Report of the 14thSession of the IOTC Working Party on Ecosystems and Bycatch

Cape Town, South Africa, 10 – 14 September 2018

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ACRONYMS

ABNJ	Areas Beyond National Jurisdiction
ACAP	Agreement on the Conservation of Albatrosses and Petrels
BPUE	Bycatch Per Unit of Effort
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
EU-DCF	European Union Data Collection Framework
F	Fishing mortality; F_{2015} is the fishing mortality estimated in the year 2015
FAD	Fish Aggregation Device
FAO	Food and Agriculture Organization of the United Nations
FOB	Floating Object
F_{MSY}	Fishing mortality at MSY
GAM	Generalised Additive Model
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
NDF	Non Detriment Finding
NGO	Non-Governmental Organisation
NOAA	National Oceanic and Atmospheric Administration
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 kilometres 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 14th Session of the Indian Ocean Tuna Commission's (IOTC) Working Party on Ecosystems and Bycatch (WPEB) was held in Cape Town, South Africa, from 10 - 14 September 2018. A total of 40 participants (39 in 2017, 34 in 2016, 37 in 2015) attended the Session. The list of participants is provided in Appendix I. The meeting was opened by the Chairperson, Dr Sylvain Bonhommeau from IFREMER, EU-France, who welcomed participants and formally opened the 14th Session of the IOTC Working Party on Ecosystems and Bycatch (WPEB14).

The following are the complete recommendations from the WPEB14 to the Scientific Committee which are also provided at Appendix XX:

Mobulid rays

WPEB14.01 (para 171): The WPEB **RECOMMENDED** that data collection for mobulid rays (if possible to species level) should be improved, that by-catch mitigation methods should be investigated and that safe release techniques and best practices should be implemented.

WPEB14.02 (para 172): The WPEB **NOTED** the status and declines of *Mobula* spp. in the Indian Ocean (which under current taxonomic revisions include the manta rays as well). Given the significant declines of these species across their range in the Indian Ocean along with evidence of these species' interaction with pelagic fisheries, in particular tuna gillnet, purse seine, and occasionally longline fisheries, the WPEB **RECOMMENDED** that management actions, such as non-retention measures in the IOTC Area of Competence (as a first step considering the Precautionary Approach) among others, are required to enable these species to recover and must immediately be adopted instead of waiting until 2020.

Revision of the WPEB Program of Work 2019–2023

WPEB14.03 (para 194): The WPEB **RECOMMENDED** that the SC consider and endorse the WPEB Program of Work (2019–2023), as provided in Appendix XIX

Review of the draft, and adoption of the Report of the 14th Session of the Working Party on Ecosystems and Bycatch

WPEB 14.04 (para 207): The WPEB **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPEB14 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
- Marine mammals – Appendix XVIII

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.

Colour key for Table 1	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		

Stock	Indicators	Prev[1]	2013	2014	2015	2016	2017	2018	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 2017: 27,259 t Estimated catch 2015: 54,735 t Not elsewhere included (nei) sharks 2017: 56,883 t Average reported catch 2013–17: 29,790 t Average estimated catch 2011–15: 54,993 t Ave. (nei) sharks[2] 2012–16: 51,712 t MSY (1,000 t) (80% CI): 33.0 (29.5-36.6) F_{MSY} (80% CI): 0.30 (0.30-0.31) SSB_{MSY} (1,000 t) (80% CI): 39.7 (35.5-45.4) F_{2015}/F_{MSY} (80% CI): 0.87 (0.67-1.09) SSB_{2015}/SSB_{MSY} (80% CI): 1.54 (1.37-1.72) SSB_{2015}/SSB_0 (80% CI): 0.52 (0.46-0.56)								Even though the blue shark in 2017 is assessed to be not overfished nor subject to overfishing, current catches are likely to result in decreasing biomass and making the stock become overfished and subject to overfishing in the near future (Table 3). If the Commission wishes to maintain stocks above MSY reference levels ($B>B_{MSY}$ and $F<F_{MSY}$) with at least a 50% probability over the next 10 years, then a reduction of 20% in catches is advised (Table 3). The stock should be closely monitored. Mechanisms need to be developed by the Commission to improve current statistics, by ensuring CPCs comply with their recording and reporting requirement on sharks, so as to better inform scientific advice in the future. Click below for a full stock status summary: o Blue sharks – Appendix IX
Oceanic whitetip shark *Carcharhinus longimanus*	Reported catch 2017: 48 t Not elsewhere included (nei) sharks[2]: 56,883t Average reported catch 2013–2017: 230 t Not elsewhere included (nei) sharks[2]: 51,712 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: o Oceanic whitetip sharks – Appendix X o Scalloped hammerhead sharks – Appendix XI o Shortfin mako sharks – Appendix XII o Silky sharks– Appendix XIII o Bigeye thresher sharks– Appendix XIV o Pelagic thresher sharks– Appendix XV
Scalloped hammerhead shark *Sphyrna lewini*	Reported catch 2017: 118 t Not elsewhere included (nei) sharks[2]: 56,883t Average reported catch 2013–2017: 76 t Not elsewhere included (nei) sharks[2]: 51,712 t								
Shortfin mako *Isurus oxyrinchus*	Reported catch 2017: 1,664 t Not elsewhere included (nei) sharks[2]: 56,883t Average reported catch 2013–2017: 1,555 t Not elsewhere included (nei) sharks[2]: 51,712 t								
Silky shark *Carcharhinus falciformis*	Reported catch 2017: 2,175 t Not elsewhere included (nei) sharks[2]: 56,883t Average reported catch 2013–2017: 2,967 t Not elsewhere included (nei) sharks[2]: 51,712 t								
Bigeye thresher shark *Alopias superciliosus*	Reported catch 2017: 0 t Not elsewhere included (nei) sharks[2]: 56,883t Average reported catch 2013–2017: 0 t Not elsewhere included (nei) sharks[2]: 51,712 t								

Pelagic thresher shark *Alopias pelagicus*	Reported catch 2017: Not elsewhere included (nei) sharks[2]: Average reported catch 2013–2017: Not elsewhere included (nei) sharks[2]:	0 t 56,883t 0 t 51,712 t								

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

1. Opening of the meeting

1. The 14th Session of the Indian Ocean Tuna Commission's (IOTC) Working Party on Ecosystems and Bycatch (WPEB) was held in Cape Town, South Africa from 10 - 14 September 2018. A total of **40** participants (39 in 2017, 34 in 2016, 37 in 2015) attended the Session. The list of participants is provided in Appendix I. The meeting was opened by the Chairperson, Dr Sylvain Bonhommeau from IRD, France, who welcomed participants and formally opened the 14th Session of the IOTC Working Party on Ecosystems and Bycatch (WPEB14). Adoption of the Agenda and arrangements for the Session

2. Adoption of the Agenda and arrangements for the Session

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

3. The IOTC process: outcomes, updates and progress

3. The WPEB **NOTED** the suggestions by the IOTC Executive Secretary to reduce and streamline the number of recommendations and requests to be made during each of the IOTC working party meetings to ensure they are more achievable.

3.1 Outcomes of the 20th Session of the Scientific Committee

4. The WPEB **NOTED** paper IOTC–2018–WPEB14–03 which outlined the main outcomes of the 20th Session of the Scientific Committee (SC20) specifically related to the work of the WPEB and **AGREED** to consider how best to progress these issues at the present meeting.

Review of the statistical data available for ecosystems and bycatch species

NOTING the highly aggregated nature of information requested on discards, the SC AGREED that the discard reporting form (Form 1DI) is updated to include seasonal (month) and spatial information (5 x 5 or 1 x 1) in a similar format to the catch and effort data reporting forms.

5. The WPEB **NOTED** that discussions on this specific topic will be deferred after the presentation of the updates on the current status of data collection and reporting for bycatch species.

CPUE Collaborative study of shark CPUE from multiple Indian Ocean longline fleets

Noting the conflicting patterns in blue shark CPUE derived from different Indian Ocean longline fleets and considering the success of using joint analysis of operational catch and effort data to resolve such conflicts in other Working Parties, the SC RECOMMENDED initiating work on joint analysis of operational catch and effort data from multiple fleets, to further develop methods and to provide indices of abundance for sharks of interest to the IOTC.

6. The WPEB **NOTED** that this work is desirable but **ACKNOWLEDGED** that this work requires a high degree of trust between the CPCs who share their operational data and the expert contracted to conduct these collaborative estimations. One such expert has been identified and has been involved in several similar estimations for other species groups at IOTC, however, he is currently involved with other species and so is not immediately available. As such the WPEB **AGREED** to continue to request this work be conducted, when the consultant becomes available in the future.

Review of mitigation measures in Resolution 12/04

The SC noted paper IOTC-2017-SC20-INF03 and REQUESTED the IOTC Secretariat to send out the version of IOTC-2017-SC20-INF03 Rev_1 revised by the SC as a data call to inform a review of the mitigation measures for marine turtles in Resolution 12/04 as requested by the Commission.

7. The WPEB **NOTED** this request and agreed to provide comment on the paper intersessionally, **NOTING** that the extent and type of information that were the object of the data call could otherwise directly come from scientific observer data once these are submitted in a proper electronic format.

3.2 Outcomes of the 22nd Session of the Commission

8. The WPEB **NOTED** paper IOTC–2018–WPEB14–04 which outlined the main outcomes of the 22nd 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.

9. The WPEB **NOTED** the 10 Conservation and Management Measures (CMMs) adopted at the 22nd Session of the Commission (consisting of 10 Resolutions and 0 Recommendations) as listed below:

IOTC Resolutions

- Resolution 18/01 *On an interim plan for rebuilding the Indian Ocean yellowfin tuna stock in the IOTC Area of Competence*
- Resolution 18/02 *On management measures for the conservation of blue shark caught in association with IOTC fisheries*
- Resolution 18/03 *On establishing a list of vessels presumed to have carried out illegal, unreported and unregulated fishing in the IOTC Area of Competence*
- Resolution 18/04 *On bioFAD experimental project*
- Resolution 18/05 *On management measures for the conservation for the conservation of billfish, striped marlin, black marlin, blue marlin and Indo-Pacific sailfish*
- Resolution 18/06 *On establishing a programme for transhipment by large-scale fishing vessels*
- Resolution 18/07 *On measures applicable in case of non-fulfilment of reporting obligations in the IOTC*
- Resolution 18/08 *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 design to reduce the incidence of entanglement of non-target species*
- Resolution 18/09 *On a scoping study of socio-economic indicators of IOTC fisheries*
- Resolution 18/10 *On vessel chartering in the IOTC Area of Competence*.

10. The WPEB **NOTED** that these 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 2018–026 (i.e. 4 October 2018)[1].

11. The WPEB **NOTED** that the Commission also made a number of general comments and requests regarding the recommendations made by the Scientific Committee in 2017, which have relevance for the WPEB (details as follows: paragraph numbers refer to the report of the Commission IOTC–2018–S22–R).

*The Commission **NOTED** the stock status summaries for species of tuna and tuna-like species under the IOTC mandate, as well as other species impacted by IOTC fisheries (Appendix 5) and considered the recommendations made by the SC20 in its report that related specifically to the Commission. The Commission **ENDORSED** the SC 2017 list of recommendations as its own, noting the additional activities requested by the Commission at this meeting (para. 26).*

Consideration of management measures related to ecosystems, bycatch and sharks

*The Commission **REQUESTED** the SC to review the status of manta and mobula rays and their interaction with IOTC fisheries and to report this to the Commission in 2020. This work should include an evaluation of data availability and data gaps. Where data is insufficient, the SC should propose options for strengthening data collection (para 34).*

*The Commission **NOTED** the working paper IOTC-2018-S22-06 by the EU, which requested a follow-up of the Resolution 17/05 on the conservation of sharks caught in the IOTC fisheries. The Commission **NOTED** there are existing limitations in current observer coverage, shortcomings in the provision of complete, accurate and timely catch records for sharks caught in association with fisheries managed by IOTC (para 37).*

[1] As per Article IX.4 of the IOTC Agreement

*The Commission **REQUESTED** the Scientific Committee to identify possible means to improve the submission of complete, accurate and timely catch records for sharks, as well as the collection of species-specific data on catch, biology, discards and trade. (para.38).*

12. The WPEB **NOTED** that the Commission **AGREED** to defer IOTC-2018-S22-PropD and PropJ *On a Regional Observer Scheme.* The proponents of these proposals attempted to merge the two proposals; however, they agreed more work needed to be done to reach a consensus and indicated that a revised proposal will be submitted to the next session of the Commission (para. 54)

13. The WPEB **NOTED** that the Commission **NOTED** that IOTC–2018–S21–PropL *On the conservation of mobula and manta rays caught in association with fisheries in the IOTC Area of competence* was deferred. The Commission also **NOTED** that there is no specific research that indicates an association of mobula and manta rays with surface fisheries. One CPC highlighted the need for data be collected in order for the SC to provide potential management advice on the conservation of this species.

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.

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

The WPEB **NOTED** paper IOTC–2017–WPEB13–05 which aimed to encourage participants to review some of the existing Conservation and Management Measures (CMM) relevant to ecosystems and bycatch, noting the CMMs contained in document IOTC–2018–WPEB14–04; 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.

3.4 Progress on the recommendations of WPEB13

14. The WPEB **NOTED** paper IOTC–2018–WPEB14–06 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.

15. 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.

16. 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.

3.4.1 Biodegradable materials in FAD construction

17. The WPEB **NOTED** that this recommendation has been formalized as a Resolution (18/04) by the Commission and expressed its support for this initiative.

3.4.2 CPUE Collaborative study of shark CPUE from multiple Indian Ocean longline fleets

18. The WPEB **NOTED** the need for this study, but as stated in the previous section, it was **AGREED** that this work would continue to be requested but delayed until the consultant becomes available.

3.4.3 Future format of WPEB

19. The WPEB **RECALLED** the recommendation that in future years when a stock assessment is planned, the meeting is extended in length to more adequately accommodate the work plan, with some of the days dedicated exclusively to the stock assessment work. This WPEB **AGREED** that this should be followed and will be considered when planning future meetings of the Working Party.

4. Review of data available on ecosystems and bycatch

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

20. The WPEB **NOTED** paper IOTC–2018–WPEB14–07 which provided an overview of the data received by the IOTC Secretariat for bycatch species, in accordance with IOTC Resolution 15/02 *Mandatory statistical reporting requirements for IOTC Contracting Parties and Cooperating Non-Contracting Parties (CPCs)*, for the period 1950–2017. A summary for sharks is provided in Appendix IV.

21. The WPEB **NOTED** the large proportion of reported shark catches that have not been identified to species level (~65% in 2017) and the issues this poses when using species-specific catch series for assessments.

22. The WPEB **ACKNOWLEDGED** that I.R. Iran has provided - in 2018 for the first time - catch-and-effort data with the recommended spatial and temporal resolution for the years 2015, 2016 and 2017 (with historical data for 2007 and following years to be submitted soon) and that this information is important to improve the understanding of the spatial distribution of I.R. Iran coastal gillnet fleet.

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

24. **NOTING** the proposed updates to the IOTC discard reporting form (Form 1DI) to include seasonal and spatial information, the WPEB **REQUESTED** CPCs to provide their feedback on the feasibility of submitting data according to the updated requirements, and that this is further discussed at the next WPDCS and SC meetings.

25. The WPEB **NOTED** that information on the status of discards (dead/alive) is rarely provided and **REQUESTED** CPCs to record and report this information through their observer programmes.

26. The WPEB **EMPHASIZED** that sourcing and reconstructing historical catch and effort data remains a high priority. However, it was also noted that the lack of historical catch data poses a challenge in assessing population status of all IOTC and associated species. Therefore, the WPEB **REQUESTED** the WPDCS explore the option of addressing this challenge through directed workshops that comprise national scientists with institutional knowledge of national fisheries and international experts to provide guidance and capacity building in analytic approaches and tools for data recovery and catch reconstruction methods.

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

27. The WPEB **NOTED** paper IOTC–2018–WPEB14–08 which provided an update on the national implementation of the IOTC regional observer scheme (ROS) for each IOTC CPC and the development of the pilot scheme.

28. **RECALLING** that the target observer coverage is 5% of all fishing operations, the WPEB **NOTED** that a small number of CPCs have met or exceeded this level in recent years. Although in future it may be possible to meet the observer requirements with a mixture of self-sampling, electronic monitoring and human observers, the current requirement is still currently 5% onboard human observer coverage (Resolution 11/04) and so **RECALLED** that these methods are considered complementary sources of information.

Pilot projects under Resolution 16/04

29. The WPEB **NOTED** progress with the ROS pilot project and that a workshop for representative of regional observer programmes and other interested parties will be held in Seychelles at the end of September 2018 to review the observer standards and training package, **ACKNOWLEDGING** that the results of this review are expected to further streamline and rationalize the data collection and reporting requirements.

30. The WPEB **NOTED** the progress made in completing the development of the ROS electronic data collection and reporting tools, which have recently undergone trials in Sri Lanka and Indonesia and that are currently being proposed for trial in other CPCs (Mauritius and Tanzania) by Q1 2019.

31. Also, the WPEB **ACKNOWLEDGED** that over 60% of the trips for which scientific observer data was submitted in suitable electronic formats to the IOTC Secretariat have been processed and incorporated within the ROS Regional Database. Therefore, given the importance of having access

to comprehensive scientific observer historical information for analytical purposes, the WPEB **REQUESTED** CPCs to report all historical scientific observer data at their availability in a proper electronic format, including information on key bycatch species groups such as marine turtles, seabirds and marine mammals.

32. The WPEB **NOTED** the ongoing development of a data conversion tool to ensure that information recorded through existing scientific observer data collection systems already adopted in the region (such as *ObServe*) could be seamlessly integrated within the ROS Regional Observer Database in the future, and **ENCOURAGED** the IOTC Secretariat and all other involved stakeholders to further collaborate on this activity.

33. The WPEB **NOTED** with thanks the support provided by SIOTI (*Sustainable Indian Ocean Tuna Initiative*) for the incorporation in the ROS Regional Database of historical data collected by scientific observers during over 45 trips onboard of Mauritius, Seychelles and Rep. of Korea purse seiners, and originally reported as Word / PDF documents.

34. The WPEB **ACKNOWLEDGED** the outcomes of the field visits conducted by the IOTC Secretariat during 2017 and 2018 to Pakistan, Sri Lanka, and I.R. Iran to assess the logistical practicalities of implementing EMS onboard coastal gillnet (and gillnet-longline) vessels and **NOTED** that the proposal developed in collaboration with the Sri Lanka Ministry of Fisheries and Aquatic Resources Development (MFARD) to trial EMS on-board around 6 coastal longline/gillnet vessels (between 15m – 24 m LOA). The implementation of the EMS has been confirmed, which will be secured through EU voluntary funds and the procurement of EMS equipment is about to be finalized, with delivery and installation planned for 2018 Q4.

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

35. 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.

36. The WPEB **RECALLED** that the IPOA-SEABIRDS is a voluntary instrument that applies to all States engaged in 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.

37. 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 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'.

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).

38. The WPEB **NOTED** paper IOTC–2018–WPEB14–09 which provided the 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)

39. 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'. The Scientific Committee recently revoked two statuses of 'not applicable' due to insufficient evidence provided, so the WPEB **REQUESTED** CPCs to continue to review

their status periodically and either update this or provide additional supporting information as necessary.

40. 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 2017, **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.

41. 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, with information provided by each CPC for the consideration at the WPEB and SC meetings. The current status is provided in Appendix VIII.

42. 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. The WPEB **WELCOMED** the update to Japan's NPOAs.

43. The WPEB **NOTED** paper IOTC–2018–WPEB14–11 which provided and update on the National Plan of Action for Sharks, South Africa.

"*South Africa has one of the most diverse shark faunas in the world and many species are caught in appreciable quantities in directed and non-directed shark fisheries. South Africa has well developed fisheries management systems for most of its fisheries and many challenges with regard to the sustainable management and conservation of sharks have already been identified and addressed in individual fisheries policies and management measures. The South African National Plan of Action for sharks (NPOA-Sharks) was finalised in 2013 and provided information on the status of chondrichthyans in South Africa and examined structure, mechanisms and regulatory framework related to research, management, monitoring, and enforcement associated with shark fishing and trade of shark product in the South African context. This information was used to identify, group and prioritize issues particular to South African chondrichthyan resources that require intervention in the forms of specific actions, associated responsibilities and time frames. It provides a guideline for identifying and resolving the outstanding issues around management and conservation of sharks to ensure their optimal, long term, sustainable use for the benefit of all South Africans. Integral to the NPOA for Sharks -South Africa was the list of issues to be addressed in terms of improving sources of data, addressing scientific knowledge on common and cryptic species and thereby improving the management of chondrichthyan fisheries. The NPOA for Sharks – South Africa is in the process of being updated and the progress in implementation is highlighted in this paper*."

44. The WPEB **NOTED** the update to the South African NPOAs for sharks and **THANKED** the authors for this comprehensive review of its status.

45. The WPEB **NOTED** that the NPOA also covers highly diverse inshore and coastal species and further collaboration with other neighbouring countries should be continued.

46. The WPEB **NOTED** that historically there have been directed fisheries for shark species in South Africa. This has become difficult to classify as many fisheries are multi-specific and although they catch sharks, it is unclear whether these are still being targeted.

47. The WPEB **NOTED** that South Africa has a regulation that requires sharks be landed with their fins naturally attached.

48. As it was clarified that this applies to both national flag vessels as well as joint venture vessels, the WPEB **ACKOWLEDGED** that this requirement is likely to have high compliance as there is 100% observer coverage on the joint-venture vessels.

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

FAD fisheries

49. The WPEB **NOTED** paper IOTC–2018–WPEB14–12 which provided information on FAD Watch: a collaborative initiative to minimize the impact of FADs in coastal ecosystems, including the following abstract provided by the authors:

> "*The FAD-Watch project is a first multi-sectorial initiative developed to prevent and mitigate FAD beaching across islands in Seychelles, in which the coastal recovery is applied as a mitigation measure. It is the result of a collaborative work among the Spanish Tuna Purse Seiner fishing representatives (OPAGAC), Island Conservation Society (ICS), Islands Development Company (IDC) and Seychelles Fishing Authority (SFA). The FAD detection system was setup by OPAGAC for 6 buffer areas (Alphonse, Farquhar, Desroches, Poivre, Aride and Silhouette islands), which make possible alerting ICS when FADs crossed buffer areas within 5 and 3 nautical miles of any of these islands. For each intercepted FAD, ICS collected information about the location, habitat type, purse seiner vessel, FAD design, entangled fauna, and fate (removed or not; & disposal method). In order to evaluate the beaching rate and entangling potential of FADs of the target fleet, information was complemented both by buoy tracked data and by data collected on the frame of the voluntary agreement for the application of good practices. FADs tracked in EEZ of Seychelles the 0.8% in 2016 and 0.5% in 2017 impacted the coast of the archipelago. During this period, a total of 19 FADs were intercepted by ICS in the buffer areas. FADs crossing EEZ of Seychelles and the beaching events have been reduced on 20% and 41% respectively, during 2016 to 2017 period. Results show how the FAD-Watch initiative in combination with other mitigation options could add great value to the package of mitigation measures on the reduction of FADs impacts on vulnerable coastal and pelagic habitats."*

50. The WPEB **ACKNOWLEDGED** the potential of the FAD-Watch initiative in reducing the impact of FADs on coastal areas (beaching) and **ENCOURAGED** the consortium to continue work in this direction.

51. The WPEB **NOTED** that in 2016-2017 a total of 335 FADs were intercepted by FAD-Watch and 15 were removed from the beaches.

52. The WPEB **NOTED** that certain number of FADs were deployed inside of the zone of observation therefore number of FADs exited from the zone is higher than number of entered FADs into the zone of observations.

53. The WPEB **NOTED** and expressed its concerns that further funding of the project is not secured and **ENCOURAGED** all parties involved to look for a solution to keep the project running and potentially extend the coverage area.

Chinese longline fisheries

54. The WPEB **NOTED** paper IOTC–2018–WPEB14–13 which compared the biological characteristics, length structure and capture status of bycatch in the Chinese longline fishery targeting different species in the Indian Ocean, including the following abstract provided by the authors:

> "*From October 2013 to January 2018, twelve Chinese tuna longline observer trips were operated in the Indian Ocean, seven targeting Bigeye tuna (N10° 14′ - S22° 47′ , E23° 12′ - E89° 54′) and the other six targeting Albacore (N0° 11′ - S34° 37′ , E25° 19′ - E89° 54′) including one trips changing the targeting species. Regarding observer trips targeting Bigeye tuna (Thunnus obesus), a total of 11,293 individuals among 49 bycatch species were observed from 2,178,636 hooks, including tunas (42.36%), billfishes (17.29%), sharks (12.26%), rays(3.19%) , dolphins and turtles (0.13%) ,and other species (24.77%). Major bycatch species (above 4% of total individuals) were as follows: Yellowfin tuna (Thunnus albacares), Longnose lancetfish (Alepisaurus ferox), Swordfish (Xiphias gladius), and the Blue shark (Prionace glauca). Regarding observer trips targeting Albacore (Thunnus alalunga), 7,860 individuals among 40 bycatch species were observed from 1,454,153 hooks, including tunas (40.01%), billfishes (5.22%), sharks(5.52%), rays (2.23%) , turtles (0.03%) ,and other species (47.00%). Major bycatch species were as follows: Bigeye tuna, Longnose lancetfish, Opah (Lampris guttatus), Escolar (Lepidocybium flavobrunneum), Dolphinfish (Coryphaena hippurus), Skipjack tuna (Katsuwonus pelamis), Yellowfin tuna and the Blue shark. The fate and condition of the capture status for bycatch were also analyzed. This report also compared the length frequency of major bycatch species between longline fishing vessels targeting bigeye tuna and albacore with Chinese*

scientific observer data."

55. The WPEB **NOTED** that observers often collect data on sex and maturity of bycatch species and **ENCOURAGED** authors to explore such data and present new information on maturity at size in the future.

56. The WPEB **REQUESTED** that the IOTC Secretariat discuss during the next WPDCS the possibility of creating a database of biological information that would be particularly useful to the WPEB and WPB among others.

57. The WPEB **NOTED** that data on depredation is collected by Chinese observers but was not available during present meeting, therefore **ENCOURAGED** China to present such depredation data during the next WPEB, as this is recognized as an important issue for longline fisheries in the South Western Indian Ocean.

58. The WPEB **NOTED** that no seabird bycatch was observed during reported cruises and **ENCOURAGED** China to continue collection of the information on bycatch species, and further reporting this information to the Secretariat and the WPEB.

