLife intends to support a collaborative approach to building capacity and expertise among national scientists in terms of analysis and reporting on bycatch matters to RFMOs, and to create a forum for these scientists to help develop analytical tools and implement these. Both processes are aimed at strengthening national capacity to manage and assess*

bycatch within national fleets, and to either harmonise approaches or identify new approaches to analysing and reporting on seabird bycatch across RFMOs."

213. The WPEB **RECOGNISED** the trans-oceanic nature of many seabird species, which necessitates evaluation of bycatch levels and the effectiveness of mitigation measures across ocean basins and through collaboration with other tuna RFMOs.

214. The WPEB **AGREED** that, in addition to the formal review of Resolution 12/06 (scheduled for 2016), it is important to conduct a wider-scale (other than the IOTC area of competence) assessment of the impacts of fisheries on seabirds, and **SUPPORTED** the proposal to work towards a collaborative assessment across tuna RFMOs. This should be progressed in a step-wise manner.

215. The WPEB **NOTED** that BirdLife International will hold a series of workshops regarding seabird bycatch estimation in 2016/17, for which funding is available through the GEF Common Oceans Programme to support participation by national scientists and experts. The primary aim of these workshops is to build capacity and collaboration amongst national scientists in the collection, curation and analysis of seabird bycatch data, to support the development of common approaches in the assessment and monitoring of seabird bycatch, and the implementation of a joint-tuna RFMO seabird bycatch assessment.

216. The WPEB **AGREED** that the proposed capacity building process would be a useful mechanism and formal announcement of these workshops to CPCs will be done through the IOTC Secretariat and the WPEB Chairperson. For the success of the capacity building meeting, the workshop conveners will work closely with relevant CPCs and the IOTC Secretariat, including through the chairperson of WPEB.

217. The WPEB **REQUESTED** that relevant CPCs and the IOTC Secretariat, including through the chairperson (or his/her delegate) of the WPEB, participate actively in the national scientist capacity building process, and in the implementation of a joint-tuna RFMO seabird bycatch assessment.

ACAP summary advice: Longline impacts on seabirds

218. The WPEB **NOTED** paper IOTC–2015–WPEB11–35 which detailed the ACAP summary advice for reducing the impact of pelagic longline fishing on seabirds, including the following abstract provided by the authors:
"*A combination of weighted branch lines, bird scaring lines and night setting are best practice mitigation in pelagic longline fisheries. These measures should be applied in areas where fishing effort overlaps with seabirds vulnerable to bycatch to reduce the incidental mortality to the lowest possible levels. Other factors such as safety, practicality and the characteristics of the fishery should also be recognised. Currently, no single mitigation measure can reliably prevent the incidental mortality of seabirds in most pelagic longline fisheries. The most effective approach is to use the above measures in combination.*"

219. The WPEB **AGREED** that the three mitigation measures listed in Resolution 12/06 are consistent with ACAP's current best practice advice. New technologies that set or release baited hooks at depth or disarm hooks to specific depths, are currently being assessed. Work to assess the relative efficacy of different line weighting options and specifications, and safety issues relating to their use, is ongoing. The outcome of these, and other initiatives, will form part of the ACAP review process at its next meeting, which is due to take place in May 2016. It would be useful to have the updated advice and other relevant information presented at its 2016 meeting.

Estimation of seabird bycatch rates and numbers

220. The WPEB **NOTED** paper IOTC–2015–WPEB11–36 which provided an estimation of seabird bycatch rates and numbers, including the following abstract provided by the authors:
"*There is a range of methods that have been used to estimate and monitor levels of seabird bycatch in fisheries. Inevitably, the assessment methods are dependent on the quantity and quality of data available, as well as the specific objectives of the review. Where there is 100% observer coverage, bycatch should be completely observed, and there is no need for extrapolation. However, in most situations, observer coverage is substantially lower, and extrapolation of bycatch from observed fishing effort to total fishing effort is required. Within IOTC and the other tuna RFMOs, analysis and monitoring of seabird bycatch levels over time will most likely include a) bycatch rates per unit fishing effort (e.g. birds per 1000 hooks) and the total number of birds killed. The Seabird Bycatch Working Group of the Agreement on the Conservation of Albatrosses and Petrels (ACAP) is currently undertaking work to identify guidelines on methodologies for estimating bycatch in both data-rich and data-poor scenarios.*" – *(see paper for full abstract)*

221. The WPEB **AGREED** that this work is of relevance to IOTC's review of the seabird conservation measure, Resolution 12/06.

222. The WPEB **NOTED** that the ACAP process would focus initially on ACAP countries, but that it is intended that the guidelines would be more broadly applicable and hopefully help facilitate a wider-scale assessment of seabird bycatch.

223. The WPEB **AGREED** that the bycatch indicators proposed (bycatch rates, and total number of birds killed) would be useful candidate indicators for the review of Resolution 12/06, and that a number of different methods should be tested and compared to derive estimates for these indicators.

Seabird bycatch mitigation measures evaluation

224. The WPEB **NOTED** paper IOTC–2015–WPEB11–37 Rev_1 which provided a preliminary analyses and evaluation of the effects of the newly employed seabird bycatch regulation for longline fisheries in IOTC conventional area with using current observer data, including the following abstract provided by the authors:

"*The new seabird mitigation regulation was enforced in July 2014 in the area south of 25S in IOTC convention area. It demand for fisheries to adopt two of three mitigation measures of tori-line, night setting and blanch line weighting which have high effectiveness for mitigation of seabird bycatch (Melvin et al. 2014, Sato et al. 2014). In this document, Japanese seabird by catch data in the south Indian Ocean (south of 25S) collected by on-board observers in the period before and after the introduction of the new regulation were reviewed, to explore the possibility to evaluate the effectiveness of the new mitigation measures. It seems that the distribution of the observer data collected form almost main fishing areas of Japanese longliners in the period analyzed. The observer data indicated that many Japanese tuna longline vessel (71-94%) had already adopted the combination use of weighting blanch line and Tori line or night setting and Tori line before the introduction of regulation (2012 - 2013).*" *– (see paper for full abstract)*

225. The WPEB **COMMENDED** Japan for the study and encouraged other CPCs to conduct similar analyses, ether by itself or collaboratively, and present the results to the WPEB.

226. The WPEB **NOTED** that the preliminary results suggest that the mitigation measures required in Resolution 12/06 have contributed to reducing seabird bycatch in the Japanese longline fleet. Seabird abundance at the stern of the vessel during setting was an important factor contributing to bycatch levels. The importance of this factor likely confounded the assessment of the relative efficacy of using one versus two tori lines because Japanese fishers often increase the number of tori lines from one to two when seabird abundance increases.

DNA identification for the southern albatross

227. The WPEB **NOTED** paper IOTC–2015–WPEB11–38 Rev_1 which detailed progress of the development of the DNA identification for the southern albatross bycatch in longline fishery, including the following abstract provided by the authors:

"Species identification by external anatomy or physical appearance of albatrosses in the southern hemisphere is often difficult because the species groups show considerable overlap in both plumage score and morphology (Cuthbert et al. 2003). Therefore we investigated a molecular biological approach for the taxonomy of those species. Firstly, a sampling protocol was developed for an observer to easily collect the necessary samples. Secondly, species or species group identification was performed using photographs. And thirdly, Alderman's method (Alderman 2003), using RFLP methods, was employed for two different types of samples: known species and known species group. The DNA taxonomy method needs to be relatively inexpensive and simple as it needs to be used by several countries with different technical resources. Using Alderman's RFLP method seven of 13 species in this study could be identified. We also suggest some improvements are required such as (1) the need to differentiate some of the wandering albatross group species by visual identification by electrophoresis, (2) quantifying intraspecific polymorphism in the grey-headed albatross, and (3) assessing levels of intraspecific polymorphism in Atlantic yellow-nosed albatrosses."

228. The WPEB **RECOGNISED** the value of the study, and that currently there remain some limitations that need to be addressed before this approach can be considered an effective and practical tool for the identification of all seabirds killed incidentally in fishing operations.

229. The WPEB **ENCOURAGED** Japanese scientists to continue their collaborative efforts in this regard and that any progress be presented at future WPEB meetings.

230. The WPEB **NOTED** that the Seabird Bycatch Identification guide prepared by ACAP in collaboration with the Japanese Fisheries Research Agency has recently been published, and can be downloaded from the ACAP website: http://www.acap.aq/en/bycatch-mitigation. The guide is intended for use at sea by fisheries observers to assist in the identification of albatrosses and some commonly caught petrels and shearwaters brought aboard after being killed in longline operations. The guide also outlines protocols for taking photographs of dead seabirds, and the collection of feather samples for DNA analysis.

Data and reporting requirements

231. The WPEB **NOTED** that there continues to be very limited information on interactions with seabirds available in the IOTC Secretariat's databases for most longline fleets and for all gillnet fleets that operate in the Indian Ocean.

232. The WPEB **RECALLED** each of the IOTC Resolutions relevant to seabirds (notably Resolutions 15/02 and 12/06, including the recording and reporting requirements (Table 15). Contracting and Cooperating Non-Contracting Parties (CPCs) are required to collect and report incidental bycatch of seabirds.

TABLE 15. IOTC data collection and reporting requirements for seabirds.

Resolution	Paragraph
IOTC Resolution 12/06: *On reducing the incidental bycatch of seabirds in longline fisheries*	Paragraph 1 (start): CPCs shall record data on seabird incidental bycatch by species, notably through scientific observers in accordance with Resolution 11/04 and report these annually. Paragraph 2: CPCs that have not fully implemented the provisions of the IOTC Regional Observer Scheme outlined in paragraph 2 of Resolution 11/04 shall report seabird incidental bycatch through logbooks, including details of species, if possible[1]. Paragraph 3: CPCs shall provide to the Commission as part of their annual reports, information on how they are implementing this measure.

[1]Discard data from logbooks should be submitted to the IOTC Secretariat formally as required according to IOTC reporting procedures based on the requested fisheries statistics and data submission forms that can be found on the IOTC website: www.iotc.org/data/requested-statistics-and-submission-forms

10.4.2 Review of seabird mitigation measures in Resolution 12/06

233. The WPEB **NOTED** that the Scientific Committee has requested that the WPEB analyse the impact of Resolution 12/06 on seabird bycatch no later than 2016.

234. The WPEB **RECOMMENDED** that CPCs with significant fishing effort south of 25°S to undertake their own assessments on the levels and nature of implementation of Resolution 12/06 by their fleets, and present papers, similar to that presented in paper IOTC–2015–WPEB11–37 Rev_1, to the WPEB meeting in 2016.

235. The WPEB **RECOMMENDED** that CPCs bring data to the WPEB meeting in 2016, as the Commission via Resolution 12/06 required the WPEB and SC to undertake this task in 2015, which has not been possible due to insufficient data, and that a collaborative analysis of the impacts of Resolution 12/06 be undertaken during the WPEB meeting, if feasible. CPC review papers and datasets should include the following information/data from logbooks and/or observer schemes, where appropriate and should cover the period 2011 to 2015:
    - Total effort south of 25°S by area and time, at the finest scale possible
    - Observed effort south of 25°S by area and time, at the finest scale possible
    - Observed seabird mortality rates south of 25°S by area and time, at the finest scale possible
    - Descriptions of fleet structure /target species by time and area, and an indication of observer coverage per fleet/target species for effort south of 25°S
    - Data on which seabird bycatch mitigation measures were used, on a set-by-set/cruise basis if possible or per vessel, or at the finest scale possible
    - Descriptions of the specifications of seabird bycatch mitigation measures used according to the fields in the Regional Observer Scheme manual and in relation to the specifications given in Res 12/06

10.4.3 Development of management advice on the status of seabird species

236. The WPEB **ADOPTED** the management advice developed for seabirds, as provided in the draft status summary and **REQUESTED** that the IOTC Secretariat update the draft stock status summary with the latest 2014 interaction data, and for the summary to be provided to the SC as part of the draft Executive Summary, for its consideration:
    - Seabird (Appendix XVII).

10.5 Marine mammals

10.5.1 Review new information on marine mammal biology, ecology, fisheries interactions and bycatch mitigation measures

Cetacean depredation on tuna longline fisheries (La Reunion)

237. The WPEB **NOTED** paper IOTC–2015–WPEB11–43 Rev_1 which detailed the results of a preliminary study of cetacean depredation on pelagic longline fisheries using passive acoustic monitoring off Reunion Island, including the following abstract provided by the authors:

"*Depredation can be defined as the predation of caught fish or bait by free-ranging animals. Since the 1900s, depredation of Reunion's longline fishery by toothed whales is known to contribute significantly to reduced commercial catch (sometimes destroying 100% of the catch). Describing depredation by cetaceans is a key driver in helping implement non-destructive adaptive fishing solutions. With fishing mainly occurring at night and over long distances, passive acoustic monitoring is a promising method. A preliminary study was launched to determine the technical feasibility accompanied by acoustic analysis of associated with depredation. Over two months (November- December 2014), 3 autonomous hydrophones (HTI-96-MIN) were attached at the extremities and central section of a 30 km longline for 9 fishing operations, 30 miles off*

Reunion Island. A total of 387 hrs of sound were recorded and analyzed. Biological sounds (clicks and whistles) and physical sounds were quantified over time with two automatic-methods in relation to recorder locations." – (see paper for full abstract)

238. The WPEB **ENCOURAGED** the constitution of a database of local acoustic reference signatures (whistles, clicks) for the Indian Ocean marine mammals since the only available references come from the other oceans.

239. **NOTING** that the use of hydrophones to identify the presence of marine mammals might be used to mitigate depredation on longlines, the WPEB **ENCOURAGED** further studies on depredation animal behaviour.

Indicators of depredation on tuna longline fisheries (La Reunion)

240. The WPEB **NOTED** paper IOTC–2015–WPEB11–44 Rev_1 which outlined indicators of depredation impacting Reunion Island pelagic longline fishery, including the following abstract provided by the authors:
"*Depredation is defined as the damage or removal of fish from fishing gear by predators. Depredation raises concerns about the conservation of marine protected species involved, fisheries yield and profitability, as well as stock assessment of target species. There is an obvious lack of knowledge about depredation impacting pelagic longline fisheries, especially in the southwest Indian Ocean. Thus, there is a real need for the development of accurate indicators to assess its impact in a given fishery. In Reunion Island, pelagic longliners targeting swordfish (Xiphias gladius) and tuna (Thunnus spp.) are affected by depredation from short-finned pilot whale (Globicephala macrorhynchus), false killer whale (Pseudorca crassidens) and various pelagic sharks. Catch and depredation data collected during self-reporting, commercial and experimental cruises between 2007 and 2015 were used to calculate depredation indicators such as the depredation occurrence (Interaction Rate), the proportion of fish depredated among the overall catch (Gross Depredation Rate), the average proportion of fish depredated per depredated set (Damage Rate) and the number of fish depredated per 1000 hooks (Depredation Per Unit Effort).*" – (see paper for full abstract)

241. The WPEB **NOTED** an uncertainty in identification of predators, however, empirical knowledge of fishers allows them to identify group of predators with certain precision.

242. **NOTING** the development of indicators for depredation, the WPEB **ENCOURAGED** CPCs to use standard indicators for depredation and develop standard templates for data collection on depredation.

243. The WPEB **NOTED** that an economic study on the impact of depredation of Reunion Island longline fishery including fish loss and running costs will be undertaken in the near future and results presented to the subsequent WPEB meeting.

Depredation and incidental catches in longline fishery of southern Mozambique

244. The WPEB **NOTED** paper IOTC–2015–WPEB11–45 Rev_1 which provided a summary of depredation and incidental catches in longline fishery of southern Mozambique: Preliminary information on ecosystem issues based on observer onboard sampling, including the following abstract provided by the authors:
"In this report, the level of depredation on longline fishery of Sothern Mozambique and the level of impacts of fishery itself on sharks, seabirds, marine mammals and turtles were assessed. The report comes as a preliminary result of deployment of observers on board of Mozambique national longline fleet. Results indicated that depredation was responsible for discarding of about 13% of the total target species caught in longline fishery, which is composed by swordfish, bigeye tuna and yellowfin tuna. Generally it is suspected that sharks are the main group of predators responsible for depredation in southern Mozambique longline fishery. A total of ten shark species were caught during fishing operations, including oceanic whitetip shark, blue shark and dusky shark as the main shark species. In total sharks represented 12 % of the total catch in numbers. Another charismatic species caught during fishing operations were marine turtles. On total it was observed two leatherback turtles and one green turtle giving an estimated bycatch ratio of 0.14 per 1000 hooks." – (see paper for full abstract)

245. **NOTING** that the Mozambique longline fleet is growing and that observer work on sampling is important to collect depredation information and levels of bycatch by species, the WPEB **ENCOURAGED** Mozambique to continue to keep the coverage rate of its observer scheme not less than the minimum 5% coverage required by the IOTC.

246. **NOTING** that some oceanic whitetip sharks were retained by Mozambique artisanal longline vessels fishing inside its EEZ, the WPEB **RECALLED** the ban on retention of oceanic whitetip shark applies only to high seas fishing (outside EEZs), unless the vessels fishing within the EEZ are larger than 24 m and the fish product is not used for domestic consumption.

247. **ASSUMING** the possibility of limited awareness of Mozambique fishers on IOTC Conservation and Management Measures (CMMs), the WPEB **REQUESTED** that Mozambique distribute widely information on current IOTC CMMs focused on shark conservation.

248. The WPEB **RECALLED** Resolution 13/06 *On a scientific and management framework on the conservation of shark species caught in association with IOTC managed fisheries*, paragraph. 3, which states:
"*Notwithstanding paragraphs 1 and 2, CPCs shall prohibit, as an interim pilot measure, all fishing vessels flying their flag and on the IOTC Record of Authorised Vessels, or authorised to fish for tuna or tuna-like species managed by the IOTC on the high seas to retain onboard, tranship, land or store any part or whole carcass of oceanic whitetip sharks with the exception of paragraph 7* [retention for scientific purposes]. *The provisions of this measure do not apply to artisanal fisheries operating exclusively in their respective Exclusive Economic Zone (EEZ) for the purpose of local consumption*."

Marine mammal identification cards

249. The WPEB **AGREED** on the importance of the development of a set of species identification cards for cetaceans in the Indian Ocean and **ENCOURAGED** experts to provide assistance to lower the costs in developing the cards.

250. The WPEB **RECALLED** that there are already several cetacean species identification guides that are publically available, including the FAO World Wide Guide for the identification of marine mammals and the WIOMSA guide. Nevertheless, it was **AGREED** that these identification guides are not suitable for use on vessels as they are not waterproof and a guide specific to the Indian Ocean may be preferable to a worldwide document.

251. **RECALLING** the Scientific Committee's recommendation SC17.21 (para. 54 of the C17 Report), the WPEB **RECOMMENDED** that the SC reiterate its previous recommendation for the Commission to allocate funds in its 2016 budget, to produce and print the IOTC best practice guidelines for the safe release and handling of encircled cetaceans. The guidelines could be incorporated into a set of IOTC cetacean identification cards: "*Cetacean identification for Indian Ocean fisheries*".

10.5.2 Development of management advice on the status of marine mammal species

252. The WPEB **NOTED** that no advice in this regard was discussed at the WPEB11.

11. WPEB PROGRAM OF WORK

11.1 Revision of the WPEB Program of Work 2016–2020

253. The WPEB **NOTED** paper IOTC–2015–WPEB11–10 which provided the WPEB11 with an opportunity to consider and revise the WPEB Program of Work (2016–2020), by taking into account the specific requests of the Commission, Scientific Committee, and the resources available to the IOTC Secretariat and CPCs.

254. The WPEB **RECALLED** the request of the Scientific Committee in 2015 (SC17. para. 178) that: "*during the 2015 Working Party meetings, each group not only develop a Draft Program of Work for the next five years containing low, medium and high priority projects, but that all High Priority projects are ranked. The intention is that the SC would then be able to review the rankings and develop a consolidated list of the highest priority projects to meet the needs of the Commission. Where possible, budget estimates should be determined, as well as the identification of potential funding sources*."

255. The WPEB **NOTED** the range of research projects on ecosystems and bycatch, currently underway, or in development within the IOTC area of competence, and reminded participants to ensure that the projects described are included in their National Reports to the SC, which are due in early November 2015.

256. The WPEB **NOTED** an informal presentation from CITES, which highlighted the opportunity for collaboration between CITES and the IOTC to support CPCs that are also CITES parties in implementing the recent listing of species of shark on Appendix II of CITES, in particular oceanic whitetip shark and hammerhead sharks.

257. The WPEB **AGREED** that a small working group involving the CITES and IOTC Secretariats, the WPEB Chairperson and Vice-Chairperson shall work in the period immediately following the WPEB11 meeting to determine areas contained within the WPEB Program of Work, that could be the focus of an IOTC CITES collaboration.

258. The WPEB **RECOMMENDED** that the SC consider and endorse the WPEB Program of Work (2016–2020), as provided at Appendix XVIII.

11.2 Development of priorities for an Invited Expert/s at the next Working Party on Ecosystems and Bycatch meeting

259. The WPEB **NOTED** with thanks, the contributions of the Invited Expert for the meeting, Dr Humber Andrade and encouraged him to maintain links with IOTC scientists to aid in the improvement of approaches to assess ecosystem and bycatch issues in the IOTC area of competence.

260. The WPEB **AGREED** to the following core areas of expertise and priority areas for contribution that need to be enhanced for the next meeting of the WPEB in 2016, by the Invited Expert:

- **Expertise:** Sharks –indicator-based analysis for sharks. Seabirds: Seabird bycatch mitigation research.
- **Priority areas for contribution:** Sharks – refining the information base, historical data series and indicators for shark species for stock assessment purposes (species focus: Oceanic whitetip shark and blue shark). Seabirds: experience in seabird bycatch mitigation measure evaluation.

12. OTHER BUSINESS

12.1 Southern hemisphere stock status assessment of porbeagle shark

261. The WPEB **NOTED** that an assessment of the southern hemisphere porbeagle stock(s) will be conducted as one of the four pan-Pacific stock status assessments planned under the Common Oceans (ABNJ) Tuna Project's shark and bycatch work being coordinated by Dr Shelley Clarke at the Western and Central Pacific Fisheries Commission. The IOTC has agreed to participate as feasible, given the limited data holdings on porbeagle shark.

262. The WPEB **THANKED** the Common Oceans (ABNJ) Tuna Project for funding the participation of the Technical Coordinator-Sharks and Bycatch (Dr Shelley Clarke), **NOTING** her excellent and highly relevant contributions to the session and **REQUESTED** funding for her participation next year.

12.2 Ecosystem Based Fisheries Management (EBFM) joint meeting of tRFMOs in 2016

263. The WPEB **NOTED** that a joint meeting of tRFMOs is being planned in Rome, Italy in 2016, to consider progress in applying an ecosystem approach to fisheries management. Due to differences between fisheries among tRFMOs, management indicators may need to be very different.

264. The WPEB **AGREED** that IOTC should participate in the planned EBFM joint meeting with participation by the WPEB Chairperson (or his delegate), the IOTC Secretariat, and interested national scientists from IOTC CPCs. Participants from the IOTC shall on discussions and findings from the meeting to the WPEB in 2016.

12.3 Election of a Chairperson and Vice-Chairperson for the WPEB for the next biennium

12.3.1 Chairperson

265. The WPEB **NOTED** that the 1st term of the current Chairperson, Dr Rui Coelho (EU,Portugal) is due to expire at the closing of the current WPEB meeting and as per the IOTC Rules of Procedure (2014), participants are required to re-elect or elect a Chairperson for the next biennium.

266. **NOTING** the Rules of Procedure (2014), the WPEB **CALLED** for nominations for the position of Chairperson of the IOTC WPEB for the next biennium. Dr Rui Coelho (EU,Portugal) was nominated, seconded and re-elected as Chairperson of the WPEB for the next biennium.

12.3.2 Vice-Chairperson/s

267. The WPEB **NOTED** that the 2nd term of the current Vice-Chairperson, Dr Evgeny Romanov (La Reunion, France) is due to expire at the closing of the current WPEB meeting and as per the IOTC Rules of Procedure (2014), participants are required to elect a new Vice-Chairperson for the next biennium.

268. The WPB **THANKED** Dr Romanov for his role in supporting the Chairperson and the WPEB, over the past four years and looked forward to his continued engagement in the activities of the WPEB in the future.

269. **NOTING** the Rules of Procedure (2014), the WPEB **CALLED** for nominations for the newly vacated position of Vice-Chairperson of the IOTC WPEB for the next biennium. Mr Reza Shahifar (I.R. Iran) and Dr Ross Wanless (South Africa) were nominated, seconded and elected as Vice-Chairpersons of the WPEB for the next biennium.

270. The WPEB **RECOMMENDED** that the SC note that Dr Rui Coelho (EU,Portugal) was elected as Chairperson, and Mr Reza Shahifar (I.R. Iran) and Dr Ross Wanless (South Africa) were elected as Vice-Chairpersons of the WPEB for the next biennium, in accordance with the IOTC Rules of Procedure (2014).

12.4 Date and place of the 12th and 13th Sessions of the Working Party on Ecosystems and Bycatch

271. The WPEB **THANKED** Portugal for hosting the 11th Session of the WPEB and commended IPMA, Portugal on the warm welcome, the excellent facilities and assistance provided to the IOTC Secretariat in the organisation and running of the Session.

272. The WPEB **AGREED** on the importance of having IOTC working party meetings within key CPCs catching species of relevance to the working party. Following a discussion on who would host the 12th and 13th Sessions of the WPEB in 2016 and 2017 respectively, the WPEB **NOTED** that advice from the WPB that the IOTC Secretariat liaise with Sri Lanka to determine if they would be able to host the 12th Session, and Kenya and Indonesia if they would host the 13th Session. The WPEB should continue to be held in conjunction with the Working Party on

Billfish. The meeting locations will be communicated by the IOTC Secretariat to the SC for its consideration at its next session to be held in November 2015 (Table 16).

Table 16. Draft meeting schedule for the WPEB (2016 and 2017)

	2016			2017		
Meeting	**No.**	**Date**	**Location**	**No.**	**Date**	**Location**
Working Party on **Billfish** (WPB)	14th	1–5 September (5d)/ or late October	Sri Lanka	15th	1–5 September (5d) or late October	Kenya or Indonesia
Working Party on **Ecosystems and Bycatch** (WPEB)	12th	7–11 September (5d) or Late October	Sri Lanka	13th	7–11 September (5d) or late October	Kenya or Indonesia

273. The WPEB **NOTED** the importance of having a degree of stability in the participation of CPCs to each of the working party meetings and **ENCOURAGED** participants to regularly attend each meeting to ensure as much continuity as possible.

12.5 Review of the draft, and adoption of the Report of the 11th Session of the Working Party on Ecosystems and Bycatch

274. The WPEB **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPEB11, provided at Appendix XIX, as well as the management advice provided in the draft resource stock status summary for each of the seven shark species, as well of those for marine turtles and seabirds:

Sharks

- Blue sharks (*Prionace glauca*) – Appendix IX
- Oceanic whitetip sharks (*Carcharhinus longimanus*) – Appendix X
- Scalloped hammerhead sharks (*Sphyrna lewini*) – Appendix XI
- Shortfin mako sharks (*Isurus oxyrinchus*) – Appendix XII
- Silky sharks (*Carcharhinus falciformis*) – Appendix XIII
- Bigeye thresher sharks (*Alopias superciliosus*) – Appendix XIV
- Pelagic thresher sharks (*Alopias pelagicus*) – Appendix XV

Other species/groups

- Marine turtles – Appendix XVI
- Seabirds – Appendix XVII

275. The report of the 11th Session of the Working Party on Ecosystems and Bycatch (IOTC–2015–WPEB11–R) was **ADOPTED** on the 11 September 2015.

