Report of the 21st Session of the IOTC Scientific Committee

Seychelles, 3 – 7 December 2018

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ACRONYMS

ACAP	Agreement on the Conservation of Albatrosses and Petrels
aFAD	Anchored fish aggregation device
ASPIC	A Stock-Production Model Incorporating Covariates
B	Biomass (total)
B_{MSY}	Biomass which produces MSY
CBD	Convention on Biological Diversity
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CCSBT	Commission for the Conservation of Southern Bluefin Tuna
CE	Catch and effort
CI	Confidence interval
CMM	Conservation and Management Measure (of the IOTC; Resolutions and Recommendations)
CoC	Compliance Committee
CPCs	Contracting Parties and Cooperating Non-Contracting Parties
CPUE	catch per unit effort
current	Current period/time, i.e. $F_{current}$ means fishing mortality for the current assessment year
EEZ	Exclusive Economic Zone
EM/EMS	Electronic Monitoring/Electronic Monitoring System
ERA	Ecological Risk Assessment
EU	European Union
F	Fishing mortality; F_{2010} is the fishing mortality estimated in the year 2010
FAD	Fish Aggregation device
FAO	Food and Agriculture Organization of the United Nations
FL	Fork Length
F_{MSY}	Fishing mortality at MSY
GLM	Generalised Linear Model
HCR	Harvest control rule
HBF	Hooks between floats
HS	Harvest strategy
HSF	Harvest strategy framework
IATTC	Inter-American Tropical Tuna Commission
ICCAT	International Commission for the Conservation of Atlantic Tunas
IO	Indian Ocean
IOTC	Indian Ocean Tuna Commission
IOSEA	Indian Ocean - South-East Asian Marine Turtle Memorandum
IPA	International Plan of Action
IPNLF	International Pole and Line Foundation
ISSF	International Seafood Sustainability Foundation
IUCN	International Union for the Conservation of Nature
IUU	Illegal, unregulated and unreported (fishing)
LJFL	Lower-jaw fork length
LRP	Limit reference point
LL	Longline
LSTLV	Large-scale tuna longline fishing vessel
M	Natural mortality
MEY	Maximum economic yield
MOU	Memorandum of Understanding
MP	Management Procedure
MPA	Marine Protected Area
MSPEA	Maldives Seafood Processors and Exporters Association
MPF	Meeting Participation Fund
MSE	Management Strategy Evaluation
MSY	Maximum Sustainable Yield
n.a.	Not Applicable
NGO	Non-Governmental Organization
NPOA	National Plan of Action
OFCF	Overseas Fishery Cooperation Foundation of Japan
OM	Operating Model
OT	Overseas Territory
PS	Purse seine
PSA	Productivity Susceptibility Analysis
q	Catchability
RBC	Recommended biological catch
RFMO	Regional fisheries management organisation
ROS	Regional Observer Scheme

RTTP-IO	Regional Tuna Tagging Project of the Indian Ocean
SB	Spawning biomass (sometimes expressed as SSB)
SB_{MSY}	Spawning stock biomass which produces MSY
SC	Scientific committee
SCAF	Standing Committee on Administration and Finance
SE	Standard error
SWIOFC	South West Indian Ocean Fisheries Commission
SWIOFP	South West Indian Ocean Fisheries Project
SS3	Stock Synthesis III
SSB	Spawning stock biomass
TAC	Total allowable catch
TAE	Total allowable effort
Taiwan,China	Taiwan, Province of China
TCAC	Technical Committee on Allocation Criteria
TCMP	Technical Committee on Management Procedures
tRFMO	tuna Regional Fishery Management Organization
TRP	Target reference point
TrRP	Trigger reference point
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
UNGA	United Nations General Assembly
VMS	Vessel Monitoring System
WP	Working Party of the IOTC
WPB	Working Party on Billfish
WPEB	Working Party on Ecosystems and Bycatch
WPDCS	Working Party on Data Collection and Statistics
WPFC	Working Party on Fishing Capacity
WPM	Working Party on Methods
WPNT	Working Party on Neritic Tunas
WPTmT	Working Party on Temperate Tunas
WPTT	Working Party on Tropical Tunas

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.

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EXECUTIVE SUMMARY

The following are a subset of the complete recommendations from the 21st Session of the Scientific Committee, which are provided in Appendix 40.

STATUS OF TUNA AND TUNA-LIKE RESOURCES IN THE INDIAN OCEAN AND ASSOCIATED SPECIES

Tuna – Highly migratory species

SC21.01 (para. 197) The SC **RECOMMENDED** that the Commission note the management advice developed for each tropical and temperate tuna species as provided in the Executive Summary for each species, and the combined Kobe plot for the four species assigned a stock status in 2018 (Fig. 4):

- Albacore (*Thunnus alalunga*) – Appendix 8
- Bigeye tuna (*Thunnus obesus*) – Appendix 9
- Skipjack tuna (*Katsuwonus pelamis*) – Appendix 10
- Yellowfin tuna (*Thunnus albacares*) – Appendix 11

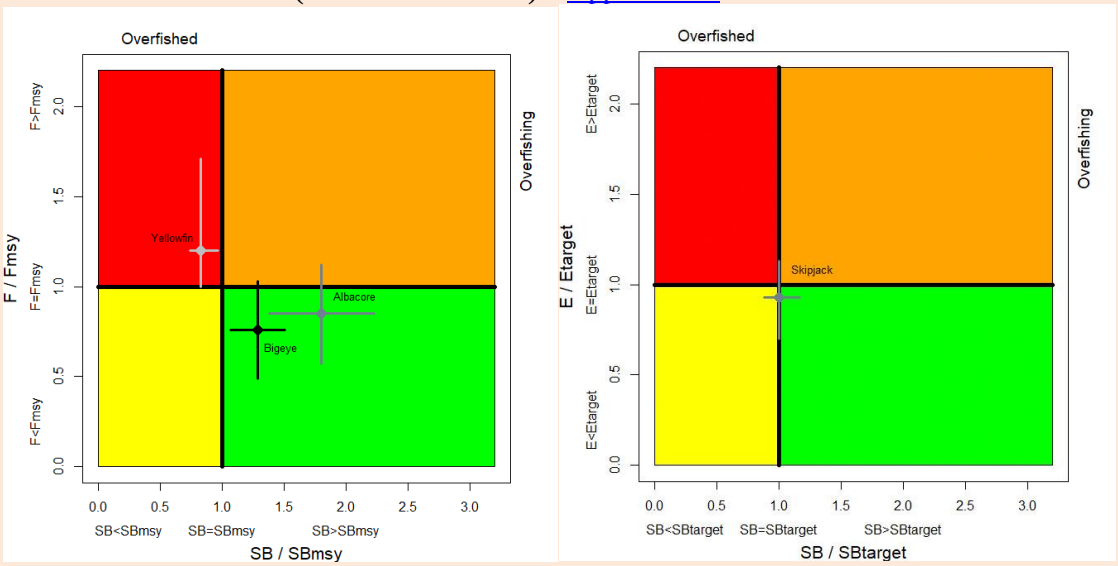

Fig. 2. (Left) Combined Kobe plot for bigeye tuna (black: 2015), yellowfin tuna (grey: 2017), and albacore tuna (dark grey: 2014) showing the estimates of current spawning stock size (SB) and current fishing mortality (F) in relation to SBtarget and Ftarget. (Right) Kobe plot for skipjack tuna (2016) showing the estimates of the current spawning stock status (SB) and exploitation rate in relation to SBtarget and Etarget. Numbers in brackets indicate the last year of data available at the time of the assessment. Cross bars illustrate the range of uncertainty from the model runs with 80% CI.

Billfish

SC21.02 (para. 200) The SC **RECOMMENDED** that the Commission note the management advice developed for each billfish species under the IOTC mandate, as provided in the Executive Summary for each species, and the combined Kobe plot for the five species assigned a stock status in 2018 (Fig. 6):

- Swordfish (*Xiphias gladius*) – Appendix 12
- Black marlin (*Makaira indica*) – Appendix 13
- Blue marlin (*Makaira nigricans*) – Appendix 14
- Striped marlin (*Tetrapturus audax*) – Appendix 15
- Indo-Pacific sailfish (*Istiophorus platypterus*) – Appendix 16

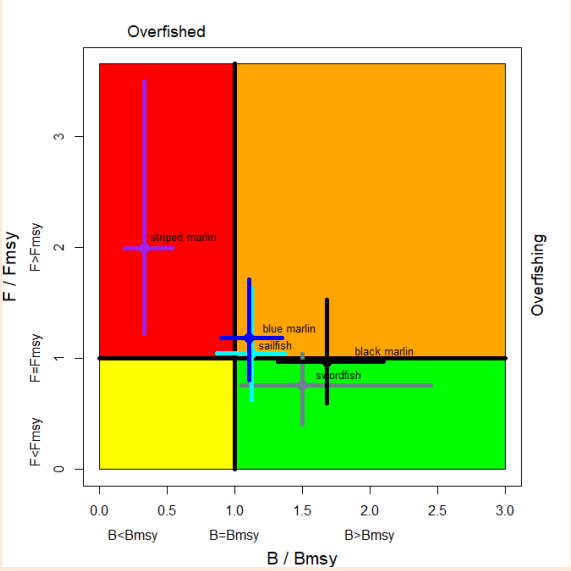

Fig. 4. Combined Kobe plot for swordfish (grey: 2015), indo-pacific sailfish (cyan: 2014), black marlin (black: 2018), blue marlin (blue: 2015) and striped marlin (purple: 2018) showing the estimates of stock size (SB or B, species assessment dependent) and fishing mortality (F) in relation to MSY-based reference points. Numbers in brackets indicate the last year of data available at the time of the assessment. Cross bars illustrate the range of uncertainty from the model runs.

Tuna and seerfish – Neritic species

SC21.03 (para. 199) The SC **RECOMMENDED** that the Commission note the management advice developed for each neritic tuna (and mackerel) species under the IOTC mandate, as provided in the Executive Summary for each species, and the combined Kobe plot for the three species assigned a stock status in 2018 (Fig. 5):

- Bullet tuna (*Auxis rochei*) – Appendix 17
- Frigate tuna (*Auxis thazard*) – Appendix 18
- Kawakawa (*Euthynnus affinis*) – Appendix 19
- Longtail tuna (*Thunnus tonggol*) – Appendix 20
- Indo-Pacific king mackerel (*Scomberomorus guttatus*) – Appendix 21
- Narrow-barred Spanish mackerel (*Scomberomorus commerson*) – Appendix 22

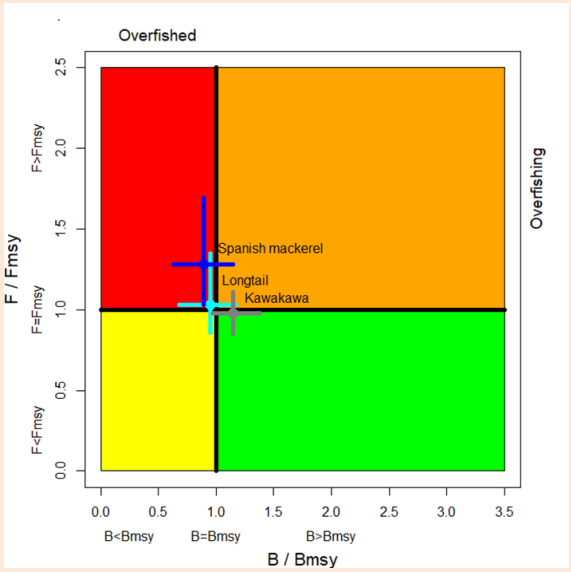

Fig. 3. Combined Kobe plot for longtail tuna (cyan: 2015), narrow-barred Spanish mackerel (dark blue: 2016), and kawakawa (white: 2013) showing the estimates of stock size (B) and current fishing mortality (F) in relation to MSY-based reference points. Numbers in brackets indicate the last year of data available at the time of the assessment. Cross bars illustrate the range of uncertainty from the model runs.

Sharks

SC21.04 (para. 201) The SC **RECOMMENDED** that the Commission note the management advice developed for a subset of shark species commonly caught in IOTC fisheries for tuna and tuna-like species:

- Blue shark (*Prionace glauca*) – Appendix 23
- Oceanic whitetip shark (*Carcharhinus longimanus*) – Appendix 24
- Scalloped hammerhead shark (*Sphyrna lewini*) – Appendix 25
- Shortfin mako shark (*Isurus oxyrinchus*) – Appendix 26
- Silky shark (*Carcharhinus falciformis*) – Appendix 27
- Bigeye thresher shark (*Alopias superciliosus*) – Appendix 28
- Pelagic thresher shark (*Alopias pelagicus*) – Appendix 29

Marine turtles

SC21.05 (para. 202) The SC **RECOMMENDED** that the Commission note the management advice developed for marine turtles, as provided in the Executive Summary encompassing all six species found in the Indian Ocean:

- Marine turtles – Appendix 30

Seabirds

SC21.06 (para. 203) The SC **RECOMMENDED** that the Commission note the management advice developed for seabirds, as provided in the Executive Summary encompassing all species commonly interacting with IOTC fisheries for tuna and tuna-like species:

- Seabirds – Appendix 31

Cetaceans

SC21.07 (para. 204) The SC **RECOMMENDED** that the Commission note the management advice developed for cetaceans, as provided in the newly developed Executive Summary encompassing all species commonly interacting with IOTC fisheries for tuna and tuna-like species:

- Cetaceans – Appendix 32

GENERAL RECOMMENDATIONS TO THE COMMISSION

NATIONAL REPORTS FROM CPCS

SC21.09 (para. 23) The SC **RECOMMENDED** that the Compliance Committee and Commission note the lack of compliance by 7 Contracting Parties (Members) and 1 Cooperating Non-Contracting Party (CNCPs) that did not submit a National Report to the Scientific Committee in 2018, noting that the Commission agreed that the submission of the annual reports to the Scientific Committee is mandatory.

REPORT OF THE 16TH SESSION OF THE WORKING PARTY ON BILLFISH (WPB16)

SC21.12 (para. 44) The SC recalled its previous **RECOMMENDATION** that on the next revision of the IOTC Agreement, the shortbill spearfish (*Tetrapturus angustirostris*) be included as an IOTC species.

Swordfish MSE

SC21.13 (para. 66) The SC noted that one of the team members involved in the development of the swordfish OM is starting a PhD in 2019 with IO Swordfish MSE included as one objective. The SC noted that salaries are already covered for next years for that team member, but further funding is required to support the travelling and time for two short-term visits to the JRC, as well as to attend IO MSE-technical workshops and WPM meeting in 2019. The SC therefore **RECOMMENDED** to fund this work during 2019 in order to progress the work on the IOTC MSE for SWO, with a total of 10.000€ requested for 2019, further noting that part of the funds (around 3.000€) should be available earlier in the year to start the work no later than March 2019.

Revision of catch levels of Marlins under Resolution 18/05

SC21.14 (para. 69) The SC noted that catches in recent years for Black Marlin, Blue Marlin, Striped Marlin and Indo-Pacific Sailfish have all exceeded the catch limits set by Resolution 18/05, and that current catch trends for all four species show no signs of decline in line with meeting the catch limits by 2020. As such, the SC urgently **RECOMMENDED** that measures are agreed to reduce current catches to the limits set for all four species covered by Resolution 18/05 as per the management advice given in the Executive Summaries.

REPORT OF THE 14TH SESSION OF THE WORKING PARTY ON ECOSYSTEMS AND BYCATCH (WPEB14)

SC21.15 (para. 71) The SC **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.

SC21.16 (para 72) The SC 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 SC **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

Bycatch species identification and data issues

SC21.17 (para. 76) Despite identification cards being available, the SC noted ongoing issues around species identification data for sea turtles, sharks, cetaceans and other bycatch species and **AGREED** that improvements to the collection of data for all bycatch species is required. The Secretariat noted that these data are currently collected through national reports and observer data submissions, but were often limited. Consequently, the SC **RECOMMENDED** to the Commission that the species reporting of turtles (as a first step) is improved through an amendment to Annexes II and III in Resolution 15/01.

REPORT OF THE 20TH SESSION OF THE WORKING PARTY ON TROPICAL TUNAS (WPTT20)

Yellowfin tuna stock assessment and development of management advice

SC21.20 (para. 103) The SC noted that the 2018 yellowfin tuna assessment indicates that the species is overfished and subject to overfishing and catch reductions required as part of Resolution 18/01 have not been met. The SC further noted that there remain significant uncertainties around the stock assessment inputs and assumptions, such that caveats are required in the interpretation of management advice developed for the species. Acknowledging these concerns, the SC **RECOMMENDED** that funding be allocated for a workplan (Appendix 38) to systematically address these issues, beginning in January 2019.

Future yellowfin tuna assessments: issues for consideration

SC21.21 (para. 123) The SC **RECOMMENDED** that development of the next stock assessment of yellowfin tuna should include, or be associated with, a detailed review of the existing data sources, including:

i. Size frequency data: Evaluation of the reliability of length composition from the longline fisheries (including recent and historical data), review of anomalies in the (EU) PS length composition data, and the need for a thorough review of the size frequency data held by IOTC, in collaboration with the fleets involved, to improve the utilization of these data in tropical tuna stock assessments.

ii. Tagging data: Further analysis of the tag release/recovery data set.

iii. Alternative CPUE series: a review of the available data from the Indian tuna longline survey data.

Review of the statistical data available for skipjack tuna

SC21.22 (para. 127) The SC noted that total catches in 2017 (524,282 t) were 12% higher than the catch limit generated by the Harvest Control Rule (470,029 t) which applies to the years 2018–2020, and that there has been an increasing trend in catches over the past 3 years. The SC **RECOMMENDED** that the Commission consider the urgent need to monitor catches of skipjack in the 2018–2020 period to ensure catches do not exceed the limit.

REPORT OF THE 9TH SESSION OF THE WORKING PARTY ON METHOD (WPM09)

Skipjack tuna MSE

SC21.23 (para. 148) Noting that the skipjack tuna harvest control rule is not a fully specified management procedure, the SC **RECOMMENDED** that a workplan and budget should be developed to undertake review and possible revision of the skipjack tuna harvest control rule under Resolution 16/02.

Stock Status Guidance

SC21.24 (para. 156) The SC noted that IOTC provide stock status relative to target reference points or MSY-based reference points. The SC further noted that WCPFC only considers a stock "overfished" when biomass falls below limit reference points, not the target reference point. The SC **RECOMMENDED** to consider

alternative formulations of the Kobe plot to indicate an appropriate buffer zone below B_{MSY} to account for natural variations in biomass. A plot such as that included in figure 1 was **SUGGESTED** to be discussed by the Working Parties and the SC as a possibility for formulating the scientific management advice to the Commission.

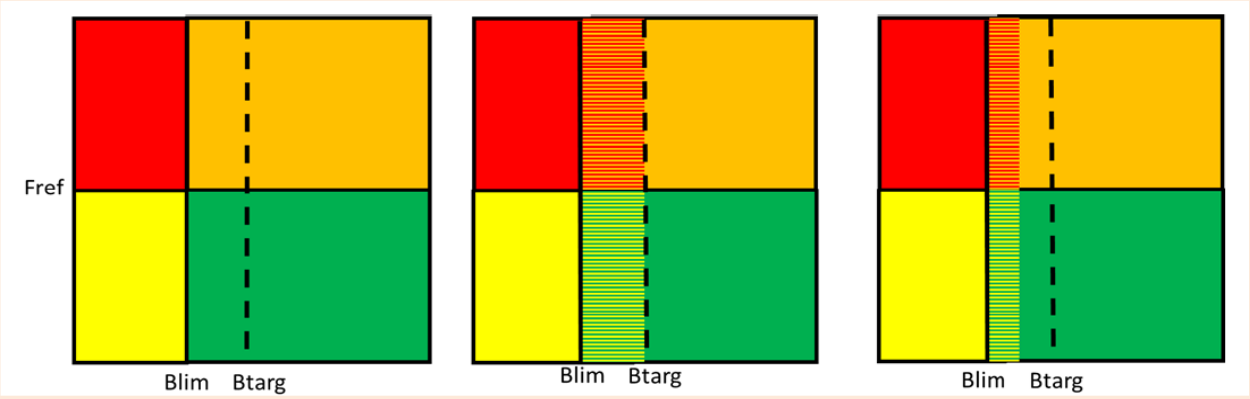

Fig. 1: Three examples of modified Kobe Plots in which there is a target biomass, B_{targ}, and a reference F (F_{ref}) such as F_{MSY}. In each plot. The red quadrant is based on biomass being below the limit (B_{lim}) rather than below a target biomass. The plot in the middle retains the four colours, but contains red-orange and yellow-green "buffer zones" between the target and limit. In the plot on the right, the buffer zone starts somewhat below the target biomass to account for natural fluctuations of the stock around the target. Note: This figure is from the ISSF Stock Assessment Workshop report (IOTC-2018-WPM09-INF06).

REPORT OF THE 14TH SESSION OF THE WORKING PARTY ON DATA COLLECTION AND STATISTICS (WPDCS14)

Electronic monitoring systems

SC21.26 (para. 168) The SC **RECOMMENDED** the development of minimum standards for EMS (including, for example, cameras) for IOTC. The SC noted that the WCPFC are currently drafting standards on EM and acknowledged that it would be pertinent for the IOTC to follow this process and utilise the outcomes where relevant.

Regional Observer Scheme Minimum Standard Data Fields

SC21.27 (para. 169) The SC **RECOMMENDED** that the ROS *Minimum Standard Data Fields* in Appendix 6a are adopted by the Commission.

ROS draft programme standards

SC21.28 (para. 174) Noting concerns with the overlap between scientific, compliance and legal issues in relation to the *draft programme standards*, the SC **RECOMMENDED** that the Commission form an ad hoc technical committee representing the breadth of mandates to specifically address this issue to ensure the relevant expertise is available to discuss scientific and operational aspects of the *draft programme standards* to be presented to the SC and CC before it is provided to the Commission for endorsement.

IOTC SCIENTIFIC STRATEGIC PLAN

SC21.36 (para. 247) The SC **AGREED** that the draft IOTC Strategic Science Plan 2020–2024 will be distributed to Heads of Delegation from each CPC for comment during early 2019, following which time comments will be collated and consolidated and another version sent to CPCs for final review. Pending agreement of CPCs, and noting that the IOTC Strategic Science Plan would be a dynamic document that would change over time, the SC **RECOMMENDED** that the revised draft of the IOTC Strategic Science Plan 2020–2024 be tabled at the Commission meeting in 2019.

Table 1. Status summary for species of tuna and tuna-like species under the IOTC mandate, as well as other species impacted by IOTC fisheries.
Temperate and tropical tuna stocks: main stocks being targeted by industrial, and to a lesser extent, artisanal fisheries throughout the Indian Ocean, both on the high seas and in the EEZ of coastal states.

Stock	Indicators		2014	2015	2016	2017	2018	Advice to the Commission
Albacore *Thunnus alalunga*	Catch 2017: Average catch 2013–2017: MSY (1000 t) (80% CI): FMSY (80% CI): SBMSY (1000 t) (80% CI): F2014/FMSY (80% CI): SB2014/SBMSY (80% CI): SB2014/SB1950 (80% CI):	38,347 t 36,004 t 38.8 (33.9–43.6) 0.07 (–) 30.0 (26.1–34.0) 0.85 (0.57–1.12) 1.80 (1.38–2.23) 0.37 (0.28–0.46)						Although considerable uncertainty remains in the SS3 assessment, particularly due to the lack of biological information on Indian Ocean albacore tuna stocks, a precautionary approach to the management of albacore tuna should be applied by capping total catch levels to MSY levels (38,800 t). Click here for full stock status summary: Appendix 8
Bigeye tuna *Thunnus obesus*	Catch in 2017: Average catch 2013–2017: MSY (1000 t) (80% CI): F_{MSY} (80% CI): SB_{MSY} (1,000 t) (80% CI): F_{2015}/F_{MSY} (80% CI): SB_{2015}/SB_{MSY} (80% CI): SB_{2015}/SB_{0} (80% CI):	90,050 t 95,997 t 104 (87-121) 0.17 (0.14-0.20) 525 (364-718) 0.76 (0.49-1.03) 1.29 (1.07-1.51) 0.38 (n.a. – n.a.)			**84%**			No new stock assessment was carried out for bigeye tuna in 2018, thus, the stock status is determined on the basis of the 2016 assessment and other indicators presented in 2018. On the weight-of-evidence available in 2018, the bigeye tuna stock is determined to be **not overfished** and is **not subject to overfishing**. If catch remains below the estimated MSY levels, then immediate management measures are not required. However, continued monitoring and improvement in data collection, reporting and analysis is required to reduce the uncertainty in assessments. Click here for full stock status summary: Appendix 9

Skipjack tuna *Katsuwonus pelamis*	Catch in 2017: Average catch 2013–2017: Yield$_{40\%SSB}$ (1000 t) (80% CI): $C_{2016}/C_{40\%SSB}$ (80% CI): SB_{2016} (1000 t) (80% CI): Total biomass B_{2016} (1000 t) (80% CI): $SB_{2016}/SB_{40\%SSB}$ (80% CI): SB_{2016}/SB_0 (80% CI): $E_{40\%SSB}$ (80% CI): SB_0 (80% CI):	524,282 t 454,103 t 510.1 (455.9–618.8) 0.88 (0.72-0.98) 796.66 (582.65-1,059.29) 910.4 (873.6-1195) 1.00 (0.88–1.17) 0.40 (0.35–0.47) 0.59 (0.53-0.65) 2,015,220 (1,651,230–2,296,135)			**47%**			No new stock assessment was carried out for skipjack tuna in 2018, thus, stock status is determined on the basis of the 2016 assessment and other indicators presented in 2018.. The 2017 stock assessment model results differ substantively from the previous (2014 and 2011) assessments, for a number of reasons. The final overall estimate of stock status indicates that the stock is at the target biomass reference point and that the current and historical fishing mortality rates are estimated to be below the target. Thus, on the weight-of-evidence available in 2018, the skipjack tuna stock is determined to be **not overfished** and is **not subject to overfishing**. Total catches in 2017 were 12% larger than the resulting catch limit from the skipjack HCR for the period 2018-2020. It should be noted that skipjack catches for most gears have increased from 2016 to 2017 (+10% for purse seine, +16% for gillnet and +17% for baitboats. The Commission needs to ensure that catches of skipjack in the 2018–2020 period do not exceed the agreed limit. Click here for full stock status summary: Appendix 10
Yellowfin tuna *Thunnus albacares*	Catch in 2017: Average catch 2013–2017: MSY (1000 t) (plausible range): F_{MSY} (plausible range): SB_{MSY} (1,000 t) (plausible range): F_{2017}/F_{MSY} (plausible range): SB_{2017}/SB_{MSY} (plausible range): SB_{2017}/SB_0 (plausible range):	409,567 t 399,830 t 403 (339–436) 0.15 (0.13–0.17) 1069 (789–1387) 1.20 (1.00–1.71) 0.83 (0.74–0.97) 0.30 (0.27.–0.33)		**94%**	**68%**			A new stock assessment was carried out for yellowfin tuna in 2018. The assessment results were only based on a grid of 24 SS3 model runs which are recognized as insufficient to explore the spectrum of uncertainties and scenarios, noting the large uncertainty associated with data quality (e.g., spatial representativeness of CPUE coverage, estimation of catch and inconsistency in length-frequency) and lack of considering model statistical uncertainty. It is noted that the quantified uncertainty in stock status is likely underestimating the underlying uncertainty of the assessment. On the weight-of-evidence available in 2017, the yellowfin tuna stock is determined to be **overfished** and **subject to overfishing.** The decline in stock status to below MSY level is not well understood due to various uncertainties. As a precautionary measure, the Commission should ensure that catches are reduced to end overfishing and allow the SSB to recover to SSB_{MSY} levels. At this stage, specific catch limits are not provided. A workplan has been developed to address the issues identified in the assessment review, aimed at increasing the Committee's ability to provide more concrete and robust advice by the 2019 meeting of the Scientific Committee. The workplan is scheduled to start in January 2019 and aims at addressing the issues identified by the WPTT and the external reviewer. The draft workplan is attached as Appendix 38 of the 2018 Scientific Committee Report (IOTC-2018-SC21-R). Click here for full stock status summary: Appendix 11

Billfish: The billfish stocks are exploited by industrial and artisanal fisheries throughout the Indian Ocean, both on the high seas and in the EEZ of coastal states. While marlins and sailfish are not usually targeted by most fleets, they are caught and retained as byproduct by the main industrial fisheries, and are also important for localised small-scale and artisanal fisheries or as targets in sports and recreational fisheries.

Stock	Indicators		2014	2015	2016	2017	2018	Advice to the Scientific Committee
Swordfish *Xiphias gladius*	Catch 2017: Average catch 2013–2017: MSY (1,000 t) (80% CI): F_{MSY} (1,000 t) (80% CI): SB_{MSY} (80% CI): F_{2015}/F_{MSY} (80% CI): SB_{2015}/SB_{MSY} (80% CI): SB_{2015}/SB_{1950} (80% CI):	34,782t 31,405t 31.59 (26.30–45.50) 0.17 (0.12–0.23) 43.69 (25.27–67.92) 0.76 (0.41–1.04) 1.50 (1.05–2.45) 0.31 (0.26–0.43)						No new stock assessment was carried out for swordfish in 2018, thus, the stock status is determined on the basis of the 2017 assessment and other indicators presented in 2018. There are some uncertainties in the catch estimates from the Indonesian fresh tuna longline; an alternative catch history was used in the base case stock assessment. Most recent catches are at the MSY level (31,590 t). On the weight-of-evidence available in 2018, the stock is determined to be ***not overfished*** and ***not subject to overfishing***. The most recent catches (34,782 t in 2017) are higher than the MSY level (31,590 t). The catches should be reduced to the MSY level (31,590 t). Click here for full stock status summary: Appendix 12
Black marlin *Makaira indica*	Catch 2017: Average catch 2013–2017: MSY (1000 t) (80% CI): F_{MSY} (80% CI): B_{MSY} (1000 t) (80% CI): F_{2017}/F_{MSY} (80% CI): B_{2017}/B_{MSY} (80% CI): B_{2017}/B_{1950} (80% CI):	21,250 t 18,673t 12.93 (9.44-18.20) 0.18 (0.11-0.30) 72.66 (45.52-119.47) 0.96 (0.77-1.12) 1.68 (1.32-2.10) 0.62 (0.49-0.78)						A stock assessment based on JABBA was conducted in 2018 for black marlin. This assessment suggests that the point estimate for the stock in 2017 is in the green zone in the Kobe plot with F/F_{MSY}=0.96 (0.77-1.12) and B/B_{MSY}=1.68 (1.32-2.10). The Kobe plot from the JABBA model indicated that the stock is not **subject to overfishing** and is currently not **overfished**, however these status estimates are subject to a high degree of uncertainty. The recent sharp increases in total catches (e.g., from 15,000 t in 2014 to over 20,000 t since 2016, mostly due to increases by I.R. Iran and India), and conflicts in information in CPUE and catch data lead to large uncertainties in the assessment outputs. This caused the point estimate of the stock status to change from the red to the green zones of the Kobe plot without any evidence of a rebuilding trend. **As such, the results of the assessment are uncertain and should be interpreted with caution** Click here for full stock status summary: Appendix 13

Blue marlin *Makaira nigricans*	Catch 2017: Average catch 2013–2017: MSY (1000 t) (80% CI): F_{MSY} (80% CI): B_{MSY} (1,000 t) (80% CI): F_{2015}/F_{MSY} (80% CI): B_{2015}/B_{MSY} (80% CI): B_{2015}/B_{1950} (80% CI):	12,155 t 11,635 t 11.93 (9.23–16.15) 0.11 (0.08 –0.16) 113 (71.7 – 162.0) 1.18 (0.80–1.71) 1.11 (0.90–1.35) 0.56 (0.44 – 0.71)					**46.8 %**	No stock assessment was carried out in 2018. The stock status based on BSP-SS stock assessment carried out in 2016 suggests that the stock status in 2015 is in the orange zone in the Kobe plot and both F and B are close to their MSYs, i.e., F/F_{MSY}=1.18 and B/B_{MSY}=1.11. Two other approaches examined in 2016 came to similar conclusions, namely ASPIC and SS3. The results of the assessment in 2016 from the BSP-SS model indicated that the stock was **subject to overfishing** but **not overfished** in 2015. The uncertainty in the catch data available at the time of the assessment and the CPUE series suggests that the advice should be interpreted with caution. A decrease in longline effort from 2005 to 2011 lowered the fishing pressure on the Indian Ocean stock, but catches in recent years have been increasing. **.** Current catches exceed the catch limit as stipulated in Resolution 18/05. The Commission should provide mechanisms to ensure the catch limits are not exceeded in the future Click here for full stock status summary: Appendix 14
Striped marlin *Tetrapturus audax*	Catch 2017: Average catch 2013–2017: MSY (1,000 t) (JABBA): F_{MSY} (JABBA): B_{MSY} (1,000 t) (JABBA): F_{2017}/F_{MSY} (JABBA): B_{2017}/B_{MSY} (JABBA): SB_{2017}/SB_{MSY} (SS3): B_{2017}/K(JABBA): SB_{2017}/SB_{1950} (SS3):	3,082t 3,587t 4.73 (4.27–5.18) 0.26 (0.20–0.34) 17.94 (14.21–23.13) 1.99 (1.21–3.62) 0.33 (0.18–0.54) 0.373 0.12 (0.07–0.20) 0.13 (0.09–0.14)					**99.8 %**	A new stock assessment for striped marlin was carried out in 2018, based on two different models. Both models were very consistent and confirmed the results from 2012, 2013, 2015 and 2017 assessments, indicating that the stock is subject to overfishing ($F>F_{MSY}$) and overfished, with the biomass for at least the past ten years is below the level which would produce MSY ($B<B_{MSY}$). On the weight-of-evidence available in 2018, the stock status of striped marlin is determined to be ***overfished*** and ***subject to overfishing***. Current or increasing catches have a very high risk of further decline in the stock status. Current 2017 catches are lower than MSY (4,730 t) but the stock has been overfished for more than two decades and is now in a highly depleted state. If the Commission wishes to recover the stock to the green quadrant of the Kobe plot with a probability ranging from 60% to 90% by 2026, it needs to provide mechanisms to ensure the maximum annual catches remain between 1,500 t – 2,200 t. Click here for full stock status summary: Appendix 15

Indo-Pacific Sailfish *Istiophorus platypterus*	Catch 2017: Average catch 2013–2017: MSY (1,000 t) (80% CI): F_{MSY} (80% CI): B_{MSY} (1,000 t) (80% CI): F_{2014}/F_{MSY} (80% CI): B_{2014}/B_{MSY} (80% CI): B_{2014}/B_{1950} (80% CI):	33,280 t 29,873 t 25.00 (16.18–35.17) 0.26 (0.15–0.39) 87.52 (56.30–121.02) 1.05 (0.63–1.63) 1.13 (0.87–1.37) 0.56 (0.44–0.67)						No new stock assessment was carried out for Indo-Pacific sailfish in 2018, thus, the stock status is determined on the basis of the 2015 assessment and other indicators presented in 2018. In 2015, data poor methods for stock assessment using Stock Reduction Analysis (SRA) techniques indicated that the stock is not yet overfished, but is subject to overfishing. The stock appears to show a continued increase catches which is a cause of concern indicating that fishing mortality levels may be becoming too high. Aspects of the biology, productivity and fisheries for this species combined with the data poor status on which to base a more formal assessment are also a cause for concern. On the weight-of-evidence available in 2018, the stock is determined to be still ***not overfished*** but ***subject to overfishing***. The catch limits as stipulated in Resolution 18/05 have been exceeded. The Commission should provide mechanisms to ensure that catch limits are not exceeded by all concerned fisheries. Click here for full stock status summary: Appendix 16

Neritic tunas and mackerel: These six species have become as important or more important as the three tropical tuna species (bigeye tuna, skipjack tuna and yellowfin tuna) to most IOTC coastal states. Neritic tunas and mackerels are caught primarily by coastal fisheries, including small-scale industrial and artisanal fisheries, and are almost always caught within the EEZs of coastal states. Historically, catches were often reported as aggregates of various species, making it difficult to obtain appropriate data for stock assessment analyses.

Stock	Indicators		2014	2015	2016	2017	2018	Advice to the Commission
Bullet tuna *Auxis rochei*	Catch 2017: Average catch 2013–2017: MSY (1,000 t) F_{MSY} : B_{MSY} (1,000 t): $F_{current}/F_{MSY}$: $B_{current}/B_{MSY}$: $B_{current}/B_0$:	11,094 t 9,959 t unknown unknown unknown unknown unknown unknown						For assessed species of neritic tunas in Indian Ocean (longtail tuna, kawakawa and narrow barred Spanish mackerel), the MSY was estimated to have been reached between 2009 and 2011 and both F_{MSY} and B_{MSY} were breached thereafter. Therefore, in the absence of a stock assessment of bullet tuna a limit to the catches should be considered by the Commission, by ensuring that future catches do not exceed the average catches estimated between 2009 and 2011 (8,870 t). The reference period (2009-2011) was chosen based on the most recent assessments of those neritic species in the Indian Ocean for which an assessment is available under the assumption that also for bullet tuna MSY was reached between 2009 and 2011. This catch advice should be maintained until an assessment of bullet tuna is available. Considering that MSY-based reference points for assessed species can change over time, the stock should be closely monitored. Mechanisms need to be developed by the Commission to improve current statistics by encouraging CPCs to comply with their recording and reporting requirements, so as to better inform scientific advice. Click here for a full stock status summary: Appendix 17
Frigate tuna *Auxis thazard*	Catch 2017: Average catch 2013–2017: MSY (1,000 t) F_{MSY} : B_{MSY} (1,000 t): $F_{current}/F_{MSY}$: $B_{current}/B_{MSY}$: $B_{current}/B_0$:	74,686 t 86,117 t unknown unknown unknown unknown unknown unknown						For assessed species of neritic tunas in Indian Ocean (longtail tuna, kawakawa and narrow barred Spanish mackerel), the MSY was estimated to have been reached between 2009 and 2011 and both F_{MSY} and B_{MSY} were breached thereafter. Therefore, in the absence of a stock assessment of frigate tuna a limit to the catches should be considered by the Commission, by ensuring that future catches do not exceed the average catches estimated between 2009 and 2011 (94,921 t). The reference period (2009-2011) was chosen based on the most recent assessments of those neritic species in the Indian Ocean for which an assessment is available under the assumption that also for bullet tuna MSY was reached between 2009 and 2011. This catch advice should be maintained until an assessment of frigate tuna is available. Considering that MSY-based reference points for assessed species can change over time, the stock should be closely monitored. Mechanisms need to be developed by the Commission to improve current statistics by encouraging CPCs to comply with their recording and reporting requirements, so as to better inform scientific advice. Click here for a full stock status summary: Appendix 18

Kawakawa *Euthynnus affinis*	Catch 2017: Average catch 2013-2017: MSY (1,000 t) : F_{MSY} : B_{MSY} (1,000 t) : F_{2013}/F_{MSY} : B_{2013}/B_{MSY} : B_{2013}/B_0 :	159,752 t 157,300 t 152 [125 –188] 0.56 [0.42–0.69] 202 [151–315] 0.98 [0.85–1.11] 1.15 [0.97–1.38] 0.58 [0.33–0.86]						Although the stock status is classified as not overfished and not subject to overfishing, the Kobe strategy II matrix developed in 2015 showed that there is a 96% probability that biomass is below MSY levels and 100% probability that $F>F_{MSY}$ by 2016 and 2023 if catches are maintained at the 2013 levels. There is a 55% probability that biomass is below MSY levels and 91% probability that $F>F_{MSY}$ by 2023 if catches are maintained at around 2016 levels. The modelled probabilities of the stock achieving levels consistent with the MSY reference points (e.g. SB > SB_{MSY} and $F<F_{MSY}$) in 2023 are 100% for a future constant catch at 80% of 2013 catch levels. If catches are reduced by 20% based on 2013 levels at the time of the assessment (170,181 t)[1], the stock is expected to recover to levels above MSY reference points with a 50% probability by 2023. Click here for a full stock status summary: Appendix 19
Longtail tuna *Thunnus tonggol*	Catch 2017: Average catch 2013–2017: MSY (1,000 t) : F_{MSY} : B_{MSY} (1,000 t) : F_{2015}/F_{MSY} : B_{2015}/B_{MSY} : B_{2015}/B_0 :	135,006 t 139,856 t 140 (103–184) 0.43 (0.28–0.69) 319 (200–623) 1.04 (0.84–1.46) 0.94 (0.68–1.16) 0.48 (0.34–0.59)					**67%**	There is a substantial risk of exceeding MSY-based reference points by 2018 if catches are maintained at current (2015) levels (63% risk that $B_{2018}<B_{MSY}$, and 55% risk that $F_{2018}>F_{MSY}$) (Table 2). If catches are reduced by 10% this risk is lowered to 33% probability $B_{2018}<B_{MSY}$ and 28% probability $F_{2018}>F_{MSY}$). If catches are capped at current (2015) levels at the time of the assessment (i.e. 136,849 t), the stock is expected to recover to levels above MSY reference points with at least a 50% probability by 2025. Catches have remained below estimated MSY since 2015. Click here for a full stock status summary: Appendix 20

Indo-Pacific king mackerel *Scomberomorus guttatus*	Catch 2017: Average catch 2013-2017: MSY (1,000 t) : F_{MSY} : B_{MSY} (1,000 t): $F_{current}/F_{MSY}$: $B_{current}/B_{MSY}$: $B_{current}/B_0$:	49,905 t 46,814 t Unknown Unknown Unknown Unknown Unknown Unknown						For assessed species of neritic tunas in Indian Ocean (longtail tuna, kawakawa and narrow barred Spanish mackerel), the MSY was estimated to have been reached between 2009 and 2011 and both F_{MSY} and B_{MSY} were breached thereafter. Therefore, in the absence of a stock assessment of Indo-Pacific king mackerel a limit to the catches should be considered by the Commission, by ensuring that future catches do not exceed the average catches estimated between 2009 and 2011 (46,787 t). The reference period (2009-2011) was chosen based on the most recent assessments of those neritic species in the Indian Ocean for which an assessment is available under the assumption that also for Indo-Pacific king mackerel MSY was reached between 2009 and 2011. This catch advice should be maintained until an assessment of Indo-Pacific king mackerel is available. This catch advice should be maintained until an assessment of Indo-Pacific king mackerel is available. Considering that MSY-based reference points for assessed species can change over time, the stock should be closely monitored. Mechanisms need to be developed by the Commission to improve current statistics by encouraging CPCs to comply with their recording and reporting requirements, so as to better inform scientific advice. Click here for a full stock status summary: Appendix 21
Narrow-barred Spanish mackerel *Scomberomorus commerson*	Catch 2017[2]: Average catch 2013-2017: MSY (1,000 t) : F_{MSY} : B_{MSY} (1,000 t) : F_{2015}/F_{MSY} : B_{2015} B_{MSY} : B_{2015}/B_0 :	159,370 t 160,812 t 131 [96–180] 0.35 [0.18–0.7] 371 [187–882] 1.28 [1.03–1.69] 0.89 [0.63–1.15] 0.44 [0.31–0.57]					**89%**	There is a continued high risk of exceeding MSY-based reference points by 2025, even if catches are reduced to 80% of the 2015 levels (73% risk that $B_{2025}<B_{MSY}$, and 99% risk that $F_{2025}>F_{MSY}$). The modelled probabilities of the stock achieving levels consistent with the MSY reference levels (e.g. $B > B_{MSY}$ and $F<F_{MSY}$) in 2025 are 93% and 70%, respectively, for a future constant catch at 70% of current catch level. If catches are reduced by 30% of the 2015 levels at the time of the assessment, which corresponds to catches below MSY, the stock is expected to recover to levels above the MSY reference points with at least a 50% probability by 2025. Click here for a full stock status summary: Appendix 22

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.

Stock	Indicators		2014	2015	2016	2017	2018	Advice to the Commission
Blue shark *Prionace glauca*	Reported catch 2017: Estimated catch 2015: Not elsewhere included (nei) sharks 2017: Average reported catch 2013–17: Average estimated catch 2011–15: Ave. (nei) sharks[2] 2012–16:	27,259 t 54,735 t 56,883 t 29,790 t 54,993 t 51,712 t					**72.6%**	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 catches are reduced at least 10%, the probability of maintaining stock biomass above MSY reference levels (B>BMSY) 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 18/07), these need to be further implemented by the Commission, so as to better inform scientific advice in the future. Click below for a full stock status summary: o Blue sharks – Appendix 23
	MSY (1,000 t) (80% CI): F_{MSY} (80% CI) : SSB_{MSY} (1,000 t) (80% CI) : F_{2015}/F_{MSY} (80% CI) : SSB_{2015}/SSB_{MSY} (80% CI) : SSB_{2015}/SSB_{0} (80% CI) :	33.1 (29.5-36.6) 0.30 (0.30-0.31) 38.9 (35.5-45.4) 0.90 (0.67-1.09) 1.50 (1.37-1.72) 0.52 (0.46-0.56)						
Oceanic whitetip shark *Carcharhinus longimanus*	Reported catch 2017: Not elsewhere included (nei) sharks: Average reported catch 2013–2017: Not elsewhere included (nei) sharks:	48 t 56,883t 230 t 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 24 o Scalloped hammerhead sharks – Appendix 25 o Shortfin mako sharks – Appendix 26 o Silky sharks– Appendix 27 o Bigeye thresher sharks– Appendix 28 o Pelagic thresher sharks– Appendix 29
Scalloped hammerhead shark *Sphyrna lewini*	Reported catch 2017: Not elsewhere included (nei) sharks: Average reported catch 2013–2017: Not elsewhere included (nei) sharks:	118 t 56,883t 76 t 51,712 t						
Shortfin mako *Isurus oxyrinchus*	Reported catch 2017: Not elsewhere included (nei) sharks: Average reported catch 2013–2017: Not elsewhere included (nei) sharks:	1,664 t 56,883t 1,555 t 51,712 t						
Silky shark *Carcharhinus falciformis*	Reported catch 2017: Not elsewhere included (nei) sharks: Average reported catch 2013–2017: Not elsewhere included (nei) sharks:	2,175 t 56,883t 2,967 t 51,712 t						
Bigeye thresher shark *Alopias superciliosus*	Reported catch 2017: Not elsewhere included (nei) sharks: Average reported catch 2013–2017: Not elsewhere included (nei) sharks:	0 t 56,883t 0 t 51,712 t						

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

*Estimated probability that the stock is in the respective quadrant of the Kobe plot (shown below), derived from the confidence intervals associated with the current stock status.

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

1. OPENING OF THE SESSION

1. The 21st Session of the Indian Ocean Tuna Commission's (IOTC) Scientific Committee (SC) was held in Seychelles, from 3 – 7 December 2018. A total of 73 delegates and other participants (78 in 2017) attended the Session, comprised of 65 delegates (53 in 2017) from 23 Contracting Parties (21 in 2017), and 0 delegates from Cooperating Non-Contracting Parties (0 in 2017), and 8 observers, including 1 invited expert and a rapporteur (12 observers in 2017). The list of participants is provided at Appendix 1. The meeting was opened on 3 December 2018 by the Chairperson (Dr Hilario Murua – EU,Spain) and the IOTC Secretariat.

2. ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION

2. The SC **ADOPTED** the Agenda provided at Appendix 2. The documents presented to the SC are listed in Appendix 3.

3. The SC noted the first and second statements from Mauritius, and the associated responses from France (OT), and United Kingdom (OT) as provided in Appendix 4a.

3. ADMISSION OF OBSERVERS

4. The SC noted that the applications by new Observers should continue to follow the procedure as outlined in Rule XIV of the IOTC Rules of Procedure (2014).

3.1 Non-governmental Organisations (NGOs)

5. In accordance with Rule VI.1 and XIV.5 of the IOTC Rules of Procedure (2014), the SC admitted the following Non-governmental organisations (NGOs) as observers to the 21st Session of the SC:
   - International Seafood Sustainability Foundation (ISSF)
   - Sustainable Fisheries Partnership (SFP)
   - WWF
   - SWIOFISH
   - Blue Resources Trust.

3.2 Invited experts

6. In accordance with Rules VI.1 and XIV.9 of the IOTC Rules of Procedure (2014), which state that the Commission may invite experts, in their individual capacity, to enhance and broaden the expertise of the SC and of its Working Parties, the SC admitted the invited experts from Taiwan,China to the 21st Session of the SC.

4. DECISIONS OF THE COMMISSION RELATED TO THE WORK OF THE SCIENTIFIC COMMITTEE

4.1 Outcomes of the 22nd Session of the Commission

7. The SC noted paper IOTC–2018–SC21–03 which outlined the decisions and requests made by the Commission at its 22nd Session, held in May 2018, specifically relating to the IOTC science process, including the 10 Conservation and Management Measures (consisting of 10 Resolutions and zero Recommendations), as detailed below:

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 of Billfishes: striped marlin, black marlin, blue marlin and Indo-Pacific sailfish.*
- Resolution 18/06 *On establishing a programme for transshipment by large scale fishing vessels.*

- Resolution 18/07 *On measures applicable in case of non-fulfilment of reporting obligations to the IOTC.*
- Resolution 18/08 *Procedures on a fish aggregating devices (FADs) management plan, including a limitation of the number of FADs, more detailed specifications of catch reporting from FAD sets, and the development of improved FAD designs to reduce the incidence of entanglement of non-target species.*
- Resolution 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.*

8. The SC noted that pursuant to Article IX.4 of the IOTC Agreement, the above mentioned Conservation and Management Measures became binding on Members on 4 October 2018, 120 days from the date of the notification communicated by the IOTC Secretariat in IOTC Circular 2018–26 (i.e. 7 June 2018). The updated *Compendium of Active Conservation and Management Measures for the Indian Ocean Tuna Commission* may be downloaded from the IOTC website at the following link, dated 4 October 2018:
   - English: http://iotc.org/cmms
   - French: http://iotc.org/fr/mcgs

9. Noting that the Commission also made a number of general comments and requests on the recommendations made by the Scientific Committee in 2017 that were listed in the report of the 22nd Session of the Commission, the SC **AGREED** that any advice to the Commission would be provided in the relevant sections of this report, in particular on the statements below from the report:

   *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 VI) 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).*

   *The Commission **ENDORSED** the Chairpersons and Vice-Chairpersons elected by the Scientific Committee and its subsidiary bodies for the coming years, as listed in Appendix VII of the 2017 Scientific Committee Report. (Para. 27).*

   *The Commission **NOTED** the information provided by the SC that there continues to be catches of oceanic whitetip shark in the IOTC Area, although prohibited as per Resolution 13/06. (Para. 36).*

   *The Commission **NOTED** that neritic tuna are vital resources to the coastal States and **EXPRESSED** its concern that the current nature and extent of management measures applying to the neritic species is much less than that being applied to other IOTC species. The Commission **EXPRESSED** further concern about the overall lack of information on neritic tunas, strongly **ENCOURAGED** the coastal States to improve data collection and reporting, and develop measures to underpin sustainable management of IOTC neritic species. Some CPCs also expressed concern that the concerned coastal States had not tabled conservation and management measures for this stock at this annual meeting in response to the Commission's call to do so at the last annual meeting. (Para. 47).*

4.1.1 FAD Management plans – particularly Annex II of Resolution 18/08

10. The SC noted a number of inconsistencies in Resolution 18/08, particularly in relation to the focus of the resolution on purse seine fisheries when anchored FAD management plans are also addressed. The SC further noted queries in relation to the scientific utility of Annex I & II of the FAD Management Plan requirements. The SC **REQUESTED** that these issues be discussed at the 22nd Session of the Working Party on Tropical Tunas in 2019.