59. **NOTING** that the observer trip reports submitted by China to the IOTC Secretariat are lacking the spatial information needed to link the reported catches and discards to the grids where these were originally recorded, the WPEB **ENCOURAGED** China to provide such information at its earliest convenience for all the historical (2014-2017) and future observer trip reports submitted to the IOTC Secretariat.

Thailand bycatch landings in fisheries

60. The WPEB **NOTED** paper IOTC–2018–WPEB14–16 which provided information on Bycatch landings in Phuket ports by foreign vessel 2017, including the following abstract provided by the authors:

"All the catch of by-catch by foreign long-line vessel were from the fishing areas in the Indian Ocean. The catch was transshipped at Phuket ports, Thailand for re-export and some to industrials in Thailand. The total caught of by-catch by foreign long-line vessel in 2017 was 78.33 tons. There are five species of by-catch were recorded in port state inspection data; Dolphinfish (Coryphaena hippurus), Spanish mackerel (Scomberomerus commersoni), oilfish (Ruvettus pretiosus), Albacore (Thunnus albacores), and Skipjack Tuna (Katsuwonus pelamis). The other transshipped was recorded in miscellaneous (MSC) or mix-frozen fish (MF); such as escolar fish (Lepidocybium spp.), Barracuda (Sphyraena barracuda), deep sea promfret and sunfish."

61. The WPEB **NOTED** that data presented correspond to landings of foreign vessels in Phuket ports.

62. The WPEB **NOTED** that the origin of sampled bycatch is known and **ACKNOWLEDGED** the interest of the IOTC Secretariat in using such data to cross check with the declarations of the foreign countries in question.

Bycatch in Iranian fisheries

63. The WPEB **NOTED** paper IOTC–2018–WPEB14–17 which provided information on Iran tuna fisheries by-catch in IOTC competence of area in 2017, including the following abstract provided by the authors:

"In order to assess the level of Iranian tuna fishing vessels By-catch in the IOTC area of competence in 2017, tuna fisheries data which are collected through the Iran Fishery Organization data Collection system are used. Base on the information, around 30 different species of Tuna, Tuna-like and some others are caught by Iranian fishermen through the Tuna fishing activities. Base on the information in total, 297251 tons of different species including, 255793 tons Tuna and Tuna-like species, 19976 tons Billfish, 3623 tons of Sharks and 17859 tons the other species, are caught by Iranian fishing vessels in the IOTC area of competence. According to IOTC target species list (16 species covered by IOTC agreement) 92.8% of Iran catch belong to target species and 7.2% of catch belong to non-target species, in the 2017. (See paper for full abstract)

64. The WPEB **NOTED** that the presented bycatch data is recorded to the specific shark species level, and that this is apparently in contrast with the recently received catch-and-effort data from I.R. Iran, in which all shark catches are recorded under the generic *Shark NEI* category, therefore **REQUESTING** the IOTC Secretariat to liaise with I.R. Iran and update the catch-and-effort data set accordingly.

65. The WPEB **NOTED** that I.R. Iran conducts regular port samplings and **ACKNOWLEDGING** that this activity could benefit from additional support from the ROS Pilot Project, the WPEB **ENCOURAGED** I.R. Iran in continuing the collection of bycatch information for its gillnet fisheries.

66. The WPEB **NOTED** that there is no market for sea turtles in I.R. Iran, therefore they are usually released by fishermen.

67. The WPEB also **ACKNOWLEDGED** that I.R. Iran is currently working on a catch reconstruction for sharks time series from 1950 to 1992 and **REQUESTED** I.R. Iran to eventually provide the results of this exercise to the IOTC Secretariat.

Purse seine fisheries

68. The WPEB **NOTED** paper IOTC–2018–WPEB14–19 which provided information on SIOTI Support for lmproving lnformation on Bycatch for Management of the lndian Ocean Purse Seine Tuna Fishery, including the following abstract provided by the authors:

"The Sustainable Indian Ocean Tuna Initiative (SIOTI) is a large-scale Fisheries Improvement Project (FIP) comprising the major purse seine fleets and tuna processors in the region. As part of his Action Plan, SIOTI facilitated a workshop for key institutions involved in bycatch data collection. This paper presents the outcomes of the Purse Seine Observer Program Coordination Workshop, that took place in Pasaia (Spain) during 16th- 17th of April 2018. It includes recommendations for improving information on bycatch for management of the Indian Ocean purse seine tuna fishery. These recommendations revolve mainly around; the observer coverage, the need to standardize the raising methodology of the sampling to the fleet level, and finally some recommendations about the need to standardize EMS (Electronic Monitoring System) programs' output to be able to merge with observers' data."

69. The WPEB **NOTED** the conclusions of the Workshop aiming to coordinate EU Observer Program for purse seine fisheries and **ENCOURAGED** EU scientists involved in such program to follow up their effort to increase the accuracy of statistics of discarded species estimates reported to the Secretariat.

70. The WPEB **NOTED** paper IOTC–2018–WPEB14–15 which described Bycatch of the European purse-seine tuna fishery in the Indian Ocean for the 2008-2016 period, including the following abstract provided by the authors:

"This paper presents an update for the period 2008-2017 of the bycatch estimations for the European and Seychelles tuna purse seine fishery operating in the Indian Ocean. Bycatch data were collected by observers onboard. Given the situation of piracy in the area, the coverage of observers decreases progressively during the first part of the series, until 2010 when the observer program was completely suspended. As of 2011, sampling was resumed, and observation coverage progressively increased; mainly thanks to the implementation of a volunteer program by the fleet. Bycatch data, as collected by the observers, were stratified by quarter, ET sampling area and fishing mode (free school and floating object sets). The total landings of the target species (skipjack, bigeye, yellowfin and albacore tunas) in each stratum was then used as raising factor. The average of the annual total bycatch estimated for the studied period was 9,188 t. However, there are differences throughout the series. More than 90% of the weight of this bycatch occurred in FOB sets. Regarding species groups, discards of target tunas represented the major part of the bycatch during the first years of the series (64% and 46% of the total bycatch in 2008 and 2009 respectively). While in the last years, the group of other bony fishes represented the majority of the bycatch (around 50%), followed by sharks (around 15%), billfishes, rays and turtles."

71. The WPEB **NOTED** the increasing trend of the observer coverage for the EU purse seine tuna fishery this last ten years thanks to the contribution of the fishing industry.

72. The WPEB **NOTED** that the number of sea turtles bycatch by Purse Seine fisheries may be underestimated because not all the entanglements by underwater structure of FADs after the fishing operation are observed.

73. The WPEB **NOTED** that high raised tuna discards levels in 2008-2009 compared to later years (2011-2017) could be explained by a combined effect of low coverage for early years and a decrease of tuna discards between the two periods.

74. The WPEB **NOTED** unusual high estimated bycatch level of swordfish (*Xiphias gladius*) in 2012 and devil rays (*Mobula spp.*) in 2016 that was explained as the result of extrapolation combined with low observer coverage in the areas and high concentration of fishing effort.

75. The WPEB **NOTED** that in French PS fisheries swordfish was also reported in the past but after data verification most swordfish reported by observers appeared to be marlins, therefore dataset was corrected accordingly.

76. The WPEB **ENCOURAGED** EU,Spain to revise their database using photo identification and other available means.

77. The WPEB **NOTED** the high unusual bycatch of mobulids in free school sets in 2016, which was not observed in previous years. This unusual numbers were the results of one single set extrapolated to the total effort and, thus, has not accurately represent mobulids bycatch of the fishery. The WPEB also **NOTED** that of the 25 individuals of *Mobula japonica* caught in that set 23 were released alive.

78. The WPEB **NOTED** that EU scientists are working on new extrapolation methods accounting for different spatial and temporal strata which will review the bycatch estimation of EU PS for the whole time series.

79. The WPEB **NOTED** paper IOTC–2018–WPEB14–14 which showed biological and ecological traits of some bycatch species of the tuna purse seine fishery in the Indian Ocean, including the following abstract provided by the authors:

> *"Tuna purse seine fishery in the western Indian Ocean is estimated to have relatively low bycatch species, representing about 3.4 % of the total catch. Yet, with the recent implementation of a yellowfin tuna quota and the new discard ban policy, removal of non-targeted species is expected to be higher in the next few years. Thanks to observer programs, it is possible to monitor incidentally catches in terms of biomass and composition estimates; nevertheless little quantitative information exists on the biology and ecology of those non-targeted species, particularly in the western Indian Ocean. Thus it is very difficult to assess their removal effect on the role and function of the pelagic ecosystem. Within this context three objectives have been defined for this paper. First the main biological and ecological traits available in the literature for those bycatch species were reviewed. Secondly, the new biological sampling launched in Seychelles was presented. Finally, some length-weight relationships were updated for the western Indian Ocean, using morphometric data collected on board and at landing."*

80. The WPEB **NOTED** the importance of this study for understanding the biology and ecological traits of 18 species of bycatch in the tuna purse seine fishery and **DISCUSSED** the current IOTC definition of "by-catch", since many of the species listed in this presentation are regularly targeted by other fisheries.

81. The WPEB **NOTED** the presented information and **ENCOURAGED** the authors to continue collecting and disseminating information on life history traits of fish species caught as bycatch of the purse seine fishery.

82. The WPEB **NOTED** that data collection on biological and ecological traits of non-target species by EU,France was ensured via EU-funding through observer and port sampling data collection programs.

Data improvement

83. The WPEB **NOTED** paper IOTC–2018–WPEB14–18 which described methods for improving the sampling protocol of electronic and human observations of tropical tuna purse seiner discards, including the following abstract provided by the authors:

> *"Observer programs have been implemented for many years in tuna purse seine fisheries to assess their impact on pelagic ecosystems by monitoring tuna discards and bycatch among which sensitive species such as sharks or rays. On board observers estimate discards using sampling*

and extrapolation methods when counting exhaustively is not possible. However, the flow of discards may be heterogeneous on the discard belt, and as a result, extrapolations may lead to over/underestimated estimations. Electronic monitoring system (EMS) on tuna fishing vessels has been tested as an alternative technology to complement and improve on board observer programs. EMS allows monitoring discards (of tuna and non-target species) at an acceptable species identification level and allows exhaustive counts on the discard belt. In this study, we used EMS "counts per minute" data from four French and one Italian purse seine vessels operating in Indian Ocean to evaluate total discards in numbers, as well as discards by species for each set. We analysed 48 fishing sets realised in 2017 and simulated different observer sampling strategies in order to optimise (i) the total sampling duration and (ii) the duration of sampling sequences. We finally propose an optimized sampling strategy, applicable to both electronic and human observations, for evaluating discards that reduces both sampling time and estimation bias."

84. The WPEB **NOTED** the statistical approach aiming to optimize discard samplings on purse seine vessels by both human and electronic observers.

85. **NOTING** that EMS and on board observations are complementary, the WPEB **ACKNOWLEDGED** that current EMS solutions are less accurate in terms of species identification but allowed to monitor simultaneously all discard locations on the boat (deck and lower deck).

86. The WPEB **ENCOURAGED** the authors to continue such work.

7. Ecosystem modeling and report cards

7.1 Ecosystem Based Fisheries Management (EBFM) approaches and ecosystem report cards results

87. The WPEB **NOTED** paper IOTC–2018–WPEB14–20 which provided information on preliminary Ecosystem Based Fisheries Management (EBFM) approaches and a proposal for the WPEB to develop ecosystem report cards and assessments, including the following abstract provided by the authors:

"To facilitate the implementation of an Ecosystem Approach to Fisheries Management in the IOTC Convention Area, the Working Party on Ecosystems and Bycatch has recommended the development of an indicator-based ecosystem report card. The main purpose of the ecosystem report card is to improve the link between ecosystem science and management and increase the awareness, communication and reporting of the state of IOTC's different ecosystem components to the Commission. Here, we first present the potential uses of an indicator-based ecosystem report card and highlight the different tools available to better link ecosystem science with fisheries management. Second, we present a reporting framework to monitor the impacts of climate and fisheries on the different components of the marine pelagic ecosystem in the IOTC convention area. Third, we present a set of candidate ecosystem indicators to be used to monitor each of the ecosystem components. Fourth, we propose a process to develop the first prototype ecosystem report card for IOTC. Continuing the development and refinement of the report card with the involvement of a diverse group of experts including scientist, managers and other key stakeholders will be pivotal to improve its utility and relevance to the management of tuna and tuna-like species and associated ecosystems in the Indian Ocean." (see paper for full abstract)

88. The WPEB **NOTED** this first step in advancing the EAFM in IOTC and **THANKED** the authors for this initiative.

89. The WPEB **NOTED** that the IOTC mandate does not contain the ecosystem approach specifically. Yet, the WPEB **NOTED** there are international guidelines calling for the implementation of the ecosystem approach in fisheries management.

90. The WPEB **NOTED** the issues with data availability and the data mining that will be undertaken as part of the ecosystem assessments as well as the difficulties to link the ecosystem assessments with practical fisheries management advice. It was **AGREED** that data limitation will remain an important impediment to provide robust advice to the Commission. However, it was suggested that more efforts are needed to make a better use of the existing data and existing knowledge to provide better ecosystem advice.

91. The WPEB **AGREED** on a work plan to work intersessionally for developing a preliminary ecosystem report card and indicator assessments. This work plan is contained in Appendix XXI and

the indicator assessments will be presented at the next session of the WPEB to be discussed by the group.

92. The WPEB **NOTED** paper IOTC-2018-WPEB14-21 which provided guidance on selecting ecosystem indicators for fisheries targeting highly migratory species, including the following abstract provided by the authors:

> *"Several international legal agreements and guidelines have set the minimum standards and key principles to guide the implementation of an ecosystem approach for the management and conservation of highly migratory fish species. Since its creation IOTC has had the ability to assimilate some of these principles in the form of adoption of formal management measures. Yet these management measures have not provided practical guidance on how to make operational an Ecosystem Approach to Fisheries Management (EAFM) within its convention area. The Specific Contract N0 2 "selecting ecosystem indicators for fisheries targeting highly migratory species-" under the Framework Contract - EASME/EMFF/2016/008 provisions of Scientific Advice for Fisheries Beyond EU Waters- addresses some scientific impediments and provides solutions that shall support the implementation of an EAFM in IOTC."* (see paper for full abstract)

93. The WPEB **NOTED** that the operationalization of the ecosystem approach is widely being discussed in many places around the world, and where there has been an attempt to operationalize it, it is challenging from a management point of view. It was also **NOTED** that there is a growing number of examples (e.g. North Pacific Fisheries Management Council in Alaska, NAFO and CCAMLR) where there has been proven progress in operationalizing EBFM and that there is an opportunity to learn from them

94. The WPEB **NOTED** there is a parallel between the process of implementing Management Strategy Evaluation (MSE) and implementing EBFM. It was **ACKNOWLEDGED** that the ecosystem approach could follow the same steps and learn from the MSE process (for example starting a dialogue to frame what are the main objectives and the expectations). It was also **NOTED** that the EAFM should also be implemented with the feedback and involvement of managers from all CPCs from the very beginning of the process.

95. It was **NOTED** several times that there are severe data limitations in the IOTC area which might hinder the implementation of EBFM. However, the WPEB **NOTED** that the existing data collected by CPCs remains an important source of information. Once a small set of ecosystem indicators are agreed for reporting on the state of the ecosystem, this approach could streamline the data collection, decreasing the load of work in data collection programs.

96. The WPEB **NOTED** that the two candidate eco-regions proposed by the EU project within the IOTC convention area did not reflect adequately the characteristics of the IOTC region. The WPEB **NOTED** that a small working group was formed to work intersessionally to progress on what criteria would best inform the delineation of candidate eco-regions within IOTC (the main outcomes of this group are reflected in section 11.2)

97. The WPEB **NOTED** the importance on drawing from other RFMOs and international bodies experiences that are already defined and use ecoregions to foster the operationalizing EBFM. It was suggested to look closer to the EBSA process by the CBD (designation of Ecologically or Biologically Significant Marine Areas by the Convention on Biological Diversity) and explore their utility to inform candidate ecoregions in IOTC.

98. The WPEB **NOTED** that while only the Ecological Component of an EBFM approach was reviewed here, it would be also important to start discussing the socio-economic and governance components and its application in the IOTC region

8. Bycatch, species interactions and ecosystem risk assessments

8.1 Review new information on other bycatch and by-product, in terms of biology, ecology, fisheries interactions and bycatch mitigation measures

99. The WPEB **NOTED** the presentation of paper IOTC–2018–WPEB14–22 which described an updated Ecological Risk Assessment for IOTC species, including the following abstract provided by the authors:

"The progress to update Ecological risk assessment (ERA), and specifically Productivity-Susceptibility Analysis (PSA), carried out in 2009 and 2012 were presented. The methodological approach of the PSA for finfishes and sharks caught in various fleets operating in the Indian Ocean was presented. The plan is to follow the methodology of Kirby (2006) for finfishes and the methodology proposed by Cortés et al. (2010) for shark, both allowing ranking the vulnerability of the species based on its productivity and susceptibility to the fishing gear. For sharks, we estimate the species productivity parameters based on Leslie matrices analysis, in which the value of Lambda (λ), population finite growth rate, was calculated (Caswell 2001). The susceptibility analysis will be carried out comparing the horizontal overlap between fisheries and stock distribution, the vertical overlap between the species and fishing gear, the gear selectivity, and post-capture mortality. The analysis has not been finalized because not all interested CPCs has provided the data but will be finalized intersessionally to present the final results to the 21st Scientific Committee meeting."

100. The WPEB **THANKED** the authors for this work and its contribution to the progress of the working party, and **NOTED** that this work is ongoing and requires further development and collaboration to be finalized. The authors informed the WPEB that they will work intersessionally and it was **AGREED** that the complete analysis will be presented to the Scientific Committee for its consideration. It was also **AGREED** that it should be included in the WPEB working plan.

101. The WPEB **NOTED** paper IOTC–2018–WPEB14–46 which described non-target species interactions in tuna fisheries and its implications in fisheries management: Case of large-mesh gillnet fisheries along the north-west coast of India, including the following abstract provided by the authors:

"*Occurrence of non-target, associated and dependent species is a feature of tuna gillnet fisheries world-over, posing a great concern for fisheries management. Predominance of small-scale or artisanal fisheries in the region compounds the concern due to the uncertainty in data. There is dearth of information on the catches and the non-target species interaction in the tuna gillnets fisheries in India, especially from the north-west coast, where gillnet is the predominant gear targeting the tuna. We collected spatially explicit catch data with voluntary participation of fishermen from Veraval, Gujarat and quantified the species wise catches over space and time for 567 fishing operations spread across six years (2011-2016).*" (see paper for full abstract)

102. The WPEB **THANKED** the authors for their presentation and **NOTED** the value of this information for artisanal and gillnet fisheries with respect to the expanse of operational area, catch composition, spatial-temporal dynamics etc.

103. The WPEB **NOTED** the small number of fishermen involved in this study and **ENCOURAGED** the authors to continue and expand this study.

104. The WPEB **ACKNOWLEDGED** that the author expressed his interest in collaborating and participating to EMS scoping studies with the support of IOTC, in particular for the gillnet fisheries of India.

105. The WPEB **NOTED** the low bycatch of billfish in this study particularly as the WPB had found that reported black marlin catches for India have increased substantially in recent years. It was **NOTED** that the low catch of billfish in gillnet fisheries is due to the limitation of the gillnet operation on the shelf areas.

8.2 Seabirds

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

106. The WPEB **NOTED** paper IOTC–2018–WPEB14–23 which provided and overview of the retrospective and geographical interaction between seabirds and the Spanish surface longline fishery targeting Swordfish in the Indian Ocean during the 1993-2017 period inferred from data provided by scientific observers at sea., including the following abstract provided by the authors:

"A total of 5.8 million hooks were scientifically observed at sea for seabird interactions in broad areas of the Indian Ocean between 1993 and 2017. Two types of information were obtained in the surface longline fleet targeting swordfish: (a) during regular commercial fishing and (b) during experimental surveys. 59.54% and 40.46% of the total effort was observed in each case, respectively. The geographical coverage of the study goes beyond the areas in which this commercial fleet has historically fished, because the information includes experimental surveys.

Twenty years of regular commercial fishing data are included in the analysis and in thirteen of these years the interactions occurring were nil. Positive interaction occurred in twenty four of the one hundred and twelve 5ºx5º areas observed during regular commercial fishing and experimental surveys combined." (see paper for full abstract)

107. In the authors' absence, IOTC–2018–WPEB14–23 was presented by the WPEB Chair.

108. The WPEB **NOTED** the high levels of observer coverage reported in the paper (40-59%), which are inconsistent with other fleets. This was however a problem in the translation of the document and these percentages actually correspond to the number of observed by-catch in the present study compared to all data available.

109. The WPEB **NOTED** the clumped nature of bycatch reported in the study, in which the majority of bycatch recorded came from a few events. For example, the highest rate recorded was in a single set in the area 35070 SE during a commercial trip. A significant finding was that 82 (49.7%) of the total interactions observed for both types of trips-data during the whole period analyzed occurred during a single boat-survey conducted between years 2005 and 2006 in areas further east than 85ºE, while at the same time other boats involved in the same survey in the same areas recorded nil or very few interactions. The reason for this unusually high rate of interaction in this particular survey-boat was not elucidated from the observer's notes.

110. The WPEB **NOTED** paper IOTC–2018–WPEB14–24 which provided a preliminary assessment of the risk of albatrosses by longline fisheries, including the following abstract provided by the authors:

"This document presents the preliminary results of applying the Spatially Explicit Fisheries Risk Assessment framework (SEFRA) developed by New Zealand to assessing the total mortality of great albatross caused by tuna longline operations in the southern hemisphere. The impacts of these mortalities on the sustainability of these albatross species are also considered. Seabird bycatch was modelled as a multiplier of a temporal and spatial overlap between fishing and seabird distributions. Seabird catchability, defined as a combination of seabird-specific vulnerability to fishing gears and gear-specific seabird catchability, was first estimated using the Japanese and New Zealand on-board observer data, and then applied to the total fishing efforts in the southern hemisphere for assessment of total annual bycatch mortality (ABM)." (see paper for full abstract)

111. The WPEB **NOTED** that the work is currently in progress, and that the results should be considered preliminary. For example, seabird distribution information used in the analysis was based on coarse range maps, and it is intended to update the analysis with finer scale tracking information.

112. The WPEB **NOTED** that the Spatially Explicit Fisheries Assessment (SEFRA) framework adopted in the study represents a promising approach to assess seabird bycatch in fisheries, especially given the limited bycatch data that are currently available. It was also noted that this is one of the methodological approaches being undertaken in the FAO Common Oceans Tuna Project (ABNJ) seabird bycatch assessment.

113. The WPEB **NOTED** that bycatch and related data obtained from observer programmes are often not spatially representative of the overall fishing effort, and that this creates challenges for assessment methods that make use of these observer data. The WPEB **ENCOURAGED** CPCs to plan the deployment of observers to improve the representativeness of observer coverage.

114. The WPEB **NOTED** paper IOTC–2018–WPEB14–25, an update on the seabird component of the Common Oceans (ABNJ) tuna project – seabird bycatch assessment workshop, including the following abstract provided by the authors:

"*This paper provides the outcomes of the Common Oceans Seabird Bycatch Data Preparation Workshop held in early 2018. The Project Team and workshop attendees revised the objectives and approaches to achieve the project goal. The assessment will now focus exclusively on estimating total seabird bycatch, or N, (which is a fisheries performance metric) and the species- or population-level consequences thereof. Three distinct, but linked, approaches were agreed: i) A ratio-based estimate of N generated by the Project Team, using publicly available data or best estimates provided by each participating country; ii) geospatial estimates of N generated by participating countries with their own data, possibly using procedures being developed collaboratively with the Project Team; iii) a Spatially Explicit Fisheries Risk Assessment (SEFRA) conducted in collaboration between participating countries and Dragonfly Data Science consultants based in New Zealand. Further intersessional work is planned before the*

final workshop to assist countries with analyses, if requested. The scale of this evaluation effort will be limited to the Southern Hemisphere."

115. The WPEB recognised the importance of the project, as the first ever global assessment of seabird bycatch from tuna longline fisheries in waters south of 25°S across all three oceans and all five tuna RFMOs and **ENCOURAGED** scientists from CPCs with fisheries relevant to this project to contribute to and engage in the process.

116. The WPEB **ACKNOWLEDGED** the limitations of the fisheries information currently available for the assessment and highlighted the importance of considering not only the fisheries performance metric (total bycatch, N), but also the consequences of this mortality for seabird populations. It was noted by the Project Team that one of the next steps for the project includes an investigation of the population-level impacts of fisheries mortality. This would likely be undertaken in the form of case studies, including candidate species and populations for which sufficient data are available to undertake such an assessment.

117. The WPEB **ENCOURAGED** the Project Team to make available the scripts and tools developed for the project **NOTING** that initial example code is currently available on GitHub at https://github.com/JSRmodels/SeabirdModeling.

118. The WPEB **NOTED** paper IOTC–2018–WPEB14–44 information on transhipment observers – a tool for understanding seabird bycatch mitigation measures use on high seas tuna longline vessels, including the following abstract provided by the authors:

> *"Understanding the extent of use of the various combinations of seabird bycatch mitigation measures required in IOTC Resolution 12/06 is an important part of meeting the challenge to reduce seabird bycatch to negligible levels. Self-reporting of use of seabird bycatch mitigation measure by fleets is variable across countries, and carries no burden of evidence. Therefore, BirdLife International through its partner BirdLife South Africa, under the FAO's Common Ocean tuna project, undertook an assessment of two readily-available sources of data to indicate use of bird scaring lines (BSL) and night setting by vessels that transhipped tuna in the IOTC area. Images from transhipment observers were evaluated for presence and likely suitability of 'tori poles' to indicate whether a Best Practice BSL, or a line that could meet the performance specifications for aerial extent in Res 12/06, could be deployed. We also evaluated likely use of night setting requirements based on logbook entries for setting times."* (see paper for full abstract)

119. The WPEB **RECALLED** the original proposal, discussed and agreed at WPEB12, which was to pilot the use of transhipment observers to collect additional information on the use of seabird bycatch mitigation measures, and that this should focus on scientific aspects, and not be used for compliance purposes.

120. The WPEB **ACKNOWLEDGED** that although it is important to keep these issues separate, there are links between the two. For example, the degree of use (and non-use) of bycatch mitigation measures in high risk areas will influence the rates of bycatch measured. If these rates remain unchanged, or even increase, following the formal adoption of these mitigation measures in an RFMO, the degree of use of these measures will clearly influence these results, and should be accounted for, or at least acknowledged.