APPENDIX I
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APPENDIX II
AGENDA FOR THE 11TH WORKING PARTY ON ECOSYSTEMS AND BYCATCH

Date: 7–11 September 2015
Location: Olhão, Portugal
Venue: Real Marina Hotel and Spa
Time: 09:00 – 17:00 daily
Chair: Dr Rui Coelho; **Vice-Chair**: Dr Evgeny Romanov

1. **OPENING OF THE MEETING** (Chairperson)

2. **ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION** (Chairperson)

3. **THE IOTC PROCESS: OUTCOMES, UPDATES AND PROGRESS**
   - 3.1 Outcomes of the 17th Session of the Scientific Committee (IOTC Secretariat)
   - 3.2 Outcomes of the 19th Session of the Commission (IOTC Secretariat)
   - 3.3 Review of Conservation and Management Measures relevant to Ecosystems and Bycatch (IOTC Secretariat)
   - 3.4 Progress on the recommendations of WPEB10 (IOTC Secretariat)

4. **REVIEW OF DATA AVAILABLE ON ECOSYSTEMS AND BYCATCH**
   - 4.1. Review of the statistical data available for ecosystems and bycatch species (IOTC Secretariat)
   - 4.2. Regional Observer Scheme – Update (IOTC Secretariat)

5. **REVIEW OF NATIONAL BYCATCH ISSUES IN IOTC MANAGED FISHERIES AND NATIONAL PLANS OF ACTION** (sharks; seabirds; marine turtles) (CPCs and IOTC Secretariat)
   - 5.1. Review of applications for '*not applicable*' NPOA status (IOTC Secretariat)
   - 5.2. Updated status of development and implementation of National Plans of Action for seabirds and sharks, and the implementation of the FAO guidelines to reduce marine turtle mortality in fishing operations (CPCs).

6. **NEW INFORMATION ON BIOLOGY, ECOLOGY, FISHERIES AND ENVIRONMENTAL DATA RELATING TO ECOSYSTEMS AND BYCATCH SPECIES**
   - 6.1. Review new information on environment and ecosystem interactions and modelling, including climate change issues affecting pelagic ecosystems in the IOTC area of responsibility (all)

7. **GILLNET FISHERIES: PROBLEMS AND NEEDS** (recommendations from the SC / decisions of the Commission)
   - 7.1. Regional review of the data available for gillnet fleets operating in the Indian Ocean (IOTC Secretariat)
   - 7.2. Update on training conducted for CPCs having gillnet fleets on species identification, bycatch mitigation and data collection methods (IOTC Secretariat)
   - 7.3. Development of plans of action for future training on species identification, bycatch mitigation and data collection for gillnet fleets and also to identify other potential sources of assistance (all)

8. **BLUE SHARK**
   - 8.1. Review new information on blue shark biology, stock structure, bycatch mitigation measures, fisheries and associated environmental data (all)
   - 8.2. Review of new information on the status of blue shark (all)
     - Nominal and standardised CPUE indices
     - Stock assessments (including data poor approaches)
     - Selection of Stock Status indicators for blue shark

8.3. Development of management advice for blue shark and update of blue shark Executive Summary for the consideration of the Scientific Committee (all)
- Consideration of options for alternative management measures for blue shark in the IOTC area of competence

9. OTHERS SHARKS AND RAYS

9.1. Review new information on other shark and ray biology, stock structure, bycatch mitigation measures, fisheries and associated environmental data (all)

9.2. Review of new information on the status of other sharks (all)
- Nominal and standardised CPUE indices
- Selection of Stock Status indicators for other sharks

9.3. Development of management advice on the status of other shark stocks and update of other shark species Executive Summaries for the consideration of the Scientific Committee (all)
- Consideration of options for alternative management measures for other sharks in the IOTC area of competence

10. OTHER BYCATCH AND BYPRODUCT SPECIES INTERACTIONS

10.1. Review new information on other bycatch and byproduct, in terms of biology, ecology, fisheries interactions and bycatch mitigation measures (all)

10.2. Review of new information on the proposed retention of non-target species by various gears (all)

10.3. Marine turtles
- Review new information on marine turtle biology, ecology, fisheries interactions and bycatch mitigation measures (all);
- Review of mitigation measures in Resolution 12/04 (all);
- Development of management advice on the status of marine turtle species (all).

10.4. Seabirds
- Review new information on seabird biology, ecology, fisheries interactions and bycatch mitigation measures (all);
- Review of mitigation measures in Resolution 12/06 (all);
- Development of management advice on the status of seabird species (all).

10.5. Marine mammals
- Review new information on marine mammal biology, ecology, fisheries interactions and bycatch mitigation measures (all);
- Development of management advice on the status of marine mammal species (all).

11. WPEB PROGRAM OF WORK

11.1. Revision of the WPEB Program of Work 2016–2020 (Chairperson and IOTC Secretariat)

11.2. Development of priorities for an Invited Expert/s at the next Working Party on Ecosystems and Bycatch meeting (Chairperson)

12. OTHER BUSINESS

12.1. Southern hemisphere stock status assessment of porbeagle shark (Chairperson and IOTC Secretariat)

12.2. Ecosystem Based Fisheries Management (EBFM) joint meeting of tRFMOs in 2016 (Chairperson and IOTC Secretariat)

12.3. Election of a Chairperson and Vice-Chairperson for the WPEB for the next biennium (IOTC Secretariat)

12.4. Date and place of the 12th and 13th Sessions of the Working Party on Ecosystems and Bycatch (Chairperson and IOTC Secretariat)

12.5. Review of the draft, and adoption of the Report of the 11th Session of the Working Party on Ecosystems and Bycatch (Chairperson)

APPENDIX III
LIST OF DOCUMENTS

Document	Title	Availability
IOTC–2015–WPEB11–01a	Agenda of the 11th Working Party on Ecosystems and Bycatch	✓(1 January 2015) ✓(7 September 2015)
IOTC–2015–WPEB11–01b	Annotated agenda of the 11th Working Party on Ecosystems and Bycatch	✓(23, 25 August 2015) ✓(11 September 2015)
IOTC–2015–WPEB11–02	List of documents of the 11th Working Party on Ecosystems and Bycatch	✓(8 April 2015) ✓(21, 25 August 2015) ✓(11 September 2015)
IOTC–2015–WPEB11–03	Outcomes of the 17th Session of the Scientific Committee (IOTC Secretariat)	✓(8 April 2015)
IOTC–2015–WPEB11–04	Outcomes of the 19th Session of the Commission (IOTC Secretariat)	✓(2 July 2015)
IOTC–2015–WPEB11–05	Review of Conservation and Management Measures relevant to ecosystems and bycatch (IOTC Secretariat)	✓(8 April 2015)
IOTC–2015–WPEB11–06	Progress made on the recommendations and requests of WPEB10 and SC17 (IOTC Secretariat)	✓(8 April 2015)
IOTC–2015–WPEB11–07 Rev_1	Review of the statistical data and fishery trends for bycatch species (IOTC Secretariat)	✓(23 August 2015) ✓(28 August 2015)
IOTC–2015–WPEB11–08	Update on the implementation of the IOTC Regional Observer Scheme (IOTC Secretariat)	✓(21 August 2015)
IOTC–2015–WPEB11–09 Rev_1	Status of development and implementation of National Plans of Action for seabirds and sharks, and implementation of the FAO guidelines to reduce marine turtle mortality in fishing operations (IOTC Secretariat)	✓(8 April 2015) ✓(9 September 2015)
IOTC–2015–WPEB11–10	Revision of the WPEB Program of Work (2016–2020) (IOTC Secretariat)	✓(8 July 2015)
IOTC–2015–WPEB11–11	The Seychelles NPOA Sharks 2007-2010 Review (Assan C)	✓(23 August 2015)
IOTC–2015–WPEB11–12 Rev_1	Status of the shark fishery ban in the Maldives and the implementation of the National Plan of Action on Sharks - An update with notes on turtles and seabirds (Ali K)	✓(23 August 2015) ✓(9 September 2015)
IOTC–2015–WPEB11–13 Rev_1	Iranian fishing vessels bycatch in the IOTC area of competence in 2014 (Shahifar R)	✓(23 August 2015) ✓(1 September 2015)
IOTC–2015–WPEB11–14	Landing bycatch of tuna longline fishery landed at Phuket Province, Thailand (Panjarat S, Hoimuk S, Jaiyen T, Rodpradit S & Singtongyam W)	✓(23 August 2015)
IOTC–2015–WPEB11–15	Optimal fishing time window: an approach to mitigate bycatch in longline fisheries (Auger L, Trombetta T, Sabarros PS, Rabearisoa N, Romanov E & Bach P)	✓(21 August 2015)
IOTC–2015–WPEB11–16	ObServe: Database and operational software for longline and purse seine fishery data (Cauquil P, Rabearisoa N, Sabarros PS, Chavance P & Bach P)	✓(21 August 2015)
IOTC–2015–WPEB11–17	A preliminary value chain analysis of shark fisheries in Madagascar (Cripps G, Harris A, Humber F, Harding S & Thomas T)	✓(19 August 2015)
IOTC–2015–WPEB11–18 Rev_1	Impact of policies on the conservation of sharks in the large pelagic fishery (Jayathilaka RAM & Maldeniya R)	✓(21 August 2015) ✓(11 September 2015)
IOTC–2015–WPEB11–19	Do common thresher sharks *Alopias vulpinus* occur in the tropical Indian Ocean? (Romanov E)	✓(23 August 2015)
IOTC–2015–WPEB11–20	Withdrawn	–
IOTC–2015–WPEB11–21 Rev_1	Shark catch characteristics by Malagasy longliners (from 2010 to 2014) (Joachim DL & Razafimandimby Y)	✓(23 August 2015) ✓(5 September 2015)
IOTC–2015–WPEB11–22	Distribution patterns of sizes and sex-ratios of blue shark in the Indian Ocean (Coelho R, Yokawa K, Liu K-M, Romanov E, da Silva C, Bach P, Lino PG, Ohshimo S, Tsai W-P & Santos MN)	✓(19 August 2015)
IOTC–2015–WPEB11–23	Blue shark (*Prionace glauca*) length composition from the Indonesian longline fleet in the Indian Ocean: period 2005–2014 (Novianto D, Rochman F, Bahtiar A, Nugraha B & Jatmiko I)	✓(18 August 2015)
IOTC–2015–WPEB11–24	Historical Catch Estimate Reconstruction for the Indian Ocean based on Shark Fin Trade Data (Clarke S)	✓(19 August 2015)
IOTC–2015–WPEB11–25	Standardized catch rates for the blue shark (*Prionace glauca*) caught by the Spanish surface longline fleet in the Indian Ocean during the 2001-2013 period (Fernández-Costa J, Ramos-Cartelle A, García-Cortés B & Mejuto J)	✓(7 August 2015)

Document	Title	Availability
IOTC–2015–WPEB11–26	Update of blue shark catches and standardized CPUE for the Portuguese pelagic longline fleet in the Indian Ocean: exploring the effects of targeting (Coelho R, Lino PG, Rosa D & Santos MN)	✓(17 August 2015)
IOTC–2015–WPEB11–27	Preliminary stock assessment of blue shark (*Prionace glauca*) caught in Indian Ocean using a Bayesian State-Space Production Model (Andrade HA)	✓(23 August 2015)
IOTC–2015–WPEB11–28	Stock assessment blue shark (*Pironce glauca*) in the Indian Ocean using Stock Synthesis (Rice J & IOTC Secretariat)	✓(23 August 2015)
IOTC–2015–WPEB11–29	Interactions of oceanic whitetip sharks with the tuna purse seine fisheries in the Indian Ocean (Travassos Tolotti M, Bach P, Romanov E & Dagorn L)	✓(23 August 2015)
IOTC–2015–WPEB11–30 Rev_1	Update of standardized CPUE of blue shark (*Prionace glauca*) in the Indian Ocean estimated from observer data in the period between 1992 and 2014 (Semba Y, Kanaiwa M & Yokawa K)	✓(22 August 2015) ✓(28 August 2015)
IOTC–2015–WPEB11–31	Proceedings of the Regional Symposium on Sea Turtle Conservation in Asia (Anon)	✓(21 August 2015)
IOTC–2015–WPEB11–32	Analysis of marine turtle mitigation measure effectiveness in tuna longline fisheries (Clarke S, Nicol S, Swimmer Y & IOTC Secretariat)	✓(21 August 2015)
IOTC–2015–WPEB11–33 Rev_1	A need for improved reporting on seabird bycatch in the longline fishery (Angel A, Wanless R & Small C)	✓(18 August 2015) ✓(7 September 2015)
IOTC–2015–WPEB11–34	New approaches for better understanding seabird bycatch in tuna longline fisheries (Wanless R & Small C)	✓(18 August 2015)
IOTC–2015–WPEB11–35	ACAP summary advice for reducing the impact of pelagic longline fishing on seabirds (ACAP Secretariat)	✓(21 August 2015)
IOTC–2015–WPEB11–36	Estimation of seabird bycatch rates and numbers (Wolfaardt A & Debski I) (on behalf of the Seabird Bycatch Working Group of ACAP)	✓(21 August 2015)
IOTC–2015–WPEB11–37 Rev_1	Preliminary analyses; evaluation of the effects of the newly employed seabird bycatch regulation for longline fisheries in IOTC conventional area with using current observer data (Inoue Y, Yokawa K & Minami H)	✓(23 August 2015) ✓(6 September 2015)
IOTC–2015–WPEB11–38 Rev_1	Progress of the development of the DNA identification for the southern albatross bycatch in longline fishery (Inoue Y, Alderman R, Taguchi M, Sakuma K, Kitamura T, Phillips RA, Burg TM, Small C, Sato M, Papworth W & Minami H)	✓(23 August 2015) ✓(6 September 2015)
IOTC–2015–WPEB11–39	Environmental impacts and causation of 'beached' Drifting Fish Aggregating Devices around Seychelles Islands: a preliminary report on data collected by Island Conservation Society (Balderson SD & Martin LEC)	✓(23 August 2015)
IOTC–2015–WPEB11–40	Preliminary review of ICCAT, WCPFC, IOTC and IATTC progress in applying ecosystem based fisheries management (Juan-Jordá MJ, Arrizabalaga H, Restrepo V, Dulvy NK, Cooper AB & Murua H)	✓(25 August 2015)
Other papers		
IOTC–2015–WPEB11–41	Proposal for a bycatch data exchange protocol (Clarke S & Nicol S)	✓(21 August 2015)
IOTC–2015–WPEB11–42	Summary of the Indian Ocean elasmobranch tagging programs (Romanov EV)	✓(20 August 2015)
IOTC–2015–WPEB11–43 Rev_1	Preliminary study of cetacean depredation on pelagic longline fisheries using passive acoustic monitoring off Reunion Island (Foulgoc LL, Richard E, Condet M, Philippe J-B, Roussel E, Chompret J & Clorennec D)	✓(23 August 2015) ✓(5 September 2015)
IOTC–2015–WPEB11–44 Rev_1	Indicators of depredation impacting Reunion Island pelagic longline fishery (Rabearisoa N, Sabarros PS, Romanov E & Bach P)	✓(23 August 2015) ✓(9 September 2015)
IOTC–2015–WPEB11–45 Rev_1	Depredation and incidental catches in longline fishery of southern Mozambique: Preliminary information on ecosystem issues based on observer onboard sampling (Mutombene RJ)	✓(23 August 2015) ✓(11 September 2015)
IOTC–2015–WPEB11–46	An update on the Shark by-catch of tuna gillnet fisheries of Pakistan (Shahid U, Khan MM & Nawaz R)	✓(23 August 2015)
IOTC–2015–WPEB11–47	An assessment of marine turtle bycatch in the tuna gillnet fisheries of Pakistan (Shahid U, Khan MM, Nawaz R & Dimmlich W)	✓(23 August 2015)

Document	Title	Availability
IOTC–2015–WPEB11–48	Update on the catch and bycatch composition of illegal fishing in the British Indian Ocean Territory (UK(OT)) and a summary of abandoned and lost fishing gear (Moir Clark J, Duffy H, Pearce J & Mees CC)	✓(23 August 2015)
IOTC–2015–WPEB11–49	Stock assessment of blue shark (*Prionce glauca*) in the Indian Ocean (IOTC Secretariat)	✓(23 August 2015)
IOTC–2015–WPEB11–50	Update of CPUE and catch for blue shark caught by Japanese longliner during 1971-1993 in the Indian Ocean (Kai M & Okamoto H)	✓(3 September 2015)
IOTC–2015–WPEB11–51	Estimation of appropriate reporting ratio for the blue shark caught by Japanese longliner in the Indian Ocean (Kai M & Yoakawa K)	✓(3 September 2015)
IOTC–2015–WPEB11–52 Rev_1	Updated and revised standardized catch rate of blue sharks caught by the Taiwanese longline fishery in the Indian Ocean (Tsai W-P & Liu K-M)	✓(7 September 2015) ✓(10 September 2015)
Information papers		
IOTC–2015–WPEB11–INF01	IOTC SC – Guidelines for the presentation of stock assessment models	✓(29 January 2015)
IOTC–2015–WPEB11–INF02	Report of the tuna RFMO expert working group: Harmonisation of longline bycatch data collected by tuna RFMOs (Anon)	✓(24 June 2015)
IOTC–2015–WPEB11–INF03	Do by-catch reduction devices in longline fisheries reduce capture of sharks and rays? A global meta-analysis (Favaro B & Cote IM)	✓(19 August 2015)
IOTC–2015–WPEB11–INF04	Vulnerability of oceanic sharks as pelagic longline bycatch (Gallagher AJ, Orbesen ES, Hammerschlaga N & Serafy JE)	✓(19 August 2015)
IOTC–2015–WPEB11–INF05	By-catch of tuna gillnet fisheries of Pakistan: A serious threat to non-target, endangered and threatened species (Moazzam M & Nawaz R)	✓(19 August 2015)
IOTC–2015–WPEB11–INF06	Deep-water observation of scalloped hammerhead Sphyrna lewini in the western Indian Ocean off Tanzania (Moore ABM & Gates AR)	✓(19 August 2015)
IOTC–2015–WPEB11–INF07	Illegal take and trade of marine turtles in the IOSEA region (Anon)	✓(19 August 2015)
IOTC–2015–WPEB11–INF08	Preliminary edits to the IOTC Marine Turtle Executive Summary	✓(23 August 2015)
IOTC–2015–WPEB11–INF09	System of verification of the code of good practices on board ANABAC and OPAGAC tuna purse seiners and preliminary results for the Atlantic Ocean (Goñi N, Ruiz J, Murua H1, Santiago J, Krug I, Sotillo de Olano B, González de Zarate A, Moreno G & Murua J)	✓(25 August 2015)
IOTC–2015–WPEB11–INF10	Guidance for National Plan of Action for sharks in India (Anon)	✓(6 September 2015)
IOTC–2015–WPEB11–INF11 Rev_1	A concept note on an IOTC shark tagging programme with pop-up satellite archival tags (PSAT) in response to Indian Ocean Shark Year Programme (ShYP) priorities (Romanov EV, Coelho R, Wilson DT, Sabarros PS & Bach P)	✓(7 September 2015) ✓(11 September 2015)
IOTC–2015–WPEB11–INF12	National Plan of Action for the conservation and management of sharks in the Maldives (Ali K and Sinan H)	✓(9 September 2015)
IOTC–2015–WPEB11–INF13	Concept note: Linking coastal livelihoods from artisanal tuna fishing with climate change and regional seabird conservation (Wanless R & Marsac F)	✓(9 September 2015)
Data sets		
IOTC–2015–WPEB11–DATA01	Bycatch datasets available	✓(4 August 2015)
IOTC–2015–WPEB11–DATA02	Data Catalogue	✓(10 August 2015)
IOTC–2015–WPEB11–DATA03 Rev_1	Data for the assessment of Indian Ocean Blue Shark	✓(3 August 2015)
IOTC–2015–WPEB11–DATA04	EU-Portugal Blue shark standardised longline CPUE series 2000–2014	✓(3 August 2015)
IOTC–2015–WPEB11–DATA05	Nominal Catches per Fleet, Year, Gear, IOTC Area and species	✓(3 August 2015)
IOTC–2015–WPEB11–DATA06	Catch and Effort - Longline	✓(3 August 2015)
IOTC–2015–WPEB11–DATA07	Catch and Effort - vessels using pole and lines or purse seines	✓(3 August 2015)
IOTC–2015–WPEB11–DATA08	Catch and Effort - Coastal	✓(3 August 2015)
IOTC–2015–WPEB11–DATA09	Catch and Effort - all vessels	✓(3 August 2015)
IOTC–2015–WPEB11–DATA10	Catch and Effort - reference	✓(3 August 2015)
IOTC–2015–WPEB11–DATA11	Size Frequency - Sharks	✓(3 August 2015)
IOTC–2015–WPEB11–DATA12	Data Shark Equations	✓(3 August 2015)
IOTC–2015–WPEB11–DATA13	Size frequency - reference	✓(3 August 2015)
IOTC–2015–WPEB11–DATA14	EU-Spain Blue shark standardised longline CPUE series 2001–2013	✓(7 August 2015)

APPENDIX IV
THE STANDING OF A RANGE OF INFORMATION RECEIVED BY THE IOTC SECRETARIAT FOR BYCATCH (INCLUDING BYPRODUCT) SPECIES

Extract from IOTC–2015–WPEB11–07

(Table, figure and appendix references in this Appendix, refer only to those contained in this appendix)

SUMMARY OF FISHERIES DATA AVAILABLE FOR SHARKS

Data available on the total catches of sharks in the Indian Ocean

The total shark nominal catch data are presented in Fig. 1 by fleet. Very few fleets have reported catches of sharks for the early years, but the number of fleets reporting increases over time. Total reported shark catches have also increased over time with a particularly dramatic increase in reported catches in the 1990s, reaching a peak of approximately 120 000mt in 1999. Since then, nominal catches have fluctuated and are currently around 100 000mt. Recent changes to the historical series are mainly due to the revised time series submitted in 2015 by Japan and Indonesia. Japan has now reported catches (disaggregated by species) dating back to 1994 while Indonesia also revised their total Indian Ocean catch estimates for the time period between 2005 and 2013, providing higher estimated shark catches for this period.

The nominal catch data should, however, be considered with caution given the historically low reporting rates. In addition to the underestimates from lack of reporting, when the catches are reported they are thought to represent only the catches of those species that are retained onboard without taking in to account discards (nominal catches). In many cases the reported catches refer to dressed weights while no information is provided on the type of processing undertaken, creating more uncertainty in the estimates of catches in live weight equivalents. Nevertheless, reporting rates in recent years have improved substantially (Appendix 3) following the adoption of new measures by the Commission on sharks and other bycatch, which call for IOTC CPCs to collect and report more detailed statistics on bycatch species to the IOTC Secretariat.

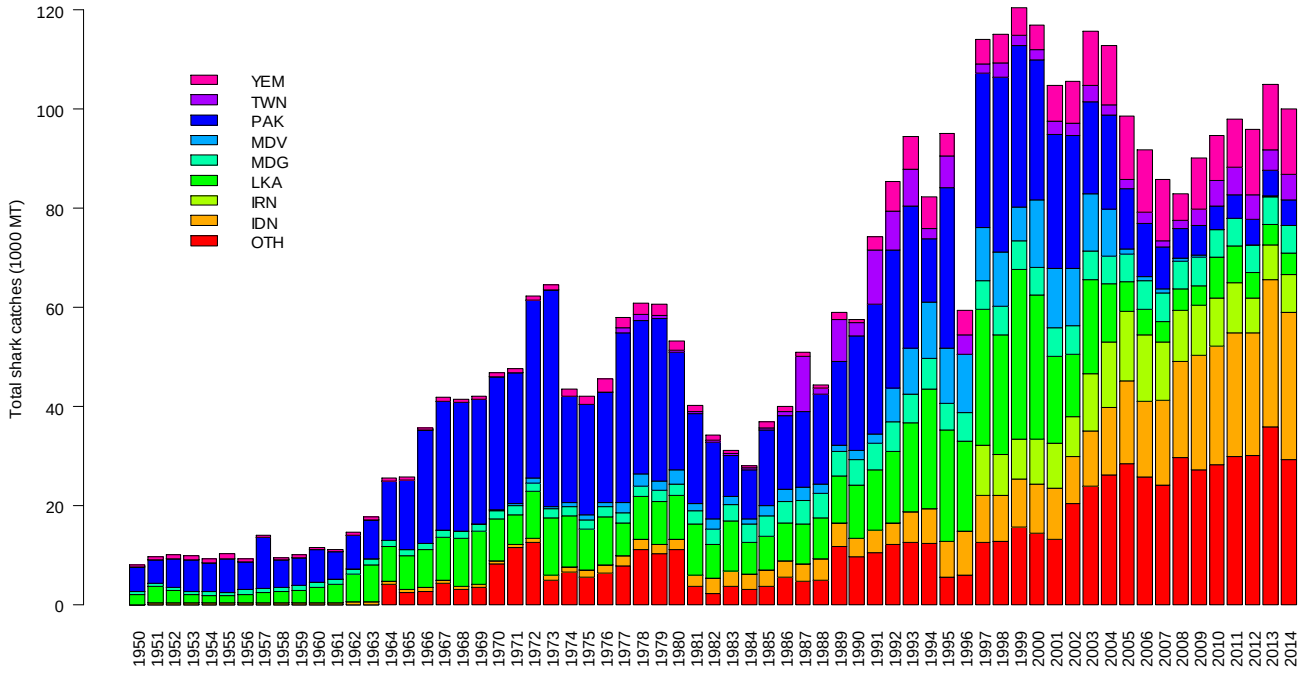


Fig. 1a. Total reported nominal catches (**IOTC database**) of sharks by fleet from 1950–2014 (YEM = Yemen, TWN = Taiwan,China, PAK = Pakistan, MDV = Maldives, MDG = Madagascar, LKA = Sri Lanka, IRN = I.R.Iran, IDN = Indonesia, OTH = all others).

Main reported gear types associated with shark bycatch for IOTC fisheries

Fig. 2 shows the distribution of catches by gear type. Gillnets report the highest nominal catches of sharks in 2014, making up nearly 40% of catches followed by the handline and longline fleets. Of gillnets, the majority comprise standard, unclassified gillnets, followed by gillnet, handline and troll line combinations and gillnet/longline combinations.

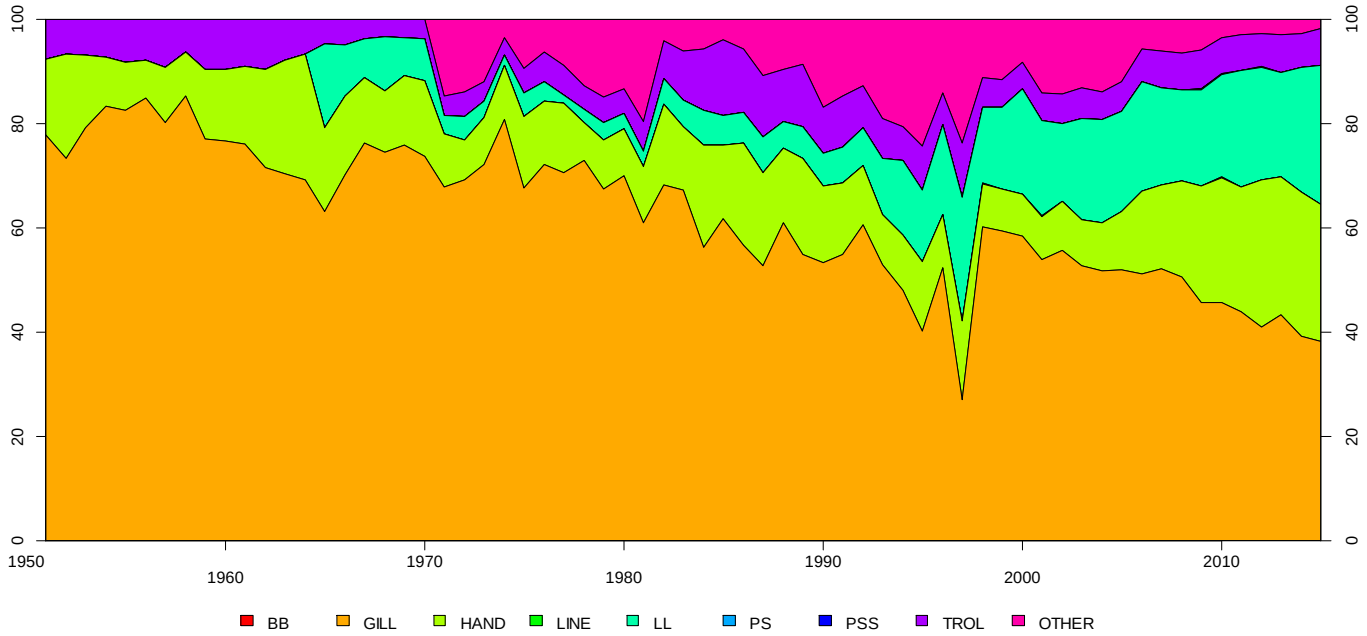


Fig. 2. Summary of shark catches reported by gear type (1950–2014). Bait boat/pole and line (BB), gillnet (GILL), Handline (HAND), Line (LINE), logline (LL), Purse seine (PS), small purse seines/ring nets (PSS), troll lines (TROLL) and all other gear types (OTHER).