4.2 Previous decisions of the Commission

11. The SC noted paper IOTC–2018–SC21–04 which outlined a number of Commission decisions, in the form of previous Resolutions that require a response from the SC in 2018, and **AGREED** to develop advice to the Commission in response to each request during the current Session.

12. In relation to Resolution 17/04 *On a ban on discards of bigeye tuna, skipjack tuna, yellowfin tuna and non-targeted species caught by purse seine vessels in the IOTC Area of Competence*, the SC noted that the deadline for providing a response to the request to examine the benefits of retaining non-targeted species catches, other than those prohibited via IOTC Resolution, to the 22nd Session of the Commission had been missed and queried whether the deadline for responses should be to the 23rd session. The SC noted that such a response was relevant to both WPEB and the WPTT. The SC also noted that Terms of Reference had already been developed by the

WPEB to undertake a study to address this issue and so **REQUESTED** that the secretariat use them to motivate funding for the study in 2019.

5. SCIENCE RELATED ACTIVITIES OF THE IOTC SECRETARIAT IN 2018

5.1 Report of the Secretariat – Activities in support of the IOTC science process in 2018

13. The SC noted paper IOTC–2018–SC21–05 which provided an overview of the work undertaken by the IOTC Secretariat in 2018, and congratulated the IOTC Secretariat for the contributions to the science process in 2018, in particular via support to the Working Parties and Scientific Committee meetings, facilitation of the IOTC Meeting Participation Fund, improvements in the quality of the data sets being collected and submitted to the IOTC Secretariat, capacity building activities, support for the development of the Regional Observer Scheme, and through the facilitation of consultants and invited experts to raise the standard of IOTC meetings.

14. The SC noted that the recruitment of the Science Manager was finalized in June 2018, and welcomed Dr Paul de Bruyn to the role.

15. The SC noted the increasing workload of the SC and relevant working parties, as evidenced at least in part by the increasing volume of papers submitted to various meetings, and suggested that the Secretariat and Chairpersons of the various committees could be more active in informing CPCs of the specific work requirements each year to ensure papers were aligned to key priority areas.

16. The SC **REQUESTED** the Secretariat to provide more details on recent past and ongoing scientific IOTC projects including sources and amount of funding support in future iterations of the document as well as to make updated technical and administrative information available on the IOTC web site.

6. NATIONAL REPORTS FROM CPCS

6.1 National Reporting to the Scientific Committee: overview

17. The SC noted that 26 National Reports were submitted to the IOTC Secretariat in 2018 by CPCs (25 Contracting Parties and 1 Cooperating Non-Contracting Party), the abstracts of which are provided at Appendix 4b.

18. The SC reminded CPCs that the purpose of the National Reports is to provide relevant information to the SC on fishing activities of Contracting Parties (Members) and Cooperating Non-Contracting Parties (collectively termed CPCs) operating in the IOTC area of competence. The report should include all fishing activities for species under the IOTC mandate as well as sharks and other byproduct/bycatch species as required by the IOTC Agreement and decisions by the Commission.

19. The SC reminded CPCs that the submission of a National Report is mandatory, irrespective of whether a CPC intends on attending the annual meeting of the SC or not and shall be submitted no later than 15 days prior to the SC meeting. In 2018, of the 26 National Reports submitted, 7 were submitted after the deadline. The National Report does not replace the need for submission of data according to the IOTC Mandatory Data Requirements listed in the relevant IOTC Resolution [currently Resolution 15/02 *On mandatory statistical reporting requirements for IOTC Contracting Parties and Cooperating Non-Contracting Parties (CPCs)*].

20. The SC noted the importance of consistency and standardisation in the format of reporting on fisheries in National Reports and **REQUESTED** that CPCs follow the reporting template agreed by the Commission.

21. The SC **AGREED** that if required, interested CPCs should seek assistance from the IOTC Secretariat in the development of National Reports. Requests should be made as early as possible so that the IOTC Secretariat may be able to better coordinate the resources available.

22. Noting that the Commission, at its 15th Session, expressed concern regarding the limited submission of National Reports to the SC, and stressed the importance of providing the reports by all CPCs, the SC **RECOMMENDED** that the Commission note that in 2018, 26 reports were provided by CPCs (23 in 2017, 23 in 2016, 26 in 2015) (Table 2).

23. The SC **RECOMMENDED** that the Compliance Committee and Commission note the lack of compliance by 7 Contracting Parties (Members) and 1 Cooperating Non-Contracting Party (CNCPs) that did not submit a National Report to the Scientific Committee in 2018, noting that the Commission agreed that the submission of the annual reports to the Scientific Committee is mandatory.

Table 2. CPC submission of National Reports to the SC from 2005 to 2018.

CPC	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Contracting Parties (Members)														
Australia														
Bangladesh	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.				
China														
Comoros														
Eritrea														
European Union														
France (OT)														
Guinea														
India														
Indonesia	n.a.	n.a.												
Iran, Islamic Rep. of														
Japan														
Kenya														
Korea, Republic of														
Madagascar														
Malaysia														
Maldives, Rep. of	n.a.	n.a.	n.a.	n.a.										
Mauritius														
Mozambique	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.								
Oman, Sultanate of														
Pakistan														
Philippines														
Seychelles, Rep. of														
Sierra Leone	n.a.	n.a.	n.a.											
Somalia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.					
Sri Lanka														
South Africa, Rep. of														
Sudan														
Tanzania, United Republic of	n.a.	n.a.												
Thailand														
United Kingdom (OT)														
Yemen	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.							
Cooperating Non-Contracting Parties														
Liberia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.				
Senegal														

Green = submitted. Red = not submitted. n.a. = not applicable (not a CPC in that year). Green hash = submitted as part of EU report.

6.2 Contracting Parties (Members)

24. The SC **NOTED** that a number of Annual Reports were not available in both English and French due to a late agreement on contracts with translators and subsequent lack of time to complete the translation of the executive summaries into the two languages. The SC **ACKNOWLEDGED** that the Secretariat is exploring ways to ensure that these preliminary translation tasks could be performed more efficiently in future years.

25. The SC **RECALLED** that this same topic had been discussed during its 20th Session in 2017 and **QUERIED** whether it should be CPCs' responsibility to provide translated national reports as opposed to placing this additional burden on the Secretariat. The SC **SUGGESTED** that updates to national report templates could be useful to facilitate these translation requirements.

26. The SC **ENCOURAGED** all CPCs to translate the executive summaries into both French and English, and ensure that captions for figures and tables are translated as well.

27. **NOTING** the 25 National Reports submitted to the IOTC Secretariat in 2018 by Contracting Parties (Members), the SC expressed concern about the difference between the catches submitted in National Reports and total catches, by fleet, in the IOTC database. The IOTC Secretariat uses the information from the National Report to update estimates of nominal catches, in the case of revisions to the data or when CPCs have not submitted any catch data; however, the time available between submission of the National Reports and the Scientific Committee makes it difficult to update the IOTC nominal database prior to the annual Session. The quality of the National Reports is highly variable and interested CPCs should contact the IOTC Secretariat prior to the report deadline to ensure their reports are compliant with the guidelines.

28. The following matters were raised in regard to the content of specific reports:
    - **Australia**: The SC noted that the increase in logbook-reported shark discards (from 5000–6000 in recent years to over 10,000 in 2017, comprised predominantly of blue and crocodile shark) can be explained by the implementation of electronic monitoring resulting in more accurate logbook data entries. The SC also noted that information on the fate of discarded sharks is collected, and that it was thought that most sharks are released in good condition.
    - **Bangladesh**: Nil comment.
    - **China**: The SC noted that the increase in the deep-frozen longline number of vessels can be explained by a shift in vessels from the Western Pacific Ocean into the Indian Ocean because of fewer problems with piracy in recent years. Furthermore, fresh tuna longline vessels are also increasingly using deep-freeze wells to maintain the quality and value of Yellowfin tuna and Bigeye tuna taken as bycatch while fishing for Albacore. The SC noted that although the Chinese longline fleet was reported fishing south of 25 degrees, seabird bycatch information has been provided only from observer data, however, the SC **ACKNOWLEDGED** that seabird mitigation measures were being used. The SC noted that China is increasing its effort to ensure fishers collect and report better data, including through the implementation of species identification guides and collaboration between the China Overseas Fisheries Association and the industry. The SC **RECALLED** that the IOTC has published identification guides for sharks, tunas, billfish, sea turtles and seabirds and **URGED** that these be translated into Chinese. The SC **REQUESTED** that more information on seabird interactions and mortality is provided in China's annual reports in the future.
    - **Comoros:** The SC noted that despite the number of vessels remaining relatively constant, the increase in catches reported between 2014 and the present could be partly explained by the characteristics of the artisanal fishery (in which effort is responsive to seasonal changes in the catchability of fish) and also due to improvements in data collection systems. The SC also noted differences between yellowfin catch figures in the National Report and IOTC database and requested Comoros to liaise with Secretariat to solve the discrepancy.
    - **Eritrea**: The SC expressed its disappointment that Eritrea did not provide a National Report and **REQUESTED** that the SC Chairperson, in conjunction with the Chairpersons of the Compliance Committee and Commission, remind Eritrea to fulfil its reporting obligations to the IOTC. Eritrea became a Contracting Party of the IOTC in 1994 and as such it is a requirement to comply with the National Report obligation to the Scientific Committee.
    - **European Union (EU):** The SC noted that despite lower effort, an increase in purse seine skipjack catches in 2017 could be explained by increased effort being directed at fishing on FAD associated schools. The SC noted that Resolution 16/02 on harvest control rules sets out a catch limit for skipjack tuna for the period 2018-2010 and that 2017 skipjack catch for IOTC was above the level specified in the Resolution. The SC noted that changes in catch composition from yellowfin tuna to skipjack tuna could be also related to the implementation of Resolution 18/01 which could result in increasing skipjack catches which may compromise the ability to comply with catch limits set out in Resolution 16/02. Furthermore, EU clarified that internal allocation of quota and monitoring of quota consumption is done through EU regulation applying to member states.
    - **France (OT)**: The SC **NOTED** the statement made by Mauritius as well as the response from France, as provided in Appendix 4a.
    - **Guinea**: The SC expressed its disappointment that Guinea did not provide a National Report and **REQUESTED** that the SC Chairperson, in conjunction with the Chairpersons of the Compliance Committee and Commission, remind Guinea to fulfil its reporting obligations to the IOTC. Guinea became a Contracting Party of the IOTC in 2005 and as such it is a requirement to comply with the National Report obligation to the Scientific Committee.
    - **India**: The SC expressed its disappointment that India did not provide a National Report and **REQUESTED** that the SC Chairperson, in conjunction with the Chairpersons of the Compliance Committee and Commission, remind India to fulfil its reporting obligations to the IOTC. India became a

Contracting Party of the IOTC in 1995 and as such it is a requirement to comply with the National Report obligation to the Scientific Committee.

- **Indonesia**: The SC noted that a recent update to official figures for Indonesia nominal catches for 2017 has been received in November 2018 and is in the process of being assessed by the Secretariat. Also, the SC noted that time-area information are included by Indonesia in its national report, but that these same data is not yet submitted to the Secretariat in accordance with Resolution 15/02. Indonesia noted that it is making efforts to comply with Resolution 15/02 and that these data will be provided as soon as possible. The SC **NOTED** that the significant decline in catches reported at the Port of Benoa in 2017 could be explained by a reduction in effort due to an issue with allocating fishing permits to fishers. In response to a query around the large increase in swordfish catches since 2012, the SC noted that the Secretariat has revised its catch reconstruction for the Indonesian fresh longline fishery, and that the detected increase has been corrected resulting in higher confidence around the data in recent years (while ongoing uncertainties still remain with historical catches).
- **Iran, Islamic Rep.**: The Secretariat and the SC **ACKNOWLEDGED** the positive efforts of I.R. Iran to ensure time-area catches and other information are collected and provided in accordance with Resolution 15/02. The SC noted that maps to illustrate the distribution of catch and effort would be useful, and encouraged I.R. Iran to include these data in future reports. The SC noted the need to clarify the definition of 'offshore catches' as these are reported by I.R. Iran to ensure catches taken inside and outside the EEZ can be appropriately separated, which is particularly important for monitoring progress towards the implementation of Resolution 18/01. The SC noted that the number of Iranian vessels has stayed relatively constant in recent years, but there has been increase in catches of YFT ~20% and >35% in catches of skipjack tuna from 2016 to 2017, and that part of this increase could potentially be explained by increasing CPUE.
- **Japan**: The SC noted that Japanese longline activity is decreasing specially in the North-western Indian Ocean. Noting the low level of size sampling undertaken by the Japanese longline fleet for several species, the SC **ENCOURAGED** a higher sampling coverage for size frequency data.
- **Kenya:** Nil comment.
- **Korea, Rep. of**: Nil comment.
- **Madagascar**: Nil comment.
- **Malaysia**: The SC **QUERIED** whether the decreasing catch trend in reported catches of Longtail tuna and the small increase in catch trend for Kawakawa may be reflecting the stock status of the two species, but that this was currently unclear.
- **Maldives, Republic of**: The SC **QUERIED** the balance between human observers and electronic monitoring coverage and noted that this had not yet been determined. The SC also **ACKNOWLEDGED** that there had been issues for Maldives with finding human observers to undertake regular fishing trips. Also, the SC **QUERIED** the large reduction in nominal effort despite large increase in Yellowfin and Skipjack catches for pole and line from 2016 to 2017 (around 28% increase for skipjack and 100% for yellowfin). The SC noted that an increasing trend in the average size of vessels in the fleet might account for an increase in catch rates per day, and that also improvements in logbook data collection systems might contribute to the increase in reported catches. The SC also noted that although the number of anchored FADs has remained around 50, an increase in fishing effort on drifting FADs from purse seine operations that drift in to the Maldives' EEZ could have contributed to the increase in catchability of Yellowfin and Skipjack.
- **Mauritius**: The SC **QUERIED** about the doubling in reported catches of Yellowfin tuna despite a reduction in the numbers of purse seine vessels (from 7 in 2015 to 2 in 2017), and also noted that catch composition of Yellowfin tuna had changed (60-65% in earlier years, only 43% in 2017). It was noted that five of the seven purse seiners were small vessels and that their contribution to the total catch was small. An effort was made to reduce the catch of yellowfin as the proportion of yellowfin in 2017 was 43% as compared to ~60% in recent years. Mauritius noted that observer coverage for longliners has recently been implemented and coverage in the purse seine fleet was low. Coverage in the purse seine fleet was above the required 5%.
- **Mozambique**: Nil comment.
- **Oman, Sultanate of**: Nil comment.
- **Pakistan**: Nil comment.
- **Philippines**: Nil comment.
- **Seychelles, Republic of**: The SC **QUERIED** uncategorised (NEI species) catches from the longline fleet in 2017 (~4000 t) and it was clarified that these were consisting mostly of oilfish and some species of sharks. The SC noted that new logbooks are being implemented to enable better reporting resolution and

that while Seychelles-flagged longliners are fishing beyond 25 degrees South there are no data on interactions with seabirds and other protected species. Seychelles noted that they are collaborating with Birdlife South Africa and are expecting to have estimates of seabird mortality in 2019. The SC **NOTED** that Seychelles are also in the process of developing a NPOA for seabirds, which is due to be completed in 2019, and that the testing of a pilot electronic monitoring system for longliners is scheduled for the near future.

- **Sierra Leone**: The SC expressed its disappointment that Sierra Leone did not provide a National Report and **REQUESTED** that the SC Chairperson, in conjunction with the Chairpersons of the Compliance Committee and Commission, remind Sierra Leone to fulfil its reporting obligations to the IOTC. Sierra Leone became a Contracting Party of the IOTC in 2008 and as such it is a requirement to comply with the National Report obligation to the Scientific Committee.
- **Somalia**: Nil comment.
- **South Africa:** The SC **QUERIED** South Africa on the composition of its pelagic longline fleet, and it was noted that only a limited number of vessels (3) operated under joint venture arrangements. In response to a query around how catch and effort for the South African fleet is managed between IOTC and ICCAT, the SC noted that most of these challenges relate to procedural issues as opposed to technical issues. And South Africa clarified that only IOTC catch and effort are included in its IOTC annual report. South Africa noted that for scientific reporting purposes (e.g. as input to stock assessment) it would usually be better to report catch and effort information at the stock level (as opposed to a regional level).
- **Sri Lanka:** The SC noted that observer coverage during 2017 was 13% and that observers were being deployed on all vessels greater than 24 m but not on vessels less than 24 m in length. The SC noted that the large spatial distribution outside Sri Lanka's EEZ is based on observer data, whereas the effort distribution from logbooks showed a much restricted spatial distribution of fishing activities within the EEZ. In response, it was noted that the spatial distribution of effort data in recent years are mostly restricted to the Sri Lankan EEZ where the spatial distribution for observer data is mapped for a four year period starting from 2013, during which time 7 Sri Lankan purse seine vessels operated..
- **Sudan:** The SC expressed its disappointment that Sudan did not provide a National Report and **REQUESTED** that the SC Chairperson, in conjunction with the Chairpersons of the Compliance Committee and Commission, remind Sudan to fulfil its reporting obligations to the IOTC. Sudan became a Contracting Party of the IOTC in 1996 and as such it is a requirement to comply with the National Report obligation to the Scientific Committee.
- **Tanzania, United Republic of**: The SC expressed its disappointment that Tanzania did not provide a National Report and **REQUESTED** that the SC Chairperson, in conjunction with the Chairpersons of the Compliance Committee and Commission, remind Tanzania to fulfil its reporting obligations to the IOTC. Tanzania became a Contracting Party of the IOTC in 2007 and as such it is a requirement to comply with the National Report obligation to the Scientific Committee.
- **Thailand**: The SC noted that Thailand purse seine fisheries on the Saya de Malha bank were mostly targeting round scad and bigeye scad, as well as neritic tunas on 0-150m depths.
- **United Kingdom (OT)**: The SC noted the statement made by Mauritius, as provided in Appendix 4a.
- **Yemen**: The SC expressed its disappointment that Yemen did not provide a National Report and **REQUESTED** that the SC Chairperson, in conjunction with the Chairpersons of the Compliance Committee and Commission, remind Yemen to fulfil its reporting obligations to the IOTC. Yemen became a Contracting Party of the IOTC in 2012, and as such it is a requirement to comply with the National Report obligation to the Scientific Committee.

29. The SC sought clarification on areas of demarcation between SIOFA and IOTC and how these fisheries and activities are differentiated. It was noted that IOTC is focused on pelagic fisheries while SIOFA is mostly dealing with midwater trawl and demersal trawl and line fishing.

30. The SC noted that there are apparent discrepancies in the IOTC database (as this is disseminated through the IOTC website) and the catch levels in 2017 and previous years for tropical tuna species as reported during the WPTT20. The SC **ACKNOWLEDGED** that this difference was due to the need to provide two distinct nominal catch series to account for the ongoing re-estimation of Indonesian fresh-tuna longline catches, that the method to produce these revised best scientific estimates for the time series has been endorsed during the last WPDCS and that therefore these apparent discrepancies will soon disappear.

6.3 Cooperating Non-Contracting Parties (CNCPs)

31. The SC noted that only one National Report was submitted to the IOTC Secretariat in 2018 by Cooperating Non-Contracting Parties (CNCPs). The following matters were raised in regard to the content of specific reports:

- **Liberia**: The SC expressed its disappointment that Liberia did not provide a National Report and **REQUESTED** that the SC Chairperson, in conjunction with the Chairpersons of the Compliance Committee and Commission, remind Liberia to fulfil its reporting obligations to the IOTC. Liberia was granted Cooperating Non-Contracting Party status for the first time by the Commission at its 18th Session (2014), and as such it is a requirement of CNCP status to comply with the National Report obligation to the Scientific Committee.
- **Senegal**: Nil comment.

6.4 Invited Experts

32. The SC noted the information provided by the Invited Experts from Taiwan,China which outlined fishing activities in the IOTC Area of Competence. The report from the Invited Experts is available from the IOTC Secretariat upon request.

7. REPORTS OF THE 2018 IOTC WORKING PARTY MEETINGS

7.1 Report of the 8th Session of the Working Party on Neritic Tunas (WPNT08)

33. The SC noted the report of the 8th Session of the Working Party on Neritic Tunas (IOTC–2018–WPNT08–R[E]), including the consolidated list of recommendations provided as an appendix to the report. The meeting was attended by 18 participants (26 in 2017), including 6 recipients of the MPF (13 in 2017).

7.1.1 Data quality issues

34. The SC noted that compliance with data reporting obligations is particularly low for neritic tuna species, despite the importance of scientific data for stock assessment, and **REQUESTED** CPCs do their best to collect data and comply with data reporting requirements adopted by the IOTC. The SC further noted that these issues have been noted for several years with little progress made intersessionally. While there are ongoing initiatives to tackle many of these issues, very little progress has been made and therefore the SC strongly **REQUESTED** that the WPDCS take up these issues and address them in that forum.

35. The SC noted ongoing technical and financial constraints with data collection and reporting requirements for these fisheries and that data was a key issue slowing progress towards better assessment and the ability to provide robust management advice to the Commission. The SC also noted that there can be a trade-off between capacity building exercises, which may be required to increase capacity to collect and provide data, and the urgency for assessment and appropriate management measures.

7.1.2 Assessment and status of neritic tunas

36. The SC noted ongoing concerns around the status of neritic tunas, in particular longtail tuna and narrow-barred Spanish mackerel, both of which are in the red zone of the Kobe plot (i.e. overfished and subject to overfishing). Furthermore, the SC noted that actions proposed to reduce catches have been rejected by some CPCs. In response to these concerns, the SC noted that these concerns would be captured in the Executive Summaries which could then be used by CPCs and the Commission in the formulation of management measures.

37. The SC noted that the stock structure for neritic species was likely to be more complex than that currently assumed and that this was a critical assumption that needs to be resolved to underpin reliable assessments and management. Consequently, it was suggested that stock structure studies should be given higher priority in the WPNT Program of Work. Genetics and other sampling to inform stock structure understanding is currently lacking or non-existent for most species.

38. The SC noted that all of the neritic tuna stock assessments that have been used for management advice are based on data limited catch-only methods, but there may be some more promising approaches such as CPUE or size-based methods that could use a smaller set of better quality data. The SC noted that these datasets are being explored and this exploration may also assist with understanding issues such as stock structuring or local depletion.

39. The SC **RECOMMENDED** that the Commission allocates funding for a consultancy to support the CPCs identified in Appendix VI of the report of the 8th session of the Working Party on Neritic Tunas (IOTC–2018–WPNT08–R[E]) with CPUE standardisation for the priority species identified.

7.1.3 Program and schedule of work

40. The SC **AGREED** that a cycle of assessments (e.g. every three years) and other intermediate meetings for data preparation and capacity building in non-assessment years would ensure momentum is maintained.

7.1.4 Working party attendance and the MPF

41. The SC noted that the technical nature of the 2018 WPNT meeting may have deterred some CPCs from attending. Furthermore, the SC noted that a number of interested CPCs could not attend the WPNT in 2018 due to overlaps with other meetings, as well as cultural and religious events, and urged the Secretariat to consider these meetings and events when planning future WPNT meetings in order to encourage higher participation.

42. Noting the low number of participants from CPCs at the 2018 WPNT meeting (six excluding the Chair and Vice-Chair), the SC **RECOMMENDED** that future capacity building actions and specialised workshops are conducted back-to-back with the regular Working Party meetings so that each CPC can send their most appropriate scientists to the meetings and workshops.

7.2 Report of the 16th Session of the Working Party on Billfish (WPB16)

43. The SC noted the report of the 16th Session of the Working Party on Billfish (IOTC–2018–WPB16–R), including the consolidated list of recommendations provided as an appendix to the report. The meeting was attended by 20 participants (25 in 2017) including 5 recipients of the MPF (8 in 2017).

44. The SC recalled its previous **RECOMMENDATION** that on the next revision of the IOTC Agreement, the short bill spearfish (*Tetrapturus angustirostris*) be included as an IOTC species.

7.2.1 Review of the statistical data available for billfish

45. The SC noted the ongoing issues regarding the reliabilities and uncertainty of the reported catch data for billfish (e.g. reconstructed catch series from Pakistan, the estimation of Indonesian fresh LL catches and the recently very high catches reported by I.R. Iran and India). The SC noted these issues are likely have a large impact on billfish stock assessments.

46. The SC noted the IOTC Secretariat has re-estimated the catches for Indonesia's fresh longline fleet and provided the WPB16 meeting with an alternative catch series (IOTC–2018–WPB16–DATA03b). The total catches mostly affect catches of swordfish, blue marlin, and striped marlin to a lesser extent, which have been revised downwards by as much as 30%. The SC further noted that these estimates have been reviewed by WPDCS14.

47. The SC noted that the key uncertainty with assessments relates to catch estimates and that attempts to explore alternative catch histories had been limited, and expressed concern that this work had not been attempted for marlins. The SC also noted that this is an issue that ranges across a broad range of species across multiple WPs and that more needs to be done to address this issue.

48. The SC noted that catches of black marlin increased by over 70% in recent years, which has a fundamental impact on the stock assessment. The SC further noted the increase is mainly for gillnet and coastal longline fleets from a small number of CPCs. The SC **AGREED** that if the recent increases reflect improvements in data collection and reporting, then catches from early years would have to be revised.

7.2.2 New information on biology

49. The SC noted that Chinese scientists used the observer data from Chinese longline fleets to provide the first estimates of the size at maturity for billfishes in the Indian Ocean: the estimates of 50% and 95% size at maturity are 161.4 cm and 226.2 cm for Blue marlin respectively, 177.0 cm and 238.1 cm for striped marlin, 166.9 cm 180.0 cm for black marlin, and 192.6 cm and 254.4 cm for Indo-pacific sailfish. The SC welcomed the study and noted that these estimates are useful in providing advice on the establishment of minimum conservation sizes for marlins and billfishes, as requested by Resolution 18/05.

50. The SC noted a preliminary study showing estimated size at maturity for marlin are much higher than the default minimum landing size specified in Resolution 18/05 (i.e. 60 cm LJFL, as specified in the Blue marlin executive summary). The SC noted the establishment of appropriate minimum conservation size should also take into account gear selectivity, and therefore **ENCOURAGED** CPCs to continue to improve catch sampling to better understand the size composition of marlin species captured by different gear types.

51. The SC noted that striped marlin shows large spatial variation in abundance and catchability in response to environmental conditions and suggested that environmental variables should be considered in future assessments. It was noted that such types of data could be accounted for during the CPUE standardisation process, or through the use of some stock assessment models (e.g. Stock Synthesis).

52. The SC noted a new genetics study (USA/VIMS Study) indicated a potential existence of 2 stocks of striped marlin in the Indian Ocean, which is different to the one-stock assumption currently used for management. Given its implications for management, the SC **REQUESTED** that marlins are prioritized in the second phase of the

IOTC stock structure project (currently implemented by CSIRO) to resolve the stock structure uncertainty for this species.

7.2.3 Black marlin stock assessment: Bayesian State Space Surplus Production Model (JABBA)

53. The SC noted that the JABBA model indicated that current stock is not overfished, and overfishing has not occurred, which differed from the result of the previous assessment which indicated that the stock status was in the red quadrant of the Kobe plot. The SC noted this may have been due to the fact that the recent large increases in catches were interpreted by the model as an increase in productivity.

54. The SC noted that the retrospective pattern suggested the model has a low predictive capability, and therefore projections were not conducted for this model.

55. The SC noted that the JABBA model indicated that the terminal stock status is in the green quadrant of the Kobe diagram, but the overall trajectory suggested the stock is heading towards the red quadrant. It also noted that current catches are well above estimated MSY. Given the large uncertainty in historical catch estimates and the inconsistence between the CPUE and recent catch levels, The SC **AGREED** that current stock status of black marlin is highly uncertain and that this should be reflected in the management advice.

7.2.4 Striped marlin stock assessment: Bayesian State Space Surplus Production Model (JABBA)

56. The SC noted the JABBA Model was consistent with the SS3 model, indicating that the stock has been subject to overfishing in the last two decades. As a result, stock biomass is well below the B_{MSY} level. The SC further noted that the JABBA model showed no retrospective pattern. The SC **AGREED** that it would be useful to carry out a comparison between estimates from current assessments and projection estimates from previous assessments in order to better evaluate the predictive power of the models and to ensure consistency between assessments.

57. The SC noted that the target and limit references have not been specified for IOTC marlin species. The current practice is to define overfished and overfishing stock status with respect to MSY related reference points. The SC is considering proposing potential refinements to the Kobe plots and foster discussion on defining "overfished" and "overfishing" in relation to target and limit reference points (which is to be conducted in collaboration with other t-RFMO, ideally through the Kobe process).

58. The SC noted that the use of 10 years for the projection represents a common practice of IOTC stock assessments, with the 3-year considered to be for the short term and the 10-year for the 'medium' term.

59. The SC noted that it is important to incorporate the uncertainty of catches in the stock assessment. The SC **AGREED** that characterising the uncertainty of historical catch estimates, especially for the early years, is a highly pertinent issue for all IOTC species and **ENCOURAGED** more work to be done to address the issues.

7.2.5 Swordfish MSE

60. The SC noted paper IOTC–2018–SC21–12 which provided an update on the conditioning of an operating model and initial testing of generic candidate management procedures for the Indian Ocean swordfish, including the following abstract provided by the authors:

*"This document presents the current status of development of an Operating Model for the Indian Ocean swordfish (*Xiphias gladius*) stock. It explores the role of the structural uncertainty in the current stock assessment by means of a grid of SS3 model fits. The current grid results in 2592 alternative population trajectories and productivity estimates. A subset of 2336 model runs is proposed to compose the base case OM, these runs were explored regarding the effects on several indicators and residual analysis of CPUE indices and stock-recruitment relationship. Cluster analysis was performed to identify model runs with similar population trajectories in order to decrease the number of runs included in the OM, as currently 2336 runs are too computationally demanding."*

61. The SC thanked the authors for their efforts and progress made so far on the swordfish MSE. The SC noted that the OM grid will consist of 2592 model runs, all of which have been carried out so far. The SC noted that the development of the OM covered the range of assumptions based on the initial set of options suggested by the WPM in 2017.

62. The SC noted that of the 2592 models, 256 models did not converge and were excluded from further analysis. The SC suggested it would be useful to identity the combination of parameter assumptions that might result in non-convergence and further noted that convergence may be improved using alternative starting values of parameters for these models.

63. The SC **AGREED** that it is important to ensure that key stock assessment estimates for swordfish are within the range of outputs of the operating models as part of the model conditioning process.

64. The SC noted that most uncertainty captured in the grid represents structural uncertainty and suggested it would be useful to consider additional uncertainty in the OM or in the robustness test (e.g. uncertainty in the catch estimates) to better evaluate fishery performance.

65. The SC noted that the technical aspect of the OM is expected to be completed in 2019 and will be followed by dialogue with the Commission. The SC further noted that tuning management objectives need to be determined for swordfish to facilitate the testing of harvest control rules.

66. The SC noted that one of the team members involved in the development of the swordfish OM is starting a PhD in 2019 with IO Swordfish MSE included as one objective. The SC noted that salaries are already covered for next years for that team member, but further funding is required to support the travelling and time for two short-term visits to the JRC, as well as to attend IO MSE-technical workshops and WPM meeting in 2019. The SC therefore **RECOMMENDED** to fund this work during 2019 in order to progress the work on the IOTC MSE for SWO, with a total of 10.000€ requested for 2019, further noting that part of the funds (around 3.000€) should be available earlier in the year to start the work no later than March 2019.

67. The SC noted that the next step of the swordfish MSE is to continue the validation of the OM and conduct initial testing of management procedures..

7.2.6 Revision of catch levels of Marlins under Resolution 18/05

68. The SC noted that Resolution 18/05 *On management measures for the conservation of billfish, striped marlin, black marlin, blue marlin and Indo-Pacific sailfish* encourages CPCs to *"…ensure that the overall catches, of the Indian Ocean Striped Marlin, Black Marlin, Blue Marlin and Indo Pacific Sailfish in any given year do not exceed either the MSY level or, in its absence, the lower limit of the MSY range of central values as estimated by the Scientific Committee…"*. Moreover, Resolution 18/05 also requires the SC to *"…annually review the information provided and assess the effectiveness of the fisheries management measures reported by CPCs on striped marlin, black marlin, blue marlin and Indo-Pacific sailfish and, as appropriate, provide advice to the Commission*".

69. The SC noted that catches in recent years for Black Marlin, Blue Marlin, Striped Marlin and Indo-Pacific Sailfish have all exceeded the catch limits set by Resolution 18/05, and that current catch trends for all four species show no signs of decline in line with meeting the catch limits by 2020. As such, the SC urgently **RECOMMENDED** that measures are agreed to reduce current catches to the limits set for all four species covered by Resolution 18/05 as per the management advice given in the Executive Summaries.

7.3 Report of the 14th Session of the Working Party on Ecosystems and Bycatch (WPEB14)

70. The SC noted the report of the 14th Session of the Working Party on Ecosystems and Bycatch (IOTC–2018–WPEB–R[E]), including the consolidated list of recommendations provided as an appendix to the report. The meeting was attended by 40 participants (39 in 2017) including 7 recipients of the MPF (7 in 2017).

71. The SC **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.

72. The SC 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 SC **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.

73. The SC noted concern in British Indian Ocean Territory around the impacts of drifting and beached FADs on habitats and species, and noted that monitoring has recorded 60 events in 10 months to October 2018 and SC requested about the possibility to expand the successful FADWATCH project, which has been focused on the Seychelles, for mitigating FAD beaching in other areas. The SC noted the request of the WPEB to expand the FADWATCH project to other areas and the Secretariat comment that funding is being secured for this initiative.

7.3.1 Bycatch species identification and data issues

74. The SC noted the encouraging results of research by WWF-Pakistan on the use of subsurface gillnet gears (i.e. net below 2m depth) as a tool to reduce bycatch of cetaceans, sharks and sea turtles, which were presented during the 2018 WPTT and WPEB meetings.

75. The SC noted issues with the species identification in Pakistan bycatch data. Pakistan noted that more precise data should be available in coming years.

76. Despite identification cards being available, the SC noted ongoing issues around species identification data for sea turtles, sharks, cetaceans and other bycatch species and **AGREED** that improvements to the collection of data for all bycatch species is required. The Secretariat noted that these data are currently collected through national reports and observer data submissions, but were often limited. Consequently, the SC **RECOMMENDED** to the Commission that the species reporting of turtles (as a first step) is improved through an amendment to Annexes II and III in Resolution 15/01.

7.3.2 BIOFAD project

77. The SC noted paper IOTC–2018–SC21–13 which provided an update on progress in the BIOFAD project, including testing designs and identifying options to mitigate impacts of drifting FADs on the ecosystem, including the following abstract provided by the authors:

"Despite currently used EU FADs designs have eliminated their entangling characteristic, these are largely made by non-biodegradable materials contributing to increase marine debris, and with other negative impacts in the ecosystem like potential FADs beaching. The IOTC, along with other tuna RFMOs, have made recommendations and published resolutions to promote reduction of the amount of synthetic marine debris by the use of natural or biodegradable materials for drifting FADs. However, there are some practical aspects that needs to be clarified for the operationalization of this type of FADs construction and effective replacement of materials. In line with this, the consortium formed by AZTI, IRD and IEO aims through the Specific Contract N0 07 under the Framework Contract EASME/EMFF/2016/008 provisions of Scientific Advice for Fisheries Beyond EU Waters to address current impediments and to provide solutions that shall support the implementation of non-entangling and biodegradable FADs in the IOTC Convention Area" (see paper for full text).

78. The SC noted that the BIOFAD trial project was more developed in the Indian Ocean than the project in the Atlantic Ocean and that comparison of results between the two regions would be useful. The SC noted that both projects had co-finance available through the FAO's ABNJ project (funded through GEF) and they are actively encouraging fleets from other countries to become involved. The SC noted the intention to deploy a similar program in the Atlantic in 2019.

79. The SC noted the intention to compare the efficacy of BIOFADs versus conventional FADs using acoustic and catch data. This phase has not commenced but data will be presented to future WPs.

7.3.3 Resolution 17/05 and the conservation of sharks in IOTC fisheries

80. The SC noted paper IOTC–2018–WPDCS14–37 which provided an update on Resolution 17/05 and the conservation of sharks in IOTC fisheries, including an assessment of shark finning in the IOTC area, including the following abstract provided by the author:

"Shark finning is the practice of removing and retaining all or some of a shark's fins and discarding its carcass at sea. With the adoption of the 1999 FAO International Plan of Action-Sharks the international community agreed to the principle of minimizing waste and discards from shark catches, citing in particular the need to retain carcasses if fins are removed (FAO 1999). Following this, regional fisheries management organizations, as well as some of their member States, adopted regulations designed to implement this principle" (see paper for full abstract).

81. The SC noted that this study was conducted in response to a request from the Commission in 2018 (IOTC–2018–S22–R):

(Para. 39) The Commission AGREED to the requests made to the Compliance Committee and Scientific Committee in working paper IOTC-2018-S22-06Rev1:

- *to analyse and document, wherever possible, whether the practice of shark finning still takes place in IOTC and to what extent, despite the adoption of Resolution 17/05, and to review the compliance with the requirements contained in Res 17/05, including the shark finning prohibition and the fins naturally attached requirement adopted by IOTC (Compliance 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. (Scientific Committee).*

82. The SC acknowledged that this document covers both points requested by the Commission, however, the SC only has the mandate to address the second point as the first point is expressly aimed at the Compliance Committee.

83. In response to a number of concerns around some of the recommendations from the paper, the SC noted that the objective was 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. The SC

noted that these were not specific recommendations for its consideration at SC21 but would be explored further during the 2019 WPEB meeting.

7.3.4 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

84. The SC noted paper IOTC–2018–SC21–06 which provided the SC with the opportunity to update and comment on the current status of development and implementation of national plans of action for seabirds and sharks, and implementation of the FAO guidelines to reduce marine turtle mortality in fishing operations, by each IOTC CPC.

85. The SC **RECOMMENDED** that the Commission note the current status of development and implementation of National Plans of Action (NPOAs) for sharks and seabirds, and the implementation of the FAO guidelines to reduce marine turtle mortality in fishing operations, by each CPC as provided in Appendix 5, recalling that the IPOA-Seabirds and IPOA-Sharks were adopted by the FAO in 1999 and 2000, respectively, and recommended the development of NPOAs.

7.3.5 Outcomes from the updated ecological risk assessments for sharks

86. The SC noted paper IOTC–2018–SC21–14 which provided an updated ecological risk assessment for shark species caught in fisheries managed by the IOTC, including the following abstract provided by the authors:

"Ecological risk assessment (ERA), and specifically Productivity-Susceptibility Analysis (PSA), is a useful methodology for assisting the management of fisheries from an ecosystem perspective in a data poor situation. Indian Ocean tuna and tuna-like fisheries, managed by the Indian Ocean Tuna Commission (IOTC), are economically important both at local and international scales and interact with several non-target or bycatch species. A PSA for shark caught in various longline fleets, purse seiner fleet and gillnet fleet operating in the Indian Ocean was carried out. We follow the methodology proposed by Cortés et al. (2010), which allow ranking the vulnerability of the species based on its productivity and susceptibility to the fishing gear. 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 was 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" (see paper for full abstract).

87. The SC thanked the authors for the work, which was undertaken by 13 collaborators from multiple member countries.

88. The SC noted that despite the encouraging progress, results were still highly uncertain and that stock status (e.g. B or F estimates) cannot be inferred from such studies. The SC acknowledged that where information on stock status was needed, simple production models or other data poor assessment methods may be more appropriate. The SC suggested that for future assessments, uncertainty in the data could be better captured in the presentation of results.

89. The SC noted that these methods are intended to give an estimate of relative risk and may be useful for prioritising species for additional data collection, more comprehensive assessments and possible management actions.

90. The SC noted that the timeframe for updating ecological risk assessments should be considered carefully in the context of the time and effort to run the assessments and the benefits derived from such assessments, including how they can be used to provide management advice. Following extensive discussion on the pros and cons of ecological risk assessment, the SC **AGREED** that such methods cannot be used to provide advice on status. The SC further suggested that ecological risk assessments should only be updated when there are significant changes in the fishery or biological characteristics or large changes in catch and/or effort (e.g. each 5-6 years).

91. The SC noted a lack of information on shark catches, as evidenced by only 55% of total shark catches across the IOTC area of competence being identified to a species level. The SC suggested that current regulations allowing the landing of headed and skinned carcasses may prohibit better identification at landing. The SC suggested that a possible solution is to use genetic testing, but that there are currently difficulties with this approach relating to the ability of observers or other sampling methods to collect reliable samples.

92. The SC noted the ecological risk assessment work for sharks, turtles and seabirds and that ERA approaches are a useful way to prioritise relative risk between species, but do not provide information that is analogous to quantitative stock assessment. It was suggested that future work could explore the overlap between ERA and stock assessment methods in the context of how they can be used to provide management advice.

93. The SC **AGREED** that the results of the marine turtles and sharks ERAs would be used to update the executive summaries for relevant species.

7.3.6 Progress towards Ecosystem Based Fisheries Management (EBFM) in IOTC – Preliminary Ecosystem Report Cards

94. The SC noted the agreement to work intersessionally to develop ecosystem indicators for different components and for this to be presented to the next WPEB meeting. This is included in Appendix XIX workplan of the WPEB report.

95. The SC noted that while IOTC may develop its own unique approaches to EBFM, collaboration with ICCAT on its recent work on the implementation of EBFM would be beneficial. The SC further noted that IOTC documents relevant to the collection of socio-economic information were available.

96. The SC noted paper IOTC–2018–WPDCS14–36 which described a proposal for the development of an ocean-climate web page for the IOTC, including the following abstract provided by the author:

"In the vein of the growing interest of fisheries scientists from the Indian Ocean to incorporate environmental factors and climate variability in fisheries research and fish stock assessment, we propose to develop an "ocean climate web page" for the Indian Ocean, to be hosted on the FAO/IOTC web site, with regular updates of the information posted on this web page. In this paper, we present a draft of the site structure and possible content that is open to discussion at the WPDCS14. The ocean climate web page is a compilation of selected information produced by ocean data centres and scientific organisations on the status of the Indian Ocean and how it responds to climate variability. This set of information is intended to inform tuna scientists, fisheries managers on the status and trends of essential characteristics in the open ocean ecosystems of the Indian Ocean, with emphasis on tuna habitat."

97. The SC agreed that this work should be incorporated into the ecosystem report card project and encouraged the authors to collaborate with that initiative.

98. Acknowledging that current models used in IOTC do not explicitly consider the influence of climate change and variability on ecosystems and fisheries resources, the SC noted variety of ecosystem models in use globally (e.g. Atlantis, ECOSIM, APECOSM) that could be used to better explore these influences. The SC suggested that assessments of the use of these systems could be undertaken by small working groups within the WPEB, noting that funding and appropriate research frameworks would be needed to underpin this work.

99. Acknowledging that the IOTC Secretariat has limited human resources, the SC noted that algorithms for automatically transferring the large amount of information from external portals to be included on the website should ensure that there is minimal strain on IOTC resources for the implementation of this initiative.

100. The SC noted that the currency of information could be maintained in near real-time, with a lag of 1-2 months.

101. Acknowledging the potential benefits of a climate-ocean web portal and regular updates on these influences to the SC and WPs, the SC **RECOMMENDED** a scoping study into how ocean-climate information as described in the proposal could be made available through the IOTC webpage and how this information would be presented to the WPs and SC. The scoping study should also consider the currency and quality of the information sources to be used.

7.4 Report of the 20th Session of the Working Party on Tropical Tunas (WPTT20)

102. The SC noted the report of the 20th Session of the Working Party on Tropical Tunas (IOTC–2018–WPTT20–R), including the consolidated list of recommendations provided as an appendix to the report. The meeting was attended by 57 participants (48 in 2017), including 7 recipients of the MPF (10 in 2017).

7.4.1 Yellowfin tuna stock assessment and development of management advice

103. The SC noted that the 2018 yellowfin tuna assessment indicates that the species is overfished and subject to overfishing and catch reductions required as part of Resolution 18/01 have not been met. The SC further noted that there remain significant uncertainties around the stock assessment inputs and assumptions, such that caveats are required in the interpretation of management advice developed for the species. Acknowledging these concerns, the SC **RECOMMENDED** that funding be allocated for a workplan (Appendix 38) to systematically address these issues, beginning in January 2019.

104. The SC noted that status is currently defined in relation to the target reference point and suggested that it may be more useful to describe status in relation to the limit reference point. Acknowledging that this issue had been discussed in detail by the SC and WPM during previous meetings, the SC noted that a change to the definition of status in relation to the limit reference point would need to be agreed by the Commission. The SC noted that the WPM had requested the SC to display status on Kobe plots in relation to the limit reference point as well as the target reference point.

105. The SC noted the usefulness of retrospective analyses to inform management advice, and that informal protocols and expert judgement have been used in the past. However, the SC noted these analyses have not been done in much detail due to a lack of time and resources and suggested that a formal protocol for how these should be undertaken would be beneficial. The SC noted its concern around the likelihood that the current assessment is overestimating F and underestimating B and noted the need to decide whether the retrospective error is significant enough to infer the reliability of B and F estimates. The SC **AGREED** that development of a protocol to decide whether retrospective errors need to be corrected would be useful.

106. Acknowledging that many improvements have been made over time, particularly with CPUE and joint CPUE analyses, the SC noted ongoing uncertainties with nominal catch, tagging, CPUE, growth and length composition data. The SC noted an activity by the Secretariat to review length composition data is to be completed before WPTT in 2019, with these activities expected to improve the analyses.

107. The SC noted that despite increasing model complexity over time, issues with uncertainty remain. The example of the surplus production model for longtail tuna provided in the WPNT08 report that had similar outcomes to the complex SS3 assessment was given. It was noted that these simpler models, including for example JABBA, a surplus production model, could be used in the attempt to compare or corroborate more complex models for tropical tuna species as well.

108. Noting the current status of the yellowfin tuna stock, the SC **ENCOURAGED** CPCs utilise the outcomes from the MSE work undertaken by the WPM to develop proposals for candidate Management Procedures for yellowfin tuna. In doing so, CPCs should follow the process outlined in the Commission's Schedule of Work for the development of management procedures, which describes the iterative process that needs to be followed, and the roles of the relevant IOTC committees and sub-committees, in developing Management Procedures.

109. The SC noted that the decrease in longline CPUE from 2007–2011 may have reflected the redistribution of fishing effort due to piracy and may be causing the model to estimate low recruitment. The SC noted sensitivity trials to test this hypothesis did not reveal the real cause for low recruitment estimates. The SC also noted the model sensitivity exploring PS CPUE included both FAD and free school CPUE rather than the free school CPUE alone as suggested. The SC **AGREED** that these (and other) uncertainties result in the need to be cautious in the development of management advice.

110. The SC noted paper IOTC–2018–SC21–15 which described requests to the joint CPUE standardization, including the following abstract provided by the authors:

"Japan requests four issues to the joint standardized CPUE (STD CPUE), (a) to create maps showing areas covered by the joint STD CPUE, (b) to produce STD CPUE by fleet to evaluate plausible ones and periods to be used for the joint CPUE, (c) to produce tempo-spatial aggregated joint CPUE and (d) to complete technical transfer for national scientists to be able to produce joint CPUE by themselves."

111. The SC suggested that more time and flexibility may be required for future joint CPUE analyses, and noted that consultant undertaking the joint CPUE analysis only had access to the data for five days and that it is not possible to replicate their analysis. The SC further noted that there are ongoing challenges with technical transfer and capacity building. The SC **AGREED** on the need to ensure that in future, sharing of relevant coding is enhanced and tutorials or manuals are produced or provided as part of the consultancy. The SC further **AGREED** that a protocol for joint CPUE is required for future iterations.

112. The SC **REQUESTED** to generate CPUEs for the whole of the Indian Ocean to be used in the current candidate management procedures that are being tested and that basing advice on CPUE that is intended to be representative of the entire stock would be very useful. The SC also **REQUESTED** the creation maps showing spatial coverage of the joint CPUE analyses.

113. The SC **AGREED** to the continuation of CPUE standardization analyses as this is a critical input to the bigeye tuna and yellowfin tuna stock assessments.

114. The SC noted paper IOTC–2018–SC21–INF02 which provided a review by the Invited Expert to WPTT20 of the 2018 yellowfin tuna stock assessment, including the following abstract provided by the author:

"Different approaches were examined in the YFT Assessment examined in 2018, however, conflicting data inputs, data weighting and catchability changes may create problems in the assessment. Issues of convergence/local minima need to be checked thoroughly with jitters. Other diagnostics such as profile likelihood techniques and retrospectives are important to examine. Overall in general this topic needs more time and coverage in the future, as currently the diagnostics examined were limited. In addition, length frequency data are particularly important for the age structured assessments used, and accuracy in these data is crucial to the inference, as large uncertainties still exist in this series (particular attention to ESS and how they influence inference are important).

Data weighting issues were not examined extensively, and further work is warranted regarding this subject, as weights between length composition data, CPUE and tagging data can provide very different inferences on the population. Overall, the process was transparent, and issues were briefly discussed relevant to uncertainty in the assessment results. A key limitation was that insufficient time was available to examine both data and assessment issues at the meeting. If we could discuss model resolution and data before the meeting, additional time would be available to discuss further refinements in the assessments. Preliminary analysis using hindcasting techniques suggest that the model has poor predictive power which is a concern, and may also be problematic as it has local minima issues. Finally, approaches dealing with uncertainty and projections were not given due importance, but as these are critical for stock status advice, and management advice that would sustain the long-term sustainability of the stock, additional time should be spent on these issues in the future."

115. The SC noted that external expert review is critical to fostering transparency and improving future stock assessments and further noted that there is currently no formal mechanism to incorporate the findings of expert review into the IOTC process. The SC suggested that small intersessional working groups could be formed to extract useful recommendations and provide a synthesis report to be taken to next assessment, which would ensure the valuable advice generated would not be lost. The SC further suggested that expert reviews should be made publicly available.

116. The SC **REQUESTED** that in the future, model diagnostics, including retrospective analyses, jittering and likelihood profiling be conducted to increase confidence that the models are reaching a global minima during fitting and to look for major conflict in data sources.