121. The WPEB **ACKNOWLEDGED** the formal objection by the Japanese participant to the presentation and proposal of this paper at the meeting.

122. The WPEB **ACKNOWLEDGED** that this meeting is not the correct forum for addressing compliance related issues and so did not consider the compliance aspects of IOTC–2018–WPEB14–44**.** It is understood that the Secretariat will make the document available to CPCs, who can then consider how best to proceed.

123. The WPEB **NOTED** paper IOTC–2018–WPEB14–45 which provided preliminary estimates of seabird bycatch from tuna longline fisheries for the southern Atlantic and southwestern Indian Oceans, based on three different methods, including the following abstract provided by the authors:

> "*Population declines of many seabirds, including albatross and petrels, are caused by a range of impacts, notably environmental change and fisheries bycatch. Despite the scale and importance of longline fishing in the southern hemisphere, the impact of this type of fishery on seabird populations is poorly understood. To date, there has been no broad scale fleet-specific assessment of seabird bycatch throughout the southern hemisphere, mainly due to the spatial*

and temporal limitations in observer data coverage. Here we use three approaches to estimate total bird bycatch across the southern Atlantic and southwestern Indian Oceans: (1) a simple, stratified, ratio based estimator, (2) generalised additive models (GAMs) and (3) the computationally intensive Integrated Nested Laplace Algorithms (INLA). To estimate the total birds captured (N), stratified estimates of Bird catch Per Unit of Effort (BPUE) were multiplied with the total reported pelagic longline effort. A comparison of preliminary estimates of N based on a common data set is presented to illustrate the various methods."

124. The WPEB **NOTED** that the work presented is an exploratory analysis, which forms part of the FAO Common Oceans Tuna Project (ABNJ) seabird bycatch assessment process.

125. The WPEB **NOTED** that the models and analyses were limited and informed by the available data, which are generally very limited. Bycatch estimates are based on the metric Birds Per Unit Fishing Effort (BPUE), more specifically the number of birds caught per 1000 hooks, and do not differentiate between birds caught during the set and those caught during the haul. It was noted that in most cases, the setting process leads to the greatest number of seabird mortalities.

126. The WPEB **NOTED** that Year effects were not included in the GAM approach to estimate BPUE. It was reported that this was due to insufficient data coverage, and thus the need to use mean estimates for the five years period and multiply these by the annual fishing effort for each of the 5x5 degree grid cells as a means of ensuring a balanced approach.

Review of mitigation measures in Resolution 12/06

127. The WPEB **NOTED** paper IOTC–2018–WPEB14–26, a document covering the ACAP advice for reducing the impact of pelagic longline fishing operations on seabirds, including the following abstract provided by the authors:

"The incidental mortality of seabirds, mostly albatrosses and petrels, in longline fisheries continues to be a serious global concern and was the major reason for the establishment of the Agreement on the Conservation of Albatrosses and Petrels (ACAP). ACAP routinely reviews the scientific literature regarding seabird bycatch mitigation in fisheries, and on the basis of these reviews updates its best practice advice. The most recent review was conducted in September 2017, and this document presents the outcome of that review and the summary advice pertaining to best practice measures for mitigating seabird bycatch. ACAP has confirmed that a combination of weighted branch lines, bird scaring lines and night setting remains the best practice approach to mitigate seabird bycatch in pelagic longline fisheries. In addition, ACAP has since 2016 also endorsed the inclusion in the list of best practice mitigation measures of two hook-shielding devices. These devices encase the point and barb of baited hooks until a prescribed depth or immersion time has been reached (set to correspond to a depth beyond the diving range of most seabirds) thus preventing seabirds gaining access to the hook and becoming hooked during line setting. On the basis of the September 2017 review, the only update to the ACAP best practice advice for reducing bycatch of seabirds in pelagic longline fisheries related to recommendations concerning the aerial extent, streamer line configuration, attachment height and weak link of bird scaring lines for small (<35m) vessels"

128. The WPEB **RECALLED** that it, and the IOTC Scientific Committee (SC), had previously (2016) considered and endorsed ACAP's updated advice regarding line-weighting specifications and hook-shielding devices.

129. The WPEB **NOTED** that the area of application of the IOTC seabird CMM (Res 12/06) – i.e. south of 25°S – is based on the distribution of albatrosses and large petrels, the groups of birds most susceptible to fisheries bycatch, and a pragmatic approach to requiring bycatch mitigation measures where they are needed.

130. The WPEB **NOTED** the updated advice from ACAP on the design and use of Bird Scaring Lines for small vessels, and **RECOGNISED** that Japanese researchers are currently undertaking further work on this issue in the North Pacific.

8.3 Sharks and rays

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

131. The WPEB **NOTED** paper IOTC–2018–WPEB14–27 which provided a progress report on the implementation of the IOTC bigeye thresher shark post-release mortality study project (IOTC BTH

PRM Project) (IOTC BTH PRM Project Team), including the following abstract provided by the authors:

"*We present a progress report on the IOTC bigeye thresher shark post-release mortality study project (IOTC BTH PRM Project). The goal of the study is to evaluate efficiency of the IOTC CMM focused on conservation of thresher sharks of the genus Alopias (Resolution 12/09). Summary of the collective efforts since IOTC WPEB 13, including development of formal documents, operation manuals, PSATs acquisition and preparation, field operations is presented.*

132. The WPEB **ACKNOWLEDGED** the progress of the IOTC bigeye thresher shark post-release mortality study project, **NOTED** the minimal information required on the tagging data collection sheets and **CLARIFIED** that although all the data on the tagging sheets are mandatory, the minimal requirement is for the provision of tagging location, exact day and time of release and release condition.

133. The WPEB **NOTED** that as the methods of the tagging programme have been designed around Observer programmes, collection of data shouldn't disrupt fishing activities aboard vessels involved in the tagging programme and that the tags should only be deployed by observers or vessels on which observers are present.

134. The WPEB **NOTED** the results of first three deployments of pSATs on BTH released by EU,Portugal and **ENCOURAGED** the IOTC BTH PRM Project team to continue the project expanding tagging activities to other participating CPCs.

135. The WPEB **NOTED** paper IOTC–2018–WPEB14–28, a preliminary assessment of shark bycatch from Kenya's nascent industrial tuna fisheries, including the following abstract provided by the authors:

"The offshore tuna fisheries in Kenya are still nascent, with two longliners in operation from 2016 after a lull of about 6 years. These longliners are normally targeting tuna, swordfish, marlin and sharks. However, sharks are as well caught as by-catch, regardless of the target fishery. Major problems with compliance exist in this fishery, as the lack of constant deployment of scientific observers hinders adequate biological data collection." (see paper for full abstract)

136. The WPEB **NOTED** the importance of this study in terms of understanding the shark bycatch from Kenya's developing tuna fishery and **THANKED** the author for his contribution.

137. The WPEB **SUGGESTED** that authors revise their identification of sharks in this study as blacktip sharks (*Carcharhinus melanopterus*) are unlikely to be caught inshore and **RECALLED** that IOTC shark identification guides are available to assist identification.

138. The WPEB **ACKNOWLEDGED** that detailed catch and bycatch data for the current industrial longline fleet of Kenya have been collected for 2016 and following years but have not yet been shared with the IOTC Secretariat, therefore the WPEB **ENCOURAGED** Kenya to provide this data to the IOTC Secretariat at its earliest convenience and in agreement with the requirements set forth by Resolution 15/02 and related.

Sri Lanka shark fisheries

139. The WPEB **NOTED** paper IOTC–2018–WPEB14–43 which reviewed the effectiveness of management measures on shark landings in Sri Lanka over past five years, including the following abstract provided by the authors:

"Sharks play an important role in the marine fishery of Sri Lanka. Though shark fishery was a target fishery in the past, it has become a non-target fishery at present. Sharks are mostly caught as a by-catch in the tuna fishery. The production statistics over the last five years (2013-2017) provided by the large pelagic fishery database (PELAGOS) of Sri Lanka was used to analyze the recent trends in the shark fishery. Recent regulations imposed on banning of three thresher shark species with oceanic white tip shark and whale shark have resulted a considerable decline in the shark landings." (see paper for full abstract)

140. The WPEB **NOTED** the high historical landings in 1999, followed by a decline and **ACKOWLEDGED** that it is vital for stock assessments that these kinds of fluctuations are clearly understood.

Silky shark information

141. The WPEB **NOTED** paper IOTC–2018–WPEB14–31 which provided abundance indices of silky shark (*Carcharhinus falciformis*) caught by the Indonesian longline fleet in the eastern Indian Ocean, including the following abstract provided by the authors:

> *"Relative abundance indices as calculated based on commercial catches are the input data to run stock assessment models to gather useful information for decision making in fishery management. In this paper a Generalized Linear Model (GLM) was used to calculate relative abundance indices and effect of longline fishing gear configuration. Data were collected by a scientific observer program from 2006 to 2017. Most of the boats monitored were based in Benoa Port, Bali*." (see paper for full abstract)

142. The WPEB **THANKED** the authors for this interesting study and its importance for understand the species dynamics in the Indian Ocean.

143. The WPEB **NOTED** that the area definitions in the model require further scrutiny and that most of the areas are very small and may not be contributing the explanatory power of the model. These areas may need to be redefined or grouped and those that have very low catch could be excluded from further analysis as these contribute to the high proportion of zero catches which the model battles to explain

144. The WPEB **NOTED** paper IOTC–2018–WPEB14–32 which asked whether it is possible to derive an Abundance Index for the Silky Shark Based on its Associative Behaviour with Floating Objects:

> *"Using data from the French tropical tuna purse seine fishery, this study proposes a new method to derive an abundance index for silky shark's populations. Two models were used: the first one describes the dynamics of sharks associated to floating objects (FOBs) used by tuna purse seiners in a social and in a non-social case. The second one illustrates the exchanges of individuals between the FOB-associated population and an external pool of sharks. The parameters estimates of the first model were obtained with fitting analysis. These parameters were then integrated into the second model. By approximating an unknown parameter (γ'), abundance indices were derived. This approach also allowed the construction of short-term temporal series relative to a reference year. This methodology has the potential to be applied to any other species associating with FOBs and serve as a tool for fisheries management."*

145. The WPEB **THANKED** the authors for this novel study and its attempt to develop an alternative index of abundance.

146. The WPEB **NOTED** that predominantly juvenile silky sharks are associated with floating devices and suggested that this study and dynamics discussed therein only applies to juvenile sharks as large sharks are seldom found associated to FOBs.

147. The WPEB **NOTED** that there are two issues with regards to probability of a shark to associate with a FOB: (i) how many FOBs are in the water (i.e. the probability of an individual encountering a FOB) and (ii) the shark's individual tendency to associate with the FOB. It was also **NOTED** that to explore the encounter probability the density term could be dropped, and the binomial distribution of counts could be investigated.

148. The WPEB **NOTED** paper IOTC–2018–WPEB14–33 which described a Preliminary Stock Assessment for the Silky Shark in the Indian Ocean Using a Data-Limited Approach, including the following abstract provided by the authors:

> *"Silky shark in the Indian Ocean can be targeted by some semi-industrial, artisanal and recreational fisheries, and is a bycatch of industrial fisheries such as pelagic longlines and purse seines. Currently there are not stock status estimations, but the WPEB has in its workplan a first assessment of this species in 2019. The objective of this paper is to provide preliminary support for that scheduled assessment, namely by providing: 1) a reconstruction of the time series of catches, 2) explore the possibility to standardize CPUEs for the EU pelagic longline fleets, 3) estimate prior for intrinsic population growth rate (r) and 4) test the feasibility to implement a data-limited assessment model (CMSY) and 5) provide a tentative stock status. From the final CMSY model configuration tested, the catches of silky shark in the Indian Ocean exceeded MSY from 1994 onwards*" (see paper for full abstract)

149. The WPEB **NOTED** the initial values for depletion and suggested that sensitivity runs be completed to cover a range of values. It was, however, further **NOTED** that most influential factor to the model results is the uncertainty in the catch series. This can be explored by including alternate catch series.

150. The WPEB **SUGGESTED** investigating the possible use of the silky shark abundance index (see paper IOTC-2018-WPEB14-32) in future silky shark assessments.

Blue shark information

151. The WPEB **NOTED** paper IOTC–2018–WPEB14–34 provided standardized CPUE and historical catch estimate of blue shark by Taiwanese large-scale tuna 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 2004-2017 were analyzed. Based on the nominal catch per unit effort (CPUE) distribution of the blue shark, four areas, namely, 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) were categorized. To cope with the large percentage of zero shark catch, the CPUE of blue shark, as the number of fish caught per 1,000 hooks, was standardized using a zero inflated negative binomial model*" (see paper for full abstract)

152. The WPEB **NOTED** that - according to the presented paper - there appear to be catches from Taiwanese vessels recorded in areas fully within the Exclusive Economic Zone of South Africa, and that these are not available within the catch-and-effort data set submitted by Taiwan,China to the IOTC Secretariat. As the authors were not present to respond to this query, no answer was provided to this apparent anomaly: however, it was **NOTED** that the majority of the 5x5 degrees grids in question were not falling exclusively in the EEZ of South Africa.

153. The WPEB **NOTED** paper IOTC–2018–WPEB14–35 which explored the use of Length Based Indicators for Blue Shark in the Indian Ocean, including the following abstract provided by the authors:

> *"Blue shark (Prionace glauca) is the pelagic sharks most frequently captured in pelagic fisheries. It is considered one of the main shark species in tuna-RFMOs worldwide, and the species for which more data is available, including size distribution data. This paper presents an alternative method for providing a snapshot assessment of status, with the development of length based indicators (LBI) and comparison to reference points derived from life-history and ecological theory. The data used came from the last IOTC blue shark stock assessment carried out in 2017"* (see paper for full abstract)

154. The WPEB **NOTED** that there are ontogenetic changes in temporal and spatial distribution of blue sharks that need to be taken into account when this information is analysed and presented, **SUGGESTING** that this data be pooled and re-analysed for all fleets jointly.

155. The WPEB **NOTED** paper IOTC–2018–WPEB14–36 that provided a Preliminary Management Strategy Evaluation for Blue Shark in the Indian Ocean Using A Data-Limited Approach, including the following abstract provided by the authors:

> *"In tuna-RFMOs there has been an effort to move to quantitative stock assessments for pelagic sharks, especially for the main species such as blue shark Prionace glauca. In IOTC, blue shark was last assessed in 2017 with the use of an integrated length-based age-structured model (SS3). This paper now presents a preliminary exercise with data-limited Management Strategy Evaluation (MSE) to test options for different potential management procedures (MPs), using the data-limited methods toolkit (DLMtool). Reference points have not yet been adopted for sharks in IOTC, so for this exercise we set some tentative reference points noting that those can be updated in the future as needed."* (see paper for full abstract)

156. The WPEB **NOTED** that the 2017 assessment had high levels of uncertainty which needs to be reflected in the MSE.

157. The WPEB **COMMENTED** that ideally MSE provides a way to link assessments with real time management. However, in reality data for assessments have a 2 years lag period before they are available for assessments. Therefore, the simulations provide advice that is 2 years out of date. Using CPUE instead of catch might reduce this issue, as CPC scientists have access to almost real time catch and effort data and can provide a far shorter lag in the time period of provision of advice.

158. The WPEB **NOTED** that this is work in progress and managers and other stakeholders have not been brought into this process yet. As such management objectives and key indicators, as well as plausible management measures have not been discussed or developed.

Other information

159. The WPEB **NOTED** paper IOTC–2018–WPEB14–37 which described a Preliminary Stock Assessment for the Shortfin Mako Shark in the Indian Ocean Using Data-Limited Approaches, including the following abstract provided by the authors:

> *"Despite its importance as a by-catch species and high biological vulnerability, there are currently no quantitative stock assessments for the shortfin mako, Isurus oxyrinchus, in the Indian Ocean. A quantitative stock assessment has been planned by the IOTC-WPEB for 2020. The aim of this paper is to provide a preliminary stock assessment and status for this stock, namely by providing 1) a catch series reconstruction between 2917-2015, 2) standardized CPUEs for EU longline fleets (Spain and Portugal), 3) estimation of a prior distribution for intrinsic growth rate (r) from demographic models, and 4) provide preliminary stock status using data-limited methods. Both a catch-only model (CMSY) and a Bayesian Schaefer production model were tested."* (see paper for full abstract)

160. The WPEB **NOTED** that most assessments for data limited species in the IOTC region have similar patterns of increasing catch and CPUE. These patterns persist even for species with varied life-history strategies (low and high resilience to fisheries) which is biologically implausible (i.e. with increasing catch and CPUE for a low productivity stock biomass increases).

161. The WPEB **REQUESTED** that in future, historical observer data be investigated for data limited species to determine if there was an increase in targeting or reporting over time. As increase in catch of sharks may be driven by market demand and availability, the WPEB **NOTED** that CPUE standardization is not robust to changes in fisheries patterns and targeting over time.

162. The WPEB **NOTED** that biological data used for this assessment were derived from the Atlantic Ocean and therefore are associated with high uncertainty.

163. The WPEB **NOTED** paper IOTC–2018–WPEB14–38 which provided a progress report of the post release mortality of the oceanic white tip shark (POREMO project) discarded by EU purse seine and pelagic longline fisheries, including the following abstract provided by the authors:

> *"In this progress report we present the context of the project POREMO funded by EU France in the frame of the development appropriate IOTC conservation measures and to mitigate this species bycatch in major European tuna fisheries in the Indian Ocean. The POREMO project aims to quantify the post release mortality of the oceanic white tip shark by-caught by the EU tuna purse seine and pelagic longline fisheries in order to assess the retention ban measure taken as conservation and management measure (CMM) for this species as specified in the IOTC resolution 13/06. The material purchased for these purposes and the present situation of electronic tag deployments are presented."*

164. The WPEB **ACKNOWLEDGED** the progress done in the frame of the POREMO project with 1 miniPAT and 6 survival PAT deployed since March 2018 from EU longliners and purse seiners respectively. The remaining electronic tags (14 sPAT and 14 miniPAT) will be deployed by the end of 2019.

165. The WPEB **NOTED** difference in at-vessel mortality values of oceanic whitetip sharks between different fishing methods. The authors mentioned that this difference is mainly related to fishing operation type, with lower at-vessel mortality from research fishing operations versus from commercial fishing operations.

166. The WPEB **NOTED** paper IOTC-2018-WPEB14-INF07 which provided information on the porbeagle shark (*Lamna nasus*) in the Southern Hemisphere: searching for biological patterns among oceans and regions, including the following abstract provided by the authors:

> *"The presentation contained information of an ongoing research on the reproduction of the porbeagle shark Lamna nasus, originally from Chilean waters but due to the circumglobal distribution of the species in the Southern Hemisphere expanded its coverage to all oceans and regions (west – east of each ocean), searching for common biological patterns across them. Preliminary findings seem to show that these patterns occur in two latitudinal bands between 20 – 40°S and between 40° - 55°S, respectively, being early stages of the reproduction occurring in the southern band and pupping and early juvenile stages in the northern one. He pointed out that it would be interesting to collect more information from the Indian Ocean, through IOTC, to complete the different areas for the analysis, receiving information from the WPEB Secretariat, France and South Africa for that purpose."*

167. The WPEB **ACKNOWLEDGED** this presentation and **ENCOURAGED** IOTC CPCs to provide data on Porbeagle interactions with their fisheries so as to contribute to the ecological knowledge of this species.

Mobulid rays

168. The WPEB **NOTED** paper IOTC–2018–WPEB14–39 which described the status of mobulid rays in Sri Lanka, including the following abstract provided by the authors:

> *"Mobula rays, while pelagic in nature with a circumglobal distribution, have one of the most conservative life cycles among elasmobranchs. They are frequently encountered as bycatch in Sri Lankan fisheries targeting tuna and billfish, and retained and landed due to their highly valued gill plates that are exported. Sri Lanka is among one of the highest mobula catching nations due to single and multi-day fishing vessels capturing these species as bycatch off the continental shelf edge and in high seas. Over 303 surveys at 19 landing sites, a total of 632 mobula rays were recorded at 11 of the sites. Across all species, the proportion of juvenile, immature rays were greater than mature adults. This, together with their life history and the fact that multiple countries catch these species within the Indian Ocean, make them extremely poor candidates for commercial fisheries. Recommendations such as improved data collection, mitigation and retention measures, are strongly recommended to curb population decline and enable recovery."*

169. The WPEB **NOTED** the potential use of bycatch mitigation techniques such as coloured lights on gillnets, and that further research is necessary to identify whether this will be effective for mobulid rays as well and will be presented next year.

170. The WPEB **REQUESTED** that authors of the new mobulid ID guide provide input on the IOTC guide to improve data collection of mobulids in IOTC fisheries.

171. The WPEB **RECOMMENDED** that data collection for mobulid rays (if possible to species level) should be improved, that by-catch mitigation methods should be investigated, and that safe release techniques and best practices should be implemented.

172. The WPEB **NOTED** the status and declines of *Mobula spp.* in the Indian Ocean (which under current taxonomic revisions include the manta rays as well). Given the significant declines of these species across their range in the Indian Ocean along with evidence of these species' interaction with pelagic fisheries, in particular tuna gillnet, purse seine, and occasionally longline fisheries, the WPEB **RECOMMENDED** that management actions, such as non-retention measures in the IOTC Area of Competence (as a first step considering the Precautionary Approach) among others, are required to enable these species to recover and must immediately be adopted instead of waiting until 2020.

173. The WPEB **NOTED** paper IOTC–2018–WPEB14–30 which described an unprecedented decline in the catches of mobulids, which are an important component of tuna gillnet fisheries of the Northern Arabian Sea, including the following abstract provided by the authors:

> *"Mobulid rays are found both in coastal and offshore waters of Pakistan and other Indian Ocean countries. Five species including giant manta, spinetail mobula (devilfish), shortfin devil ray, Chilean devil ray and smoothtail mobula are known to occur in Pakistan. These rays are caught as bycatch of pelagic gillnets which are used for targeting tuna and tuna like species in Pakistan. Mobulids were found to be quite common in bycatch prior to May 2015, however, there was an unprecedented decrease in landings of mobulids at Karachi Fish Harbour (where major sampling was done) and other landing centers along the coast of Pakistan. Although there is ban imposed on catching of mobulids in Pakistan since 2016, but there is need for taking immediate management measures by IOTC because of vulnerability of mobulids to fishing pressure and considering their decrease landings in Pakistan as well as other Indian Ocean countries."*

174. The WPEB **AGREED** that mitigation methods (lights, hanging ratios for gillnets etc.) for all fisheries with a by-catch of mobulids be investigated, developed and distributed. In addition, gear modifications could be investigated that could reduce the capture of Mobulids in different gear while maintaining the catch of target species.

175. The WPEB **NOTED** paper IOTC–2018–WPEB14–29 which gave a perspective on the mobulid rays interactions with surface fisheries in the Indian Ocean, including the following abstract provided by the authors:

"Mobulids are globally threatened as they have experienced high levels of bycatch and direct exploitation throughout their range and are currently at risk of extinction. At its 22nd session, the IOTC failed to adopt conservation and management measures for Mobula species due to lack of evidence on its interactions with surface fisheries. Without the information available robust measures will not be put in place and implemented risking the future of mobulid populations in the Indian Ocean. This report reviews available information on Mobulid interaction with surface tuna fisheries in the Indian Ocean Tuna Commission areas of competence."

176. The WPEB **ENCOURAGED** further research to explore the use of available observer data in conjunction with fisheries independent data to identify hot spots for conservation and management of mobulids within and beyond EEZs..

177. Considering that at-vessel and post-release mortality in mobulids is unknown, the WPEB **SUGGESTED** that any non-retention measure should be accompanied with research on post-release mortality based on satellite tagging programmes to investigate the effectiveness of this measure.

178. The WPEB **SUGGESTED** that post-release mortality from gillnets and other fisheries impacting mobulid rays be investigated. The WPEB **NOTED** that that studies should be undertaken to reduce mobulid bycatch (and bycatch in general). In addition, best practices for the safe release of mobulid rays shall be developed.

8.4 Marine turtles

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

179. The WPEB **NOTED** paper IOTC–2018–WPEB14–40 which provided an assessment of the vulnerability of sea turtles to IOTC tuna fisheries, including the following abstract provided by the authors:

"Mortality from interactions with fishing gear poses a significant threat to sea turtle populations globally. Within the Indian Ocean Tuna Commission (IOTC) area of competence, semi-quantitative risk assessments in 2012 and 2013 identified specific sub-populations of olive ridley, loggerhead, leatherback and hawksbill turtles to be highly vulnerable to the impacts of fishing. Here, we present an update to these previous risk assessments using a Productivity-Susceptibility Analysis (PSA) within the Ecological Risk Assessment for the Effects of Fishing (ERAEF) framework developed by Hobday et al. (2011)." (see paper for full abstract)

180. The WBEP **NOTED** that current models used for PSAs are not able to capture the effects of different fishing practices (e.g. sea turtle captures on FAD-associated vs. free schools for purse seines) or variations in gear used (e.g. tuna hooks vs. circle hooks).

181. The WPEB also **NOTED** that although data is still limited, information from Pakistan suggests that release alive of sea turtles is relatively high in drift gillnet fisheries (~90%, for surface gillnet deployments) and that bycatch rates of sea turtles (particularly Olive Ridley and green turtles) are significantly lower in subsurface drift gillnet deployments. Therefore, the WBEP **REQUESTED** that CPCs provide information on sea turtles bycatch in gillnets, including sea turtle released alive following gillnet entanglements.

182. The WPEB **NOTED** the recent developments in risk assessment models that quantify the cumulative impacts of multiple fisheries and report the vulnerability status against recognised biological reference points (e.g. B_{MSY}, F_{MSY}), thus facilitating communication of results to managers (e.g. EASI-Fish, Griffiths et al. 2018). The WPEB **REQUESTED** CPCs to explore the application of these new approaches for evaluating the vulnerability of IOTC bycatch species and **AGREED** to include this in the WPEB work plan. The WPEB **ACKNOWLEDGED** that other threats than fishing-related impacts are not included in this kind of approach.

183. The WPEB **RECALLED** the findings of the Common Oceans Tuna Project (ABNJ)-funded sea turtle workshop for the Pacific Ocean that were presented to WPEB13 and **NOTED** that consideration of the mitigation techniques evaluated in the Pacific workshop should also be evaluated for Indian Ocean fisheries.