Main species of sharks caught in IOTC fisheries

A list of all species of sharks that are known to occur in Indian Ocean fisheries directed at IOTC species (IOTC fisheries) or pelagic sharks is provided in Appendix 2. In addition to an increase in reporting of shark catches over time, the resolution of the data provided has been improving with an increased proportion of reported shark catches provided identified to species/genus (Fig.4a). Of the shark catches reported by species, the blue shark forms the greatest proportion, comprising ~ 60% of total catches, with silky, oceanic whitetip, thresher, hammerhead and mako sharks forming a smaller percentage (Fig. 4b).

The increase in reporting by species is apparent in the species-specific catch series (Fig. 4) with steadily increasing trends in reporting since the 1970s seen for blue sharks, thresher sharks, hammerhead sharks and mako sharks. The reporting of catches of oceanic whitetip sharks shows an unusual trend which is dominated by the Sri Lankan longline-gillnet fisheries with the addition of proportionately very large catches by India in the last years (2013-2014). Reported catches of silky shark peak just prior to 2000, since when they have been steadily declining, a trend which is based almost exclusively on data from the Sri Lankan longline-gillnet combination fisheries. The effect of single fleet reports in the nominal catch series by species is apparent when looking at Fig.5b which highlights how the catch series of each species is dominated by very few fleets.

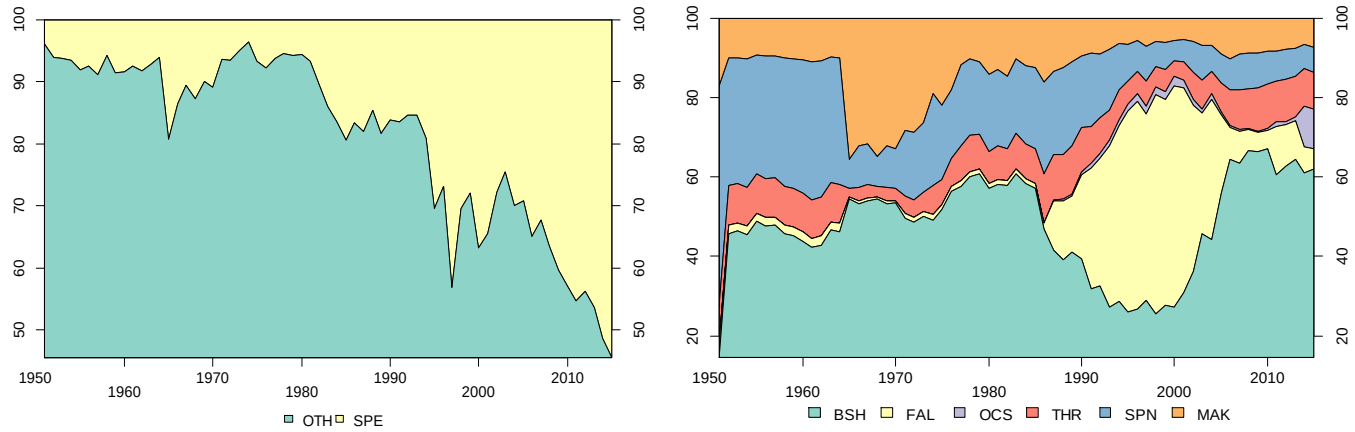


Fig. 3. a) Proportion of shark catches reported by species and as aggregate catch (OTH) and b) nominal shark catches by species

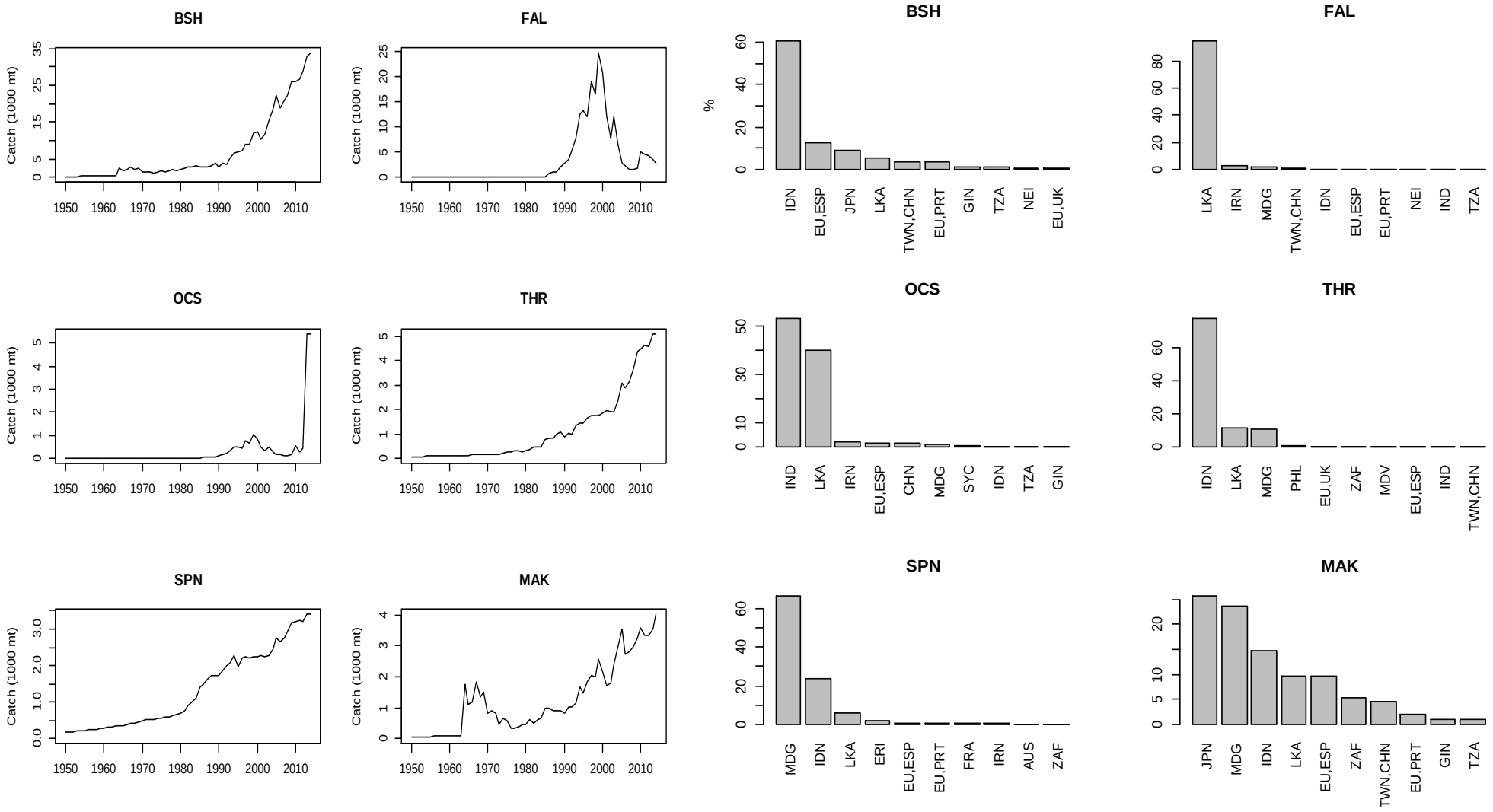


Fig. 4. a) Total nominal catches by species for all fleets (1950-2014) and b) contribution of each fleet to the total data series

There are some clear trends in species catches by gear types as indicated in Table 1. Nominal shark catches by longliners comprise predominantly blue shark followed by mako sharks, while reported catches of handline gears are also dominated by blue shark, followed by thresher sharks. Purse seine catches are dominated by silky shark. Troll lines reported relatively high catches of hammerhead sharks. Reporting by species is very uncommon for gillnet fleets, where the majority of catches are reported in aggregate.

Table 1. Species-specific catches by gear type from 2005–2014 (Bait boat/pole and line (BB), gillnet (GILL), Handline (HAND), Line (LINE), logline (LL), Purse seine (PS), small purse seines/ring nets (PSS) and troll lines (TROL).

	BB	GILL	HAND	LINE	LL	PS	PSS	TROL
OTH	100%	92%	13%	100%	13%	28%	100%	62%
BSH	0%	3%	60%	0%	58%	0%	0%	0%
FAL	0%	4%	0%	0%	7%	72%	0%	2%
OCS	0%	0%	0%	0%	6%	0%	0%	0%
THR	0%	0%	17%	0%	0%	0%	0%	3%
SPN	0%	0%	6%	0%	0%	0%	0%	25%
MAK	0%	0%	3%	0%	10%	0%	0%	8%
OCS	0%	0%	0%	0%	6%	0%	0%	0%
RMB	0%	0%	0%	0%	1%	0%	0%	0%

Reported catches and catch rates by fleet

Fleets reporting the greatest nominal catches of sharks since 2000 are shown in Fig. 5. This highlights the relatively high catches of the Indonesia line fisheries (including troll lines, hook and line, hand line and coastal longlines[1]) and the gillnet fisheries of Pakistan, Yemen and I.R. Iran. The lack of species disaggregation in reporting is also apparent here, particularly for the gillnet fleets.

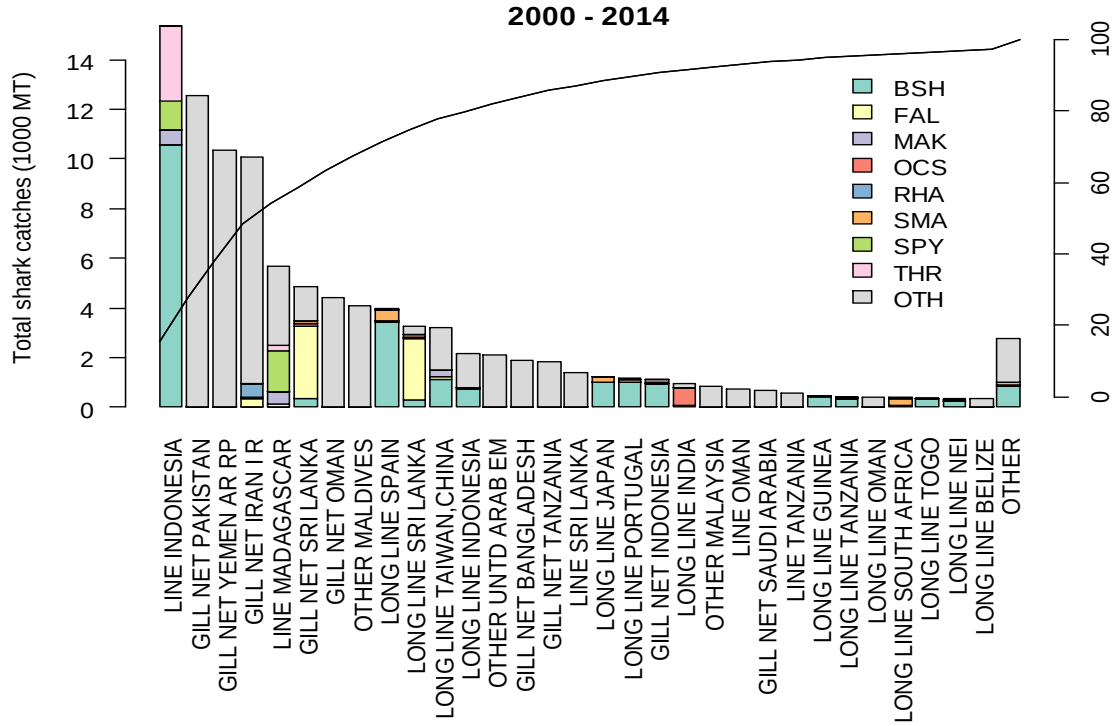


Fig. 5. Annual average shark catches reported by fleet and species from 2000–2014

While industrial longliners and drifting gillnets harvest important amounts of pelagic sharks, industrial purse seiners, pole-and-lines and most coastal fisheries are unlikely to harvest important amounts of pelagic sharks.

- **Pole and line fisheries:** The shark catches reported for the pole and line fisheries of Maldives are very low and none are reported for India. The amounts of sharks caught by these fisheries, if any, are not thought significant.

[1] These are longlines which are operated by smaller vessels (<15m) and generally deployed within the EEZ.

- **Gillnet fisheries:** The species of sharks caught are thought to vary significantly depending on the area of operation of the gillnets:
    - Gillnets operated in areas having low concentrations of pelagic sharks: The gillnet fisheries of most coastal countries operate these gears in coastal waters. The abundance of pelagic sharks in these areas is thought low.
    - Gillnets operated in areas having high concentrations of pelagic sharks: Gillnets operated in Sri Lanka, Indonesia and Yemen (waters around Socotra), in spite of being set in coastal areas, are likely to catch significant amounts of pelagic sharks.
- **Gillnets operated on the high seas:** Vessels from Taiwan,China were using drifting gillnets (driftnets) from 1982 to 1992, when the use of this gear was banned worldwide. The catches of pelagic sharks were very high during this period. Driftnet vessels from I.R. Iran and Pakistan have been fishing on the high seas since, but with lower catch rates. This was initially in waters of the Arabian Sea but covering a larger area in recent years as they expanded their range to include the tropical waters of the western Indian Ocean and Mozambique Channel. The quantity of sharks caught by these fleets is thought to be relatively high, representing between 25–50% of the total combined catches of sharks and other species.

- **Gillnet/longline fishery of Sri Lanka:** Between 1,200 and 3,200 vessels (12 m average length) operating gillnets and longlines in combination have been harvesting important amounts of pelagic sharks since the mid-1980s. The longlines are believed to be responsible for most of the catches of sharks. Catches of sharks comprised ~45% of the total combined catch for all species in 1995 and declined to <2% in the late 2000s. The fleet has been shifting towards predominantly longline gear in recent years but most catches are still reported as aggregates of the combination gear.

- **Fisheries using handlines:** The majority of fisheries using hand lines and trolling in the Indian Ocean operate these gears in coastal waters, so although the total proportion of sharks caught has been high historically, the amount of pelagic sharks caught are thought to be low. The proportion of other species of sharks might change depending on the area fished and time of the day.

- **Deep-freezing tuna longliners** and **fresh-tuna longliners**: Catches of sharks are thought to represent between 20–40% of the total combined catch for all species. However, the catches of sharks recorded in the IOTC database only make up a small proportion of the total catches of all species by longline fleets. These catches series for sharks are, therefore, thought to be very incomplete. Nevertheless, levels of reporting have improved in recent years, following the implementation of catch monitoring schemes in different ports of landing of fresh-tuna longliners[2], and the recording of catches of main species of sharks in logbooks and observer programmes. The catches estimated, however, are unlikely to represent the total catches of sharks for these fisheries due to the paucity of information on levels of discards of sharks, which are thought high in some areas and for some species.
- **Freezing (fresh) swordfish longliners**: Catches of sharks are thought to represent between 40–60% of the total combined catch for all species. The amount of sharks caught by longliners targeting swordfish in the IOTC area of competence has been monotonically increasing since the mid-1990s. The catches of sharks recorded for these fleets are thought more realistic than those recorded for other longline fisheries. The high catches are thought to be due to:
    - Gear configuration and time fished: The vessels targeting swordfish use surface longlines and set the lines at dusk or during the night. Many pelagic sharks are thought to be abundant at these depths and most active during dusk or night hours.
    - Area fished: The fleets targeting swordfish have been deploying most of the fishing effort in the Southwest Indian Ocean, in the vicinity of South Africa, southern Madagascar, Reunion and Mauritius. High amounts of sharks are thought to occur in these areas.
    - Changes in the relative amounts of swordfish and sharks in the catches: Some of the vessels are known to alternate between targeting swordfish and sharks (particularly blue sharks) depending on the season, or when catch rates of swordfish are poor.

[2] The IOTC-OFCF (Overseas Fisheries Cooperation Foundation of Japan) Project implemented programmes in cooperation with local institutions in Thailand and Indonesia.

- **Industrial tuna purse seiners:** Catches of sharks are thought to represent less than 0.5% of the total combined catch for all species. Limited nominal catch data have been reported for the purse seine fleets.
- **Trolling fisheries:** The majority of fisheries trolling in the Indian Ocean operate in coastal waters so the amounts of pelagic sharks caught are thought to be low. The amount that other species of sharks make out of the catches of tuna and tuna-like species might change depending on the area fished and time of the day.

Spatial information on sharks catches

Fig. 6 and Fig. 7 present the spatial catches of sharks reported in numbers for deep-freezing longliners flagged by Taiwan,China over time. The reporting by species has improved over time, indicating that the majority of the catches are blue shark with an increase in catches of silky shark in the northern Indian Ocean apparent in recent years, however, the presence of low numbers of dusky shark in the reported catches are somewhat surprising given its coastal distribution and may reflect species identification errors.

Fig. 8 shows the shark catches reported by the Japanese longline fleet from 2009–14. These show a clear dominance of blue sharks, followed by relatively minor catches of shortfin mako shark and porbeagle shark. However, it is important to note that time-area catches of sharks by species are only available from 2007 for Taiwan,China or 2009 for Japan, while these fleets have been operating in the Indian Ocean since the 1950s. Unlike Taiwan,China, for which spatially disaggregated catches of sharks are available aggregated by species from up to the late 1970s, Japan has not provided spatially disaggregated catches of sharks other than those reported for 2009 and following years. In addition, the catches available are considered to be incomplete, as they are likely to not include discards, only including those species which have been listed as mandatory for reporting. More limited time-area catches of sharks are also available from some other fleets, as recorded in Table 9.

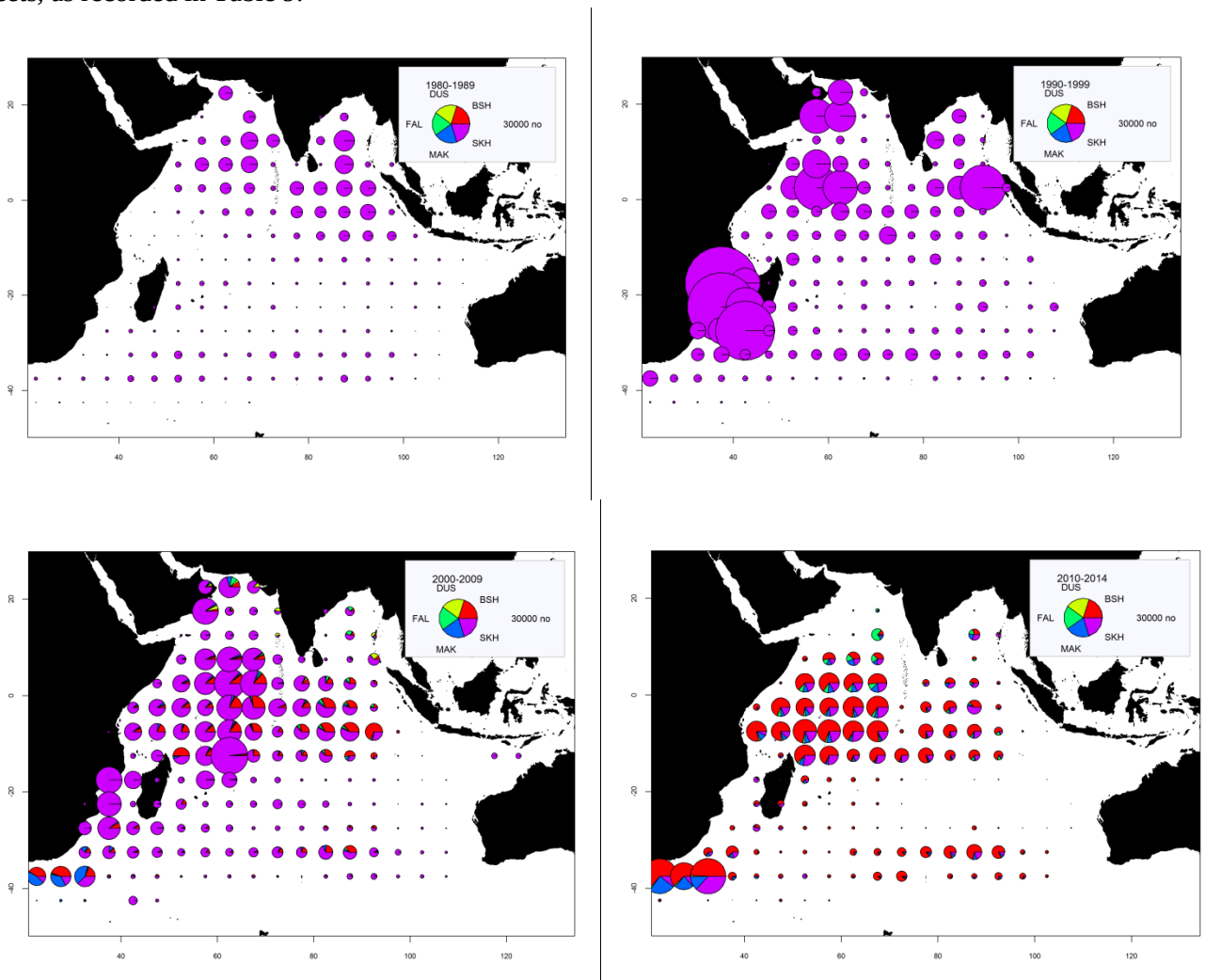


Fig. 6. Time-area catches (total numbers) of sharks for deep-freezing longliners flagged in Taiwan,China, by decade (also including 2010–14) and species. Unidentified sharks catches are shown in purple.

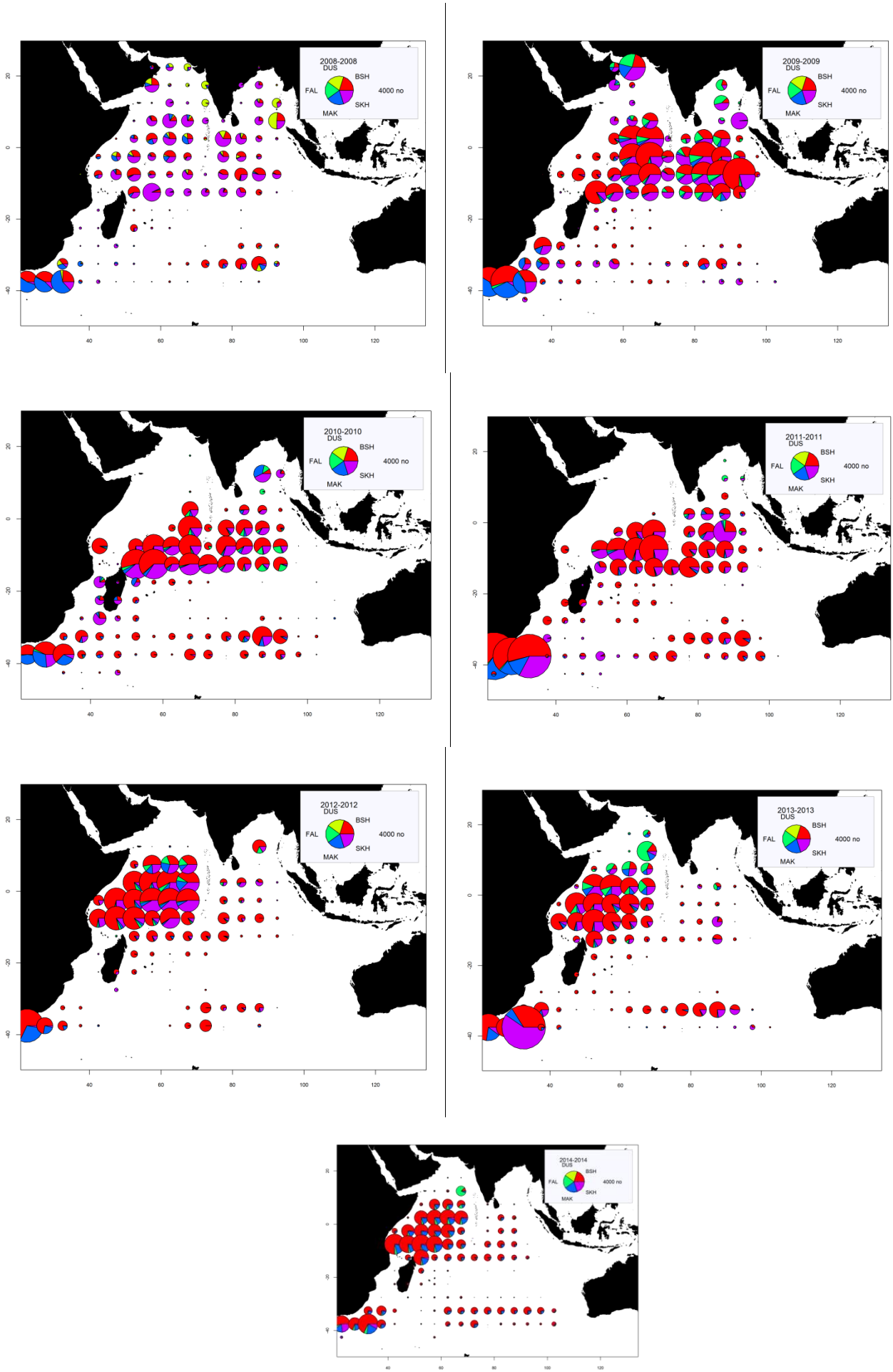


Fig. 7. Time-area catches (total numbers) of sharks for deep-freezing longliners flagged in Taiwan,China, by year (2008–14) and species. Unidentified sharks catches are shown in purple.

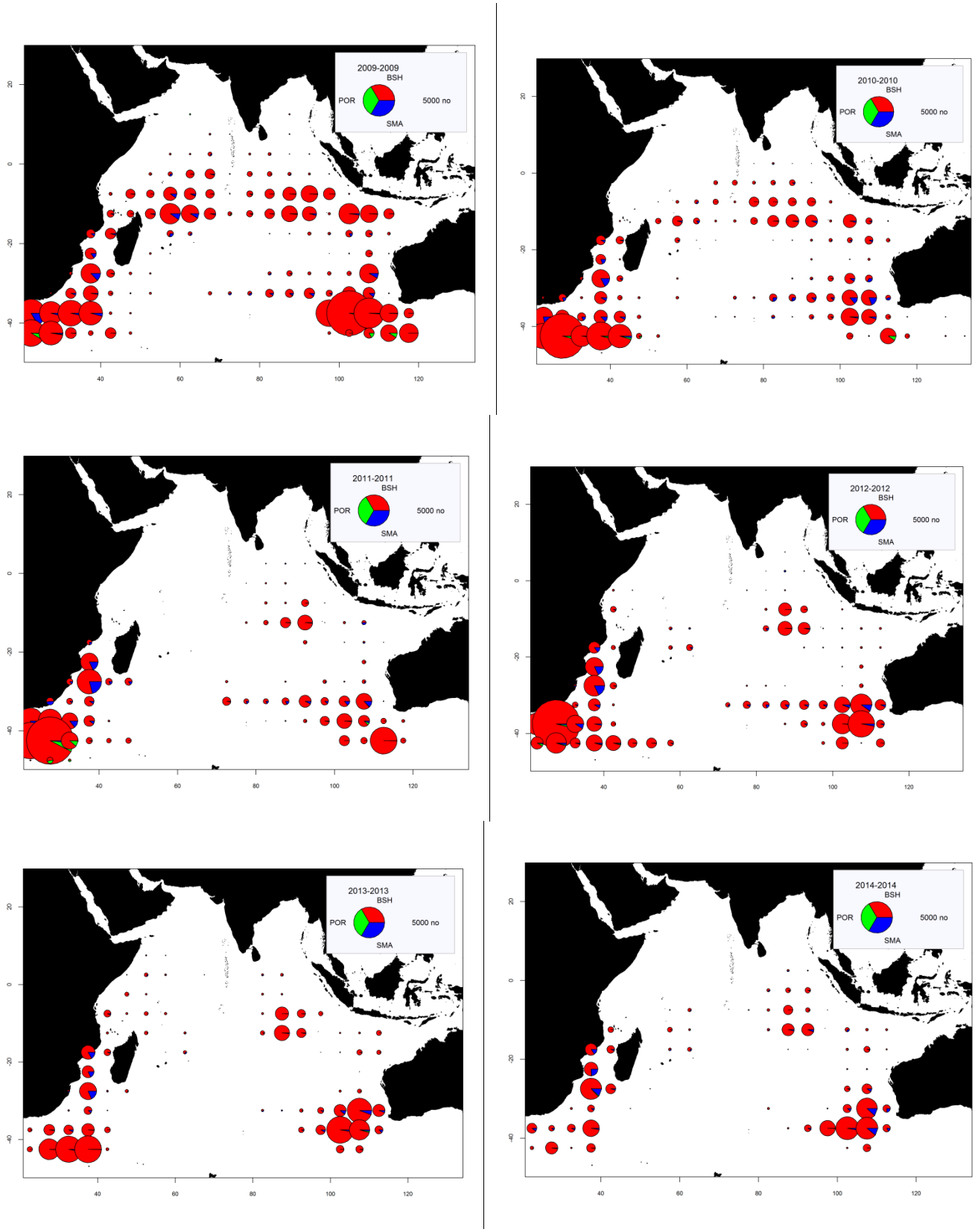


Fig. 8. Time-area catches (total numbers) of sharks for deep-freezing longliners flagged in Japan by year (2009–14) and species.