117. The SC noted paper IOTC–2018–SC21–16 which provided the Indian Ocean yellowfin tuna SS3 model projections, including the following abstract provided by the authors:

"This document presents projections and K2SM for the 2018 Indian Ocean tuna Stock Synthesis assessment model. Deterministic projections were conducted for the 24 reference grid scenarios for 2018 – 2027 assuming a constant level of catch at 60%–120% of the 2017 catch level. The projection incorporates the range of uncertainty among model selection but does not describe uncertainty due to parameter estimation error, or stochastic future recruitment variability."

118. The SC noted the limitations with the use of deterministic runs out of 24 models with regards to the complexity of the yellowfin stock assessment and that confidence intervals had not been available for each model. As a result, the K2SM probabilities have only considered the structural uncertainty of the assessment but not the statistical uncertainty of the models.

119. The SC noted that examination of the projections from the last iteration of the assessment in 2015/2016 had not been used to evaluate performance of the current assessment, but that efforts had been made to ensure continuity of assessments over time and the process followed has allowed understanding of how updated data has influenced results. The SC noted that hindcasting and retrospective techniques could be used to look at predictive capacity but that it was difficult to meaningfully compare the two assessments. The SC further noted that the 2016 assessment trying to build a base case characterizing statistical uncertainty whereas the current assessment was based on a model grid capturing model uncertainties.

120. The SC noted the retrospective and hindcasting analysis appeared to suggest that the current assessment model has a poor predictive capacity. The SC noted that large uncertainty is also likely associated with biological reference points which are estimated from the same stock assessment models.

7.4.2 Future yellowfin tuna assessments: issues for consideration

121. Noting uncertainty in data and in some biological parameters in the yellowfin tuna assessment, some of which were not captured in the final grid for the assessment, the SC **REQUESTED** that future assessments capture a broader range of uncertainties.

122. The SC noted that in the interests of transparency and to enable further exploration of uncertainty, future WPTT reports need to explicitly list all major assumptions.

123. The SC **RECOMMENDED** that development of the next stock assessment of yellowfin tuna should include, or be associated with, a detailed review of the existing data sources, including:

    i. Size frequency data: Evaluation of the reliability of length composition from the longline fisheries (including recent and historical data), review of anomalies in the (EU) PS length composition data, and the need for a thorough review of the size frequency data held by IOTC, in collaboration with the fleets involved, to improve the utilization of these data in tropical tuna stock assessments.

    ii. Tagging data: Further analysis of the tag release/recovery data set.

iii. Alternative CPUE series: a review of the available data from the Indian tuna longline survey data.

7.4.3 Review of the implementation of Resolution 18/01 On an interim plan for rebuilding the Indian Ocean yellowfin tuna stock

124. The Commission has an interim plan for the rebuilding the yellowfin stock, with catch limitations based on 2014/2015 levels (Resolution 18/01). Some of the fisheries subject to catch reductions had fully achieved a decrease in catches in 2017 in accordance with the levels of reductions specified in the Resolution; however, these reductions were offset by increases in the catches from some CPCs exempt and some CPCs subject to limitations on their catches of yellowfin tuna (see table 3 below). Thus, while catches for fleets subject to Resolution 18/01 decreased by 1% in 2017 compared to the baseline (2014/2015), the total catches of yellowfin in 2017 increased by around 3% from 2014/2015 levels. The Commission should ensure that any revision of the management measure can effectively achieve any prescribed catch reduction to ensure the effectiveness of the management measure.

125. The SC noted that information on catches from coastal fisheries is particularly limited.

Table 3: Catches of YFT in relation to the implementation of Resolution 18/01

Purse seine fleets		Target: catch reduction from baseline	2014	2015*	2016	2017	% change from baseline
Subject to Resolution 18/01	EU	-15%	91,405	86,149	87,075	86,893	-5%
	Rep. of Korea		8,852	7,509	10,347	6,362	-28%
	Seychelles*		23,463	39,072	40,014	41,694	7%
	Sub-total		**123,720**	**132,730**	**137,437**	**134,949**	**-3%**
Not subject to Resolution 18/01	Egypt		-	-	0	-	-
	India		98	76	84	84	-15%
	Indonesia		5,598	5,493	5,214	5,214	-7%
	I.R. Iran		4,832	3,842	3,465	1,764	-63%
	Japan		433	338	422	657	52%
	Jordan		-	-	0	-	-
	Mauritius		4,844	5,448	7,404	7,681	59%
	Mozambique		-	-	126	-	-
	Philippines		-	-	-	73	-
	Sri Lanka		2,627	3,532	1,966	5,505	110%
	Sub-total		**18,432**	**18,729**	**18,682**	**20,978**	**14%**
Resolution 18/01: PS change in catches from baseline (*2015 Seychelles PS; 2014 all other PS fleets*)							**-1%**
Longline fleets		Target: catch reduction from baseline	2014	2015	2016	2017	% change from baseline
Subject to Resolution 18/01	Taiwan,China	-10%	12,285	13,921	16,958	9115	-26%
	Sri Lanka		8,625	5,933	3,939	6448	-25%
	Sub-total		**20,910**	**19,855**	**20,896**	**15,563**	**-26%**
Exempt from Resolution 18/01	Australia	N/A	19	73	66	65	-
	Belize		46	-	-	-	-100%
	China		1,078	1,793	1,812	2,962	175%
	EU		596	430	329	169	-72%
	EU,Reunion		298	302	322	200	-33%
	India		327	669	106	106	-68%
	Indonesia		4,009	5,077	2,826	2,353	-41%
	Japan		3,639	3,140	2,976	3,305	-9%
	Rep. of Korea		1,557	1,674	1,374	1,802	16%
	Madagascar		59	72	61	28	-53%
	Malaysia		77	144	156	370	379%
	Maldives		120	63	286	220	83%
	Mauritius		15	32	94	266	1675%
	Mozambique		1	56	21	89	6291%
	NEI.Fresh		4,065	3,009	418	-	-
	NEI.Frozen		417	451	693	-	-
	Oman		28	205	135	135	385%
	Philippines		69	-	-	-	0%
	Seychelles		1,616	2,395	3,247	3,963	145%
	South Africa		83	182	183	247	198%
	Tanzania		155	108	109	-	-
	Thailand		187	109	-	-	-
	Sub-total		**18,462**	**19,985**	**15,214**	**16,280**	**-12%**
Resolution 18/01: LL change in catches from baseline (*2014*)							**-19%**

Gillnet fleets		Target: catch reduction from baseline	2014	2015	2016	2017	% change from baseline
Subject to Resolution 18/01	India (offshore GN)	-10%	5,153	3,974	4,392	4392	-15%
	I.R. Iran (offshore GN)		24,401	26,780	31,079	32,347	33%
	Sub-total		**29,554**	**30,754**	**35,471**	**36,739**	**24%**
Exempt from Resolution 18/01	Australia	N/A	0	0	1	1	226%
	Bahrain		1	1	1	0	-55%
	Comoros		16	117	905	547	3295%
	Djibouti		37	31	51	26	-29%
	East Timor		0	1	1	0	-29%
	Egypt		-	6	5	3	-
	Indonesia		341	334	317	317	-7%
	I.R. Iran		16,925	11,632	4,031	13,204	-22%
	Jordan		12	9	8	5	-56%
	Kenya		54	82	82	82	52%
	Oman		2,268	8,145	6,914	9,646	325%
	Pakistan**		7,533	7,533	7,533	7,533	0%
	Qatar		110	133	120	77	-30%
	Sri Lanka		11,246	8,559	5,469	3,142	-72%
	Tanzania		3,210	3,814	3,814	3,814	19%
	Yemen		81	-	-	-	-
	Sub-total		**41,836**	**40,398**	**29,252**	**38,397**	**-8%**
Resolution 18/01: GN change in catches from baseline (*2014*)							**5%**
All other (coastal) gears		Target: catch reduction from baseline	2014	2015	2016	2017	% change from baseline
Subject to Resolution 18/01	Maldives (bait boats)	-5%	18,481	15,796	8,550	17500	-5%
	Maldives (hand-lines)		30,246	36,300	44,385	30563	1%
	Sub-total		**48,727**	**52,096**	**52,935**	**48,063**	**-1%**
Exempt from Resolution 18/01	Australia	N/A	0	0	0	1	63%
	Comoros		1,383	1,630	4,679	4259	208%
	East Timor		3	3	3	3	0%
	Egypt			10	10	12	0%
	EU		171	5	89	81	-52%
	EU,Reunion		120	357	476	363	203%
	India		27,849	12,440	14,662	14662	-47%
	Indonesia		15,327	15,041	14,278	14278	-7%
	I.R. Iran		57	345	6,535	8806	15252%
	Jordan		14	16	17	20	45%
	Kenya		17	27	27	27	52%
	Madagascar		675	675	675	675	0%
	Maldives		364	279	485	1078	196%
	Mauritius		50	50	87	69	39%
	Mozambique		4	13	27	80	1888%
	Oman		4,912	6,833	13,935	9693	97%
	Seychelles		0	0	0	0	-70%
	South Africa		0	-	-	-	-
	Sri Lanka		15,280	14,647	22,361	22883	50%
	Tanzania		76	90	90	90	19%
	UK,Territories		2	2	2	3	63%
	Yemen		29,093	24,576	21,100	21100	-27%
	Sub-total		**95,398**	**77,040**	**99,536**	**98,182**	**3%**
Resolution 18/01: Other gears change in catches from baseline (*2014*)							**1%**

Note: Some figures presented in table 3 may be subject to revision.

7.4.4 Review of new information on fisheries and associated environmental data

126. The SC acknowledged the importance of the proposed harmonisation of FOB types and FOB activity definitions and **REQUESTED** that the concept of harmonisation be taken up by the WPDCS in collaboration with the Scientific Committee with the aim of harmonising IOTC definitions with those used by other tRFMOs in the context of the joint tRFMO Working Group on FADs.

7.4.5 Review of the statistical data available for skipjack tuna

127. The SC noted that total catches in 2017 (524,282 t) were 12% higher than the catch limit generated by the Harvest Control Rule (470,029 t) which applies to the years 2018–2020, and that there has been an increasing trend in catches over the past 3 years. The SC **RECOMMENDED** that the Commission consider the urgent need to monitor catches of skipjack in the 2018–2020 period to ensure catches do not exceed the limit.

128. The SC noted that Resolution 16/02 does not define exceptional circumstances other than those caused by environmental influences (for example, increases in catch) and **REQUESTED** the MSE working group and WPM to review the range of exceptional circumstances that may be relevant for skipjack tuna as well as other species. The SC noted 15% implementation error of the TAC was evaluated in the skipjack tuna MSE.

7.4.6 WPTT priorities and Program of Work

129. The SC noted the importance of exploring uncertainties in growth curves and noted that this was listed in the priorities for work of the WPTT.

7.5 Report of the 6th Session of the Working Party on Temperate Tunas

130. The SC noted that no meeting of the Working Party on Temperate Tunas was held in 2017 or 2018, and that an update on the status and priorities for temperate tuna species, as well progress on recommendations from WPTmT06 and the previous SC meeting, was provided by the Secretariat.

131. The SC noted that the 7th Session of the Working Party on Temperate Tuna: Data Prepatory Meeting is planned for January 2019 in Kuala Lumpur, Malaysia and the 7th session of the WPTmT is planned for July 2019 in Shimizu, Japan.

132. The SC noted paper IOTC–2018–SC21–17 which provided an update on conditioning of an operating model and testing of generic candidate management procedures for Indian Ocean albacore, including the following abstract provided by the authors:

"*This document presents first the latest iteration in the development of the operating model (OM) for Indian Ocean albacore tuna, developed around the Stock Synthesis (SS3) stock assessment, conducted by WPTmT in 2016, and considers a number of sources of uncertainty, as identified by WPTmT and WPM, in the estimation of population trajectories and dynamics. The tuning of management procedures according to the objectives decided by TCMP has been carried out and results show some of the trade-offs involved in achieving those objectives"* (see paper for full abstract).

133. The SC thanked the author for his effort and the progress made so far on the albacore MSE. The SC noted that updating that OM, based on a model up to 2014, to 2017 led to a number of runs not being able to explain reported catches, and these run being eliminated from the OM grid, which consists now of a total of 414 model runs.

134. The SC noted that some of the current tuning objectives for this stock, provided by TCMP, led to trajectories that drive the stock towards overexploitation. This is due to the effect of estimating performance along the whole projection period. The SC noted that a more satisfactory performance could be obtained by either (i) tuning objectives with higher probabilities of a safe stock status (e.g. P(green) = 60%) or (ii) tuning for the performance to be achieved on the final half of the period. The SC **REQUESTED** the MSE development team to discuss the matter and to bring it to the attention of the next TCMP.

135. The SC noted that a new stock assessment of albacore will be carried out by WPTmT in 2019. The SC **REQUESTED** that a comparison is made of whether this stock assessment provides a view of the stock that differs markedly from the conditioned OM, and that WPTmT and WPM discuss whether a new OM conditioning is required.

136. The SC noted that the results of the evaluation of management procedures following the tuning objectives specified by TCMP will be presented to the next session of TCMP in 2019.

7.6 Report of the 9th Session of the Working Party on Methods (WPM09)

137. The SC noted the report of the 9th Session of the Working Party on Methods (IOTC–2018–WPM09–R), including the consolidated list of recommendations provided as an appendix to the report. The meeting was attended by 23 participants (27 in 2017), including 2 recipients of the MPF (5 in 2017).

138. The SC noted the good progress made in Management Strategy Evaluations exercises for IOTC species in 2018 including the initiation of the swordfish MSE work.

139. The SC noted that MSE is a dynamic and iterative process that represents an interface between science and management. The SC further noted that the WPM and SC were the appropriate forums for technical aspects while the Commission's focus is on management. The SC **AGREED** that forums such as the TCMP were effective in bridging this interface and maintaining interaction between the SC/WPs and the Commission.

140. The SC noted that the WPM schedule had been optimistic and there had been some delays. Based on these delays, the SC **AGREED** that 2019 is an important year to report back to TCMP on discussion to be subsequently endorsed by Commission and TCMP in 2020.

141. The SC noted the importance of ensuring CPCs, particularly those with limited capacity, are aware of the potential implications of harvest control rules and operating models and **AGREED** that strong engagement between CPCs, SC/WPs and the Commission was required to ensure these implications are understood.

142. The SC noted paper IOTC–2018–SC21–INF03, which was a report of the 7th workshop on MSE of IOTC WPM Scientists. The workshop was held in Lisbon at the Portuguese Institute for the Ocean and Atmosphere in March 2018.

7.6.1 Yellowfin tuna and Bigeye tuna MSE

143. The SC noted papers IOTC–2018–SC21–INF04 and IOTC–2018–SC21–INF05 which provided updates on IOTC Bigeye and Yellowfin Tuna MSE Operating Model Developments, respectively.

144. The SC noted that the same tuning criteria can lead to different outcomes amongst populations. The SC further noted that TCMP has identified some changes in the tuning criteria to be applied and **AGREED** there is the need to develop protocols on the refinement or changes of tuning criteria in the future.

7.6.2 Albacore MSE

145. The SC noted that the MSE for albacore commenced about 8 years ago and that the development of the operating model and management plan has been a long process.

146. The SC noted that a new assessment for albacore is expected in 2019 and that this may postpone the finalisation of the albacore MSE/MP, particularly if the assessment results differ significantly from the current assessment and in that case, there might be the need to re-condition the OM.

147. Acknowledging that there may be circumstances in which understanding of the productivity of stocks changes markedly, or where management or fleet changes result in large changes to the fishery, the SC **REQUESTED** that the WPM and MSE working groups discuss the issue of exceptional circumstances in the context of how these influence the validity of operating models, and produce a guideline or protocol and a series of recommendations for the SC's consideration. The WPM Chairperson agreed to progress this work during 2019.

7.6.3 Skipjack tuna MSE

148. Noting that the skipjack tuna harvest control rule is not a fully specified management procedure, the SC **RECOMMENDED** that a workplan and budget should be developed to undertake review and possible revision of the skipjack tuna harvest control rule under Resolution 16/02.

149. The SC noted that catches of skipjack tuna had exceeded the catch limits derived from the harvest control rule and suggested that urgent work is required to evaluate the harvest control rule with a view towards developing full management procedures. However, the SC noted that it would not be possible to undertake this work at TCMP in 2019 because the work had not been started and is currently unfunded. SC noted that 2020 or later is more realistic for this priority.

7.6.4 Review of IOTC MSE Process and Methods Meetings

150. The SC noted paper IOTC–2018–SC21–INF01 which provided a review by the Invited Expert to WPM09 of the IOTC MSE process and methods meetings, including the following abstract provided by the author:

"An overview of the processes and OMs used for Albacore (ALB), Yellowfin (YFT) and Bigeye (BET) were examined. Skipjack (SKJ) was covered with respect to what needs to be developed next and what a full Management procedure (MP) would entail. Finally, swordfish (SWO) is initially being set up with regard to conditioning. The ALB, BET and YFT OMs are completed, and candidate HCR's are being tested currently. Issues with respect to projections were discussed, and further clarity in the robustness tests to be examined were discussed, and reference set of OMs were also discussed."

151. The SC noted that the WPM has made plans for internal review for technical issues of MSE, and experts within the WPM have been identified to undertake this work. The SC queried whether there was discussion around external peer review process on the various MSEs that had been conducted and **AGREED** that external peer review processes should be considered in the formulation of budgets and workplans. The SC noted that the external review undertaken in 2015 was beneficial, and suggested that a guidelines be developed to assist the incorporation of external review results into the IOTC MSE process.

152. The SC noted the issue of budget/resourcing in terms of the schedule of MSE development but that so far, the budgetary commitment from the Commission has been limited. The SC therefore **RECOMEMNDED** that the Commission allocate additional resources to the MSE work.

153. The SC noted that the chair will work in conjunction with the Secretariat to prepare a budget for the scientific activities 2019-2020, including MSE, to be presented to SCAF; which will avoid a situation where the budget is approved before SC recommendations are presented to the Commission.

7.6.5 Management Strategy Evaluation joint tuna RFMO meeting

154. The SC noted that a joint tuna RFMO meeting took place in Seattle in June 2018 to discuss common matters in relation to MSE process. The SC noted that this meeting falls under the Kobe process and referred CPCs to IOTC–2018–WPM09–INF04 for additional details.

7.6.6 Stock Status Guidance

155. The SC queried how to proceed with the characterisation of the stock status in relation to target and limit reference points (i.e. whether to use TRPs or LRPs). The SC noted that WPM09 was unable to complete discussions but that these discussions would be continued at TCMP and MSE workshops. The SC further noted that it was up to the SC to decide on what to display in terms of its management advice, but that the Commission was ultimately responsible for deciding how the stock status should be defined and how management is undertaken in relation to these reference points.

156. The SC noted that IOTC provide stock status relative to target reference points or MSY-based reference points. The SC further noted that WCPFC only considers a stock "overfished" when biomass falls below limit reference points, not the target reference point. The SC **RECOMMENDED** to consider alternative formulations of the Kobe plot to indicate an appropriate buffer zone below B_{MSY} to account for natural variations in biomass. A plot such as that included in figure 1 was **SUGGESTED** to be discussed by the Working Parties and the SC as a possibility for formulating the scientific management advice to the Commission.

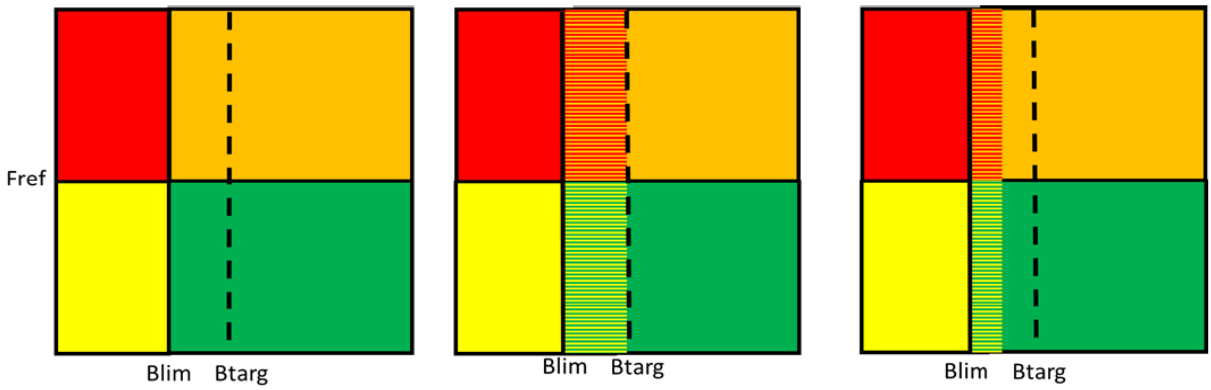

Fig. 1: Three examples of modified Kobe Plots in which there is a target biomass, Btarg, and a reference F (Fref) such as FMSY. In each plot, the red quadrant is based on biomass being below the limit (Blim) rather than below a target biomass. The plot in the middle retains the four colours, but contains red-orange and yellow-green "buffer zones" between the target and limit. In the plot on the right, the buffer zone starts somewhat below the target biomass to account for natural fluctuations of the stock around the target. Note: This figure is from the ISSF Stock Assessment Workshop report (IOTC-2018-WPM09-INF06).

157. However, the SC **NOTED** the Kobe plot has been used to formulate the IOTC (Resolution 15/10) and ICCAT stock conservation decision frameworks and also to provide advice to various commissions. The SC further noted that the Kobe plot is more or less the same across RFMOs and there is a risk that if modified they may no longer be consistent with the common understanding as to how they were initially developed and have been used until now. The SC therefore **AGREED** that any revision or modification to the Kobe plot requires careful considerations and ideally this type of modified display should be coordinated with other tRFMOs through a Kobe process.

158. The SC noted one key element of precautionary fisheries management is to separate the limit and target reference points and to manage towards targets, therefore reference points for fishing mortality (F) (as well as biomass (B)) may need to be represented in any alternative plot.

7.6.7 Presentation of stock status advice for data limited stocks

159. The SC noted that funding has been received through an EU grant to conduct work for improving the data-limited methods for WPNT species and that this is due to commence in 2019. The SC welcomed this information and **REQUESTED** that the WPEB and WPB also be included in the planning and review.

160. The SC **AGREED** that work on the presentation of stock status advice for data limited stocks will need to be carried out inter-sessionally, and that this will require some level of preparation and planning. The SC **REQUESTED** the WPM Chairperson liaise with the Chairs of the WPNT, WPEB and WPB in order to draft a study proposal on this issue.

7.6.8 Update on the status of the joint CPUE indices (yellowfin tuna, albacore)

161. The SC queried the idea of 'trustworthy' CPUE standardisation indices and noted that a protocol for the joint CPUE standardisation needs to be developed for these inputs to stock assessments because the contributions of catch and selectivity differ amongst member fleets which may influence the interpretation of the standardisation results.

162. Noting that yellowfin tuna assessment results are sensitive to the target variable in the standardisation, the SC **REQUESTED** that further joint CPUE analysis should continue to explore and test alternative methods for identifying and accounting for targeting.

163. The SC congratulated the WPM on its work in response to prior recommendations of the WPM and SC. It was again noted that the process has greatly improved the ability of the SC to provide management advice to the Commission. Unfortunately, the lack of access to the operational level longline CPUE, except during the limited time available for joint meetings between authors, greatly reduces the efficiency of the process and limits the degree of capacity building for participating scientists, because these data are only available for analysis and quality assurance for a limited time. In the interest of normalizing the process for producing joint longline CPUE for future assessments, the SC **REQUESTED** that the Secretariat continue discussions with the affected CPCs to develop a confidential data repository at the IOTC that would permit more detailed evaluation of these data as well as assuring the confidential nature of the information.

7.7 Report of the 14th Session of the Working Party on Data Collection and Statistics (WPDCS14)

164. The SC noted the report of the 14th Session of the Working Party on Data Collection and Statistics (IOTC–2018–WPDCS14–R), including the consolidated list of recommendations provided as an appendix to the report. The meeting was attended by 52 participants (45 in 2017), including 7 recipients of the MPF (10 in 2017).

165. The SC noted a number of issues that may prevent observers from collecting data on all fishing operations. Specifically, the SC noted that it is not possible for some CPCs to check hook by hook information for catch and bycatch.

166. The SC noted that there has been an increase in participation and submission of documents to the WPDCS in recent years. The SC acknowledged that the current duration of the meeting (3 days) is not sufficient to facilitate the presentation and discussion of these documents. The SC therefore **RECOMMENDED** that future sessions of the WPDCS be extended to four days

7.7.1 Electronic monitoring systems

167. The SC noted results presented to WPDCS14 on tools such as EM that can be used to collect and verify catch data.

168. The SC **RECOMMENDED** the development of minimum standards for EMS (eg. cameras) for IOTC. The SC noted that the WCPFC are currently drafting standards on EM and acknowledged that it would be pertinent for the IOTC to follow this process and utilise the outcomes where relevant.

7.7.2 Regional Observer Scheme Minimum Standard Data Fields

169. The SC **RECOMMENDED** that the ROS *Minimum Standard Data Fields* in Appendix 6a are adopted by the Commission.

170. The SC noted that there is a lack of data for small-scale fisheries that are currently unable to deploy human observers and other means of data collection are required. The SC **REQUESTED** the WPDCS to continue to evaluate the validity of alternative data collection tools to onboard human observers (such as the use of crew as observers (i.e. self-sampling), electronic monitoring (e.g. cameras) and port sampling), and combinations of these, as potential alternatives to onboard human observer coverage for the collection of the minimum standard data fields for small-scale fisheries. The SC acknowledged that the results of the ROS should inform this evaluation.

7.7.3 Species of special interest

171. For the purpose of improving the voluntary collection of information on the post release mortality of discarded species of special interest, the SC considered and **ENDORSED** the list of species considered of special interest

as proposed by the expert workshop and reported in Appendix VIII of the WPDCS14 report, noting that the SC agreed to simplify the list according to Appendix 6b.

172. The Secretariat clarified that these fields for species of special interest are voluntary and are for encouraging better reporting where this is possible.

7.7.4 ROS draft programme standards

173. The SC noted the *draft Programme Standards and Guidelines* developed by the ROS Expert Workshop and that there was insufficient time during the meeting as well as a lack of appropriate expertise to fully review these standards. Therefore, the SC **REQUESTED** that the Secretariat work with CPCs and the Compliance Committee to consolidate feedback on scientific and operational aspects of the *draft programme standards*.

174. Noting concerns with the overlap between scientific, compliance and legal issues in relation to the *draft programme standards*, the SC **RECOMMENDED** that the Commission form an ad hoc technical committee representing the breadth of mandates to specifically address this issue to ensure the relevant expertise is available to discuss scientific and operational aspects of the *draft Programme Standards and Guidelines* to be presented to the SC and Compliance Committee before it is provided to the Commission for endorsement.

7.7.5 FAD data

175. The SC noted concerns around the ongoing paucity of FAD data being requested from CPCs and urged that progress is made towards this issue. The SC further noted that the WPTT20 recommended the harmonisation of FAD category definitions. It was noted that there is a meeting between different RFMOs on FADs which would discuss terminology differences used in different RFMOs. IOTC will participate in this meeting and the outputs from this will help inform harmonisation. The SC further noted that ICCAT has already accepted standard definition terms. The SC suggested that the IOTC Secretariat provide additional resources to CPCs looking to provide FAD data.

7.8 Summary discussion of matters common to Working Parties (capacity building activities; connecting science and management, etc.)

7.8.1 Data collection and capacity building

176. The SC noted that the recorded success of any management measure adopted by IOTC will depend on the availability of the necessary monitoring information. This relates not only to the types of data being collected, but also their spatio-temporal resolution and the ability of CPCs to report these data in a timely manner.

7.8.2 Invited Expert(s) at the WP meetings

177. Given the importance of external peer review for working party meetings, the SC **RECOMMENDED** that the Commission continues to allocate sufficient budget for an invited expert to be regularly invited to all scientific WP meetings.

7.8.3 Meeting participation fund

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

7.8.4 IOTC species identification guides: Tuna and tuna-like species

179. The SC reiterated its **RECOMMENDATION** that the Commission allocates budget towards continuing the translation and printing of the IOTC species ID guides so that hard copies of the identification cards can continue to be printed as many CPCs scientific observers, both on board and port, still do not have smart phone technology/hardware access and need to have hard copies on board.

7.8.5 IOTC Secretariat staffing

180. Noting the very heavy workload at the IOTC Secretariat and the ever increasing demands by the Commission and the Scientific Committee, and also the capacity to respond to requests for assistance by countries, the SC **RECOMMENDED** that the recommendation from the Performance Review PRIOTC02.07(g) is implemented, and that permanent staff of the IOTC Data and Science Section be increased by two (2) (1 x P4 and 1 x P3 level positions), supplemented by additional short-term consultants. Funding for these new positions should come from both the IOTC regular budget and from external sources to reduce the financial burden on the IOTC membership.

7.8.6 Chairpersons and Vice-Chairpersons of the SC and its subsidiary bodies

181. The SC **RECOMMENDED** that the Commission note and endorse the Chairpersons and Vice-Chairpersons for the SC and its subsidiary bodies for the coming years, as provided in Appendix 7.

7.8.7 Development of management advice

182. The SC **REQUESTED** that the agreed IOTC *Guidelines for the presentation of CPUE standardisations and stock assessment models* are used in future by all authors presenting CPUE analyses to the WPs.

183. The SC noted that although the stock assessments for IOTC species are conducted periodically (e.g., 3 years), the management advice is reviewed every year to account for the potential for exceptional circumstances (e.g., large increase in catches, or revisions to data, between assessment years).

184. The SC noted that there is no clear protocol for addressing the stock assessment evaluation reports provided by external reviewers. It was therefore **REQUESTED** that a standard method for considering the advice of the external reviewer should be developed.

185. The SC **AGREED** that a small expert committee would be formed by the SC Chairperson in consultation with the WP chair. This small expert committee would be tasked with discussing the reviewer's stock assessment evaluation report. It would then distil and compile a document containing the relevant/feasible advice for guiding the future assessment process. This document would then be made available to the relevant Working Party, to be taken into consideration in the subsequent assessment. Both the expert committee's report and the original reviewer's stock assessment evaluation report would be made openly available and published on the IOTC webpage as info documents.

186. The SC **AGREED** that analysis should be carried out to evaluate potential retrospective patterns in stock assessments, noting that this can have a great impact on the stock assessment quality and is already part of the advice in the IOTC Guidelines for the presentation of CPUE standardisations and stock assessment models which states:

*"Alternative scenarios and retrospective analyses should ideally be carried and, if included, a description of the motivation for the selection of base and alternative cases should be added, giving detail of how the alternative case assumptions differ from those of the base case" (Appendix I, IOTC–2014–SC17–06***).**

187. The SC noted the current format of the KOBE II Strategy Matrix can provide information that is of very coarse resolution and **AGREED** that the projections are based on catches which vary in intervals of 5% instead of the current 10%, especially around the values close to the 50% probability. The SC further **REQUESTED** that the tables are extended to ensure that an appropriate range is covered to enable management advice to be provided based on a 50% probability. The SC **REQUESTED** that the performance of catch projection be evaluated retrospectively to ensure the quality of risk analysis in developing management advice.

188. The SC noted the lack of target/limit reference points for species other than the main five species in Resolution 15/10, although the SC also noted the management decision framework objective held therein to maintain and/or rebuild stocks to the Kobe green quadrant in a "short" timeframe with "high" probability.

189. The SC noted that there is currently no structured protocol for establishing base case scenarios and that this may be difficult given that the data varies greatly among species, in terms of availability and quality, and decisions need to be made that are specific to each particular case. The SC **REQUESTED** the WPM develop guidelines for the selection of the grid based approach and/or base case for the provision of management advice.

8. OUTCOMES OF THE SECOND IOTC TECHNICAL COMMITTEE ON MANAGEMENT PROCEDURES (TCMP)

190. The SC noted the presentation of the Report of the 2nd IOTC Technical Committee on Management Procedures (IOTC–2018–TCMP02–R).

191. The SC noted a key benefit of the meeting was that it provides a forum whereby managers could work towards agreement on management objectives and associated tuning of the management procedures.

192. The SC **AGREED** that the term 'tuning' and other relevant terms should be defined more clearly in relevant reports to ensure it is understood by all CPCs. It was noted that the joint tRFMO MSE working group report includes a glossary of these definitions and that WPM has adopted this glossary.

193. The SC noted the limited number of experts available to run the complex MSE and operating model analyses and noted that the FAO is developing a list of experts that could be drawn on to contract experts in future. The SC

REQUESTED CPCs to contact the IOTC Secretariat if they are interested in nominating experts to be included on this list.

194. Acknowledging that stakeholders often have competing interests, the SC noted the importance of ensuring that products being derived from the MSE processes are transparent and unbiased, and that peer review (including desktop reviews) had been used effectively to fulfil this need. The SC noted the need to implement mechanisms to ensure the results of expert reviews are fed into the process.

195. Acknowledging the existing processes for internal and external review of MSE and operating model processes, the SC **AGREED** that terms of reference for reviews would be beneficial and **REQUESTED** that these terms of reference are determined by WPM and TCMP.

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

9.1 IOTC Executive Summaries

196. Acknowledging the concerns around increasing complexity and attempts to highlight uncertainty, the SC suggested that some form of guidance to interpret Executive Summaries may be useful for the Commission. The SC further suggested that language used for describing stock status should be consistent between Executive Summaries.

9.2 Tuna – Highly migratory species

197. The SC **RECOMMENDED** that the Commission note the management advice developed for each tropical and temperate tuna species as provided in the Executive Summary for each species, and the combined Kobe plot for the four species assigned a stock status in 2018 (Fig. 2):
    - Albacore (*Thunnus alalunga*) – Appendix 8
    - Bigeye tuna (*Thunnus obesus*) – Appendix 9
    - Skipjack tuna (*Katsuwonus pelamis*) – Appendix 10
    - Yellowfin tuna (*Thunnus albacares*) – Appendix 11

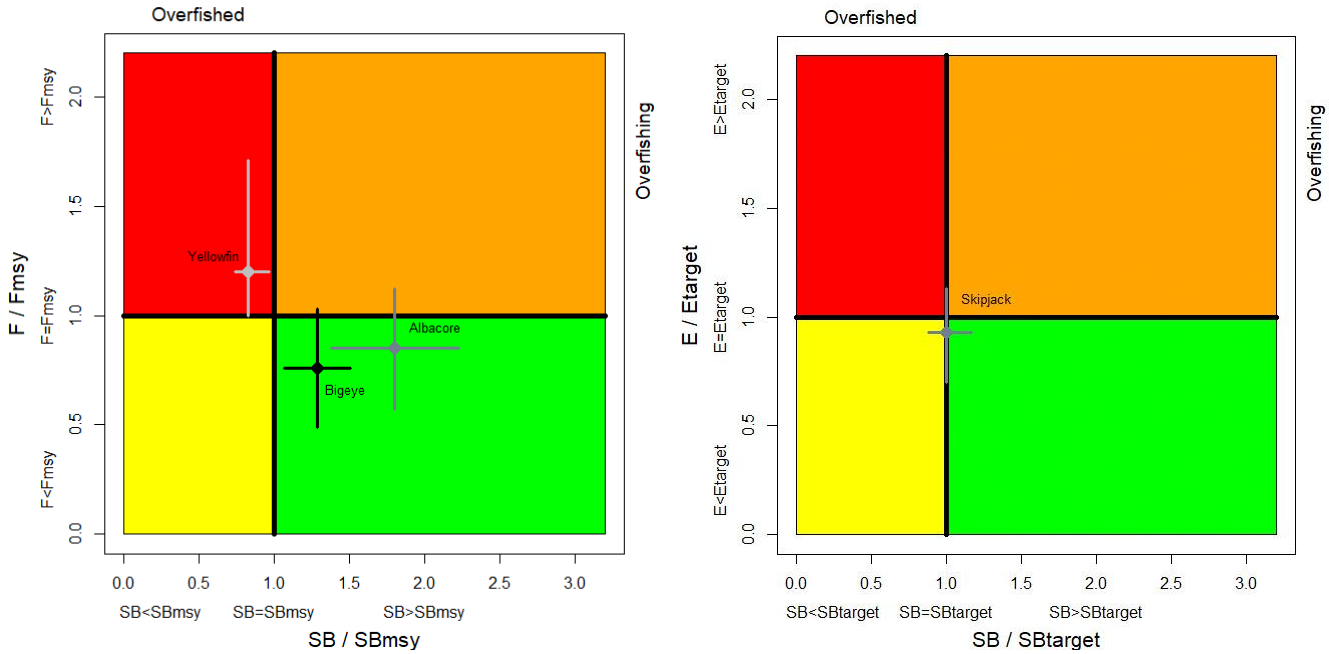

Fig. 2. (Left) Combined Kobe plot for bigeye tuna (black: 2015), yellowfin tuna (grey: 2017), and albacore tuna (dark grey: 2014) showing the estimates of current spawning stock size (SB) and current fishing mortality (F) in relation to SBtarget and Ftarget. (Right) Kobe plot for skipjack tuna (2016) showing the estimates of the current spawning stock status (SB) and exploitation rate in relation to SBtarget and Etarget. Numbers in brackets indicate the last year of data available at the time of the assessment. Cross bars illustrate the range of uncertainty from the model runs with 80% CI.

198. The SC noted paper IOTC–2018–SC21–ES05 which provided an overview of the biology, stock status and management of southern bluefin tuna (*Thunnus maccoyii*), and thanked CCSBT for providing it.

9.3 Tuna and mackerel – neritic species

199. The SC **RECOMMENDED** that the Commission note the management advice developed for each neritic tuna (and mackerel) species under the IOTC mandate, as provided in the Executive Summary for each species, and the combined Kobe plot for the three species assigned a stock status in 2018 (Fig. 3):
    - Bullet tuna (*Auxis rochei*) – Appendix 17
    - Frigate tuna (*Auxis thazard*) – Appendix 18
    - Kawakawa (*Euthynnus affinis*) – Appendix 19
    - Longtail tuna (*Thunnus tonggol*) – Appendix 20
    - Indo-Pacific king mackerel (*Scomberomorus guttatus*) – Appendix 21
    - Narrow-barred Spanish mackerel (*Scomberomorus commerson*) – Appendix 22

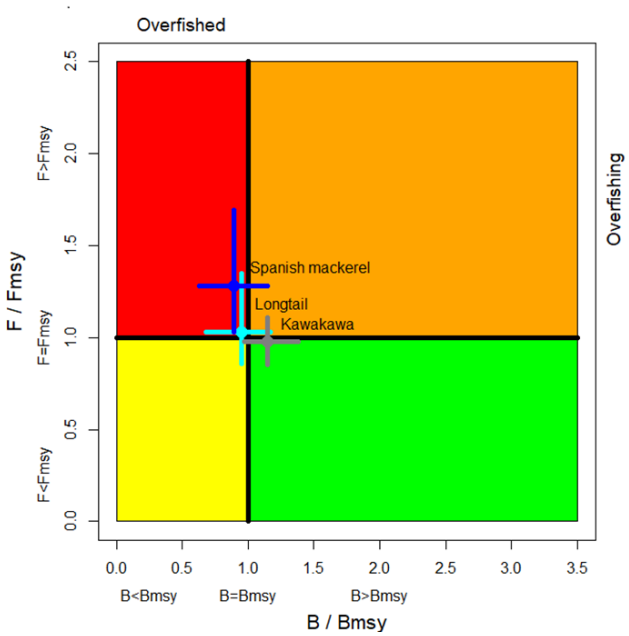

Fig. 3. Combined Kobe plot for longtail tuna (cyan: 2015), narrow-barred Spanish mackerel (dark blue: 2016), and kawakawa (white: 2013) showing the estimates of stock size (B) and current fishing mortality (F) in relation to MSY-based reference points. Numbers in brackets indicate the last year of data available at the time of the assessment. Cross bars illustrate the range of uncertainty from the model runs.

9.4 Billfish

200. The SC **RECOMMENDED** that the Commission note the management advice developed for each billfish species under the IOTC mandate, as provided in the Executive Summary for each species, and the combined Kobe plot for the five species assigned a stock status in 2018 (Fig. 4):
    - Swordfish (*Xiphias gladius*) – Appendix 12
    - Black marlin (*Makaira indica*) – Appendix 13
    - Blue marlin (*Makaira nigricans*) – Appendix 14
    - Striped marlin (*Tetrapturus audax*) – Appendix 15
    - Indo-Pacific sailfish (*Istiophorus platypterus*) – Appendix 16

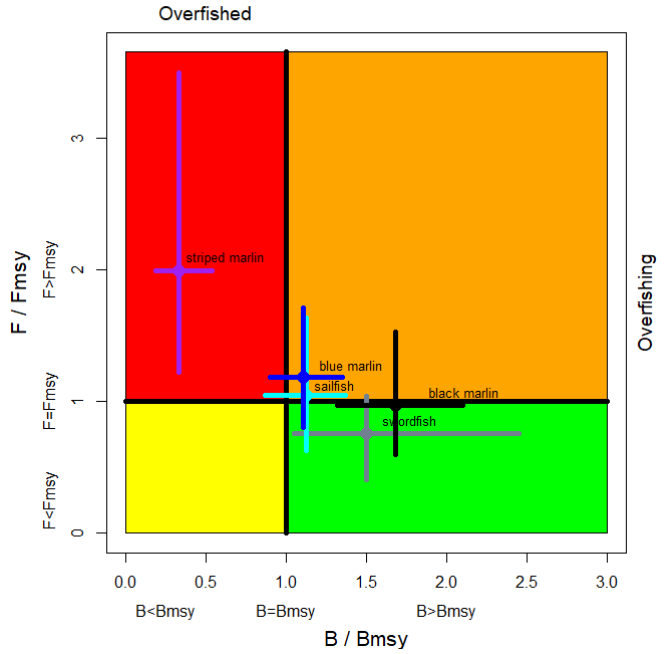

Fig. 4. Combined Kobe plot for swordfish (grey: 2015), indo-pacific sailfish (cyan: 2014), black marlin (black: 2018), blue marlin (blue: 2015) and striped marlin (purple: 2018) showing the estimates of stock size (SB or B, species assessment dependent) and fishing mortality (F) in relation to MSY-based reference points. Numbers in brackets indicate the last year of data available at the time of the assessment. Cross bars illustrate the range of uncertainty from the model runs.

10. STATUS OF SHARKS, MARINE TURTLES, SEABIRDS AND MARINE MAMMALS IN THE INDIAN OCEAN

10.1 Sharks

201. The SC **RECOMMENDED** that the Commission note the management advice developed for a subset of shark species commonly caught in IOTC fisheries for tuna and tuna-like species:
    - Blue shark (*Prionace glauca*) – Appendix 23
    - Oceanic whitetip shark (*Carcharhinus longimanus*) – Appendix 24
    - Scalloped hammerhead shark (*Sphyrna lewini*) – Appendix 25
    - Shortfin mako shark (*Isurus oxyrinchus*) – Appendix 26
    - Silky shark (*Carcharhinus falciformis*) – Appendix 27
    - Bigeye thresher shark (*Alopias superciliosus*) – Appendix 28
    - Pelagic thresher shark (*Alopias pelagicus*) – Appendix 29

10.2 Marine turtles

202. The SC **RECOMMENDED** that the Commission note the management advice developed for marine turtles, as provided in the Executive Summary encompassing all six species found in the Indian Ocean:
    - Marine turtles – Appendix 30

10.3 Seabirds

203. The SC **RECOMMENDED** that the Commission note the management advice developed for seabirds, as provided in the Executive Summary encompassing all species commonly interacting with IOTC fisheries for tuna and tuna-like species:
    - Seabirds – Appendix 31

10.4 Marine mammals

204. The SC **RECOMMENDED** that the Commission note the management advice developed for cetaceans, as provided in the newly developed Executive Summary encompassing all species commonly interacting with IOTC fisheries for tuna and tuna-like species:
    - Cetaceans – Appendix 32.

11. IMPLEMENTATION OF THE REGIONAL OBSERVER SCHEME

205. The SC noted paper IOTC–2018–SC21–07 which provided an update on the status of implementation and reporting to the IOTC Secretariat set out by Resolution 11/04 *On a Regional Observer Scheme* (ROS).

206. The SC thanked the IOTC Secretariat and all contributors to the ROS project for the excellent progress made so far, and noted that it was looking forward to seeing the results of the initial stages of implementation.

207. The SC recalled the issue with potential double accounting of catches taken under joint venture agreements by Japan in South African fisheries. Although Japan and South Africa consider no double counting is occurring, they agreed to work with the IOTC Secretariat to resolve this issue.

208. The SC recalled that Australia has a purse seine fishery for Southern Bluefin Tuna and that catches for this fishery are reported to IOTC. However, observer data are submitted to CCSBT and not IOTC. Australia noted that its observer coverage meets the requirement of 20% for this fishery.

11.1 Consideration of Resolution 16/04 On the implementation of a Pilot Project in view of promoting the Regional Observer Scheme of IOTC

209. The SC noted that as of 16th November 2018, fifteen CPCs (Australia, China (including Taiwan,China), Comoros, EU (France[2], Portugal, Spain and the UK), Indonesia, Japan, Kenya, Rep. of Korea, Madagascar, Maldives, Mauritius, Mozambique, Seychelles, South Africa and Thailand) have submitted a list of observers and have been allocated an IOTC observer registration number. A total of 375 observers are currently registered as active.

210. The SC noted that as of 16th November 2018, a total of 1374 trips have been reported to the IOTC Secretariat by Australia, China (including Taiwan,China), EU (France, Italy, Portugal, Spain and the UK), France OT, Indonesia, Japan, Kenya, Rep. of Korea, Madagascar, the Maldives, Mauritius, Mozambique, Seychelles, South Africa, Sri Lanka and Tanzania.

11.1.1 Update on the Pilot Project approved by the Commission in 2017

211. The SC noted that it was particularly interested in the results of the EMS trials for coastal gillnet fisheries (to be trialled for 2-3 Sri Lankan vessels) which is expected to begin in January 2019.

12. PROGRESS ON THE IMPLEMENTATION OF THE RECOMMENDATIONS OF THE PERFORMANCE REVIEW PANEL

212. The SC noted paper IOTC–2018–SC21–08 which provided an update on progress regarding Resolution 16/03 *On the second performance review follow-up*.

213. The SC noted the recommendation that *innovative and/or alternative means of data collection and reporting should be explored and, as appropriate, implemented, including a move towards electronic data collection and reporting for all fleets* (Appendix A of paper IOTC–2018–SC21–08) and that the intention of this was to explore ways of collecting data for fleets that may not currently be collecting data in standard ways. The SC noted that objective of this recommendation should not be interpreted as a push towards compulsory electronic data collection and reporting for all fleets. The SC noted that there was no definitive timeframe for this work.

214. The SC **RECOMMENDED** that the Commission note the updates on progress regarding Resolution 16/03, as provided at Appendix 33.

12.1 Outcomes from the 1st Technical Committee on Performance Review

215. The SC noted paper IOTC–2018–TCPR01–R: Report for the 1st Technical Committee on Performance Review (TCPR01), which was held from 8–9 February 2018 in Seychelles. A total of 46 delegates attended the Session, comprised of delegates from 19 Contracting Parties, 2 observer organisations, and 3 invited experts.

13. PROGRAM OF WORK AND SCHEDULE OF WORKING PARTY AND SCIENTIFIC COMMITTEE MEETINGS

13.1 Progress on previous recommendations from WPs and the SC

216. The SC noted paper IOTC–2018–SC21–11 which provided the Scientific Committee (SC) with an update on the progress made on its previous recommendations made in 2017, also available in Appendix 34.

2 Including Mayotte due to its status as a French outermost region since January 2014

217. The SC thanked the Secretariat for the update on progress and noted that encouraging progress was being made.

218. In relation to recommendation 53 (joint CPUE standardization), the SC suggested that there may be merit in trying to reach a broader range of experts through tender processes to speed up this work and ensure transparency. However, the SC further noted that the sharing of operational data for CPUE standardisation is quite a sensitive matter and that building trust between experts and CPCs was important in the development and continuation of this work.

13.2 Program of Work (2019–2023) and assessment schedule

13.2.1 Program of Work

219. The SC noted IOTC–2018–SC21–09 which provided the Scientific Committee (SC) with a proposed Program of Work for each of its Working Parties (WP), including prioritisation of the elements requested by each WP.

220. The SC noted the proposed Program of Work and priorities for the Scientific Committee and each of the Working Parties and **AGREED** to a consolidated Program of Work as outlined in Appendix 35a-g. The Chairpersons and Vice-Chairpersons of each working party shall ensure that the efforts of their working party are focused on the core areas contained within the appendix, taking into account any new research priorities identified by the Commission at its next Session.

221. The SC recalled the process for developing the consolidated SC PoW (IOTC–2014–SC17–R, para. 179):

• Step 1: Working Parties to identify research needs (based on the needs of the Commission), rank them by order of priority, provide cost estimates and list potential funding sources;

• Step 2: The SC and Working Party Chair and Vice-Chair, in liaison with the IOTC Secretariat should develop a consolidated document taking into account the different Working Party research needs and priorities, with the objective of ranking the research needs among all Working Parties;

• Step 3: The Chair of the SC shall present these to the SC, to be discussed and endorsed as the consolidated research priorities for the IOTC Science process;

• Step 4: The IOTC Secretariat, in consultation with the Chair and Vice-Chair of the SC and Chair and Vice-Chair or relevant Working Parties, shall identify funding possibilities to undertake the consolidated research priorities;

• Step 5: Once the funding sources have been committed to a particular research priority, the panel mentioned above in Step 2 shall develop terms of reference of the 'Expression of Interest' (including tasks, timelines and deliverables) and the selection procedure/criteria;

• Step 6: IOTC Secretariat to advertise a call for 'Expression of Interest' among the IOTC Commissioner's and Science contact lists, and via the IOTC website;

• Step 7: The Chair of the SC, Chair(s) and Vice-Chair(s) of the WP(s) concerned, in liaison with the IOTC Secretariat shall determine the most appropriate project proposal, based on the criteria defined in Step 5 and in line with the financial rules of the Commission and FAO. Potential contracted candidate will be contacted by the IOTC Secretariat to confirm availability.

222. The SC **AGREED** on the consolidated table of priorities across all Working Parties, as developed by each WP Chair, and **REQUESTED** that the IOTC Secretariat, in consultation with the Chair and vice-Chair of the SC and relevant Working Parties, develop ToRs for the specific projects to be carried out.

223. The SC noted that the consolidated table of priorities does not replace the full programme of work of each Working Party (Appendix 35a-g) and that adequate attention and focus should still be allocated to those activities where possible. The SC further noted that Table 5 has been developed by the SC and WP Chairs to provide more specific direction to the IOTC Secretariat and the SC Chair as to the priorities of the SC so that, if and when external funding becomes available intersessionally, it is possible to clearly prioritise across all WPs based on the objectives of the SC (as agreed in IOTC–2014–SC17–R, para. 179).

224. The SC noted that the WPM has selected five species for MSE (albacore, yellowfin, bigeye, skipjack and swordfish). While these species are equally prioritised in terms of science, albacore has been labelled as the first priority.

225. The SC noted Table 5 outlining the highest priorities from each WP in terms of funding requirements. The complete set of research priorities identified (and ranked according their importance) by each WP are detailed more fully in Appendix 35a-g.