184. The WPEB **REQUESTED** the IOTC Secretariat to explore the potential for a similar workshop to be held in the Indian Ocean with funding from the Commission and/or from the ABNJ. The WPEB **AGREED** to retain this in the WPEB work plan.

8.5 Marine mammals

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

185. The WPEB **NOTED** paper IOTC–2018–WPEB14–41 which provided a methodology for assessing the magnitude of cetacean bycatch in tuna drift gillnet fisheries in the Arabian Sea: effectiveness of surface gillnets in reducing captures, including the following abstract provided by the author:

> *"Bycatch is the most significant threat to cetacean populations worldwide. Therefore, assessing and identifying bycatch mitigation measures is critical for cetacean conservation and management. Here we provide the first assessment of cetacean bycatch in tuna drift-gillnet fisheries in the Arabian Sea. Using a network of trained captains (four 15-20 m vessels), targeted-catch (tunas) and bycatch data were collected systematically from 2013 to 2017. Over the study period, a total of 3,874 drift-gillnet sets was monitored. Two fishing methods using multifilament gillnets were used: surface and subsurface gillnets. Surface gillnets were deployed at the surface, whereas subsurface gillnets were deployed at 2 m below the surface; net height varied from 10 to 14 m). A total of 203 cetacean captures were recorded (0.04% of all catch). A total of seven species of cetaceans was recorded as bycatch, including spinner dolphin (Stenella longirostris), common bottlenose dolphin (Tursiops truncatus), common dolphin (Delphinus delphis), striped dolphin (Stenella coeruleoalba), pantropical spotted dolphin (Stenella attenuata), Risso's dolphin (Grampus griseus), dwarf sperm whale (Kogia sima) and an unidentified baleen whale (Balaenoptera spp., probably Balaenoptera edeni)."* (see paper for full abstract)

186. The WBEP **NOTED** the promising results presented in this study and **ENCOURAGED** the continuation of initiatives aiming at assessing and mitigating cetacean bycatch in gillnet fisheries in the IOTC area of competence.

187. The WBEP **RECALLED** Resolution 13/04 On the conservation of cetaceans, which includes data collection and reporting requirements at the species-specific level, where possible, and the banning of intentional sets on marine mammals. Although these are mandatory requirements for all CPCs there is still a lack of data regarding species-specific marine mammal bycatch in the IOTC Area of Competence, particularly for tuna gillnet fisheries where interactions are of particular concern.

188. The WPEB further **NOTED** that interactions between gillnet and cetaceans have only been reported by WWF Pakistan and **REQUESTED** CPCs to provide information on records of cetaceans interactions in the gillnet fleets and share information regarding discards, mortality and releases**.**

9. Ecologically or biologically significant marine areas (ebsas) in the indian Ocean

189. The WPEB **NOTED** paper IOTC–2018–WPEB14–42 which provided an introduction to ecologically or biologically significant marine areas (EBSAs) in the Indian Ocean.

190. The WPEB **NOTED** that at this stage, no comment is required from the Working Party, but that CPC scientists should note the designation of these areas, particularly when they are within their territorial waters and EEZ.

191. The WPEB **SUGGESTED** that these areas could be taken into account by the scientists working on the EBFM, particularly as they may provide guidance on the identification of ecoregions.

10. WPEB Program of work

10.1 Revision of the WPEB Program of Work 2019–2023

192. The WPEB **NOTED** paper IOTC–2018–WPEB14–10 which provided the WPEB14 with the latest Program of Work (2019-2023) with an opportunity to consider and revise this by taking into account the specific requests of the Commission and Scientific Committee, given the current status of resources available to the IOTC Secretariat and CPCs.

193. 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."

194. The WPEB **RECOMMENDED** that the SC consider and endorse the WPEB Program of Work (2019–2023), as provided in Appendix XIX.

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

195. 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 2019, by the Invited Expert:
    - **Expertise:** Data poor shark assessment expert.

11. Other business

11.1 International Whaling Commission Bycatch Mitigation Initiative

196. The WBEP **NOTED** that the International Whaling Commission (IWC) has established its Bycatch Mitigation Initiative, which aims to raise awareness of the issue of cetacean bycatch at national and international level and promote effective tools, in collaboration with others, to tackle the problem. The initiative includes a Coordinator within the IWC Secretariat, a governance body (Standing Working Group on Bycatch) and a multi-disciplinary Expert Panel with expertise ranging from economics to fisheries technology and cetacean ecology. The Initiative has a ten years strategic plan and a detailed 2-year workplan which is to be implemented following the IWC Commission meeting in September 2018. The IWC has expressed interests to collaborate with the IOTC on cetacean bycatch issues in the Indian Ocean. The IWC plans to hold a 2-day workshop focused on cetacean bycatch in the Indian Ocean prior to the upcoming Scientific Committee meeting that will be help in Nairobi, Kenya in May 2019. This workshop will work to bring together experts, relevant stakeholders and those with data on fisheries and bycatch (multi-taxa) and cetacean and marine megafauna distribution to try and evaluate the utility of existing data for evaluating bycatch and identify priority gaps for future data collection. The workshop will also explore the challenges with tackling cetacean bycatch and mitigation in the Indian Ocean and explore the current approaches. More information can be provided by contacting the IWC Secretariat (IWCBycatchMitigationInitiative@groups.iwc.int and marguerite.tarzia@iwc.int)

11.2 Summary and main outcomes of the small working group meeting on the delineation of regions in IOTC to foster the operationalization of EBFM

197. A small breakout working group (the group) **DISCUSSED** the main purposes of ecoregions and potential benefits and their uses to facilitate the operationalization of EBFM.

198. The group **DISCUSSED** the importance to establish ecoregions that have boundaries that make ecological sense but that at the same time are practical to inform fisheries management.

199. The group **NOTED** that two candidate ecoregions proposed by the EU project does not entirely account for some of the main fisheries in the region, such as many coastal fisheries. The analysis from the EU project only considered the industrial fisheries, and it should include coastal fisheries in future assessments.

200. The group **NOTED** that the criteria to inform the boundaries of the ecoregions need to be revised and should account for a larger number of factors and characteristics of the region. The revised criteria could account for the biogeography of the region, the knowledge on fisheries (coastal artisanal, semi-industrial and industrial), their dynamics and how they overlap with each other, socio-economic and geopolitical factors, compatibility with other regional initiatives (e.g. SWIOFC, IUCN, RFMOs, etc.), as well as expert knowledge from CPCs in all the above.

201. The group **ACKNOWLEDGED** it is important to involve all the CPCs in the different steps of the process from developing to implementing the ecoregion project

202. The group **ACKNOWLEDGED** the importance of establishing criteria to inform the delineation of potential candidate ecoregions with the input of ecosystem experts and fisheries managers (from CPCs of IOTC area of competence). It also highlighted the importance of the consultative nature of this initiative.

203. The group **NOTED** on the importance on drawing from other RFMOs and international bodies experiences who have already in place ecoregions to inform the operationalization of EBFM.

204. The group **RECALLED** the recommendation to convene a workshop in 2019 to carry out the delineation of candidate regions to foster the discussion on operationalizing EBFM. The group highlighted the importance of defining criteria prior to the workshop to inform the delineation of candidate regions. The criteria will be shared with workshop participants before the workshop, in order to receive their feedback and comments that will eventually be discussed during the workshop to set the stage for informing candidate regions.

11.3 Date and place of the 15thand 16thSessions of the Working Party on Ecosystems and Bycatch

205. 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 15th and 16th Sessions of the WPEB in 2019 and 2020 respectively, the WPEB **NOTED** that Reunion had offered to host the 15th session of the WPEB in 2019. With regards to 2020, the IOTC Secretariat would liaise with potential hosts intersessionally to determine who might be able to host the 16th Session 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 in December 2018 (Table 2).

Table 2. Draft meeting schedule for the WPEB (2018 and 2019), proposed to continue to be held back-to-back with WPB.

	2019			2020		
Meeting	**No.**	**Date**	**Location**	**No.**	**Date**	**Location**
Working Party on **Billfish** (WPB)	17th	9-12 September (4d)	La Réunion (TBC)	18th	1-5 September (5d)	(TBC)
Working Party on **Ecosystems and Bycatch** (WPEB)	15th	3-7 September (5d)	La Réunion (TBC)	16th	7-11 September (5d)	(TBC)

206. 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.

11.4 Review of the draft, and adoption of the Report of the 14thSession of the Working Party on Ecosystems and Bycatch

207. The WPEB **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPEB14, 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
- Marine mammals - Appendix XVIII

208. The report of the 14th Session of the Working Party on Ecosystems and Bycatch (IOTC–2018–WPEB14–R) was **ADOPTED** on the 14th September 2018.

APPENDIX I
LIST OF PARTICIPANTS

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APPENDIX II
AGENDA FOR THE 14TH WORKING PARTY ON ECOSYSTEMS AND BYCATCH

Date: 10 - 14 September 2018
Location: Cape Town, South Africa
Venue: Protea Hotel, Victoria Junction
Time: 09:00 – 17:00 daily
Chair: Dr. Sylvain Bonhommeau(EU,France); **Vice-Chair**: Dr. Reza Shahifar (I.R. Iran) & Dr. Ross Wanless (South Africa)

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 20th Session of the Scientific Committee (IOTC Secretariat)
   - 3.2 Outcomes of the 22st 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 WPEB13 (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)
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. **ECOSYSTEM MODELING AND REPORT CARDS** (recommendations from the SC / decisions of the Commission)
   - 7.1. Ecosystem Based Fisheries Management (EBFM) approaches and ecosystem report cards results
8. **BYCATCH, SPECIES INTERACTIONS, AND ECOSYSTEM RISK ASSESSMENTS**
   - 8.1. Review new information on other bycatch and by-product, in terms of biology, ecology, fisheries interactions and bycatch mitigation measures (all)
   - 8.2. 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).
   - 8.3. Sharks and rays (all)
     - Review new information on shark and ray biology, stock structure, bycatch mitigation measures, fisheries and associated environmental data (all);
     - Review of new information on the status of sharks (all);

- Development of management advice on the status of shark stocks and update of other shark species Executive Summaries for the consideration of the Scientific Committee (all).

8.4. Marine turtles (all)

- Review new information on marine turtle biology, ecology, fisheries interactions and bycatch mitigation measures (all);

8.5. Marine mammals (all)

- 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).

9. ECOLOGICALLY OR BIOLOGICALLY SIGNIFICANT MARINE AREAS (EBSAs) IN THE INDIAN OCEAN

10. WPEB PROGRAM OF WORK

10.1. Revision of the WPEB Program of Work 2019–2023 (Chairperson and IOTC Secretariat)

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

11. OTHER BUSINESS

11.1. International Whaling Commission Bycatch Mitigation Initiative (all)

11.2. Summary and main outcomes of the small working group meeting on the delineation of regions in IOTC to foster the operationalization of EBFM (all)

11.3. Date and place of the 15th and 16th Sessions of the Working Party on Ecosystems and Bycatch (Chairperson and IOTC Secretariat)

11.4. Review of the draft, and adoption of the Report of the 14th Session of the Working Party on Ecosystems and Bycatch (Chairperson)

APPENDIX III
LIST OF DOCUMENTS

Document	Title	Availability
IOTC-2018-WPEB14-01a	Agenda of the 14th Working Party on Ecosystems and Bycatch	✓ 16 February ✓ 8 August
IOTC-2018-WPEB14-01b	Annotated agenda of the 14th Working Party on Ecosystems and Bycatch	✓ 17 August ✓ 6 September
IOTC-2018-WPEB14-02	List of documents of the 14th Working Party on Ecosystems and Bycatch	✓ 27 August ✓ 6 September
IOTC-2018-WPEB14-03	Outcomes of the 20th Session of the Scientific Committee (IOTC Secretariat)	✓ 27 August
IOTC-2018-WPEB14-04	Outcomes of the 22st Session of the Commission (IOTC Secretariat)	✓ 27 August
IOTC-2018-WPEB14-05	Review of Conservation and Management Measures relevant to ecosystems and bycatch (IOTC Secretariat)	✓ 27 August
IOTC-2018-WPEB14-06	Progress made on the recommendations and requests of WPEB13 and SC19 (IOTC Secretariat)	✓ 29 August
IOTC-2018-WPEB14-07	Review of the statistical data and fishery trends for ecosystems and bycatch species (IOTC Secretariat)	✓ 4 September
IOTC-2018-WPEB14-08	Update on the implementation of the IOTC Regional Observer Scheme (IOTC Secretariat)	✓ 30 August ✓ 5 September
IOTC-2018-WPEB14-09	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)	✓ 29 August
IOTC-2018-WPEB14-10	Revision of the WPEB Program of Work (2019–2023) (IOTC Secretariat & Chairperson)	✓ 31 August
IOTC-2018-WPEB14-11	An update on the National Plan of Action for Sharks, South Africa. (C. da Silva, H. Winker, D. Parker, C. Wilke, S. Lamberth and S. Kerwath.	✓ 29 August
IOTC-2018-WPEB14-12	FAD Watch: a collaborative initiative to minimize the impact of FADs in coastal ecosystems (I. Zudaire, J. Santiago, M. Grande, H. Murua, P-A. Adam, M. Herrera)	✓ 7 September
IOTC-2018-WPEB14-13	Comparing the biological characteristics, length structure and capture status of bycatch in the Chinese longline fishery targeting different species in the Indian Ocean (Z. Gheng, J. Zhu and Y. Wang)	✓ 28 August
IOTC-2018-WPEB14-14	Biological and ecological traits of some bycatch species of the tuna purse seine fishery in the Indian Ocean. (A. Médieu, P. Bach, N. Bodin, P. Cauquil, E. Chassot, N. Rabearisora, P. Sabarros)	✓ 28 August
IOTC-2018-WPEB14-15	Bycatch of the European purse-seine tuna fishery in the Indian Ocean for the 2008-2016 period (J. Ruiz, P. Sabarros, F. Abascal Crespo, P. Bach, José. Baez, P. Cauquil, M. Grande, I. Krug, H. Murua, M. Ramos, A. Tirant.	✓ 7 September
IOTC-2018-WPEB14-16	Bycatch landings in Phuket ports by foreign vessel 2017. (K. Maeroh, S. Hoimuk and N. Somkliang)	✓ 28 August
IOTC-2018-WPEB14-17	Iran tuna fisheries by-catch in IOTC competence of area in 2017 (R. Shahifar)	✓ 28 August
IOTC-2018-WPEB14-18	Improving the sampling protocol of electronic and human observations of tropical tuna purse seiner discards (K. Briand, P. Sabarros, A. Maufroy, A. Relot-Stirnemann, S.Lecouls, M. Goujon, P.Bach)	✓ 28 August
IOTC-2018-WPEB14-19	SIOTI Support for lmproving lnformation on Bycatch for Management of the lndian Ocean Purse Seine Tuna Fishery. (J. Ruiz, P. Bach, I. Krug, H. Murua, J. Robinson, C. Shearlock)	✓ 28 August
IOTC-2018-WPEB14-20	An indicator-based ecosystem report card – an evolving process (M-J. Juan-Jordá, H. Murua and E. Andonegi)	✓ 28 August
IOTC-2018-WPEB14-21	SELECTING ECOSYSTEM INDICATORS FOR FISHERIES TARGETING HIGHLY MIGRATORY SPECIES. (M-J. JUAN-JORDÁ, H. MURUA AND CONSORTIUM MEMBERS)	✓ 28 August
IOTC-2018-WPEB14-22	Updated Ecological Risk Assessment for IOTC species. (H. Murua)	

Document	Title	Availability
IOTC-2018-WPEB14-23	Retrospective and geographical overview of the interaction between seabirds and the Spanish surface longline fishery targeting Swordfish in the Indian Ocean during the 1993-2017 period inferred from data provided by scientific observers at sea. (J. Fernández-Costa, A. Ramos-Cartelle, A. Carroceda and J. Mejuto)	✓ 28 August
IOTC-2018-WPEB14-24	Preliminary assessment of the risk of albatrosses by longline fisheries (D. Ochi , E. Abraham , Y. Inoue, K. Oshima, N. Walker, Y. and S. Tsuji)	✓ 28 August
IOTC-2018-WPEB14-25	Update on the seabird component of the Common Oceans (ABNJ) tuna project – seabird bycatch assessment workshop (Abraham E, Carneiro A, Fahmi Z, Inoue Y, Kathena JN, Kim DN, Lee SI, Maree B, Oshima K, Parsa M, Rice J, Sant'Ana R, Sharma R, Small C, Tsuji S, Wanless R, Winker H and Wolfaardt A)	✓ 29 August
IOTC-2018-WPEB14-26	ACAP advice for reducing the impact of pelagic longline fishing operations on seabirds. (A. Wolfaardt)	✓ 28 August
IOTC-2018-WPEB14-27	A progress report on the implementation of the IOTC bigeye thresher shark post-release mortality study project (IOTC BTH PRM Project) (IOTC BTH PRM Project Team)	✓ 28 August
IOTC-2018-WPEB14-28	Preliminary assessment of shark bycatch from Kenya's nascent industrial tuna fisheries (B. Kiilu and S. Ndegwa).	✓ 28 August
IOTC-2018-WPEB14-29	A perspective on the Mobulid Rays interactions with surface fisheries in the Indian Ocean (J.Kiszka, U.Shahid)	✓ 28 August
IOTC-2018-WPEB14-30	Unprecedented decline in the catches of mobulids: an important component of tuna gillnet fisheries of the Northern Arabian Sea. (M. Moazzam)	✓ 28 August
IOTC-2018-WPEB14-31	Standardized CPUE OF Silky Shark (*Carcharhinus Falciformis*) Caught by Indonesian Longline Fleet in the Eastern Indian Ocean (I. Jatmiko, B. Setyadji, Z. Fahmi and F. Rochman)	✓ 28 August
IOTC-2018-WPEB14-32	Can we Derive an Abundance Index for the Silky Shark Based on its Associative Behavior with Floating Objects? (A. Diallo, M. Travassos Tolotti, P. Sabarros, L. Dagorn and M. Capello)	✓ 29 August
IOTC-2018-WPEB14-33	A Preliminary Stock Assessment for the Silky Shark in the Indian Ocean Using a Data-Limited Approach (J. Ortiz de Urbina, T. Brunel, R. Coelho, G. Merino, D. Rosa, C. Santos, H. Murua, P. Bach, S. Saber, D. Macias)	✓ 28 August
IOTC-2018-WPEB14-34	Updated standardized CPUE of blue shark by Taiwanese large-scale tuna longline fishery in the Indian Ocean (T.Wen-Pei and K-M. Liu)	✓ 28 August
IOTC-2018-WPEB14-35	Exploring the use of Length Based Indicators for Blue Shark in the Indian Ocean (N. Walker, J. Ellis, R. Coelho, H. Murua, D. Rosa)	✓ 28 August
IOTC-2018-WPEB14-36	Preliminary Management Strategy Evaluation for Blue Shark in the Indian Ocean Using A Data-Limited Approach (J. Ortiz de Urbina, T. Carruthers, R. Coelho, D. Rosa, H. Murua, S. Saber, D. Macias)	✓ 28 August
IOTC-2018-WPEB14-37	A Preliminary Stock Assessment for the Shortfin Mako Shark in the Indian Ocean Using Data-Limited Approaches (T. Brunel, R. Coelho, G. Merino, J. Ortiz de Urbina, D. Rosa, C. Santos, H. Murua, P. Bach, S. Saber, D. Macias)	✓ 28 August
IOTC-2018-WPEB14-38	Progress report of the post release mortality of the oceanic white tip shark (POREMO project) discarded by EU purse seine and pelagic longline fisheries (P. Bach, P. Sabarros, R. Coelho, H. Murua, I. Krug, E. Romanov)	✓ 28 August
IOTC-2018-WPEB14-39	Status of mobulid rays in Sri Lanka (D. Fernando)	✓ 28 August
IOTC-2018-WPEB14-40	Assessment of the vulnerability of sea turtles to IOTC tuna fisheries. (A. Williams)	✓ 28 August
IOTC-2018-WPEB14-41	Cetacean bycatch in tuna drift gillnet fisheries off Pakistan (Arabian Sea) (J. Kizka, M. Moazzam, M. Niviere, U. Shahid, B. Khan and R. Nawaz)	✓ 28 August
IOTC-2018-WPEB14-42	Ecologically or biologically significant marine areas (EBSAs) in the Indian Ocean (Secretariat)	✓ 29 August

Document	Title	Availability
IOTC-2018-WPEB14-43	Reviewing effectiveness of management measures on shark landings in Sri Lanka over past five years (D. Balawardhana, K. Dalpathaduand S. Haputhantri)	✓ 28 August
IOTC-2018-WPEB14-44	Transhipment observers – a tool for understanding seabird bycatch mitigation measures use on high seas tuna longline vessels (P. Augustyn and R. Wanless)	✓ 28 August
IOTC-2018-WPEB14-45	Preliminary estimates of seabird bycatch from tuna longline fisheries for the southern Atlantic and southwestern Indian Oceans, based on three different methods (H. Winker, R. Sant'Ana, S. Kerwath, D. Parker, J. Rice, R. Sharma, D. Kim, S. Lee).	✓ 28 August
IOTC-2018-WPEB14-46	Non-target species interactions in tuna fisheries and its implications in fisheries management: Case of large-mesh gillnet fisheries along the north-west coast of India (Koya MK, Rohit P, Vase VK, Azeez AP)	✓ 6 September
Information papers		
IOTC-2018-WPEB14-INF01	Draft marine turtle data call	✓ 29 August
IOTC-2018-WPEB14-INF02	IOTC manual for tagging bigeye thresher shark (BTH) with pop-up satellite archival tags (PSAT) to evaluate post-release mortality (PRM)	✓ 29 August
IOTC-2018-WPEB14-INF03	Using a Crew-Based Observer Programme as a Platform of Opportunity for Understanding the Distribution of Whales in the Northern Arabian Sea (M. Moazam and R. Nawaz)	✓ 29 August
IOTC-2018-WPEB14-INF04	Troubled waters: Threats and extinction risk of the sharks, rays and chimaeras of the Arabian Sea and adjacent waters (R. Jabado, P. Kyne, R. Pollom, et al.,).	✓ 29 August
IOTC-2018-WPEB14-INF05	An update on Western and Central Pacific Fisheries Commission shortfin mako and silky shark post-release mortality tagging studies (W. Lyon, S. Clarke, M. Francis, C. Sanchez, T. Peatman and N. Smith)	✓ 29 August
IOTC-2018-WPEB14-INF06	Risk to the Indo-Pacific Ocean whale shark population from interactions with Pacific Ocean purse-seine fisheries (Common Oceans (ABNJ) Tuna Project)	✓ 29 August
IOTC-2018-WPEB14-INF07	The porbeagle shark (Lamna nasus) in the Southern Hemisphere: searching for biological patterns among oceans and regions (E. Acuna)	✓ 12 September
Data Sets		
IOTC-2018-WPEB14-DATA01	Bycatch datasets available	✓
IOTC-2018-WPEB14-DATA02	Data Catalogue	✓
IOTC-2018-WPEB14-DATA03a	Nominal Catches per Fleet, Year, Gear, IOTC Area and species (scenario 1)	✓ 20th August
IOTC-2018-WPEB14-DATA03b	Nominal Catches per Fleet, Year, Gear, IOTC Area and species (scenario 2)	✓ 20th August
IOTC-2018-WPEB14-DATA04	Catch and effort data - vessels using drifting longlines	✓ 20th August
IOTC-2018-WPEB14-DATA05	Catch and effort data - surface fisheries	✓ 20th August
IOTC-2018-WPEB14-DATA06	Catch and effort data - vessels using other gears (e.g., gillnets, lines and unclassified gears)	✓ 20th August
IOTC-2018-WPEB14-DATA07	Catch and effort data - all gears	✓ 20th August
IOTC-2018-WPEB14-DATA08	Catch and effort – reference file	✓ 20th August
IOTC-2018-WPEB14-DATA09	Size frequency data - sharks	✓ 20th August
IOTC-2018-WPEB14-DATA10	Size frequency – reference file	✓ 20th August
IOTC-2018-WPEB14-DATA11	Equations used to convert from fork length to round weight for shark species	✓ 27th August

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

Extract from IOTC–2018–WPEB14–07

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

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

The nominal catch data for all shark species are presented in Fig. 2 by fleet. Very few fleets reported catches of sharks in the 1950s, but the number of fleets reporting has increased 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 120 000 mt in 1999. Since then, nominal catches have fluctuated and are currently around 100 000 mt.

The nominal catch data should be considered with caution given the historically low reporting rates. In addition to the low level of reporting, catches that have been reported are thought to represent only those species that are retained onboard without taking in to account discards. 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 4) 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.

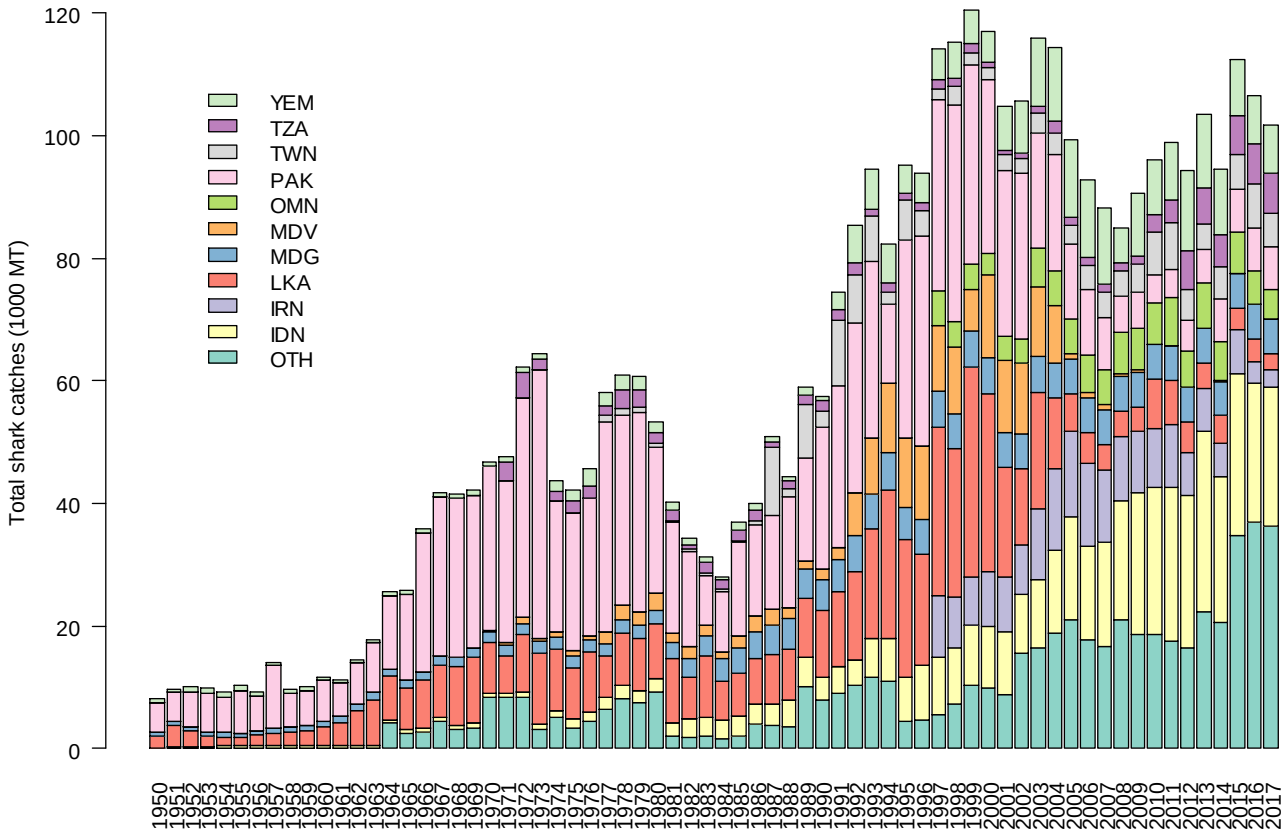


Fig. 1. Total reported nominal catches of sharks by fleet from 1950–2017 (YEM = Yemen, TZA = Tanzania, TWN = Taiwan,China, PAK = Pakistan, OMN = Oman, MDV = Maldives, MDG = Madagascar, LKA = Sri Lanka, IRN = I.R.Iran, IDN = Indonesia, OTH = all others).