Length frequency data

Due to the different types of length measurement reported, a number of conversions were performed to standardise the length-frequency information. Given the increasing amount of data reported and the need for standardisation, a set of species-specific conversion factors and proxies that have been agreed by the Working Party on Ecosystems and Bycatch could help improve the estimates. Conversion factors currently used are provided in Appendix 4. Size frequency data are reported using different length classes ranging from 1cm to 10cm intervals. In addition to this, there appears to be rounding taking place when the smaller size intervals are used, creating abnormal peaks in the distributions. The graphs shown below have been aggregated to 5cm intervals in order to smooth this effect.

Fig. 9 shows the aggregated fork length frequency distribution for the longline fleets reporting size information on blue sharks for all areas between 2005 and 2014. The data reported for vessels flagged for China, Japan, Rep. of Korea and EU,Portugal include data reported for longline fleets with observers onboard. The results highlight the difference in the selectivity of fleets for different sized specimens, with the EU fleets, on average, selecting larger blue sharks than the other fleets. Fig. 10 shows the length distributions for the other shark species with reported size frequency data aggregated across all fleets and all years given the more limited amount of data available for these species.

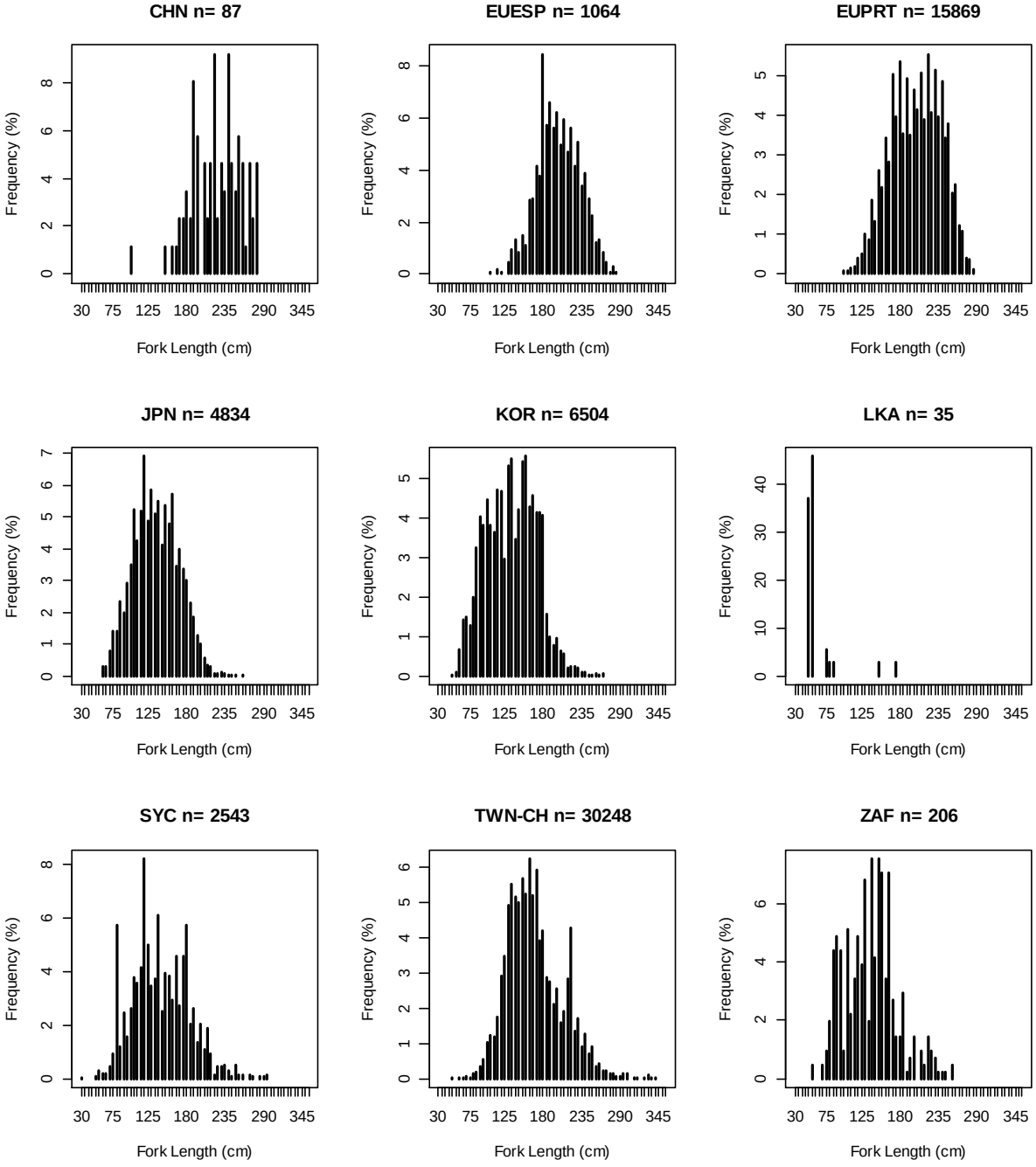


Fig. 9. Fork length frequency distributions (%) of blue shark derived from the samples reported for the longline fleets of China (CHN LL), EU,Spain (EUESP ELL), EU,Portugal (EUPRT ELL), Japan (JPN LL), Korea (KOR LL), Sri Lanka LKA (G/L), Seychelles (SYC LL), Taiwan,China (TWN FLL/LL) and South Africa (ZAF ELL) between 2005 and 2014 in 5 cm length classes.

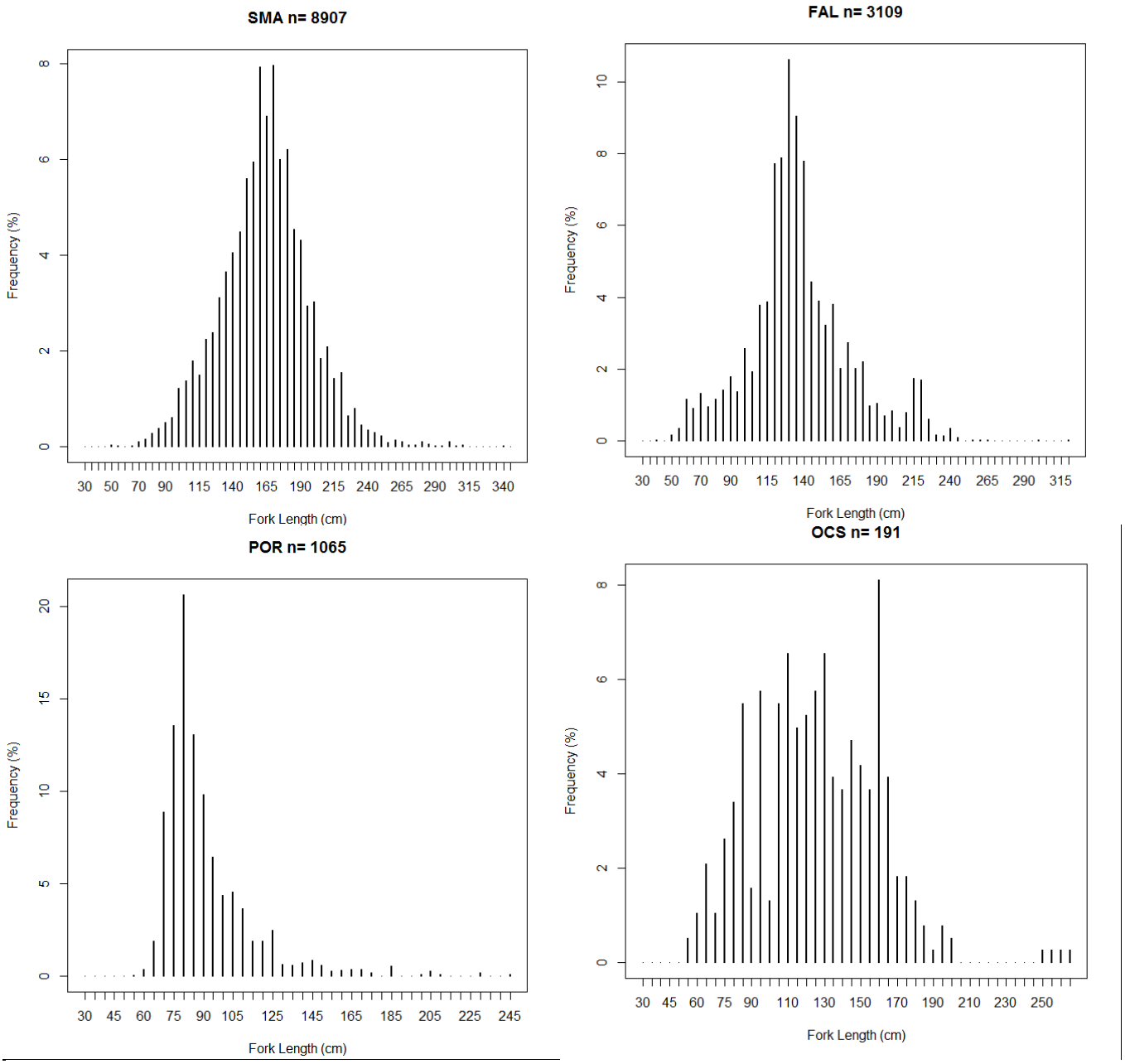


Fig. 10. Fork length frequency distributions (%) for silky shark (FAL), porbeagle shark (POR), shortfin mako shark (SMA) and oceanic whitetip shark (OCS) between 2005 and 2014.

SUMMARY OF FISHERIES DATA AVILABLE FOR SEABIRDS

Main species and fisheries concerned

The main species of seabirds likely to be caught as bycatch in IOTC fisheries are presented in Table 2[3].

Table 2. Main species of seabirds likely to be incidentally caught on longline operations

Common Name	Status*	Scientific Name
Amsterdam Albatross	Critically Endangered	*Diomedea amsterdamensis*
Antipodean Albatross	Vulnerable	*Diomedea antipodensis*
Black-browed Albatross	Endangered	*Thalassarche melanophrys*
Buller's Albatross	Near Threaten	*Thalassarche bulleri*
Campbell Albatross	Vulnerable	*Thalassarche impavida*
Chatham Albatross	Vulnerable	*Thalassarche eremite*
Grey-headed Albatross	Vulnerable	*Thalassarche chrysostoma*
Light-mantled Albatross	Near Threatened	*Phoebetria palpebrata*
Northern Royal Albatross	Endangered	*Diomedea sanfordi*
Southern Royal Albatross	Vulnerable	*Diomedea epomophora*
Salvin's Albatross	Vulnerable	*Thalassarche salvini*
Shy Albatross	Near Threatened	*Thalassarche cauta*
White-capped Albatross	Near Threatened	*Thalassarche steadi*
Sooty Albatross	Endangered	*Phoebetria fusca*
Tristan Albatross	Critically Endangered	*Diomedea dabbenena*
Wandering Albatross	Vulnerable	*Diomedea exulans*
Atlantic Yellow-nosed Albatross	Endangered	*Thalassarche chlororhynchos*
Indian Yellow-nosed Albatross	Endangered	*Thalassarche carteri*
Northern Giant Petrel	Least Concern	*Macronectes halli*
Southern Giant Petrel	Least Concern	*Macronectes giganteus*
White-chinned Petrel	Vulnerable	*Procellaria aequinoctialis*
Westland Petrel	Vulnerable	*Procellaria westlandica*
Short-tailed Shearwater	Least Concern	*Puffinus tenuirostris*
Sooty Shearwater	Near Threatened	*Puffinus griseus*

*****Source IUCN 2006, BirdLife International 2004b.

[3] As in IOTC–2007–WPEB–22, Appendix 2, page 24. Paper submitted on behalf of the Agreement for the Conservation of Albatrosses and Petrels (ACAP)

Longline vessels fishing in southern waters

The interaction between seabirds and IOTC fisheries is likely to be significant only in Southern waters (south of 25° degrees South), an area where most of the effort is exerted by longliners. Incidental catches are, for this reason, likely to be of importance only for longline fleets having vessels operating in these areas. The main fleets reporting longline fishing effort since 1955 in this area are those of Japan (accounting for 61%) and Taiwan,China (accounting for 34%) (Figure 11). Figure 12 shows the spatial distribution of reported effort exerted by longliners for fleets fishing south of 25° south.

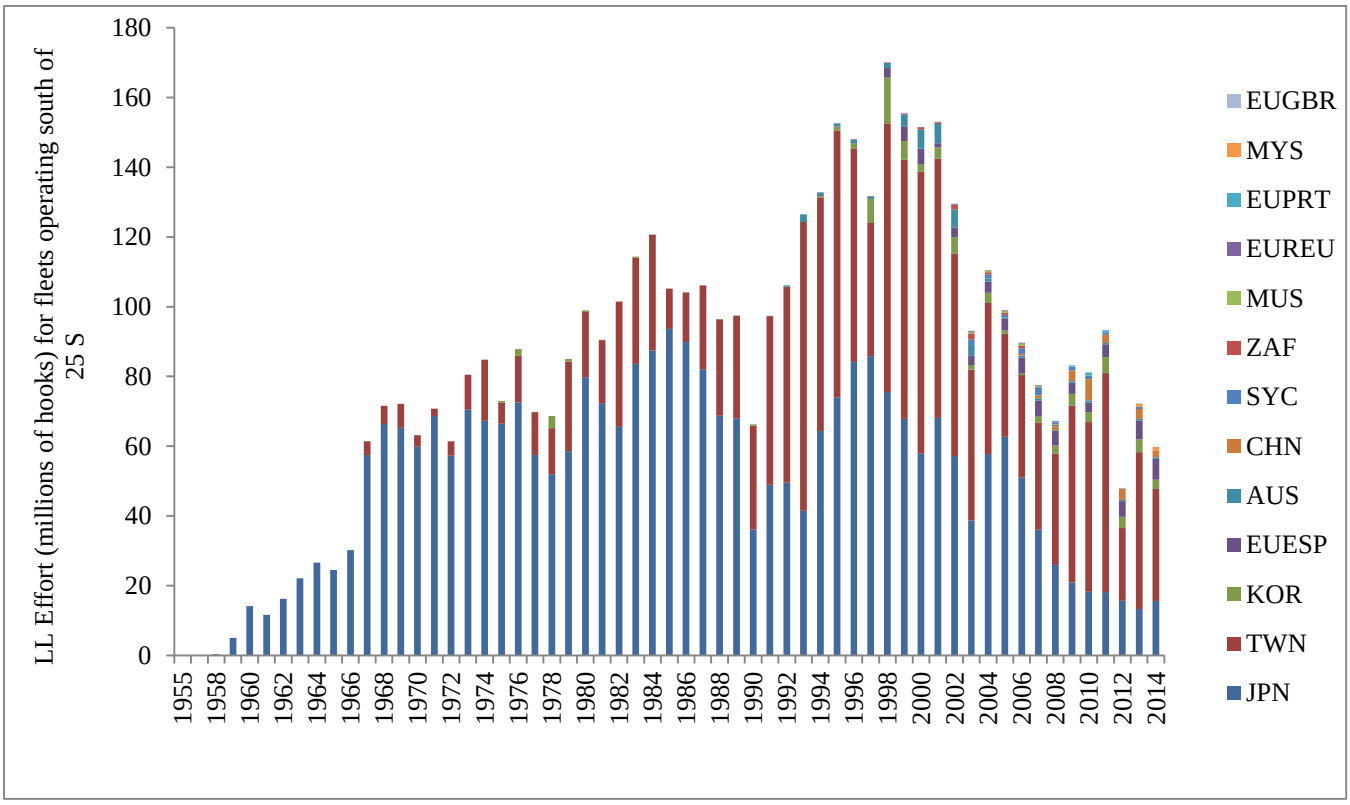
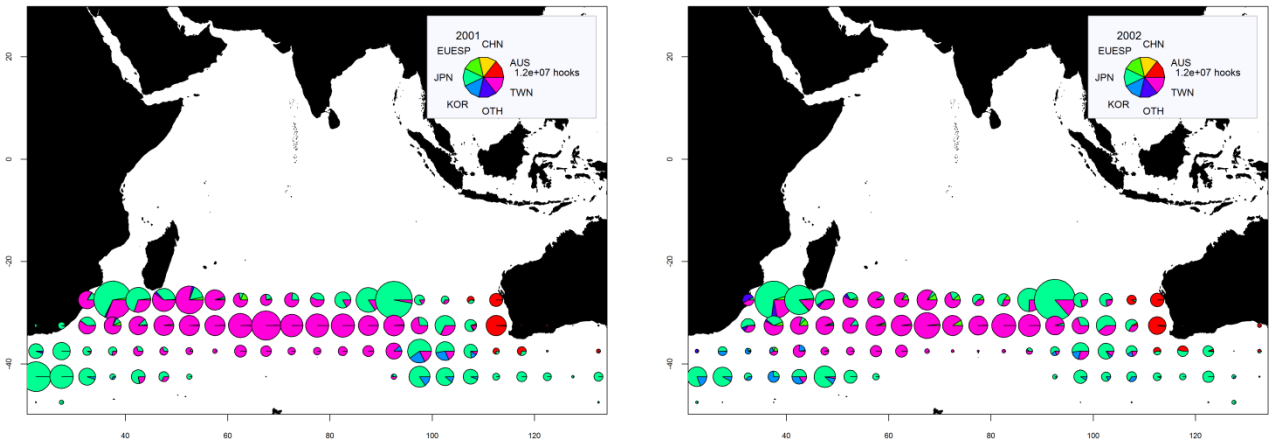
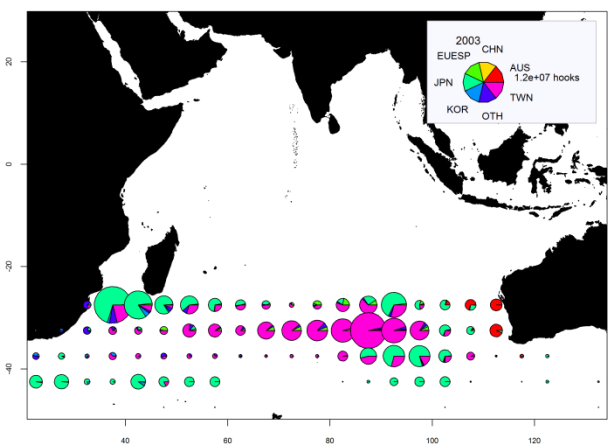
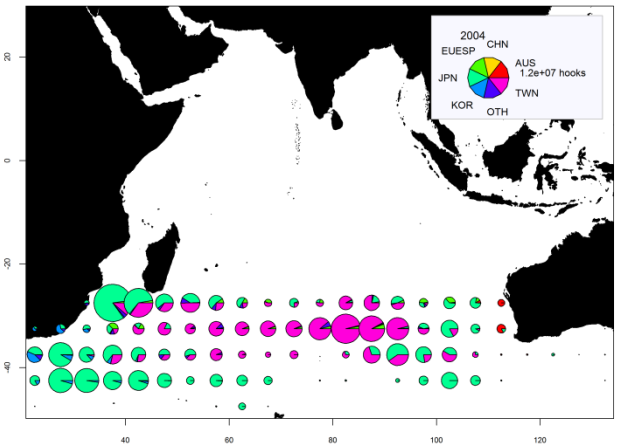
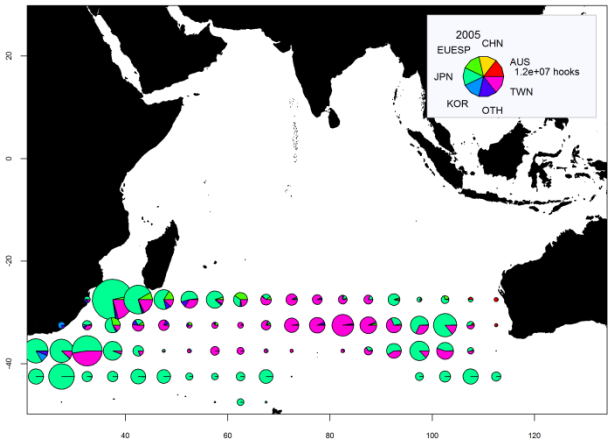


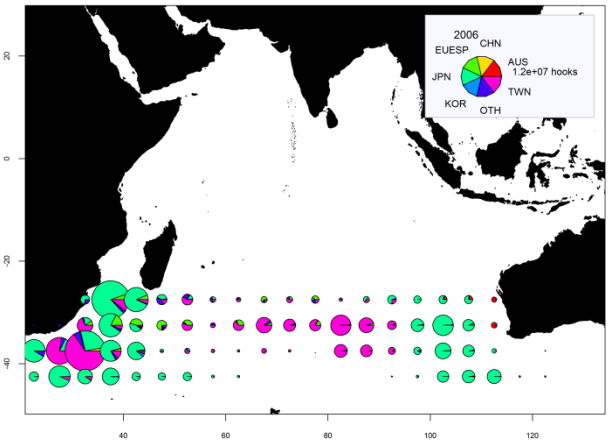
Figure 11. Longline effort for fleets operating south of 25° south between 1955 and 2014. (EUGBR = EU,UK, MYS = Malaysia, EUPRT = EU,Portugal, EU,REU = EU,France, MUS = Mauritius, ZAF, = South Africa, SYC = Seychelles, CHN = China, AUS = Australia, EUESP = EU,Spain, KOR = Rep. of Kora, TWN = Taiwan,China, JPN = Japan).

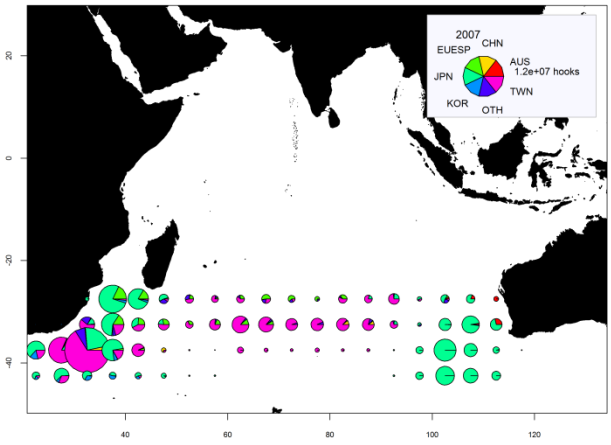


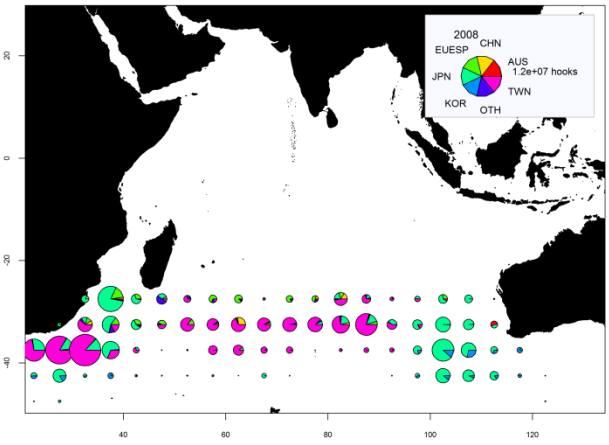

2003
EUESP
CHN
AUS
1.2e+07 hooks
JPN
TWN
KOR
OTH


2004
EUESP
CHN
AUS
1.2e+07 hooks
JPN
TWN
KOR
OTH


2005
EUESP
CHN
AUS
1.2e+07 hooks
JPN
TWN
KOR
OTH


2006
EUESP
CHN
AUS
1.2e+07 hooks
JPN
TWN
KOR
OTH


2007
EUESP
CHN
AUS
1.2e+07 hooks
JPN
TWN
KOR
OTH


2008
EUESP
CHN
AUS
1.2e+07 hooks
JPN
TWN
KOR
OTH

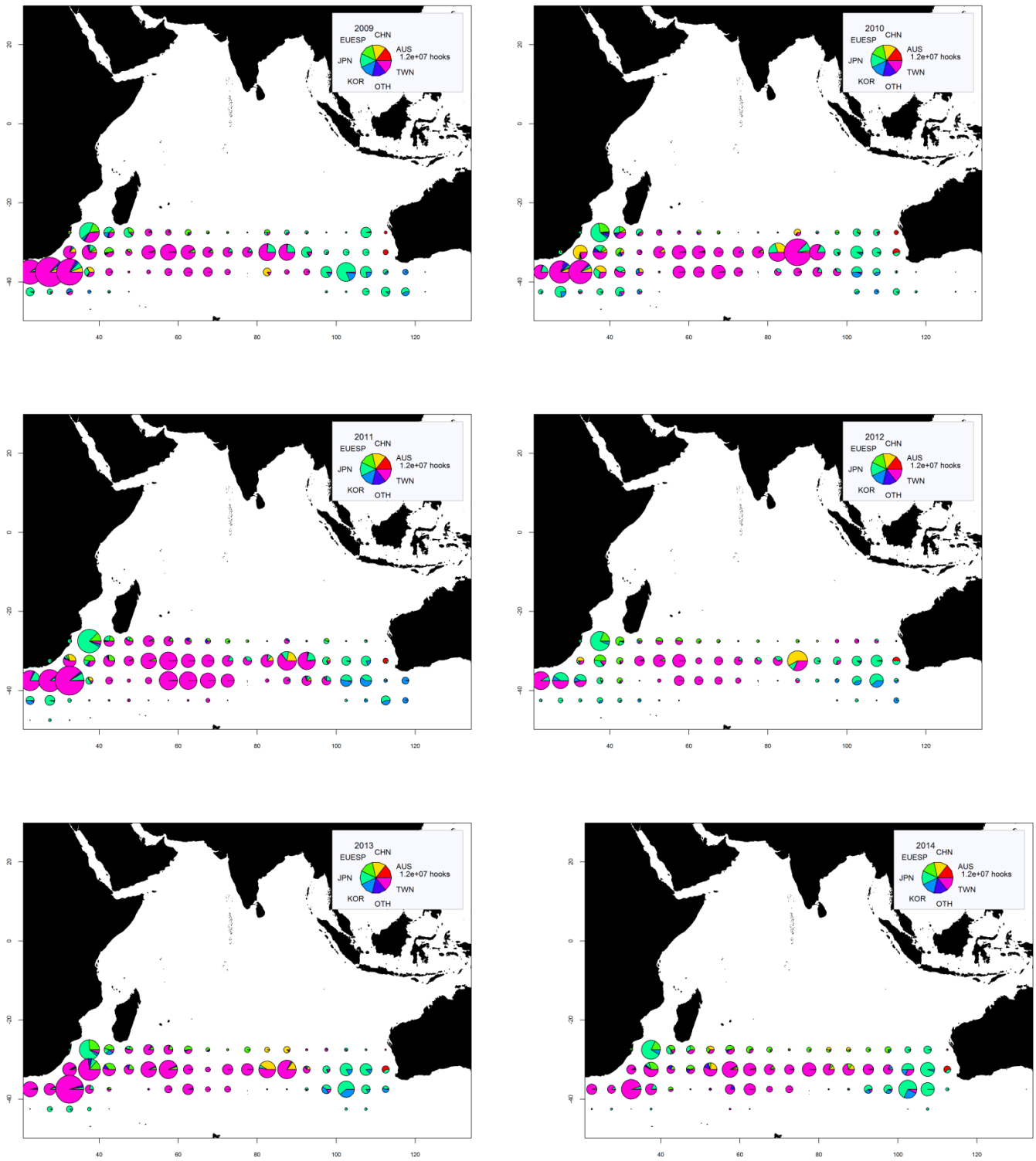


Figure 12. Longline effort for fleets operating south of 25° south between 2001 and 2014.