226. The SC noted the presentation on the project *Population Structure of IOTC species and sharks of interest in the Indian Ocean*. The SC noted the objective of the project is to describe the population structure and connectivity of a range of tuna, tuna-like and billfish species within the Indian Ocean (and adjacent waters as appropriate), as well as some of the key shark species that interact with IOTC fisheries. The methods used include genetics (single nucleotide polymorphisms, SNPs) and otolith/vertebrate microchemistry (elemental and isotope). Participation and capacity building with coastal states are part of the project objectives.

227. The SC thanked the authors for the presentation and noted that it represented encouraging progress towards understanding population structure for these species, which is critical to underpin delineation of stocks to inform assessment and management.

228. The SC noted that it would be beneficial to collect ageing data from otoliths that are not used as part of the elemental and isotope microchemistry, which results in the destruction of the otolith pairs. The SC noted that the targets for otolith samples for almost all species had been exceeded and as such the unused otoliths could be used for age data collection. The SC also noted that there may be scope to use tissue samples for close-kin genetics studies.

229. Noting delays in the development and implementation of the project, and that delays may risk the full benefits of the project being realised, the SC **REQUESTED** that the Secretariat liaise with EU/FAO for the project to be extended for a six month duration at no additional cost.

230. The SC noted that the EUR1.3m funding from the EU (out of a total project funding of EUR2.5m) had been pivotal in the success of the project and that this had been complemented by funding from the project partners.

231. Noting that catches for neritic tunas, in particular longtail tuna and narrow-barred Spanish mackerel had declined in some regions (e.g. Oman), the SC suggested that the collection of samples for these species from coastal states such as Oman would be beneficial. The SC noted that there are a number of pre-requisites for engagement in the project but that opportunities to collaborate were welcome. The SC noted that the project team had contacted Oman several times but did not receive a response.

Table 5. Priority topics for obtaining the information necessary to develop stock status indicators for all Working Parties. Numbering (in bold) represents numbers of each specific WP workplan, of which further details can be found in Appendix 35a-g.

Priority	1	2	3
WPTT	**6.4.** Stock assessment priorities – detailed review of the existing data sources, including: i. Size frequency data. ii. Tagging data iii. Organisation of expert group to investigate tagging mortality iv. Re-estimation of M using updated tagging data	Growth studies	**2.1.** Biological Sampling
Budget (potential source)	US$?? (TBD	US$?? (TBD	US$?? (TBD
WPEB	**2.1** Historical data mining for the key species and IOTC fleets (e.g. as artisanal gillnet and longline coastal fisheries)	**10.1** Develop a plan for Ecosystem Based Fisheries Management (EBFM) approaches in the IOTC, in conjunction with the Common Oceans Tuna Project.	**10.2** Assessing the impacts of climate change and socio-economic factors on IOTC fisheries
Budget (potential source)	US$?? (TBD	US$?? (TBD	US$?? (TBD
WPNT	**1.** Collate and characterise operational level data for the main neritic tuna fisheries in the Indian Ocean to investigate their suitability to be used for developing standardised CPUE indices.	**2.** Develop standardised CPUE series for the main fisheries for longtail, kawakawa, Indo-Pacific King mackerel and Spanish mackerel in the Indian Ocean, with the aim of developing CPUE series for stock assessment purposes.	**3.** Explore alternative assessment approaches and develop improvements where necessary based on the data available to determine stock status for longtail tuna, kawakawa and Spanish mackerel
Budget (potential source)	US$?? (TBD	US$?? (TBD	IOTC Regular budget/EU Grant 305
WPTmT	**2.1.** Age and growth to construct catch at age and growth curves to use in the stock assessments.	**4.1.** Develop standardized CPUE series for each albacore fishery for the Indian Ocean, with the aim of developing a single CPUE series.	**2.2.1** Age-at-maturity Quantitative biological studies are necessary for albacore throughout its range to determine key biological parameters including age-at-maturity and fecundity-at-age/length relationships, age-length keys, age and growth, which will be fed into future stock assessments
Budget (potential source)	US$?? (TBD	US$?? (TBD	US$?? (TBD
WPB	**1.2** Tagging research to determine connectivity, movement rates and mortality estimates of billfish(Priority species: swordfish).	**2.1** Age and growth research	**2.2.** Reproductive biology study
Budget (potential source)	US$400,K (requested)	(CPCs: age & growth study = USD$50,000) (requested)	(CPCs: Maturity study = USD$30,000) (Requested)

WPDCS	**6.4** Scoping study to assess and endorse the feasibility of using crew-based observer programmes for ROS purposes	**6.3.2** Collaborate with CPCs for the development of standards for EMS data collection and reporting applicable to different gear types	**6.1.1** Support the adoption of the ROS e-tools for CPCs not having any existing observer data collection and management system in place
Budget (potential source)	US$?? (TBD	US$?? (TBD	US$30K (IOC/IRD?)
WPM	**1.**1. Albacore MSE	**1.4.** Bigeye and Yellowfin tuna MSE	**1.3.** Skipjack tuna MSE
Budget (potential source)	Funded (EC JRC)	$150,000 (ABNJ/CSIRO) pending)	US$?? (TBD

13.2.2 Assessment schedule

232. The SC **ADOPTED** a revised assessment schedule, ecological risk assessment and other core projects for 2019–23, for the tuna and tuna-like species under the IOTC mandate, as well as the current list of key shark species of interest, as outlined in Appendix 36.

13.2.3 Invited Experts

233. The SC **REQUESTED** that at least one 'Invited Expert' be brought to each of the science Working Parties in 2019 and in each subsequent year, so as to further increase the capacity of the Working Parties to undertake the work detailed in the Program of Work.

13.2.4 Consultants

234. Noting the highly beneficial and relevant work done by IOTC stock assessment consultants in previous years, the SC **RECOMMENDED** that the engagement of consultants be continued for each coming year based on the Program of Work. Consultants will be hired to supplement the skill set available within the IOTC Secretariat and CPCs.

13.3 Schedule of meetings for 2019 and 2020

235. The SC noted paper IOTC–2018–SC21–10 which outlined the proposed schedule for IOTC Working Parties and SC meetings for 2019 and 2020.

236. The SC noted that meetings of the WPDCS would be extended from three to four days and **REQUESTED** that the meeting schedule on the IOTC website is updated to reflect this.

237. The SC noted that Pakistan offered to host the WPDCS and SC meetings in 2019. The Secretariat thanked Pakistan for the offer to host these meetings and agreed to investigate the logistics for this and discuss with Pakistan.

13.3.1 Increasing workload of science meetings

238. The SC noted the issue with increasing workload of Working Party meetings. Many Working Parties have been receiving an increasing number of papers year-on-year. For example, in 2018 there were 54 papers accepted for WPEB14, 50 for WPTT20 and 44 for WPDCS14. In some cases, this is despite filtering of papers by the Chairs and IOTC Secretariat based on relevance to priority agenda items for the meeting and requests to some authors to withdraw papers, submit them as information documents (not for presentation) or pass them to a different meeting.

239. The SC therefore noted the need to develop guiding principles for the provision of papers to ensure they are directly related to the Program of Work of the respective Working Parties and SC, as endorsed by the Commission, and give greater discretion to Chairs on the matter, while still encouraging new and emerging issues to be presented.

13.3.2 Data preparatory meetings

240. Acknowledging that holding data preparatory meetings prior to stock assessments is considered to be best practice as identified by the YFT Stock Assessment external reviewer and the WPTT, the SC **AGREED** to explore the possibility of having data preparatory meetings in addition to stock assessment meetings for the main assessed IOTC species. The SC also **SUGGESTED** exploring other methods such as electronic correspondence amongst WP participants ahead of assessments to agree on items such as data inclusion for base case model runs, reviews of provisional model assumptions and structure and to propose sensitivity runs to address alternative model assumptions, thereby further increasing the transparency of the process.

13.3.3 WPNT meeting schedule

241. The SC noted the serious issues with data limitations faced by the WPNT and the difficulty in progressing with the planned assessment schedule. Results produced based on the limited data are highly uncertain and, hence, progress in providing appropriate advice to the Commission has been relatively slow. The SC noted that low information stock assessments for six species in 2020 may be challenging but that they should be retained in the schedule. The SC **AGREED** to maintain the assessments using a

triennial cycle with capacity building/data mining workshops to be held in the intermediate years, focussing on a particular priority topic as per the assessment schedule outlined in Appendix 36.

13.3.4 WPTT meeting schedule

242. The SC noted the intention to update the yellowfin tuna stock assessment in 2019, provided that the work by the expert group (planned for commencement in January 2019 and as per the workplan at Appendix 38) is completed in time for the WPTT21 meeting.

13.3.5 WPTmT meeting schedule

243. The SC **REQUESTED** that the schedule of Working Party and Scientific Committee meetings for 2019 and 2020 provided at Appendix 37 be communicated by the IOTC SC Chairperson to the Commission for its endorsement.

14. IOTC SCIENTIFIC STRATEGIC PLAN

244. The SC noted paper IOTC–2018–SC21–18 which provided the draft IOTC Strategic Science Plan 2020–2024 for SC review.

245. The SC congratulated the Secretariat and Chairperson for the development of the Plan and noted the importance of this work in communicating targets, objectives and indicators for monitoring progress on scientific work of the IOTC to the Commission.

246. The SC noted that a number of minor changes requested by CPCs could be communicated intersessionally.

247. The SC **AGREED** that the draft IOTC Strategic Science Plan 2020–2024 will be distributed to Heads of Delegation from each CPC for comment during early 2019, following which time comments will be collated and consolidated and another version sent to CPCs for final review. Pending agreement of CPCs, and noting that the IOTC Strategic Science Plan would be a dynamic document that would change over time, the SC **RECOMMENDED** that the revised draft of the IOTC Strategic Science Plan 2020–2024 be tabled at the Commission meeting in 2019.

15. OTHER BUSINESS

15.1 Ecosystem and bycatch issues

248. The SC noted that the presentation on the status of the implementation of seabird mitigation measures presented to WPEB in 2018 had included sensitive data that should not have been displayed. The SC noted that Japan had provided a letter to the IOTC Secretariat in relation to this issue. The SC **AGREED** to include this letter as Appendix 39 of the SC21 report.

249. In response to these concerns, the IOTC Secretariat noted that this issue was being taken very seriously and that secretariat proposal to update and revise the data confidentiality protocols contained in Resolution 12/02 had been endorsed by the WPDCS14. The Secretariat is undertaking a comprehensive review of this process and will respond to Japan's letter, and informing all CPCs as soon as possible.

16. ADOPTION OF THE REPORT OF THE 21ST SESSION OF THE SCIENTIFIC COMMITTEE

250. The SC **RECOMMENDED** that the Commission consider the consolidated set of recommendations arising from SC21, provided at Appendix 40.

251. The SC **ADOPTED** the report of the 21st Session of the Scientific Committee (IOTC–2018–SC21–R) on 7 December 2018.

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APPENDIX 2
AGENDA FOR THE 21ST SESSION OF THE SCIENTIFIC COMMITTEE

Date: 3 - 7 December 2018

Location: Seychelles

Venue: Eden Bleu Hotel, Eden Island

Time: 09:00 – 17:00 daily

Chair: Dr Hilario Murua (EU,Spain); **Vice-Chair:** Dr M. Shiham Adam (Maldives)

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

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

3. **ADMISSION OF OBSERVERS** (Chairperson)

4. **DECISIONS OF THE COMMISSION RELATED TO THE WORK OF THE SCIENTIFIC COMMITTEE** (IOTC Secretariat)
   - 4.1 Outcomes of the 22nd Session of the Commission.
   - 4.2 Previous decisions of the Commission

5. **SCIENCE RELATED ACTIVITES OF THE IOTC SECRETARIAT IN 2018** (IOTC Secretariat)
   - 5.1 Report of the Secretariat – Activities in support of the IOTC science process in 2018

6. **NATIONAL REPORTS FROM CPCs** (CPCs)

7. **REPORTS OF THE 2018 IOTC WORKING PARTY MEETINGS**
   - 7.1 IOTC–2018–WPNT08–R Report of the 8th Session of the Working Party on Neritic Tunas
   - 7.2 IOTC–2018–WPB16–R Report of the 16th Session of the Working Party on Billfish
     - 7.2.1 Revision of catch levels of Marlins under Resolution 15/05
   - 7.3 IOTC–2018–WPEB14–R Report of the 14th Session of the Working Party on Ecosystems and Bycatch
     - 7.3.1 Status of development and implementation of national plans of action for seabirds and sharks, and implementation of the FAO guidelines to reduce marine turtle mortality in fishing operations
     - 7.3.2 Outcomes from the Updated Ecological Risk Assessments for sharks and marine turtles
     - 7.3.3 Progress towards Ecosystem Based Fisheries Management (EBFM) in IOTC – Preliminary Ecosystem Report Cards (Chairperson)
   - 7.4 IOTC–2018–WPTT20–R Report of the 20th Session of the Working Party on Tropical Tunas
     - 7.4.1 Review of the effect of the revised interim plan for rebuilding yellowfin tuna in the IOTC Area (Resolution 17/01) as amended in Proposal IOTC-2018-S22-08
   - 7.5 IOTC-2016-WPTmT06-R Report of the 6th Session of the Working Party on Temperate Tunas
   - 7.6 IOTC–2018–WPM09–R Report of the 9th Session of the Working Party on Methods
     - 7.6.1 Management Strategy Evaluation joint tuna RFMO meeting (Chairperson)
   - 7.7 IOTC–2018–WPDCS14–R Report of the 14th Session of the Working Party on Data Collection and Statistics
   - 7.8 Summary discussion of matters common to Working Parties (capacity building activities; connecting science and management, etc.)

8. **OUTCOMES OF THE SECOND TECHNICAL COMMITTEE ON MANAGEMENT PROCEDURES (TCMP)**

9. **STATUS OF TUNA AND TUNA-LIKE RESOURCES IN THE INDIAN OCEAN** (Chairperson)
   - 10.1 Tuna – Highly migratory species
   - 10.2 Tuna and mackerel – Neritic species
   - 10.3 Billfish

10. **STATUS OF SHARKS, MARINE TURTLES, SEABIRDS AND MARINE MAMMALS IN THE INDIAN OCEAN** (Chairperson)
    - 11.1 Sharks
    - 11.2 Marine turtles
    - 11.3 Seabirds

11.4 Marine Mammals

11. IMPLEMENTATION OF THE REGIONAL OBSERVER SCHEME (IOTC Secretariat)
- 12.1 Consideration of Resolution 16/04 On the implementation of a Pilot Project in view of promoting the Regional Observer Scheme of IOTC
  - 12.1.1 Update on the Pilot Project approved by the Commission in 2017
  - 12.1.2 Minimum standards for the implementation of the ROS – Outcomes from the expert workshop

12. PROGRESS ON THE IMPLEMENTATION OF THE RECOMMENDATIONS OF THE PERFORMANCE REVIEW PANEL (IOTC Secretariat)
- 13.1 Outcomes from the 1st Technical Committee on Performance Review

13. PROGRAM OF WORK AND SCHEDULE OF WORKING PARTY AND SCIENTIFIC COMMITTEE MEETINGS (IOTC Secretariat and Chairperson)
- 14.1 Progress on previous Recommendations from WPs and SC
- 14.2 Program of Work (2019–2023) and assessment schedule
- 14.3 Schedule of meetings for 2019 and 2020

14. IOTC SCIENTIFIC STRATEGIC RESEARCH PLAN (Chairperson)

15. OTHER BUSINESS (Chairperson)

16. REVIEW OF THE DRAFT, AND ADOPTION OF THE REPORT OF THE 20th SESSION OF THE SCIENTIFIC COMMITTEE (Chairperson)

APPENDIX 3
LIST OF DOCUMENTS

Document	Title
IOTC–2018–SC21–01a	Draft: Agenda of the 21st Session of the Scientific Committee
IOTC–2018–SC21–01b	Draft: Annotated agenda of the 21st Session of the Scientific Committee
IOTC–2018–SC21–02_Rev4	Draft: List of documents of the 21st Session of the Scientific Committee
IOTC–2018–SC21–03	Outcomes of the 22nd Session of the Commission (IOTC Secretariat)
IOTC–2018–SC21–04_Rev1	Previous decisions of the Commission (IOTC Secretariat)
IOTC–2018–SC21–05_Rev1	Report of the Secretariat – Activities in support of the IOTC science process in 2018 (IOTC Secretariat)
IOTC–2018–SC21–06_Rev1	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)
IOTC–2018–SC21–07	Update on the implementation of the regional observer scheme (IOTC Secretariat)
IOTC–2018–SC21–08	Update on progress regarding Resolution 16/03 – on the second performance review follow–up (IOTC Secretariat)
IOTC–2018–SC21–09	Revision of the program of work (2019–2023) for the IOTC science process (IOTC Secretariat)
IOTC–2018–SC21–10_Rev1	Proposed schedule of Working Party and Scientific Committee meetings for 2019 and 2020 (IOTC Secretariat)
IOTC–2018–SC21–11	Progress on SC20 recommendations (IOTC Secretariat)
IOTC–2018–SC21–12_Rev1	Update on the conditioning of an operating model and model inspection for the Indian Ocean swordfish (Rosa D, Mosqueira I, Fu D, Coelho R)
IOTC–2018–SC21–13	Progress in BIOFAD Project: Testing designs and identify options to mitigate impacts of drifting FADs on the ecosystem (Zudaire et al)
IOTC–2018–SC21–14_Rev1	Updated Ecological Risk Assessment for IOTC species (Murua H, Santiago J, Coelho R, Zudaire I, Neves C, Rosa D, Semba Y, Geng Z, Bach P, Arrizabalaga H, Baez J-C, Ramos M, Zhu, J-F and Ruiz J.)
IOTC–2018–SC21–15_Rev1	Requests to the joint CPUE standardization (Japan)
IOTC–2018–SC21–16	Indian Ocean Yellowfin Tuna SS3 Model Projections (Fu D, Langley A, Merino G and Urtizberea A)
IOTC–2018–SC21–17_Rev1	Update on conditioning of an operating model and testing of generic candidate management procedures for Indian Ocean albacore (Mosqueira I)
IOTC–2018–SC21–18	IOTC Science Strategic Plan (IOTC-SSP), (SC Chair and IOTC Secretariat)
IOTC–2018–SC21–19	Public resource, private profit: Investigating tuna subsidies in the IOTC area of compliance (Bailey M, Willis, C and Sinan H)
IOTC–2018–SC21–ES01	Status of the Indian Ocean Albacore (ALB: *Thunnus alalunga*) resource
IOTC–2018–SC21–ES02	Status of the Indian Ocean bigeye tuna (BET: *Thunnus obesus*) resource
IOTC–2018–SC21–ES03	Status of the Indian Ocean skipjack tuna (SKJ: *Katsuwonus pelamis*) resource
IOTC–2018–SC21–ES04	Status of the Indian Ocean yellowfin tuna (YFT: *Thunnus albacares*) resource
IOTC–2018–SC21–ES05	Report on biology, stock status and management of southern bluefin tuna: 2018 (from CCSBT)
IOTC–2018–SC21–ES06	Status of the Indian Ocean bullet tuna (BLT: *Auxis rochei*) resource
IOTC–2018–SC21–ES07	Status of the Indian Ocean frigate tuna (FRI: *Auxis thazard*) resource
IOTC–2018–SC21–ES08	Status of the Indian Ocean kawakawa (KAW: *Euthynnus affinis*) resource
IOTC–2018–SC21–ES09	Status of the Indian Ocean longtail tuna (LOT: *Thunnus tonggol*) resource
IOTC–2018–SC21–ES10	Status of the Indian Ocean Indo-Pacific king mackerel (GUT: *Scomberomorus guttatus*) resource
IOTC–2018–SC21–ES11	Status of the Indian Ocean narrow-barred Spanish mackerel (COM: *Scomberomorus commerson*) resource
IOTC–2018–SC21–ES12	Status of the Indian Ocean black marlin (BLM: *Makaira indica*) resource
IOTC–2018–SC21–ES13	Status of the Indian Ocean blue marlin (BUM: *Makaira nigricans*) resource
IOTC–2018–SC21–ES14	Status of the Indian Ocean striped marlin (MLS: *Tetrapturus audax*) resource
IOTC–2018–SC21–ES15	Status of the Indian Ocean Indo-Pacific sailfish (SFA: *Istiophorus platypterus*) resource
IOTC–2018–SC21–ES16	Status of the Indian Ocean swordfish (SWO: *Xiphias gladius*) resource

Document	Title
IOTC–2018–SC21–ES17	Status of the Indian Ocean blue shark (BSH: *Prionace glauca*)
IOTC–2018–SC21–ES18	Status of the Indian Ocean oceanic whitetip shark (OCS: *Carcharhinus longimanus*)
IOTC–2018–SC21–ES19	Status of the Indian Ocean scalloped hammerhead shark (SPL: *Sphyrna lewini*)
IOTC–2018–SC21–ES20	Status of the Indian Ocean shortfin mako shark (SMA: *Isurus oxyrinchus*)
IOTC–2018–SC21–ES21	Status of the Indian Ocean silky shark (FAL: *Carcharhinus falciformis*)
IOTC–2018–SC21–ES22	Status of the Indian Ocean bigeye thresher shark (BTH: *Alopias superciliosus*)
IOTC–2018–SC21–ES23	Status of the Indian Ocean pelagic thresher shark (PTH: *Alopias pelagicus*)
IOTC–2018–SC21–ES24	Status of marine turtles in the Indian Ocean
IOTC–2018–SC21–ES25	Status of seabirds in the Indian Ocean
IOTC–2018–WPNT08–R	Report of the 8th Session of the Working Party on Neritic Tunas
IOTC–2018–WPB16–R	Report of the 16th Session of the Working Party on Billfish
IOTC–2018–WPEB14–R	Report of the 14th Session of the Working Party on Ecosystems and Bycatch
IOTC–2018–WPM09–R	Report of the 9th Session of the Working Party on Methods
IOTC–2018–WPDCS14–R	Report of the 14th Session of the Working Party on Data collection and Statistics
IOTC–2018–WPTT20–R	Report of the 20th Session of the Working Party on Tropical Tunas
IOTC-2018-TCMP02-R	Report of the 2nd Technical Committee on Management Procedures (TCMP)
IOTC–2018–TCPR01–R	Report for the 1st Technical Committee on Performance Review
IOTC–2018–SC21–NR01	Australia
IOTC–2018–SC21–NR02	China
IOTC–2018–SC21–NR03	Comoros
IOTC–2018–SC21–NR05_Rev1	European Union
IOTC–2018–SC21–NR06	France (OT)
IOTC–2018–SC21–NR09	Indonesia
IOTC–2018–SC21-NR10	Iran, Islamic Republic of
IOTC–2018–SC21–NR11_Rev1	Japan
IOTC–2018–SC21–NR12	Kenya
IOTC–2018–SC21–NR13	Korea, Republic of
IOTC–2018–SC21–NR14	Madagascar
IOTC–2018–SC21–NR15	Malaysia
IOTC–2018–SC21–NR16	Maldives, Republic of
IOTC–2018–SC21–NR17	Mauritius
IOTC–2018–SC21–NR18	Mozambique
IOTC–2018–SC21–NR19	Oman, Sultanate of
IOTC–2018–SC21–NR20	Pakistan
IOTC–2018–SC21–NR21	Philippines
IOTC–2018–SC21–NR22	Seychelles, Republic of
IOTC–2018–SC21–NR24	Somalia
IOTC–2018–SC21–NR25	Sri Lanka
IOTC–2018–SC21–NR26	South Africa, Republic of
IOTC–2018–SC21–NR29	Thailand
IOTC–2018–SC21–NR30	United Kingdom (OT)
IOTC–2018–SC21–NR32	Bangladesh
IOTC–2018–SC21–NR34	Senegal

Document	Title
Other Documents	
IOTC-2018-WPDCS14-36	Proposal for the development of an ocean-climate web page for the IOTC (Marsac F)
IOTC-2018-WPDCS14-37	An Assessment of Shark Finning in Indian Ocean Tuna Commission Fisheries (Clarke S)
Information Papers	
IOTC-2018-SC21-INF01	Review of IOTC MSE Process and Methods Meetings (Sharma R)
IOTC-2018-SC21-INF02	Review of IOTC YFT in 2018 (Sharma R)
IOTC-2018-SC21-INF03	Report of the 7th workshop on MSE of IOTC WPM Scientists (Anon)
IOTC-2018-SC21-INF04	Update on IOTC Bigeye Tuna Management Procedure Evaluation March 2018 (Kolody D and Jumppanen P)
IOTC-2018-SC21-INF05	Update on IOTC Yellowfin Tuna Management Procedure Evaluation March 2018 (Kolody D and Jumppanen P)

APPENDIX 4A
NATIONAL STATEMENTS

Agenda Item 2: Adoption of the Agenda and Arrangements for the Session

The SC noted the following statement made by the Republic of Mauritius (1st statement):

"*The Government of the Republic of Mauritius reiterates that the Chagos Archipelago, including Diego Garcia, and the Island of Tromelin form an integral part of the territory of the Republic of Mauritius.*

The Government of the Republic of Mauritius reaffirms that it does not recognize the so-called "British Indian Ocean Territory" ("BIOT") which the United Kingdom purported to create by illegally excising the Chagos Archipelago from the territory of Mauritius prior to its accession to independence, in violation of international law and of United Nations General Assembly Resolutions 1514 (XV) of 14 December 1960, 2066 (XX) of 16 December 1965, 2232 (XXI) of 20 December 1966 and 2357 (XXII) of 19 December 1967. The dismemberment of the territory of Mauritius prior to independence is a matter of direct interest to all members of the United Nations which has historically played a central role in addressing decolonization.

The Government of the Republic of Mauritius further reiterates that the United Kingdom is not entitled to be a member of the Indian Ocean Tuna Commission (IOTC) as it is not a "coastal State situated wholly or partly within the Area [of competence of the Commission]". Nor can the so-called "BIOT" claim to be a member of the IOTC on the basis of Article IV of the Agreement for the Establishment of the Indian Ocean Tuna Commission.

Moreover, the Government of the Republic of Mauritius rejects the sovereignty claim of France over the Island of Tromelin as well as France's claim to any sovereign right or jurisdiction over the Exclusive Economic Zone adjacent to the Island of Tromelin. Further, the Government of the Republic of Mauritius does not recognize the validity of the inclusion of the Island of Tromelin in the French Southern and Antarctic Lands (TAAF) or the Scattered Islands/Iles Eparses. The Government of the Republic of Mauritius reaffirms that the Republic of Mauritius has full and complete sovereignty over the Island of Tromelin, including its maritime zones.

The Government of the Republic of Mauritius strongly objects to the use of terms such as "United Kingdom (OT) and "UK (OT)" in documents which have been circulated for this meeting, in so far as these terms purport to refer to the Chagos Archipelago as a British territory or to imply that the United Kingdom or the so-called "BIOT" is entitled to be a member of the IOTC.

The Government of the Republic of Mauritius also objects to the use of terms such as "France (OT)" and "France (territories)" in the documents which have been circulated for this meeting, in so far as these terms purport to refer to the Island of Tromelin as a French territory.

On 20 December 2010, the Republic of Mauritius initiated proceedings against the United Kingdom under Article 287 of, and Annex VII to, the United Nations Convention on the Law of the Sea (UNCLOS) to challenge the legality of the 'marine protected area' ('MPA') which the United Kingdom purported to establish on 1 April 2010 around the Chagos Archipelago. The Arbitral Tribunal constituted under Annex VII to UNCLOS to hear the dispute delivered its Award on 18 March 2015. The Tribunal ruled that in establishing the 'MPA' around the Chagos Archipelago, the United Kingdom breached its obligations under Articles 2(3), 56(2) and 194(4) of UNCLOS.

Since the 'MPA' purportedly established by the United Kingdom around the Chagos Archipelago has been held to be in breach of international law, it cannot be enforced. Any reference to or consideration given by the IOTC, including this Committee, to the purported 'MPA' in disregard of the Award will be in contradiction with the Tribunal's ruling and international law. The Government of the Republic of Mauritius urges the Committee to ensure compliance with the Award of the Arbitral Tribunal constituted under Annex VII to UNCLOS.

In the light of the foregoing, the delegation of the Republic of Mauritius has no objection to the adoption of the draft agenda, subject to:

(a) there being no discussions at this meeting on the 'MPA' purportedly established by the United Kingdom around the Chagos Archipelago which has been held to be illegal under international law; and

(b) the Republic of Mauritius reserving its right to object to the consideration of any documents purportedly submitted by the United Kingdom, including in respect of the so-called "BIOT" which is not recognized by the Government of the Republic of Mauritius, and any other documents submitted by the Secretariat or any other party in relation to the so-called "BIOT".

Should any document which purports to refer to the Chagos Archipelago as the so-called "BIOT" or as a British territory be considered, such consideration as well as any action or decision that may be taken on the basis of any such document cannot and should not be construed in any way whatsoever as implying that the United Kingdom has sovereignty or analogous rights over the Chagos Archipelago or that the United Kingdom or the so-called "BIOT" is entitled to be a member of the IOTC.

Further, any consideration of any document which purports to refer to the Island of Tromelin as a French territory or use terms such as "France (OT)" and "France (territories)" as well as any action or decision that may be taken on the basis of any such document, cannot and should not be construed in any way whatsoever as implying that France has sovereignty or analogous rights over the Island of Tromelin or that the Island of Tromelin is part of the French Southern and Antarctic Lands (TAAF) or the Scattered Islands/Iles Eparses or is a French territory.

The Republic of Mauritius also reserves all its rights under international law, including under Article XXIII of the Agreement for the Establishment of the Indian Ocean Tuna Commission.

This statement is applicable to all agenda items under which the Chagos Archipelago and the Island of Tromelin are dealt with."

The SC noted the following statement made by the United Kingdom (Overseas Territories):
UK Position on Sovereignty of the British Indian Ocean Territory:

"The Government of the United Kingdom is clear about its sovereignty of the Chagos Archipelago, which has been British since 1814, and which it administers as the British Indian Ocean Territory. No international tribunal, including the March 2015 United National Convention on the Law of the Sea (UNCLOS) ad hoc arbitral tribunal, has ever found the United Kingdom's sovereignty to be in doubt. We strongly refute Mauritius' claim that the Chagos Archipelago, which the UK administers as the British Indian Ocean Territory, is part of Mauritius.

While we do not recognise the Republic of Mauritius' claim to sovereignty of the Archipelago, the UK has repeatedly undertaken to cede it to Mauritius, when no longer required for defence purposes; we maintain that commitment though it is for the UK alone to determine when this condition is met. In the meantime, BIOT is still needed for defence purposes. It is used to combat some of the most difficult problems of the 21st Century including terrorism, international criminality, instability and piracy.

<u>Marine Protected Area</u>

The BIOT Marine Protected Area (MPA), which the UK declared in 2010, is highly valued by scientists from many countries. They consider it a global reference site for marine conservation in an ocean which is heavily overfished.

The UNCLOS arbitral tribunal found no evidence of ulterior motive or improper purpose in the creation of the MPA. The issue of improper purpose has also been scrutinised by UK Courts in great detail. On 8 February 2018 the UK Supreme Court found there had been no improper purpose behind and also dismissed the claimant's appeal that the MPA had been declared on the basis of a flawed consultation.

The Arbitral Tribunal was also clear that it took no view on the substantive quality or nature of the MPA; its concern was confined to the manner in which it was established. The Tribunal found that the UK needed to have further consultation with Mauritius about the establishment of the MPA in order to have due regard to its rights and interests under the 1965 Agreement between the UK and Mauritius. Implementation of the Tribunal's Award has started with a series of bilateral talks, the latest of which took place in August 2016.

The UK is committed to implementing the Arbitral Tribunal Award. In line with the Award, the UK will continue to work with Mauritius to agree the best way to meet our obligation to ensure fishing rights in the territorial sea remain available to Mauritius, so far as practicable. The Arbitral Award did not require the termination of the MPA.

UK Position on the right to participate at IOTC

The Agreement for the Establishment of the Indian Ocean Tuna Commission provides that IOTC membership shall be open, inter alia, to FAO members that are situated wholly or partly within the IOTC's Area of Competence. As the British Indian Ocean Territory is situated wholly within the IOTC's Area of Competence, there can therefore be no doubt that the United Kingdom, as the State with sovereignty over BIOT as aforementioned, is entitled to be a member of IOTC. As such, we are full members of the IOTC and have every right to be here.

IOTC incorrect forum to raise bilateral issues

The United Kingdom regrets the continued use of this important multilateral forum by the Republic of Mauritius to address a bilateral matter. This only serves to distract from the important work of IOTC members to combat the regional IUU threat and other matters considered by this Committee.

The UK notes the statement from the FAO at the IOTC meeting in May 2016 recognising that this is a bilateral matter between Mauritius and the United Kingdom and that the FAO Secretariat would not express any views on the question. The FAO Secretariat went on to state that "The United Kingdom and Mauritius are both Parties to the IOTC Agreement and Members of the IOTC and that the instruments of acceptance of the IOTC Agreement of 1994 and 1995 and none of the instruments contains any declaration, restriction or reservation on the matter. The IOTC is not a forum to discuss issues of sovereignty." The FAO Secretariat requested both Members not to raise the matter in this forum. As such, the UK thanks the FAO for recognising this matter as a bilateral issue and rather than respond to Mauritius each time it inappropriately raises it, has submitted this written statement for the record, to avoid any further disruption to the work of this meeting."

The SC noted the following statement made by France:

"La France déclare qu'elle ne reconnaît à la déclaration mauricienne aucune valeur juridique, car elle méconnaît le fait que l'île de Tromelin est un territoire français sur lequel la France exerce de façon constante une souveraineté pleine et entière. Ainsi, la France jouit des droits souverains ou de juridiction que lui confère le droit international dans la zone économique exclusive adjacente à l'île de Tromelin. Les réunions des ORGP de l'océan Indien ne sont pas le lieu pour discuter des questions de souveraineté territoriale, mais la France souligne qu'elle continuera d'entretenir à ce sujet un dialogue constructif avec la République de Maurice"

The SC noted the following statement made by the Republic of Mauritius in response to UK's and France's Exercise of Right of Reply (2nd statement):

"The Government of the Republic of Mauritius reiterates that it does not recognize the so-called "British Indian Ocean Territory" ("BIOT") and that the Chagos Archipelago, including Diego Garcia, forms an integral part of the territory of the Republic of Mauritius.

In the arbitral proceedings initiated in December 2010 by the Republic of Mauritius against the United Kingdom under the United Nations Convention on the Law of the Sea, two of the arbitrators found that the excision of the Chagos Archipelago from the territory of Mauritius prior to independence showed a complete disregard for the territorial integrity of Mauritius by the United Kingdom and violated the international law of self-determination.

The Government of the Republic of Mauritius reaffirms that the United Kingdom is not entitled to be a member of the Indian Ocean Tuna Commission (IOTC). Nor can the so-called "BIOT" claim to be a member of the IOTC.

The Government of the Republic of Mauritius maintains in no uncertain terms that the 'marine protected area' ('MPA') purportedly established by the United Kingdom around the Chagos Archipelago is illegal and cannot be enforced. At paragraph 547(B) of its Award, the Arbitral Tribunal constituted in the case brought

by the Republic of Mauritius against the United Kingdom under the United Nations Convention on the Law of the Sea (UNCLOS) to challenge the legality of the purported 'MPA' declared that in establishing the purported 'MPA' around the Chagos Archipelago, the United Kingdom breached its obligations under Articles 2(3), 56(2) and 194(4) of UNCLOS.

Moreover, the Government of the Republic of Mauritius reiterates that the Island of Tromelin forms an integral part of the territory of the Republic of Mauritius and that it does not recognize the validity of the inclusion of the Island of Tromelin in the French Southern and Antarctic Lands (TAAF) or the Scattered Islands/Iles Eparses. The Government of the Republic of Mauritius reaffirms that the Republic of Mauritius has full and complete sovereignty over the Island of Tromelin, including its maritime zones.

Since the United Kingdom and France purport to assert under the Agreement for the Establishment of the Indian Ocean Tuna Commission and in this multilateral forum rights which they do not have over the Chagos Archipelago and the Island of Tromelin respectively, the Republic of Mauritius considers that it is entitled to raise issues relating to the Chagos Archipelago and the Island of Tromelin in this forum. These are no doubt multilateral and not bilateral matters."

Agenda Item 6: National Reports from CPCs

The SC noted the following statement made by the Republic of Mauritius on the National Report made by France (3rd statement):

"The Government of the Republic of Mauritius reiterates that the Island of Tromelin forms an integral part of the territory of the Republic of Mauritius.

The Island of Tromelin is not a French territory, as claimed by France. The Government of the Republic of Mauritius rejects France's sovereignty claim over the Island of Tromelin as well as France's claim to any sovereign right or jurisdiction over the Exclusive Economic Zone adjacent to the Island of Tromelin.

Further, the Government of the Republic of Mauritius does not recognize the validity of the inclusion of the Island of Tromelin in the French Southern and Antarctic Lands (TAAF) or the Scattered Islands/Iles Eparses.

The Government of the Republic of Mauritius reaffirms that the Republic of Mauritius has full and complete sovereignty over the Island of Tromelin, including its maritime zones."

The SC noted the following statement made by the Republic of Mauritius on the National Report made by the United Kingdom (Overseas Territories) (4th statement):

"The Government of the Republic of Mauritius reiterates that the Chagos Archipelago, including Diego Garcia, forms an integral part of the territory of the Republic of Mauritius and that it does not recognize the so-called "British Indian Ocean Territory" ("BIOT").

The Government of the Republic of Mauritius reaffirms that the United Kingdom is not entitled to be a member of the Indian Ocean Tuna Commission (IOTC). Nor can the so-called "BIOT" claim to be a member of the IOTC.

Since the 'marine protected area' ('MPA') purportedly established by the United Kingdom around the Chagos Archipelago has been held to be in breach of international law by the Arbitral Tribunal constituted in the case brought by the Republic of Mauritius against the United Kingdom under the United Nations Convention on the Law of the Sea, it cannot be enforced. Any reference to or consideration given by the IOTC, including this Committee, to the purported 'MPA' in disregard of the Award will be in contradiction with the Tribunal's ruling and international law.

In this regard, the Government of the Republic of Mauritius wrote on 20 April 2015 to the Executive Secretary of the IOTC to request that the purported 'MPA' should not be the subject of any discussions at the level of the IOTC. This request was reiterated by the Government of the Republic of Mauritius in a letter dated 24 April 2015 which it addressed to the Executive Secretary of the IOTC.

The Government of the Republic of Mauritius urges this Committee to ensure compliance with the Award of the Arbitral Tribunal."

APPENDIX 4B
NATIONAL REPORT ABSTRACTS (2018)

Australia (IOTC-2018-SC21-NR01)

Pelagic longline and purse seine are the two main fishing methods used by Australian vessels to target tuna and billfish in the Indian Ocean Tuna Commission (IOTC) Area of Competence. The number of active longliners and levels of fishing effort have remained low since 2001 due to reduced profitability, primarily as a result of lower fish prices and higher operating costs. In 2017, three Australian longliners from the Western Tuna and Billfish Fishery and seven longliners from the Eastern Tuna and Billfish Fishery operated in the IOTC Area of Competence. They caught 18.6 t of albacore (*Thunnus alalunga*), 59.3 t of bigeye tuna (*Thunnus obesus*), 65.3 t of yellowfin tuna (*Thunnus albacares*), 155.8 t of swordfish (*Xiphius gladius*) and 1.5 t of striped marlin (*Kajikia audax*). These catches represent approximately 12 per cent of the peak catches taken by Australian vessels fishing in the IOTC Area of Competence in 2001, for these five species combined. In 2017, 1.8 t of shark was landed by the Australian longline fleet operating in the IOTC Area of Competence and 10 184 sharks were discarded/released. In addition, 11.7 per cent of hooks deployed in the WTBF were observed with electronic monitoring in the 2017 calendar year. The catch of southern bluefin tuna (*Thunnus maccoyii*) in the purse seine fishery was 3951 t in 2017. There was no skipjack tuna (*Katsuwonus pelamis*) caught by purse seine fishing.

China (IOTC-2018-SC21-NR02)

Deep-frozen longline and ice fresh-longline are the only two fishing gears used by Chinese fleets to catch tuna and tuna-like species in the IOTC waters. The total number of Chinese longline vessels operated in the IOTC waters in 2017 was 81. The number of active deep-frozen longline vessels increased from 54 in 2016 to 71 in 2017. The tropical tunas catch (bigeye and yellowfin tuna) of Chinese longline fleet in 2017 was estimated at 7,880 MT, 1,982 MT higher than that in 2016(5,898MT). The number of ice-fresh longline vessels decreased from 13 in 2016 to 10 in 2017. The albacore longline catch for 2017 was estimated at 3,646 MT, higher than in 2016 (1,920 MT). Both the logbook and observer programs are being implemented for the Chinese longline fleets. In 2017, four scientific observers were deployed on board longline vessels, and collected the data for both targeted and bycatch species as required.

Comoros (IOTC-2018-SC21-NR03)

La pêche aux Comores est exclusivement artisanale, pratiquée sur des embarcations non pontées en bois ou en fibre de verre, motorisé ou non motorisé d'une longueur de 3 m à 9 m. Elle exploite essentiellement les espèces pélagiques (*Thunnus albacares, Katsuwonus pelamis, Thunnus alalunga Istiophorus platypterus, Thunnus obesus, Euthynnus affinis*) et aussi des espèces benthiques. Elle contribue pour sa totalité à l'alimentation de la population comorienne, tout en fournissant 55% de l'emploi total du secteur agricole soit environ 7000 pêcheurs. Les techniques de pêche utilisées sont essentiellement la ligne de traine, la palangrotte et peu de filet pour les petits pélagiques. La durée de la marée est d'une journée à 7 jours. Depuis février 2011 les Comores ont mis en place un système de collecte des données sur les lieux de débarquement en collaboration avec la CTOI. En 2016 nous avons effectué une phase pilote en introduisant partiellement l'utilisation de smartphone pour la collecte des données. Au titre de 2017, la collecte de données est réalisée intégralement sur smartphone. La production annuelle issue de cette enquête est estimé à 13 295 tonnes toutes espèces confondues soit environ 9350 tonnes de thonidés sur un ensemble de 5006 embarcations. Pour le moment la pêche industrielle est inexistante au niveau national.

Eritrea (IOTC-2018-SC21-NR04)

National Report not submitted

European Union (IOTC-2018-SC21-NR05)

The EU fleet fishing in the waters of the Indian Ocean is composed of two main segments.

1. The first is an offshore segment including:
   - Purse seiners métiers targeting the three species of tropical tunas

   o Data 2017:
   - 27 active vessels
   - 36.035 m³.j transport capacity
   - 5.970 searching days and 6.117 days at sea
   - 223.764 t of catch
   - • YFT 38,8 %

- SKJ 53,5 %
- BET 7,6 %

- Longliners targeting swordfish with significant associated catches of some pelagic shark species
  - Data 2017
    - 22 active vessels
    - 5,697 * 10^6 hooks
    - 10.763 t of catch
      - SWO 42,8 %
      - BSH 41,8 %
      - SMA 7,4 %

- Longliners targeting swordfish with significant associated catches of tunas
  - Data 2017
    - 17 active vessels (>12m)
    - 3,067 * 10^6 hooks
    - 1.172 t of catch
      - SWO 42,7 %
      - YFT & BET 33,0 %
      - ALB 12,9 %

2. The second is a coastal segment, comprising vessels of less than 12 m fishing for and harvesting large pelagic species and associated species, some of which use anchored fish aggregating devices (AFADs) around Mayotte and Reunion Island, the two outermost regions of the European Union of the Indian Ocean. This coastal segment corresponds to the following métiers:

- Longliners

  - Data 2017
    - 24 vessels at Reunion Island
      - 0,73 * 10^6 hooks
      - 305 t of catch
    - 3 vessels at Mayotte Island
      - 89 fishing days
      - 138 *10^3 hooks
      - 58,2 t of catch

- Trolling line and hand-lines
  - Data 2017
    - Reunion :152 vessels
      - 9.156 fishing days
      - 755 t of catch
      - Mayotte : 145 yoles (141 en 2017) in the formal professional sector, 369 boats and 729 canoes in the non-professional sector (2016 data; 2017 N/A). Total production estimated at 2,050 t (in 2006) and between 965 and 1320 t in 2013/2015. The provisional estimate for 2017, only for professional boats, is 646t.

3. The fishing capacity of the EU fleet authorized to deploy a fishing activity for large pelagic species in the IOTC Convention Area is governed by provisions on capacity limits set out in the IOTC Resolution and by European Union legislation.

Furthermore, the conditions of access to certain fishing areas in waters under the jurisdiction of coastal states of the South West Indian Ocean are subject to specific provisions defined in public agreements engaging the European Union and called Sustainable Fisheries Partnership Agreements (SFPA).

In accordance with IOTC Resolution 10/02, flag EU Member States (Spain, France, Italy, Portugal and United Kingdom) have submitted scientific data characterizing the activity of the EU fleet fishing in 2017 in the IOTC area of competence, and enabling the IOTC Scientific Committee to conduct its work.

France-territories (IOTC-2018-SC21-NR06)

Depuis le passage de Mayotte comme territoire sous régime communautaire depuis le 1er Janvier 2014, **l'outre-mer français tropical de l'océan Indien ne concerne plus que les îles Eparses qui sont rattachées à l'administration supérieure des Terres Australes et Antarctiques françaises (TAAF)**. Un parc naturel marin a été créé le 22 février 2012 (décret n°2012-245), il s'agit du PNM des Glorieuses, qui dépend des îles Eparses et s'étend sur l'ensemble de la ZEE des Glorieuses.

Les Iles Eparses (France Territoires) ne disposent pas de flottilles thonières immatriculées pour ce territoire. Néanmoins, l'administration des TAAF délivre des licences de pêche à des palangriers et senneurs français et étrangers souhaitant pêcher dans les eaux administrées par France Territoires, et un programme observateur embarqué accompagne l'octroi de ces licences. **En 2017, l'administration des TAAF a accueilli 3 nouveaux observateurs pour la formation Obspec, alors que 7 autres avaient déjà été formés et avaient déjà embarqués sur des thoniers senneurs parmi les 10 observateurs qui ont embarqués pour les TAAF en 2017 entre le 18 Février et le 25 Juin 2017. Les embarquements d'observateurs scientifiques ont concerné 10 navires de pavillon français, espagnol, italien et seychellois. Ces embarquements ont totalisé 583 jours d'observations parmi lesquels 44% et 41% ont concerné respectivement les eaux internationales et seychelloises. Peu d'observations ont été réalisées dans les ZEE de Mayotte (20,5 jours soit 3,5%) et des TAAF (14,5 jours soit 2,5%). Un total de 607 coups de pêche a été observé durant cette campagne. Parmi ces coups de pêche 14 (soit 2,3% du total) ont réalisés dans les ZEE des Iles Eparses, 9 à Juan de Nova, 4 à Bassas Da India et 1 à Europa. Au cours des calées dans la ZEE des Iles Eparses 400t de thons majeurs ont été capturées.**

Le dispositif de recherche sur les grands pélagiques actuel de la France (IRD & Ifremer essentiellement) couvre des activités de type observatoire, l'étude des comportements migratoires des grands pélagiques, des études génétiques pour la délimitation des stocks, des études sur la biologie de la reproduction, la mise au point de mesures d'atténuations des prises accessoires et l'étude de la dynamique de l'écosystème tropical. La plupart des projets sont financés sur appels d'offre internationaux, européens ou nationaux. On trouvera à la fin de ce rapport la liste des différents projets qui se sont poursuivis ou ont débuté en 2017. La France a participé activement à tous les groupes de travail organisés par la CTOI, et a présenté 29 contributions scientifiques en 2017 en incluant les rapports nationaux proposés pour l'élaboration du rapport Européen et le rapport France-Territoires à l'intention du Comité Scientifique de la Commission.

Guinea (IOTC-2018-SC21-NR07)
National Report not submitted

India (IOTC-2018-SC21-NR08)
National Report not submitted

Indonesia (IOTC-2018-SC21-NR09)

For fisheries management purpose, Indonesian waters are divided into eleven Fisheries Management Areas (FMA). Three of them located within the IOTC area of competence, namely FMA 572 (Western Sumatera and Sunda Strait), FMA 573 (South of Java to East Nusa Tenggara, Sawu Sea and western part of Timor Sea) and 571 (Malacca Strait and Andaman Sea). Indonesian fishers operated various fishing gears such as Long line, Purse seine, hand line to catch large pelagic fishes such as tuna, skipjack, marlins etc. Longline is the main fishing gear type targeting tunas which operated in those FMAs. Number of active vessel operated in high seas in 2017 was 247 vessel dominated by longline followed by purse seine. Total catch of main species of tunas in 2017 was estimated around 165,725 mt which composed of albacore (6,994 mt), bigeye tuna (21,945 mt), skipjack tuna (96,872 mt) and yellowfin tuna (39,913 mt). Nominal hook rate derived from logbook data 2017 for albacore, bigeye, and yellowfin in kg/1000 hooks were 69.13, 29.51, and 65.79 respectively. Observer coverage 2017 was 6.9% increase than previous year in term proportion number of vessel observed. Nominal hook rate for billfishes from longline fishery was decreased rather than previous years, dominated by swordfish, followed by black marlin and blue marlin. Interaction longline fishery with seabird were operated above 25S was occurred, also reported that marine turtle interaction decreased rather than from previous years. Meanwhile bycatch of shark still dominated by blue sharks and crocodile sharks.

Iran (Islamic Republic of) (IOTC-2018-SC21-NR10)

Iran fishing grounds in southern part of the country is the most important resources for large pelagic species. There are 4 coastal provinces (Khozeastan, Boshehr, Hormozgan and Sistan& Blochestan Provinces) beside the Persian Gulf and Oman Sea where they are located between the longitudes from 48° 30' north to 61° 25' east. Iran, with an

interest in fisheries has concluded a number of bilateral agreements that regulate fishing in the area (through RECOFI and bilateral agreement e.g. Iraq, Oman, Kuwait and etc.) For Iranian fishermen the Arabian Sea is the gateway to the northwest Indian Ocean and the opportunity to harvest tuna and other highly migratory large pelagic species. It has been a tradition for Iranian fishers to fish offshore and in the last few decades gillnet and purse seine fisheries have become the established fishing method for Iranian fishers in the international waters of the northwest of the Indian Ocean. So, Iran joint to the Indian Ocean Tuna Commission (IOTC) in 2002 and it has been one of the active countries in the commission.

In a briefed view the total amount of fish production including catch and aquaculture has been 1202086 tons in 2017, which around 724817 tons came from catch and 477269 tons from aquaculture. Around On this way around 131000 fishermen with 10493 different type of vessels including fishing boats, dhows and ships are active in gillnet, Purse seine, Trolling, Trawl and Wire-trap which are engaged in fishing operation according to time schedule during different fishing seasons in the coastal and offshore waters and landed their fish in 130 fishing harbors or landing areas. On this way, large pelagic species catch is one of the most important group of fish that are caught by Iranian fishermen. There are four fishing gear types which targeting large pelagic species in the IOTC area of competence , included gillnet, purse seine, long line (by traditional boats) and also some of small trolling boats in coastal fisheries.