Main reported gear types associated with shark bycatch for IOTC fisheries

Fig. 3 shows the distribution of catches across gear type. Gillnets are associated with the highest reported nominal catches of sharks, historically and are currently responsible for over 40% of reported catches. This is followed by the longline fleets which contributed substantially to shark catches from the 1990s, and handline and troll line fisheries which have increased in more recent years. Of the gillnet fisheries, the majority comprise standard, unclassified gillnets, followed by combinations of gillnets, handlines and troll lines and gillnet/longline combinations. Fig. 4 shows the main gear types used by fleets since 2000.

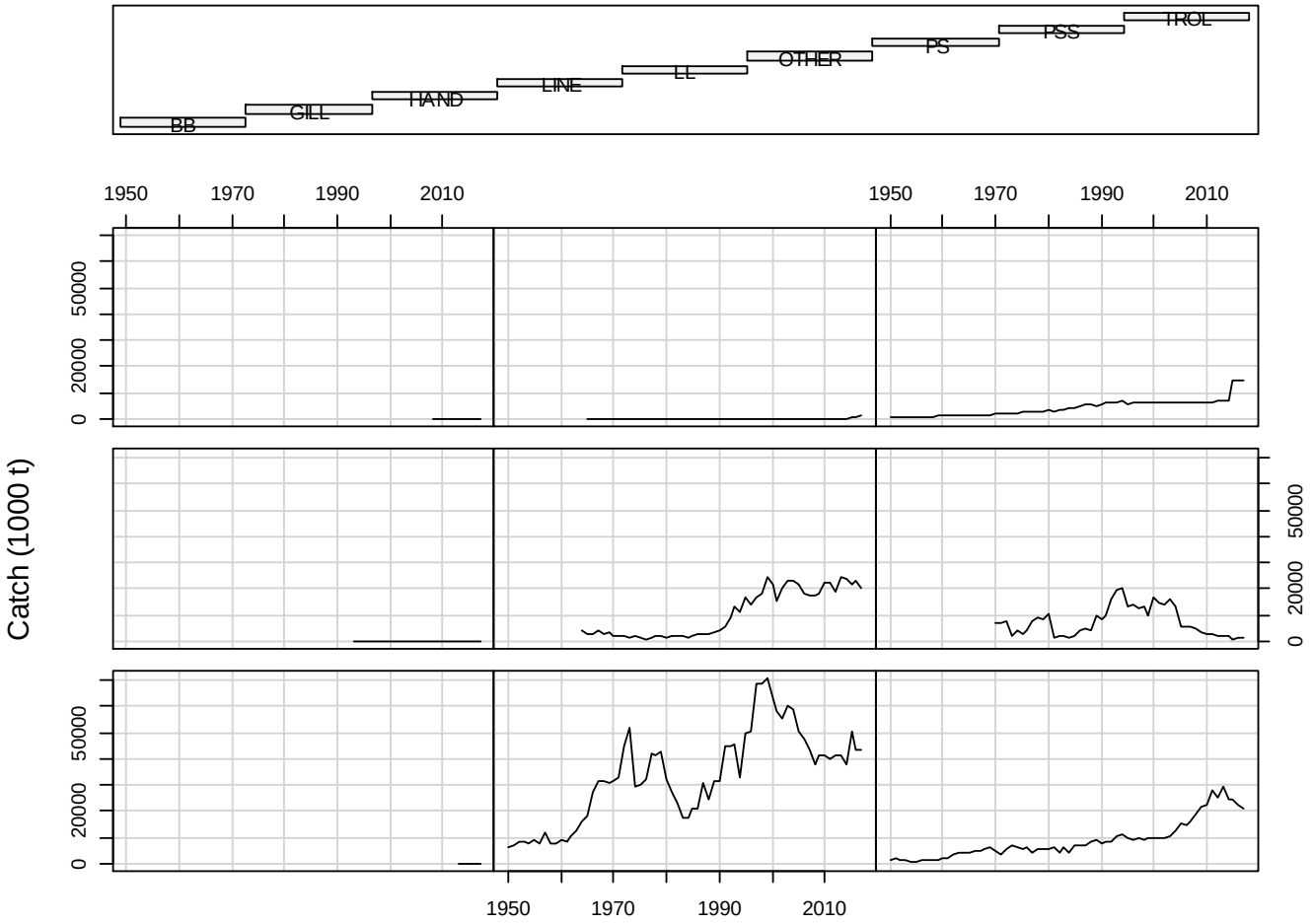


Figure 2. Nominal catches of sharks reported by gear type (1950–2017). Gears are listed in rows from bottom left to top right: Bait boat/pole and line (BB), gillnet (GILL), Handline (HAND), Line (LINE), Longline (LL), Purse seine (PS), Small purse seines/Ring nets (PSS), Troll lines (TROLL) and all other gear types (OTHER).

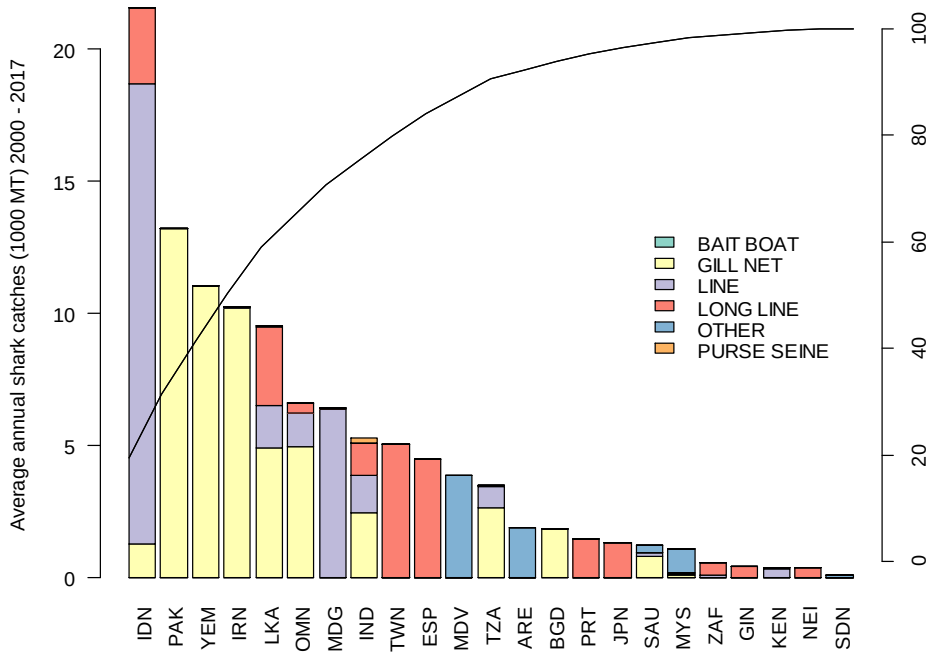


Fig. 3. Average annual shark catches by gear type and reporting country in recent years (2000-2017)

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.5a). Of the shark catches reported by species, the blue shark forms the greatest proportion, comprising over 60% of total catches, with silky, milk, threshers, hammerheads, makos, oceanic whitetip sharks and manta rays forming a smaller percentage (Fig. 5b).

The increase in reporting by species is apparent in the species-specific catch series (Fig. 5a) with steadily increasing trends in reporting since the 1970s seen for blue sharks, thresher sharks, hammerhead sharks and mako sharks, all levelling off in recent years. The oceanic whitetip shark nominal catch series is dominated by the Sri Lankan longline-gillnet fisheries for which catches peaked just prior to 2000. The reported catches of silky shark show a similar trend with a peak just prior to 2000 followed by a steady decline, again based almost exclusively on data from the Sri Lankan longline-gillnet combination fisheries. Fig.6b highlights how the catch series of each species is dominated by very few fleets which are reporting by species and may therefore not be fully reflective of the ocean-wide trend.

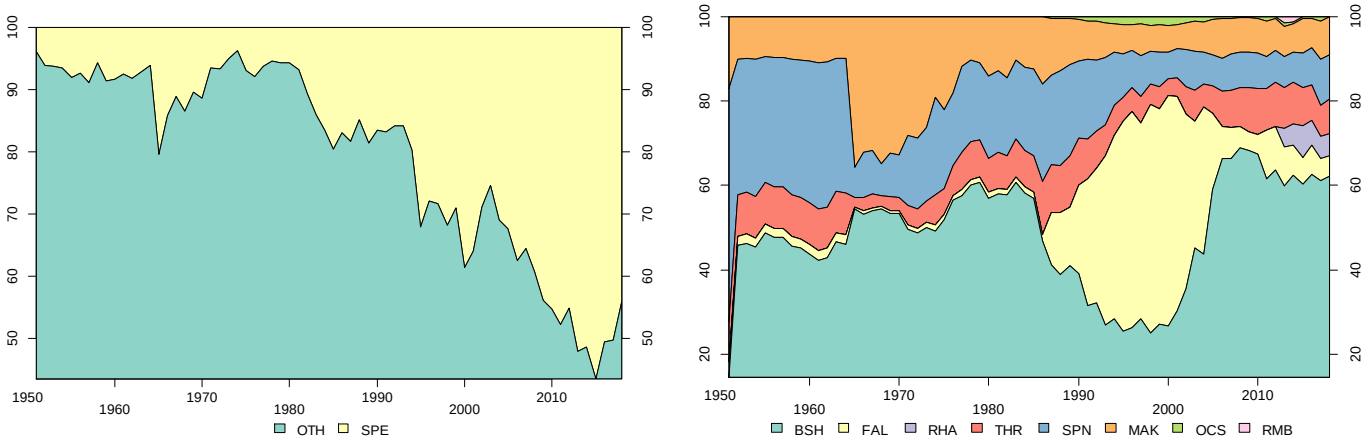


Fig. 4. a) Proportion of shark catches reported by species and as aggregate catch (OTH) and b) proportion of nominal shark catches by species

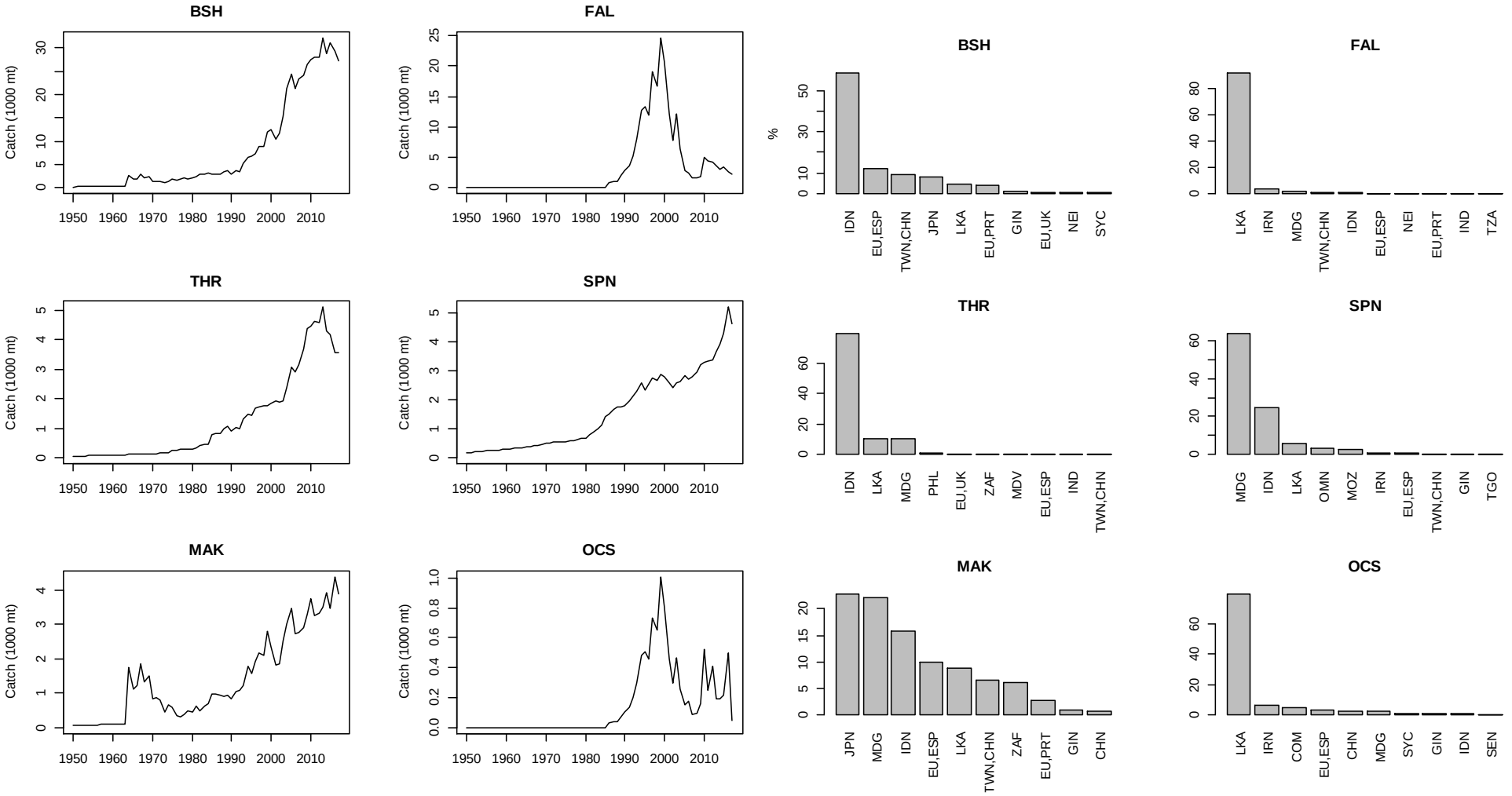


Fig. 5. a) Total nominal catches by species for all fleets (1950-2017) and b) contribution of each fleet to the total data series

Trends in species catches by gear types are summarised in Table 3. Longline fleets reported predominantly blue shark catches, followed by mako and silky sharks, while catches of handline gears are also dominated by blue shark, followed by thresher sharks. Purse seine catches are dominated by silky shark while troll lines reported relatively high catches of hammerhead sharks. Reporting by species is very uncommon for gillnet fleets, where the majority of shark catches are reported as aggregates. Nevertheless, this is improving as shown in Fig. 6 by the level of species-specific reporting, particularly by the gillnet fleet of I.R. Iran. This figure highlights the relatively high catches of the Indonesia line fisheries (including troll lines, hook and line, hand line and coastal longlines[2]) and the gillnet fisheries of Pakistan, Yemen and I.R. Iran.

Table 3. Species-specific catches by gear type from 2005–2017 (pole and line (PL), gillnet (GILL), Handline (HAND), Line (LINE), longline (LL), Purse seine (PS), small purse seines/ring nets (PSS) and troll lines (TROL).

	BB	GILL	HAND	LINE	LL	PS	PSS	TROL
OTH	100	89	15	98	20	28	89	70
BSH	0	3	58	0	63	0	2	0
FAL	0	4	1	2	6	72	6	1
RHA	0	3	0	0	0	0	0	0
THR	0	0	16	0	0	0	0	3
SPN	0	1	7	0	0	0	3	20
MAK	0	0	3	0	10	0	0	6

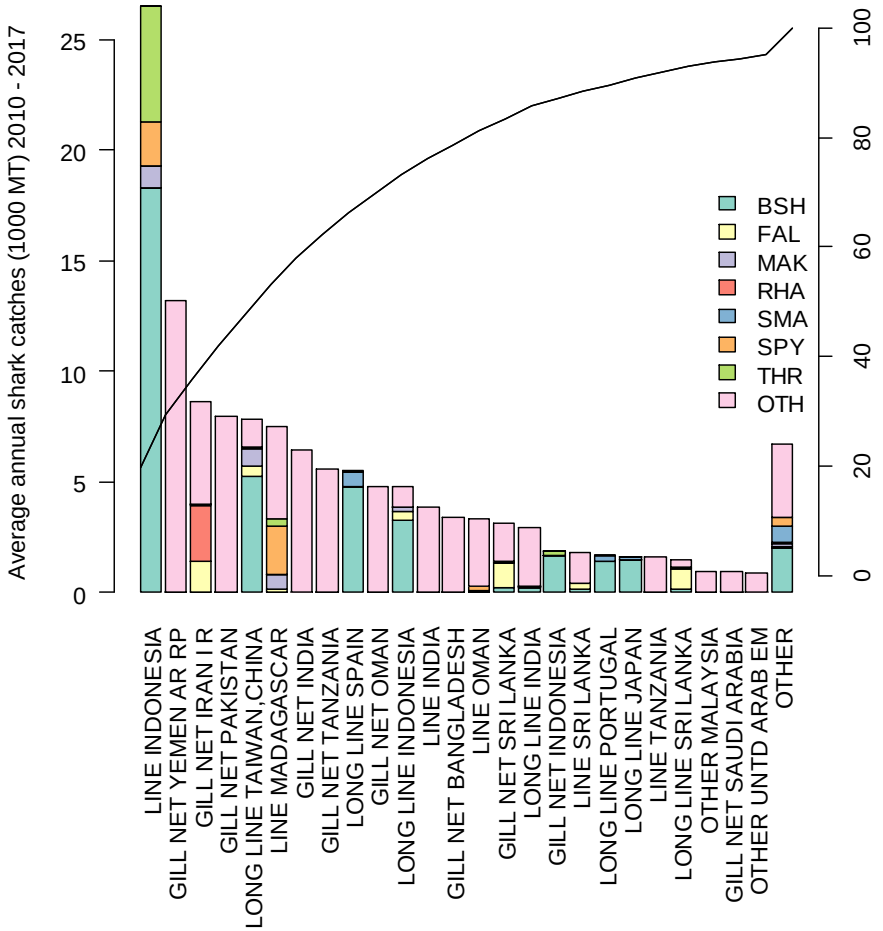


Fig. 6. Annual average shark catches reported by fleet and species from 2010–2017

Catch rates of IOTC fleets

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 quantities of pelagic sharks.

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

- **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 extent of shark catches taken by these fisheries, if any, is not thought to be significant.

- **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[3], 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 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.

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

- 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.

- **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.

Fig. 8 shows the catch rates of sharks as a proportion of total catches as reported in the IOTC database. This suggests that some of the reported catch rates for the longline fleet are lower than expected and highlights the patchiness of the data leading to highly variable catch rates over time.

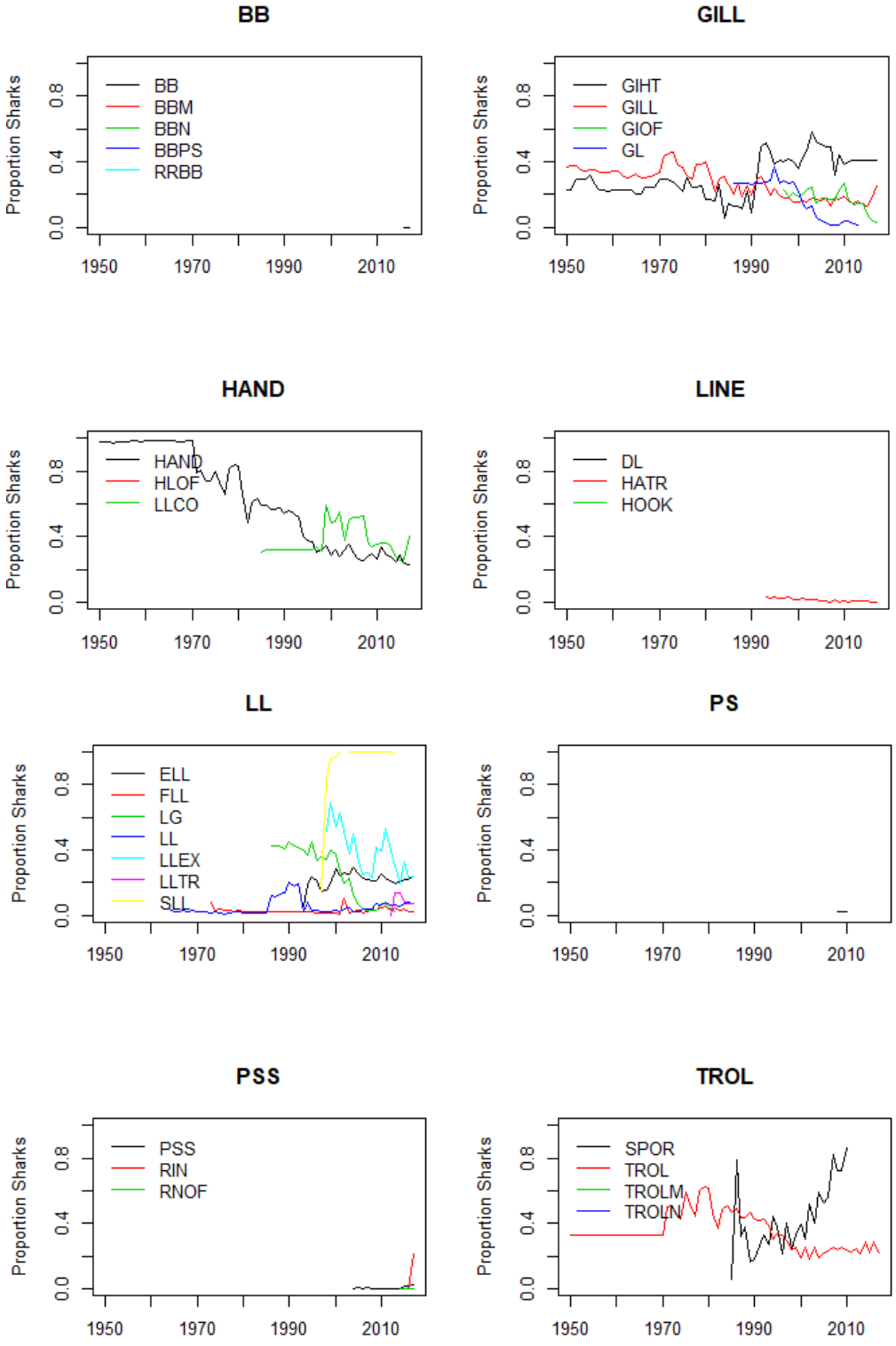


Fig. 7. Proportion of reported shark catch as a fraction of total reported catch by gear type over time

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. 8 shows the aggregated fork length frequency distribution for the longline fleets reporting size information on blue sharks for all areas between 2005 and 2017. 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 size of the individuals caught by different fleets, with the EU fleets, on average, catching larger blue sharks than the other fleets. Fig. 9 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.

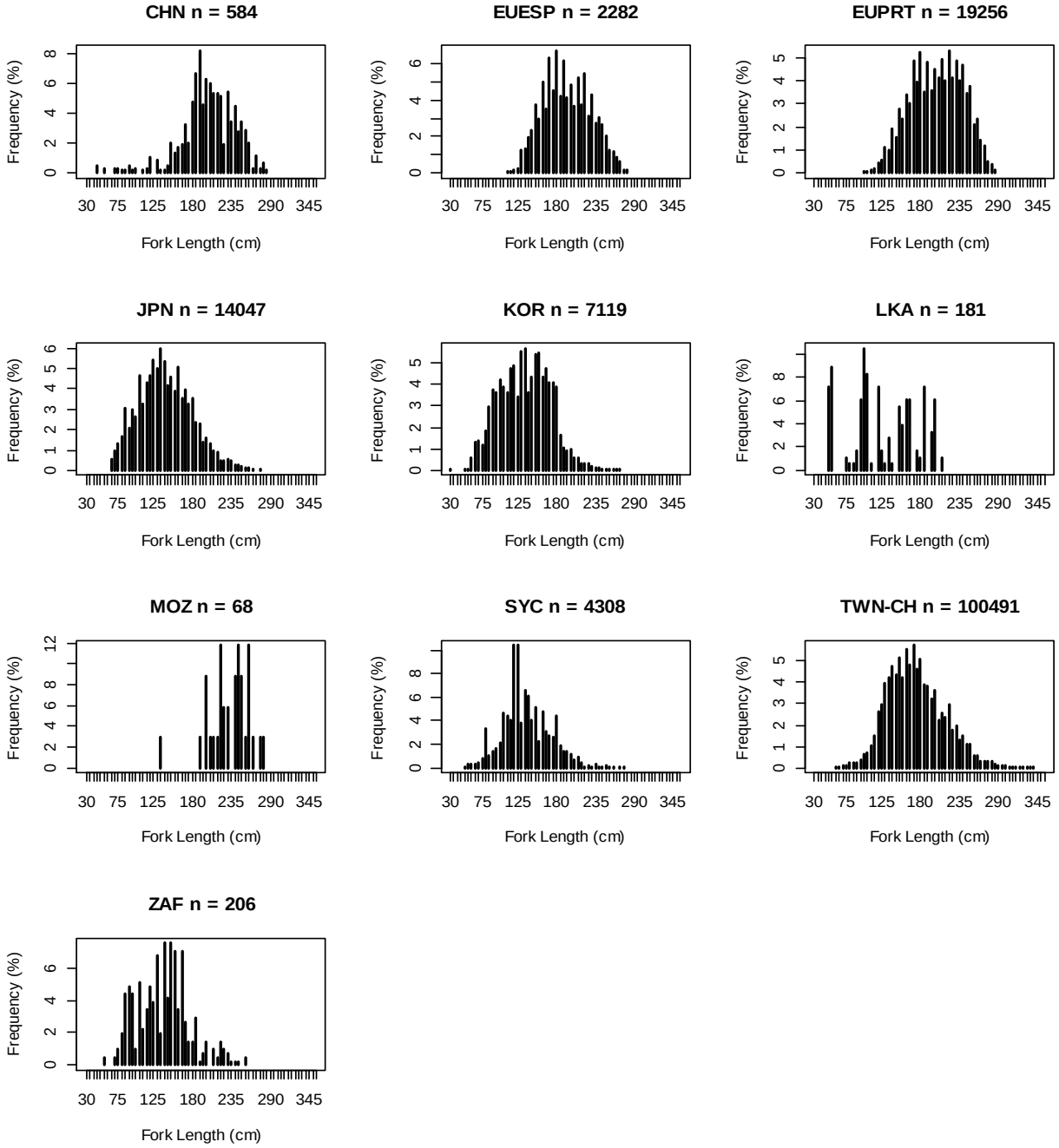


Fig. 8. Fork length frequency distributions (%) of blue shark derived from the samples reported for the longline and gillnet fleets of China (CHN LL), EU,Spain (EUESP ELL), EU,Portugal (EUPRT ELL), Japan (JPN LL), Korea (KOR LL), Sri Lanka LKA (FLL, G/L), Mozambique (MOZ HAND) Seychelles (SYC LL), Taiwan,China (TWN-CHN FLL,LL) and South Africa (ZAF ELL) between 2005 and 2017 in 5 cm length classes.