Status of data on seabird bycatch

Table 3 provides a summary of the data reported to date on the interactions of IOTC fisheries with seabirds. The data have been collated from a number of sources including formal data submissions such as discard reporting forms and data submitted through the Regional Observer Scheme as well as ad hoc data summarised in sources such as Working Party documents and National Reports, where available. While data were previously only available as ad hoc items in working party documents or national reports, more data have been formally submitted through discard forms in recent years, according to IOTC agreed data reporting procedures. This has helped to gradually standardise more of the data received, however, a lot of data are still only summarised in various reports and not formally submitted which hinders data management and subsequent analysis. All the data presented are based on longline interactions with seabirds, except

for Sri Lanka where the interactions were with the gillnet-longline combination fishery and the Maldivian pole and line fishery which has recorded nil interactions. Where the fate of the birds involved in these interactions was available this indicated that 28% were released alive, while the remainder were discarded dead (Table 4). These tables primarily highlight the paucity, poor quality and lack of standardisation of the information available which makes it difficult to estimate total levels of seabird bycatch by vessels in the IOTC area of competence.

Table 3. Number of reported interactions of IOTC fisheries with seabirds by species and year. Data sources include formally submitted discard reports, ad hoc data obtained from working party and national report documents and data submitted formally through the Regional Observer Scheme (Obs). Data were provided by Australia (nil interactions), the EU (France, Spain, Portugal), Rep. of Korea, Indonesia, Japan, Maldives (nil interactions), Sri Lanka, South Africa and Taiwan,China. [87% of data from discard reports, 11% from national reports and 2% from working party papers].

	2005	2006	2007	2008	2009	2010	(Obs)	2011	(Obs)	2012	(Obs)	2013	(Obs)	2014	(Obs)
Albatrosses nei		8	21		36	16	2	18	107	5		37	8	29	
Antarctic giant petrel							1				1				
Atlantic yellow-nosed albatross							15	10		18		10	5	77	
Black-browed albatross	9		24	10	13	35	26	8	4	62	16	19	5	11	2
Buller's albatross					1	9	9			1		1			
Cape gannet		1	61		7	12		10	8	1		1	1		
Cape Petrel			5		34	1	1			13	2	1			
Chatham Islands albatross										1326(t)					
Flesh-footed shearwater							2		2						
Grey-headed albatross			15	5	1	3	2	5	5	6	9	2		2	
Indian yellow-nosed albatross									52		7		17		
Light-mantled sooty albatross												11	7		
Northern giant petrel									1		1	2			
Northern royal albatross					1									2	
Petrels		2	96	2	27	1	1	45	8	3	1	14	4	2	
Shy albatross		6	252	69	74	31	3	23	19	13	13	41	10	9	
Skuas nei					2			1	1						
Sooty albatross									1			21	11	7	
Southern giant petrel			13	1	2	1			1	11		2			
Southern royal albatross					11	1				1		1			
Wandering albatross			16	6	1	9	12		3	36	9	5	1		
White-capped albatross							1		2	8		2		3	
White-chinned petrel		2	590	169	198	57		208	68	81	67	154	45	105	
Yellow-nosed albatross			66	11	15	47	1	65	18	29		102		53	
Great-winged petrel			1												
Terns nei					1										
Shearwaters nei														1	
Other seabirds	33		17	23	287	437	10	13	41	12	14	27			
Total	**42**	**19**	**1177**	**296**	**711**	**660**	**86**	**406**	**341**	**300**	**140**	**453**	**114**	**301**	**2**

Table 4. Fate of seabird bycatch recorded by observers (numbers)

Bycatch fate	**2010**	**2011**	**2012**	**2013**	**2014**
Released alive	1	75	24	33	
Dead	75	77	113	81	2

SUMMARY OF FISHERIES DATA AVILABLE FOR MARINE TURTLES

Main species and fisheries concerned

The main species of marine turtles likely to be caught as bycatch by IOTC fisheries are listed in Table 5**.**

Table 5. Main species of Indian Ocean marine turtles[4].

Common Name	Scientific Name
Loggerhead turtle	*Caretta caretta*
Olive ridley turtle	*Lepidochelys olivacea*
Green turtle	*Chelonia mydas*
Hawksbill turtle	*Eretmochelys imbricata*
Leatherback turtle	*Dermochelys coriacea*
Flatback turtle	*Natator depressus*

The interaction between marine turtles and IOTC fisheries is likely to be significant only in tropical areas, involving both industrial and artisanal fisheries, notably for:

- Industrial purse seine fisheries, in particular on sets using fish aggregating devices (EU, Seychelles, I.R. Iran, Thailand, Japan)
- Gillnet fisheries operating in coastal waters or on the high seas (Sri Lanka, I.R. Iran, Pakistan, Indonesia)
- Industrial longline fisheries operating in tropical areas (China, Taiwan,China, Japan, Indonesia, Seychelles, India, Oman, Malaysia and the Philippines)

Status of data on marine turtle bycatch

Table 6 provides a summary of the data reported to date on the interactions of IOTC fisheries with marine turtles. The data have been collated from a number of sources including formal data submissions such as discard reporting forms and data submitted through the Regional Observer Scheme as well as collated from summaries such as Working Party documents and National Reports, where available. The majority of the reported data are based on longline interactions (95%), followed by purse seine (3%) and gillnet (2%) fisheries, while the reported interactions for the pole and line fisheries were nil. Many turtles are still not identified to species level even when they are reported, but of those that are identified, the interactions were most frequently observed with Leatherback followed by Loggerhead and Olive Ridley turtles. There were also some unusual findings such as the presence of Kemp's ridley turtle, suggesting there may also be issues with species identification. Where data were available on the survival of marine turtles, 82% were reported to be released alive, while the remainder were discarded dead (Table 7). These tables highlight the paucity and poor quality of the information available which makes it difficult to estimate total levels of marine turtle bycatch by species.

[4] Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia

Table 6. Number of reported interactions of IOTC fisheries with turtles by species and year. Data sources include formally submitted discard reports, ad hoc data obtained from working party and national report documents and data submitted formally through the Regional Observer Scheme (Obs). Data were provided by the longline fisheries of Australia, China (nil interactions), EU (all fleets), South Africa, Rep. of Korea, Indonesia, Japan, Madagascar, Maldives, Sri Lanka and Taiwan,China. Data were also provided from the surface fisheries of Maldives (nil interactions), EU and the Republic of Korea and the gillnet fisheries of I.R. Iran and Sri Lanka. [70% of data from discard reports, 5% from national reports and 25% from working party papers].

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	(Obs)	2011	(Obs)	2012	(Obs)	2013	(Obs)	2014	(Obs)
Flatback turtle												1							
Green turtle				2	2			2				1	1	6		39	4	1	
Hawksbill turtle							2		6				1	1		14	1	1	
Kemp's ridley turtle																		2	
Leatherback turtle	40	49	37	4	2	5	14	12	20	24	2	5	4	7	4	5	3	12	1
Loggerhead turtle	2	2	14	6	4	5	13	16	17	5	1	5	4	14	5	23	13	15	2
Olive ridley turtle	2				2		6	4	30	4	12			47	2	21	1		1
Marine turtles NEI	4	8	283	192	242	519	575	331	323	137		13	2	37	3	175	4	23	1

Table 7. Fate of turtle bycatch recorded by observers (numbers)

Values	**2010**	**2011**	**2012**	**2013**	**2014**
Dead		2	4	4	
Released alive	1	10	8	22	5

SUMMARY OF FISHERIES DATA AVILABLE FOR MARINE MAMMALS

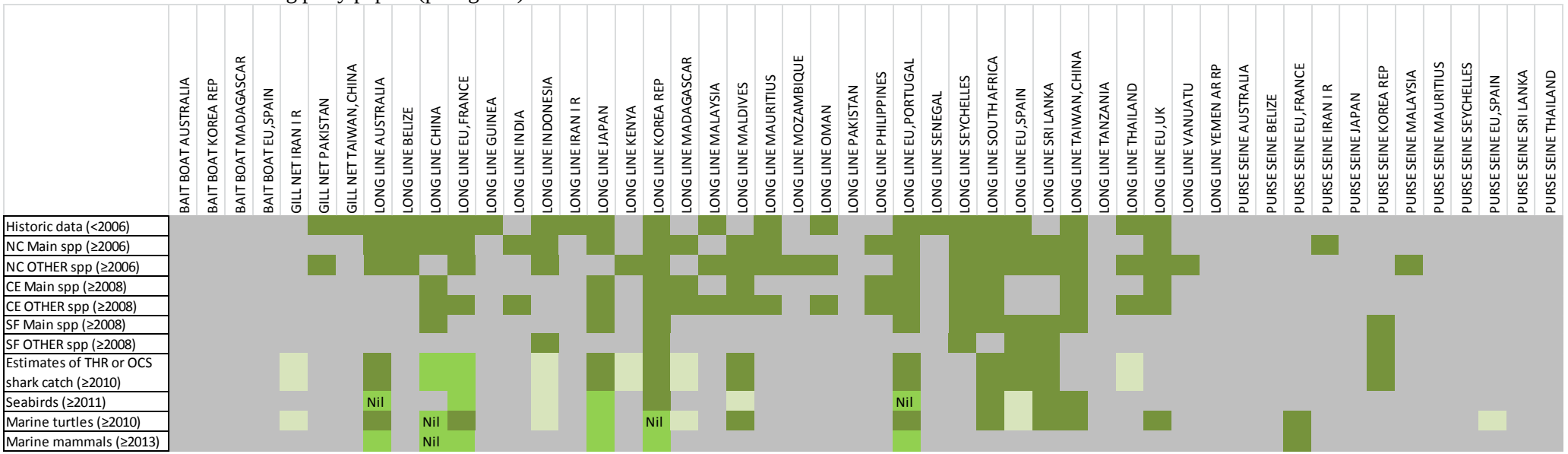
The reporting of the interactions of IOTC fisheries with marine mammals has been extremely limited to date. Most of the little data that have been reported are from the longline fisheries of Australia, China (nil interactions), EU, Indonesia, Rep. of Korea, Japan, South Africa and Taiwan,China, the purse seine fisheries of EU and Korea, Iranian gillnet fishery and nil interactions reported from the pole and line fisheries. The current low level, lack of standardisation and ad hoc nature of data reporting are not conducive to supporting regional level analyses.

Table 8. Reported interactions of marine mammals with IOTC fisheries

	2006	2007	2008	2009	2010	2011	2012	2013	2014
Baleen whales nei								80	
Bottlenose dolphin		1		1			1		
Common Dolphin					1				
Dolphins nei	2	1	1				24kg		
Spinner dolphin				1			1		
False killer whale					1				
Pygmy killer whale				1			1		
Humpback whale						1			
Seal	2	1		1		1			
South African fur seal			1						
Killer whale	1	1			1	1			
unidentified mammals			18	3		6	5		1
Total	5	4	20	7	3	9	8	80	1

Table 9 provides a summary of the data that have been provided by CPCs for industrial fleets according to IOTC reporting requirements

Table 9. Datasets provided by industrial fleets according to IOTC reporting requirements[5]. Grey cells indicate which fleets have reported data for IOTC species, whereas green cells indicate which fleets have provided the bycatch data specified. Results are based on the nominal catch, catch–and-effort and size frequency data held within the databases at the IOTC Secretariat on 14 August 2015 and other information on seabirds, marine turtles, mammals, thresher shark and oceanic whitetip shark is taken from formally submitted discard reports (dark green), reported observer data (medium green) or information that has been summarised in documents such as national reports to the Scientific Committee or working party papers (pale green).



[5] NB: seabird discard reports for the Japan longline fleet and turtle discard reports for the Japan and Taiwan,China longline fleets were all submitted by South Africa

APPENDIX V
MAIN ISSUES IDENTIFIED CONCERNING DATA ON NON-IOTC SPECIES

General issues

There are a number of key issues with the data that are apparent from this summary. The main points are discussed below.

Sharks

- Unreported catches

Although some fleets have been operating since 1950, there are many cases where historical catches have gone unreported as many countries were not collecting fishery statistics in years prior to 1970. It is therefore thought that important catches of sharks might have gone unrecorded in several countries. There are also a number of fleets which are still not reporting on their interactions with bycatch species, despite fleets using similar gears reporting high catch rates of bycatch.

Some fleets have also been noted to report catches by species only for those that have been specifically identified by the Commission and do not report catches of other species even in aggregate form. This creates problems for the estimation of total catches of all sharks and for attempts to apportion aggregate catches into species groups at a later date. The changing requirements for species-specific reporting also complicates the interpretation of these data.

- Errors in reported catches

For the fleets that do report interactions, there are a number of issues with these estimates. The estimates are sometimes based on retained catches rather than total catches, and so if discarding is high then this is a major source of error. Errors are also introduced due to the processing of the retained catches that is undertaken. This creates problems for calculating total weight or numbers, as sometimes dressed weight might be recorded instead of live weights. For high levels of processing, such as finning where the carcasses are not retained, the estimation of total live weight is extremely difficult.

- Poor resolution of data

Historically, shark catches have not been reported by species but simply as an aggregated total, however, the proportion of catches reported by species has increased substantially in recent years. Misidentification of shark species is also common. Processing creates further problems for species identification, requiring a high level of expertise and experience in order to be able to accurately identify specimens, if at all. The level of reporting by gear type is much higher and catches reported with no gear type allocated form a small proportion of the total.

The main consequence of this is that the estimation of total catches of sharks in the Indian Ocean is compromised by the paucity of the data available.

Other bycatch species groups

The reporting of non-IOTC species other than sharks is extremely poor and where it does occur, this is often in the form of patchy information which is not submitted according to IOTC data reporting procedures, is unstandardized and often lacking in clarity. While ad hoc pieces of information from a number of sources have been collated here as far as possible, it is noted that data presented in various documents such as Working Party papers and National Reports are not considered to be formal data submissions to the IOTC. Formal submissions of data in an electronic and standardized format using the available IOTC templates will considerably improve the quality of data obtained and the type of regional analyses that these data can be used for.

The following list is provided by the IOTC Secretariat for the consideration of the WPEB. The list covers the main issues which the IOTC Secretariat considers to affect the quality of the statistics available at the IOTC Secretariat, by type of dataset and type of fishery.

SHARKS

1. Catch-and-Effort data from gillnet fisheries:

- Drifting gillnet fisheries of I.R. Iran and Pakistan: To date, I.R. Iran and Pakistan have not reported catches of sharks, by species, for the gillnet fisheries.
- Gillnet/longline fishery of Sri Lanka: Sri Lanka has not reported catch-and-effort data for sharks since 2006 and has not submitted these data according IOTC standards.
- Driftnet fishery of Taiwan,China (1982–92): Catch-and-effort data does not include catches of sharks by species.

2. **Catch-and-Effort data from Longline Fisheries:**
   - Historical catches of sharks from major longline fisheries: To date, Japan, Taiwan,China, Indonesia and Rep. of Korea, have not provided estimates of catches of sharks, by species, for years before 2006.
   - Fresh-tuna longline fisheries of Indonesia and Malaysia: Indonesia and Malaysia have not reported catches of sharks by IOTC standards for longliners under their flag. In addition Indonesia has not reported catch-and-effort data for its longline fishery to date.
   - Freezing longline fisheries of EU,Spain, India, Indonesia, Malaysia, and Oman: These countries have not reported catch-and-effort data of sharks by species for longliners under their flag.
3. **Catch-and-Effort data from coastal fisheries:**
   - Coastal fisheries of India, Indonesia, Madagascar, Sri Lanka and Yemen: To date, these countries have not provided detailed catches of sharks to the IOTC, in particular thresher sharks and other pelagic shark species caught by their coastal fisheries.
4. **Discard levels from surface and longline fisheries:**
   - Discard levels of sharks from major longline fisheries: To date the EU (France, Spain, UK), Japan, Taiwan,China and Indonesia, have not provided estimates of total discards of sharks, by species, in particular thresher sharks and oceanic whitetip sharks, although the EU,France and Japan are reporting discards in their observer data.
   - Discard levels of sharks for industrial purse seine fisheries: To date, the EU,Spain, I.R. Iran, Japan, Seychelles, and Thailand have not provided estimates of total quantities of discards of sharks, by species, for industrial purse seiners under their flag.
5. **Size frequency data:**
   - Gillnet fisheries of I.R. Iran and Pakistan: To date, I.R. Iran and Pakistan have not reported size frequency data for their driftnet fisheries.
   - Longline fisheries of India, Malaysia, Oman and Philippines: To date, these countries have not reported size frequency data for their longline fisheries. Sri Lanka has recently reported some size frequency data by species for 2014, however, these data are very limited.
   - Coastal fisheries of India, Indonesia, Madagascar and Yemen: To date, these countries have not reported size frequency data for their coastal fisheries.
6. **Biological data:**
   - Surface and longline fisheries, in particular China, Taiwan,China, Indonesia and Japan: The IOTC Secretariat had to use length-age keys, length-weight keys, ratios of fin-to-body weight, and processed weight-live weight keys for sharks from other oceans due to the limited amount of biological data available.

OTHER BYCATCH

1. **Incidental catches of SEABIRDS:**
   - Longline fisheries operating in areas with high densities of seabirds. Seychelles, Malaysia, Mauritius, China, EU(UK) have not reported incidental catches of seabirds for longliners under their flag.
2. **Incidental catches of MARINE TURTLES:**
   - Gillnet fisheries of Pakistan and Indonesia: to date, there have been no reports on incidental catches of marine turtles for the driftnet fisheries.
   - Longline fisheries of Malaysia, Oman, India, Philippines and Seychelles: To date, these countries have not reported incidental catches of marine turtles for their longline fisheries.
   - Purse seine fisheries of Japan, Seychelles, I.R. Iran and Thailand: To date these countries have not reported incidental catches of marine turtles for their purse seine fisheries, including incidental catches of marine turtles on Fish Aggregating Devices.

While the CPCs that have not provided any information have been mentioned specifically here, there are still many CPCs that are providing data that are not consistent with the IOTC minimum reporting standards. This includes not reporting bird bycatch data by species and not providing an estimation of the total mortality of marine turtles incidentally caught in their fisheries.

APPENDIX VI
AVAILABILITY OF CATCH DATA FOR SHARKS BY GEAR

Availability of catch data for the main shark species expressed as the proportion of fleets for which catch data on sharks are available out of the total number of fleets for which data on IOTC species are available, by fishery, species of shark, and year, for the period 1950–2014.

Shark species in bold are those identified as mandatory for reporting by each fleet, for which data shall be recorded in logbooks and reported to the IOTC Secretariat; reporting of catch data for other species can be done in aggregated form (i.e. all species combined as ***sharks nei*** or ***mantas and rays nei***).
Hook and line refers to fisheries using handline and/or trolling and ***Other gears nei*** to other unidentified fisheries operated in coastal waters.
Catch rates of sharks on pole-and-line fisheries are thought to be nil or negligible.
Average levels of reporting for 1950–2014 and 2010–2014 are shown in columns ***All*** and ***Last***, respectively.

APPENDIX VII
IMPLEMENTATION OF THE REGIONAL OBSERVER SCHEME
(Updated 9 September 2015)

CPCs	Active Vessels LOA≥24m or High Seas vessels[6]				Progress	List of accredited observers submitted	Number of observer reports provided[7]					
	LL	PS	GN	BB			2010	2011	2012	2013	2014	2015
MEMBERS												
Australia	3	5			Australia has implemented an observer programme for the longline fleet	**YES: 21**	**2(O)**	**1(O)**	**3(O)**	**No**	**2(O)**	**No**
Belize	4				No information received by the Secretariat.	**No**	**No**	**No**	**No**	**No**	**No**	**No**
China –Taiwan,China	47 241				China has implemented an observer programme	**YES: 3** **YES: 54**	**1(O)** **No**	**No** **No**	**1(O)** **No**	**1(O)** **No**	**No** **No**	**No** **No**
Comoros					Comoros does not have vessels ≥ 24m. Two observers were trained under the IOC Regional Monitoring Project, and 5 by SWIOFP.	**YES: 7**	N/A	N/A	N/A	N/A	N/A	N/A
Eritrea	No information received				No information received by the Secretariat.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
European Union	15 6 22 2	13 0 15 0			EU has an observer programme on-board its purse seine and longline fleets. To date, no information has been received from EU,Spain and EU,UK.	Partial: **EU,France: 52** **EU,Portugal: 4** **EU,Spain : 9** **EU,UK : No**	**No**	EU, France: 13+9**(O)** EU, Portugal: 1**(O)**	EU, France: 13+7**(O)** EU, Portugal: 1**(O)**	EU, France: 15+7**(O)** EU, Portugal: 1**(O)**	EU, France: 18(O) EU, Portugal: 1**(O)**	**No**
Guinea					Guinea has had no vessels operating in the Indian Ocean since 2006	N/A	N/A	N/A	N/A	N/A	N/A	N/A
India					India has not yet developed an observer programme.	**No**	**No**	**No**	**No**	**No**	**No**	**No**
Indonesia	458				Indonesia has 13 registered IOTC observers and a number of initiatives, however, no data have been submitted to the IOTC Secretariat	**YES:13**	**No**	**No**	**No**	**No**	**No**	**No**
Iran, Isl. Rep. of		5	1223		30 observers have been selected and are due to be deployed in 2016. IOTC observer training will be taking place in 2015.	**No**	**No**	**No**	**No**	**No**	**No**	**No**
Japan	53				Japan started its observer programme on the 1st of July 2010, and currently deploys 19 observers in the Indian Ocean.	**YES: 19**	**6(E)**	**8(E)**	**7(E)**	**No**	**No**	**No**
Kenya					Kenya is developing an observer programme and 5 observers have been trained by SWIOFP. Kenya has had no vessels listed in the active vessel registry since 2010.	**YES: 5**	**No**	N/A	N/A	N/A	N/A	N/A

[6] The number of active vessels is given for 2014
[7] Year in which the observed trip has started (E: Electronic; O: Other)

CPCs	Active Vessels LOA≥24m or High Seas vessels[6]				Progress	List of accredited observers submitted	Number of observer reports provided[7]					
	LL	PS	GN	BB			2010	2011	2012	2013	2014	2015
Korea, Rep. of	10	4			Korea has had an observer programme since 2002 and has 28 observers registered in the Indian Ocean.	YES: 28	2(O)	No	2(O)	3(O)	3(O)	No
Madagascar	7				Madagascar has developed an observer programme. Five and three observers have been trained through SWIOFP and IOC respectively.	YES: 7	No	No	5(O) [8]	8(O)	7(O)	No
Malaysia	11				Malaysia is developing plans for the implementation of an observer programme.	No	No	No	No	No	No	No
Maldives	27			317	Maldivian vessel landings are monitored by field samplers at landing sites. Maldives is currently developing an at-sea observer programme.	YES: 4	No	No	No	No	No	No
Mauritius		7			Mauritius is developing an observer programme. Five observers have been trained through SWIOFP and three through the IOC.	YES: 8	No	No	No	No	No	No
Mozambique	2				Mozambique has an observer programme and has submitted one trip report, but did not have any active vessels ≥24m in 2013.	YES: 11	No	No	1(O)	N/A	No	No
Oman	3				No onboard observers have yet been deployed, however IOTC training will take place in 2015.	No	No	No	No	No	No	No
Pakistan					Onboard observers have been deployed through WWF-Pakistan, however no data has been submitted to the IOTC Secretariat. Training will be taking place in 2015.	No	No	No	No	No	No	No
Philippines	4				No information received by the Secretariat.	No	No	No	No	No	No	No
Seychelles	31	8			Seychelles is developing an observer programme. Four observers have been trained through SWIOFP and three through the IOC.	YES: 7	No	No	No	No	No	No
Sierra Leone	No information received				No information received by the Secretariat.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Somalia	No information received				No information received by the Secretariat.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sri Lanka	13	7	1589		Sri Lanka has begun a pilot observer initiative and submitted observer data from pilot trips in 2015 for review.	No	No	No	No	No	No	No
Sudan	No information received				No information received by the Secretariat.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tanzania, United Rep.of	3				Tanzania does not currently have an observer programme in place.	No	No	No	No	No	No	No
Thailand	6				No information received by the Secretariat.	No	No	No	No	No	No	No
United Kingdom (OT)					The UK(OT) does not have any active vessels in the Indian Ocean.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vanuatu					Vanuatu does not currently have an observer programme in place.	No	No	N/A	No	No	No	No

[8] Reports from Madagascar include observers onboard foreign vessels

CPCs	Active Vessels LOA≥24m or High Seas vessels[6]				Progress	List of accredited observers submitted	Number of observer reports provided[7]					
	LL	PS	GN	BB			2010	2011	2012	2013	2014	2015
Yemen	No information received				No information received by the Secretariat.	**No**	**No**	**No**	**No**	**No**	**No**	**No**
COOPERATING NON-CONTRACTING PARTIES												
Bangladesh					No information received by the Secretariat.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Djibouti					No information received by the Secretariat.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Liberia					No information received by the Secretariat.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Senegal					Senegal has not had any active vessels in the Indian Ocean since 2007.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
South Africa	6				South Africa currently only operates an observer programme for foreign vessels operating within the EEZ.	**YES: 16**	**No**	**13(O)[9]**	**10(O)**	**13(O)**	**9(O)**	**No**

[9] Reports from South African observers onboard foreign vessels operating in the EEZ of South Africa, except for one report in 2014 on a S.African flagged vessel.

APPENDIX VIII

2015: STATUS OF DEVELOPMENT AND IMPLEMENTATION OF NATIONAL PLANS OF ACTION FOR SEABIRDS AND SHARKS, AND IMPLEMENTATION OF THE FAO GUIDELINES TO REDUCE MARINE TURTLE MORTALITY IN FISHING OPERATIONS

(*Current as of 11 September 2015*)

CPC	Sharks	Date of Implementation	Seabirds	Date of implementation	Marine turtles	Date of implementation	Comments
MEMBERS							
Australia		1st: April 2004 2nd: July 2012		1st: 1998 2nd: 2006 3rd: 2014		2003	**Sharks:** 2nd NPOA-Sharks (Shark-plan 2) was released in July 2012, along with an operational strategy for implementation: http://www.daff.gov.au/fisheries/environment/sharks/sharkplan2 **Seabirds:** Has implemented a Threat Abatement Plan [TAP] for the Incidental Catch (or Bycatch) of Seabirds During Oceanic Longline Fishing Operations since 1998. The present TAP took effect from 2014 and largely fulfills the role of an NPOA in terms of longline fisheries. http://www.antarctica.gov.au/__data/assets/pdf_file/0017/21509/Threat-Abatement-Plan-2014.pdf Australia is developing an NPOA to address the potential risk posed to seabirds by other fishing methods, including longline fishing in state and territory waters, which are not covered by the current threat abatement plan. **Marine turtles:** Australia's current marine turtle bycatch management and mitigation measures fulfill Australia's obligations under the FAO-Sea turtles Guidelines.
Belize							**Sharks:** No information received by the Secretariat. **Seabirds:** No information received by the Secretariat. **Marine turtles:** No information received by the Secretariat.
China		–		–			**Sharks:** Development has not begun. **Seabirds:** Development has not begun. **Marine turtles:** No information received by the Secretariat.
–Taiwan,China		1st: May 2006 2nd: May 2012		1st: May 2006 2nd: Jul 2014			**Sharks:** No revision currently planned. **Seabirds:** No revision currently planned. **Marine turtles:** Domestic laws introduced in 2013. Available on request.
Comoros		–		–			**Sharks:** Development has not begun. **Seabirds:** Development has not begun. **Marine turtles:** No information received by the Secretariat.
Eritrea							**Sharks:** No information received by the Secretariat. **Seabirds:** No information received by the Secretariat. **Marine turtles:** No information received by the Secretariat.
European Union		5 Feb 2009		16-Nov-2012		2007	**Sharks:** Approved on 05-Feb-2009 and it is currently being implemented. **Seabirds:** The EU adopted on Friday 16 November an Action Plan to address the problem of incidental catches of seabirds in fishing gears. **Marine turtles**: European Union Council Regulation (EC) No 520/2007 of 7 May 2007 lay down technical measures for the conservation of marine turtles including articles and provisions to reduce marine turtle bycatch. The regulation urges Member States to do their utmost to reduce the impact of

							fishing on sea turtles, in particular by applying the measures provided for in paragraphs 2, 3 and 4 of the resolution.
France (territories)		5 Feb 2009		2009, 2011		Pending: 2015	**Sharks:** Approved on 05-Feb-2009. **Seabirds:** Implemented in 2009 and 2011. 2009 for Barrau's petrel and 2011 for Amsterdam albatross. **Marine turtles:** To be implemented in 2015 for the five species of marine turtles that are present in the southwest Indian Ocean.
Guinea							**Sharks:** No information received by the Secretariat. **Seabirds:** No information received by the Secretariat. **Marine turtles:** No information received by the Secretariat.
India							**Sharks:** In preparation. In June 2015, India published a document entitled "Guidance on National Plan of Action for Sharks in India" which is intended as a guidance to the NPOA-Sharks, and seeks to (1) present an overview of the currents status of India's shark fishery, (2) assess the current management measures and their effectiveness, (3) identify the knowledge gaps that need to be addressed in NPOA-Sharks and (4) suggest a theme-based action plan for NPOA-Sharks. **Seabirds:** India has determined that seabird interactions are not a problem for their fleets. However, a formal evaluation has not yet taken place which the WPEB and SC require. **Marine turtles:** No information received by the Secretariat.
Indonesia		–		–			**Sharks:** NPOA guidelines developed and released for public comment among stakeholders in 2010 (funded by ACIAR Australia—DGCF). Training commenced in 2011, including data collection for sharks based on forms of statistical data to national standards (by DGCF (supported by ACIAR Australia). Implementation expected late 2011/early 2012. **Seabirds:** Development has not begun. **Marine turtles:** No information received by the Secretariat.
Iran, Islamic Republic of		–		–		_	**Sharks:** Have communicated to all fishing cooperatives the IOTC resolutions on sharks. Have in place a ban on the retention of live sharks. **Seabirds:** I.R. Iran determined that seabird interactions are not a problem for their fleet as they consist of gillnet vessels only. i.e. no longline vessels. **Marine turtles:** No information received by the Secretariat.
Japan		03-Dec-2009		03-Dec-2009			**Sharks:** NPOA–Shark assessment implementation report submitted to COFI in July 2012 **Seabirds:** NPOA–Seabird implementation report submitted to COFI in July 2012. **Marine turtles:** No information received by the Secretariat.
Kenya			n.a.	–			**Sharks:** A National Plan of Action for sharks is being developed and shall put in place a framework to ensure the conservation and management of sharks and their long-term sustainable use in Kenya. A shark assessment Report shall be developed by the end of the 2015 calendar year. **Seabirds:** Kenya does not have any flagged longline vessels on its registry. There is no evidence of any gear seabird interaction with the current fishing fleet. Kenya does not therefore consider developing NPOA seabirds as necessary for the time being. **Marine turtles:** The Kenyan fisheries law prohibits retention and landing of turtles caught incidentally in fishing operations. Public awareness efforts are conducted for artisanal gillnet and artisanal longline fishing fleets on the mitigations measures that enhance marine turtle conservation.