The main fishing grounds for large pelagic species in southern part of the country are located in the coastal area of the Persian Gulf and Oman Sea. Total production of tuna and tuna like species (including by-catch and discards) was 296192 Mt In 2017, which 274589 Mt belongs to tuna and tuna-like fishes in the Indian Ocean. This amount of catch contains 75.1% (222279 Mt) of Tunas, 11.3% (33514 Mt) of Seerfish, 6.3% (18795 Mt) of Billfish, 1.2% (3623 Mt) different species of shark and 6.1% (17981 Mt) other species. Also around 93.6% of tuna and tuna like species catch comes from gillnet gear, while around 2.1% of catch belong to purse seiners and 1.5% comes from trolling vessels and 2.8% comes from small artisanal gillnetter as a seasonal and temporal long-liner where they are fish in coastal waters.

Iran, has been one of the active countries in tuna fisheries and has had a progressively trend in participation of IOTC programs and implementation of the resolutions. As, the amount of compliance with IOTC resolutions has rising year to year and has increased from 11% in 2011 to 71% in 2017. Although, Iran's tuna fisheries is an artisanal fisheries and majority of fishermen only are working for their livelihood, but during past decade, Iranian fisheries organization monitoring and control system are developed very well and the country intent to make more progress in implementation of responsible and sustainable fisheries.

Japan (IOTC-2018-SC21-NR11)
This Japanese national report describes following 8 issues in recent five years (2013-2017), i.e., (1) tuna fisheries (longline fishery and purse seine fishery) (2) fleet information, (3) catch and effort by species and gear, (4) recreational fishery, (5) ecosystem and bycatch, (6) national data collection and processing systems including “logbook data collection and verification”, “vessel monitoring system”, “scientific observer program”, “port sampling program” and “unloading and transshipment”, (7) national research programs and (8) Implementation of Scientific Committee recommendations & resolutions of the IOTC relevant to the Scientific Committee and (9) working documents.

Kenya (IOTC-2018-SC21-NR12)
The Kenyan tuna fishing fleet structure consists of an artisanal commercial segment and recreational fleets which all combined target and impact species under the IOTC mandate. The commercial artisanal fishing fleet is composed of a multi-gear and multi-species fleet operating in the territorial waters. The local boats are broadly categorized as outrigger boats or dhows which come with variants depending on the construction designs. It is estimated that 414 artisanal vessels are engaged in the fishing for tuna and tuna like species in 2017 within the coastal waters. The Main gears used are artisanal long line hooks, gillnets, monofilament nets and artisanal trolling lines. Catches of scombrids from artisanal fisheries were 1,931 tons which is a decrease from 3,431 tons, recorded in 2016. Other IOTC species landed during the year were sailfish (356 tons), Swordfish (166 tons), Sharks (466 tons), Rays and Skates (707 tons) and hammerhead sharks (20 tons). The main target species from the recreational fisheries are marlins and sailfish (Istiophiridae), swordfish (Xiiphidae) and tuna (Scombridae).Other species caught include small pelagic species such as barracuda, Spanish mackerel, Wahoo and sharks are landed. The artisanal fisheries and recreational fishing fleets have interactions with sharks where sharks are caught and the carcass is retained and fully utilised in artisanal fisheries and recreational trolling line fisheries have a voluntary shark release policy for sharks.

Republic of Korea (IOTC-2018-SC21-NR13)

The number of active vessels in 2017 was 13 for longline fishery and 3 for purse seine fishery. With this fishing capacity, Korean tuna longline fishery caught 3,017 ton in 2017, which was 13% higher than that of 2016. The fishing efforts in 2017 were 6,463 thousand hooks and distributed in only the western Indian Ocean, while the fishing efforts averaged for 5 recent years (2013-2017) were 6,223 thousand hooks and distributed in the western tropical areas around 0-20°S as well as in the western and eastern areas around 20°S-40°S. Since 2015, some vessels have moved to the western tropical area between 5°N-10°S to fish for bigeye tuna and yellowfin tuna. As results, the catch of bigeye tuna increased, while the catch of albacore tuna decreased. Korean tuna purse seine fishery in the Indian Ocean recorded about 18,246 ton in 2017. In 2017, 3 vessels of Korean tuna purse seine fishery operated mainly in the western and central tropical areas around 10°N-10°S to fish for skipjack tuna and yellowfin tuna. The fishing efforts in 2017 were 697 sets, which mainly distributed in the western and central tropical areas around 40°E-70°E. In 2017, 2 scientific observers for longline fishery and 1 scientific observer for purse seine fishery were dispatched onboard for implementing observer program and scientific data collection, which carried out 5.9% and 8.4% of observer coverage in terms of the number of hooks and sets, respectively.

Madagascar (IOTC-2018-SC21-NR14)

La flotte nationale ciblant les thons et espèces assimilées est toujours constituée par les palangriers moins de 24 mètres. Ils sont actuellement au nombre de 7 et opèrent sur la côte Est de Madagascar. Depuis 2010, les techniques et les méthodes demeurent les mêmes. En général, les navires déploient entre 800 à 1300 hameçons par filage et ils effectuent une sortie relativement courte d'une durée de 4 à 7 jours afin de maintenir les captures fraiches en arrivant aux ports de débarquement que sont le port de Sainte Marie et celui de Toamasina. Le programme de collecte de fiches de pêche et d'échantillonnage au port de débarquement mis en œuvre depuis 2014 pour Sainte Marie et depuis aout 2016 pour Toamasina nous permet de visualiser la distribution de taille des espèces capturées. Ces dernières années, on constate que l'effort de pêche thonière (exprimé en nombre d'hameçons déployés) par les navires nationaux varie de 2010 à 2017. En outre, la variation annuelle des captures est légèrement proportionnelle à la variation de l'effort de pêche. La capture moyenne annuelle des palangriers est de 383 tonnes, et elle est constituée de 49% de thons, 19% de poissons porte-épées, 12% de requins et 19% d'autres espèces. La capture en thons est majoritairement composée des thons obèses, des germons et des albacores.

Les navires de pêche ayant des licences sur les poissons démersaux peuvent aussi avoir une interaction accidentelle avec certaines espèces sous mandat de la CTOI notamment celles dites néritiques. Il s'agit des ligneurs, palangriers et polyvalent exploitant la partie benthique des façades Ouest et Est de la Zone Economique Exclusive de Madagascar.

En outre, depuis 2015, l'USTA a initié le suivi de débarquements des poissons pélagiques issus de la petite pêche et de la pêche artisanale aux alentours de la ville d'Antsiranana avec deux villages pilotes. En 2017, ce suivi couvre 19 sites de débarquement des quatre Régions (DIANA, SOFIA, BOENY et ANALANJIROFO) de Madagascar. Les données relatives à cette filière sont figurées dans ce rapport.

Malaysia (IOTC-2018-SC21-NR15)

Total catch of marine fish from Malaysian waters in 2017 were 1.47 million metric tonne (mt), a slide decreased 6% compared to 1.57 million in 2016. The total landing in 2017 were attributed to the catch from 56,111 registered vessels with trawlers, purse seines, drift nets contributed large percentage of the catches. In 2017, marine fish production from the west coast of Peninsular Malaysia (Malacca Straits) contribute 723,545 mt (49%) out of the total catch. The remaining catches were from the South China Sea and Sulu Celebes Seas, east coast of Sabah. Coastal fisheries produced 53% (785,484.1 mt) and 47% (706,686.6 mt) from offshore fisheries.

Therefore, there is an emphasis by the government to develop tuna fisheries not only in coastal waters, but also in offshore waters within the Exclusive Economic Zone (EEZ). Tuna fisheries, which include both oceanic and neritic tuna, are targeted to be developed in the near future. The second strategic development plan for tuna fisheries 2012 – 2020 was launched at the end of 2013.

Neritic tuna contributes more 5.0% of Malaysia's marine fish landings in 2017. Purse seines are the most important fishing gear in neritic tuna fisheries, especially the 40-69.9 GRT and >70 GRT vessel size. It contributed more than 82% of the annual catches of neritic tuna in Malaysia. In Kuala Perlis, neritic tuna species are the second most abundant (13%) landed by purse seines after scad (16%), with longtail tuna dominated the landings followed by kawakawa and frigate tuna. In the year 2017, neritic tuna landings in west coast Peninsular Malaysia (Perlis, Kedah, Perak, Penang and Selangor) amounted to 18,450.16 mt; slight increased by 0.98% compared to 18,207.17 mt in 2016. The landing data for neritic tuna also included tuna-like species; Narrow-barred Spanish mackerel amounted 5961.82 mt in 2017 and 4060.57 in 2016. Meanwhile total landings for neritic tuna in Malaysia ranged from 50,000 mt to 75,000 mt.

The catch of oceanic tuna in 2017 increased significantly by 49% from 1,797.56 mt in 2016 to 2,682.55 mt in 2017. The increment is due to the increase of total number of vessels under Malaysian Flag that are authorized to operate

in the IOTC area from 10 vessels in 2016 to 19 vessels in 2017. Albacore showed most apparent increasing from 1,330.61 mt in 2016 to 1,607.24 mt in 2017. The fleet which consisted of 6 fishing vessels and one carrier, unloaded and exported the catches at the Port Louis, Mauritius. Albacore tuna formed nearly 70% of the catches in the form of frozen tuna. Another 13 vessels were unload at Penang Port, Malaysia. On observer program, Malaysia is currently in the process of developing national observer scheme. Malaysia has communicated with neighbouring countries who have developed and implemented regional Observer program and will start the Observer Program in mid 2019. Malaysia also have update and introduced the new logbook in September 2017 which includes all species under IOTC and size frequency for long line fisheries. Malaysia had conducted several stakeholders consultation programs to explain and to elaborate the IOTC Resolutions that is inforce. Several requirements under the relevant resolutions have been addressed in the national policies, license conditions and ATF.

The revised NPOA- Sharks II is published in 2014. On sea turtle, 2 sanctuary and information centers have regularly implementing awareness program for student and fishermen communities. Hatching program at these canters managed to release over 65,000 baby turtles back to the sea. There are several research programs on sea turtle been carried out at different areas in Malaysian waters and the ongoing projects are c-hook and satellite tracking.

Maldives (IOTC-2018-SC21-NR16)
The Maldives tuna fishery comprises of four main components; pole-and-line, handline, longline and troll line. In terms of total landings, livebait pole-and-line is still the most important gear for tunas. The main target species is skipjack tuna (*Katsuwonus pelamis*) and yellowfin tuna (*Thunnus albacares*), but small amounts of juvenile bigeye tuna (*Thunnus obesus*), (about 5-10%) is caught along with yellowfin tuna. Handline fishery is a relatively new gear, which targets large yellowfin tuna (> 70 cm FL) from the surface (<10m). Following termination of joint venture licencing in 2010, a fully Maldivian-flagged longline fishery is now established. Troll fishery is minor and used to target mainly neritic species of kawakawa (*Euthynnus affinis*) and frigate tuna (*Auxis thazard*), but occasionally also caught skipjack and yellowfin tuna.

The pole-and-line and handline fleets operate within about 100 miles although historically, the fleet operated closer, and returned to the home island daily. The foreign licensed longline fleet (1985-2010) operated in the outer waters of the EEZ, beyond 75 miles. With the Longline Regulation, the fishery was limited to 100 miles and beyond and into the high seas. The trolling fleet, still operates in the coastal areas and mostly within the atolls.

Maldives reported a total of 139,000 t of tunas in 2017, comprising of skipjack, yellowfin, bigeye, frigate and kawakawa. Pole-and-line fishery landed 99% of skipjack tuna in 2017 (almost 88,600 t), and was the second most important gear for yellowfin tunas, landing 35% of all yellowfin tuna caught (17,500 t) in 2017. Handline gear almost exclusively lands yellowfin tuna (30,562 t in 2017) which represented 98% of all species landed by the gear. Longline catch of tunas increased by 66% from 2016, landing 1,961 t comprising of 1,269 t of yellowfin tuna and 691 t of bigeye tuna.

Catches of skipjack registered an increase in 2017 relative to 2016. Recent catches have been of the order of 68,000 – 88,000 t, still much less than the catch recorded in 2006. Caches of yellowfin are increasing, due to the growing handline fishery although 2017 reported a slight drop in catch. No specialized vessel is required for handline fishing hence many pole-and-line vessels now carry both sets of gears and switch target fishery and gear depending on fishing opportunities.

Maldives pole-and-line and handline tuna fishery have minimal impact on the ecosystem. Catch and interactions with Endangered, Threatened and Protected (ETP) species and other species of ecological importance is virtually non-existent. Sharks bycatch and turtles are reported from the longline fishery, which has strict measures to report and release those that are caught. In addition, measures to mitigate bird entanglement in the longline gear are mandated by law. Logbooks for all the tuna fisheries have provisions to report catch and interactions of non-targeted and ETP species. Marine Research Centre currently conducts scientific observations of fishing trips that allow verification of logbook reported data.

The national data collection was based on complete enumeration system, which is now replaced by a modern logbook data collection system. The logbooks, introduced in 2010 was revised and now has provisions to record catch and effort, catch of bycatch and non-target as well as Endangered, Threatened and Protected species, and also catch and effort data for bait fishery. Introduction of the logbooks was a significant improvement to accommodate the changing fishing patterns and data requirements. A web-enabled database is now online and allows compilation and processing of catch and effort data. The database is also used to record tuna purchases by the exporters and also help maintain records of active fishing vessel and fishing licenses. Vessel monitoring system covers 100% of the

longline vessels and trips and a number of PL and HL vessels. In addition, the observer data collected from pole-and-line and handline fisheries enable verification of fishermen reported data.

A number of donor and local funded programs are being implemented to improve fishery and biological data collection, monitoring and management of the fisheries. The programs are geared towards improving national reporting and compliance to IOTC Conservation and Management Measures and towards understanding and minimising impacts of fisheries on the ecosystem.

Mauritius (IOTC-2018-SC21-NR17)
In 2017, Mauritius had 2 purse seiners, 1 supply vessel and 12 semi-industrial longliners operating in the tuna fishery in the IOTC area of competence. The two purse seiners are large freezer vessels having an overall length of 89.4 M each. The longliners are semi-industial boats less than 24 Metres in length, operating mostly in the EEZ of Mauritius and some operated outside the EEZ. These vessels carry out short trips of about 9-11 days and land their fish mostly chilled. The purse seiners operated largely outside the EEZ of Mauritius.

The semi-industrial longline fleet operating exclusively inside the EEZ of Mauritius comprised of 9 boats which undertook 69 fishing trips for a total of 824 fishing days and a deployment of 952344 hooks. The majority of the catch consisted of yellowfin and swordfish. Their total catch amounted to 378 tonnes. The CPUE was 0.4kg/ hook. The three longliners operating outside the EEZ carried out 59 trips for a total of 577 fishing days. They landed 512.6t of fish with a deployment of 701,637 hooks. Majority of their catch consisted of swordfish (40%).

The Mauritian purse seiners operated between latitudes 14oN to 14oS and longitudes 40o to 85ºE. Total catch of the two purse seiners amounted to 17,686t comprising of 48% skipjack, 43% yellowfin and 7% bigeye tuna for 678 positive sets out of a total of 719 sets. An observer was deployed on a Mauritian purse seiner for 71 days. Sampling exercises were carried out at Port Louis on local semi-industrial longliners. About a thousand fish were sampled. Sampling exercises were also carried out on the Mauritian purse seiners.

Mauritius has produced its National Plan of action for sharks. Marine sea turtles and cetaceans are protected under Mauritian law. Mauritius has put in place a Vessel Monitoring System since 2005 and all licensed vessels are monitored.

Mozambique (IOTC-2018-SC21-NR18)
The present report is an update of all activities, at national level, related to fisheries and species under IOTC mandate, including fisheries statistics, management and research activities. In the year 2017 the total catch of IOTC primary species within Mozambique EEZ was 7,700 tons of which 67% came from domestic fisheries. A total of 33 longliners and four purse seiners of distant water fishing nations were licensed in 2017 and produced a total catch of 2,728 tons, representing a decrease of 21% when compared with the catch reported by the foreign fleet operating in Mozambican waters during 2016. The national industrial tuna fleet licensed two longline vessels, which produced a total catch of 257 tons, representing an increase of 119% compared to the catch of the year 2016. The semi-industrial linefishery fleet of 33 vessels (14m-19m LOA) targeting primarily rocky bottom demersal fish, landed about 60 tons Narrow-barred Spanish mackerel. The multi-gears and multi-species artisanal sector landed 4,821 tons of IOTC primary species, representing an increase of 30% compared to the catch of the year 2016. Like in the previous year this group was dominated by Narrow-barred Spanish mackerel with 73% of the total catch. The capture of shark (IOTC and non IOTC sharks) by this sector, in the year 2017, was 2336 ton of which hammerhead sharks represented 71%. The recreational and sport fishing sector, which also catches IOTC primary species, issued 4486 individual licenses in 2017, a same figure of the year 2016. The total catch of IOTC primary species by this sector was roughly estimated around 58 tons. Data collection and reporting of fisheries statistics for this sector, including the nominal catch, is still a challenge.

To improve the knowledge about the dynamic of tuna fisheries, some tools and programs have been implemented at national level. A logbook system is in place for industrial and semi-industrial fleet and scientific observers have been regularly embarked on-board the fishing vessels. In 2017, 11 % of the total fishing days were covered by scientific observers on-board national longline vessels. For artisanal fisheries, a landing sampling scheme is in place and to continue improving the coverage and the quality of fisheries data, there are ongoing activities which include a pilot implementation of the FAO ARTFISH data collection framework. With respect to sharks, in 2017 Mozambique organized a training course on shark's species identification including identification based on fins and, in order to get inputs for the NPOA-sharks, a national workshop for shark's main issues identification was conducted. For the recreational fisheries, a comprehensive update of the recreational fisheries census conducted in 2008 is planned for year 2019 in order to fill the gaps and improve the knowledge on the dynamic of the fishery.

Oman (IOTC-2018-SC21-NR19)
The total production of the Omani fishery sector amounted to around 348,000 Tons in 2017 with an increase of approximately 24% compared to 2016.

Tuna species considered as highly valuable products for Omani consumers, have experienced significant increases in the total annual production and increasing (for Tuna and Sharks species) from 47,517 mt in 2015 to 54,824mt in 2016 and to 57,426 mt in 2017. This increase finds its origin, in the dynamism shown by the traditional fleet on the tuna coastal resources and probably the slowdown of the fishing pressure in the Yemen waters. For the industrial fleet, the number of vessels decreased from 10 vessels in 2011 to 3 vessels in 2014 and to 1 vessel in 2017. This reduction in the industrial fishing capacity was initiated by the national Authorities for the purpose of restructuring the industrial fishing sector to improve its competitiveness and efficiency. At the annual IOTC meeting in 2018, the Sultanate has submitted a revised version of its Fleet Development Plan which is scheduled to be implemented in the upcoming years. Artisanal and coastal fleets have, however, increased slightly in the number of vessels and fishermen.
For the monitoring aspects of the Tuna fishery, the Omani Government has introduced the logbook data collection scheme, the Vessel Monitoring System (Upgrading the system is ongoing), Port Sampling Program (PSP), and a scheme to enhance the quality of data gathered in order to contribute to manage and sustain efficiently the Omani fisheries.

At the same time, the Government started to run and monitor several other projects for other marine species such as sea birds and marine turtles. While the sea birds program is still in its starting stages, the turtle program has been launched and several assessment missions and reports have been completed and multiple public awareness sessions and fishermen sensitisation programs have been executed particularly in Massirah Island. A very informative conference has been organized in October 2018 by the Environment Society of Oman during which the status of loggerhead sea turtles has been presented and discussed by a large audience of Government participants and other concerned stakeholders.

Pakistan (IOTC-2018-SC21-NR20)
Tuna and tuna like fishes are one of the components of pelagic resources. In Pakistan, mainly neritic and oceanic species are encountered in the tuna fishery. Tuna fishing fleet comprises of about 709 gillnet boats. The total production of tunas and tuna-like fishes, including Neritic and Oceanic tunas, Billfishes and Seerfishes during the year 2017 was 102,225 m. tonnes.

There are no reported instances of sea bird interaction in any of the tuna fishing boat. Sea turtles, Marine mammals and Whale sharks are protected in Pakistan under various national and provincial fisheries and wildlife legislations. Data on tuna production is collected by provincial fisheries departments of maritime provinces of Sindh and Balochistan and compiled by Marine Fisheries Department, Government of Pakistan, Ministry of Ports & Shipping. Tuna and allied resources called as large pelagic resources. The large pelagic resources contributed 102,225 ton, accounting for 26.9% of the marine capture fish production. Major share of the landing was by Tunas (69%) followed by Seerfishes (21%) and dolphinfish (5.0%) and billfish (4%). Among the tunas, yellowfin was dominating with 35%, followed by longtail (27), frigate (18.5%), tuna-nei (8.5%), kawakawa (5.9%) and skipjack (4.4%). There was some landings of bullet tuna and striped bonito as well. There is a change in the pattern over the years, the contribution of the skipjack was 1.6% in 2016 and decreased down to 4.4 %.

Significant progress has been made during the year 2016, for the conservation of bycatch species which include promulgation of fisheries legislations by both provinces of Sindh and Balochistan. These legislation prohibited the catching of turtle, cetacean (whales & dolphins), whale shark, silky shark, oceanic whitetip shark, thresher shark, hammerhead sharks, all species of sawfishes of family Pristidae, all species of guitar fishes and wedge fishes of family Rhinidae, Rhinobatidae or Rhynchobatodae. To monitor the activities of local tuna boat, it is made mandatory to have VMS on all fishing vessel larger than 15 meters (in length overall). The contravention of these regulation is punishable with fine and imprisonment.

Philippines (IOTC-2018-SC21-NR21)
The Philippines had only one active vessel in 2017, the FV Marilou 888, a purse seiner, with a GT of 349 (period covered: October 7 to December 19, 2017/ IOTC area of competence: 10º S to 5º N – 075º E to 090º E). A total of 25,551 kg bigeye, 72,680 kg yellow fin and 144,566 kg skip jack were caught and all catches landed in General Santos City. Thirty three Silky Sharks (FAL) were captured, 12 were released alive and 22 were released dead (no sharks retained). There were one olive ridley turtle (LKV) released alive and one smooth tail mobula (RMO) released dead encountered during the operation. Mandatory application of conservation and management measures

for sharks and other species was observed during the operation. The entire trip was 100% observer covered and the vessel was VMS equipped.

Seychelles (IOTC-2018-SC21-NR22)
The Seychelles National Report summarizes activities of the Seychelles' fishing fleet targeting tuna and tuna-like species in the WIO for the year 2017 in comparison with previous years. It also summarizes research, and data collection related activities as well as actions undertaken in 2017 to implement Scientific Committee recommendations and IOTC Conservation and Management Measures.

The Seychelles purse seine fleet increased from 8 vessels in 2012 to 13 vessels in 2017. The number of supply vessels also increased from 4 to 8 during the same period. In 2017 the nominal effort decreased by 821 days (20%) when compared to the previous year to a total of 3,271 days fished, whilst the overall catch increased by 13% from 108,613MT in 2016 to 122,202 MT in 2017. Catches of yellowfin tuna increased by 4% from (40,121 MT to 41,711 MT), whilst catches of skipjack and bigeye tuna also increased by 15% and 33% respectively. Catch rate increased from 26.55 Mt/Fishing days to 37.36 Mt/Fishing days.

Two more fishing vessels joined the Seychelles Industrial longline fleet in 2017 making a total of 48 vessels. The total catch reported by this fleet for 2017 was estimated at 10,243 MT representing a decrease of 32% in catches, as a consequence of a significant decrease (29%) in fishing effort. Catches were dominated by NEI category comprising of mostly 'oilfish' (30%). Bigeye tuna and yellowfin tuna, represented 27% and 23% respectively.

In 2017, the semi industrial fishery recorded the highest catch since the beginning of the fishery, with a total of 1,162 Mt, representing an increase of 18% over the previous year. The fishing effort also increased by 66% from 1.23 million hooks set in 2016 to 2.05 million hooks in 2017. However, catch rate decreased from 0.80 MT/1000 hooks to 0.57 MT/1000 hooks. Yellowfin catch increase by 26% from 585 MT to 740 MT for the period under review.

During 2017, SFA continued to implement various actions to improve the quantity and quality of data collected from its fleet targeting tuna and tuna-like species in the Indian Ocean. Actions include improved logbook for data capture, review and upgrade of data collection and management system, capacity building for field samplers and implementation of National Scientific Observer Programme. Current coverage level for the observer programme on the purse seine fleet is at 38% of all sets. Electronic Monitoring System are also being tested, particularly for industrial longliners, currently not being covered by human observers.

Sierra Leone (IOTC-2018-SC21-NR23)
National Report not submitted

Somalia (IOTC-2018-SC21-NR24)
Somali has the longest coastline in Africa (3,330km) and an EEZ of 1,165,500 Km2, there is potential to sustainably increase employment, food security, nutrition and revenues from its fisheries but there is currently no unified fisheries management. The fishery resources in Somali waters are said to be one of the richest in the African continent.

The marine fisheries can be further divided into offshore (conducted by foreign vessels), coastal or artisanal (limited to waters of the relatively narrow continental shelf, operated by traditional vessels and vessels with outboard/inboard engines) and Houri by traditional boats. The fishing seasons of Somali waters is governed by the monsoon winds that occur in the calendar year between May and September. In this period, high waves and strong winds force small and medium size commercial boats not to call at Somali ports. The fishing days of the artisanal fishery varies between 220-240 days per year while the offshore fishing vessels were forced to change their fishing ground, gear or target species.

Large pelagic species including tuna and tuna-like species such as yellow-fin, big-eye, skipjack, and mackerel are the most highly priced species locally. Although they are highly migratory, the traditional fishing grounds for these species are found along the Indian Ocean from latitude 05 to 100 N due to upwelling that occurs twice annually in the period of southwest monsoons. It is also known that there are good fishing opportunities in the Gulf of Aden and Indian Ocean for tuna during the Southwest monsoon in the deeper waters.

Besides, there is no MCS of the marine resources and centralize data collection system on marine products on both inshore and offshore fisheries. Strengthen its capacity in development and implementation of central database along its coast for artisanal fishery is the key priority areas in Somalia.

Sri Lanka (IOTC-2018-SC21-NR25)
The total production of tuna and tuna like species of Sri Lanka in year 2017 was 110, 721t. 85% of the catch was from the EEZ. Skipjack tuna dominated the catch amounting to 39,556t. 34% of the catch is Yellow fin tuna (37,972t) and 5% was bigeye tuna. The bill fish were the second most group which contributed 16% to the catch where sword fish dominate in the catch. The shark catch was 1764t. Legal ban on catching of certain species of sharks has reduced shark catches. Over 4000 multi day boats engaged in large pelagic fishing. Out of the authorized vessels 1374 were active at high seas however most of the catch is from the EEZ. Almost all high seas vessels are within the range of 10- 15m in length. 1461 numbers of vessels fitted with VMS and monitored by land based FMC. VMS is mandatory for high seas fishing.Long line and gill net are the major fishing gears used. 34%of vessel operated for tuna are dedicated long liners and 28% are gillnetters. Measures are underway to restrict the use of large gill nets within EEZ. 100 multi purpose mechanised boats were made exclusively deep sea long liners by installing winch and better cooling systems. High fuel cost has restricted the vessel operations and mostly kept anchored. The VMS data are being used to crosscheck the accuracy of position data provided in the logbooks. Electronic catch data recording is being carried out at pilot scale. On board observers were deployed in all possible vessels. Port State Measures legalized andE-PSM application is followed. The coverage of coastal data collection expanded.

South Africa (IOTC-2018-SC21-NR26)
South Africa has two commercial fishing sectors that target tuna – the Large Pelagic Longline and the Tuna Pole-Line (baitboat) sectors. The latter sector mainly targets (*Thunnus alalunga)* and to a lesser degree yellowfin tuna (*Thunnus albacares*) and rarely operates in the IOTC Area of Competence. The Large Pelagic Longline sector comprises two fleets with different histories: the South African-flagged Large Pelagic Longline vessels that traditionally used swordfish (*Xiphias gladius*) targeting methods, and the Japanese-flagged vessels that operate under joint-ventures and fish for South African Rights Holders. The Japanese-flagged vessels typically target tropical tunas and southern bluefin tuna (*Thunnus maccoyii*) with their effort focused in the Indian Ocean. In 2017, 16 longline vessels were active in the IOTC Area of Competence, which is less than that in 2016. However, effort has remained constant and the number of hooks set in 2017 (1 284 160) is remarkably similar to that in 2016 (1 284 756). Despite constant effort, catches increased from 2016 for southern bluefin tuna (163%), albacore (33%) and bigeye tuna (29%). The substantial increase in southern bluefin tuna catch is a result of South Africa's longline fleet actively targeting this species due to the increased nominal TAC from 40 tons in 2015 to 150 tons in 2016/2017. For the same period, decreases in catch were observed in swordfish (39%), blue shark (39%), yellowfin tuna (25%) and shortfin mako shark (23%). The high inter-annual variability in catches for species can largely be attributed to a high proportion of longline vessels fishing across the IOTC/ICCAT boundary line. Observer coverage exceeded all RFMO requirements and 73% (939 835) of hooks set in the IOTC Area of Competence were set while an observer was onboard, of which approximately 42% of hooks set were actively observed. In 2017, only a single Tuna Pole-Line vessel fished in the Indian Ocean for 12 hours – this vessel was likely searching for tuna and crossed the ICCAT/IOTC boundary temporarily. Negligible catches of yellowtail (S*eriola lalandi*) were made by this vessel.

Sudan (IOTC-2018-SC21-NR27)
National Report not submitted.

Tanzania (IOTC-2018-SC21-NR28)
National Report not submitted

Thailand (IOTC-2018-SC21-NR29)
For the past 30 years, fisheries resources and the marine environment have been seriously degraded through overfishing brought about by a lack of control of fishing capacity that was allowed expand, both in terms of increasing number of fishing vessels and in adopting new technologies, which were not commensurate with the natural productivity of the resources. These challenges provided fertile ground for the proliferation of illegal, unreported and unregulated (IUU) fishing within Thai fisheries waters by both Thai and foreign vessels and outside Thai waters (high seas and fisheries waters of other States) by Thai fishing vessels.

Thailand has built upon the reforms of all dimensions undertaken during nearly the past 3 years, including the reform of legal framework and implementing regulations, the fisheries management limiting the fishing license issuance in compliance with the quantity of aquatic animals, the fleet management putting control over fishing vessels of all sizes and types, the monitoring, control and surveillance through port-in and port-out control. Moreover, for Thai oversea vessels installation of vessel monitoring system (VMS), and especially installation of electronic reporting system (ERS) electronic monitoring system (EM) for oversea fishing fleet, as well as the development of traceability system for catches from Thai-flagged vessel.

Neritic tuna in the Andaman Sea in 2017, there were 12,802 tons of Neritic tuna caught by 4 fishing gears. The main gear was Purse seine caught 12,768 tons while Anchovy falling net, Otter board Trawl, and Squid falling nets caught 24, 6 and 4 tons respectively. Anyway, to study on the length distribution of neritic tuna was done only for purse seine.

During 2011-2015, six Thai tuna longliners operated in the Western coast of the Indian Ocean, but in 2016 - present, Thailand did not have commercial longliner vessels operated in Indian Ocean. In 2017, there was one Thai purse seiner operated only two month in this area. They declared logbook to Department of Fisheries, Thailand. Data from logbook displayed important information of their fishing operation and effort. The fishing operations were recorded 11 times. The major neritic tuna species consisted of kawakawa 13,469 kg and longtail tuna 979 kg. The average percentage composition by weight of kawakawa, longtail tuna, narrow-barred spanish mackerel and other species group (round scad, bigeye scad, Indian mackerel etc.) were 34.76%, 2.53%, 0.16% and 62.56%, respectively. The average CPUE was 3522.82 kg/time.
Foreign tuna fleets unloading in Phuket in 2017, the annual catches were estimated 21,657.59 tonnes. The main species composition were tuna group, billfish group and other species group which 20,714.87, 889.28 and 53.44 tonnes. The main species composition of Tuna group were Skipjack tuna, yellowfin tuna, bigeye tuna, bill fish group (Swordfish, Blue marlin, Indo-Pacific sailfish) and other species group (Oilfish, Dolphin Fish, Wahoo).

United Kingdom (OT) (IOTC-2018-SC21-NR30)
The United Kingdom (BIOT) waters are a no take Marine Protected Area (MPA) to commercial fishing. Diego Garcia and its territorial waters are excluded from the MPA and include a recreational fishery. UK (BIOT) does not operate a flag registry and has no commercial tuna fleet or fishing port. The UK(BIOT) National Report summarises fishing in its recreational fishery in 2017 and provides details of research activities undertaken to date within the MPA.

The recreational fishery landed 13.18 tonnes of tuna and tuna like species on Diego Garcia in 2017. Principle target tuna species of the industrial fisheries (yellowfin, bigeye and skipjack tunas) contributed 21.48% of the total catch of tuna and tuna like species of the recreational fishery. Recognising that yellowfin tuna are currently overfished and subject to overfishing in the Indian Ocean and that Resolution 18/01 seeks to address this, UK(BIOT) are taking action to reduce the number of yellowfin tuna caught in the BIOT recreational fishery and to encourage their live-release. Length frequency data were recorded for a sample of 305 yellowfin tuna from this fishery. The mean length was 74.66cm. Sharks caught in the recreational fishery are released alive.

IUU fishing remains one of the greatest threats to the BIOT ecosystem but a range of other threats exist including invasive and pest species, climate change, coastal change, disease, and pollution, included discarded fishing gear such as Fish Aggregating Devices. During 2017/18 the BIOT Environment Officer continued to take forward the BIOT Interim Conservation Management Framework which will be replaced with the BIOT Conservation Management Plan 2018-2023 by the end of 2018. In 2017/18 Recommendations of the Scientific Committee and those translated into Resolutions of the Commission have been implemented as appropriate by the BIOT Authorities and are reported.

Yemen (IOTC-2018-SC21-NR31)
National Report not submitted

Bangladesh (IOTC-2018-SC21-NR32)
Bangladesh is blessed with vast coastal and marine resources. The coastal area of the country is known as one of the highly productive areas of the world by virtue of her geographical position and climatic condition. Bangladesh is rich not only in terms of its vast water areas but also in terms of the biological diversity. One of the unique features of the coastal areas is the influence of the mangrove forests, which support a high number of fishes and other commercially important aquatic organisms. The biological and ecological values of the Bay of Bengal have been pointed out by many authors. The coastal and marine fisheries have been playing considerable roles not only in the social and economic development of the country but also in the regional ecological balance. A large number of commercially important fishes have long been exploited which are of high export values and consume locally as precious item. Tuna and tuna like other highly migratory species have become high pace in the priority list to the government of Bangladesh for a couple of years especially after demarcated sea boundary with the neighbour that lead to the access of Bangladeshi fishers to the Area Beyond National Jurisdiction (ABNJ) of high seas. Simultaneously, the study of tuna and tuna like fishes of Bangladesh marine waters are one of the most poorly studied areas of the world although it possesses high potential. Proper attention is needed in every aspect of exploitation, handling and processing, export and marketing as well as in biological and institutional management

strategies. Basically, there is no specific tuna fishery in Bangladesh. Tuna are by catch of industrial trawlers and artisanal gill netters. In quantity, tuna comprises about 1% of the industrial catch and 9% of catch is mackerel in the year 2017-18. The coastal and marine fisheries of Bangladesh are briefly reviewed in this report to provide a salient feature of the available information of marine fisheries with a view to identify sustainable management of the resources.

Liberia (IOTC-2018-SC21-NR33)
National Report not submitted

Senegal (IOTC-2018-SC21-NR34)
NA

APPENDIX 5
STATUS OF DEVELOPMENT AND IMPLEMENTATION OF NATIONAL PLANS OF ACTION (NPOA) FOR SEABIRDS AND SHARKS AND IMPLEMENTATION OF THE FAO GUIDELINES TO REDUCE MARINE TURTLE MORTALITY IN FISHING OPERATIONS (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 NPOA in 2018		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 in 2018, developed 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 6A
IOTC ROS MINIMUM REPORTING STANDARDS

IOTC ROS Minimum Reporting Standard Data Fields & Instructions

The format of how these data fields will be presented for collection by observers is up to the observer programmes to develop. However if providers need a format to use as a guide that includes all the fields in this set of minimum data standard fields, they can use forms and formats developed by the IOTC-ROS. These are available on the IOTC Website under Science: Regional Observer Scheme[3] and could be adapted to suit your programme.

Unless otherwise instructed:

- **All dates to be reported to the IOTC Secretariat as YYYY/MM/DD independently of the format in which they were collected.**
- **All times to be reported to the IOTC Secretariat in UTC[4] (hh:mm) independently of the time fuse and format in which they were collected.**
- **All positions to be reported to the IOTC Secretariat as dd°mm,m' mentioning if collected South or North of the equator (independently of the format in which they were collected).**
- **All units of measure to be clearly indicated.**

[3] http://www.iotc.org/science/regional-observer-scheme-science

[4] Coordinated Universal Time

GENERAL VESSEL AND TRIP INFORMATION FOR ALL VESSEL TYPES

Data field name	Data field description	Mandatory
Observed trip number	This is the observed trip unique identifier. This should begin with trip's start date (YYYY-MM-DD), followed by IOTC observer number, and vessel main gear code as per IOTC classification (E.g. 2018/01/23-IOTCFRA001-PS).	**Yes**
VESSEL IDENTIFICATION		
Name of the vessel	Vessel full name as recorded on vessel official documentation and crosschecked with the name recorded on the vessel itself (any discrepancies are to be reported to the IOTC Secretariat). Care should be taken to record the correct spelling of the vessel's name including any corresponding numbers. i.e. "Agnes 83".	**Yes**
Flag state (or where chartering occurs, chartering state)	Name of country in which vessel is registered as shown on its registration documents according to the IOTC categories (Table 2). Note this should be chartering state, where chartering occurs. Note this may not be the same as the nationality from which the vessel originates.	**Yes**
Vessel's IOTC number	Vessel IOTC number as per the IOTC Record of Authorized Vessels[5] and crosschecked with the number recorded on vessel certificates (any discrepancies are to be reported to the IOTC Secretariat).	**Yes**
Vessel's IMO or Lloyd's number	This is the number allocated to the vessel when registered to the International Maritime Organization of the United Nations. Example: IMO8814275.	**Yes**
Vessel's Port of registration	The name of vessel's port of registry (also called home port), shown on its registration documents and lettered on the stern of the ship's hull.	**Yes**
Licensed target species	Vessels will generally target a narrow range or aggregation of species. Report licensed target species as specified in vessel licences or permit conditions (FAO spp. 3-alpha code).	**No**
OBSERVER DETAILS		
Observer IOTC registration number	Observer registration number allocated by the IOTC Secretariat to be used on all observer data submissions.	**Yes**
OBSERVER TRIP INFORMATION		
Number of fishing events/sets conducted by the vessel while the observer was on-board.	The total number of fishing events/sets conducted by the vessel while the observer was on-board, independently of their success and of being sampled or not by the observer. (Note that this should not include pole and line bait fishing events/sets).	**Yes**
Number of fishing events/sets observed	The total number of fishing sets/events monitored by the observer. (Note that this should not include pole and line bait fishing events/sets).	**Yes**
Number of days searching	The total number of days that the vessel was engaged in actively searching for fish (this include active fishing days).	**Yes**
Number active fishing days	The total number of days that the vessel actually fished (when the vessel had gear in the water).	**Yes**

Number of days lost	The total number of days where the vessel was unable to fish dues to factors such as adverse weather conditions, mechanical failure or other unforeseen events.	**Yes**
Reasons for days lost	The reasons why the vessel was unable to fish: (i) adverse weather conditions, (ii) mechanical breakdown or inoperative gear or (iii) unforeseen events (specify).	**Yes**
VESSEL ATTRIBUTES		
Tonnage (specify units)	The vessel tonnage as specified in vessel registration papers. Specify if the vessel is registered using Gross Tonnage (GT) or Gross Registered Tonnage (GRT).	**Yes**
Length overall (specify units)	The vessel overall length as specified in vessel registration papers (specify units).	**Yes**
Fish storage capacity	The vessel total maximum capacity to store catches in metric Tons (mT.) or cubic meters (m^3). This should include blast freezer(s) capacity.	**Yes**
Hull material	The vessel hull material (s) (steel, wood, aluminium, fibre glass, etc.), according to IOTC categories (Table 3.Vessel hull material).	**Yes**
Main engines (make/ power)	The make and power of the main engines (specify units: HP, Kilowatt or BHP).	**Yes**
VESSEL ELECTRONICS		
Global Positioning System (GPS)	Indicate Yes if on board No if not sighted	**Yes**
Vessel Monitoring System	Indicate Yes if on board No if not sighted	**Yes**
Radars	Indicate Yes if on board No if not sighted	**Yes**
Track Plotter	Indicate Yes if on board No if not sighted	**Yes**
Depth Sounder	Indicate Yes if on board No if not sighted	**Yes**
Sonar	Indicate Yes if on board No if not sighted	**Yes**
Doppler Current Meter	Indicate Yes if on board No if not sighted	**Yes**
Expendable Bathythermograph (XBT)	Indicate Yes if on board No if not sighted	**Yes**

[5] http://www.iotc.org/vessels/current

LONGLINE INFORMATION

Data field name	Data field description	Mandatory
SPECIAL EQUIPMENT OR MACHINERY		
Line setter	Indicate Yes if on board No if not sighted - Many long line vessels will be fitted with equipment or machinery that regulates line setting speed allowing the line to be set at uniform depth.	**Yes**
Line hauler	Indicate Yes if on board No if not sighted - Most long line vessel will be fitted with equipment or machinery that hauls the line in after it has been set.	**Yes**
Bait casting machine	Indicate Yes if on board No if not sighted - Most vessels manually deploy branch lines with the bait. However there are a number of vessels that use automatic bait casting machines.	**Yes**
GENERAL GEAR ATTRIBUTES		
Mainline material	The material the mainline is made out of, e.g. kevlar, nylon, nylon multifilament according to the IOTC categories (Table 4).	**Yes**
Mainline length	The total length of the mainline in kilometres (i.e. mainline maximum length).	**Yes**
Branchline lenght (specify units)	The length of each of the branchline sections (1, 2, 3 and 4), where section 1 is that closest to the mainline and section 4 is the leader.	**Yes**
Branchline diameter (specify units)	The diameter of each of the branchline sections (1, 2, 3 and 4), where section 1 is that closest to the mainline and section 4 is the leader.	**Yes**
TORI LINE DETAILS	If the vessel was equipped with a tori line provide tori line details below. If no tori line wasn't present on-board fill in NA for not applicable.	
Tori line length (specify units)	The total length of the tori line (not including streamers).	**Yes**
Streamer type	The type of streamers used with the tori line (e.g. paired or single).	**Yes**
Streamer line length (specify units)	The length of individual streamer lines (minimum and maximum where lengths vary).	**Yes**
No. streamers per line	The number of streamers that are attached to a single tori line	**Yes**
Attached height (specify units)	The height that the tori line is attached above the water level.	**Yes**
SETTING OPERATIONS		
Start setting date and time	The date at the time the first dhan buoy and / or radio buoy is deployed to start the setting of the line.	**Yes**
Start setting position	The position in latitude and longitude for the start of the setting operation.	**Yes**
End setting date and time	The date and time that the last dhan buoy and / or radio buoy is deployed. (Note that longline vessels often set lines at the night and the setting operation may continue beyond midnight and into the following day.)	**Yes**

Length of mainline set (specify units)	The mainline total set length (i.e. the total deployed length of the mainline for the specific set). Usually calculated by multiplying the total time to set the line and the average line setter speed. (Note take into account any interruption times).	**Yes**
Shark lines set	Indicate Y or No if shark lines were set during the operation. (Note: shark lines are branch lines running directly off the longline floats or drop lines, specifically for targeting sharks).	**Yes**
Total number of hooks set	The total number of hooks deployed for the set, usually calculated by multiplying number of baskets by the average number of hooks between the baskets.	**Yes**
Target species	The target species for the set (FAO spp. 3-alpha code).	**Yes**
VMS on	Indicate Y or No to sign if he VMS was on or not while setting and hauling.	**No**
Mitigation measures		
Number of Tori lines deployed	The total number of tori lines deployed during the setting operation. Zero if none was deployed.	**Yes**
Low light night setting	Indicate Y or No - minimum deck lighting is used during night setting.	**Yes**
Branch line weighted	Indicate Y or No if the branch line is weighted.	**Yes**
Sinkers average weight (specify units)	The average weight of weights/sinkers attached to the branchlines.	**Yes**
Proportion weighted	The proportion of branchlines weighted (%). If all weighted than record 100%.	**Yes**
Hook-sinker distance (specify units)	The distance of the weights/sinkers from the eye of the hook.	**Yes**
Hook type	The type of hooks used according to the IOTC categories (Table 5).	**Yes**
% of hooks set by type	The percentage (%) of hooks set by type according to IOTC categories (Table 5).	**Yes**
Bait type	The bait type/condition used to according to the IOTC categories (Table 6).	**Yes**
Bait species	The bait species used (FAO spp. 3-alpha code).	**Yes**
Bait ratio (%)	The approximate proportion of each bait type and species used across all hooks in the set.	**Yes**
HAULING OPERATIONS		
Start hauling date and time	The date and time when the first dhan buoy and / or radio buoy is hauled back on-board to start hauling the line.	**Yes**
Start hauling Position	The position in latitude and longitude for the start of the hauling operation.	**Yes**
Sampling protocol	The sampling protocol followed by the observer according to IOTC categories (Table 22).	**Yes**
Number of retrieved hooks observed	The number of hooks observed for catch and bycatch composition.	**Yes**

CATCH DETAILS (i.e. information on catch for each set)		
Species code	The species code for each specimen observed (FAO spp. 3-alpha code). If species FAO code is not available, the species scientific name.	**Yes**
Fate	The species fate which includes whether it was retained or discarded and the reason according to the IOTC categories (Table 12).	**Yes**
Depredation details		
Depredation source	For depredated specimens, the depredation source based on depredation scar characteristics according to the IOTC categories (Table 19). For non-depredated specimens record NA.	**Yes**
Predator Observed	For depredated specimens, the predator species directly observed and identified (FAO spp. 3-alpha code). If the predator was not observed record UNK (unknown). For non-depredated specimens record NA.	**Yes**
Additional catch details on non-target species	Catch details on non-target species to be collected where possible and reported to the IOTC Secretariat as recommended by the Scientific Committee.	
Condition at capture	The condition of the specimen at capture according to the IOTC categories (Table 17).	**No**
Condition at release	The condition of the specimen at the time of release according to the IOTC categories (Table 17).	**No**
Additional catch details on SSIs[6]	Additional catch details on Species of Special Interest (p. **Error! Bookmark not defined.**) to be collected where possible and reported to the IOTC Secretariat as recommended by the Scientific Committee.	
Gear interaction	The interaction of the specimen with the fishing gear according to IOTC categories (Table 16).	**No**
Hook type	The type of hook the individual was hauled on according to the IOTC categories (Table 5). *[Consistent with IOTC Res 12-04]*	**No**
Bait type	The type of bait the individual was hauled on according to the IOTC categories (Table 6). *[Consistent with IOTC Res 12-04]*	**No**
Leader material	The leader material the individual was hauled on according to the IOTC categories (Table 4). *[Consistent with IOTC Res 12-04 and IOTC Res. 17/05]*	**No**
Leader thickness	The thickness of the leader the individual was hauled on. *[Consistent with IOTC Res 12-04 and IOTC Res. 17/05]*	**No**
De-hooker/line cutter	The de-hooking or line cutting device used to extract the hook. *[Consistent with IOTC Res 12-04]*	**No**
Brought on board	Indicate Yes or No, if the specimen brought on board. *[Consistent with IOTC Resolutions 13/04; 13/05; 12/04; 12/06; 12/09]*	**No**

[6] List of Species of Special Interest (SSI) approved by IOTC Scientific Committee (SC) is included at the end of this document under the Codes and guideline section.

Hauling method	The detail how the specimen was brought on-board according to the IOTC categories (Table 18). *[Consistent with IOTC Res 12-04]*	**No**
SAMPLING DETAILS Details concerning any sampling conducted, including where possible extra biometric measurements, sex, maturity and the collection of samples.		
Sampling methods for the collection of biological information	The sampling method used for the collection of biological sub-sample according to the IOTC categories (Table 20).	**Yes**
Length code 1	The length code used for the measurement according to the IOTC categories (Table 24).	**Yes**
Length 1	The length corresponding to the length type taken rounded to the lower centimetre. For LD1 this should be rounded to the lower half centimetre.	**Yes**
Length code 2	When an additional length measurement is taken. The length code used should be reported according to the IOTC categories (Table 24).	**No**
Length 2	When an additional length measurement is taken. The corresponding length should be reported rounded to the lower centimetre. For LD1 this should be rounded to the lower half centimetre.	**No**
Weight (specify units)	The specimens' weight corresponding to the specified product type. If the fish hasn't been processed than make sure to record the unprocessed (or round, whole, live) weight (i.e. RD).	**No**
Weight code	The code corresponding to the type of processing the specimen underwent previous to be weighted according to the IOTC categories (Table 15).	**No**
Weight estimation method	The weight estimation method used to collect weight according to the IOTC categories (Table 14).	**No**
Sex	The sex, male or female of the sampled fish specimen. If unknown record UNK.	**No**
Maturity stage	The stage of maturity of the sampled fish specimen according to standard maturity scales approved by the IOTC. If unknown record UNK.	**No**
Sample collected	The details on the collection of samples: a) type (e.g. otoliths, spine clippings, and genetic samples) b) preservation method (e.g. alcohol, frozen, etc.) c) destination (i.e. location to be sent/stored)	**No**
TAG DETAILS Note that all tagged specimens are to be identified to species level and to be sampled for length. Elasmobranches and turtles are also to be sexed.		
Tag release	Indicate Yes or No, whether this individual was re-released with a tag attached	**Yes**
Tag recovery	Indicate Yes or No, whether a tag was recovered from this individual	**Yes**

Tag number	Provide the tag number. If a turtle make sure to provide both tag numbers (right and left flipper).	**Yes**
Tag type	The type of tag used according to the IOTC categories (Table 21).	**Yes**
Tag finder	The name and contact details of the person who recovered the tag.	**Yes**

GILLNET INFORMATION

Data field name	Data field description	Mandatory
SPECIAL EQUIPMENT OR MACHINERY		
Net drum/hauler	Indicate Yes if on board No if not sighted - Vessels are normally equipped with a hydraulic net hauler; However they can also use net drums to both haul and store the net.	**Yes**
GILLNET ATTRIBUTES Detail the specifications of each gillnet present on-board during the observed trip.		
Total number of nets	The total number of operational pelagic gillnets held on-board.	**Yes**
Gillnet sequential number	Specify gillnet sequential number. (Note: a unique sequential number is allocated to different gillnets to allow to relate gillnet used with its specifications).	**Yes**
Total number of panels	The number of panels[7] making up the net[8].	**Yes**
Panels stacked	Indicate Yes or No if there are any panels stacked. (Note: two panels of netting can be sewn together vertically, one on top of the other, to intentionally fish "double deep").	**Yes**
Net length (specify units)	The net string length. Usually calculated by multiplying the panel average length by the number of panels used in the net.	**Yes**
Stretched mesh sizes (specify units)	The mesh average stretched lengths (knot to knot) and range. Usually calculated by measuring at least 10 meshes from 5 panels in different areas of the net.	**Yes**
Hanging ratio (%)	The ratio between the length of the float line and the length of the stretched mesh hanging on the float line. Usually calculated by counting 10 or 12 meshes horizontally, measuring the length of the floatline they are attached to, and comparing that distance to the stretched out length of the meshes.	**Yes**
Net web colour	The colour(s) of the net webbing according to the IOTC categories (Table 7).	**Yes**
SETTING OPERATIONS		
Start setting date and time	The date and the time that first panel enters the water (i.e. start of the setting of the net).	**Yes**

[7] A section of continuous netting of exactly the same characteristics between two end-lines (up and down lines).