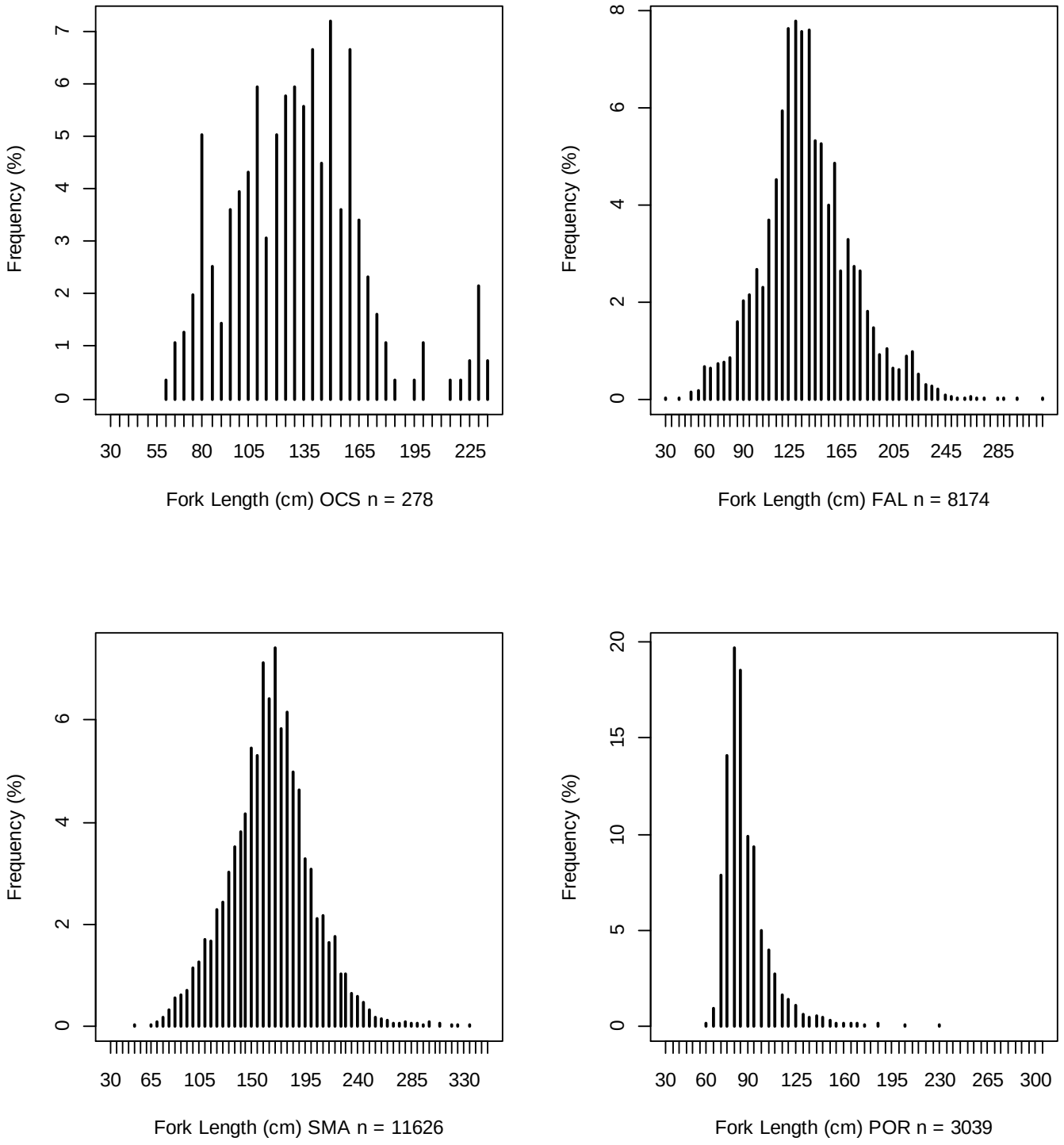


Fig. 9. Fork length frequency distributions (%) for oceanic whitetip shark (OCS), shortfin mako shark (SMA), porbeagle shark (POR) and silky shark (FAL) between 2005 and 2017.

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 4[4].

Table 4. 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.

[4] 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 and Taiwan,China, accounting for 13% and 62% of total effort in the area in 2017 (Figure 10). This summarises total reported effort, however, this is incomplete for some reporting fleets, i.e. for Malaysia, South Africa, Seychelles, Rep. of Korea and Taiwan,China the effort is likely to be higher. It is also important to note that these are only the countries that are reporting some information on effort, while it is expected that a number of other longline fleets also fish in this area based on the presence of temperate species in their catch data. These include Indonesia, Madagascar, Tanzania, Philippines, Mozambique and Belize. The effort from some of these CPCs is also likely to be substantial, given the catch quantities of temperate species (e.g. Indonesia National Report Fig; 3b IOTC-2016-SC19-NR01).

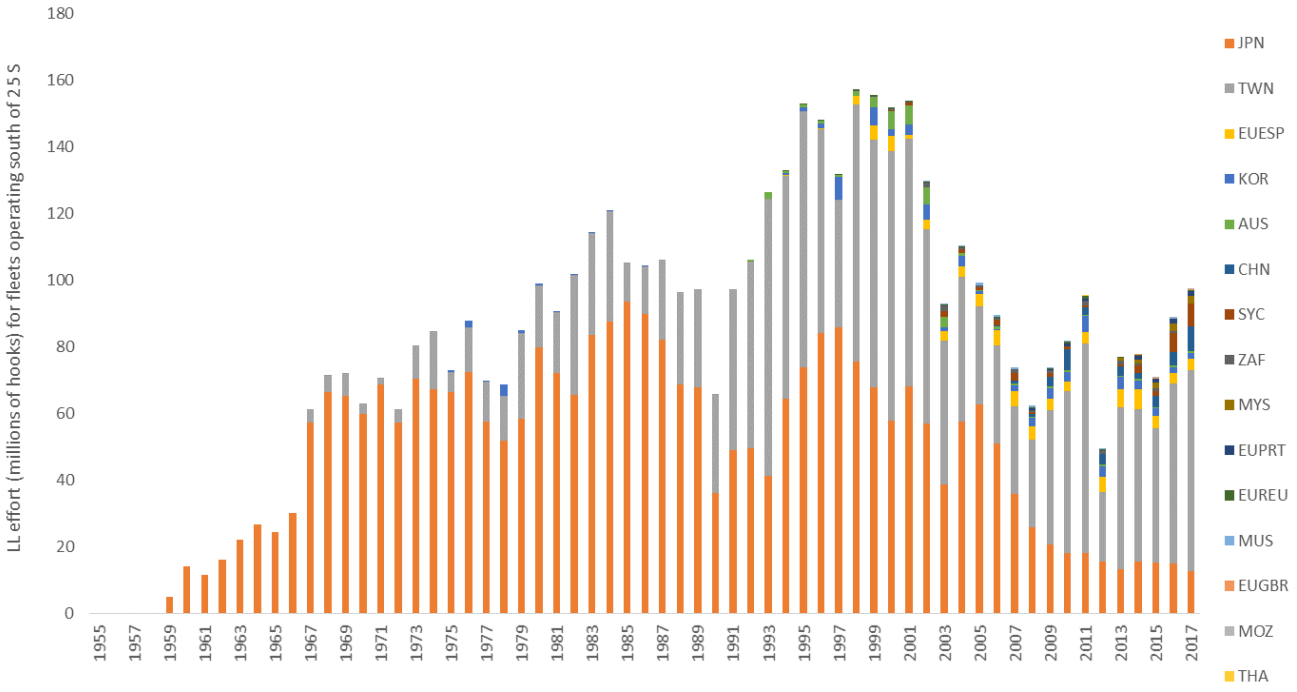


Figure 10. Reported longline effort for fleets operating south of 25° south between 1955 and 2017. (THA = Thailand, EUGBR = EU,UK, MYS = Malaysia, EUPRT = EU,Portugal, EU,REU = EU,France, MUS = Mauritius, ZAF, = South Africa, SYC = Seychelles, CHN = China, AUS = Australia, EUESP = EU,Spain, KOR = Rep. of Kora, TWN = Taiwan,China, JPN = Japan).

Status of data on seabird bycatch

The reported data available on seabirds caught in the IOTC area of competence are generally fairly limited. In 2016 six CPCs (Australia, EU-Portugal, EU-Spain, EU-France, Japan, Rep. of Korea, Taiwan,China and South Africa) of the 15 CPCs which report effort or are likely to exert longline fishing effort south of 25°S to IOTC submitted data in response to a call for data submission on seabirds which was reported to the SC.[5] In addition, three CPCs submitted substantive papers on seabird bycatch to the WPEB12: China[6], EU-Spain[7]), and Japan[8].

[5] IOTC-2016-SC19-INF02

[6] Gai, C.; Dai, X. (2016). Estimating the composition and capture status of bycatch using Chinese longline observer data in the Indian Ocean. IOTC–2016–WPEB12–16.

[7] Fernández-Costa J.; Ramos-Cartelle, A.; Carroceda, A.; Mejuto, J. (2016). Interaction between seabirds and Spanish surface longline targeting swordfish in the Indian Ocean (≥ 25º South) during the period 2011-2015. IOTC–2016–WPEB12–29.

[8] Inoue, Y.; Kanaiwa, M.; Yokawa, K.; Oshima, K. (2016a). Examination of factors affecting seabird bycatch occurrence rate in southern hemisphere in Japanese longline fishery with using random forest. IOTC–2016–WPEB12–INF07.

Inoue, Y.; Kanaiwa, M.; Yokawa, K.; Oshima, K. (2016b). MODELING OF BYCATCH OCCURRENCE RATE OF SEABIRDS FOR JAPANESE LONGLINE FISHERY OPERATED IN SOUTHERN HEMISPHERE. IOTC–2016–WPEB12–INF08.

The information provided highlighted some general trends in seabird bycatch rates across the Indian Ocean with higher catch rates at higher latitudes, even within the area south of 25°S and higher catch rates in the coastal areas in the eastern and western parts of the southern Indian Ocean. Because the reporting of effort has been low (some CPCs fishing south of 25°S in the Indian Ocean did not report any effort while for others it was incomplete), and the observer coverage is relatively low (though improving) for many fleets, data submitted through the data-call is unlikely to be able to provide reliable estimates of total bycatch of seabirds from the longline fishery south of 25°S latitude in the Indian Ocean and so extrapolations of the information to total Indian Ocean captures were not undertaken. Bycatch mortality, where reported, was high but there is a lack of information on post release mortality/survival as well as total effort which means that the total fishery induced mortality on the seabird populations cannot be estimated.

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[9].

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).

Yokawa, K.; Oshima, K.; Inoue, Y.; Katsumata, N. (2016). Operational pattern of Japanese longliners in the south of 25S in the Atlantic and the Indian Ocean for the consideration of seabird bycatches. IOTC–2016–WPEB12–INF09.
Katsumata, N.; Yokawa, K.; Oshima, K. (2016). Information of seabirds bycatch in area south of 25 S latitude in 2010 from 2015. IOTC–2016–WPEB12–INF10.

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

Extract from IOTC–2018–WPEB14–07

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

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 often based on retained catches rather than total catches, and so if discarding is high then this is a major source of error where discards are not reported. 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.

1. **Catch-and-Effort data from gillnet fisheries:**
   - Driftnet fishery of Taiwan,China (1982–92): Catch-and-effort data does not include catches of sharks by species.
   - Drifting gillnet fisheries of I.R. Iran and Pakistan: To date, I.R.Iran and Pakistan have not reported time-area catches of sharks, by species, for the gillnet fisheries, although both CPCs are now providing nominal 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.
   - 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 and Yemen: to date, these countries have not provided detailed catches of sharks to the IOTC.

4. Discard levels from surface and longline fisheries:

- Discard levels of sharks from major longline fisheries: to date the EU (Spain, UK), Japan, Taiwan,China and Indonesia, have not provided estimates of total discards of sharks, by species, although all are now 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, although EU, Spain and Seychelles are now reporting discards in their observer data.

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.
- 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 has 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 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. 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.

1. Incidental catches of SEABIRDS:

- Longline fisheries operating in areas with high densities of seabirds. Seychelles, Malaysia and Mauritius 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 reported 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 a number of CPCs have been mentioned specifically here as they have important fisheries or have not provided any information, 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 (as required by Resolution 12/06) and not providing an estimation of the total mortality of marine turtles incidentally caught in their fisheries (as required by Resolution 12/04).

Extract from IOTC–2018–WPEB14–07

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

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[10] for which data on IOTC species are available, by fishery, species of shark, and year, for the period 1950–2017.

- 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 1950–2015 and 2010–2015 are shown in columns ***All*** and ***Last***, respectively.

[10] The definition of fleets has changed since the previous report. Previously a fleet fishing in two areas were considered as two separate fleets, whereas here they are considered as one.

Extract from IOTC–2018–WPEB14–08

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

APPENDIX VII
IMPLEMENTATION OF THE REGIONAL OBSERVER SCHEME

(Updated September 2018)

CPCs	Vessels on active list (2017)				List of registered observers submitted	Number of observer reports provided							
	LL	PS	GN	BB		2010	2011	2012	2013	2014	2015	2016	2017
MEMBERS													
Australia	3	7		1	YES: 21	2(O)	1(O)	3(O)	No	2(O) + 4(E)	11(E)	28(E)	No
China	81				YES: 8	1(O)	No	1(O)	1(O)	2(O)	1(O)	4(O)	4(O)
–Taiwan,China	314				YES: 54	No	No	1(O)	19(O)	18(O)	26(O)	18(O)	12(O)
Comoros					YES: 7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Eritrea	No information received				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
European Union	17	12			YES: EU,France: 64	FRA 6(O)	FRA 12(O)	FRA 17 (O)	FRA 89(E)	FRA 94(E)	FRA 109(E)	FRA 106(E)	FRA 119(E)
		1			No: EU,Italy	N/A	N/A	N/A	N/A	N/A	ITA 6(O)	ITA 4(O)	No
	5				YES: EU,Portugal: 5	No	PRT 1(O)	PRT 1(O)	PRT 1(O)	PRT 1(O)	PRT 1(O)	PRT 1(O)	PRT 1(E)
	13	14			YES: EU,Spain : 9	No	No	No	ESP 1(O)	ESP 2(O)	ESP 23(E)	ESP 15(E)	ESP 19(E)
	2				YES: EU,UK 1	No	No	No	No	No	No	No	GBR 2(E)
France (OT)					N/A	No	9(O)	7(O)	7(O)	NA	NA	NA	NA
Guinea					N/A	N/A	N/A	N/A	N/A	N/A	N/A	NA	NA
India					No	No	No	No	No	No	No	No	No
Indonesia	216	30			YES:9	No	No	No	No	5(E)	No	7(E)	No
Iran, Isl. Rep. of		3	1232		No	No	No	No	No	No	No	No	No
Japan	39	2			YES: 19	pending	pending	pending	pending	pending	pending	pending	pending
Kenya	1				YES: 5	No	N/A	N/A	N/A	N/A	N/A	1(E)	No
Korea, Rep. of	15	3			YES: 40	2(O)	No	2(O)	3(O)	3(O)	4(O)	11(O)	4(O)

Madagascar	7				YES: 7	No	No	18(O)	7+1(O)	2+5(O)	No	No	No
Malaysia	19				No	No	No	No	No	No	No	No	No
Maldives	44			356	YES: 4	No	No	No	No	No	No	No	No
Mauritius	5	2			YES: 8	No	No	No	No	No	5(O)	8(O+E)	4(O)
Mozambique	2				YES: 11	No	No	1(O)	N/A	No	7(E)	3(E)	No
Oman	1				No	No	No	No	No	No	No	No	No
Pakistan					No	No	No	No	No	No	No	No	No
Philippines	2				No	No	No	No	No	No	N/A	N/A	No
Seychelles	58	13			YES: 78	No	No	No	No	6(O)	46(O)	47(O)	4(O)
Sierra Leone	No information received				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Somalia	No information received				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
South Africa	14			3	YES: 25	pending	pending	pending	pending	pending	pending	pending	pending
Sri Lanka	2		1372		No	No	No	No	No	2(O)	2(O)	No	2(O)
Sudan	No information received				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tanzania, United Rep.of					No	No	No	No	No	No	No	1(O)	No
Thailand		1			YES: 18	No	No	No	No	No	No	No	No
United Kingdom (OT)					N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Yemen	No information received				No	No	No	No	No	No	No	No	No
COOPERATING NON-CONTRACTING PARTIES													
Bangladesh					N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Liberia					N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Senegal					N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Year = year in which the observed trip began (E:Electronic, O:Other)
Reports from Madagascar include observers onboard foreign vessels
Totals for Japan and South Africa will be provided once agreement has been reached about the Joint Venture Agreement vessels

APPENDIX VIII

2018: 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

(*updated September 2018*)

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.
China		–		–			**Sharks:** China is currently considering developing an NPOA for sharks. **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:** Wildlife Protection Act introduced in 2013, Protected Wildlife shall not be disturbed, abused, hunted, killed, traded, exhibited, displayed, owned, imported, exported, raised or bred, unless under special circumstances recognized in this or related legislation. *Cheloniidae spp*., *Caretta Caretta*, *Chelonia mydas*, *Eretmochelys imbricate*, *Lepidochelys olivacea* and *Dermochelys coriacea* are listed into List of Protected Species. Domestic Fisheries Management Regulation on Far Sea Fisheries request all fishing vessels have to carry line cutters ,de-hookers and hauling net in order to facilitate the appropriate handling and prompt release of marine turtles caught or entangled.
Comoros		–		–			**Sharks:** Shark fishing is prohibited **Seabirds:** There is no fleet in operation south of 25 degrees south. **Marine turtles:** According to the Comoros Fisheries Code Article 78, fishing, capture, possession and marketing of turtle and marine mammals or of protected aquatic organisms is strictly forbidden in accordance with national legislation in force and International Conventions applicable to the Comoros.

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		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:** 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:** Indonesia has established an NPOA for sharks and rays in 2015-2019 **Seabirds:** An NPOA was finalized in 2016 **Marine turtles:** Indonesia has established an NPOA for Marine Turtles but this does not fully conform with FAO guidelines. Indonesia has also been implementing Ministerial Regulation 12/2012 regarding captured fishing business on high seas to reduce turtle bycatch.
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 (Revised in 2016) **Seabirds:** NPOA–Seabird implementation report submitted to COFI in July 2012 (Revised in 2016) **Marine turtles:** All Japanese fleets fully implement Resolution 12/04.
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. Preliminary meetings have been held and there are plans to finalise the NPOA by 2017. **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		2014 – domestic fisheries		–	**Sharks:** Currently being implemented. **Seabirds:** This has already been applied in domestic fisheries and there are plans to submit an IPOA-seabirds to FAO by the end of 2018. **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:** There is zero capture of marine turtle recorded in logbooks. All longliners use circle hooks. This has been confirmed by onboard observers and port samplers.

Malaysia		2008 2014		–		2008	**Sharks:** A revised NPOA-sharks was published in 2014. **Seabirds:** To be developed **Marine turtles:** A NPOA For Conservation and Management of Sea Turtles had been published in 2008. A revision will be published in 2017.
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		2016					**Sharks:** The NPOA-sharks has been finalised; it focuses on actions needed to exercise influence on foreign fishing through the IOTC process and licence conditions, as well as improving the national legislation and the skills and data handling systems available for managing sharks. **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:** 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 the NPOA-Shark started in 2016. At this stage, a baseline assessment was performed and the relevant information of coastal, pelagic and demersal shark species along the Mozambican coast was gathered. The ongoing process is expected to be completed by the end of 2018. **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:** An NPOA-sharks is currently being drafted and is due to be finalized in 2017 **Seabirds:** Not yet initiated. **Marine turtles:** The law does not allow the catch of sea turtles, and the fishermen are requested to release any hooked or entangled turtle. The longline fleet are required to carry out the line cutters and de-hookers.

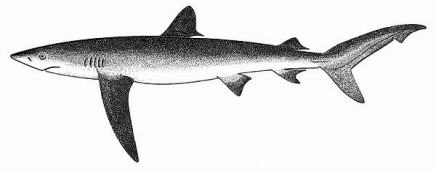
Pakistan							**Sharks:** Sharks are landed with the fins attached and each and every part of the body of sharks are utilised. A stakeholder consultation workshop was conducted from 28-30 March 2016 to review the actions of the draft NPOA - Sharks. The draft NPOA was circulated to the key stakeholders and comments were received with an end-date of 30 June 2016. The final version of the NPOA - Sharks has been submitted to the provincial fisheries departments for endorsement. Meanwhile, the provincial fisheries departments have passed notification on catch, trade and/or retention of sharks including Thresher sharks, hammerheads, oceanic whitetip, whale sharks, guitarfishes, sawfishes, wedgefishes and mobulids. **Seabirds:** Pakistan considers that seabird interactions are not a problem for the Pakistani fishing fleet as the 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. **Marine turtles:** No information received by the Secretariat.
Seychelles, Republic of		Apr-2007		–			**Sharks:** Seychelles has developed and is implementing a new NPOA for Sharks for years 2016-2020 **Seabirds:** SFA is collaborating with Birdlife South Africa to develop an NPOA for sea bird. A consultant will be recruited to start development in December 2017 **Marine turtles:** An NPOA for turtles is planned to start in 2018.
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:** The Somali national fisheries law and legislation was reviewed and approved in 2014. This incudes Articles on the protection of marine turtles. Further review of the National Law is underway to harmonize this with IOTC Resolutions and is expected to be presented to the new parliament for endorsement in 2017.

South Africa, Republic of		–		2008			**Sharks**: The NPOA-sharks was approved and published in 2013. **Seabirds**: Published in August 2008 and fully implemented. The NPOA-seabirds has been earmarked for review. **Marine turtles**: The South African permit conditions for the large pelagic longline fishery prohibits landing of turtles. All interactions with turtles are recorded, by species, within logbooks and in observer reports, including data on release condition. Vessels are required to carry a de-hooker on board and instructions on turtle handling and release in line with the FAO guidelines are included in the South African Large Pelagic permit conditions. All turtle interactions in respective areas of competence are reported to the respective RFMOs. Recent South African led studies on impact of marine debris on turtles have been published in the scientific literature (Ryan et al. 2016). Marine turtle nesting sites in South Africa are protected by coastal MPAs since 1963.
Sri Lanka							**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 been provided to the WPEB and SC for approval. **Marine turtles:** Implementation of the FAO Guideline to Reduce Sea Turtle Mortality in Fishing Operation in 2015 was submitted to IOTC in January 2016. Marine turtles are legally protected in Sri Lanka. Longliner vessels are required to have dehookers for removal of hooks and a line cutter on board, to release the caught marine turtles. Gillnets longer than 2.5 km are now prohibited in domestic legislation. Reporting of bycatch has made legally mandatory and facilitated via logbooks.
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:** Sea turtles are protected by law. However as there is a national turtle and Dugong conservation committee that oversee all issues related to sea turtles and dugongs. There is no information so far with regards to interaction between sea turtles and long line fishery.
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).
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.
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.

APPENDIX IX
EXECUTIVE 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[11]	Indicators		2018 stock status determination
Indian Ocean	Reported catch 2017:	27,259 t	**72.6%**
	Estimated catch 2015:	54,735 t	
	Not elsewhere included (nei) sharks[12] 2017:	56,883 t	
	Average reported catch 2013-17:	29,790 t	
	Average estimated catch 2011–15:	54,993 t	
	Ave. not elsewhere included (nei) sharks[2] 2012-16:	51,712 t	
	MSY (1,000 t) (80% CI)[3]:	33.0 (29.5 - 36.6)	
	F_{MSY} (80% CI) [3]:	0.30 (0.30 - 0.31)	
	SB_{MSY} (1,000 t) (80% CI) [3,4]:	39.7 (35.5 - 45.4)	
	F_{2015}/F_{MSY} (80% CI) [3]:	0.86 (0.67 - 1.09)	
	SB_{2015}/SB_{MSY} (80% CI) [3]:	1.54 (1.37 - 1.72)	
	SB_{2015}/SB_0 (80% CI) [3]:	0.52 (0.46 - 0.56)	

[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 (i.e., SHK: sharks various nei; RSK: requiem sharks nei).
[3]Estimates refer to the base case model using estimated catches.
[4]Refers to fecund stock biomass

Colour key	Stock overfished ($SB_{2015}/SB_{MSY}< 1$)	Stock not overfished ($SB_{2015}/SB_{MSY}\geq 1$)
Stock subject to overfishing($F_{2015}/F_{MSY}> 1$)	0%	27.4%
Stock not subject to overfishing ($F_{2015}/F_{MSY}\leq 1$)	0%	72.6%
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[3]		
		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

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

Sources: IUCN 2007, Stevens 2009

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. Considerable progress was made since the last Indian Ocean blue shark assessment on the integration of new data sources and modelling approaches. Uncertainty in data inputs and model configuration were explored through sensitivity analysis. Four stock assessment models were applied to the blue shark in 2017, specifically a data-limited catch only model (SRA), two Bayesian biomass dynamic models (JABBA with process error and a Pella-Tomlinson production model without process error) and an integrated age-structured model (SS3) (Fig. 1). All models produced similar results suggesting the stock is currently not overfished nor subject to overfishing, but with the trajectories showing consistent trends towards the overfished and subject to overfishing quadrant of the Kobe plot (Fig 1). A base

case model was selected based on the best Indian Ocean biological data, consistency of CPUE standardized relative abundance series, model fits and spatial extent of the data (Fig. 1, Table 1). The major change in biological parameters since the previous stock assessment is the stock recruitment relationship, i.e., steepness = 0.79 due to the update of the key biological parameters calculated specific to the Indian Ocean. The major axes of uncertainties identified in the current model are catches and CPUE indices of abundance. Model results were explored with respect to their sensitivity to the major axes of uncertainty identified. If the alternative CPUE groupings were used then the stock status was somewhat more positive (B>>Bmsy and F<<Fmsy), while if the alternative catch series (trade and EUPOA) were used then the estimated stock status resulted in F>Fmsy. The ecological risk assessment (ERA) conducted for the Indian Ocean by the WPEB and SC in 2012[13] 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 live until at least 25 years, mature at 4–6 years, and have 25–50 pups every year – they are considered to be the most productive of the pelagic sharks. On the weight-of-evidence available in 2017, the stock status is determined to be not overfished and not subject to overfishing (Table 1).