Korea, Republic of		08-Aug-11		–		–	**Sharks:** Currently being implemented. **Seabirds:** Drafted in January 2014 and on standby for approval by the minister. **Marine turtles:** All Rep. of Korea vessels fully implement Res 12/04.
Madagascar		–		–			**Sharks:** Development has not begun. **Seabirds:** Development has not begun. Note: A fisheries monitoring system is in place in order to ensure compliance by vessels with the IOTC's shark and seabird conservation and management measures. **Marine turtles:** No information received by the Secretariat.
Malaysia		2008	n.a.	–		2008	**Sharks:** A review of the NPOA-Shark (2008) is in the final stages, with stakeholder consultation due to be completed in September 2013. A revised NPOA-Sharks is expected to be published by the end of 2013. **Seabirds:** Malaysia has carried out a review and determined that an NPOA-Seabirds is not necessary as no longline vessels flagged to Malaysia fish south of 20 degrees south. **Marine turtles:** A NPOA For Conservation and Management of Sea Turtles had been published in 2008.
Maldives, Republic of		Apr 2015	n.a.	–			**Sharks:** Maldives has developed the NPOA-Sharks with the assistance of Bay of Bengal Large Marine Ecosystem (BoBLME) Project. A stakeholder consultation for the NPOA-Sharks was held in April of 2014. The NPOA-Sharks is in the finalization process and is expected to be published in November of 2014. The longline logbooks ensure the collection of shark bycatch data to genus level. Maldives would be reporting on shark bycatch to the appropriate technical Working Party meetings of IOTC. **Seabirds:** Article 12 of IPOA states that if a 'problem exists' CPCs adopt an NPOA. IOTC Resolution 05/09 suggests CPCs to report on seabirds to the IOTC Scientific Committee if the issue is appropriate'. Maldives considers that seabirds are not an issue in the Maldives fisheries, both in the pole-and-line fishery and in the longline fishery. The new longline fishing regulations has provision on mitigation measures on seabird bycatch. **Marine turtles:** Longline regulation has provisions to reduce marine turtle bycatch. The regulation urges longline vessels to have dehookers for removal of hook and a line cutter on board, to release the caught marine turtles as prescribed in Resolution 12/04.
Mauritius							**Sharks:** Mauritius does not issue national or foreign fishing licence to vessels targeting sharks in its Exclusive Economic Zone. However, sharks are usually landed as bycatch. Mauritius will work in consultation with the IOTC Secretariat to prepare a simplified NPOA-sharks for Mauritius. **Seabirds:** Mauritius does not have national vessels operating beyond 25^0S. However, fishing companies have been requested to implement all mitigation measures as provided in the IOTC Resolutions. **Marine turtles:** Mauritius does not have national boats operating outside its EEZ. Moreover, marine turtles are protected by the national law. Fishing companies have been **requested** to carry line cutters and de-hookers in order to facilitate the appropriate handling and prompt release of marine turtles caught or entangled.
Mozambique		–		–			**Sharks**: Drafting of new legislation is in progress which considers the issues of shark conservation in licensing requirements. The SWIOFish project within the framework of the implementation of the Linefish Management Plan is

							going to finance the NPOA shark from 2015. Moreover, Mozambique has developed in 2014, the Terms and Conditions of Licensing for tuna fishing to be attached to fishing license. These contain all the measures for the conservation and management of tuna fisheries and include the aspects related to conservation of sharks, seabirds and marine turtles. **Seabirds**: Mozambique is regularly briefing the Masters of their fishing vessels on the mandatory requirement to report any seabird interaction with longliner fleet. **Marine turtles**: see above.
Oman, Sultanate of							**Sharks:** No information received by the Secretariat. **Seabirds:** No information received by the Secretariat. **Marine turtles:** No information received by the Secretariat.
Pakistan							**Sharks:** Sharks are landed with the fins attached and each and every part of the body of sharks are utilised. A workshop on "Conservation and Management of Sharks was conducted on 15th September 2014. As per recommendations of the workshop, there is still a need for collection and synthesis of more compatible data to prepare Shark Assessment Report (SAR) / draft NPOA. PLAN: (i) October, 2014 to March 2015: Collection and synthesis of additional data. (ii) April, 2015 to June 2015: Preparation of SAR and draft NPOA. Circulation of draft NPOA to concerned stakeholders for comments. (iii) July, 2015 to September 2015: Holding workshop, presentations of draft NPOA / comments, recommendations and adoption of NPOA. **Seabirds:** Pakistan considers that seabird interactions are not a problem for Pakistani fishing fleet as our tuna fishing operations do not include longline vessels. **Marine turtles:** Pakistan has already framed Regulations regarding the prohibition of catching and retaining marine turtles. As regards to the reduction of marine turtle bycatch by gillnetters; presently Marine Fisheries Department (MFD) in collaboration with International Union for Conservation of Nature (IUCN) Pakistan, is undertaking an assessment. Stakeholder Coordination Committee Meeting was conducted on 10th September 2014. The "Turtle Assessment Report (TAR)" will be finalized by February 2015 and necessary guidelines / action plan will be finalized by June 2015. As per clause-5 (c) of Pakistan Fish Inspection & Quality Control Act, 1997, "Aquatic turtles, tortoises, snakes, mammals including dugongs, dolphins, porpoises and whales etc" are totally forbidden for export and domestic consumption.
Philippines		Sept. 2009		–			**Sharks:** Under periodic review. **Seabirds:** Development has not begun. No seabird interactions recorded. **Marine turtles:** No information received by the Secretariat.
Seychelles, Republic of		Apr-2007		–			**Sharks:** NPOA-sharks to currently being reviewed and a new NPOA is being developed for 2016-19. **Seabirds:** Development has not begun. The industrial longline fleet of Seychelles has been instructed to conform with the requirements of Res. 12/06. **Marine turtles:** No plan developed as the moment.
Sierra Leone							**Sharks:** No information received by the Secretariat. **Seabirds:** No information received by the Secretariat. **Marine turtles:** No information received by the Secretariat.

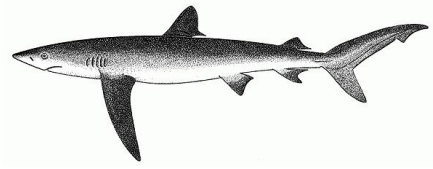
Somalia							**Sharks:** Somalia is currently revising its fisheries legislation (current one being from 1985) and will consider the development of NPOAs as part of this revision process. **Seabirds:** See above. **Marine turtles:** See above.
Sri Lanka			n.a. (provisional)				**Sharks:** An NPOA-sharks has been finalized and is currently being implemented. **Seabirds:** Sri Lanka has determined that seabird interactions are not a problem for their fleets. However a formal review has not yet taken place which the WPEB and SC have approved. **Marine turtles:** Marine turtles are legally protected in Sri Lanka. In the longline fishery only circle hooks are used (J-hooks are banned). Gillnets longer than 2.5 km are now prohibited in domestic legislation on the high-seas. Reporting of bycatch is facilitated via logbooks reserving a separated box.
Sudan							**Sharks:** No information received by the Secretariat. **Seabirds:** No information received by the Secretariat. **Marine turtles:** No information received by the Secretariat.
Tanzania, United Republic of		–		–			**Sharks:** Initial discussions have commenced. **Seabirds:** Initial discussions have commenced. Note: Terms and conditions related to protected sharks and seabirds contained within fishing licenses. **Marine turtles:** No information received by the Secretariat.
Thailand		23-Nov-2005		–			**Sharks:** Second NPOA-sharks currently being drafted. **Seabirds:** Development has not begun. **Marine turtles:** Not yet implemented.
United Kingdom	n.a.	–	n.a.	–		–	British Indian Ocean Territory (Chagos Archipelago) waters are a Marine Protected Area closed to fishing except recreational fishing in the 3nm territorial waters around Diego Garcia. Separate NPOAs have not been developed within this context. **Sharks/Seabirds:** For sharks, UK is the 24th signatory to the Convention on Migratory Species 'Memorandum of Understanding on the Conservation of Migratory Sharks' which extends the agreement to UK Overseas Territories including British Indian Ocean Territories; Section 7 (10) (e) of the *Fisheries (Conservation and Management) Ordinance* refers to recreational fishing and requires sharks to be released alive. No seabirds are caught in the recreational fishery. **Marine turtles:** No marine turtles are captured in the recreational fishery. A monitoring programme is taking place to assess the marine turtle population in UK (OT).
Vanuatu		Aug 2014					**Sharks:** Commenced in August 2014. **Seabirds:** No information received by the Secretariat. **Marine turtles:** No information received by the Secretariat.
Yemen							**Sharks:** No information received by the Secretariat. **Seabirds:** No information received by the Secretariat. **Marine turtles:** No information received by the Secretariat.
COOPERATING NON-CONTRACTING PARTIES							
Bangladesh							**Sharks:** No information received by the Secretariat. **Seabirds:** No information received by the Secretariat. **Marine turtles:** No information received by the Secretariat.

Djibouti							**Sharks:** No information received by the Secretariat. **Seabirds:** No information received by the Secretariat. **Marine turtles:** No information received by the Secretariat.
Liberia							**Sharks:** No information received by the Secretariat. **Seabirds:** No information received by the Secretariat. **Marine turtles:** No information received by the Secretariat.
Senegal		25-Sept-2006		–			**Sharks:** The Sub-Regional Fisheries Commission supported the development of a NPOA-sharks for Senegal in 2005. Other activities conducted include the organization of consultations with industry, the investigation of shark biology and social -economics of shark fisheries). The NPOA is currently being revised. Consideration is being made to the inclusion of minimum mesh size, minimum shark size, and a ban on shark finning. **Seabirds:** The need for a NPOA-seabirds has not yet been assessed. **Marine turtles:** No information received by the Secretariat.
South Africa, Republic of		–		2008			**Sharks:** The gazetting of the draft NPOA-sharks for public comment has been approved by the Minister of the Department of Agriculture, Forestry and Fisheries (6 July 2012). **Seabirds:** Published in August 2008 and fully implemented. The NPOA-seabirds has been earmarked for review. **Marine turtles:** No information received by the Secretariat.

Colour key	
NPOA Completed/ FAO Guidelines fully implemented	
NPOA Drafting being finalized / FAO Guidelines partially implemented	
NPOA Drafting commenced / FAO Guidelines being communicated	
Not begun	

APPENDIX IX
DRAFT RESOURCE STOCK STATUS SUMMARY – BLUE SHARK

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



Status of the Indian Ocean blue shark (BSH: *Prionace glauca*)

TABLE 1. Blue shark: Status of blue shark (*Prionace glauca*) in the Indian Ocean.

Area[1]	Indicators		2015 stock status determination
Indian Ocean	Reported catch 2014:	33,714 t	
	Not elsewhere included (nei) sharks[2]:	55,361 t	
	Average reported catch 2010–2014:	29,628 t	
	Not elsewhere included (nei) sharks[2]:	62,160 t	
	MSY (1,000 t) (80% CI):	Unknown	
	F_{MSY} (80% CI):	Unknown	
	SB_{MSY} (1,000 t) (80% CI):	Unknown	
	F_{2014}/F_{MSY} (range):	(0.44–4.84)[3]	
	SB_{2014}/SB_{MSY} (range):	(0.83–1.75)[3]	
	SB_{2014}/SB_0 (range):	Unknown	

[1]Boundaries for the Indian Ocean = IOTC area of competence
[2]Includes all other shark catches reported to the IOTC Secretariat, which may contain this species
[3]Estimates reflect the range of the plausible model runs agreed

Colour key	Stock overfished($SB_{year}/SB_{MSY}< 1$)	Stock not overfished ($SB_{year}/SB_{MSY}\geq 1$)
Stock subject to overfishing($F_{year}/F_{MSY}> 1$)		
Stock not subject to overfishing ($F_{year}/F_{MSY}\leq 1$)		
Not assessed/Uncertain		

TABLE 2. Blue shark: IUCN threat status of blue shark (*Prionace glauca*) in the Indian Ocean.

Common name	Scientific name	IUCN threat status[10]		
		Global status	WIO	EIO
Blue shark	*Prionace glauca*	Near Threatened	–	–

IUCN = International Union for Conservation of Nature; WIO = Western Indian Ocean; EIO = Eastern Indian Ocean
Sources: IUCN 2007, Stevens 2009

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. There remains considerable uncertainty about the relationship between abundance, CPUE series and total catches over the past decade (Table 1). Three stock assessment models were applied to the blue shark resource in 2015. Two models (SS3 and SRA) produced similar results suggesting the stock is currently subject to overfishing, but not yet overfished, while a third model (BSSPM) suggest the stock was close to MSY levels, but not yet subject to overfishing A best case model could not be selected and so the results represented the range of plausible model runs. The ecological risk assessment (ERA) conducted for the Indian Ocean by the WPEB and SC in 2012 (IOTC–2012–SC15–INF10 Rev_1) consisted of a semi-quantitative risk assessment analysis to evaluate the resilience of shark species to the impact of a given fishery, by combining the biological productivity of the species and its susceptibility to each fishing gear type. Blue sharks received a medium vulnerability ranking (No. 10) in the ERA rank for longline gear because it was estimated as the most productive shark species, but was also characterised by the second highest susceptibility to longline gear. Blue shark was estimated as not being susceptible thus not vulnerable to purse seine gear. The current IUCN threat status of 'Near Threatened' applies to blue sharks globally (Table 2). Information available on this species has been improving in recent years. Blue sharks are commonly taken by a range of fisheries in the Indian Ocean and in some areas they are fished in their nursery grounds. Because of their life history characteristics – they are relatively long lived (20–25 years), mature relatively late (at 4–6 years), and have relativity few offspring (25–50 pups every year), the blue shark is vulnerable to overfishing. However, blue shark assessments in the Atlantic and Pacific oceans seem to indicate that blue shark stocks can sustain relatively high fishing pressure. On the weight-of-evidence available in 2015,

[10] The process of the threat assessment from IUCN is independent from the IOTC and is presented for information purpose only

the stock status is determined to be **uncertain** (Table 1). However, total catches of this species should not exceed 2014 levels, while efforts are made to further evaluate stock status.

Outlook. Increasing effort could result in declines in biomass. The impact of piracy in the western Indian Ocean has resulted in the displacement and subsequent concentration of a substantial portion of longline fishing effort into certain areas in the southern and eastern Indian Ocean. It is therefore unlikely that catch and effort on blue shark will decline in these areas in the near future, and may result in localised depletion.

Management advice. A precautionary approach to the management of blue shark should be considered by the Commission, by ensuring that future catches do not exceed current catches. The stock should be closely monitored. Mechanisms need to be developed by the Commission to improve current statistics by encouraging CPCs to comply with their recording and reporting requirement on sharks, so as to better inform scientific advice.

The following key points should be noted:

- **Maximum Sustainable Yield (MSY)**: estimate for the whole Indian Ocean is unknown.
- **Reference points**: The Commission has not adopted reference points or harvest control rules for any shark species.
- **Main fishing gear** (2011–14): Longline
- **Main fleets** (2011–14): Indonesia; EU,Spain; Japan, Sri Lanka; Taiwan,China; EU,Portugal.

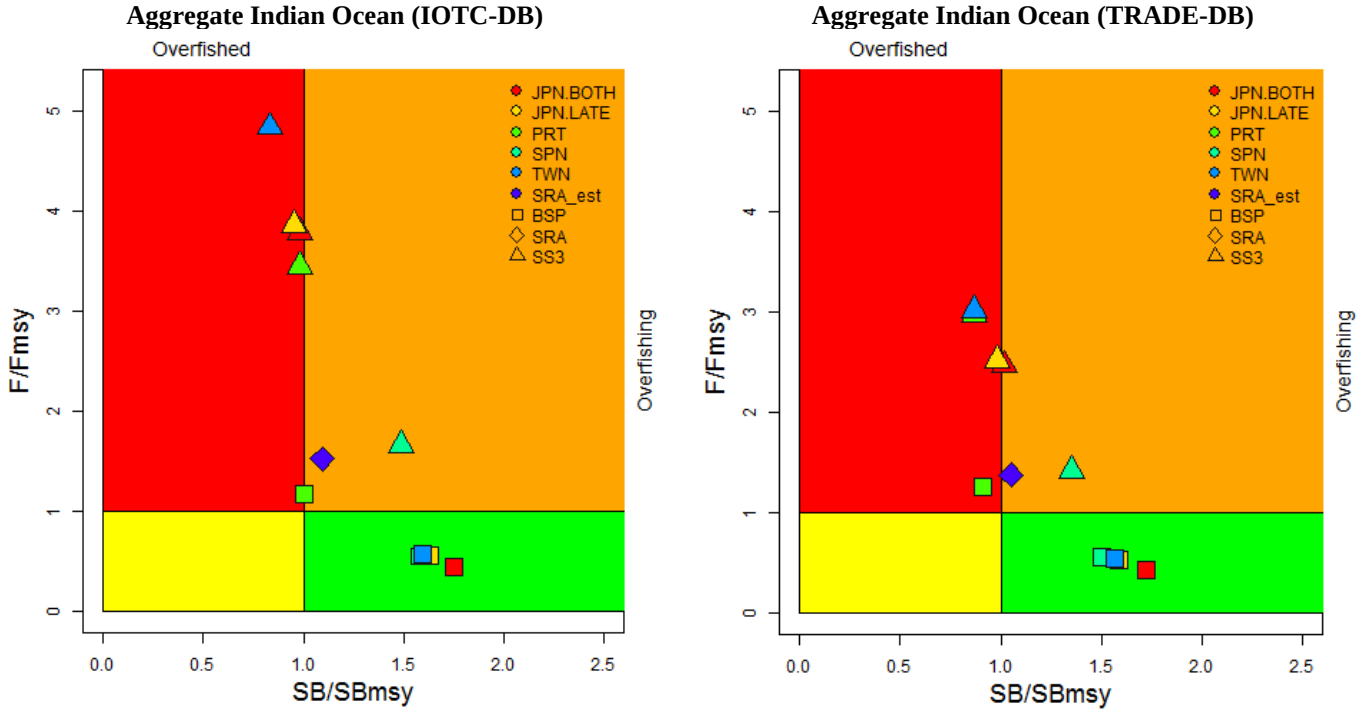


Fig. 1. Blue shark: Aggregated Indian Ocean stock assessment Kobe plot for the 2014 estimate based on a range of models explored with steepness = 0.5, and fits to CPUE series. Note that these are for different datasets, namely the IOTC DB and Trade based datasets (IOTC DB: left panel and TRADE DB: right panel). SS3: Stock Synthesis III; SRA: Stock Reduction Analysis; BSP: Bayesian State-Space Production Model.

Table 3a. Blue shark: Aggregated Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of violating the MSY-based reference points for nine constant catch projections using IOTC DB (average catch level from 2012–14 (31,759 t), ± 10%, ± 20%, ± 30% and ± 40%) projected for 3 and 10 years. **Note: K2MSM projections were not run due to large uncertainty in catch estimates.**

Reference point and projection timeframe	Alternative catch projections (relative to the average catch level from 2012–2014, 31,759 t) and probability (%) of violating MSY-based target reference points ($B_{targ} = B_{MSY}$; $F_{targ} = F_{MSY}$)								
	60% (19,055t)	**70%** (22,231 t)	**80%** (25,407 t)	**90%** (28,583 t)	**100%** (31,759 t)	**110%** (34,935 t)	**120%** (38,110 t)	**130%** (41,286 t)	**140%** (44,462 t)
$B_{2017} < B_{MSY}$									
$F_{2017} > F_{MSY}$									
$B_{2024} < B_{MSY}$									

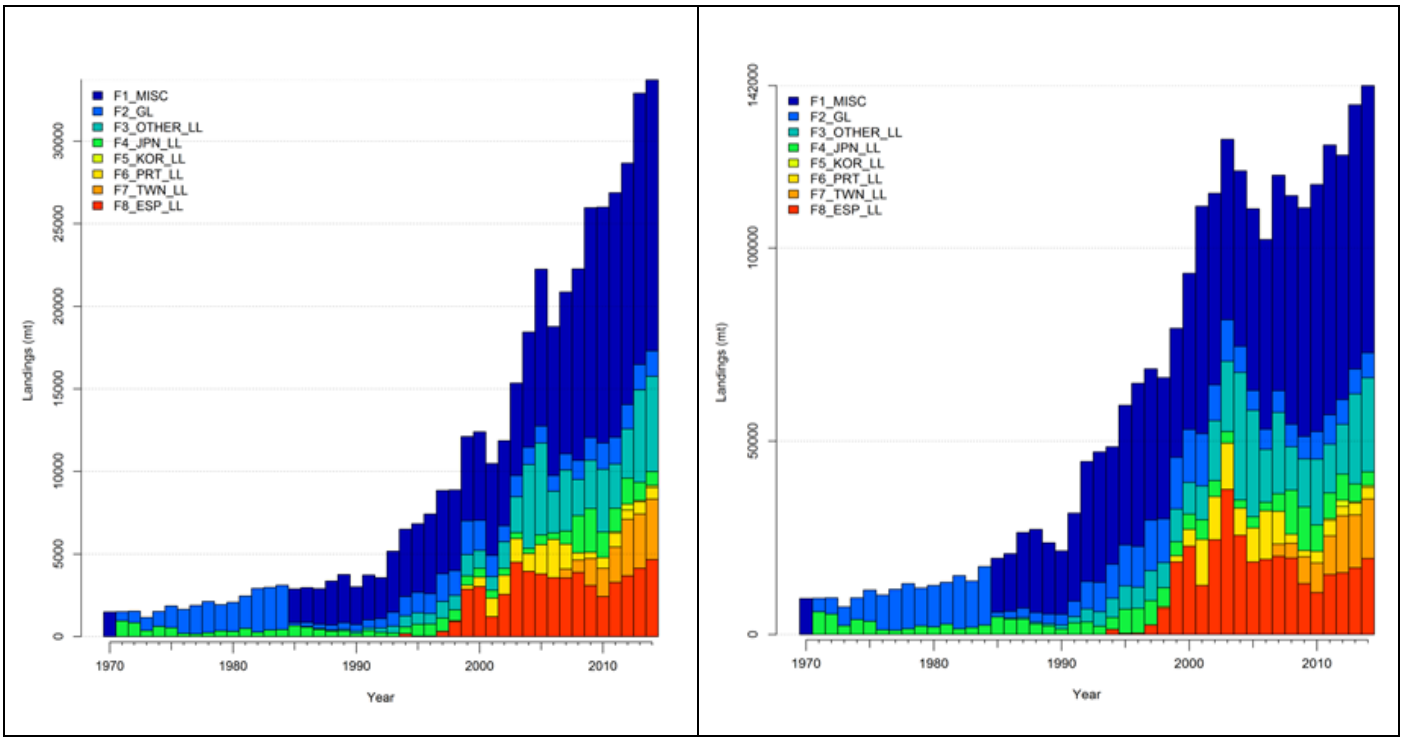
$F_{2024} > F_{MSY}$

Table 3b. Blue shark: Aggregated Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of violating the MSY-based reference points for nine constant catch projections using TRADE DB (average catch level from 2012–14 (134,212 t), ± 10%, ± 20%, ± 30% and ± 40%) projected for 3 and 10 years. **Note: K2MSM projections were not run due to large uncertainty in catch estimates.**

Reference point and projection timeframe	Alternative catch projections (relative to the average catch level from 2012–2014, 134,212 t) and probability (%) of violating MSY-based target reference points ($B_{targ} = B_{MSY}$; $F_{targ} = F_{MSY}$)								
	60% (80,527 t)	**70%** (93,948 t)	**80%** (107,369 t)	**90%** (120,790 t)	**100%** (134,212 t)	**110%** (147,663 t)	**120%** (161,054 t)	**130%** (174,475 t)	**140%** (187,896 t)
$B_{2017} < B_{MSY}$									
$F_{2017} > F_{MSY}$									
$B_{2024} < B_{MSY}$									
$F_{2024} > F_{MSY}$									

APPENDIX I

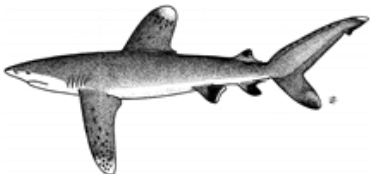
SUPPORTING INFORMATION



Blue shark: Total reported catch estimates (Top: IOTC database; Bottom: **Trade data**) by fleet from 1970–2014 (MISC = other gears; GL = Gillnet; LL = Longline; JPN = Japan; KOR = Rep. of Korea; PRT = EU,Portugal; TWN = Taiwan,China; ESP = EU,Spain)

APPENDIX X
DRAFT RESOURCE STOCK STATUS SUMMARY – OCEANIC WHITETIP SHARK

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



Status of the Indian Ocean oceanic whitetip shark (OCS: *Carcharhinus longimanus*)

CITES APPENDIX II species

TABLE 1. Oceanic whitetip shark: Status of oceanic whitetip shark (*Carcharhinus longimanus*) in the Indian Ocean.

Area[1]	Indicators		2015 stock status determination
Indian Ocean	Reported catch 2014: Not elsewhere included (nei) sharks[2]: Average reported catch 2010–2014: Not elsewhere included (nei) sharks[2]:	5,389 t 55,361 t 2,400 t 62,160 t	
	MSY (1,000 t) (80% CI): F_{MSY} (80% CI): SB_{MSY} (1,000 t) (80% CI): F_{2014}/F_{MSY} (80% CI): SB_{2014}/SB_{MSY} (80% CI): SB_{2014}/SB_0 (80% CI):	unknown	

[1]Boundaries for the Indian Ocean = IOTC area of competence
[2]Includes all other shark catches reported to the IOTC Secretariat, which may contain this species.

Colour key	Stock overfished($SB_{year}/SB_{MSY}< 1$)	Stock not overfished ($SB_{year}/SB_{MSY}\geq 1$)
Stock subject to overfishing($F_{year}/F_{MSY}> 1$)		
Stock not subject to overfishing ($F_{year}/F_{MSY}\leq 1$)		
Not assessed/Uncertain		

NOTE: IOTC Resolution 13/06 *on a scientific and management framework on the conservation of shark species caught in association with IOTC managed fisheries*, prohibits retention onboard, transhipping, landing or storing any part or whole carcass of oceanic whitetip sharks.

TABLE 2. Oceanic whitetip shark: IUCN threat status of oceanic whitetip shark (*Carcharhinus longimanus*) in the Indian Ocean.