[8] A string of panels sewn together. The entire string may be referred to as "the net".

Data field name	Data field description	Mandatory
Start setting position	The position in latitude and longitude for the start of the setting operation.	**Yes**
End setting date and time	The date and time the gillnet is secured to the vessel, an anchoring device, or completely deployed (i.e. end of net setting). (Note that gillnet vessels often set dusk and the setting operation may continue beyond midnight and into the following day.)	**Yes**
Gillnet sequential number (previously named 'Net type')	Specify gillnet used on this set by recording its sequential number. (Note: a unique sequential number is allocated to different gillnets to allow to relate gillnet used with its specifications).	**Yes**
Net setting strategy (previously named 'Set type')	How the net is set according to the IOTC categories (Table 8).	**Yes**
Vertical set	The level the net is set at vertically in the water column. I.e. if the net is set at the surface or at sub-surface	**Yes**
Mitigation measures		
Mitigation measures	Indicate Yes or No if any bycatch mitigation devices were used during the set. .	**Yes**
HAULING OPERATIONS		
Start hauling date and time	The date and time at the start of line hauling. I.e. the time when the hauling equipment is put into gear or when the net starts being hauled. (Note: vessels often haul nets in the early morning after a night soak period).	**Yes**
Start hauling position	The position in latitude and longitude for the start of the hauling operation.	**Yes**
Net condition	The condition of the net at haul-back (even if the condition was the same at setting) according to the IOTC categories (Table 13).	**Yes**
Number of net panels retrieved	The total number of net panels retrieved at haul.	**Yes**
Number of net panels observed	The total number of hauled net panels that are observed.	**Yes**
CATCH DETAILS (i.e. information on catch for each set)		
Sampling methods *for obtaining total catch estimates per species*	The sampling method used to obtain total catch estimates per species for the observed set according to the IOTC categories (Table 11).	**Yes**
Species code	The species code for the species observed (FAO spp. 3-alpha code). If species FAO code is not available, the species scientific name.	**Yes**
Fate	The species fate which includes whether it was retained or discarded and the reason according to the IOTC categories (Table 12).	**Yes**

Data field name	Data field description	Mandatory
Number	The number of individuals per species for each specified fate. If weight is recorded, insert NA here (Note: for large fish, record number of individuals).	**Yes**
Weight (specify units)	The weight corresponding to the specified species and fate category. For small fish, record weight. (Note: if number of individuals is recorded, insert NA here).	**Yes**
Weight estimation method	The weight estimation method used to collect weight according to the IOTC categories (Table 14). (Note: If number of individuals is recorded, insert NA here).	**Yes**
Weight code	The code corresponding to the type of processing the specimen underwent previous to be weighted according to the IOTC categories (Table 15). If the fish hasn't been processed than make sure to record code for unprocessed (or round, whole, live) weight (i.e. RD). (Note: If number of individuals is recorded, insert NA here).	**Yes**
Depredation details		
Depredation source	For depredated specimens, the depredation source based on depredation scar characteristics according to the IOTC categories (Table 19). For non-depredated specimens record NA.	**Yes**
Predator Observed	For depredated specimens, the predator species directly observed and identified (FAO spp. 3-alpha code). If the predator was not observed record UNK (unknown). For non-depredated specimens record NA.	**Yes**
Additional catch details on non-target species	Catch details on non-target species to be collected where possible and reported to the IOTC Secretariat as recommended by the Scientific Committee.	
Condition at capture	The condition of the specimen at capture according to the IOTC categories (Table 17).	**No**
Condition at release	The condition of the specimen at the time of release according to the IOTC categories (Table 17).	**No**
Additional catch details on SSIs[9]	Additional catch details on Species of Special Interest (p. **Error! Bookmark not defined.**) to be collected where possible and reported to the IOTC Secretariat as recommended by the Scientific Committee.	
Gear interaction	The interaction of the specimen with the fishing gear according to IOTC categories (Table 16).	**No**
Brought on board	Indicate Yes or No, if the specimen brought on board. *[Consistent with IOTC Resolutions 13/04; 13/05; 12/04; 12/06; 12/09]*	**No**
Hauling method	The detail how the specimen was brought on-board according to the IOTC categories (Table 18). *[Consistent with IOTC Res 12-04]*	**No**

[9] List of Species of Special Interest (SSI) approved by IOTC Scientific Committee (SC) is included at the end of this document under the Codes and guideline section.

Data field name	Data field description	Mandatory
SAMPLING DETAILS Details concerning any sampling conducted, including where possible extra biometric measurements, sex, maturity and the collection of samples.		
Sampling methods for the collection of biological information	The sampling method used for the collection of biological sub-sample according to the IOTC categories (Table 20).	**Yes**
Length code 1	The length code used for the measurement according to the IOTC categories (Table 24).	**Yes**
Length 1	The length corresponding to the length type taken rounded to the lower centimetre. For LD1 this should be rounded to the lower half centimetre.	**Yes**
Length code 2	When an additional length measurement is taken. The length code used should be reported according to the IOTC categories (Table 24).	**No**
Length 2	When an additional length measurement is taken. The corresponding length should be reported rounded to the lower centimetre. For LD1 this should be rounded to the lower half centimetre.	**No**
Sex	The sex, male or female of the sampled fish specimen. If unknown record UNK.	**No**
Maturity stage	The stage of maturity of the sampled fish specimen according to standard maturity scales approved by the IOTC. If unknown record UNK.	**No**
Sample collected	The details on the collection of samples: d) type (e.g. otoliths, spine clippings, and genetic samples) e) preservation method (e.g. alcohol, frozen, etc.) f) destination (i.e. location to be sent/stored)	**No**
TAG DETAILS Note that all tagged specimens are to be identified to species level and to be sampled for length. Elasmobranches and turtles are also to be sexed.		
Tag release	Indicate Yes or No, whether this individual was re-released with a tag attached	**Yes**
Tag recovery	Indicate Yes or No, whether a tag was recovered from this individual	**Yes**
Tag number	Provide the tag number. If a turtle make sure to provide both tag numbers (right and left flipper).	**Yes**
Tag type	The type of tag used according to the IOTC categories (Table 21).	**Yes**
Tag finder	The name and contact details of the person who recovered the tag.	**Yes**

PURSE-SEINE INFORMATION

Data field name	Data field description	Mandatory
SPECIAL EQUIPMENT OR MACHINERY		
Power block	Indicate Yes if on board No if not sighted.	**Yes**
Purse winch	Indicate Yes if on board No if not sighted.	**Yes**
GENERAL GEAR ATTRIBUTES		
Maximum length of the net (specify units)	The maximum length of the net; This corresponds to the length of the topline.	**Yes**
Maximum depth of the net (specify units)	The maximum fishing depth according to the net specifications.	**Yes**
Bag stretched mesh size	The mesh average stretched lengths (knot to knot) of the bag of the net. Usually calculated by measuring 3 stretched mesh lengths.	**Yes**
Mid-net stretched mesh size	The mesh average stretched lengths (knot to knot) of the mid-net. Usually calculated by measuring 3 stretched mesh lengths.	**Yes**
Maximum Brail Capacity	The maximum weight capacity of a full brail in metric tonnes (Mt).	**Yes**
SETTING OPERATIONS		
Start setting date and time	The date and time the skiff is launched to start the setting operation.	**Yes**
Start setting position	The position in latitude and longitude for the start of the setting operation.	**Yes**
School sighting cue	Report up to the first three cues which leads the vessel to detect the presence of a tuna school according to IOTC categories (Table 23).	**Yes**
School type	The type of school detected according to IOTC categories (Table 23)	**Yes**
Time net pursed	The time when the net is fully pursed. All rings are up	**Yes**
Object Details	For sets conducted on FADs (natural or artificial), the following detailed information should be collected where possible and reported to the IOTC Secretariat.	
Buoy ID	For every activity involving artificial or a natural FADs equipped with a buoy report BUOY ID (i.e. Buoy marking or any information allowing identifying the owner). *[Consistent with IOTC Res 18/08]*	**No**
Buoy equipped with artificial lights	Report if devices equipped with artificial lights are deployed and/or recovered. *[Consistent with IOTC Res 16/07]*	**No**
Artificial FAD design	Characterize artificial FAD design using codes provided to describe raft (floating part) and tail (underwater hanging structure) materials (Table 10). *[Consistent with IOTC Res. 12/04 and Res 18/08]*	**No**

Data field name	Data field description	Mandatory
Cetaceans and whale sharks sightings during setting	Details on cetaceans and whale sharks sightings during purse-seine setting are to be collected where possible and reported to the IOTC Secretariat. [Consistent with IOTC Res 13/04 and 13/05]	
Sighting occurred before setting	Indicate YES if the sighting occurred before setting or NO if it occurred after.	**No**
Species	The species code for the sighted specimen/s (FAO spp. 3-alpha code). If species FAO code is not available, the species scientific name.	**No**
N° sighted	The number of individuals sighted per species.	**No**
Caught inside the net	Indicate YES or NO whether sighted specimen/s was/were caught inside the net once the purse line was closed.	**No**
CATCH DETAILS (i.e. information on catch for each set)		
Sampling methods *for obtaining total catch estimates per species*	The sampling method used to obtain total catch estimates per species for the observed set according to the IOTC categories (Table 11).	**Yes**
Species code	The species code for the species observed (FAO spp. 3-alpha code). If species FAO code is not available, the species scientific name.	**Yes**
Fate	The species fate which includes whether it was retained or discarded and the reason according to the IOTC categories (Table 12).	**Yes**
Number	The number of individuals per species for each specified fate. If weight is recorded, insert NA here (Note: for large fish, record number of individuals.)	**Yes**
Weight (specify units)	The weight corresponding to the specified species and fate category. For small fish, record weight. (Note: if number of individuals is recorded, insert NA here).	**Yes**
Weight estimation method	The weight estimation method used to collect weight according to the IOTC categories (Table 14). (Note: If number of individuals is recorded, insert NA here).	**Yes**
Weight code	The code corresponding to the type of processing the specimen underwent previous to be weighted according to the IOTC categories (Table 15). If the fish hasn't been processed than make sure to record code for unprocessed (or round, whole, live) weight (i.e. RD). (Note: If number of individuals is recorded, insert NA here).	**Yes**
Additional catch details on non-target species	Catch details on non-target species to be collected where possible and reported to the IOTC Secretariat as recommended by the Scientific Committee.	
Condition at capture	The condition of the specimen at capture according to the IOTC categories (Table 17).	**No**
Condition at release	The condition of the specimen at the time of release according to the IOTC categories (Table 17).	**No**

Data field name	Data field description	Mandatory
Additional catch details on SSIs[10]	Additional catch details on Species of Special Interest (p. **Error! Bookmark not defined.**) to be collected where possible and reported to the IOTC Secretariat as recommended by the Scientific Committee.	
Gear interaction	The interaction of the specimen with the fishing gear according to IOTC categories (Table 16).	**No**
Brought on board	Indicate Yes or No, if the specimen brought on board. *[Consistent with IOTC Resolutions 13/04; 13/05; 12/04; 12/06; 12/09]*	**No**
Hauling method	The detail how the specimen was brought on-board according to the IOTC categories (Table 18). *[Consistent with IOTC Res 12-04]*	**No**
SAMPLING DETAILS Details concerning any sampling conducted, including where possible extra biometric measurements, sex, maturity and the collection of samples.		
Sampling methods for the collection of biological information	The sampling method used for the collection of biological sub-sample according to the IOTC categories (Table 20).	**Yes**
Length code 1	The length code used for the measurement according to the IOTC categories (Table 24).	**Yes**
Length 1	The length corresponding to the length type taken rounded to the lower centimetre. For LD1 this should be rounded to the lower half centimetre.	**Yes**
Length code 2	When an additional length measurement is taken. The length code used should be reported according to the IOTC categories (Table 24).	**No**
Length 2	When an additional length measurement is taken. The corresponding length should be reported rounded to the lower centimetre. For LD1 this should be rounded to the lower half centimetre.	**No**
Sex	The sex, male or female of the sampled fish specimen. If unknown record UNK.	**No**
Maturity stage	The stage of maturity of the sampled fish specimen according to standard maturity scales approved by the IOTC. If unknown record UNK.	**No**
Sample collected	The details on the collection of samples: g) type (e.g. otoliths, spine clippings, and genetic samples) h) preservation method (e.g. alcohol, frozen, etc.) i) destination (i.e. location to be sent/stored)	**No**
TAG DETAILS Note that all tagged specimens are to be identified to species level and to be sampled for length. Elasmobranches and turtles are also to be sexed.		

[10] List of Species of Special Interest (SSI) approved by IOTC Scientific Committee (SC) is included at the end of this document under the Codes and guideline section.

Data field name	Data field description	Mandatory
Tag release	Indicate Yes or No, whether this individual was re-released with a tag attached	**Yes**
Tag recovery	Indicate Yes or No, whether a tag was recovered from this individual	**Yes**
Tag number	Provide the tag number. If a turtle make sure to provide both tag numbers (right and left flipper).	**Yes**
Tag type	The type of tag used according to the IOTC categories (Table 21).	**Yes**
Tag finder	The name and contact details of the person who recovered the tag.	**Yes**
Well	The well number from which the tagged fish has been recovered, if the fish is recovered during shifting, transhipping or unloading. (Note: this information will allow tracing back tagged fish to the location where it was caught).	**Yes**

POLE AND LINE INFORMATION

Data field name	Data field description	Mandatory
SPECIAL EQUIPMENT OR MACHINERY		
Live bait tanks capacity	The total volume of the tanks used to keep the live bait, in cubic metres (m3).	**Yes**
Number of automatic poles	The total number of automatic poles that are fixed on a vessel.	**Yes**
GENERAL GEAR ATTRIBUTES		
Number of anglers	The maximum number of anglers observed during the trip.	**Yes**
Pole material	The material the pole is made of (e.g. bamboo, fibre glass, carbon).	**Yes**
Hook type	The type of hooks used according to the IOTC categories (Table 5).	**Yes**
TUNA FISHING OPERATIONS		
Event date and time	The data and time that the first line enters the water.	**Yes**
Event start position	The position in latitude and longitude at the start of the fishing event.	**Yes**
Event end time	The time when the last line comes out of the water. If the vessel targets the same school more than once and it stops fishing for a period of at least 10 minutes than it should be considered that the fishing event ended even if fishing is to restarts shortly after.	**Yes**
Maximum lines fishing at the same time	The maximum number of lines fishing at the same time, these should include lines deployed from manual and automatic poles. Specify if other lines are deployed and include them in the total count. This should be one count taken when the fishing activity is well established (not right at the beginning or right at the end).	**Yes**

Data field name	Data field description	Mandatory
Bait used (Y/N)	Indicate Yes or No, whether any bait was used during the fishing event.	**Yes**
Bait type	The bait type/condition used to according to the IOTC categories (Table 6).	**Yes**
Bait species	The species of bait used (FAO spp. 3-alpha code).	**Yes**
Number of hooks lost	The total number of hooks lost during the poling operation.	**Yes**
CATCH DETAILS (i.e. information on catch for each set)		
Sampling methods *for obtaining total catch estimates per species*	The sampling method used to obtain total catch estimates per species for the observed set according to the IOTC categories (Table 11).	**Yes**
Species code	The species code for the species observed (FAO spp. 3-alpha code). If species FAO code is not available, the species scientific name.	**Yes**
Fate	The species fate which includes whether it was retained or discarded and the reason according to the IOTC categories (Table 12).	**Yes**
Number	The number of individuals per species for each specified fate. If weight is recorded, insert NA here (Note: for large fish, record number of individuals.)	**Yes**
Weight (specify units)	The weight corresponding to the specified species and fate category. For small fish, record weight. (Note: if number of individuals is recorded, insert NA here).	**Yes**
Weight estimation method	The weight estimation method used to collect weight according to the IOTC categories (Table 14). (Note: If number of individuals is recorded, insert NA here).	**Yes**
Weight code	The code corresponding to the type of processing the specimen underwent previous to be weighted according to the IOTC categories (Table 15). If the fish hasn't been processed than make sure to record code for unprocessed (or round, whole, live) weight (i.e. RD). (Note: If number of individuals is recorded, insert NA here).	**Yes**
Depredation details		
Depredation source	For depredated specimens, the depredation source based on depredation scar characteristics according to the IOTC categories (Table 19). For non-depredated specimens record NA.	**Yes**
Predator Observed	For depredated specimens, the predator species directly observed and identified (FAO spp. 3-alpha code). If the predator was not observed record UNK (unknown). For non-depredated specimens record NA.	**Yes**
Additional catch details on non-target species	Catch details on non-target species to be collected where possible and reported to the IOTC Secretariat as recommended by the Scientific Committee.	

Data field name	Data field description	Mandatory
Condition at capture	The condition of the specimen at capture according to the IOTC categories (Table 17).	**No**
Condition at release	The condition of the specimen at the time of release according to the IOTC categories (Table 17).	**No**
Additional catch details on SSIs[11]	Additional catch details on Species of Special Interest (p. **Error! Bookmark not defined.**) to be collected where possible and reported to the IOTC Secretariat as recommended by the Scientific Committee.	
Gear interaction	The interaction of the specimen with the fishing gear according to IOTC categories (Table 16).	**No**
Brought on board	Indicate Yes or No, if the specimen brought on board. *[Consistent with IOTC Resolutions 13/04; 13/05; 12/04; 12/06; 12/09]*	**No**
Hauling method	The detail how the specimen was brought on-board according to the IOTC categories (Table 18). *[Consistent with IOTC Res 12-04]*	**No**
SAMPLING DETAILS Details concerning any sampling conducted, including where possible extra biometric measurements, sex, maturity and the collection of samples.		
Sampling methods for the collection of biological information	The sampling method used for the collection of biological sub-sample according to the IOTC categories (Table 20).	**Yes**
Length code 1	The length code used for the measurement according to the IOTC categories (Table 24).	**Yes**
Length 1	The length corresponding to the length type taken rounded to the lower centimetre. For LD1 this should be rounded to the lower half centimetre.	**Yes**
Length code 2	When an additional length measurement is taken. The length code used should be reported according to the IOTC categories (Table 24).	**No**
Length 2	When an additional length measurement is taken. The corresponding length should be reported rounded to the lower centimetre. For LD1 this should be rounded to the lower half centimetre.	**No**
Sex	The sex, male or female of the sampled fish specimen. If unknown record UNK.	**No**
Maturity stage	The stage of maturity of the sampled fish specimen according to standard maturity scales approved by the IOTC. If unknown record UNK.	**No**
Sample collected	The details on the collection of samples: j) type (e.g. otoliths, spine clippings, and genetic samples) k) preservation method (e.g. alcohol, frozen, etc.)	**No**

[11] List of Species of Special Interest (SSI) approved by IOTC Scientific Committee (SC) is included at the end of this document under the Codes and guideline section.

Data field name	Data field description	Mandatory
	l) destination (i.e. location to be sent/stored)	
TAG DETAILS Note that all tagged specimens are to be identified to species level and to be sampled for length. Elasmobranches and turtles are also to be sexed.		
Tag release	Indicate Yes or No, whether this individual was re-released with a tag attached	**Yes**
Tag recovery	Indicate Yes or No, whether a tag was recovered from this individual	**Yes**
Tag number	Provide the tag number. If a turtle make sure to provide both tag numbers (right and left flipper).	**Yes**
Tag type	The type of tag used according to the IOTC categories (Table 21).	**Yes**
Tag finder	The name and contact details of the person who recovered the tag.	**Yes**
BAIT FISHING OPERATIONS		
Event date and time	The data and time when chumming for bait starts.	**Yes**
Event start position	The position in latitude and longitude at the start of the fishing.	**Yes**
Event depth	Depth of the place where the net is being deployed (specify units).	**Yes**
CATCH DETAILS (i.e. information on catch for each set)		
Sampling methods *for obtaining total catch estimates per species*	The sampling method used to obtain total catch estimates per species for the observed set according to the IOTC categories (Table 11).	**Yes**
Species code	The species code for the species observed (FAO spp. 3-alpha code). If species FAO code is not available, the species scientific name.	**Yes**
Fate	The species fate which includes whether it was retained or discarded and the reason according to the IOTC categories (Table 12. Fate).	**Yes**
Weight (specify units)	The weight corresponding to the specified species and fate category. (Note: small amounts are to be recorded in numbers).	**Yes**
Weight code	The code corresponding to the type of processing the specimen underwent previous to be weighted according to the IOTC categories (Table 15). If the fish hasn't been processed than make sure to record code for unprocessed (or round, whole, live) weight (i.e. RD).	**Yes**
Weight estimation method	The weight estimation method used to collect weight according to the IOTC categories (Table 14).	**Yes**
Additional catch details on SSIs	Additional catch details on Species of Special Interest (SSI) to be collected where possible and reported to the IOTC Secretariat as recommended by the Scientific Committee.	

Data field name	Data field description	Mandatory
Condition at capture	The condition of the specimen at capture according to the IOTC categories (Table 17).	**No**
Gear interaction	The interaction of the specimen with the fishing gear according to IOTC categories (Table 16).	**No**
Brought on board	Indicate Yes or No, if the specimen brought on board. *[Consistent with IOTC Resolutions 13/04; 13/05; 12/04; 12/06; 12/09]*	**No**
Hauling method	The detail how the specimen was brought on-board according to the IOTC categories (Table 18). *[Consistent with IOTC Res 12-04]*	**No**
Condition at release	The condition of the specimen at the time of release according to the IOTC categories (Table 17).	**No**
DAILY ACTIVITY INFORMATION		
Date and time	The date and time at the start of the activity.	**Yes**
Position	The position in latitude and longitude at the start of the activity	**Yes**
Activity	Every change in vessel's activity is to be signalled according to IOTC categories (Table 9).	**Yes**
School sighting cue	Report up to the first three cues which leads the vessel to detect the presence of a tuna school according to IOTC categories (Table 23).	**Yes**
School type	The type of school detected according to IOTC categories (Table 23)	**Yes**
Object ID	For every activity involving artificials FAD (DFAD/AFAD) report FAD identifier (i.e. FAD marking or beacon ID or any information allowing identifying the owner).	**No**
Buoys equipped with artificial lights	Report if devices equipped with artificial lights. *[Conforms to IOTC Res 16/07]*	**No**

IOTC codes to be used to describe activities, detection and school associations

Table 2. Country codes/names FAO[12] (ISO3)

Code	English name
AUS	Australia
BLZ	Belize
CHN	China
COM	Comoros
ERI	Eritrea
FRA	European Union
GIN	France (EU)
IND	Guinea
IDN	India
IRN	Indonesia
ITA	Iran
JPN	Italy (EU)
KEN	Japan
KIR	Kenya
KOR	Kiribati
AUS	Korea, Republic of
LBR	Lyberia
MDG	Madagascar
MYS	Malaysia
MDV	Maldives
MUS	Mauritius
MOZ	Mozambique
NLD	Netherlands (EU)
OMN	Oman
PAK	Pakistan
PAN	Panama
PHL	Philippines
PRT	Portugal (EU)
SYC	Seychelles
SLE	Sierra Leone
SGP	Singapore
SOM	Somalia
ZAF	South Africa
ESP	Spain (EU)
LKA	Sri Lanka
SDN	Sudan
TZA	Tanzania
THA	Thailand
GBR	United Kingdom (EU)
YEM	Yemen

Table 3.Vessel hull material

Code	English description
STE	Steel
FRP	Fibre glass reinforced plastic
WOO	Wood
ALU	Aluminium
OTH	Other

Table 4. Line material types

Code	English Description
MON	Monofilament nylon
GLW	Galvanized wire (mat)
SSW	Stainless steel wire (bright)
TR3	3 strand tarred rope (red or black)
BRL	Braided line (kuralon- braided nylon)
SKW	Sekiyama wire (central part of the wire is surrounded by a cotton or synthetic fiber thread, and usually tarred)
MUN	Multifilament nylon
MUC	Multifilament Cremona
MOC	Monofilament Cremona
MUD	Multifilament Dyneema
MOD	Monofilament Dyneema
MUK	Multifilament Kevlar
MOK	Monofilament Kevlar
MUT	Multifilament Tetoron
MOT	Monofilament Tetoron

Table 5. Hooks type and size[13]

Code	English Description
C11	Circle hooks 11/0
C12	Circle hooks 12/0

[12] http://www.fao.org/countryprofiles/iso3list/en/
[13] www.spc.int/DigitalLibrary/Doc/FAME/Manuals/Beverly_09_LLTerminalGear.pdf

C13	Circle hooks 13/0
C14	Circle hooks 14/0
C15	Circle hooks 15/0
C16	Circle hooks 16/0
C18	Circle hooks 18/0
H32	Japan tuna hooks 3.2
H34	Japan tuna hooks 3.4
H36	Japan tuna hooks 3.6
H38	Japan tuna hooks 3.8
H40	Japan tuna hooks 4.0
H42	Japan tuna hooks 4.2
J08	J Hooks 8/0
J09	J Hooks 9/0
J10	J Hooks 10/0
J12	J Hooks 12/0
S01	Spanish hooks 1
S02	Spanish hooks 2
S03	Spanish hooks 3
S04	Spanish hooks 4
T32	Teracima hooks 3.2 sun
T34	Teracima hooks 3.4 sun
T36	Teracima hooks 3.6 sun
T38	Teracima hooks 3.8 sun

Table 6. Bait type/condition

Code	English description
BLI	Live bait
FRC	Frozen/chopped
THC	Thawed/chopped
FRW	Frozen/whole
THW	Thawed/whole
BOT	Other

Table 7. Gillnet web colour

Code	English description
GRE	Green
CLA	Clear
WHI	White
PIN	Pink
BLA	Black
GRY	Grey
BLU	Blue.
MUL	Multi-colour
RED	Red
OTH	Other

Table 8. Net setting strategy

Code	English description
NAN	Net anchored (i.e. remains attached to boat or another anchoring method)
NDR	Net is left drifting
GEN	Encircling
DOL	Dolphin associated
NTA	No tuna associated (blank set)
SM	Seamount (common for P&L)
UNK	Unknown
OTH	Other, record on comments

Table 9. Pole and line activity codes

Code	Proposed revision IOTC-ROS
BA	Searching / gathering bait Vessel is engaged in the process of searching for bait using vessel sonar or gathering bait using lights to attract and concentrate bait near the vessel.
BF	Bait fishing (the net is set or launched)
CH	Chasing a tuna school Chumming should be part of the Tuna fishing activity.
DF	Drifting with a tuna school, log or FAD.
DN	Drifting during the night (engine stopped)
DT	Drifting due to mechanical problems
DW	Drifting because of bad weather
FI	Tuna Fishing (Spraying, chumming or poling)
PO	In port
SE	Searching in general (for tuna schools, logs, or FADs or other vessels)
SI	Steaming towards (& investigating) observed system (birds, floating object, etc.) associated to the tuna school.
ST	Transit (steaming without searching day or night).
OT	Other activities (describe in comments)

Table 10. Artificial FAD design/materials[14]

Code	Proposed revision IOTC-ROS

[14] ISSF GUIDE FOR NON-ENTANGLING FADs, International Seafood Sustainability Foundation (ISSF), 2015

RE	Raft covered with ecological materials (Burlap, Canvas of sisal, thick fabric, tarpaulin, rafia, canvas claustra, horticultural felt).
RNS	Raft covered using a net with a stretched mesh of less than 7 cm
RNL	Raft covered with large mesh net (stretched mesh of more than 7 cm)
RNC	Raft not covered
TNS	Tail made of nets rolled in "sausages“
TNS	Tail made of nets panels with a stretched mesh of less than 7 cm
TRO	Tail made of ropes
TRC	Tail made of ropes and cavas
TNL	Tail made of hanging large mesh net (stretched mesh of more than 7 cm)

Table 11. Sampling methods for obtaining total catch estimates per species

Code	English Description
EXS	Exhaustive Sampling: The observer weighted/counted every individual for the entire catch (only feasible if the catch is small)
MRS	Observer collected Multiple Random Samples, divided fish into species and weighted/counted them. Observer raised sample to obtain set catch per species (e.g. brail capacity x brail tally; fish weight x number of fish)
SPS	Systematic Proportional Sampling: a proportion (%) of the catch or of the individuals caught and brought on-board was weighted/counted in a systematic way to obtain set catch composition (e.g. every 3rd hook/ panel/brail, first 10 fish per section/panel/brail, 20 minutes/hour of hauling/brailing/fishing, etc.)
VES	Observer used Vessel Estimates to estimate catch per species (e.g. logbook, well contents, etc.)
CMB	Observer used a Combination of vessel estimates for retained catch and own estimates for discards to estimate catch per species.
OTH	Other. Provide details in comments

Table 12. Fate

Code	English Description
DTS	Discarded - too small. Fish of no commercial value due to being of small size
DUS	Discarded - unwanted species (e.g. with no commercial value or other than target species)
DRB	Discarded - retention ban on the species due to flag state measures
DFL	Discarded - vessel fully loaded
DUD	Discarded – due to IOTC retention ban
DPQ	Discarded – are unfit for human consumption[15]
DDL	Discarded - too difficult to land
DFR	Discarded - trunk - fins retained (shark only)
DTR	Discarded - trunk retained, fins discarded (shark only)
RCC	Retained - crew consumption
RFL	Retained - for landing / sold
RFR	Retained trunk - fins retained (shark only)
RFT	Retained for at-sea-transhipment
ESC	Escaped
UNK	Unknown fate

Table 13. Gillnet condition at hauling

Code	English description
NGD	No gear damage or very few small, scattered holes.
005	Less than 5% of the net torn
025	Between 5% and 25% of the net torn.
050	Between 25% and 50% of the net torn.
075	Greater than 50% of the net torn.
100	Net totally rolled up.

[15] IOTC Res 17/04 : "unfit for human consumption" are fish that:

- is meshed or crushed in the purse seine; or

- is damaged due to depredation; or

- has died and spoiled in the net where a gear failure has prevented both the normal retrieval of the net and catch, and efforts to release the fish alive;

OTH	Other, specify in comments
UNK	Unknown

Table 14. Weight estimation method

Code	English Description
EB	Electronic balance
SB	Spring balance
MB	Mechanical balance
EM	Eye measurement (observer)
LO	Vessel logbook (eye measurement crew)
LW	Length weight relationship

Table 15. Processing/product type

Code	English Description
RD	Unprocessed; Round (whole, live)
GG	Gilled-and-gutted (bill-off)
HD	Headed-and-gutted
PD	Headed and caudal peduncle-off
HT	Headed and tailed
HG	Headed, gutted and tailed
FL	Fish loins
GT	Gilled, gutted and tailed
GO	Gutted only (gills left)
FW	Fillet
FT	Fins and trunk (shark)
SF	Fins (shark)

Table 16. Gear interaction

Code	English Description
HB	Hooked in the beak or mouth
HR	Hooked in the rostrum (billfish only)
HJ	Hooked in the fish/shark jaw (include jaw hinge, lower and upper jaw).
HL	Hooked in the fish/shark lip
HG	Hooked in the gills / gill plate / gill slits)
HI	Hooked in the throat (internal including gullet)
HG	Hooked in the gut (internal)
HO	Foul hooked (any other external location)
EN	Entangled in the net
EN	Entangled in the line
EF	Entangled with FAD
EG	Entangled in ghost fishing gear
OT	Other (describe)
UK	Unknown

Table 17. Condition

Code	English description
A0	Alive excellent condition (Hutchinson, et al 2015 MEPS)
A1	Alive - active, healthy
A2	Alive - injured, distressed
A3	Alive - very weak, dying
S	Stunt – condition unknown
D	Dead
U	Condition unknown

Table 18. Hauling methods

Code	English description
HD	By hand
GR	Using the gear
GF	Using a gaff
BR	Using a brailler
SN	Using a scoop net
ON	Using another net
OT	Using another method (describe)

Table 19. Depredation source

Code	English Description
SH	Shark
TW	Toothed whales
SW	Sharks/toothed whales
MM	Marine mammal
CC	Cookie-cutter shark
BA	Depredation on bait
SQ	Squid
SB	Birds
OT	Other (specify)
UNK	Unknown

Table 20. Sampling methods for the collection of biological information

Code	English Description
EXS	Exhaustive Sampling: the totality of the catch or all individuals caught for this species has been subsampled.
SPS	Systematic Proportional Sampling: a proportion (%) of the catch or of the individuals caught and brought on-board for this species has been subsampled in a systematic way. (E.g. every 10th fish is sub-sampled).
SSS	Stratified Sampling of a sample taken via "Spill method". The observer tipped the fish from a pile/receptacle/conveyer belt into a bin to avoid hand selection of individual fish, divided fish into

	homogeneous subgroups before subsampling. (e.g.: observer sub-sampled 50 fish for large fish (≥15 kg))
SSG	Stratified Sampling of a sample taken via "Grab method". The observer pulls by hand a selected number of fish from a pile/ receptacle/ conveyer belt and divided fish into homogeneous subgroups before subsampling (e.g.: observer sub-sampled 50 yellowfin tuna).
SRF	Systematic Random sampling of a Fixed number of each species: of the random sample taken, the fish are identified to species level. Once the main species have been determined, a pre-determined number of fish of each species is subsampled.
SRM	Systematic Random sampling of a Mixed species sample: of the random sample taken, a small random subsample is taken and biological information extracted.
SRP	Systematic Random sampling of Priority species: of the random sample taken, priority species are selected and biological information extracted.
OTH	Other. Provide details in comments

Table 21. Tag type

Code	English description
TC	Conventional (plastic spaghetti or dart tags are attached on the back of the fish)
TR	Rototags (a two-piece, plastic cattle ear tag, which is inserted through the first dorsal fin)
TS	Sonic tags (miniature radio transmitting devices that are surgically implanted inside the tuna. Since these are not visible externally, a conventional tag of a certain colour will be visible on the outside).
TP	Pop-up tags (Pop-up Satellite Archival Tags are inserted with an anchor and a tether into the dorsal musculature, recording temperature, pressure, and light, and they detach from the animal on a pre-programmed date).
TI	Internal archival tags (internal archival tags are implanted in the body cavity and record internal body temperature and the environment's temperature, pressure, and light).
TT	Smart Position or Temperature Transmitting tags are attached to the dorsal fin and send a signal to a satellite every time the animal surfaces
MB	Metal legband tag used to tag seabirds
MT	Metal tag used to tag sea turtles flippers (a different tag number for each flipper, make sure to collect both numbers if both tags are present).
ST	External satellite tag placed in turtle / bird back.
TO	Other (specify)

Table 22. Sampling protocol for longliners

Code	English Description
EX	Exhaustive Sampling: The totality of the hooks hauled was observed.
MRS	Random sampling: hooks were sampled randomly (e.g. Batch of 10 hooks selected at random along the line, or all hooks sampled for a period of 10 minutes selected at random during the hauling time).
SPS	Systematic sampling: a proportion (%) of the line was observed (e.g. Batch of 10 hooks selected at every 100 hooks along the line or all hooks sampled for a period of 10 minutes every hour).
EWP	Exhaustive When Present: the observer monitors the totality of hooks except when, for practical reasons, the observer is not present (e.g. breaking for meals/rest)

Table 23. School sighting cue / School type

Sighting code	School sighting description	School type code	School type description
NSC	No sighting cue	**0**	**Undetermined**
UTS	Tuna school (no details given on the type of school)	**2**	**Free school**
CSA	Changes on sea surface appearance. Marks left by the fish on the surface of the water. It can take the form of a track or oil marks left by the presence of tuna. It can be a rippling of the sea surface, an area of extremely choppy sea, an area of very choppy / foamy sea surface. Or the presence of a fish school can be indicated by the jump of individual tuna.	**2**	**Free school**
DTS	Presence of a deep tuna school	**2**	**Free school**
BIR	Presence of birds	**2**	**Free school**
LWH	Presence of large whales (killer whales, sperm whales, baleen whales))	**2**	**Free school**
SWH	Presence Small toothed whales / dolphins (dolphins, pilot and/or false killer whales)	**2**	**Free school**
SHA	Presence of shark(s)	**2**	**Free school**
OVF	Another tuna vessel	**1**	**Associated school**
STS	Same school that escaped the previous set	**0**	**Undetermined**
SAV	School associated to the tuna vessel	**1**	**Associated school**
SEM	Fishing on a seamount	**1**	**Associated school**
OTH	Other (to detail in the comments)	**0**	**Undetermined**
SBV	Supply or bait-boat vessel	**1**	**Associated school**
WSB	Whale shark seen before set	**1**	**Associated school**
WSA	Whale shark seen later during set	**1**	**Associated school**
AFAD	Artificial FAD (man-made)	**1**	**Associated school**
NFAD	Natural FAD (non-man made)	**1**	**Associated school**
FSB	Feeding on bait fish	**2**	**Free school**

Table 24. Length measurement descriptions[16][17][18]

Code	Tools	Type EN	Description EN
CKL	Caliper	Cleithrum-keel length	Projected straight distance between the point on the cleithrum that provides the shortest possible measurement to the anterior portion of the caudal keel. The cleithrum is the semi-circular bony structure at the posterior edge of the gill opening19.
D2FL	Caliper	Second dorsal fork length	Projected straight distance between the most anterior insertion of the second dorsal fin and the fork of the tail
DFL	Caliper	Dorsal fork length	Projected straight distance between the most anterior insertion of the dorsal fin and the fork of the tail
EFL	Caliper	Eye fork length	Projected straight distance from the caudal margin of orbit to the fork of the tail

16 IOTC-2013-WPDCS09-13 Rev_1

17 Collette, B.B. and C.E. Nauen, 1983. FAO species, catalogue. Vol. 2. Scombrids of the world. An annotated and illustrated catalogue of tunas, mackerels, bonitos and related species known to date. FAO Fish.Synop., (125)Vol.. 2: 137 p.

18 Nakamura, I., 1985. FAO species catalogue. Vo1.5. Billfishes of the World. An annotated and illustrated catalogue of marlins, sailfishes, spearfishes and swordfishes known to date. FAO Fish.Synop., (125)Vo1.5:65 p.

19 Location of the cleithrum

FL	Caliper	Fork length	Projected straight distance from the tip of the upper jaw (snout) to the shortest caudal ray (fork)
IDS	Caliper	Interdorsal space	First dorsal-second dorsal (projected straight distance between the most posterior insertion of the first dorsal fin and the most anterior insertion of the second dorsal fin)
LD1	Caliper	Pre-dorsal length	Length to the first dorsal fin (projected straight distance from the tip of the snout to the anterior based of the first dorsal fin)
LJFL	Caliper	Lower jaw fork length	Projected straight distance from the tip of the lower jaw to the shortest caudal ray (fork of the caudal fin)
P1A	Caliper	Pectoral anterior margin	Projected straight distance between the tip and the base of the anterior margin of the pectoral fin (shark fin)
PAL	Caliper	Pectoral-anal length	Projected straight distance between the most anterior insertion of the pectoral fin to the most posterior rim of the anal sphincter
PDL	Caliper	Pectoral dorsal length	Projected straight distance between the most anterior insertion of the pectoral fin and the most anterior insertion of the second dorsal fin
PFL	Caliper	Pectoral fork length	Projected straight distance between the most anterior insertion of the pectoral fin and the fork of the tail
PPS	Caliper	Pectoral-pelvic space	Projected straight distance between the most posterior insertion of the pectoral fin to the most anterior insertion of the pelvic fin
TL	Caliper	Total length (relaxed)	Projected straight distance from the most forward point of the head to the tip of the tail when the tail is left in the 'natural position' (unsqueezed)
CKLT	Tape measure	Curved cleithrum keel length	Projected curved body distance between the point on the cleithrum that provides the shortest possible measurement to the anterior portion of the caudal keel. The cleithrum is the semi-circular bony structure at the posterior edge of the gill opening.
D2FLT	Tape measure	Curved second dorsal fork length	Projected curved body distance between the most anterior insertion of the second dorsal fin and the fork of the tail
DFLT	Tape measure	Curved dorsal fork length	Projected curved body distance between the most anterior insertion of the dorsal fin and the fork of the tail
EFLT	Tape measure	Curved eye fork length	Projected curved body distance from the caudal margin of orbit to the fork of the tail along the contour of the body in a line that runs along the top of the pectoral fin and the top of the caudal keel
FLT	Tape measure	Curved fork length	Projected curved body distance from the tip of the upper jaw (snout) to the shortest caudal ray (fork)
IDST	Tape measure	Curved interdorsal space	Projected curved body distance between the most posterior insertion of the first dorsal fin and the most anterior insertion of the second dorsal fin
LD1T	Tape measure	Curved pre-dorsal length	Projected curved body distance from the tip of the snout to the anterior base of the first dorsal fin
LJFLT	Tape measure	Curved lower jaw fork length	Projected curved body distance from the tip of the lower jaw to the shortest caudal ray (fork of the caudal fin)
P1AT	Tape measure	Curved pectoral anterior margin	Projected curved body distance between the tip and the base of the anterior margin of the pectoral fin (shark fin)
PALT	Tape measure	Curved pectoral anal length	Projected curved body distance between the most anterior insertion of the pectoral fin to the most posterior rim of the anal sphincter
PDLT	Tape measure	Curved pectoral dorsal length	Projected curved body distance between the most anterior insertion of the pectoral fin and the most anterior insertion of the second dorsal fin
PFLT	Tape measure	Curved pectoral fork length	Projected curved body distance between the most anterior insertion of the pectoral fin and the fork of the tail
PPST	Tape measure	Curved pectoral pelvic space	Projected curved body distance between the most posterior insertion of the pectoral fin to the most anterior insertion of the pelvic fin
TLT	Tape measure	Total length (relaxed)	Projected curved body from the most forward point of the head to the tip of the tail when the tail is left in the 'natural position' (unsqueezed)
PCL	Caliper	Precaudal Length	Projected straight distance from the most forward point of the head to the anterior portion of the caudal keel (sharks).
PCLT	Tape measure	Precaudal Length	Projected straight distance from the most forward point of the head to the anterior portion of the caudal keel (sharks).

TWT	Tape measure	Total width	Total disc width (for skates and rays)
TW	Caliper	Total width	Total disc width (for skates and rays)
CLXT	Tape measure	Carapace Length	Total carapace length – maximum length from the anterior-most part of the carapace to the posterior-most tip of the carapace on the same side (turtles)
CLX	Caliper	Carapace Length	Total carapace length – maximum length from the anterior-most part of the carapace to the posterior-most tip of the carapace on the same side
CLNT	Tape measure	Carapace Length	Total carapace length – notch to notch (turtles)
CLN	Caliper	Carapace Length	Total carapace length - notch to notch (turtles)
TL	Caliper	Total length	Tip of bill to tip of tail (birds)
WL	Caliper	Wing length	Bend of the wing to the tip of the longest primary feathers (birds)
TI	Caliper	Tail length	Base of tail to tip of longest feathers (birds)
TS	Caliper	Tarsus length	Inner bend of the tibiotarsal articulation to the base of the toes (often marked by a difference in scalation) (birds)
CL	Caliper	Culmen length	Tip of the upper mandible and the other at base of the skull (birds)

APPENDIX 6B
SPECIES OF SPECIAL INTEREST FOR THE IOTC ROS

There are a number of observer data reporting fields related to the condition, type of interaction, handling and release of discards. As this information is not of scientific interest for all discards, a list of Species of Special Interest (SSI) has been developed to enable the observer to focus efforts on the collection of this information for only those listed.

The intention is for this to be a living document which may be reviewed and updated by the SC as and when necessary without requiring any changes to the data reporting fields.

i. **All marine turtles**
ii. **All marine mammals**
iii. **All seabirds**
iv. **Designated shark species**
- Species with a retention ban (*whale sharks*[20], *oceanic whitetip shark*[21] and *thresher sharks*[22]);

v. **Designated billfish species**[23]
- Species included in Resolution 18/05 *(striped marlin, black marlin, blue marlin and Indo-Pacific sailfish)*

[20] Resolution 13/05 *On the conservation of whale sharks (Rhincodon typus)*

[21] Resolution 13/06 *On a scientific and management framework on the conservation of shark species caught in association with IOTC managed fisheries*

[22] Resolution 12/09 *On the conservation of thresher sharks (family Alopiidae) caught in association with fisheries in the IOTC Area of Competence*

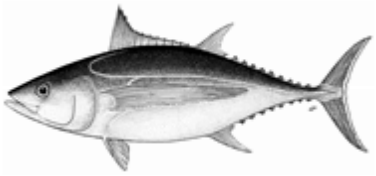
[23] Resolution 18/05 indicates that the Commission is interested in the conservation of striped marlin, black marlin, blue marlin and Indo-Pacific sailfish

APPENDIX 7
LIST OF CHAIRS, VICE-CHAIRS AND THEIR RESPECTIVE TERMS FOR THE IOTC SCIENTIFIC COMMITTEE AND ITS SUBSIDIARY BODIES

Group	Chair/Vice-Chair	Chair	CPC/Affiliation	1st Term commencement date	Term expiration date (End date is until replacement is elected)	Comments
SC	Chair	Dr Hilario Murua	EU,Spain	28–Nov–15	End of SC in 2019	2nd term
	Vice-Chair	Dr Shiham Adam	Maldives, Rep. of	28–Nov–15	End of SC in 2019	2nd term
WPB	Chair	Dr Rui Coelho	EU,Portugal	14–Sept–17	End of WPB in 2019	1st term
	Vice-Chair	Dr Evgeny Romanov	EU,France	05–Sep–15	End of WPB in 2019	2nd term
WPTmT	Chair	Dr Jiangfeng Zhu	China	21–July–16	End of WPTmT in 2018	1st term
	Vice-Chair	Dr Toshihide Kitakado	Japan	21–July–16	End of WPTmT in 2018	1st term
WPTT	Chair	Dr Gorka Merino	EU,Spain	03–Nov–18	End of WPTT in 2020	1st term
	Vice-Chair	Dr Shiham Adam	Maldives, Rep. of	13–Nov–18	End of WPTT in 2020	1st term
WPEB	Chair	Dr Sylvain Bonhommeau	EU,France	08–Sept–17	End of WPEB in 2019	1st term
	Vice-Chair	Dr Reza Shahifar; Dr Ross Wanless	I.R. Iran / South Africa	11–Sept–15	End of WPEB in 2019	2nd term
WPNT	Chair	Dr Farhad Kaymaram	I.R. Iran	29–May–15	End of WPNT in 2019	2nd term
	Vice-Chair	Dr Mathias Igulu	Tanzania	29–May–15	End of WPNT in 2019	2nd term
WPDCS	Chair	Mr Stephen Ndegwa	Kenya	28–Nov–17	End of WPDCS in 2019	1st term
	Vice-Chair	Dr Julien Barde	EU,France	28–Nov–17	End of WPDCS in 2019	1st term
WPM	Chair	Dr Toshihide Kitakado	Japan	21–Oct–15	End of WPM in 2019	2nd term
	Vice-Chair	Dr Iago Mosqueira	EU,Spain	21–Oct–15	End of WPM in 2019	2nd term

APPENDIX 8
EXECUTIVE SUMMARY: ALBACORE

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



Status of the Indian Ocean albacore (ALB: *Thunnus alalunga*) resource

TABLE 1. Albacore: Status of albacore (*Thunnus alalunga*) in the Indian Ocean.

Area[1]	Indicators – 2016 assessment		2018 stock status[3] determination
Indian Ocean		SS3	
	Catch 2017[2]:	38,347 t	
	Average catch 2013–2017:	36,004 t	
	MSY (1000 t) (80% CI):	38.8 (33.9–43.6)	
	F_{MSY} (80% CI):	0.07 (–)	
	SB_{MSY} (1000 t) (80% CI):	30.0 (26.1–34.0)	
	F_{2014}/F_{MSY} (80% CI):	0.85 (0.57–1.12)	
	SB_{2014}/SB_{MSY} (80% CI):	1.80 (1.38–2.23)	
	SB_{2014}/SB_{1950} (80% CI):	0.37 (0.28–0.46)	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2] Proportion of catch estimated or partially estimated by IOTC Secretariat in 2017: 17%
[3] The stock status refers to the most recent years' data used in the last assessment conducted in 2016.

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)		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. No new stock assessment was carried out for albacore in 2018, thus, the stock status is determined on the basis of the 2016 assessment and other indicators presented in 2018.

Trends in the CPUE series suggest that the longline vulnerable biomass has declined to around 65% of the levels observed in 1980–82. Prior to 1980 there was 20 years of moderate fishing, after which total catches of albacore tuna in the Indian Ocean have more than doubled in subsequent years (**Fig. 1**). Catches have also increased substantially since 2007 for some fleets (i.e., Indonesian and Taiwan,China longline fisheries), although there is substantial uncertainty regarding the reliability of the catch estimates. Catches in 2017 were marginally below the MSY level of the SS3 model. Fishing mortality represented as F_{2014}/F_{MSY} is 0.85 (0.57–1.12). Biomass is considered to be above the SB_{MSY} level (SB_{2014}/SB_{MSY} = 1.80 (1.38–2.23)) from the SS3 model (**Table 1**, **Fig. 2**). The results from the other model options were also generally consistent with these estimates of stock status. Thus, the stock status in relation to the Commission's B_{MSY} and F_{MSY} target reference points indicates that the stock is **not overfished** and **not subject to overfishing** (**Table 1**).

Outlook. Maintaining or increasing effort in the core albacore fishing grounds is likely to result in further decline in the albacore tuna biomass, productivity and CPUE. The impacts of piracy in the western Indian Ocean have resulted in the displacement of a substantial portion of longline fishing effort into the traditional albacore fishing areas in the southern and eastern Indian Ocean. With the decline in the threat of piracy in recent years – and the presumption that longline fishing effort in the western Indian Ocean may return to levels similar to years pre-piracy – it is unlikely that catch and effort on albacore will increase in the near future.

Management advice. Although considerable uncertainty remains in the SS3 assessment conducted in 2016, particularly due to the lack of biological information on Indian Ocean albacore tuna stocks, a precautionary approach

to the management of albacore tuna should be applied by capping total catch levels to MSY levels (38,800 t; **Table 2**).