Outlook. Increasing effort could result in declines in biomass. The Kobe II Strategy Matrix (Table 3) provides the probability of exceeding reference levels in the short (3 years) and long term (10 years) given a range of percentage changes in catch.

Management advice. Even though the blue shark in 2017 was assessed to be not overfished nor subject to overfishing, maintaining current catches is likely to result in decreasing biomass and the stock becoming overfished and subject to overfishing in the near future (Table 3). If the catches are reduced at least 10%, the probability of maintaining stock biomass above MSY reference levels ($B>B_{MSY}$) over the next 8 years will be increased (Table 3). The stock should be closely monitored. While mechanisms exist for encouraging CPCs to comply with their recording and reporting requirements (Resolution 16/06), these need to be further implemented by the Commission, so as to better inform scientific advice in the future.

The following key points should also be noted:

- **Maximum Sustainable Yield (MSY)**: estimate for the Indian Ocean stock is 33,000 t.
- **Reference points**: The Commission has not adopted reference points or harvest control rules for any shark species.
- **Main fishing gear** (2013–17): Coastal longline; longline targeting swordfish; longline (deep-freezing).
- **Main fleets** (2013–17): Indonesia; EU,Spain; Taiwan, China; Japan; EU,Portugal.

[13] Murua et al., 2012.

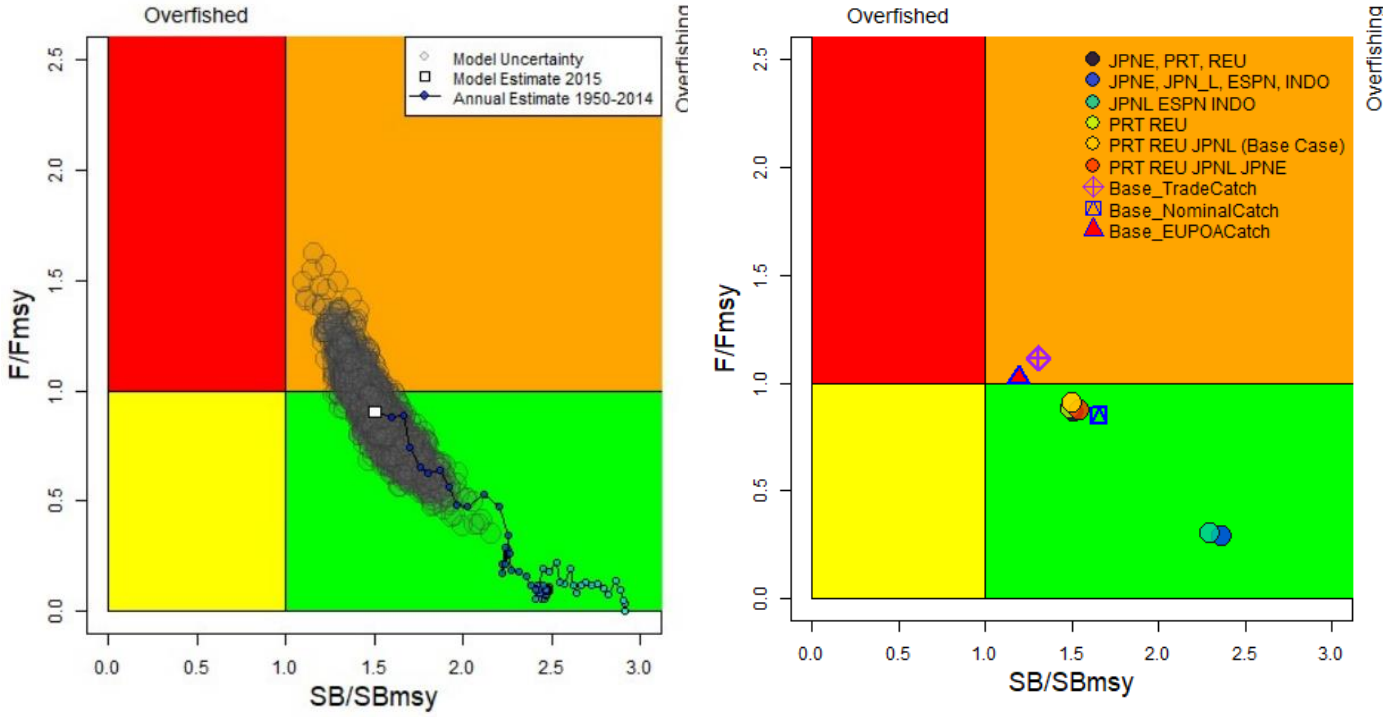


Fig. 1. Blue shark: Aggregated Indian Ocean stock assessment Kobe plot for the 2017 estimate based on the base case model and a range of sensitivity models explored with several catch reconstructions and fits to CPUE series. (Left panel: base case model with trajectory and MCMC uncertainties in the terminal year; Right panel: terminal year estimates of the sensitivity model runs). All models shown are run using SS3 - Stock Synthesis III.

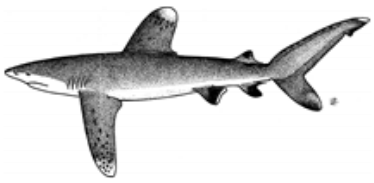
TABLE 3. Blue shark: Aggregated Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of violating the MSY-based reference points for nine constant catch projections using the base case model (catch level from 2015* (54,735t), ± 10%, ± 20%, ± 30% and ± 40%) projected for 3 and 10 years.

Reference point and projection time frame	**Alternative catch projections (relative to the catch level* from 2015) and probability (%) of violating MSY-based reference points**								
Catch Relative to 2015	60%	70%	80%	90%	100%	110%	120%	130%	140%
Catch (t)	(32,841)	(38,315)	(43,788)	(49,262)	(54,735)	(60,209)	(65,682)	(71,156)	(76,629)
$B_{2018} < B_{MSY}$	0%	0%	0%	0%	0%	0%	1%	1%	3%
$F_{2018} > F_{MSY}$	0%	1%	7%	25%	49%	69%	83%	91%	95%
$B_{2025} < B_{MSY}$	0%	1%	8%	25%	48%	68%	82%	89%	92%
$F_{2025} > F_{MSY}$	0%	7%	35%	67%	87%	95%	97%	94%	90%

*: average catch level and respective % changes refer to the estimated catch series used in the final base case model (IOTC-2017-WPEB13-23)

APPENDIX X
EXECUTIVE 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		2018 stock status determination
Indian Ocean	Reported catch 2017: Not elsewhere included (nei) sharks[2] 2017: Average reported catch 2013-17: Av. not elsewhere included 2013-2017 (nei) sharks[2]:	48 t 56,883 t 230 t 51,712 t	
	MSY (1,000 t) (80% CI): F_{MSY} (80% CI): SB_{MSY} (1,000 t) (80% CI): $F_{current}/F_{MSY}$ (80% CI): $SB_{current}/SB_{MSY}$ (80% CI): $SB_{current}/SB_0$ (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(i.e., SHK: sharks various nei; RSK: requiem sharks nei)

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

Common name	Scientific name	IUCN threat status[3]		
		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

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

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[14] 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 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

[14] Murua et al., 2012.

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 to the gear. 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 limited amount of data, recent studies (Tolotti et al., 2016) suggest that oceanic whitetip shark abundance has declined in recent years (2000 - 2015) compared with historic years (1986 - 1999). Available pelagic longline standardised CPUE indices from Japan and EU,Spain indicate conflicting trends as discussed in the IOTC Supporting Information 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 **unknown** (Table 1).

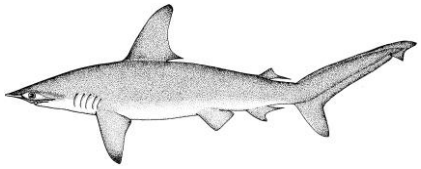
Outlook. Maintaining or increasing effort with associated fishing mortality can result in declines in biomass, productivity and CPUE. Piracy in the western Indian Ocean resulted in the displacement and subsequent concentration of a substantial portion of longline fishing effort into certain areas in the southern and eastern Indian Ocean. Some longline vessels have returned to their traditional fishing areas in the northwest Indian Ocean, due to the increased security onboard vessels, with the exception of the Japanese fleet which has still not returned to the levels seen before the start of the piracy threat. It is therefore unlikely that catch and effort on oceanic whitetip sharks declined in the southern and eastern areas, and may have resulted in localised depletion there.

Management advice. A cautious approach to the management of oceanic whitetip shark should be considered by the Commission, noting that recent studies suggest that longline mortality at haulback is high (50%) in the Indian Ocean (IOTC-2016-WPEB12-26), while mortality rates for interactions with other gear types such as purse seines and gillnets may be higher. While mechanisms exist for encouraging CPCs to comply with their recording and reporting requirements (Resolution 16/06), these need to be further implemented by the Commission, so as to better inform scientific advice. 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.
The following key points should be also noted:

- **Maximum Sustainable Yield (MSY)**: Not applicable. Retention prohibited.
- **Reference points**: Not applicable.
- **Main fishing gear** (2013-17): Gillnet; gillnet-longline.
- **Main fleets** (2013-2017): Comoros; I.R. Iran; Sri Lanka; India; and Maldives; (Reported as discarded/released alive by China, Maldives, Korea, France, Mauritius, Australia, South Africa, Sri Lanka, Japan).

APPENDIX XI
EXECUTIVE 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		2018 stock status determination
Indian Ocean	Reported catch 2017: Not elsewhere included (nei) sharks[2]2017: Average reported catch 2013-17: Av. not elsewhere included (nei) sharks[2] 2013-2017:	118 t 56,883 t 76 t 51,712 t	
	MSY (1,000 t) (80% CI): F_{MSY} (80% CI): SB_{MSY} (1,000 t) (80% CI): $F_{current}/F_{MSY}$ (80% CI): $SB_{current}/SB_{MSY}$ (80% CI): $SB_{current}/SB_0$ (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 (i.e., SHK: sharks various nei; RSK: requiem sharks nei).

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[3]		
		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

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

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[15] 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 to be 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

[15] Murua et al., 2012

commonly taken by a range of fisheries in the Indian Ocean. They are extremely vulnerable to gillnet fisheries. Furthermore, pups occupy shallow coastal nursery grounds, often heavily exploited by inshore fisheries. Because of their life history characteristics – they are relatively long lived (over 30 years), and have relativity few offspring (<31 pups each year), the scalloped hammerhead shark is vulnerable to overfishing. 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 **unknown** (Table 1).

Outlook. Maintaining or increasing effort can result in declines in biomass and productivity. 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. Some longline vessels have returned to their traditional fishing areas in the northwest Indian Ocean, due to the increased security onboard vessels, with the exception of the Japanese fleet which has still not returned to the levels seen before the start of the piracy threat. It is therefore unlikely that catch and effort on scalloped hammerhead shark declined in the southern and eastern areas during this time period, and may have resulted in localised depletion there.

Management advice. Despite the absence of stock assessment information, the Commission should consider taking a cautious approach by implementing some management actions for scalloped hammerhead sharks. While mechanisms exist for encouraging CPCs to comply with their recording and reporting requirements (Resolution 16/06), these need to be further implemented by the Commission 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** (2013-2017): Ringnet, Gillnet, longline (fresh), longline-coastal.
- **Main fleets** (2013-17): Sri Lanka; Seychelles; NEI-Fresh (report as released alive/discarded by EU-France, South Africa, Indonesia, Japan).

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APPENDIX XII
EXECUTIVE 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		2018 stock status determination
Indian Ocean	Reported catch 2017: Not elsewhere included (nei) sharks[2] 2017: Average reported catch 2013-17: Av. not elsewhere included (nei) sharks[2] 2013-17:	1,664 t 56,883 t 1,555 t 51,712 t	
	MSY (1,000 t) (80% CI): F_{MSY} (80% CI): SB_{MSY} (1,000 t) (80% CI): $F_{current}/F_{MSY}$ (80% CI): $SB_{current}/SB_{MSY}$ (80% CI): $SB_{current}/SB_0$ (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 (i.e., SHK: sharks various nei; RSK: requiem sharks nei).

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[3]		
		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

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

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[16] 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 has a high susceptibility to longline gear. Shortfin mako sharks were estimated to be the third most vulnerable shark species in the ERA ranking for purse seine gear, but had lower levels of vulnerability than to longline gear, because of the lower susceptibility of the species to 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

[16] Murua et al., 2012

standardised CPUE series suggest that the biomass has declined from 1999 to 2004, and has been increasing since then (see IOTC Supporting Information). 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 to overfishing. There is no quantitative stock assessment currently available for shortfin mako shark in the Indian Ocean therefore the stock status is **unknown**.

Outlook. Maintaining or increasing effort can result in declines in biomass, productivity and CPUE. 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. Some longline vessels have returned to their traditional fishing areas in the northwest Indian Ocean, due to the increased security onboard vessels, with the exception of the Japanese fleet which has still not returned to the levels seen before the start of the piracy threat. It is therefore unlikely that catch and effort on shortfin mako shark has declined in the southern and eastern areas, and may have resulted in localised depletion there.

Management advice. Despite the absence of stock assessment information, the Commission should consider taking a cautious approach by implementing some management actions for shortfin mako sharks. While mechanisms exist for encouraging CPCs to comply with their recording and reporting requirements (Resolution 16/06), these need to be further implemented by the Commission 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** (2013-17): Longline targeting swordfish; longline (fresh); longline (targeting sharks); gillnet.
- **Main fleets** (2013-17): EU,Spain; South Africa; EU,Portugal; Japan, Iran, China, Sri Lanka, (Reported as discarded/released alive: Australia, EU-France, Indonesia, Japan, Korea, South Africa).

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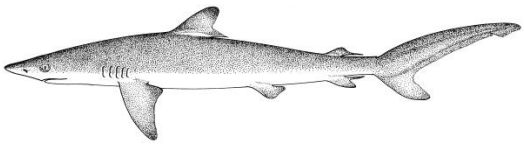
Murua H, Coelho, R., Santos, M.N., Arrizabalaga, H., Yokawa, K., Romanov, E., Zhu, J.F., Kim, Z.G., Back, P., Chavance, P., Delgado de Molina and Ruiz, J. (2012). Preliminary Ecological Risk Assessment (ERA) for shark species caught in fisheries managed by the Indian Ocean Tuna Commission (IOTC). IOTC–2012–SC15–INF10 Rev_1.

APPENDIX XIII
EXECUTIVE SUMMARY: SILKY SHARK



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		2018 stock status determination
Indian Ocean	Reported catch 2017: Not elsewhere included (nei) sharks[2] 2017: Average reported catch 2013-17: Av. not elsewhere included (nei) sharks[2] 2013-17:	2,175 t 56,883 t 2,967 t 51,712 t	
	MSY (1,000 t) (80% CI): F_{MSY} (80% CI): SB_{MSY} (1,000 t) (80% CI): $F_{current}/F_{MSY}$ (80% CI): $SB_{current}/SB_{MSY}$ (80% CI): $SB_{current}/SB_0$ (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 (i.e., SHK: sharks various nei; RSK: requiem sharks nei).

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

Common name	Scientific name	IUCN threat status[3]		
		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

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

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[17] 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 to be one of the least productive shark species, and with a high susceptibility to longline gear. Silky shark was estimated to be the second most vulnerable shark species in the ERA ranking for purse seine gear, due to its low productivity and high susceptibility to purse seine gear. The current IUCN threat status of 'Near Threatened' applies to silky shark in the western and eastern Indian Ocean

[17] Murua et al., 2012.

and globally (Table 2). There is a paucity of information available on this species but several 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 are described in the IOTC Supporting Information 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 **unknown**.

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. Some longline vessels have returned to their traditional fishing areas in the northwest Indian Ocean, due to the increased security onboard vessels, with the exception of the Japanese fleet which has still not returned to the levels seen before the start of the piracy threat. It is therefore unlikely that catch and effort on silky shark has declined in the southern and eastern areas, and may have resulted in localised depletion there.

Management advice. Despite the absence of stock assessment information, the Commission should consider taking a cautious approach by implementing some management actions for silky sharks. While mechanisms exist for encouraging CPCs to comply with their recording and reporting requirements (Resolution 16/06), these need to be further implemented by the Commission 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** (2013-17): Gillnet; longline (fresh), longline-coastal, longline (deep-freezing)
- **Main fleets** (2013-17): Sri Lanka; I.R. Iran; Taiwan,China.

APPENDIX XIV
EXECUTIVE 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		2018 stock status determination
Indian Ocean	Reported catch 2017: Not elsewhere included (nei) sharks[2] 2017: Average reported catch 2013–17: Av. not elsewhere included (nei) sharks[2] 2013–17:	0 t 56,883 t 0 t 51,712 t	
	MSY (1,000 t) (80% CI): F_{MSY} (80% CI): SB_{MSY} (1,000 t) (80% CI): $F_{current}/F_{MSY}$ (80% CI): $SB_{current}/SB_{MSY}$ (80% CI): $SB_{current}/SB_0$ (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 (i.e., SHK: sharks various nei; RSK: requiem sharks nei).

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[3]		
		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

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

Sources: IUCN 2007, Amorim et al. 2009

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[18] 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 to 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 thresher sharks are commonly taken by a range

[18] Murua et al., 2012.

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 has been no quantitative stock assessment and limited basic fishery indicators are available for bigeye thresher shark in the Indian Ocean. Therefore the stock status is **unknown**.

Outlook. Current longline fishing effort is directed at other species, however, bigeye thresher sharks are commonly taken as bycatch in these fisheries. Hooking mortality is apparently very high, therefore IOTC Resolution 12/09 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 and a reluctance of fishing fleets to report information on discards/non-retained catch. Piracy in the western Indian Ocean 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. Some longline vessels have returned to their traditional fishing areas in the northwest Indian Ocean, due to the increased security onboard vessels, with the exception of the Japanese fleet which has still not returned to the levels seen before the start of the piracy threat. It is therefore unlikely that catch and effort on bigeye thresher shark declined in the southern and eastern areas over that time period, potentially resulting in localised depletion.

Management advice. The prohibition on retention of bigeye thresher shark should be maintained. While mechanisms exist for encouraging CPCs to comply with their recording and reporting requirements (Resolution 16/06), these need to be further implemented by the Commission, so as to better inform scientific advice. 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[19].

The following key points should also be noted:

- **Maximum Sustainable Yield (MSY)**: Not applicable. Retention prohibited.
- **Reference points**: Not applicable.
- **Main fishing gear** (2013–17): ~~Gillnet-longline; longline-gillnet~~. No report after 2012. Or can mention overall reported gear.
- **Main fleets** (2013–17): ~~Sri Lanka~~ (reported as discarded/released alive: South Africa, Sri Lanka, Japan, Korea, EUFRA, Indonesia).

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Murua H, Coelho, R., Santos, M.N., Arrizabalaga, H., Yokawa, K., Romanov, E., Zhu, J.F., Kim, Z.G., Back, P., Chavance, P., Delgado de Molina and Ruiz, J. (2012). Preliminary Ecological Risk Assessment (ERA) for shark species caught in fisheries managed by the Indian Ocean Tuna Commission (IOTC). IOTC–2012–SC15–INF10 Rev_1

[19]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).

APPENDIX XV
EXECUTIVE 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		2018 stock status determination
Indian Ocean	Reported catch 2017: Not elsewhere included (nei) sharks[2] 2017: Average reported catch 2013-17: Av. not elsewhere included (nei) sharks[2] 2013-17:	0 t 56,883 t 0 t 51,712 t	
	MSY (1,000 t) (80% CI): F_{MSY} (80% CI): SB_{MSY} (1,000 t) (80% CI): $F_{current}/F_{MSY}$ (80% CI): $SB_{current}/SB_{MSY}$ (80% CI): $SB_{current}/SB_0$ (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 (i.e., SHK: sharks various nei; RSK: requiem sharks nei).

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[3]		
		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

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

Sources: IUCN 2007, Reardon et al. 2009

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 (Table 1). The ecological risk assessment (ERA) conducted for the Indian Ocean by the WPEB and SC in 2012[20] consisted of a semi-quantitative analysis to evaluate the resilience of shark species to the impact of a given fishery, by combining the biological productivity of the species and susceptibility to each fishing gear type. Pelagic thresher shark received a high vulnerability ranking (No. 3) in the ERA 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 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

[20] Murua et al., 2012

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 are currently available for pelagic thresher shark in the Indian Ocean. Therefore the stock status is **unknown.**

Outlook. Current longline fishing effort is directed at other species, however, pelagic thresher sharks are commonly taken as bycatch in these fisheries. Hooking mortality is apparently very high, therefore IOTC Resolution 12/09 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, and a reluctance of fishing fleets to report information on discards/non-retained catch. Piracy in the western Indian Ocean 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. Some longline vessels have returned to their traditional fishing areas in the northwest Indian Ocean, due to the increased security onboard vessels, with the exception of the Japanese fleet which has still not returned to the levels seen before the start of the piracy threat. It is therefore unlikely that catch and effort on pelagic thresher shark declined in the southern and eastern areas over that time period, potentially resulting in localised depletion there.

Management advice. The prohibition on the retention of pelagic thresher shark should be maintained. While mechanisms exist for encouraging CPCs to comply with their recording and reporting requirements (Resolution 16/06), these need to be further implemented by the Commission s, so as to better inform scientific advice. 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[21].

The following key points should also be noted:

- **Maximum Sustainable Yield (MSY)**: Not applicable. Retention prohibited.
- **Reference points**: Not applicable.
- **Main fishing gear** (2013-17): ~~Gillnet-longline; longline-gillnet~~.
- **Main fleets** (2013-17): Sri Lanka (reported as discarded/released alive: Japan, Korea, Sri Lanka, South Africa, Indonesia).

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Murua H, Coelho, R., Santos, M.N., Arrizabalaga, H., Yokawa, K., Romanov, E., Zhu, J.F., Kim, Z.G., Back, P., Chavance, P., Delgado de Molina and Ruiz, J. (2012). Preliminary Ecological Risk Assessment (ERA) for shark species caught in fisheries managed by the Indian Ocean Tuna Commission (IOTC). IOTC–2012–SC15–INF10 Rev_1.

[21]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).

APPENDIX XVI
EXECUTIVE 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[22]
Flatback turtle	*Natator depressus*	Data deficient
Green turtle	*Chelonia mydas*	Endangered
Hawksbill turtle	*Eretmochelys imbricata*	Critically Endangered
Leatherback turtle	*Dermochelys coriacea*	
	(N. East Indian Ocean subpopulation)	Data deficient
	(S. West Indian Ocean subpopulation)	Critically Endangered
Loggerhead turtle	*Caretta caretta*	
	(N. West Indian Ocean subpopulation)	Critically Endangered
	(S. East Indian Ocean subpopulation)	Near Threatened
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 relatively recent Ecological Risk Assessment (ERA)[23], and an order of magnitude higher than longline and purse seine gears for which mitigation measures are in place. Stock assessments of all species of marine turtles in the Indian Ocean are limited due to data insufficiencies as well as limited data quality[24]. Bycatch and mortality from gillnet fisheries has greater population-level impacts on marine turtles relative to other gear types, such as longline, purse seine and trawl fisheries in the Indian Ocean[25]. Population levels of impacts of leatherback turtles caught in longline gear in the Southwest Indian Ocean were also identified as a conservation priority.

[22] IUCN, 2017. The process of the threat assessment from IUCN is independent from the IOTC and is presented for information purpose only

[23] R. Nel, R.M. Wanless, A. Angel, B. Mellet & L. Harris, 2013. Ecological Risk Assessment and Productivity - Susceptibility Analysis of sea turtles overlapping with fisheries in the IOTC regionIOTC–2013–WPEB09–23

[24] Wallace BP, DiMatteo AD, Bolten AB, Chaloupka MY, Hutchinson BJ, et al. (2011) Global Conservation Priorities for Marine Turtles. PLoS ONE 6(9): e24510. doi:10.1371/journal.pone.0024510

[25] Wallace, B. P., C. Y. Kot, A. D. DiMatteo, T. Lee, L. B. Crowder, and R. L. Lewison. 2013. Impacts of fisheries bycatch on marine turtle populations worldwide: toward conservation and research priorities. Ecosphere 4(3):40. http:// dx.doi.org/10.1890/ES12-00388.1 (figure 13)

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 will increase as fishing pressure increases, and that the status of the marine turtle populations will continue to worsen due to other factors such as an increase in fishing pressure from other fisheries or anthropological or climatic impacts.