Common name	Scientific name	IUCN threat status[11]		
		Global status	WIO	EIO
Oceanic whitetip shark	*Carcharhinus longimanus*	Vulnerable	–	–

IUCN = International Union for Conservation of Nature; WIO = Western Indian Ocean; EIO = Eastern Indian Ocean
Sources: IUCN 2007, Baum et al. 2006
CITES - In March 2013, CITES agreed to include oceanic whitetip shark to Appendix II to provide further protections prohibiting the international trade; which will become effective on September 14, 2014.

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. There remains considerable uncertainty about the relationship between abundance, standardised CPUE series and total catches over the past decade (Table 1). The ecological risk assessment (ERA) conducted for the Indian Ocean by the WPEB and SC in 2012 (IOTC–2012–SC15–INF10 Rev_1) consisted of a semi-quantitative risk assessment analysis to evaluate the resilience of shark species to the impact of a given fishery, by combining the biological productivity of the species and its susceptibility to each fishing gear type. Oceanic whitetip shark received a

[11] The process of the threat assessment from IUCN is independent from the IOTC and is presented for information purpose only

high vulnerability ranking (No. 5) in the ERA rank for longline gear because it was estimated as one of the least productive shark species, and was also characterised by a high susceptibility to longline gear. Oceanic whitetip shark was estimated as being the most vulnerable shark species to purse seine gear, as it was characterised as having a relatively low productive rate, and high susceptibility. The current IUCN threat status of 'Vulnerable' applies to oceanic whitetip sharks globally (Table 2). There is a paucity of information available on this species in the Indian Ocean and this situation is not expected to improve in the short to medium term. Oceanic whitetip sharks are commonly taken by a range of fisheries in the Indian Ocean. Because of their life history characteristics – they are relatively long lived, mature at 4–5 years, and have relativity few offspring (<20 pups every two years), the oceanic whitetip shark is likely vulnerable to overfishing. Despite the lack of data, there is anecdotal information suggesting that oceanic whitetip shark abundance has declined over recent decades. Available standardised CPUE indices from Japan and EU,Spain indicate conflicting trends as discussed in the full Executive Summary for oceanic whitetip sharks. There is no quantitative stock assessment and limited basic fishery indicators currently available for oceanic whitetip sharks in the Indian Ocean therefore the stock status is **uncertain** (Table 1).

Outlook. Maintaining or increasing effort with associated fishing mortality can result in declines in biomass, productivity and CPUE. The impact of piracy in the western Indian Ocean has resulted in the displacement and subsequent concentration of a substantial portion of longline fishing effort into certain areas in the southern and eastern Indian Ocean. It is therefore unlikely that catch and effort on oceanic whitetip sharks will decline in these areas in the near future, and may result in localised depletion.

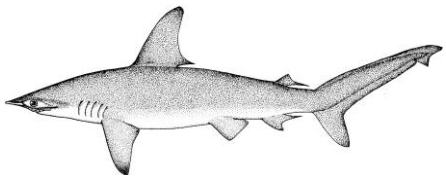
Management advice. A precautionary approach to the management of oceanic whitetip shark should be considered by the Commission. Mechanisms need to be developed by the Commission to encourage CPCs to comply with their recording and reporting requirement on sharks, so as to better inform scientific advice.

The following key points should be noted:

- **Maximum Sustainable Yield (MSY)**: Not applicable. Retention prohibited.
- **Reference points**: Not applicable.
- **Main fishing gear** (2011–14): Longline; purse seine.
- **Main fleets** (2011–14): Indonesia; Sri Lanka; I.R. Iran; EU,Spain; China; Madagascar; Seychelles.

APPENDIX XI
DRAFT RESOURCE STOCK STATUS SUMMARY – SCALLOPED HAMMERHEAD SHARK

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



Status of the Indian Ocean Scalloped Hammerhead Shark (SPL: *Sphyrna lewini*)

CITES APPENDIX II species

TABLE 1. Status of scalloped hammerhead shark (*Sphyrna lewini*) in the Indian Ocean.

Area[1]	Indicators		2015 stock status determination
Indian Ocean	Reported catch 2014: Not elsewhere included (nei) sharks[2]: Average reported catch 2010–2014: Not elsewhere included (nei) sharks[2]:	42 t 55,361 t 89 t 62,160 t	
	MSY (1,000 t) (80% CI): F_{MSY} (80% CI): SB_{MSY} (1,000 t) (80% CI): F_{2014}/F_{MSY} (80% CI): SB_{2014}/SB_{MSY} (80% CI): SB_{2014}/SB_0 (80% CI):	unknown	

[1]Boundaries for the Indian Ocean = IOTC area of competence
[2]Includes all other shark catches reported to the IOTC Secretariat, which may contain this species.

Colour key	Stock overfished($SB_{year}/SB_{MSY}< 1$)	Stock not overfished ($SB_{year}/SB_{MSY}\geq 1$)
Stock subject to overfishing($F_{year}/F_{MSY}> 1$)		
Stock not subject to overfishing ($F_{year}/F_{MSY}\leq 1$)		
Not assessed/Uncertain		

TABLE 2. IUCN threat status of scalloped hammerhead shark (*Sphyrna lewini*) in the Indian Ocean.

Common name	Scientific name	IUCN threat status[12]		
		Global status	WIO	EIO
Scalloped hammerhead	*Sphyrna lewini*	Endangered	Endangered	–

IUCN = International Union for Conservation of Nature; WIO = Western Indian Ocean; EIO = Eastern Indian Ocean
Sources: IUCN 2007, Baum 2007

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. The current IUCN threat status of 'Endangered' applies to scalloped hammerhead sharks globally and specifically for the western Indian Ocean (Table 2). The ecological risk assessment (ERA) conducted for the Indian Ocean by the WPEB and SC in 2012 (IOTC–2012–SC15–INF10 Rev_1) consisted of a semi-quantitative risk assessment analysis to evaluate the resilience of shark species to the impact of a given fishery, by combining the biological productivity of the species and its susceptibility to each fishing gear type. Scalloped hammerhead shark received a low vulnerability ranking (No. 14) in the ERA rank for longline gear because it was estimated as one of the least productive shark species, but was also characterised by a lower susceptibility to longline gear. Scalloped hammerhead shark was estimated as the sixth most vulnerable shark species in the ERA ranking for purse seine gear, but with lower levels of vulnerability compared to longline gear, because the susceptibility was lower for purse seine gear. There is a paucity of information available on this species and this situation is not expected to improve in the short to medium term. Scalloped hammerhead sharks are commonly taken by a range of fisheries in the Indian Ocean. They are extremely vulnerable to gillnet fisheries. Furthermore, pups occupy shallow coastal nursery grounds, often heavily

[12] The process of the threat assessment from IUCN is independent from the IOTC and is presented for information purpose only

exploited by inshore fisheries. Because of their life history characteristics – they are relatively long lived (over 30 years), and have relativity few offspring (<31 pups each year), the scalloped hammerhead shark is vulnerable to overfishing. There is no quantitative stock assessment or basic fishery indicators currently available for scalloped hammerhead shark in the Indian Ocean therefore the stock status is **uncertain** (Table 1).

Outlook. Maintaining or increasing effort can result in declines in biomass and productivity. The impact of piracy in the western Indian Ocean has resulted in the displacement and subsequent concentration of a substantial portion of longline fishing effort into certain areas in the southern and eastern Indian Ocean. It is therefore unlikely that catch and effort on scalloped hammerhead shark will decline in these areas in the near future.

Management advice. A precautionary approach to the management of scalloped hammerhead shark should be considered by the Commission. Mechanisms need to be developed by the Commission to encourage CPCs to comply with their recording and reporting requirement on sharks, so as to better inform scientific advice.

The following key points should be noted:

- **Maximum Sustainable Yield (MSY)**: Unknown.
- **Reference points**: Not applicable.
- **Main fishing gear** (2011–14): Gillnet; Handline; Trolling; longline.
- **Main fleets** (2011–14): Indonesia; EU,Spain.

APPENDIX XII
DRAFT RESOURCE STOCK STATUS SUMMARY – SHORTFIN MAKO SHARK

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

Status of the Indian Ocean shortfin mako shark (SMA: *Isurus oxyrinchus*)

TABLE 1. Shortfin mako shark: Status of shortfin mako shark (*Isurus oxyrinchus*) in the Indian Ocean.

Area[1]	Indicators		2015 stock status determination
Indian Ocean	Reported catch 2014: Not elsewhere included (nei) sharks[2]: Average reported catch 2010–2014: Not elsewhere included (nei) sharks[2]:	1,683 t 55,361 t 1,538 t 62,160 t	
	MSY (1,000 t) (80% CI): F_{MSY} (80% CI): SB_{MSY} (1,000 t) (80% CI): F_{2014}/F_{MSY} (80% CI): SB_{2014}/SB_{MSY} (80% CI): SB_{2014}/SB_0 (80% CI):	unknown	

[1]Boundaries for the Indian Ocean = IOTC area of competence
[2]Includes all other shark catches reported to the IOTC Secretariat, which may contain this species.

Colour key	Stock overfished(SB_{year}/SB_{MSY}< 1)	Stock not overfished (SB_{year}/SB_{MSY}≥ 1)
Stock subject to overfishing(F_{year}/F_{MSY}> 1)		
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)		
Not assessed/Uncertain		

TABLE 2. Shortfin mako shark: IUCN threat status of shortfin mako shark (*Isurus oxyrinchus*) in the Indian Ocean.

Common name	Scientific name	IUCN threat status[13]		
		Global status	WIO	EIO
Shortfin mako shark	*Isurus oxyrinchus*	Vulnerable	–	–

IUCN = International Union for Conservation of Nature; WIO = Western Indian Ocean; EIO = Eastern Indian Ocean
SOURCES: IUCN 2007, Cailliet 2009

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. There remains considerable uncertainty about the relationship between abundance, the standardised CPUE series, and total catches over the past decade (Table 1). The ecological risk assessment (ERA) conducted for the Indian Ocean by the WPEB and SC in 2012 (IOTC–2012–SC15–INF10 Rev_1) consisted of a semi-quantitative risk assessment analysis to evaluate the resilience of shark species to the impact of a given fishery, by combining the biological productivity of the species and its susceptibility to each fishing gear type. Shortfin mako sharks received the highest vulnerability ranking (No. 1) in the ERA rank for longline gear because it was characterised as one of the least productive shark species, and with a high susceptibility to longline gear. Shortfin mako shark was estimated as the third most vulnerable shark species in the ERA ranking for purse seine gear, but with lower levels of vulnerability compared to longline gear, because the susceptibility was lower for purse seine gear. The current IUCN threat status of 'Vulnerable' applies to shortfin mako sharks globally (Table 2). Trends in the Japanese standardised CPUE series from its longline fleet suggest that the biomass has declined from 1994 to 2003, and has been increasing since then. Trends in EU,Portugal longline standardised CPUE series suggest that the biomass has declined from 1999 to 2004, and has been increasing since then. There is a paucity of information available on this species, but this situation has been improving in recent years. Shortfin mako sharks are commonly taken by a range of fisheries in the Indian Ocean. Because of their life history characteristics – they are relatively long lived (over 30 years), females mature at 18–21 years, and have relativity few offspring (<25 pups every two or three years), the shortfin mako shark can be vulnerable

[13] The process of the threat assessment from IUCN is independent from the IOTC and is presented for information purpose only

to overfishing. There is no quantitative stock assessment currently available for shortfin mako shark in the Indian Ocean therefore the stock status is **uncertain**.

Outlook. Maintaining or increasing effort can result in declines in biomass, productivity and CPUE. The impact of piracy in the western Indian Ocean has resulted in the displacement and subsequent concentration of a substantial portion of longline fishing effort into certain areas in the southern and eastern Indian Ocean. It is therefore unlikely that catch and effort on shortfin mako shark will decline in these areas in the near future, and may result in localised depletion.

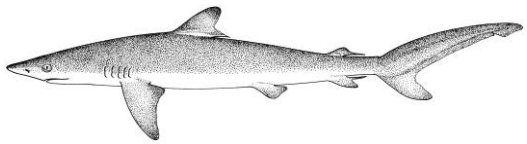
Management advice. A precautionary approach to the management of shortfin mako shark should be considered by the Commission. Mechanisms need to be developed by the Commission to encourage CPCs to comply with their recording and reporting requirement on sharks, so as to better inform scientific advice.

The following key points should also be noted:

- **Maximum Sustainable Yield (MSY)**: Unknown.
- **Reference points**: Not applicable.
- **Main fishing gear** (2011–14): Longline; Handline.
- **Main fleets** (2011–14): Madagascar; Indonesia; Taiwan,China; EU,UK; India.

APPENDIX XIII
DRAFT RESOURCE STOCK STATUS SUMMARY – SILKY SHARK

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



Status of the Indian Ocean silky shark (FAL: *Carcharhinus falciformis*)

TABLE 1. Silky shark: Status of silky shark (*Carcharhinus falciformis*) in the Indian Ocean.

Area[1]	Indicators		2015 stock status determination
Indian Ocean	Reported catch 2014: Not elsewhere included (nei) sharks[2]: Average reported catch 2010–2014: Not elsewhere included (nei) sharks[2]:	2,782 t 55,361 t 4,064 t 62,160 t	
	MSY (1,000 t) (80% CI): F_{MSY} (80% CI): SB_{MSY} (1,000 t) (80% CI): F_{2014}/F_{MSY} (80% CI): SB_{2014}/SB_{MSY} (80% CI): SB_{2014}/SB_0 (80% CI):	unknown	

[1]Boundaries for the Indian Ocean = IOTC area of competence
[2]Includes all other shark catches reported to the IOTC Secretariat, which may contain this species.

Colour key	Stock overfished(SB_{year}/SB_{MSY}< 1)	Stock not overfished (SB_{year}/SB_{MSY}≥ 1)
Stock subject to overfishing(F_{year}/F_{MSY}> 1)		
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)		
Not assessed/Uncertain		

TABLE 2. Silky shark: IUCN threat status of silky shark (*Carcharhinus falciformis*) in the Indian Ocean.

Common name	Scientific name	IUCN threat status[14]		
		Global status	WIO	EIO
Silky shark	*Carcharhinus falciformis*	Near Threatened	Near Threatened	Near Threatened

IUCN = International Union for Conservation of Nature; WIO = Western Indian Ocean; EIO = Eastern Indian Ocean
Sources: IUCN 2007, 2012

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. There remains considerable uncertainty about the relationship between abundance and the nominal CPUE series from the main longline fleets, and about the total catches over the past decade (Table 1). The ecological risk assessment (ERA) conducted for the Indian Ocean by the WPEB and SC in 2012 (IOTC–2012–SC15–INF10 Rev_1) consisted of a semi-quantitative risk assessment analysis to evaluate the resilience of shark species to the impact of a given fishery, by combining the biological productivity of the species and its susceptibility to each fishing gear type. Silky shark received a high vulnerability ranking (No. 4) in the ERA rank for longline gear because it was estimated as one of the least productive shark species, and with a high susceptibility to longline gear. Silky shark was estimated as the second most vulnerable shark species in the ERA ranking for purse seine gear, due to its low productivity and high susceptibility for purse seine gear. The current IUCN threat status of 'Near Threatened' applies to silky sharks in the western and eastern Indian Ocean and globally (Table 2). There is a paucity of information available on this species but several recent studies have been carried out for this species in the recent years. Silky sharks are commonly taken by a range of fisheries in the Indian Ocean. Because of their life history characteristics – they are relatively long lived (over 20 years), mature relatively late (at 6–12 years), and have relativity few offspring (<20 pups every two years), the silky shark can be vulnerable to overfishing. Despite the lack of data, there is some anecdotal information suggesting that silky shark abundance has declined over recent decades, including from Indian longline research surveys, which is

[14] The process of the threat assessment from IUCN is independent from the IOTC and is presented for information purpose only

described in the full Executive Summary for silky shark sharks. There is no quantitative stock assessment or basic fishery indicators currently available for silky shark in the Indian Ocean therefore the stock status is **uncertain**.

Outlook. Maintaining or increasing effort can probably result in declines in biomass, productivity and CPUE. The impact of piracy in the western Indian Ocean has resulted in the displacement and subsequent concentration of a substantial portion of longline fishing effort into certain areas in the southern and eastern Indian Ocean. It is therefore unlikely that catch and effort on silky shark will decline in these areas in the near future, and may result in localised depletion.

Management advice. A precautionary approach to the management of silky shark should be considered by the Commission. Mechanisms need to be developed by the Commission to encourage CPCs to comply with their recording and reporting requirement on sharks, so as to better inform scientific advice.

The following key points should also be noted:

- **Maximum Sustainable Yield (MSY)**: Unknown.
- **Reference points**: Not applicable.
- **Main fishing gear** (2011–14): Purse seine; Longline; Gillnet.
- **Main fleets** (2011–14): Sri Lanka; I.R. Iran; Madagascar; Taiwan,China; Indonesia.

APPENDIX XIV
DRAFT RESOURCE STOCK STATUS SUMMARY – BIGEYE THRESHER SHARK

Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien
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Status of the Indian Ocean bigeye thresher shark (BTH: *Alopias superciliosus*)

TABLE 1. Bigeye thresher shark: Status bigeye thresher shark (*Alopias superciliosus*) in the Indian Ocean.

Area[1]	Indicators		2015 stock status determination
Indian Ocean	Reported catch 2014: Not elsewhere included (nei) sharks[2]: Average reported catch 2010–2014: Not elsewhere included (nei) sharks[2]:	0 t 55,361 t 159 t 62,160 t	
	MSY (1,000 t) (80% CI): F_{MSY} (80% CI): SB_{MSY} (1,000 t) (80% CI): F_{2014}/F_{MSY} (80% CI): SB_{2014}/SB_{MSY} (80% CI): SB_{2014}/SB_0 (80% CI):	unknown	

[1]Boundaries for the Indian Ocean = IOTC area of competence
[2]Includes all other shark catches reported to the IOTC Secretariat, which may contain this species.

Colour key	Stock overfished($SB_{year}/SB_{MSY} < 1$)	Stock not overfished ($SB_{year}/SB_{MSY} \geq 1$)
Stock subject to overfishing($F_{year}/F_{MSY} > 1$)		
Stock not subject to overfishing ($F_{year}/F_{MSY} \leq 1$)		
Not assessed/Uncertain		

TABLE 2. Bigeye thresher shark: IUCN threat status of bigeye thresher shark (*Alopias superciliosus*) in the Indian Ocean.

Common name	Scientific name	IUCN threat status[15]		
		Global status	WIO	EIO
Bigeye thresher shark	*Alopias superciliosus*	Vulnerable	–	–

IUCN = International Union for Conservation of Nature; WIO = Western Indian Ocean; EIO = Eastern Indian Ocean
Sources: IUCN 2007, Amorim et al. 2009

NOTE: IOTC Resolution 12/09 *On the conservation of thresher sharks (family Alopiidae) caught in association with fisheries in the IOTC area of competence*, prohibits retention onboard, transhipping, landing, storing, selling or offering for sale any part or whole carcass of thresher sharks of all the species of the family Alopiidae[16].

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. There remains considerable uncertainty in the stock status due to lack of information necessary for assessment or for the development of other indicators of the stock (Table 1). The ecological risk assessment (ERA) conducted for the Indian Ocean by the WPEB and SC in 2012 (IOTC–2012–SC15–INF10 Rev_1) consisted of a semi-quantitative risk assessment analysis to evaluate the resilience of shark species to the impact of a given fishery, by combining the biological productivity of the species and its susceptibility to each fishing gear type. Bigeye thresher shark received a high vulnerability ranking (No. 2) in the ERA rank for longline gear because it was characterised as one of the least productive shark species, and highly susceptible to longline gear. Despite its low productivity, bigeye thresher shark has a low vulnerability ranking to purse seine gear due to its low susceptibility for this particular gear. The current IUCN threat status of 'Vulnerable' applies to bigeye thresher shark globally (Table 2). There is a paucity of information available on this species and this situation is not expected to improve in the short to medium term. Bigeye

[15] The process of the threat assessment from IUCN is independent from the IOTC and is presented for information purpose only
[16] Scientific observers shall be allowed to collect biological samples from thresher sharks that are dead at haulback, provided that the samples are part of the research project approved by the Scientific Committee (or the Working Party on Ecosystems and Bycatch).

thresher sharks are commonly taken by a range of fisheries in the Indian Ocean. Because of their life history characteristics – they are relatively long lived (+20 years), mature at 9–3 years, and have few offspring (2–4 pups every year), the bigeye thresher shark is vulnerable to overfishing. There is no quantitative stock assessment and limited basic fishery indicators currently available for bigeye thresher shark in the Indian Ocean therefore the stock status is **uncertain**.

Outlook. Current longline fishing effort is directed to other species, however bigeye thresher sharks is a common bycatch in these fisheries. Hooking mortality is apparently very high, therefore IOTC regulation 10/12 prohibiting retaining of any part of thresher sharks onboard and promoting life release of thresher shark may be largely ineffective for species conservation. Maintaining or increasing effort, with associated fishing mortality, can result in declines in biomass, productivity and CPUE. However there are few data to estimate CPUE trends, in view of IOTC Resolution 12/09 and reluctance of fishing fleet to report information on discards/non-retained catch. The impact of piracy in the western Indian Ocean has resulted in the displacement and subsequent concentration of a substantial portion of longline fishing effort into other areas in the southern and eastern Indian Ocean. It is therefore unlikely that catch and effort on bigeye thresher shark will decline in these areas in the near future, which may result in localised depletion.

Management advice. The prohibition on retention of bigeye thresher shark should be maintain. Mechanisms need to be developed by the Commission to encourage CPCs to comply with their reporting requirement on sharks, so as to better inform scientific advice.

The following key points should also be noted:

- **Maximum Sustainable Yield (MSY)**: Not applicable. Retention prohibited.
- **Reference points**: Not applicable.
- **Main fishing gear** (2011–14): Handline; Trolling; Longline.
- **Main fleets** (2011–14): Indonesia; Madagascar; Philippines; EU,UK.

APPENDIX XV
DRAFT RESOURCE STOCK STATUS SUMMARY – PELAGIC THRESHER SHARK

Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien
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Status of the Indian Ocean pelagic thresher shark (PTH: *Alopias pelagicus*)

TABLE 1. Pelagic thresher shark: Status pelagic thresher shark (*Alopias pelagicus*) in the Indian Ocean.

Area[1]	Indicators		2015 stock status determination
Indian Ocean	Reported catch 2014: Not elsewhere included (nei) sharks[2]: Average reported catch 2010–2014: Not elsewhere included (nei) sharks[2]:	0 t 55,361 t 122 t 62,160 t	
	MSY (1,000 t) (80% CI): F_{MSY} (80% CI): SB_{MSY} (1,000 t) (80% CI): F_{2014}/F_{MSY} (80% CI): SB_{2014}/SB_{MSY} (80% CI): SB_{2014}/SB_0 (80% CI):	unknown	

[1]Boundaries for the Indian Ocean = IOTC area of competence
[2]Includes all other shark catches reported to the IOTC Secretariat, which may contain this species.

Colour key	Stock overfished($SB_{year}/SB_{MSY} < 1$)	Stock not overfished ($SB_{year}/SB_{MSY} \geq 1$)
Stock subject to overfishing($F_{year}/F_{MSY} > 1$)		
Stock not subject to overfishing ($F_{year}/F_{MSY} \leq 1$)		
Not assessed/Uncertain		

TABLE 2. Pelagic thresher shark: IUCN threat status of pelagic thresher shark (*Alopias pelagicus*) in the Indian Ocean.

Common name	Scientific name	IUCN threat status[17]		
		Global status	WIO	EIO
Pelagic thresher shark	*Alopias pelagicus*	Vulnerable	–	–

IUCN = International Union for Conservation of Nature; WIO = Western Indian Ocean; EIO = Eastern Indian Ocean
Sources: IUCN 2007, Reardon et al. 2009

NOTE: IOTC Resolution 12/09 *On the conservation of thresher sharks (family Alopiidae) caught in association with fisheries in the IOTC area of competence*, prohibits retention onboard, transhipping, landing, storing, selling or offering for sale any part or whole carcass of thresher sharks of all the species of the family Alopiidae[18].

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. There remains considerable uncertainty in the stock status due to lack of information necessary for assessment or to for the development of other indicators of the stock (Table 1). The ecological risk assessment (ERA) conducted for the Indian Ocean by the WPEB and SC in 2012 (IOTC–2012–SC15–INF10 Rev_1) consisted of a semi-quantitative risk assessment analysis to evaluate the resilience of shark species to the impact of a given fishery, by combining the biological productivity of the species and its susceptibility to each fishing gear type. Pelagic thresher shark received a high vulnerability ranking (No. 3) in the ERA rank for longline gear because it was characterised as one of the least productive shark species, and with a high susceptibility to longline gear. Despite its low productivity, pelagic thresher shark has a low vulnerability ranking to purse seine gear due to its low susceptibility for this particular gear. The current IUCN threat status of 'Vulnerable' applies to pelagic thresher shark globally (Table 2). There is a

[17] The process of the threat assessment from IUCN is independent from the IOTC and is presented for information purpose only
[18] Scientific observers shall be allowed to collect biological samples from thresher sharks that are dead at haulback, provided that the samples are part of the research project approved by the Scientific Committee (or the Working Party on Ecosystems and Bycatch).

paucity of information available on this species and this situation is not expected to improve in the short to medium term. Pelagic thresher sharks are commonly taken by a range of fisheries in the Indian Ocean. Because of their life history characteristics – they are relatively long lived (+ 20 years), mature at 8–9 years, and have few offspring (2 pups every year), the pelagic thresher shark is vulnerable to overfishing. There is no quantitative stock assessment and limited basic fishery indicators currently available for pelagic thresher shark in the Indian Ocean therefore the stock status is **uncertain.**

Outlook. Current longline fishing effort is directed to other species, however pelagic thresher sharks is a common bycatch these fisheries. Hooking mortality is apparently very high, therefore IOTC regulation 10/12 prohibiting retaining of any part of thresher sharks onboard and promoting life release of thresher shark may be largely ineffective for species conservation. Maintaining or increasing effort can result in declines in biomass, productivity and CPUE. However there are few data to estimate CPUE trends, in view of IOTC regulation 10/12 and reluctance of fishing fleet to report information on discards/non-retained catch. The impact of piracy in the western Indian Ocean has resulted in the displacement and subsequent concentration of a substantial portion of longline fishing effort into other areas in the southern and eastern Indian Ocean. It is therefore unlikely that catch and effort on pelagic thresher shark will decline in these areas in the near future, which may result in localised depletion.

Management advice. The prohibition on retention of pelagic thresher shark should be maintain. Mechanisms need to be developed by the Commission to encourage CPCs to comply with their reporting requirement on sharks, so as to better inform scientific advice.

The following key points should also be noted:

- **Maximum Sustainable Yield (MSY)**: Not applicable. Retention prohibited.
- **Reference points**: Not applicable.
- **Main fishing gear** (2011–14): Handline; Trolling; Longline.
- **Main fleets** (2011–14): Indonesia; Madagascar; Philippines; EU,UK.

APPENDIX XVI
DRAFT RESOURCE STOCK STATUS SUMMARY – MARINE TURTLES

Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien
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Status of marine turtles in the Indian Ocean

TABLE 1. Marine turtles: IUCN threat status for all marine turtle species reported as caught in fisheries within the IOTC area of competence.

Common name	Scientific name	IUCN threat status[19]
Flatback turtle	*Natator depressus*	Data deficient
Green turtle	*Chelonia mydas*	Endangered
Hawksbill turtle	*Eretmochelys imbricate*	Critically Endangered
Leatherback turtle	*Dermochelys coriacea*	Vulnerable
Loggerhead turtle	*Caretta caretta*	Endangered
Olive Ridley turtle	*Lepidochelys olivacea*	Vulnerable

Sources: Marine Turtle Specialist Group 1996, Red List Standards & Petitions Subcommittee 1996, Sarti Martinez (Marine Turtle Specialist Group) 2000, Seminoff 2004, Abreu-Grobois & Plotkin 2008, Mortimer et al. 2008, IUCN 2014, The IUCN Red List of Threatened species. Version 2015.2 <www.iucnredlist.org>. Downloaded on 15 July 2015.