The following should be noted:

- The two primary sources of data that drive the assessment, total catches and CPUE, are highly uncertain and should be developed further as a priority.
- Catches in 2014 (39,507 t) marginally exceeded MSY levels.
- The catch estimates for 2017 (38,347 t) are marginally below the current estimated MSY levels (**Table 1**).
- A Kobe 2 Strategy matrix was calculated to quantify the risk of different future catch scenarios, using the projections from the SS3 model (**Table 2**).
- Provisional reference points: noting that the Commission in 2015 adopted Resolution 15/10 *On interim target and limit reference points and a decision framework*, the following should be noted:
  - **Fishing mortality**: Current fishing mortality is considered to be below the provisional target reference point of F_{MSY}, and the provisional limit reference point of $1.4*F_{MSY}$ (**Fig. 2**).
  - **Biomass**: Current spawning biomass is considered to be above the target reference point of SB_{MSY}, and therefore above the limit reference point of $0.4*SB_{MSY}$ (**Fig. 2**).
- **Main fishing gear (average catches 2013–17)**: Albacore tuna are currently caught almost exclusively using drifting longliners, with the remaining catches recorded using purse seines and other gears. Catches from the longline fisheries are split between deep-freezing longliners, and fresh-tuna longliners (Fig. 1).
- **Main fleets (average catches 2013–17)**: The majority of albacore catches are attributed to vessels flagged to distant water fishing nations (i.e., Taiwan,China and Japan), followed by coastal countries such as Indonesia and Malaysia.

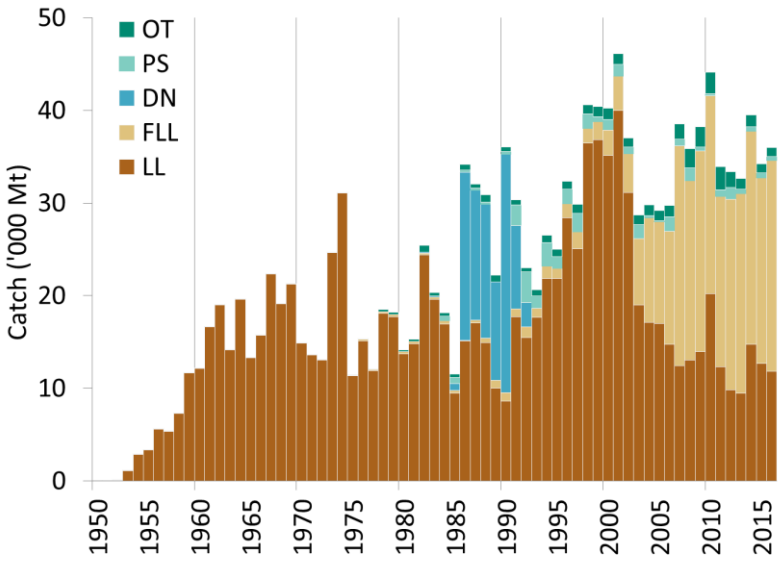


Fig. 1. Albacore: Catches of albacore by gear (1950-2017)[24].

[24] **Definition of fisheries**: Driftnet (**DN; Taiwan,China**); Freezing-longline (**LL**); Fresh-tuna longline (**FLL**); Purse seine (**PS**); Other gears nei (**OT**).

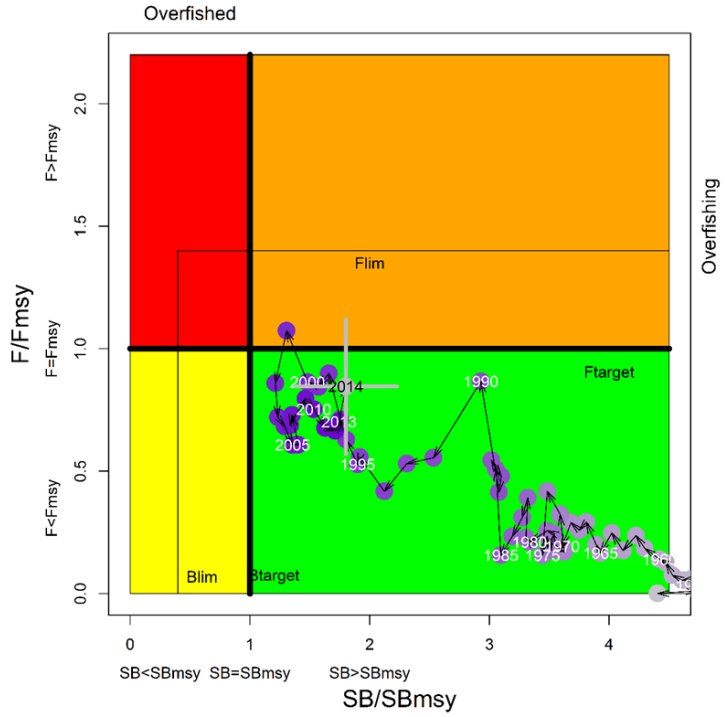


Fig. 2. Albacore: SS3 Aggregated Indian Ocean assessment Kobe plot. Blue circles indicate the trajectory of the point estimates for the SB ratio and F ratio for each year 1950–2014 (the grey lines represent the 80 percentiles of the 2014 estimate). Target (F_{targ} and SB_{targ}) and limit (F_{lim} and SB_{lim}) reference points are shown.

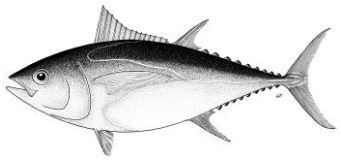
TABLE 2. Albacore: SS3 aggregated Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of violating the MSY-based target (top) and limit (bottom) reference points for constant catch projections (2014 catch levels*, ± 10%, ± 20%, ± 30%, and ± 40%) projected for 3 and 10 years.

Reference point and projection timeframe	**Alternative catch projections (relative to the catch level for 2014*) and probability (%) of violating MSY-based target reference points (SB_{targ} = SB_{MSY}; F_{targ} = F_{MSY})**								
	60%	**70%**	**80%**	**90%**	**100%**	**110%**	**120%**	**130%**	**140%**
	(23,821)	**(27,791)**	**(31,761)**	**(35,731)**	**(39,701)**	**(43,671)**	**(47,641)**	**(51,611)**	**(55,581)**
$SB_{2017} < SB_{MSY}$	1	2	4	7	14	19	24	33	44
$F_{2017} > F_{MSY}$	0	1	5	18	33	47	59	71	77
$SB_{2024} < SB_{MSY}$	4	8	9	31	42	50	62	NA	92
$F_{2024} > F_{MSY}$	0	0	3	NA	39	56	66	70	100
Reference point and projection timeframe	**Alternative catch projections (relative to the catch level for 2014*) and probability (%) of violating MSY-based limit reference points (SB_{lim} = 0.4 SB_{MSY}; F_{Lim} = 1.4 F_{MSY})**								
	60%	**70%**	**80%**	**90%**	**100%**	**110%**	**120%**	**130%**	**140%**
	(23,821)	**(27,791)**	**(31,761)**	**(35,731)**	**(39,701)**	**(43,671)**	**(47,641)**	**(51,611)**	**(55,581)**
$SB_{2017} < SB_{Lim}$	0	0	0	0	0	0	1	1	4
$F_{2017} > F_{Lim}$	0	0	0	0	2	10	20	34	46
$SB_{2024} < SB_{Lim}$	0	0	1	13	20	24	30	NA	65
$F_{2024} > F_{Lim}$	0	0	0	NA	10	27	48	60	100

** Catches for 2014, at the time of the last albacore assessment conducted in 2016.*

APPENDIX 9
EXECUTIVE SUMMARY: BIGEYE TUNA

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



Status of the Indian Ocean bigeye tuna (BET: *Thunnus obesus*) resource

TABLE 1. Bigeye tuna: Status of bigeye tuna (*Thunnus obesus*) in the Indian Ocean.

Area[1]	Indicators		2018 stock status[3] determination
Indian Ocean	Catch in 2017[2]: Average catch 2013–2017:	90,050 t 95,997 t	**83.7%***
	MSY (1,000 t) (80% CI): F_{MSY} (80% CI): SB_{MSY} (1,000 t) (80% CI): F_{2015}/F_{MSY} (80% CI): SB_{2015}/SB_{MSY} (80% CI): SB_{2015}/SB_0 (80% CI):	104 (87-121) 0.17 (0.14-0.20) 525 (364-718) 0.76 (0.49-1.03) 1.29 (1.07-1.51) 0.38 (n.a. – n.a.)	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2] Proportion of catch estimated or partially estimated by IOTC Secretariat for catches in 2017: 21%
[3] The stock status refers to the most recent years' data used in the last assessment conducted in 2016.
* Estimated probability that the stock is in the respective quadrant of the Kobe plot (shown below), derived from the confidence intervals associated with the current stock status. The confidence intervals for SB_{2015}/SB_0 were not estimated for the models used.

Colour key	Stock overfished ($SB_{year}/SB_{MSY}< 1$)	Stock not overfished ($SB_{year}/SB_{MSY}\geq 1$)
Stock subject to overfishing ($F_{year}/F_{MSY}> 1$)	**2.1%**	13.8%
Stock not subject to overfishing ($F_{year}/F_{MSY}\leq 1$)	0.4%	83.7%
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. No new stock assessment was carried out for bigeye tuna in 2018, thus, stock status is determined on the basis of the 2016 assessment and other indicators presented in 2018. In 2016, six models were applied to the bigeye tuna stock in the IOTC area of competence (ASAP, BDM, ASPIC, SCAA, BSPM and SS3). The reported stock status is based on the SS3 model formulation using a grid designed to capture the uncertainty on stock recruitment relationship and the influence of tagging information. Spawning stock biomass in 2015 was estimated to be 38% of the unfished levels (Table 1) and 129% (107–151%) of the level that can support MSY. The assessment is qualitatively similar to the stock assessment conducted in 2013 but with a lower relative biomass (from 144 to 129% SB/SB_{MSY}) and higher relative fishing mortality (from 42 to 76% F/F_{MSY}). Considering the quantified uncertainty, which is conservative, the assessment indicates that, with high likelihood, SB_{2015} is above SB_{MSY} and F_{2015} is below F_{MSY}. The median value of MSY from the model runs presented with SS3 was 104,000 t with a range between 87,000 and 121,000 t (a median level 22% lower than the estimate in 2013). Catches in 2017 (≈90,050 t) remain lower than the estimated MSY values from the stock assessment conducted in 2016. The average catch over the previous five years (2013–17; ≈95,997 t) also remains below the estimated MSY. Thus, on the weight-of-evidence available in 2018, the bigeye tuna stock is determined to be **not overfished** and is **not subject to overfishing** (**Table 1**).

Outlook. Declines in longline effort since 2007, particularly from the Japanese, Taiwanese and Rep. of Korea longline fleets have lowered the pressure on the Indian Ocean bigeye tuna stock, indicating that current fishing mortality would not reduce the population to an overfished state in the near future. The Kobe strategy matrix based on the plausible model runs from SS3 in 2016 illustrates the levels of quantified risk associated with varying catch levels over time and could be used to inform future management actions (**Table 2**). The SS3 projections from the 2016 assessment

show that there is a low risk of exceeding MSY-based reference points by 2018, and 2025 if catches are maintained at a level of 90,050 t (2017 catches) (Table 2).

Management advice. The stock status determination did not qualitatively change in 2018. If catches remain below the estimated MSY levels estimated for the current mix of fisheries, then immediate management measures are not required. However, increased catch or increases in the mortality on immature fish will likely increase the probabilities of breaching reference levels in the future. Continued monitoring and improvement in data collection, reporting and analysis is required to reduce the uncertainty in assessments (**Table 2**).

The following key points should also be noted:

- **Maximum Sustainable Yield (MSY):** estimate for the Indian Ocean stock is 104,101 t with a range between 87,000–121,000 t for SS3 (Table 1). The average 2013-2017 catches of ≈95,997 t, and catches for each year since 2009 were below the MSY level.
- **Interim reference points**: Noting that the Commission in 2015 agreed to Resolution 15/10 *on target and limit reference points and a decision framework*, the following should be noted:
    - **Fishing mortality**: Current fishing mortality is considered to be at 76% of the interim target reference point of F_{MSY}, and 54% of the interim limit reference point of 1.3*F_{MSY} (**Fig. 2**).
    - **Biomass**: Current spawning biomass is considered to at 129% of the interim target reference point of SB_{MSY} and well above the interim limit reference point of 0.5*SB_{MSY} (**Fig. 2**).
- **Main fishing gear** (Average catch 2013–17): Longline ≈48%; Purse seine ≈26% (FAD associated school (LS) ≈19%; free swimming school (PS) ≈7%); All other (artisanal) gears ≈26% (**Fig 1**).
- **Main fleets** (Average catch 2013–17): Indonesia ≈27%; Taiwan,China ≈18%; European Union ≈17% (EU-Spain: ≈12%; EU-France: ≈5%); Seychelles ≈13%.

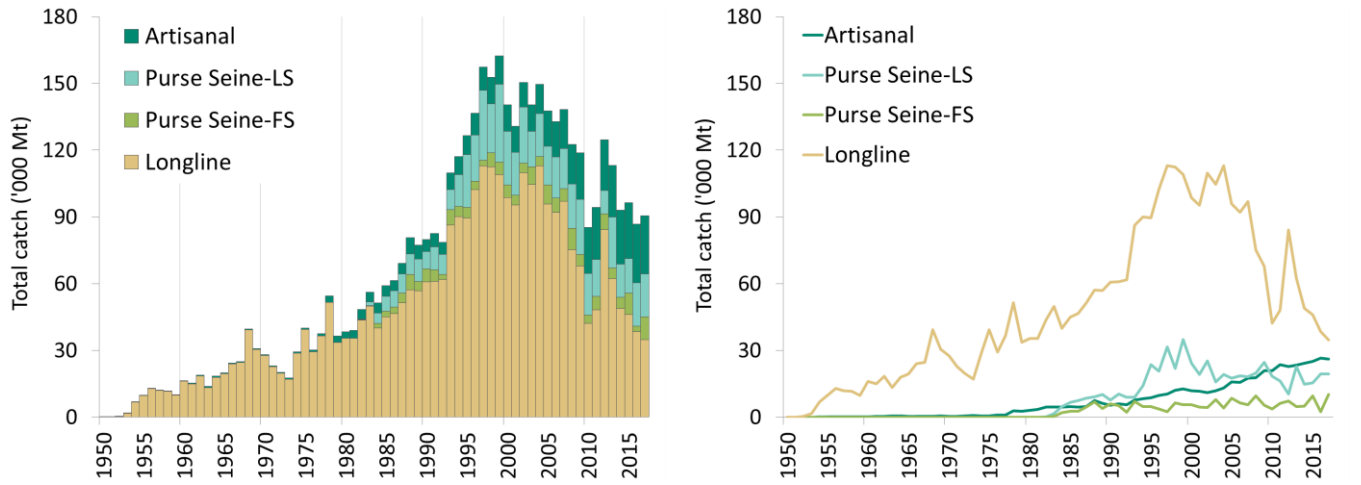


Fig. 1(a-b). Annual catches of bigeye tuna by gear (1950–2017). Data as of September 2018.

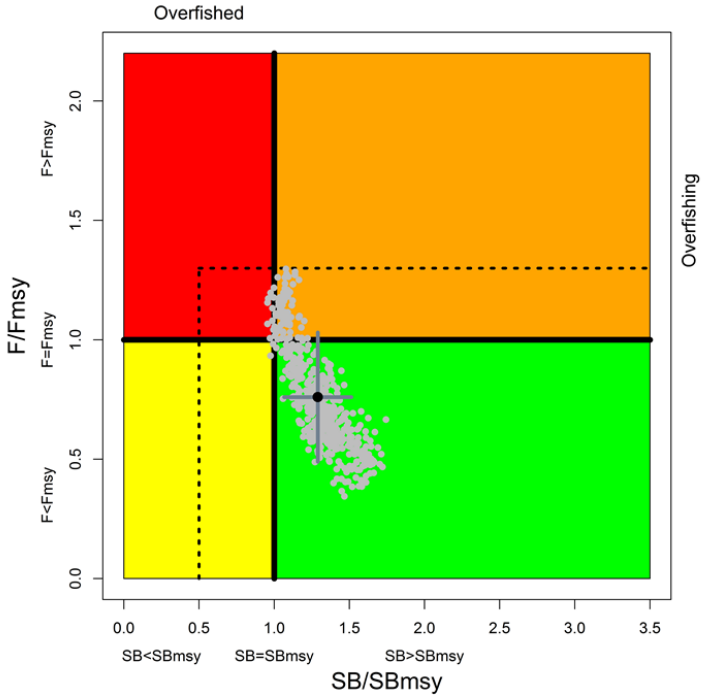


Fig. 2. Bigeye tuna: SS3 Aggregated Indian Ocean assessment Kobe plot. Dotted black lines are the interim limit reference points adopted by the Commission via Resolution 15/10. The grey points represent 500 estimates of 2015 stock status from the six SS3 scenarios. The black point represents the average of the six SS3 scenarios with associated 80% confidence interval.

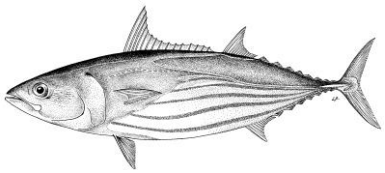
TABLE 2. Bigeye tuna: Stock Synthesis base case Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of violating the MSY-based target (top) and limit (bottom) reference points for constant catch projections (relative to catches from 2015* (93,040t), ± 20%, + 40%) projected for 3 and 10 years.

Reference point and projection timeframe	**Alternative catch projections (relative to the catch level from 2015*) and weighted probability (%) scenarios that violate MSY-based target reference point**			
	80% (74,432t)	**100%** (93,040t)	**120%** (111,648t)	**140%** (130,256t)
$B_{2018} < B_{MSY}$	11	20	30	40
$F_{2018} > F_{MSY}$	2	19	40	61
$B_{2025} < B_{MSY}$	6	25	49	60
$F_{2025} > F_{MSY}$	1	19	42	53
Reference point and projection timeframe	**Alternative catch projections (relative to the catch level from 2015*) and probability (%) of violating MSY-based limit reference points (B_{lim} = 0.5 B_{MSY}; F_{Lim} = 1.3 F_{MSY})**			
	80% (74,432t)	**100%** (93,040t)	**120%** (111,648t)	**140%** (130,256t)
$B_{2018} < B_{LIM}$	0	0	0	0
$F_{2018} > F_{LIM}$	0	4	18	37
$B_{2025} < B_{LIM}$	0	1	12	33
$F_{2025} > F_{LIM}$	0	9	30	48

** Catches for 2015 at the time of the last bigeye tuna assessment conducted in 2016.*

APPENDIX 10
EXECUTIVE SUMMARY: SKIPJACK TUNA

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



Status of the Indian Ocean skipjack tuna (SKJ: *Katsuwonus pelamis*) resource

TABLE 1. Skipjack tuna: Status of skipjack tuna (*Katsuwonus pelamis*) in the Indian Ocean.

Area[1]	Indicators		2018 stock status[4] determination
Indian Ocean	Catch 2017[2]: Average catch 2013–2017:	524,282 t 454,103 t	**47%***
	$Yield_{40\%SSB}$ (1000 t) (80% CI): $C_{2016}/C_{40\%SSB}$ (80% CI): SB_{2016} (1000 t) (80% CI): Total biomass B_{2016} (1000 t) (80% CI): $SB_{2016}/SB_{40\%SSB}$ (80% CI): SB_{2016}/SB_0 (80% CI): $E^3_{40\%SSB}$ (80% CI): SB_0 (80% CI):	510.1 (455.9–618.8) 0.88 (0.72-0.98) 796.66 (582.65-1,059.29) 910.4 (873.6-1195) 1.00 (0.88–1.17) 0.40 (0.35–0.47) 0.59 (0.53-0.65) 2,015,220 (1,651,230–2,296,135)	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2] Proportion of catch estimated or partially estimated by IOTC Secretariat in 2017: 21%
[3] E is the annual harvest rate.
[4] The stock status refers to the most recent years' data used in the last assessment conducted in 2017.
* Estimated probability that the stock is in the respective quadrant of the Kobe plot (shown below), derived from the confidence intervals associated with the current stock status.

Colour key	Stock overfished ($SB_{year}/SB_{40\%} < 1$)	Stock not overfished ($SB_{year}/SB_{40\%} \geq 1$)
Stock subject to overfishing ($F_{year}/F_{40\%} > 1$)	**38%**	2%
Stock not subject to overfishing ($F_{year}/F_{40\%} \leq 1$)	13%	47%
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. No new stock assessment was carried out for skipjack tuna in 2018, thus, stock status is determined on the basis of the 2017 assessment and other indicators presented in 2018. The 2017 stock assessment model results differ substantively from the previous (2014 and 2011) assessments. The main reasons for this are: (i) the correction of an error in specifying selectivity for small fish in the previous assessments, (ii) the addition of tag-release mortality in the model and (iii) assuming effort creep of 1% per year since 1995 for the standardized European purse seine CPUE. The final overall estimate of stock status indicates that the stock is at the target biomass reference point and that the current and historical fishing mortality rates are estimated to be below the target. Over the history of the fishery, biomass has been well above and the fishing mortality has been well below the established limit reference points. The median value of Catch at the target fishing mortality ($C_{SB40\%}$) from the model runs investigated is 510,090 t with a range between 455,920 and 618,760t. Current spawning stock biomass relative to unexploited levels is estimated at 40% (Table 1). Catch in 2016 (≈446,723 t) remain lower than the estimated range of $C_{SB40\%}$ (Table 1). The average catch over the previous five years (2013–17; ≈ 454,103 t) also remains below the estimated range of $C_{SB40\%}$. Thus, on the weight-of-evidence available in 2017, the skipjack tuna stock is determined to be **not overfished** and is **not subject to overfishing** (Table 1).

Outlook. Total catches in 2017 were 12% larger than the resulting catch limit from the skipjack HCR for the period 2018-2020. It should be noted that skipjack catches for most gears have increased from 2016 to 2017 (+10% for purse seine, +16% for gillnet and +17% for baitboats). In particular, due to Resolution 18/01, an increase in fishing operations on FADs by purse seine fleets has been observed. CPUE fluctuations coincide with environmental signals at inter-annual timescale (e.g., Indian Ocean Dipole). Due to its specific life traits, skipjack can respond quickly to ambient foraging conditions driven by ocean productivity. Environmental indicators should be closely monitored to inform on the potential increase/decrease of stock productivity.

Management advice. Based on the results of the stock assessment of skipjack tuna in 2017, the Commission, following Resolution 16/02, adopted an annual catch limit of 470,029 tonnes for the years 2018 to 2020. Total catches in 2017 (524,282 t) were 12% larger than the catch limit generated by the Harvest Control Rule (470,029 t) which applies to the years 2018–2020, and there has been an increasing trend in catches over the past 3 years. The Commission needs to ensure that catches of skipjack in the 2018–2020 period do not exceed the agreed limit.

Following Resolution 16/02, the annual catch limit for the period 2018-2020 was established at 470,029 t.

The SC has included in its programme of work further development of Management Strategy Evaluation (MSE) for the IOTC Skipjack tuna fishery including, but not limited to: refinement of operating model(s) used, specifications for the assessment and data to be used, and alternative management procedures.

It should also be noted that:

- **Reference points:** Commission in 2016 agreed to Resolution 16/02 on *harvest control rules for skipjack tuna in the IOTC area of competence;*
- **Fishing mortality**: Current fishing mortality was considered to be below the target reference point, and also below the limit reference point (**Fig. 2**) as per Resolution 15/10;
- **Biomass**: Current spawning biomass was considered to be at the target reference point of 40% of SB_0, and above the limit reference point of $0.2*SB_0$ (**Fig. 2**) as per Resolution 15/10;
- **Main fishing gear** (average catches 2013–17): Purse seine ≈35% (FAD associated school ≈33% and free swimming school ≈1%); Gillnet ≈22%; Pole-and-line ≈21%; Other ≈23% (**Fig. 1(a-c)**);

Main fleets (average catches 2013–17): Indonesia ≈19%; European Union ≈20% (EU-Spain: ≈15%; EU-France: ≈5%); ≈Maldives 16%; Sri Lanka ≈12%; Seychelles ≈10%; ≈I.R. Iran 9%.

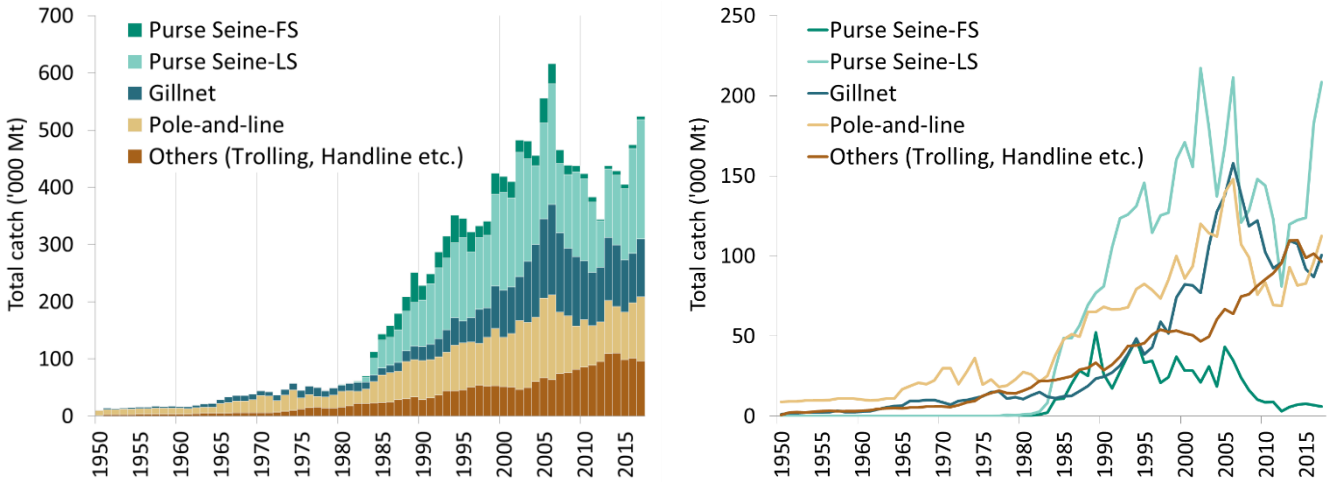


Fig. 1(a-b). Annual catches of skipjack tuna by gear (1950–2017). Data as of September 2018.

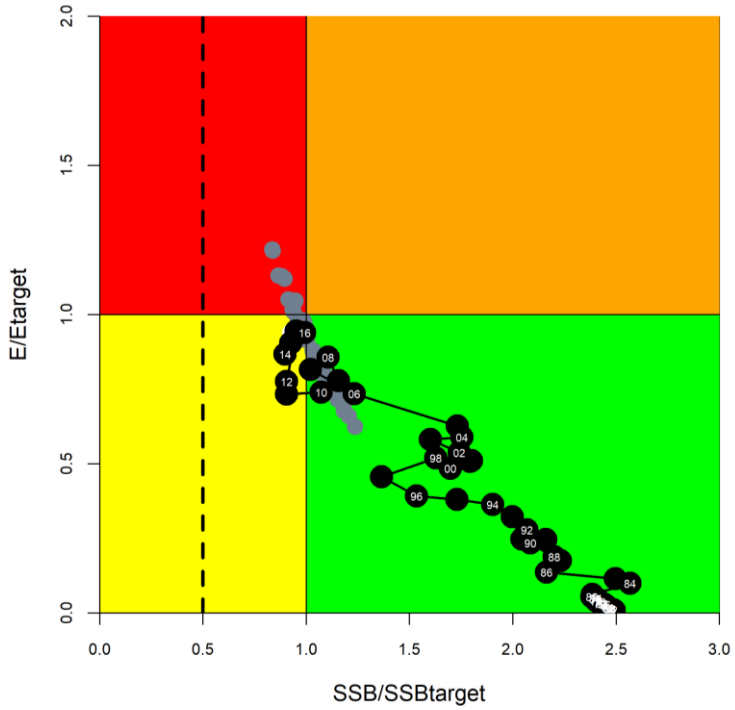
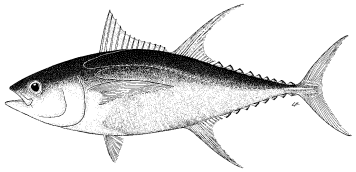


Fig. 2. Skipjack tuna: SS3 Aggregated Indian Ocean assessment Kobe plot of the 2017 uncertainty grid. Black circles indicate the trajectory of the median estimates for the SB/SB_{target} ratio and E/E_{target} ratio across all models of the 2017 uncertainty grid for each year 1950–2016; grey dots are the estimates for year 2016 from individual models. The dashed line indicates SB_{limit} (20% SB_0)

APPENDIX 11
EXECUTIVE SUMMARY: YELLOWFIN TUNA

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



Status of the Indian Ocean yellowfin tuna (YFT: *Thunnus albacares*) resource

TABLE 1. Yellowfin tuna: Status of yellowfin tuna (*Thunnus albacares*) in the Indian Ocean.

Area[1]	Indicators		2018 stock status[3] determination
Indian Ocean	Catch 2017[2]: Average catch 2013–2017:	409,567t 399,830 t	
	MSY (1000 t) (80% CI) [3]: F_{MSY} (80% CI): SB_{MSY} (1,000 t) (80% CI): F_{2017}/F_{MSY} (80% CI): SB_{2017}/SB_{MSY} (80% CI): SB_{2017}/SB_0 (80% CI):	403 (339–436) 0.15 (0.13–0.17) 1069 (789–1387) 1.20 (1.00–1.71) 0.83 (0.74–0.97) 0.30 (0.27 – 0.33)	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2] Proportion of catch estimated or partially estimated by IOTC Secretariat for catches in 2017: 24%
[3] Median and quantiles calculated from the uncertainty grid taking into account of weighting on models

Colour key	Stock overfished ($SB_{year}/SB_{MSY} < 1$)	Stock not overfished ($SB_{year}/SB_{MSY} \geq 1$)
Stock subject to overfishing ($F_{year}/F_{MSY} > 1$)	**94**	**2**
Stock not subject to overfishing ($F_{year}/F_{MSY} \leq 1$)	**4**	**0**
Not assessed/Uncertain		

The percentages are calculated as the proportion of model terminal values that fall within each quadrant with model weights taken into account

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. In 2018 a new stock assessment was carried out for yellowfin tuna in the IOTC area of competence to update the stock status undertaken in 2016. The stock assessment was carried out using Stock Synthesis III (SS3), a fully integrated model that is currently used to provide scientific advice for the three tropical tunas stocks in the Indian Ocean. The model used in 2018 is based on the model developed in 2016 with a series of revisions that were noted during the WPTT. The model uses four types of data: catch, size frequency, tagging and joint longline CPUE indices. The SS3 stock assessment gave overall similar results to the 2015/2016 assessment but is somewhat more pessimistic than the stock assessment undertaken in 2016 (but similar to the one done in 2015) due to the steeper declining trend of the composite longline CPUE series and sustained large catches in the most recent years. The assessment results were only based on a grid of 24 SS3 model runs which are recognized as insufficient to explore the spectrum of uncertainties and scenarios, noting the large uncertainty associated with data quality (e.g., spatial representativeness of CPUE coverage, estimation of catch and inconsistency in length-frequency) and lack of considering model statistical uncertainty. Spawning stock biomass in 2017 was estimated to be 30.0% of the unfished levels (Table 1). According to the information available for the stock assessment, the total catch has remained relatively stable at levels around the estimated MSY since 2012 (i.e., between 390,000 t and 410,000 t). The 2018 stock assessment estimates SB_{2017}/SB_{MSY} at 0.83 (0.74-0.97) and F_{2017}/F_{MSY} at 1.20 (1.00 -1.71). However, it is noted that the quantified uncertainty in stock status is likely underestimating the underlying uncertainty of the assessment. On the weight-of-evidence available in 2018, the yellowfin tuna stock is determined to remain **overfished** and subject to **overfishing** (Table 1 and Fig. 1).

Outlook. The increase in catches in recent years has substantially increased the pressure on the Indian Ocean stock, resulting in fishing mortality exceeding the MSY-related levels. The results of projections of the Stock Synthesis are provided in the form of K2SM (Table 2). There is a high risk of continuing to violate the MSY-based reference points

if catches remain at around current levels (≈409,000 t in 2017) (Table 2). However, the projections shown in K2SM results do not adequately reflect known sources of uncertainty due to a series of issues with data and model performance, and should be taken with caution given the issues identified by the Committee.

Management advice. The decline in stock status to below MSY reference level is not well understood due to various uncertainties. As a precautionary measure, the Commission should ensure that catches are reduced to end overfishing and allow the SSB to recover to SSB_{MSY} levels. At this stage, specific catch limits are not provided.

A workplan has been developed to address the issues identified in the assessment review, aimed at increasing the Committee's ability to provide more concrete and robust advice by the 2019 meeting of the Scientific Committee. The workplan is scheduled to start in January 2019 and aims at addressing the issues identified by the WPTT and the external reviewer. The draft workplan is attached as Appendix 38 of the 2018 Scientific Committee Report (IOTC-2018-SC21-R). The Commission should ensure that this workplan is budgeted appropriately.

The Commission has an interim plan for the rebuilding the yellowfin stock, with catch limitations based on 2014/2015 levels (Resolution 18/01). Some of the fisheries subject to catch reductions had fully achieved a decrease in catches in 2017 in accordance with the levels of reductions specified in the Resolution; however, these reductions were offset by increases in the catches from CPCs exempt and some CPCs subject to limitations on their catches of yellowfin tuna (see table 3 in IOTC-2018-SC21-R). Thus, the total catches of yellowfin in 2017 increased by around 3% from 2014/2015 levels. The Commission should ensure that any revision of the management measure can effectively achieve any prescribed catch reduction to ensure the effectiveness of the management measure.

The following key points should also be noted:

- **Maximum Sustainable Yield (MSY):** estimate for the Indian Ocean stock is 403,000 t with a range between 339,000-436,000 t (Table 1). The 2013-2017 average catches (399,830 t) were below the estimated MSY level. However, the last two years of catches were slightly higher than the median MSY.
- **Interim reference points**: Noting that the Commission in 2015 agreed to Resolution 15/10 *on target and limit reference points and a decision framework*, the following should be noted:
    - **Fishing mortality**: Current fishing mortality is considered to be 20% above the interim target reference point of F_{MSY}, and below the interim limit reference point of $1.4*F_{MSY}$ (**Fig. 2**).
    - **Biomass**: Current spawning biomass is considered to be 17 % below the interim target reference point of SB_{MSY} and above the interim limit reference point of $0.4*SB_{MSY}$ (**Fig. 2**).
- **Main fishing gear** (average catches 2013–17): Purse seine ≈35% (FAD associated school ≈23%; free swimming school ≈12%); Longline ≈16%; Gillnet ≈17%; All other gears ≈31% (**Fig. 1**).
- **Main fleets** (average catches 2013–17): European Union ≈22% (EU-Spain ≈14%; EU-France ≈8%); Maldives ≈13%; I.R. Iran ≈11%; Seychelles ≈9%; Sri Lanka ≈9%; All other fleets ≈37%.

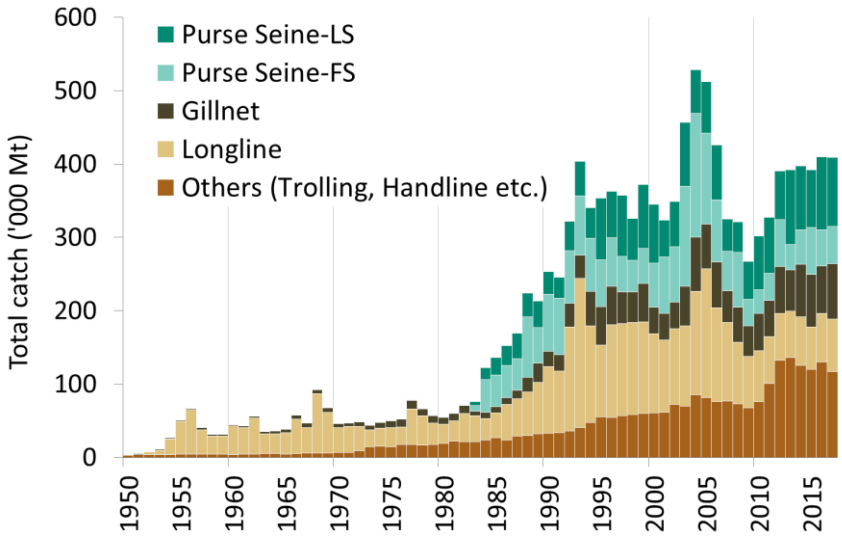


Fig. 1. Annual catches of yellowfin tuna by gear (1950–2017)[25].

[25] **Definition of fisheries**: Gillnet, including offshore gillnet (**GI**); Purse seine free-school (**FS**); Purse seine associated school (**LS**); Deep-freezing longline (**LL**); Fresh-tuna longline (**FL**); Other gears (including, Pole-and-Line (**BB**); Hand line (**HD**); Trolling (**TR**); Other gears nei (**OT**)).

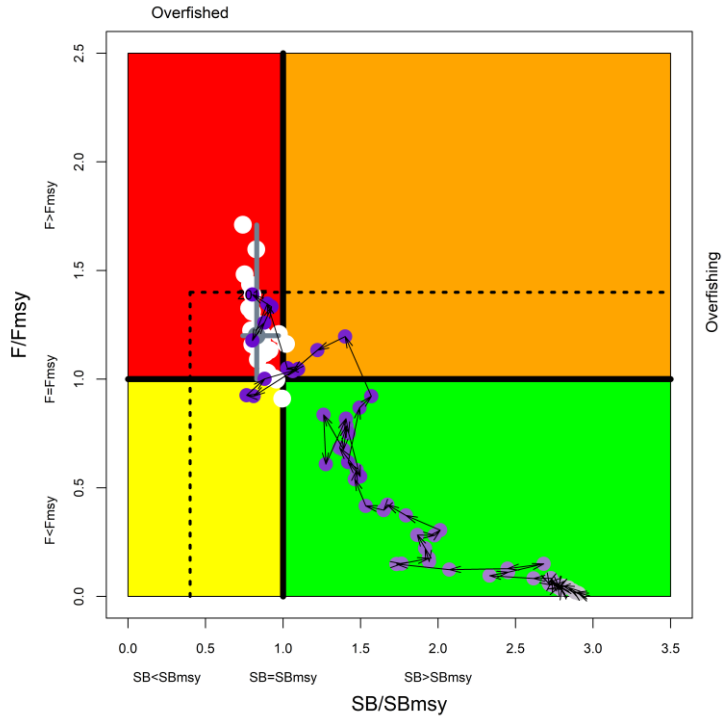


Fig. 2. Yellowfin tuna: Stock synthesis Kobe plot. Blue dots indicate the trajectory of the point estimates for the SB/SB_{MSY} ratio and F/F_{MSY} ratio for each year 1950–2017. The grey line represents the 80% confidence interval associated with the 2017 stock status. Dotted black lines are the interim limit reference points adopted by the Commission via Resolution 15/10. The white circles represent 2017 stock status for each grid run.

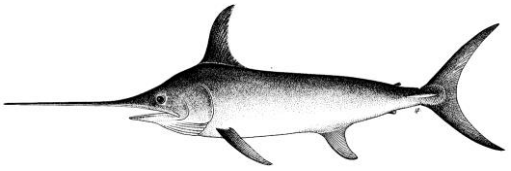
TABLE 2. Yellowfin tuna: Stock synthesis assessment Kobe II Strategy Matrix. Probability of violating the MSY-based target (top) and limit (bottom) reference points for constant catch projections (relative to the catch level from 2017 (409,567t), -35%, - 30%, -25%, -20%, -15%, ± 10%, -5%) projected for 3 and 10 years.

Reference point and projection timeframe	**Alternative catch projections (relative to the catch level from 2017) and probability (%) of violating MSY-based target reference points ($B_{targ} = B_{MSY}$; $F_{targ} = F_{MSY}$)**								
	65% (266,218t)	70% (286,697t)	75% (307,175t)	80% (327,654t)	85% (348,132t)	90% (368,610t)	95% (389,089t)	100% (409,567t)	110% (450,523t)
$B_{2020} < B_{MSY}$	0.48	0.48	0.73	0.85	0.85	0.96	0.98	0.98	1.00
$F_{2020} > F_{MSY}$	0.08	0.23	0.25	0.48	0.56	0.79	0.96	0.98	1.00
$B_{2027} < B_{MSY}$	0.08	0.08	0.25	0.42	0.56	0.79	0.98	1.00	1.00*
$F_{2027} > F_{MSY}$	0.06	0.08	0.23	0.42	0.63	0.85	1.00	1.00	1.00*
Reference point and projection timeframe	**Alternative catch projections (relative to the catch level from 2017) and probability (%) of violating MSY-based limit reference points ($B_{lim} = 0.4\ B_{MSY}$; $F_{Lim} = 1.4\ F_{MSY}$)**								
	65% (266,218t)	70% (286,697t)	75% (307,175t)	80% (327,654t)	85% (348,132t)	90% (368,610t)	95% (389,089t)	100% (409,567t)	110% (450,523t)
$B_{2020} < B_{Lim}$	0.00	0.00	0.00	0.00	0.00	0.06	0.15	0.23	0.42
$F_{2020} > F_{Lim}$	0.00	0.06	0.08	0.21	0.23	0.42	0.56	0.63	0.92
$B_{2027} < B_{Lim}$	0.00	0.06	0.08	0.27	0.42	0.50	0.83	0.90	1.00*
$F_{2027} > F_{Lim}$	0.00	0.08	0.23	0.42	0.50	0.65	0.94	0.94	1.00*

** stock crashed or at least one fishery not able to take the catch due to absence of vulnerable fish in the projection period for all models. The probability levels are not well determined, but likely progressively high as the catch level increases beyond 100%.*

APPENDIX 12
EXECUTIVE SUMMARY: SWORDFISH

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



Status of the Indian Ocean swordfish (SWO: *Xiphias gladius*) resource

TABLE 1. Swordfish: Status of swordfish (*Xiphias gladius*) in the Indian Ocean.

Area[1]	Indicators		2018 stock status determination
Indian Ocean	Catch 2017[2]: Average catch 2013-2017:	34,782t 31,405 t	
	MSY (1,000 t) (80% CI): F_{MSY} (80% CI): SB_{MSY} (1,000 t) (80% CI): F_{2015}/F_{MSY} (80% CI): SB_{2015}/SB_{MSY} (80% CI): SB_{2015}/SB_{1950} (80% CI):	31.59 (26.30–45.50) 0.17 (0.12–0.23) 43.69 (25.27–67.92) 0.76 (0.41–1.04) 1.50 (1.05–2.45) 0.31 (0.26–0.43)	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2] Proportion of catch estimated or partially estimated by IOTC Secretariat in 2018: 48%.

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		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. No new stock assessment was carried out for swordfish in 2018, thus, the stock status is determined on the basis of the 2017 assessment and other indicators presented in 2018. In 2017 a stock synthesis assessment was conducted, with fisheries catch data up to 2015. The assessment uses a spatially disaggregated, sex explicit and age structured model. The SS3 model, used for stock status advice, indicated that MSY-based reference points were not exceeded for the Indian Ocean population ($F_{2015}/F_{MSY} < 1$; $SB_{2015}/SB_{MSY} > 1$). Most other models applied to swordfish also indicated that the stock was above a biomass level that would produce MSY. Spawning stock biomass in 2015 was estimated to be 26%–43% of the unfished levels. Last year catches are higher than the MSY level (31,590 t). On the weight-of-evidence available in 2018, the stock is determined to be ***not overfished*** and ***not subject to overfishing***.

Outlook. The decrease in longline catch and effort from 2005 to 2011 lowered the pressure on the Indian Ocean stock, and despite the recent increase in total recorded catches, current fishing mortality is not expected to reduce the population to an overfished state over the next decade. There is a very low risk of exceeding MSY-based reference points by 2026 if catches are maintained at 2015 levels (<1% risk that $SB_{2026} < SB_{MSY}$, and <1% risk that $F_{2026} > F_{MSY}$) (Table 2).

Management advice. The most recent catches (34,782 t in 2017) are higher than the MSY level (31,590 t). The catches should be reduced to the MSY level (31,590 t).

The following key points should also be noted:

- **Maximum Sustainable Yield (MSY)**: estimate for the Indian Ocean is 31,590 t.
- **Provisional reference points**: Noting that the Commission in 2015 agreed to Resolution 15/10 *on target and limit reference points and a decision framework*, the following should be noted:
    a. **Fishing mortality**: Current fishing mortality is considered to be below the provisional target reference point of F_{MSY} and below the provisional limit reference point of $1.4*F_{MSY}$ (**Fig. 2**).
    b. **Biomass**: Current spawning biomass is considered to be above the target reference point of SB_{MSY}, and therefore above the limit reference point of $0.4*SB_{MSY}$ (**Fig. 2**).

- **Main fishing gear (average catches 2013-17)**: Longline catches are currently estimated to comprise approximately 69% of total swordfish catches in the Indian (Fig. 1).
- **Main fleets (average catches 2013-17):**
  Taiwan,China (longline): 21%; Sri Lanka (longline-gillnet): 18%; EU,Spain (swordfish targeted longline): 12%**;** Indonesia (fresh longline): 9%.

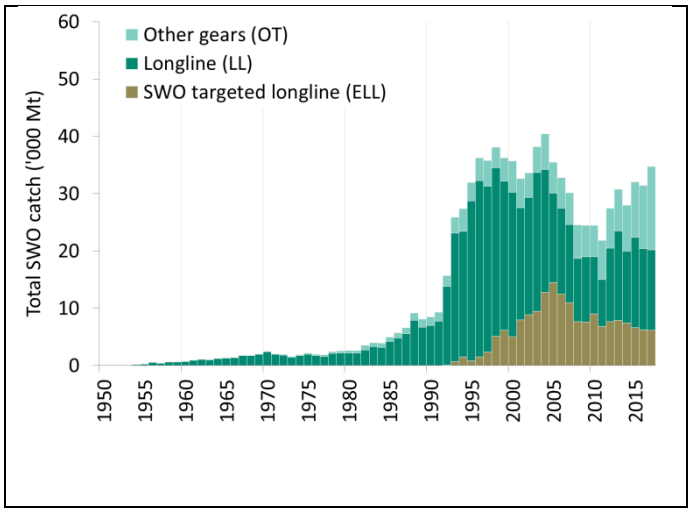


Fig. 1. Swordfish catches by gear and year recorded in the IOTC database (1950–2017);
***Note**: Other gears (OT) includes: longline-gillnet, handline, gillnet, coastal longline, troll line, sport fishing, and all other gears.*

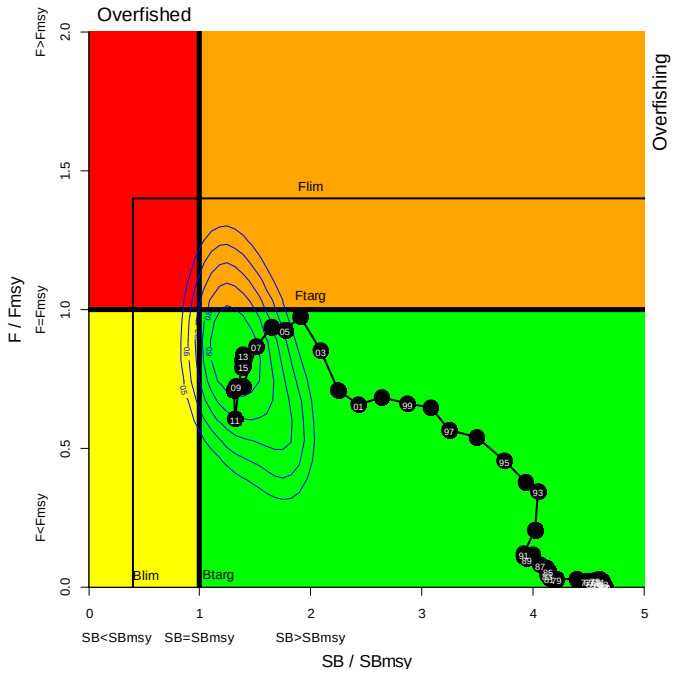


Fig. 2. Swordfish: SS3 Aggregated Indian Ocean assessment Kobe plot (contours are the 50, 60, 70, 80 and 90 percentiles of the 2015 estimate). Blue circles indicate the trajectory of the point estimates for the SB ratio and F ratio for each year 1950–2015. Interim target (F_{targ} and SB_{targ}) and limit (F_{lim} and SB_{lim}) reference points, as set by the Commission, are shown.

TABLE 2. Swordfish: SS3 aggregated Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of violating the MSY-based target (top) and limit (bottom) reference points for nine constant catch projections relative to 2015* catch level (32,129 t), ± 10%, ± 20%, ± 30% ± 40%) projected for 3 and 10 years.

Reference point and projection timeframe	**Alternative catch projections (relative to the average catch level from 2015* (32,129 t) and probability (%) of violating MSY-based target reference points (SBtarg = SBMSY; Ftarg = FMSY)**								
	60% (19,278 t)	**70%** (22,491 t)	**80%** (22,704 t)	**90%** (28,917 t)	**100%** (32,129 t)	**110%** (35,343 t)	**120%** (38,556 t)	**130%** (41,769 t)	**140%** (44,982 t)
$SB_{2018} < SB_{MSY}$	0	0	0	0	0	0	0	8	13
$F_{2018} > F_{MSY}$	0	0	0	0	13	33	42	58	71
$SB_{2025} < SB_{MSY}$	0	0	0	0	8	33	46	63	75
$F_{2025} > F_{MSY}$	0	0	0	4	38	54	71	83	88

Reference point and projection timeframe	**Alternative catch projections (relative to the average catch level from 2015* (32,129 t) and probability (%) of violating MSY-based limit reference points (SB_{lim} = 0.4 SB_{MSY}; F_{Lim} = 1.4 F_{MSY})**								
	60% (19,278 t)	**70%** (22,491 t)	**80%** (22,704 t)	**90%** (28,917 t)	**100%** (32,129 t)	**110%** (35,343 t)	**120%** (38,556 t)	**130%** (41,769 t)	**140%** (44,982 t)
$SB_{2018} < SB_{Lim}$	0	0	0	0	0	0	0	0	0
$F_{2018} > F_{Lim}$	0	0	0	0	0	0	0	13	33
$SB_{2025} < SB_{Lim}$	0	0	0	0	0	0	0	0	21
$F_{2025} > F_{Lim}$	0	0	0	0	0	21	42	63	75

** 2015 catches, at the time of the last swordfish assessment conducted in 2017.*

APPENDIX 13
EXECUTIVE SUMMARY: BLACK MARLIN

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

Status of the Indian Ocean black marlin (BLM: *Makaira indica*) resource

TABLE 1. Black marlin: Status of black marlin (*Makaira indica*) in the Indian Ocean.