The following should also be noted:

- The available evidence indicates considerable risk to marine turtles in the Indian Ocean.
- Given the high mortality rates associated with marine turtle interactions with gillnet fisheries and the increasing use of gillnets in the Indian Ocean[26] there is a need to both assess and mitigate impacts on threatened and endangered marine turtle populations.
- The primary sources of data that drive the ability of the WPEB to determine a status for the Indian Ocean, total interactions by fishing vessels or in net fisheries, are highly uncertain and should be addressed as a matter of priority.
- Current reported interactions are known to be a severe underestimate.
- The Ecological Risk Assessment[2] estimated that ~3,500 and ~250 marine turtles are caught by longline and purse seine vessels, respectively, per annum, with an estimated 75% of turtles released alive[27]. The ERA 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, leatherback and olive Ridley turtles are caught in varying proportions depending on the region, season and type of fishing gear.
- Maintaining or increasing fishing effort in the Indian Ocean without appropriate mitigation measures in place, will likely result in further declines in marine turtle populations.
- Efforts should be undertaken to encourage CPCs to investigate means to reduce marine turtle bycatch and mortality in IOTC fisheries.
- That appropriate mechanisms are developed by the Compliance Committee to ensure CPCs comply with their data collection and reporting requirements for marine turtles.

[26] IOTC-2017-WPEB13-18

[27] Bourjea et al. 2014

APPENDIX XVII
EXECUTIVE 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[28]
Albatross		
Atlantic Yellow-nosed Albatross	*Thalassarche chlororynchos*	Endangered
Black-browed albatross	*Thalassarche melanophris*	Near Threatened
Indian yellow-nosed albatross	*Thalassarche carteri*	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. Following a data call in 2016, the IOTC Secretariat received seabird bycatch data from 6 CPCs, out of the 15 with reported or expected longline effort South of 25ºS (IOTC-2016-SC19-INF02). Due to the lack of data submissions from other CPCs, and the limited information provided on the use of seabird bycatch mitigations, it has not yet been possible to undertake an assessment for seabirds. 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 the IUCN threat status for all birds is currently being re-assessed; this process is expected to be completed by the end of 2016. 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.

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

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 Resolution 12/06 and the frequency of use of each of the 3 measures (because vessels can choose two out of three possible options) are still poorly known. 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. Following the data call in 2016 it was possible to carry out a preliminary and qualitative analysis. The information provided suggests higher sea bird catch rates at higher latitudes, even within the area south of 25°S, and higher catch rates in the coastal areas in the eastern and western parts of the southern Indian Ocean. In terms of mitigation measures, the preliminary information available suggests that those currently in use (Resolution 12/06) may be proving effective in some cases, but there are also some conflicting aspects that need to be explored further. 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 fully address this issue.

The following should also 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
EXECUTIVE SUMMARY: CETACEANS

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

Status of cetaceans in the Indian Ocean

TABLE 1. Cetaceans: IUCN Red List status and records of interaction (including entanglements and, for purse seines, encirclements) with tuna fishery gear types for all cetacean species that occur within the IOTC area of competence.

Family	Common name	Species	IUCN Red List status	Interactions by Gear Type*
Balaenidae	Southern right whale	*Eubalaena australis*	LC	GN
Neobalaenidae	Pygmy right whale	*Caperea marginata*	DD	-
Balaenopteridae	Common minke whale	*Balaenoptera acutorostrata*	LC	-
	Antarctic minke whale	*Balaenoptera bonaerensis*	DD	-
	Sei whale	*Balaenoptera borealis*	EN	PS
	Bryde's whale	*Balaenoptera edeni/brydei*	DD	-
	Blue whale	*Balaenoptera musculus*	EN	-
	Fin whale	*Balaenoptera physalus*	EN	-
	Omura's whale	*Balaenoptera omurai*	DD	-
	Humpback whale	*Megaptera novaeangliae*	LC**	GN
Physeteridae	Sperm whale	*Physeter macrocephalus*	VU	GN
Kogiidae	Pygmy sperm whale	*Kogia breviceps*	DD	GN
	Dwarf sperm whale	*Kogia sima*	DD	GN
Ziphiidae	Arnoux's beaked whale	*Berardius arnuxii*	DD	-
	Southern bottlenose whale	*Hyperoodon planifrons*	LC	-
	Longman's beaked whale	*Indopacetus pacificus*	DD	GN
	Andrew's beaked whale	*Mesoplodon bowdini*	DD	-
	Blainville's beaked whale	*Mesoplodon densirostris*	DD	-
	Gray's beaked whale	*Mesoplodon grayi*	DD	-
	Hector's beaked whale	*Mesoplodon hectori*	DD	-
	Deranigala's beaked whale	*Mesoplodon hotaulata*	NA	-
	Strap-toothed whale	*Mesoplodon layardii*	DD	-
	True's beaked whale	*Mesoplodon mirus*	DD	-
	Spade-toothed whale	*Mesoplodon traversii*	DD	-
	Shepherd's beaked Whale	*Tasmatecus shepherdi*	DD	-
	Cuvier's beaked whale	*Ziphius cavirostris*	LC	GN
Delphinidae	Long-beaked common dolphin	*Delphinus capensis*	DD	GN
	Short-beaked common dolphin	*Delphinus delphis*	LC	GN

	Pygmy killer whale	*Feresa attenuata*	DD	GN
	Short-finned pilot whale	*Globicephala macrorhynchus*	DD	LL, GN
	Long-finned pilot whale	*Globicephala melas*	DD	-
	Risso's dolphin	*Grampus griseus*	LC	LL, GN
	Fraser's dolphin	*Lagenodelphis hosei*	LC	-
	Irrawaddy dolphin	*Orcaella brevirostris*	VU	GN
	Australian snubfin dolphin	*Orcaella heinshoni*	NT	GN
	Killer whale	*Orcinus orca*	DD	LL, GN
	Melon-headed whale	*Peponocephala electra*	LC	LL, GN
	False killer whale	*Pseudorca crassidens*	DD	LL, GN
Delphinidae	Indo-Pacific humpback dolphin	*Sousa chinensis*	VU	GN
	Indian Ocean humpback dolphin	*Sousa plumbea*	EN	GN
	Australian humpback dolphin	*Sousa sahulensis*	VU	GN
	Pantropical spotted dolphin	*Stenella attenuata*	LC	PS, GN, LL
	Striped dolphin	*Stenella coeruleoalba*	DD	-
	Spinner dolphin	*Stenella longirostris*	DD	GN
	Rough-toothed dolphin	*Steno bredanensis*	LC	GN
	Indo-Pacific bottlenose dolphin	*Tursiops aduncus*	DD	GN
	Bottlenose dolphin	*Tursiops truncatus*	LC	LL, GN
Phocoenidae	Indo-Pacific finless porpoise	*Neophocaena phocaenoides*	VU	GN

* Published bycatch records only (reference at the end of the document)
** Arabian Sea population: EN
The IUCN Red List of Threatened species. Version 2017-01. <www.iucnredlist.org>. Downloaded on 6 September 2017.

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Stock status. The current[29] International Union for Conservation of Nature (IUCN) Red List status for each of the cetacean species reported in the IOTC Area of Competence is provided in Table 1. Information on their interactions with IOTC fisheries is also provided. 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), International Whaling Commission (IWC)), as well as numerous fisheries agreements obligate States to provide protection for these species. The status of cetaceans is affected by a range of factors such as direct harvesting and habitat degradation, but the level of cetacean mortality due to capture in tuna drift gillnets is likely to be substantial and is also a major cause for concern[30]. Many reports[31] also suggest some level of cetacean mortality for species involved in depredation of pelagic longlines, and these interactions need to be further documented throughout the IOTC Area of Competence. Recently published information suggests that the incidental capture of cetaceans in purse seines is low[32], but should be further monitored.

Outlook. Resolution 13/04 *On the conservation of cetaceans* highlights the concerns of the IOTC regarding the lack of accurate and complete data collection and reporting to the IOTC Secretariat of interactions and mortalities of cetaceans in association with tuna fisheries in the IOTC Area of Competence. In this resolution, the IOTC have agreed that CPCs

[29] October 2017

[30] Anderson 2014

[31] e.g. IOTC-2013-WPEB07-37

[32] e.g. Escalle *et al.* 2015

shall prohibit their flagged vessels from intentionally setting a purse seine net around a cetacean if the animal is sighted prior to the commencement of the set. The IOTC also agreed that CPCs using other gear types targeting tuna and tuna-like species found in association with cetaceans shall report all interactions with cetaceans to the relevant authority of the flag State and that these will be reported to the IOTC Secretariat by 30 June of the following year. It is acknowledged that the impact on cetacean populations from fishing for tuna and tuna-like species may increase if fishing pressure increases (which is already clear for tuna gillnet fisheries from IOTC data) or if the status of cetacean populations worsens due to other factors such as an increase in external fishing pressure or other anthropogenic or climatic impacts.

The following should be noted:

- The number of fisheries interactions involving cetaceans is highly uncertain and should be addressed as a matter of priority as it is a prerequisite for the WPEB to determine a status for any Indian Ocean cetacean species.
- Available evidence indicates considerable risk to cetaceans in the Indian Ocean, particularly from tuna drift gillnets[33].
- Current reported interactions and mortalities are scattered, but are most likely severely underestimated.
- Maintaining or increasing fishing effort in the Indian Ocean without appropriate mitigation measures in place will likely result in further declines in a number of cetacean species. An increasing effort by tuna drift gillnet fisheries has been reported to the IOTC, which is a major cause of concern for a number of species, particularly in the northern Indian Ocean.
- Appropriate mechanisms should be developed by the Compliance Committee to ensure CPCs comply with their data collection and reporting requirements for cetaceans.

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[33] Anderson 2014

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APPENDIX XIX
WORKING PARTY ON ECOSYSTEMS AND BYCATCH PROGRAM OF WORK (2019–2023)

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				
						2019	2020	2021	2022	2023
	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	17	CSIRO/AZTI/IRD/RITF	Financed (1.3m Euro (EU + 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	High	3							
	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 (PSAT).			AZTI, IRD, Others	Partially funded (153,000€ IOTC + 100.000€ EU/DCF)	SMA, PTH				
	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).				Funded (50,000€ EU/DCF)	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) including:	High	1							
	2.1.1 Capacity building of fisheries observers (including the provision of ID guides, training, etc.)			WWF-Pakistan/ ACAP (seabirds)	US$20,000 (ID guides)					
	2.1.2 Historical data mining for the key species, including the collection of information about			CPCs with assistance from secretariat	TBD					

	catch, effort and spatial distribution of those species and fleets catching them									
	2.2 Implementation of the Pilot Project (Resolution 16/04) for the Regional Observer Scheme	High	4							
	2.2.1 Definition of minimum standards and development of a training package for the ROS to be reviewed and rolled out in voluntary CPCs (Sri Lanka, I.R.Iran, Tanzania)				Funded (EC)					
	2.2.2 Development of a Regional Observer database and population with historic observer data				Funded (NOAA and EC)					
	2.2.3 Development, piloting and implementation of an electronic reporting tool to facilitate data reporting				Funded (NOAA and EC)					
	2.2.4 Development and trial of Electronic Monitoring Systems for gillnet fleets				Partially funded (EC)					
	2.2.5 Port sampling protocols for artisanal fisheries				to be funded					
	2.3 Review the status of manta and mobula rays and their interaction with IOTC fisheries. Evaluation of data availability and data gaps. Include ID guide revision and translation.	High	X?	Consultant?	US$?? (TBD)					
3. Biological and ecological information (incl. parameters for stock assessment)	3.1 Age and growth research (Priority species: blue shark (BSH), shortfin mako shark (SMA) and oceanic whitetip shark (OCS); Silky shark (FAL))	High	6		US$?? (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.			CPCs directly	US$?? (TBD)	OCS				
3.2 Post-release mortality	High	16							
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			IRD/ NRIFSF	Partially funded (IOTC + EU/DCF)	, BTH OCS				
3.2.2Post-release mortality (electronic tagging), to assess the efficiency of management resolutions on no retention species ranked as the most vulnerable species to longline fisheries, and blue shark as the most frequent in catches			IRD/ NRIFSF	TBD	SMA, PTH				
3.2.3 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 and longline fisheries			IRD/AZTI/IPMA/CAPRUN	Funded (EU/DCF)	OCS				
3.2.4 Post-release survivorship (electronic tagging) on whale shark to assess the effect of unintended interaction and efficiency of management			IRD/AZTI	Funded (EU/DCF)					

	resolution of non-intentioned encirclement on purse seine									
	3.3 Reproduction research Priority species: blue shark (BSH), shortfin mako shark (SMA) and oceanic whitetip shark (OCS), and silky shark (FAL))	High	7	CPCs directly	US$??(TBF)					
	3.4 Ecological Risk Assessment (sharks & rays)	High	2	AZTI	Funded (EU/DCF)					
	3.5 Close kin feasibility study for sharks	High	X	Consultant	TBD					
4. Shark bycatch mitigation measures	4.1 Develop studies on shark mitigation measures (operational, technological aspects and best practices)	High	14							
	4.1.1 Longline selectivity, to assess the effects of hooks styles, bait types and trace materials on shark catch rates, hooking-mortality, bite-offs and fishing yield (socio-economics)				US$?? (TBD)					
	4.1.2 Gillnet selectivity, to assess the effect of mesh size, hanging ratio and net twine on sharks and rays catches composition (i.e. species and size), and fishing yield (socio-economics)			WWF-Pakistan	US$?? (ABNJ funding to WWF)					
	4.1.3 Develop guidelines and protocols for safe handling and release of sharks and rays caught on longlines and gillnets fisheries									
	4.1.4 Biodegradable FADs testing and implementing biodegradable FADs in the IO Purse Seine fleet to reduce environmental footprint of the gear			EU Consortium + ISSF	Funded					

5. CPUE standardisation / Stock Assessment / Other indicators	5.1 Develop standardised CPUE series for each key shark species and fishery in the Indian Ocean	High	13		US$?? (TBD)					
	5.1.1 Development of CPUE guidelines for standardisation of CPC data.			TBD	TBD					
	5.1.2 Blue shark: Priority fleets: TWN,CHN LL, EU,Spain LL, Japan LL; Indonesia LL; EU,Portugal LL			CPCs directly						
	5.1.3 Shortfin mako shark: Priority fleets: Longline and Gillnet fleets			CPCs directly						
	5.1.4 Oceanic whitetip shark: Priority fleets: Longline fleets; purse seine fleets			CPCs directly						
	5.1.5 Silky shark: Priority fleets: Purse seine fleets			CPCs directly						
	5.2 Joint CPUE standardization across the main LL fleets for SLK?, using detailed operational data	High	11	Consult.	30,000 €					
	5.3 Stock assessment and other indicators	High	12							
	MARINE TURTLES									
6. Marine turtle bycatch mitigation measures	6.1 Review of bycatch mitigation measures	High	8							
	6.1.1 Res. 12/04 (para. 11) Part I. The IOTC Scientific Committee shall request the IOTC Working Party on Ecosystems and Bycatch to:			CPCs directly	US$??					

a) Develop recommendations on appropriate mitigation measures for gillnet, longline and purse seine fisheries in the IOTC area; [mostly completed for LL and PS]			(TBD)					
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. [partially completed for non-entangling FADS; ongoing or biodegradable FADs)]								
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		CPCs directly	US$?? (TBD)					

	species catch rates, marine turtle mortalities and other bycatch species.								
	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 Commission on ways to strengthen efforts to reduce marine turtle interactions with IOTC fisheries.			CPCs directly	Nil				
	6.1.4 Regional workshop to review the effectiveness of marine turtle mitigation measures (Recommendation SC20.23)				TBD				
	6.1.5 Review mortality studies for sea turtles, particularly for PS and gillnets								
	SEABIRDS								
7. Seabird bycatch mitigation measures	7.1 Review of bycatch mitigation measures	High	10						

	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.			Rep. of Korea, Japan, Birdlife Int.	US$?? (TBD)					
	7.1.2 Bycatch assessment for seabirds taking into account the information from the various ongoing initiatives in the IO and adjacent oceans 7.1.3 Study on cryptic mortality of seabirds in tuna LL fisheries. 7.1.4 Post release survival rates for seabirds and review of safe release techniques.			ACAP, Birdlife						
	CETACEANS									
8.Bycatch assessment and mitigation	8.1 Review and development of cetacean bycatch mitigation measures	High	9							
	8.1.1 Collate all data available on bycatch of key species interacting with all tuna fisheries in the IOTC area (tuna drift gillnets, longlines, purse seines)			Consultancy?	U.S.$??					
	8.1.3 Conduct an ecological risk assessment for cetaceans in the IOTC area			CPCs directly						

	8.1.4 Collaborate with other organisations on the assessment of marine mammal abundance and collect data on marine mammal bycatch interactions with gillnets across the IOTC region			FIU/WWF-Pakistan?	U.S.$? (IWC)					
	8.1.5 Testing mitigation methods for cetacean bycatch in tuna drift gillnet fisheries			WWF Pakistan	U.S. MM Commission? Others?					
	DISCARDS									
9. Bycatch mitigation measures	9.1 Review proposal on retention of non-targeted species	High	5							
	9.1.1 The Commission requested that the Scientific Committee review proposal IOTC–2014–S18–PropL Rev_1, and to make recommendations on the benefits of retaining non-targeted species catches, other than those prohibited via IOTC Resolutions, for consideration at the 19th Session of the Commission. (S18 Report, para. 143). Noting the lack of expertise and resources at the WPEB and the short timeframe to fulfil this task, the SC RECOMMENDED that a consultant be hired to conduct this work and present the results at the next WPEB meeting. The following tasks, necessary to address this issue, should be considered for the terms of reference, taking into account all species that are usually discarded on all major gears (i.e., purse-seines, longlines and gillnets), and fisheries that take place on the			Consultant – status to be checked	US$?? (TBD)					

high seas and in coastal countries EEZs:						
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.					
		ECOSYSTEMS					
10.	Ecosystems	10.1 Develop a plan for Ecosystem Based Fisheries Management (EBFM) approaches in the IOTC, in conjunction with the Common Oceans Tuna Project. 10.1.1 Training workshop for CPCs on EBFM Introduction and review of case studies and approaches and discussion on ecological and socio economic components that are needed. Ideally 2020 10.1.2 Workshop for CPCs on developing strategic plan for formalized implementation of EBFM (2019) including delineation of candidate eco regions within IOTC.	High	15	WPEB	US$?? (TBD)	

10.1.3 Practical Implementation of EBFM with the development and testing of ecosystem report cards.						
10.1.4 Evaluation of EBFM plan in IOTC area of competence by the WPEB to review its elements components and make any corrective measures.						
10.2 Assessing the impacts of climate change and socio-economic factors on IOTC fisheries	TBD					
10.3 Evaluate alternative approaches to ERAs to assess ecological risk	TBD					

Table 2. Draft: Assessment schedule for the IOTC Working Party on Ecosystems and Bycatch 2019–2023 (adapted from IOTC–2017–SC20–R).

Species	2019	2020	2021	2022	2023
Blue shark		**Indicators**	**Full assessment***	**Indicators**	–
Oceanic whitetip shark	**Indicators**	**Full assessment***	–	**Indicators**	–
Scalloped hammerhead shark		–	–	**Indicators**	–
Shortfin mako shark	**Indicators**	**Full assessment***	–	–	**Indicators**
Silky shark	**Full assessment***	-	**Indicators;**	**Full assessment***	–
Bigeye thresher shark	–	–	–	–	**Indicators**
Pelagic thresher shark	–	–	–	–	**Indicators**
Porbeagle shark	–	–	–	–	**Indicators**
Mobulid rays		**Interactions/Indicators**			
Marine turtles	–	**Review of mitigation measures in Res. 12/04**	–	–	**Indicators**
Seabirds	**ERA; Review of mitigation measures in Res. 12/06**	–	-	**Review of mitigation measures in Res. 12/06**	–
Marine Mammals	**Report from the IWC**	–	**ERA**	–	–
Ecosystem Based Fisheries Management (EBFM) approaches	**Indicators**	–	–	–	–

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

APPENDIX XX
CONSOLIDATED RECOMMENDATIONS OF THE 14THSESSION OF THE WORKING PARTY ON ECOSYSTEMS AND BYCATCH

Note: Appendix references refer to the Report of the 14th Session of the Working Party on Ecosystems and Bycatch (IOTC–2018–WPEB14–R)

Mobulid rays

WPEB14.01 (para 171): The WPEB **RECOMMENDED** that data collection for mobulid rays (if possible to species level) should be improved, that by-catch mitigation methods should be investigated and that safe release techniques and best practices should be implemented.

WPEB14.02 (para 172): The WPEB **NOTED** the status and declines of *Mobula* spp. in the Indian Ocean (which under current taxonomic revisions include the manta rays as well). Given the significant declines of these species across their range in the Indian Ocean along with evidence of these species' interaction with pelagic fisheries, in particular tuna gillnet, purse seine, and occasionally longline fisheries, the WPEB **RECOMMENDED** that management actions, such as non-retention measures in the IOTC Area of Competence (as a first step considering the Precautionary Approach) among others, are required to enable these species to recover and must immediately be adopted instead of waiting until 2020.

Revision of the WPEB Program of Work 2019–2023

WPEB14.03 (para 194): The WPEB **RECOMMENDED** that the SC consider and endorse the WPEB Program of Work (2019–2023), as provided in Appendix XIX

Review of the draft, and adoption of the Report of the 14th Session of the Working Party on Ecosystems and Bycatch

WPEB 14.04 (para 207): The WPEB **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPEB14 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

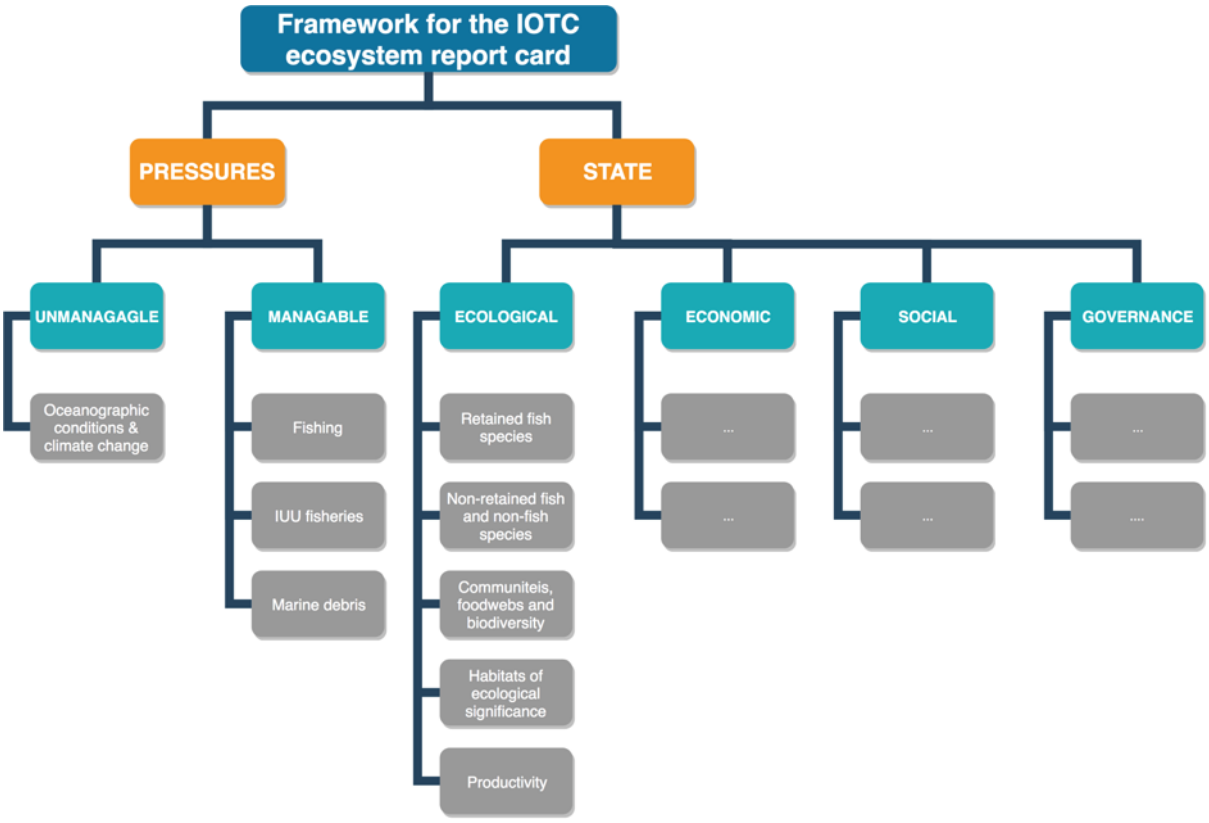
- Marine turtles – Appendix XVI
- Seabirds – Appendix XVII
- Marine mammals – Appendix XVIII

APPENDIX XXI
WORK PLAN FOR DEVELOPING AN ECOSYSTEM REPORT CARD AND ASSESSMENTS IN IOTC

Document IOTC-2018-WPEB14-20 proposed a process to develop the first prototype ecosystem report card for IOTC. The main purpose of the ecosystem report card is to improve the link between ecosystem science and fisheries management in IOTC. Accordingly, the ecosystem report card (and associated ecosystem assessment) aims to report on the relevant *pressures* affecting the state of the ecosystem, and report on the ecological *state* of the pelagic ecosystem interacting with IOTC fisheries.

In conjunction with the proposal, the WPEB14 drafted the following work plan. The plan includes:

(1) A **reporting framework** to monitor the full range of interactions between IOTC fisheries and the different components of the pelagic ecosystem.



(2) The inter-sessional **development of indicator assessments for each of the ecosystem component** in the reporting framework which will be used to inform the report card. Each indicator assessment will propose, evaluate and develop potential candidate ecosystem indicators, with a brief description of the indicators selected, the rational for selection and operational challenges encountered in their development. Document IOTC-2018-WPEB14-20 includes some guidance for the development of the ecosystem assessments and additional guidance on the exact requirements will be prepared following the SC21 in December 2018.

(3) **Each indicator assessment will be presented and reviewed in the WPEB15** which will inform the development of the first ecosystem report card in IOTC. It is expected this will be an iterative and collaborative process with the ultimate goal of creating useful products to provide better ecosystem advise to the Commission.

(4) The following WPEB participants have been tasked with the development of the indicator assessments. A tentative team leader has been identified for each group (in bolded text). It is recommended that the teams organize themselves quickly given the constraints of not working face to face.

ECOSYSTEM COMPONENTS TO REPORT	**ASSESSORS (team leaders)**
Retained fish species (including only assessed species)	**Maria Jose Juan Jordá**
Retained fish species (including not assessed species)	**Umair Shahid**
Non-retained sharks and rays	**Mariana Tolotti**
Sea turtles	**TBD**
Seabirds	**Ross Wanless**
Marine mammals	**Jeremy Kiszka**
Community and foodweb	**Eider Andonegi**
Habitat of ecological significance	**Maria José Juan Jordá**
Fishing Pressure	**Reza Shahifar**
Marine debris	**Iker Zudaire**
Socio-economic aspects	IOTC consultant
Oceanography and climate change	**TBD**