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. No assessment has been undertaken by the IOTC WPEB for marine turtles due to the lack of data being submitted by CPCs. However, the current International Union for Conservation of Nature (IUCN) threat status for each of the marine turtle species reported as caught in IOTC fisheries to date is provided in Table 1. It is important to note that a number of international global environmental accords (e.g. Convention on Migratory Species (CMS), Convention on Biological Diversity (CBD)), as well as numerous fisheries agreements obligate States to provide protection for these species. In particular, there are now 35 Signatories to the Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia (IOSEA MoU). Of the 35 Signatories to the IOSEA MoU, 23 are also members of the IOTC. While the status of marine turtles is affected by a range of factors such as degradation of marine turtle natural habitats and targeted harvesting of eggs and turtles, the level of mortality of marine turtles due to capture by gillnets is likely to be substantial as shown by the Ecological Risk Assessment undertaken in 2012/13, and an order of magnitude higher than longline and purse seine gears for which mitigation measures are in place.

Outlook. Resolution 12/04 *On the conservation of marine turtles* includes an annual evaluation requirement (para. 17) by the Scientific Committee (SC). However, given the lack of reporting of marine turtle interactions by CPCs to date, such an evaluation cannot be undertaken. Unless IOTC CPCs become compliant with the data collection and reporting requirements for marine turtles, the WPEB and the SC will continue to be unable to address this issue. Notwithstanding this, it is acknowledged that the impact on marine turtle populations from fishing for tuna and tuna-like species may increase if fishing pressure increases, or if the status of the marine turtle populations worsens due to other factors such as an increase in fishing pressure from other fisheries or anthropological or climatic impacts.

The following should be noted:

- The available evidence indicates considerable risk to marine turtles in the Indian Ocean.
- The primary source of data that drive the ability of the WPEB to determine a status for the Indian Ocean, total interactions by fishing vessels, is highly uncertain and should be addressed as a matter of priority.
- Current reported interactions are known to be a severe underestimate.
- From the limited data received, longlining posed the greater apparent risk to marine turtles. The ERA estimated that ~3,500 marine turtles are caught by longline vessels annually, while it was estimated that ~250 marine turtles p.a. are observed in purse seine operations, 75% being released alive (Bourjea et al.

[19] The process of the threat assessment from IUCN is independent from the IOTC and is presented for information purpose only

2014). The Ecological Risk Assessment conducted by Nel et al. (2013) set out two separate approaches to estimate gillnet impacts on marine turtles, based on very limited data. The first calculated that 52,425 marine turtles p.a. and the second that 11,400–47,500 turtles p.a. are caught in gillnets (with a mean of the two methods being 29,488 marine turtles p.a.). Anecdotal/published studies reported values of >5000–16,000 marine turtles p.a. for each of India, Sri Lanka and Madagascar. Of these reports, green turtles are under the greatest pressure from gillnet fishing, constituting 50–88% of catches for Madagascar. Loggerhead, hawksbill and olive Ridley turtles are caught in varying proportions depending on the region.

- Maintaining or increasing fishing effort in the Indian Ocean without appropriate mitigation measures in place, will likely result in further declines in the number of individuals.
- That appropriate mechanisms are developed by the Compliance Committee to ensure CPCs comply with their data collection and reporting requirements for marine turtles.

APPENDIX XVII
DRAFT RESOURCE STOCK STATUS SUMMARY – SEABIRDS

Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien
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Status of seabirds in the Indian Ocean

TABLE 1. IUCN threat status for all seabird species reported as caught in fisheries within the IOTC area of competence.

Common name	Scientific name	IUCN threat status[20]
Albatross		
Atlantic Yellow-nosed Albatross	*Thalassarche chlororynchos*	Endangered
Black-browed albatross	*Thalassarche melanophrys*	Near Threatened
Indian yellow-nosed albatross	*Thalassarche car teri*	Endangered
Shy albatross	*Thalassarche cauta*	Near Threatened
Sooty albatross	*Phoebetria fusca*	Endangered
Light-mantled albatross	*Phoebetria palpebrata*	Near Threatened
Amsterdam albatross	*Diomedea amsterdamensis*	Critically Endangered
Tristan albatross	*Diomedea dabbenena*	Critically Endangered
Wandering albatross	*Diomedia exulans*	Vulnerable
White-capped albatross	*Thalassarche steadi*	Near Threatened
Grey-headed albatross	*Thalassarche chrysostoma*	Endangered
Petrels		
Cape/Pintado petrel	*Daption capense*	Least Concern
Great-winged petrel	*Pterodroma macroptera*	Least Concern
Grey petrel	*Procellaria cinerea*	Near Threatened
Southern giant petrel	*Macronectes giganteus*	Least Concern
Northern giant-petrel	*Macronectes halli*	Least Concern
White-chinned petrel	*Procellaria aequinoctialis*	Vulnerable
Others		
Cape gannet	*Morus capensis*	Vulnerable
Flesh-footed shearwater	*Puffinus carneipes*	Least Concern

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. No assessment has been undertaken by the IOTC WPEB for seabirds due to the lack of data being submitted by CPCs. However, the current International Union for Conservation of Nature (IUCN) threat status for each of the seabird species reported as caught in IOTC fisheries to date is provided in Table 1. It is important to note that a number of international global environmental accords (e.g. Convention on Migratory Species (CMS), the Agreement on the Conservation of Albatrosses and Petrels (ACAP), Convention on Biological Diversity (CBD)), as well as numerous fisheries agreements obligate States to provide protection for these species. While the status of seabirds is affected by a range of factors such as degradation of nesting habitats and targeted harvesting of eggs, for albatrosses and large petrels, fisheries bycatch is generally considered to be the primary threat. The level of mortality of seabirds due to fishing gear in the Indian Ocean is poorly known, although where there has been rigorous assessment of impacts in areas south of 25 degrees (e.g. in South Africa), very high seabird incidental catches rates have been recorded in the absence of a suite of proven incidental catches mitigation measures.

Outlook. Resolution 12/06 *On Reducing the Incidental Bycatch of Seabirds in Longline Fisheries* includes an evaluation requirement (para. 8) by the Scientific Committee in time for the 2016 meeting of the Commission. The level of compliance with 12/06 and the frequency of use of each of the 3 measures (because vessels can chose two out of three

[20] The process of the threat assessment from IUCN is independent from the IOTC and is presented for information purpose only

possible options) are currently unknown. Methods to evaluate the effectiveness of the incidental catches mitigation measures prescribed in Res 12/06 need to be developed. Observer reports and logbook data should be analysed to support assessments of the effectiveness of mitigation measures used and relative impacts on seabird mortality rates. Information regarding seabird interactions reported in National Reports should be stratified by season, broad area, and in the form of catch per unit effort. Unless IOTC CPCs become compliant with the data collection, Regional Observer Scheme and reporting requirements for seabirds, the WPEB will continue to be unable to address this issue. The following should be noted:

- The available evidence indicates considerable risk from longline fishing to the status of seabirds in the Indian Ocean, where the best practice seabird incidental catches mitigation measures outlined in Resolution 12/06 are not implemented.
- CPCs that have not fully implemented the provisions of the IOTC Regional Observer Scheme outlined in paragraph 2 of Resolution 11/04 shall report seabird incidental catches through logbooks, including details of species, if possible.
- Appropriate mechanisms should be developed by the Compliance Committee to assess levels of compliance by CPCs with the Regional Observer Scheme requirements and the mandatory measures described in Res 12/06.

APPENDIX XVIII
WORKING PARTY ON ECOSYSTEMS AND BYCATCH PROGRAM OF WORK (2016–2020)

The Program of Work consists of the following, noting that a timeline for implementation would be developed by the SC once it has agreed to the priority projects across all of its Working Parties:

- **Table 1**: Priority topics for obtaining the information necessary to develop stock status indicators for bycatch in the Indian Ocean; and
- **Table 2**: Stock assessment schedule.

Table 1. Priority topics for obtaining the information necessary to develop stock status indicators for bycatch species in the Indian Ocean

Topic	Sub-topic and project	Priority ranking	Lead	Est. budget (potential source)	Timing				
					2016	2017	2018	2019	2020
	SHARKS								
1. Stock structure (connectivity and diversity)	1.1 Genetic research to determine the connectivity of select shark species throughout their distribution (including in adjacent Pacific and Atlantic waters as appropriate) and the effective population size.	High	CSIRO/AZTI /IRD/RITF	1.3 m Euro: (European Union; 20% additional co-financing)					
	1.1.1 Next Generation Sequencing (NGS) to determine the degree of shared stocks for select shark species (highest priority species: blue shark, scalloped hammerhead shark, oceanic whitetip shark and shortfin mako shark) in the Indian Ocean with the southern Atlantic Ocean and Pacific Ocean, as appropriate. Population genetic analyses to decipher inter- and intraspecific evolutionary relationships, levels of gene flow (genetic exchange rate), genetic divergence, and effective population sizes.								
	1.1.2 Nuclear markers (i.e. microsatellite) to determine the degree of shared stocks for select shark species (highest priority species: blue shark, scalloped hammerhead shark and oceanic whitetip shark) in the Indian Ocean with the southern Atlantic Ocean and Pacific Ocean, as appropriate.								
	1.2 Connectivity, movements and habitat use								
	1.2.1 Connectivity, movements, and habitat use, including identification of hotspots and investigate associated environmental conditions affecting the sharks distribution, making use of conventional and electronic tagging (P-SAT).	High	AZTI, IRD, Others	US$80K each species (TBD)	BSH SMA	BSH SMA OCS	SMA OCS		

Topic	Sub-topic and project	Priority ranking	Lead	Est. budget (potential source)	Timing				
					2016	2017	2018	2019	2020
	1.2.2 Whale sharks (RHN): Connectivity, movements, and habitat use, including identification of hotspots and investigate associated environmental conditions affecting distribution, making use of conventional and electronic tagging (P-SAT).	High	IRD	US$50,000 (available from IRD)	RHN	RHN			
2. Fisheries data collection	2.1 Historical data mining for the key species and IOTC fleets (e.g. as artisanal gillnet and longline coastal fisheries) and implementation of Regional Observer Schemes, including:								
	2.1.1 Capacity building of fisheries observers (including the provision of ID guides, training, etc.)	High		US$?? (TBD)					
	2.1.2 Define observer scheme (including minimum requirements) for fleets which are believed to have large catches on pelagic sharks (i.e. various longline and gillnet coastal fisheries) and where those statistics are mostly absent	High		US$?? (TBD)					
	2.1.3 Historical data mining for the key species, including the collection of information about catch, effort and spatial distribution of those species and fleets catching them	High	TBD	US$80K (CITES)	OCS SPL				
	2.1.4 Integration of data mining with observer programs to reconstruct species composition and catches of sharks	Medium		US$?? (TBD)					
	2.1.5 Electronic monitoring (NOTING the recommendation from the Scientific Committee (SC17.43) that the Commission considers assigning the IOTC Secretariat, in consultation with interested IOTC scientists, to develop a project on electronic monitoring in the IOTC area of competence, the Commission NOTED that a concept note/proposal should be developed to allow an evaluation of the efficacy of electronic monitoring in the collection of information on catch, discards and fishing effort as a means to supplement scientific observer coverage for large-scale gillnet vessels. The concept note should include a detailed budget and be communicated to a range of potential funding organisations. (para. 41 of the S19 report))	High		US$?? (TBD)					

Topic	Sub-topic and project	Priority ranking	Lead	Est. budget (potential source)	Timing				
					2016	2017	2018	2019	2020
3. Biological and ecological information (incl. parameters for stock assessment)	3.1 Age and growth research (Priority species: blue shark (BSH), shortfin mako shark (SMA) and oceanic whitetip shark (OCS); Silky shark (FAL))			US$?? (TBD)					
	3.1.1 CPCs to provide further research reports on shark biology, namely age and growth studies including through the use of vertebrae or other means, either from data collected through observer programs or other research programs.	High	CPCs directly	US$?? (TBD)	BSH SMA OCS	SMA OCS	OCS		
	3.2 Post-release mortality								
	3.2.1 Post-release mortality (electronic tagging), to assess the efficiency of management resolutions on no retention species (i.e. oceanic whitetip shark (OCS) and thresher sharks), shortfin mako shark SMA) ranked as the most vulnerable species to longline fisheries, and blue shark as the most frequent in catches.	High	IRD/ NRIFSF	US$170K per species (TBD)	THR, OCS	BSH, SMK			
	3.2.2 Post-release mortality (electronic tagging), to assess the efficiency of management resolutions on no retention species (i.e. oceanic whitetip shark (OCS) for purse seine fisheries	High	IRD/AZTI	US$80K (TBD)	OCS				
	3.2.3 Post-release survivorship (electronic tagging) on whale shark to assess the effect of unintended interaction and efficiency of management resolution of non-intentioned encirclement on purse seine	High	IRD/AZTI	US$50,000 IRD (commenced)	RHN	RHN			
	3.3 Reproduction research Priority species: blue shark (BSH), shortfin mako shark (SMA) and oceanic whitetip shark (OCS), and silky shark (FAL))	High	CPCs directly	US$?? (TBD)	BSH SMA OCS FAL	SMA OCS FAL	OCS		
4. Shark bycatch mitigation measures	4.1 Develop studies on shark mitigation measures (operational, technological aspects and best practices)								

Topic	Sub-topic and project	Priority ranking	Lead	Est. budget (potential source)	Timing				
					2016	2017	2018	2019	2020
	4.1.1 Longline selectivity, to assess the effects of hooks styles, bait types and trace materials on shark catch rates, hooking-mortality, bite-offs and fishing yield (socio-economics)	High		US$?? (TBD)					
	4.1.2 Gillnet selectivity, to assess the effect of mesh size, hanging ratio and net twine on sharks catches composition (i.e. species and size), and fishing yield (socio-economics)	High	WWF-Pakistan	US$?? (WWF)					
	4.1.3 Develop guidelines and protocols for safe handling and release of sharks caught on longlines and gillnets fisheries	Med							
5. CPUE standardisation / Stock Assessment / Other indicators	5.1 Develop standardised CPUE series for each key shark species and fishery in the Indian Ocean			US$?? (TBD)					
	5.1.1 Blue shark: Priority fleets: TWN,CHN LL, EU,Spain LL, Japan LL; Indonesia LL; EU,Portugal LL	High	CPCs directly	US$?? (TBD)					
	5.1.2 Shortfin mako shark: Priority fleets: Longline and Gillnet fleets	High	CPCs directly	US$?? (TBD)					
	5.1.3 Oceanic whitetip shark: Priority fleets: Longline fleets; purse seine fleets	High	CPCs directly	US$?? (TBD)					
	5.1.4 Silky shark: Priority fleets: Purse seine fleets	Med	CPCs directly	US$?? (TBD)					
	5.2 Stock assessment and other indicators								
	5.2.1 Develop and compare multiple assessment approaches to determining stock status for key shark species (see Table 2)	High	TBD	Part of: 600K Euro (European Union)					

Topic	Sub-topic and project	Priority ranking	Lead	Est. budget (potential source)	Timing				
					2016	2017	2018	2019	2020
	MARINE TURTLES								
6. Marine turtle bycatch mitigation measures	6.1 Review of bycatch mitigation measures								
	6.1.1 Res. 12/04 (para. 11) Part I. The IOTC Scientific Committee shall request the IOTC Working Party on Ecosystems and Bycatch to:		CPCs directly	US$?? (TBD)					
	a) Develop recommendations on appropriate mitigation measures for gillnet, longline and purse seine fisheries in the IOTC area; [mostly completed for LL and PS]	High							
	b) Develop regional standards covering data collection, data exchange and training;	High							
	c) Develop improved FAD designs to reduce the incidence of entanglement of marine turtles, including the use of biodegradable materials. [partially completed for non-entangling FADS; ongoing or biodegradable FADs)]	Med							
	6.1.2 Res. 12/04 (para. 11) Part II. The recommendations of the IOTC Working Party on Ecosystems and Bycatch shall be provided to the IOTC Scientific Committee for consideration at its annual session in 2012. In developing its recommendations, the IOTC Working Party on Ecosystems and Bycatch shall examine and take into account the information provided by CPCs in accordance with paragraph 10 of this measure, other research available on the effectiveness of various mitigation methods in the IOTC area, mitigation measures and guidelines adopted by other relevant organizations and, in particular, those of the Western and Central Pacific Fisheries Commission. The IOTC Working Party on Ecosystems and Bycatch will specifically consider the effects of circle hooks on target species catch rates, marine turtle mortalities and other bycatch species.	Low	CPCs directly	US$?? (TBD)					
	6.1.3 Res. 12/04 (para. 17) The IOTC Scientific Committee shall annually review the information reported by CPCs pursuant to this measure and, as necessary, provide recommendations to the	High	CPCs directly	Nil					

Topic	Sub-topic and project	Priority ranking	Lead	Est. budget (potential source)	Timing				
					2016	2017	2018	2019	2020
	Commission on ways to strengthen efforts to reduce marine turtle interactions with IOTC fisheries.								
	SEABIRDS								
7. Seabird bycatch mitigation measures	7.1 Review of bycatch mitigation measures								
	7.1.1 Res. 12/06 (para. 8) The IOTC Scientific Committee, based notably on the work of the WPEB and information from CPCs, will analyse the impact of this Resolution on seabird bycatch no later than for the 2016 meeting of the Commission. It shall advise the Commission on any modifications that are required, based on experience to date of the operation of the Resolution and/or further international studies, research or advice on best practice on the issue, in order to make the Resolution more effective.	High	Rep. of Korea, Japan, Birdlife International	US$?? (TBD)					
	DISCARDS								
8. Bycatch mitigation measures	8.1 Review proposal on retention of non-targeted species								
	8.1.1 The Commission requested that the Scientific Committee review proposal IOTC–2014– S18–PropL Rev_1, and to make recommendations on the benefits of retaining non-targeted species catches, other than those prohibited via IOTC Resolutions, for consideration at the 19th Session of the Commission. (S18 Report, para. 143). Noting the lack of expertise and resources at the WPEB and the short timeframe to fulfil this task, the SC RECOMMENDED that a consultant be hired to conduct this work and present the results at the next WPEB meeting. The following tasks, necessary to address this issue, should be considered for the terms of reference, taking into account all species that are usually discarded on all major gears (i.e., purse-seines, longlines and gillnets), and fisheries that take place on the high seas and in coastal countries EEZs:	High	Consultant	US$?? (TBD)					

Topic	Sub-topic and project	Priority ranking	Lead	Est. budget (potential source)	Timing				
					2016	2017	2018	2019	2020
	i) Estimate species-specific quantities of discards to assess the importance and potential of this new product supply, integrating data available at the Secretariat from the regional observer programs, ii) Assess the species-specific percentage of discards that is captured dead versus alive, as well as the post-release mortality of species that are discarded alive, in order to estimate what will be the added fishing mortality to the populations, based on the best current information, iii) Assess the feasibility of full retention, taking into account the specificities of the fleets that operate with different gears and their fishing practices (e.g., transhipment, onboard storage capacity). iv) Assess the capacity of the landing port facilities to handle and process this catch. v) Assess the socio-economic impacts of retaining non-target species, including the feasibility to market those species that are usually not retained by those gears, vi) Assess the benefits in terms of improving the catch statistics through port-sampling programmes, vii) Evaluate the impacts of full retention on the conditions of work and data quality collected by onboard scientific observers, making sure that there is a strict distinction between scientific observer tasks and compliance issues.								
9. Ecosystem Based Fisheries Management (EBFM)	Develop a plan for EBFM approaches in the IOTC	High	WPEB	US$?? (TBD)					

Table 2. Draft: Assessment schedule for the IOTC Working Party on Ecosystems and Bycatch 2016–2020.

	Working Party on Ecosystems and Bycatch				
Species	**2016**	**2017**	**2018**	**2019**	**2020**
Blue shark	Data prep.	**Full assessment***	Indicators; Revisit ERA	**Full assessment***	Indicators
Oceanic whitetip shark	Indicators; Review of mitigation measures in Res. 13/06	Indicators	Revisit ERA	Indicators	**Full assessment***
Scalloped hammerhead shark	–	Indicators	Revisit ERA	Indicators	–
Shortfin mako shark	–	Indicators	Revisit ERA	–	–
Silky shark	–	Indicators	Indicators; Revisit ERA	**Full assessment***	–
Bigeye thresher shark	–		Revisit ERA	–	–
Pelagic thresher shark	–	Indicators	Revisit ERA	–	–
Porbeagle shark	–	tRFMO assessment	–	–	–
Marine turtles	–	Review of mitigation measures in Res. 12/04	Revisit ERA	–	Review of mitigation measures in Res. 12/04
Seabirds	Review of mitigation measures in Res. 12/06	–	–	Review of mitigation measures in Res. 12/06	–
Marine Mammals	–	–	–	–	–
Ecosystem Based Fisheries Mangement (EBFM) approaches	tRFMO approaches: workshop				

*Including data poor stock assessment methods; Note: the assessment schedule may be changed dependant on the annual review of fishery indicators, or SC and Commission requests.

APPENDIX XIX
CONSOLIDATED RECOMMENDATIONS OF THE 11TH SESSION OF THE WORKING PARTY ON ECOSYSTEMS AND BYCATCH

Note: Appendix references refer to the Report of the 11th Session of the Working Party on Ecosystems and Bycatch (IOTC–2015–WPEB11–R)

Meeting Participation Fund (MPF)

WPEB11.01 (para. 10) The WPEB **RECOMMENDED** that the IOTC Rules of Procedure (2014), for the administration of the Meeting Participation Fund be modified so that applications are due not later than 60 days (current deadline is 45 days), and that the full Draft paper be submitted no later than 45 days (current deadline is 15 days) before the start of the relevant meeting, so that the Selection Panel may review the full paper rather than just the abstract, and provide guidance on areas for improvement, as well as the suitability of the application to receive funding using the IOTC MPF. The earlier submission dates would also assist with Visa application procedures for candidates.

Identification cards for shark, seabirds and marine turtles

WPEB11.02 (para. 16) **NOTING** that the Commission has approved US$30,000 for the printing of the species identification cards in 2016, as confirmed by the IOTC Secretariat at the 19th Session of the Commission, the WPEB **RECOMMENDED** that the marine turtle, seabird and shark species identification cards already translated into languages other than English and French, be printed in the first quarter of 2016 for dissemination.

WPEB11.03 (para. 19) The WPEB reiterated the **RECOMMENDATION** that the IOTC Secretariat ensure that hard copies of the identification cards continue to be printed as many CPCs scientific observers, both on board and port, still do not have smart phone technology/hardware access and need to have hard copies on board. At this point in time, electronic formats, including 'applications or apps' are only suitable for larger scale vessels, and even in the case of EU purse seine vessels, the use of hard copies is relied upon due to on board fish processing and handling conditions, as well as weather conditions. Electronic versions may be developed as a complimentary tools.

Review of the statistical data available for ecosystems and bycatch species

WPEB11.04 (para. 26) **NOTING** the high level of uncertainty in the nominal catches of blue sharks and high proportion caught by Indonesia, the WPEB **RECOMMENDED** that the IOTC consultancy work that is currently taking place to improve the Indonesian nominal catch data series is extended in order to provide sufficient attention to sharks as well as tuna.

Regional observer scheme – Update (Resolution 11/04 On a regional observer scheme)

WPEB11.05 (para. 38) **NOTING** the upcoming projects planned to support the ROS (including the development of an electronic reporting system, and a proposal for an electronic monitoring system), the WPEB **RECOMMENDED** that funding from the IOTC regular budget is allocated to support these activities over the next few years. The IOTC Secretariat has been tasked by the Commission to develop a proposal and budget for its consideration.

WPEB11.06 (para. 47) The WPEB **RECOMMENDED** that capacity building activities continue to be supported via the Commission's annual budget, to improve the lack of compliance with the implementation of observer schemes by CPCs for their fleets and lack of reporting to the IOTC Secretariat as per the provisions contained within Resolution 11/04 *on a Regional Observer Scheme*.

Revision of Resolution 11/04 *on a regional observer scheme*

WPEB11.07 (para. 48) **RECALLING** the objectives of Resolution 11/04 on a regional observer scheme as follows:

> "Para 1: *The objective of the IOTC Observer Scheme shall be to collect verified catch data and other scientific data related to the fisheries for tuna and tuna-like species in the IOTC area of competence*"

and **NOTING** that the objective of the ROS contained in Resolution 11/04, and the rules contained in Resolution 12/02 *On data confidentiality policy and procedures* makes no reference to the data collected not being used for compliance purposes, the WPEB reiterated its **RECOMMENDATION** that at the next revision of Resolution 11/04, it be clearly stated that the data collected shall not be used for compliance purposes.

Pakistan shark bycatch in gillnet fisheries

WPEB11.08 (para. 113) **NOTING** that gillnets are regularly being used in excess of 4,000 m (and up to 7,000 m) within and occasionally beyond the EEZ of Pakistan and other IOTC CPCs in the region, and that those used within the EEZ may sometimes drift onto the high seas in contravention of Resolution 12/12, the WPEB **RECOMMENDED** that the Commission should consider if a ban on large scale gillnets should also apply within IOTC CPC EEZ. This would be especially important given the negative ecological impacts of large scale drifting gillnets in areas frequented by marine mammals and turtles.

Review of seabird mitigation measures in Resolution 12/06

WPEB11.09 (para. 234) The WPEB **RECOMMENDED** that CPCs with significant fishing effort south of 25°S to undertake their own assessments on the levels and nature of implementation of Resolution 12/06 by their fleets, and present papers, similar to that presented in paper IOTC–2015–WPEB11–37 Rev_1, to the WPEB meeting in 2016.

WPEB11.10 (para. 235) The WPEB **RECOMMENDED** that CPCs bring data to the WPEB meeting in 2016, as the Commission via Resolution 12/06 required the WPEB and SC to undertake this task in 2015, which has not been possible due to insufficient data, and that a collaborative analysis of the impacts of Resolution 12/06 be undertaken during the WPEB meeting, if feasible. CPC review papers and datasets should include the following information/data from logbooks and/or observer schemes, where appropriate and should cover the period 2011 to 2015:

- Total effort south of 25°S by area and time, at the finest scale possible
- Observed effort south of 25°S by area and time, at the finest scale possible
- Observed seabird mortality rates south of 25°S by area and time, at the finest scale possible
- Descriptions of fleet structure /target species by time and area, and an indication of observer coverage per fleet/target species for effort south of 25°S
- Data on which seabird bycatch mitigation measures were used, on a set-by-set/cruise basis if possible or per vessel, or at the finest scale possible
- Descriptions of the specifications of seabird bycatch mitigation measures used according to the fields in the Regional Observer Scheme manual and in relation to the specifications given in Res 12/06

Marine mammal identification cards

WPEB11.11 (para. 251) **RECALLING** the Scientific Committee's recommendation SC17.21 (para. 54 of the C17 Report), the WPEB **RECOMMENDED** that the SC reiterate its previous recommendation for the Commission to allocate funds in its 2016 budget, to produce and print the IOTC best practice guidelines for the safe release and handling of encircled cetaceans. The guidelines could be incorporated into a set of IOTC cetacean identification cards: "*Cetacean identification for Indian Ocean fisheries*".

Revision of the WPEB Program of Work 2016–2020

WPEB11.12 (para. 258) The WPEB **RECOMMENDED** that the SC consider and endorse the WPEB Program of Work (2016–2020), as provided at Appendix XVIII.

Election of a Chairperson and Vice-Chairperson for the WPEB for the next biennium

WPEB11.13 (para. 270) The WPEB **RECOMMENDED** that the SC note that Dr Rui Coelho (EU,Portugal) was elected as Chairperson, and Mr Reza Shahifar (I.R. Iran) and Dr Ross Wanless (South Africa) were elected as Vice-Chairpersons of the WPEB for the next biennium, in accordance with the IOTC Rules of Procedure (2014).

Review of the draft, and adoption of the Report of the 11th Session of the Working Party on Ecosystems and Bycatch

WPEB11.14 (para. 274) The WPEB **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPEB11, provided at Appendix XIX, as well as the management advice provided in the draft resource stock status summary for each of the seven shark species, as well of those for marine turtles and seabirds:

Sharks

- Blue sharks (*Prionace glauca*) – Appendix IX
- Oceanic whitetip sharks (*Carcharhinus longimanus*) – Appendix X
- Scalloped hammerhead sharks (*Sphyrna lewini*) – Appendix XI
- Shortfin mako sharks (*Isurus oxyrinchus*) – Appendix XII
- Silky sharks (*Carcharhinus falciformis*) – Appendix XIII
- Bigeye thresher sharks (*Alopias superciliosus*) – Appendix XIV
- Pelagic thresher sharks (*Alopias pelagicus*) – Appendix XV

Other species/groups

- Marine turtles – Appendix XVI
- Seabirds – Appendix XVII