Area[1]	Indicators		2018 stock status determination
Indian Ocean	Catch 2017[2]: Average catch 2013–2017:	21,250 t 18,673 t	
	MSY (1,000 t) (80% CI): F_{MSY} (80% CI): B_{MSY} (1,000 t) (80% CI): F_{2017}/F_{MSY} (80% CI): B_{2017}/B_{MSY} (80% CI): B_{2017}/B_0 (80% CI):	12.93 (9.44-18.20) 0.18 (0.11-0.30) 72.66 (45.52-119.47) 0.96 (0.77-1.12) 1.68 (1.32-2.10) 0.62 (0.49-0.78)	

[1] Boundaries for the Indian Ocean = IOTC area of competence;
[2] Proportion of catch fully or partially estimated by IOTC Secretariat in 2018: 54%

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

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. A stock assessment based on JABBA was conducted in 2018 for black marlin. This assessment suggests that the point estimate for the stock in 2017 is in the green zone in the Kobe plot with F/F_{MSY}=0.96 (0.77-1.12) and B/B_{MSY}=1.68 (1.32-2.10). The Kobe plot (Fig. 2) from the JABBA model indicated that the stock is not **subject to overfishing** and is currently not **overfished** (Table 1; Fig. 2), however these status estimates are subject to a high degree of uncertainty. The recent sharp increases in total catches (e.g., from 15,000 t in 2014 to over 20,000 t since 2016, mostly due to increases by I.R. Iran and India), and conflicts in information in CPUE and catch data lead to large uncertainties in the assessment outputs. This caused the point estimate of the stock status to change from the red to the green zones of the Kobe plot without any evidence of a rebuilding trend. **As such, the results of the assessment are uncertain and should be interpreted with caution.**

Outlook. While the recent high catches seem to be mainly due to developing coastal fisheries operating in the core habitat of the species, the CPUE indicators are from industrial fleets operating mostly offshore on the edges of the species distribution. However, the recent increases in catches are much higher than MSY and are a cause for concern and will likely continue to drive the population towards overfished status.

Management advice. Current catches (>20,000 t in 2017) (Fig. 1) are considerably higher than MSY (12,930 t) estimate, which is likely to associate with high uncertainty. The catch limits as stipulated in Resolution 18/05 have been exceeded. The Commission should provide mechanisms to ensure that catch limits are not exceeded by all concerned fisheries. Projections were not carried out due to the poor predictive capabilities identified in the assessment diagnostics.

The following key points should be noted:

- **Maximum Sustainable Yield (MSY)**: estimate for the whole Indian Ocean is 12,930 t.
- **Provisional reference points**: Although the Commission adopted reference points for swordfish in Resolution 15/10 *on target and limit reference points and a decision framework*, no such interim reference points nor harvest control rules have been established for black marlin.
- **Main fishing gear (average catches 2013-17)**: Black marlin are largely considered to be a non-target species of industrial and artisanal fisheries. Gillnets account for around 49% of total catches in the Indian Ocean, followed by longlines (19%), with remaining catches recorded under troll and handlines (Fig. 1).
- **Main fleets (average catches 2013-17):**
  India (gillnet and trolling): 28%; I.R. Iran (gillnet): 27%; Sri Lanka (gillnet and fresh longline): 19%; Indonesia (fresh longline and hand lines): 10%.

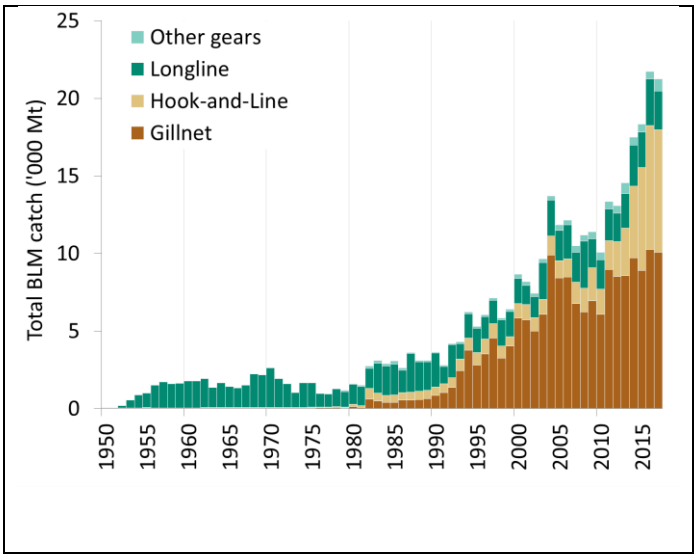


Fig. 1a-b. Black marlin catches by gear and year recorded in the IOTC database (1950–2017):
***Notes**: Other gears (OT) includes: longline-gillnet, handline, gillnet, coastal longline, troll line, sport fishing, and all other gears.*

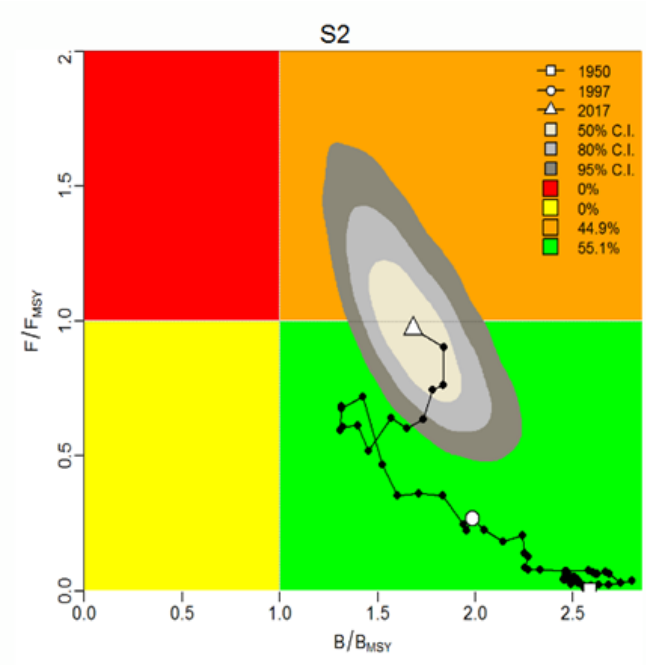
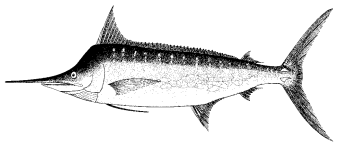


Fig. 2. Black marlin: JABBA Indian Ocean assessment Kobe plots for black marlin (contours are the 50, 80 and 95 percentiles of the 2017 estimate). Black line indicates the trajectory of the point estimates for the total biomass (B) ratio and F ratio for each year 1950–2017.

APPENDIX 14
EXECUTIVE SUMMARY: BLUE MARLIN

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



Status of the Indian Ocean blue marlin (BUM: *Makaira nigricans*) resource

TABLE 1. Blue marlin: Status of blue marlin (*Makaira nigricans*) in the Indian Ocean.

Area[1]	Indicators		2017 stock status determination
Indian Ocean	Catch 2017[2]:	12,155 t	**46.8%***
	Average catch 2013-2017:	11,635 t	
	MSY (1,000 t) (80% CI):	11.93 (9.23–16.15)	
	F_{MSY} (80% CI):	0.11 (0.08 –0.16)	
	B_{MSY} (1,000 t) (80% CI):	113 (71.7 – 162.0)	
	H_{2015}/H_{MSY} (80% CI):	1.18 (0.80–1.71)	
	B_{2015}/B_{MSY} (80% CI):	1.11 (0.90–1.35)	
	B_{2015}/B_0 (80% CI):	0.56 (0.44 – 0.71)	

[1] Boundaries for the Indian Ocean = IOTC area of competence
[2] Proportion of catch estimated or partially estimated by IOTC Secretariat in 2017: 45%
* Estimated probability that the stock is in the respective quadrant of the Kobe plot (shown below), derived from the confidence intervals associated with the current stock status.

Colour key	Stock overfished($B_{year}/B_{MSY}< 1$)	Stock not overfished ($B_{year}/B_{MSY}\geq 1$)
Stock subject to overfishing($F_{year}/F_{MSY}> 1$)	24.6%	46.8%
Stock not subject to overfishing ($F_{year}/F_{MSY}\leq 1$)	1.0%	27.6%
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. No stock assessment was carried out in 2018**.** Stock status based on BSP-SS stock assessment carried out in 2016 suggests that the stock status in 2015 is in the orange zone in the Kobe plot and both F and B are close to their MSYs, i.e., F/F_{MSY}=1.18 and B/B_{MSY}=1.11. Two other approaches examined in 2016 came to similar conclusions, namely ASPIC and SS3. The results of the assessment in 2016 from the BSP-SS model indicated that the stock was **subject to overfishing** but **not overfished** in 2015 (Table 1; Fig. 2).

Outlook. The uncertainty in the catch data available at the time of the assessment and the CPUE series suggests that the advice should be interpreted with caution. A decrease in longline effort from 2005 to 2011 lowered the fishing pressure on the Indian Ocean stock, but catches in recent years have been increasing. The MSY estimates provided are derived from the previous assessment carried out in 2016 (data until 2015), in which a high catch scenario was considered. However, the catch data have subsequently been revised and a low catch scenario is currently adopted by the Scientific Committee. As such, the previous MSY value estimated from the high catch scenario is likely over-estimated and cannot be used for a direct comparison with the current catches provided in Table 1.

Management advice. Current catches exceed the catch limit as stipulated in Resolution 18/05. The Commission should provide mechanisms to ensure the catch limits are not exceeded in the future

The following key points should also be noted:

- **Maximum Sustainable Yield (MSY)**: estimate for the Indian Ocean blue marlin stock is 11,926 t (estimated range 9,232–16,149 t).

- **Provisional reference points**: Although the Commission adopted reference points for swordfish in Resolution 15/10 *on target and limit reference points and a decision framework*, no such interim reference points, nor harvest control rules have been established for blue marlin.
- **Main fishing gear (average catches 2013-17)**: Blue marlin are largely considered to be a non-target species of industrial and artisanal fisheries. Longline catches account for around 71% of total catches in the Indian Ocean, followed by gillnets (23%), with remaining catches recorded under troll and handlines (Fig. 1).
  Main fleets (average catches 2013-17):
  Taiwan,China (longline): 40%; Pakistan (gillnet): 15%; I.R. Iran (gillnet): 13%; Sri Lanka (gillnet): 10%; Indonesia (longline): 7%.

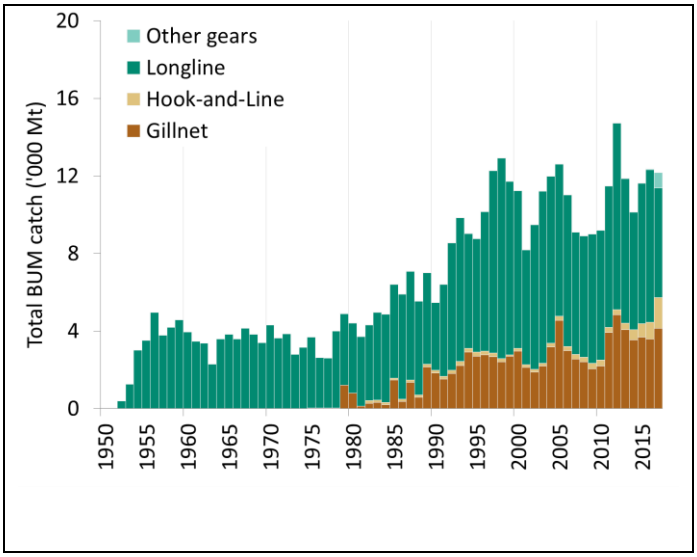


Fig. 1a-b. Blue marlin catches by gear and year recorded in the IOTC database (1950–2017):
- (Left): High-case catch scenario (IOTC-2018-WPB16-DATA03a): includes IOTC Secretariat revised catch estimates for Indonesian fresh tuna.
- (Right): Low-case catch scenario (IOTC-2018-WPB16-DATA03b): alternative catch series incorporating changes to IOTC Secretariat's methodology for estimating for Indonesia's fresh tuna longline catches.

***Notes**: Other gears (OT) includes: longline-gillnet, handline, gillnet, coastal longline, troll line, sport fishing, and all other gears.*

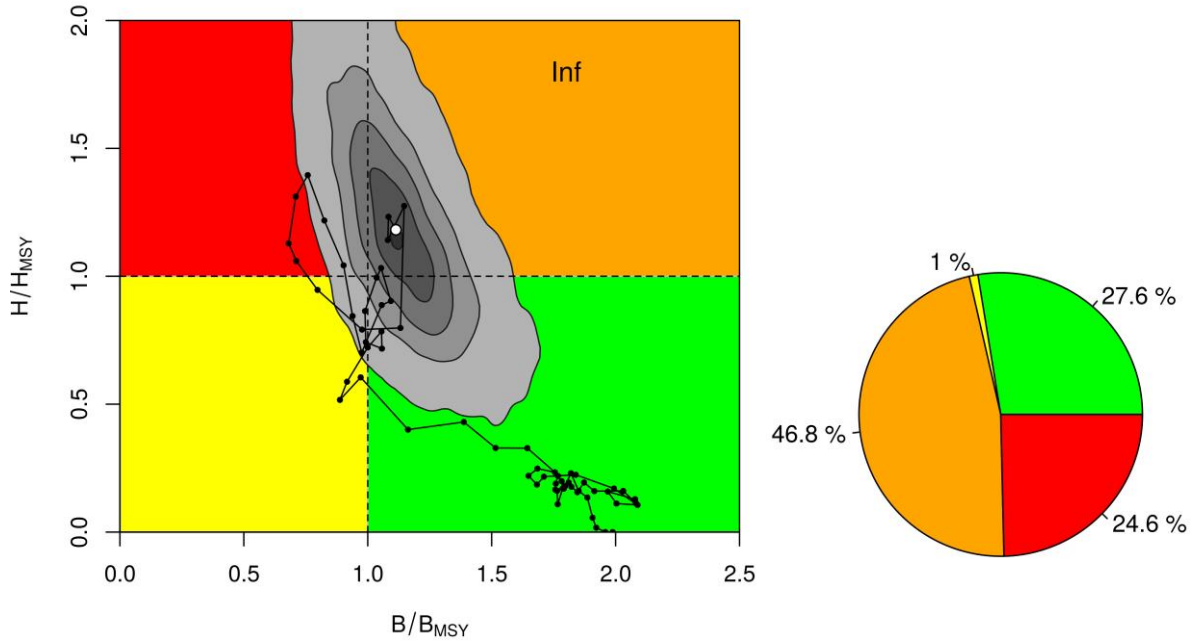


Fig. 2. Blue marlin: BSP-SS Aggregated Indian Ocean assessment Kobe plot for blue marlin (90% bootstrap confidence surfaces shown around 2015 estimate). Black line indicates the trajectory of the point estimates for the total biomass (B) ratio and Harvest ratio for each year 1950–2015.

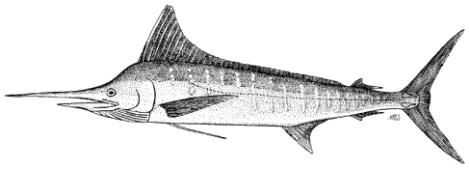
Table 2. Blue Marlin: Indian Ocean BSP-SS Kobe II Strategy Matrix. Probability (percentage) violating the MSY-based reference points for nine constant catch projections (average catch level from 2013 to 2015 - 15,401 t ± 10%, ± 20%, ± 30% ± 40%) projected for 3 and 10 years.

Reference point and projection timeframe	**Alternative catch projections (relative to the average catch from 2013 to 2015* (15,401 t) and probability (%) of violating MSY-based reference points**								
	60%	**70%**	**80%**	**90%**	**100%**	**110%**	**120%**	**130%**	**140%**
	9,240 t	10,780 t	12,321t	13,861 t	15,401 t	16,941 t	18,481 t	20,021 t	21,561 t
$B_{2018}<B_{MSY}$	26	31	37	43	48	54	59	64	69
$F_{2018}> F_{MSY}$	14	30	47	63	75	84	90	94	96
$B_{2025}<B_{MSY}$	16	30	46	60	73	82	88	93	95
$F_{2025}> F_{MSY}$	12	30	51	68	80	89	93	96	98

** Average catches for 2013–2015, at the time of the last blue marlin assessment conducted in 2016.*

APPENDIX 15
EXECUTIVE SUMMARY: STRIPED MARLIN

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



Status of the Indian Ocean striped marlin (MLS: *Tetrapturus audax*) resource

TABLE 1. Striped marlin: Status of striped marlin (*Tetrapturus audax*) in the Indian Ocean.

Area[1]	Indicators		2018 stock status determination
Indian Ocean	Catch 2017[2]:	3,082t	**99.8%***
	Average catch 2013-2017:	3,587t	
	MSY (1,000 t) (JABBA):	4.73 (4.27–5.18)[5]	
	F_{MSY} (JABBA):	0.26 (0.20–0.34)	
	B_{MSY} (1,000 t) (JABBA):	17.94 (14.21–23.13)	
	F_{2017}/F_{MSY} (JABBA):	1.99 (1.21–3.62)	
	B_{2017}/B_{MSY} (JABBA):	0.33 (0.18–0.54)	
	SB_{2017}/SB_{MSY} (SS3)[6]:	0.373	
	B_{2017}/K(JABBA):	0.12 (0.07–0.20)	
	SB_{2017}/SB_{1950} (SS3):	0.13 (0.09–0.14)	

[1] Boundaries for the Indian Ocean = IOTC area of competence
[2] Proportion of catch estimated or partially estimated by IOTC Secretariat in 2018: 41%
[5] JABBA estimates are the range of central values shown in Figure 2.
[6] SS3 is the only model that used SB/SB_{MSY}, all others used B/B_{MSY}.
* Estimated probability that the stock is in the respective quadrant of the Kobe plot (shown below), derived from the confidence intervals associated with the current stock status.

Colour key	Stock overfished(B_{year}/B_{MSY}< 1)	Stock not overfished (B_{year}/B_{MSY}≥ 1)
Stock subject to overfishing(F_{year}/F_{MSY}> 1)	**99.8%**	**0.0%**
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)	**0.2%**	**0.0%**
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. A new stock assessment for striped marlin was carried out in 2018, based on two different models: JABBA, a Bayesian state-space production model; and SS3, an integrated length-based model. Both models were very consistent and confirmed the results from 2012, 2013, 2015 and 2017 assessments, indicating that the stock is subject to overfishing ($F>F_{MSY}$) and overfished, with the biomass for at least the past ten years below the level which would produce MSY ($B<B_{MSY}$). On the weight-of-evidence available in 2018, the stock status of striped marlin is determined to be ***overfished*** and ***subject to overfishing*** (**Table 1**; **Fig. 2**)

Outlook. The decrease in longline catches and fishing effort in the years 2009–11 reduced the pressure on the Indian Ocean stock. However, given the increase in catches reported since 2011 (mostly from coastal fisheries), combined with the results obtained from the last stock assessments conducted in 2012, 2013, 2015, 2017 and 2018, the outlook is pessimistic. As requested by IOTC Resolution 18/05, K2SM probabilities are provided with options to reduce fishing mortality with a view to recover the stocks to the green zone of the Kobe Plot with levels of probability ranging from 60% to 90% by 2026 at latest (Table 2).

Management advice. Current or increasing catches have a very high risk of further decline in the stock status. Current 2017 catches (Fig. 1) are lower than MSY (4,730 t) but the stock has been overfished for more than two decades and is now in a highly depleted state. If the Commission wishes to recover the stock to the green quadrant of the Kobe plot with a probability ranging from 60% to 90% by 2026, it needs to provide mechanisms to ensure the maximum annual catches remain between 1,500 t – 2,200 t (Table 3).

The following key points should also be noted:

- **Maximum Sustainable Yield (MSY)**: estimates for the Indian Ocean stock are highly uncertain and estimates range between 4,270 t – 5,180 t. However, the current biomass is well below the B_{MSY} reference point and fishing mortality is in excess of F_{MSY} at recent catch levels.
- **Provisional reference points**: Although the Commission adopted reference points for swordfish in Resolution 15/10 *on target and limit reference points and a decision framework*, no such interim reference points have been established for striped marlin.
- **Main fishing gear (average catches 2013-17)**: Striped marlin are largely considered to be a non-target species of industrial fisheries. Longlines account for around 66% of total catches in the Indian Ocean (or 56% according to the alternative low-case catch scenario) with remaining catches recorded gillnets, and troll and handlines (Fig. 1).
- **Main fleets (average catches 2013-17):**
  Taiwan,China (drifting longline): 24%; Indonesia (drifting longline and coastal longline): 21%; I.R. Iran (gillnet): 20%; and Pakistan (gillnet): 10%.

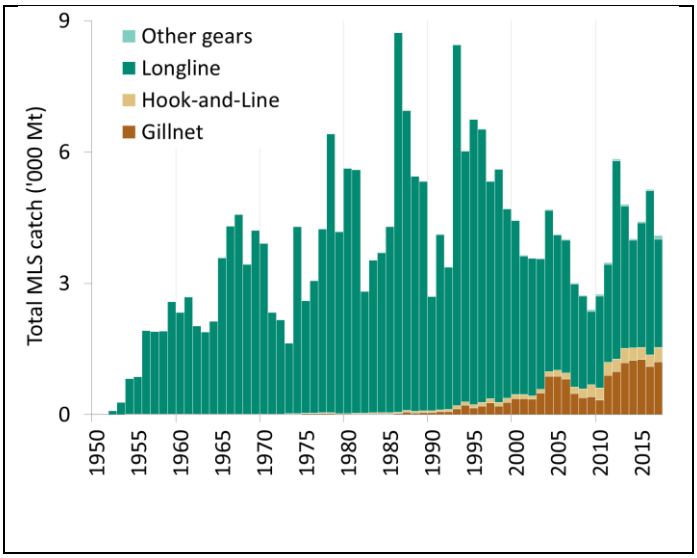


Fig. 1. Striped marlin catches by gear and year recorded in the IOTC database (1950–2017
***Notes**: Other gears (OT) includes: longline-gillnet, handline, gillnet, coastal longline, troll line, sport fishing, and all other gears.*

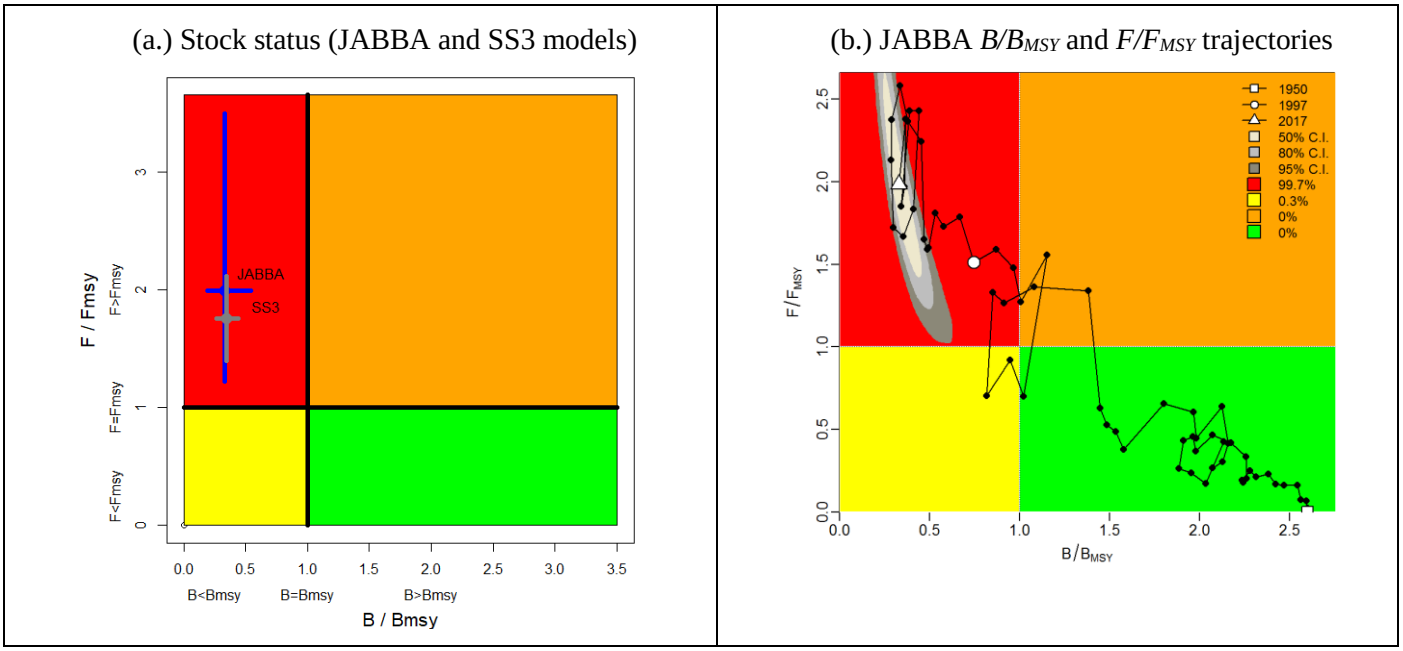


Fig. 2. (a): Striped marlin: Stock status from the Indian Ocean assessment JABBA (Bayesian State Space Surplus Production Model) and SS3 models with the confidence intervals (left); (b): Trajectories (1950-2017) of *B/B$_{MSY}$ and F/F$_{MSY}$* from the JABBA model. NB: SS3 refers to SB/SB$_{MSY}$ while the JABBA model correspond to B/B$_{MSY}$.

TABLE 2. Striped marlin: JABBA Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of violating the MSY-based target reference points for nine constant catch projections relative to the average 2015-2017 catch level (3,512 t)*, ± 10%, ± 20%, ± 30% ± 40%) projected for 3 and 10 years.

Reference point and projection timeframe	**Alternative catch projections (relative to the average catch level from 2015-2017* (3,512 t)) and probability (%) of violating MSY-based target reference points (SBtarg = SBMSY; Ftarg = FMSY)**								
	60% (2,107 t)	**70%** (2,459 t)	**80%** (2,810 t)	**90%** (3,161 t)	**100%** (3,512 t)	**110%** (3,864 t)	**120%** (4,215 t)	**130%** (4,566 t)	**140%** (4,917 t)
$SB_{2020} < SB_{MSY}$	99	100	100	100	100	100	100	100	100
$F_{2020} > F_{MSY}$	48	70	87	95	99	100	100	100	100
$SB_{2027} < SB_{MSY}$	25	43	64	81	92	97	99	100	100
$F_{2027} > F_{MSY}$	9	21	40	63	83	94	99	100	100

** 2015-2017 average catches, based on low catch scenario (IOTC-2018-WPB16-DATA03b).*

TABLE 3. Striped marlin: Probability (percentage) of achieving the KOBE green quadrat from 2018-2027 for a range of constant catch projections (JABBA).

TAC | Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
1500	0	0	2	11	29	51	70	83	90	94
1600	0	0	2	10	25	47	66	79	87	92
1700	0	0	2	8	23	42	61	75	84	90
1800	0	0	1	7	20	38	56	71	81	87
1900	0	0	1	6	17	34	52	66	77	84
2000	0	0	1	5	15	30	48	62	73	80
2100	0	0	1	4	13	26	42	56	68	76
2200	0	0	1	4	11	23	38	52	62	71
2300	0	0	1	3	9	20	33	46	57	66
2400	0	0	1	3	8	17	29	41	52	61
2500	0	0	1	3	7	15	25	36	47	55

APPENDIX 16
EXECUTIVE SUMMARY: INDO-PACIFIC SAILFISH

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

Status of the Indian Ocean Indo-Pacific sailfish (SFA: *Istiophorus platypterus*) resource

TABLE 1. Indo-Pacific sailfish: Status of Indo-Pacific sailfish (*Istiophorus platypterus*) in the Indian Ocean.

Area[1]	**Indicators**		**2018 stock status determination**
Indian Ocean	Catch 2017[2]: Average catch 2013-2017:	33,280[3] t 29,873[3] t	
	MSY (1,000 t) (80% CI): F_{MSY} (80% CI): B_{MSY} (1,000 t) (80% CI): F_{2014}/F_{MSY} (80% CI): B_{2014}/B_{MSY} (80% CI): B_{2014}/B_0 (80% CI):	25.00 (16.18–35.17) 0.26 (0.15–0.39) 87.52 (56.30–121.02) 1.05 (0.63–1.63) 1.13 (0.87–1.37) 0.56 (0.44–0.67)	

[1] Boundaries for the Indian Ocean = IOTC area of competence.
[2] Proportion of catches estimated or partially estimated by IOTC Secretariat in 2018: 52%.
[3] Source: Nominal catches (IOTC-2018-WPB16-DATA03b).

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

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. No new stock assessment was carried out for Indo-Pacific sailfish in 2018, thus, the stock status is determined on the basis of the 2015 assessment and other indicators presented in 2018. In 2015, data poor methods for stock assessment using Stock Reduction Analysis (SRA) techniques indicated that the stock is not yet overfished, but is subject to overfishing (**Table 1**). The stock appears to show a continued increase catches which is a cause of concern (**Fig. 1**), indicating that fishing mortality levels may be becoming too high (**Fig. 2**). Aspects of the biology, productivity and fisheries for this species combined with the data poor status on which to base a more formal assessment are also a cause for concern. On the weight-of-evidence available in 2018, the stock is determined to be still **not overfished** but **subject to overfishing**.

Outlook. The estimated increase in coastal gillnet catch and effort in recent years is a substantial cause for concern for the Indian Ocean stock, however there is not sufficient information to evaluate the effect this will have on the resource. It is also noted that 2017 catches (34,891 t) exceed the catch limit prescribed in Resolution 18/05 (25,000 t).

Management advice. The catch limits as stipulated in Resolution 18/05 have been exceeded. The Commission should provide mechanisms to ensure that catch limits are not exceeded by all concerned fisheries. Research emphasis on further developing possible CPUE indicators from gillnet fisheries, and further exploration of stock assessment approaches for data poor fisheries are warranted. Given the limited data being reported for coastal gillnet fisheries, and the importance of sports fisheries for this species, efforts must be made to rectify these information gaps. The lack of catch records in the Persian Gulf should also be examined to evaluate the degree of localised depletion in Indian Ocean coastal areas.

The following key points should also be noted:

- **Maximum Sustainable Yield (MSY):** estimate for the Indian Ocean stock is 25,000 t.
- **Provisional reference points:** Although the Commission adopted reference points for swordfish in Resolution 15/10 on target and limit reference points and a decision framework, no such interim reference points have been established for I.P. sailfish.
- **Main fishing gear (average catches 2013-17)**: gillnets account for around 70% of total catches in the Indian Ocean, followed by troll and hand lines (21%), with remaining catches recorded under longlines and other gears (Fig. 1).
- **Main fleets (average catches 2013-17):** Three quarters of the total catches of Indo-Pacific sailfish are accounted for by four countries situated in the Arabian Sea: I.R. Iran (gillnets): 31%; India (gillnets and trolling): 19%; Pakistan (gillnets): 16%; and Sri Lanka (gillnets and fresh longline): 9%.

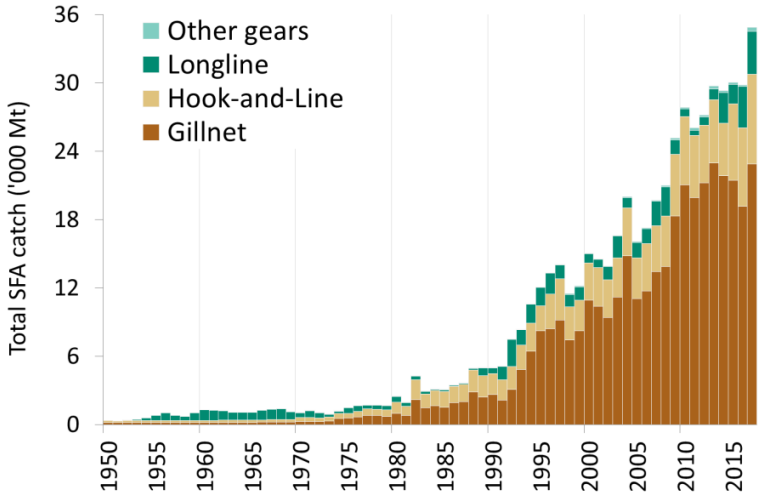


Fig. 1. Indo-Pacific sailfish: catches by gear and year recorded in the IOTC Database (1950–2017).
***Notes**: Other gears (OT) includes: longline-gillnet, handline, gillnet, coastal longline, troll line, sport fishing, and all other gears*

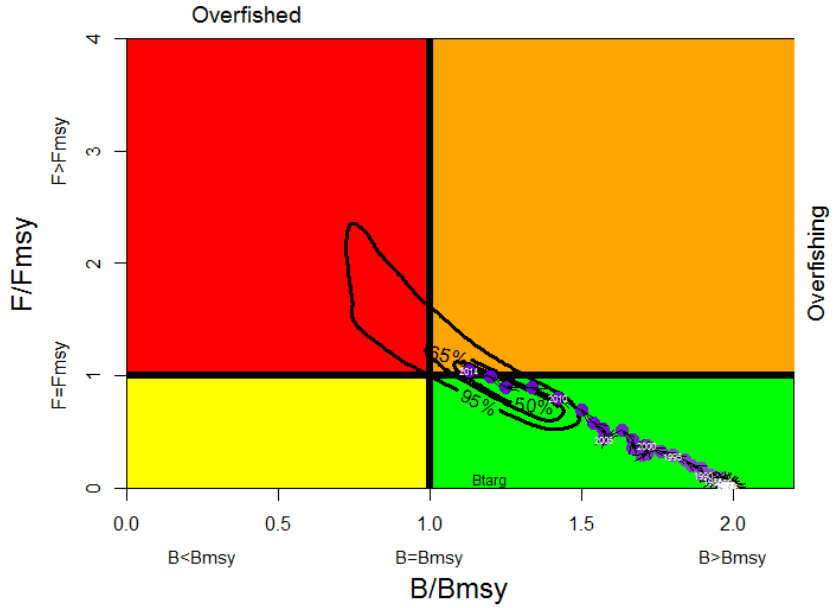


Fig.2. Indo-Pacific sailfish: Stock reduction analysis (Catch MSY Method) of aggregated Indian Ocean assessment Kobe plot (contours are the 50, 65 and 90 percentiles of the 2014 estimate). Black lines indicate the trajectory of the point estimates (blue circles) for the B ratio and F ratio for each year 1950–2014.

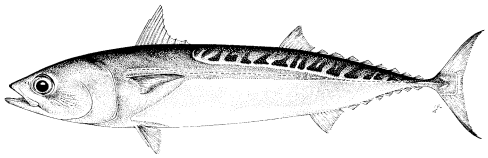
Table 2. Indo-Pacific sailfish: Indian Ocean stock reduction analysis Kobe II Strategy Matrix.Probability (percentage) of violating the MSY-based reference points for nine constant catch projections (relative to the average catch levels from 2012–2014 (29,164 t)*, ± 10%, ± 20%, ± 30% ± 40%) projected for 3 and 10 years.

Reference point and projection timeframe	**Alternative catch projections (relative to the average catch level from 2012–14* (29,164 t) and probability (%) of violating MSY-based reference points**								
	60%	**70%**	**80%**	**90%**	**100%**	**110%**	**120%**	**130%**	**140%**
	17,498 t	20,415 t	23,331 t	26,248 t	29,164 t	32,080 t	34,997 t	37,913 t	40,830 t
$B_{2017}<B_{MSY}$	10	15	20	25	30	35	41	47	53
$F_{2017}> F_{MSY}$	16	27	38	49	61	72	83	94	99
$B_{2024}<B_{MSY}$	6	16	28	41	55	68	81	91	97
$F_{2024}> F_{MSY}$	12	23	36	52	68	84	97	100	100

** Average catches for 2012-2014 at the time of the last I.P. sailfish assessment conducted in 2015.*

APPENDIX 17
EXECUTIVE SUMMARY: BULLET TUNA

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



Status of the Indian Ocean bullet tuna (BLT: *Auxis rochei*) resource

TABLE 1. Bullet tuna: Status of bullet tuna (*Auxis rochei*) in the Indian Ocean.

Area[1]	Indicators		2018 stock status determination
Indian Ocean	Catch 2017[2]: Average catch 2013–2017:	11,094 t 9,959 t	
	MSY (1,000 t) (80% CI): F_{MSY} (80% CI): B_{MSY} (1,000 t) (80% CI): $F_{current}/F_{MSY}$ (80% CI): $B_{current}/B_{MSY}$ (80% CI): $B_{current}/B_0$ (80% CI):	unknown unknown unknown unknown unknown unknown	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2] Proportion of catch estimated or partially estimated by IOTC Secretariat in 2016: 85%
Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.

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		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. No quantitative stock assessment is currently available for bullet tuna in the Indian Ocean, and due to a lack of fishery data for several gears, only preliminary stock status indicators can be used. Aspects of the fisheries for bullet tuna combined with the lack of data on which to base an assessment of the stock are a cause for concern. Stock status in relation to the Commission's B_{MSY} and F_{MSY} reference points remains unknown (Table 1).

Outlook. Total annual catches for bullet tuna over the past six years have fluctuated but remained around 10,000 t (Fig.1). There is insufficient information to evaluate the effect that these levels of catches, or an increase in catches, may have on the resource. Research emphasis on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.) should be considered of high priority for the Commission.

Management advice.

For assessed species of neritic tunas in Indian Ocean (longtail tuna, kawakawa and narrow barred Spanish mackerel), the MSY was estimated to have been reached between 2009 and 2011 and both F_{MSY} and B_{MSY} were breached thereafter. Therefore, in the absence of a stock assessment of bullet tuna a limit to the catches should be considered by the Commission, by ensuring that future catches do not exceed the average catches estimated between 2009 and 2011 (8,870 t). The reference period (2009-2011) was chosen based on the most recent assessments of those neritic species in the Indian Ocean for which an assessment is available under the assumption that also for bullet tuna MSY was reached between 2009 and 2011. This catch advice should be maintained until an assessment of bullet tuna is available. Considering that MSY-based reference points for assessed species can change over time, the stock should be closely monitored. Mechanisms need to be developed by the Commission to improve current statistics by encouraging CPCs to comply with their recording and reporting requirements, so as to better inform scientific advice.

The following should be also noted:

- The Maximum Sustainable Yield estimate for the Indian Ocean stock is unknown.
- Limit reference points: The Commission has not adopted limit reference points for any of the neritic tunas under its mandate.
- Further work is needed to improve the reliability of the catch series. Reported catches should be verified or estimated, based on expert knowledge of the history of the various fisheries or through statistical extrapolation methods.
- Research emphasis on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.) should be considered a high priority for the Commission.
- Species identification, data collection and reporting urgently need to be improved.
- There is limited information submitted by CPCs on total catches, catch and effort and size data for neritic tunas, despite their mandatory reporting status. In the case of 2016 catches, 85% of the total catches were either fully or partially estimated by the IOTC Secretariat, which increases the uncertainty of the stock assessments using these data. Therefore the management advice to the Commission includes the need for CPCs to comply with IOTC data requirements per Resolution 15/01 and 15/02.
- **Main fishing gear (average catches 2013-17)**: bullet tuna is mainly caught using gillnets (≈28%), handlines and trolling (≈30%). This species is also an important catch for coastal purse seiners (Fig. 1).
- **Main fleets (average catches 2013-17)**: Catches are highly concentrated: in recent years over 90% of catches in the Indian Ocean have been accounted for by fisheries in Sri Lanka, Indonesia and India.

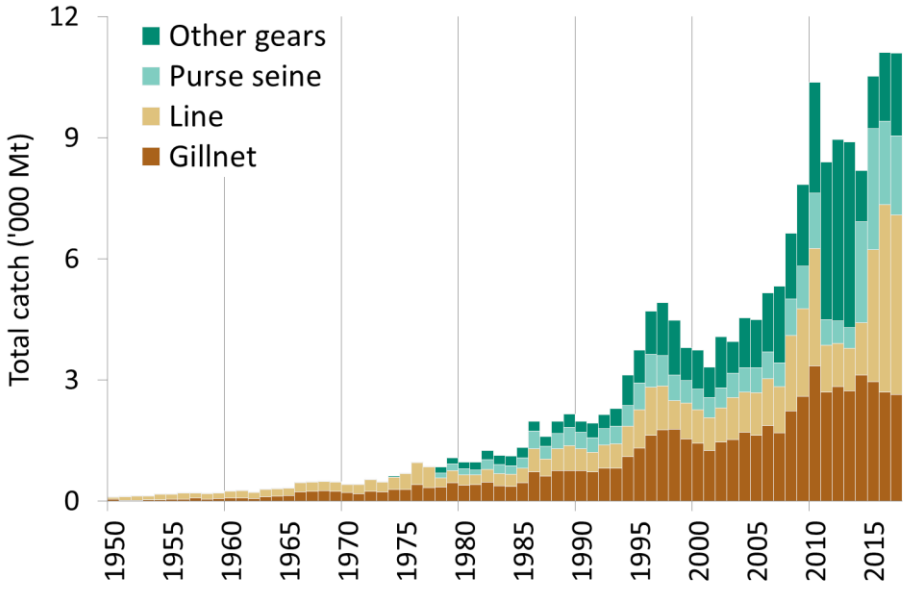
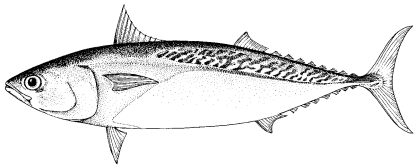


Fig. 1. Bullet tuna: Annual catches of bullet tuna by gear recorded in the IOTC Database (1950–2017)[26].

[26] **Definition of fisheries:** Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, Danish seine, liftnet, longline, longline fresh, trawling.

APPENDIX 18
EXECUTIVE SUMMARY: FRIGATE TUNA

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



Status of the Indian Ocean frigate tuna (FRI: *Auxis thazard*) resource

TABLE 1. Frigate tuna: Status of frigate tuna (*Auxis thazard*) in the Indian Ocean.

Area[1]	Indicators		2018 stock status determination
Indian Ocean	Catch 2017[2]: Average catch 2013–2017:	74,886 t 86,157 t	
	MSY (1,000 t) (80% CI): F_{MSY} (80% CI): B_{MSY} (1,000 t) (80% CI): $F_{current}/F_{MSY}$ (80% CI): $B_{current}/B_{MSY}$ (80% CI): $B_{current}/B_0$ (80% CI):	unknown unknown unknown unknown unknown unknown	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2] Proportion of catch estimated or partially estimated by IOTC Secretariat in 2018: 80%
Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.

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		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. No quantitative stock assessment is currently available for frigate tuna in the Indian Ocean, and due to a lack of fishery data for several gears, only preliminary stock status indicators can be used. Aspects of the fisheries for frigate tuna combined with the lack of data on which to base an assessment of the stock are a cause for considerable concern. Stock status in relation to the Commission's B_{MSY} and F_{MSY} reference points remains **unknown** (Table 1).

Outlook. Total annual catches for frigate tuna have increased substantially in recent years with peak catches taken in 2010 (~100,000 t) which have been maintained at that level until 2014 after which they declined to <80,000 t (Fig.1). There is insufficient information to evaluate the effect that this level of catch or a further increase in catches may have on the resource. Research emphasis on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.) should be considered of high priority for the Commission.

Management advice. For assessed species of neritic tunas in Indian Ocean (longtail tuna, kawakawa and narrow barred Spanish mackerel), the MSY was estimated to have been reached between 2009 and 2011 and both F_{MSY} and B_{MSY} were breached thereafter. Therefore, in the absence of a stock assessment of frigate tuna a limit to the catches should be considered by the Commission, by ensuring that future catches do not exceed the average catches estimated between 2009 and 2011 (94,921 t). The reference period (2009-2011) was chosen based on the most recent assessments of those neritic species in the Indian Ocean for which an assessment is available under the assumption that also for bullet tuna MSY was reached between 2009 and 2011. This catch advice should be maintained until an assessment of frigate tuna is available. Considering that MSY-based reference points for assessed species can change over time, the stock should be closely monitored. Mechanisms need to be developed by the Commission to improve current statistics by encouraging CPCs to comply with their recording and reporting requirements, so as to better inform scientific advice.

The following should be also noted:

- The Maximum Sustainable Yield estimate for the Indian Ocean stock is unknown.
- Limit reference points: The Commission has not adopted limit reference points for any of the neritic tunas under its mandate.
- Further work is needed to improve the reliability of the catch series, such as verification or estimation based on expert knowledge of the history of the various fisheries or through statistical extrapolation methods.
- Research emphasis on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.) should be considered of high priority for the Commission.
- Species identification, data collection and reporting urgently need to be improved.
- There is limited information submitted by CPCs on total catches, catch and effort and size data for neritic tunas, despite their mandatory reporting status. In the case of 2017 catches, 80% of the total catches were either fully or partially estimated by the IOTC Secretariat, which increases the uncertainty of the stock assessments using these data. Therefore the management advice to the Commission includes the need for CPCs to comply with IOTC data requirements per Resolution 15/01 and 15/02.
- **Main fishing gear (average catches 2013-17)**: frigate tuna is mainly caught using gillnets (≈35%), coastal longline and trolling, handlines and trolling (≈37%), and to a lesser extent coastal purse seine nets (Table 3; Fig.12). The species is also a bycatch for industrial purse seine vessels and is the target of some ring net fisheries.
- **Main fleets (average catches 2013–17)**: Catches of frigate tuna are highly concentrated: Indonesia accounts for around two-thirds of catches, while over 90% of catches are accounted for by four countries (Indonesia, India, Sri Lanka and I.R. Iran).

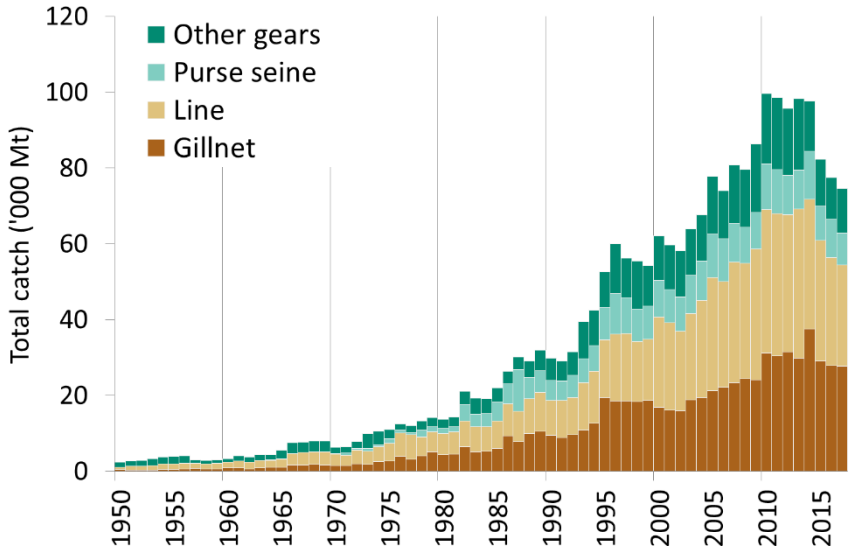
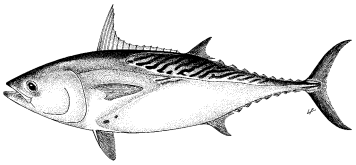


Fig. 1. Frigate tuna: Annual catches of frigate tuna by gear recorded in the IOTC Database (1950–2017)[27].

[27] **Definition of fishery:** Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, Danish seine, liftnet, longline, longline fresh, trawling.

APPENDIX 19
EXECUTIVE SUMMARY: KAWAKAWA

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



Status of the Indian Ocean kawakawa (KAW: *Euthynnus affinis*) resource

TABLE 1. Kawakawa: Status of kawakawa (*Euthynnus affinis*) in the Indian Ocean.

Area[1]	Indicators		2018 stock status determination
Indian Ocean	Catch 2017[2]: Average catch 2013-2017:	159,881 t 157,326 t	
	MSY (1,000 t) [*] F_{MSY} [*] B_{MSY} (1,000 t) [*] F_{2013}/F_{MSY} [*] B_{2013}/B_{MSY} [*] B_{2013}/B_0 [*]	152 [125 –188] 0.56 [0.42–0.69] 202 [151–315] 0.98 [0.85–1.11] 1.15 [0.97–1.38] 0.58 [0.33–0.86]	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2] Proportion of catch estimated or partially estimated by IOTC Secretariat in 2017: 58%
Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.
*Range of plausible values of biologically realistic OCOM (Optimized Catch-Only Method) model realizations (see IOTC-2015-WPNT05-R)

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		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. A stock assessment was not undertaken for kawakawa in 2017 and the status is determined on the basis of the 2015 assessment, which used catch data from 1950 to 2013. Analysis using an Optimised Catch Only Method (OCOM) approach in 2015 indicates that the stock is near optimal levels of F_{MSY}, and stock biomass is near the level that would produce MSY (B_{MSY}). Due to the quality of the data being used, the simple modelling approach employed in 2015, and the large increase in kawakawa catches over the last decade (Fig. 1), measures need to be taken in order to decrease the level of catches which surpassed the estimated MSY levels since 2011. Catches between 2014 and 2017 are lower than those estimated in 2013. Based on the weight-of-evidence available, the kawakawa stock for the Indian Ocean is classified as **not overfished** and **not subject to overfishing** (Table 1, Fig. 2).

Outlook. There is considerable uncertainty about stock structure and the estimate of total catches. Due to the uncertainty associated with catch data (e.g. 58% of catches partially or fully estimated by the IOTC Secretariat in 2017) and the limited number of CPUE series available for fleets representing a small proportion of total catches, only data poor assessment approaches can currently be used. Aspects of the fisheries for this species, combined with the lack of data on which to base a more complex assessment (e.g. integrated models) are a cause for considerable concern. In the interim, until more traditional approaches are developed, data-poor approaches will be used to assess stock status. The continued increase in annual catches for kawakawa is likely to have further increased the pressure on the Indian Ocean stock. Research emphasis on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.) should be considered a high priority for the Commission. The assessment projections conducted in 2015 concluded that there would be a high risk of exceeding MSY-based reference points if catches were maintained at 2013 levels (96% risk that $B_{2016}<B_{MSY}$, and 100% risk that $F_{2016}>F_{MSY}$) (Table 2). However, catches have since declined from 167,348 t (2013) to 159,881 t (2017).

Management Advice. Although the stock status is classified as not overfished and not subject to overfishing, the Kobe strategy II matrix developed in 2015 showed that there is a 96% probability that biomass is below MSY levels and 100% probability that $F>F_{MSY}$ by 2016 and 2023 if catches are maintained at the 2013 levels. There is a 55% probability that biomass is below MSY levels and 91% probability that $F>F_{MSY}$ by 2023 if catches are maintained at around 2016 levels. The modelled probabilities of the stock achieving levels consistent with the MSY reference points (e.g. $SB > SB_{MSY}$ and $F<F_{MSY}$) in 2023 are 100% for a future constant catch at 80% of 2013 catch levels. If catches are reduced by 20% based on 2013 levels at the time of the assessment (170,181 t)[28], the stock is expected to recover to levels above MSY reference points with a 50% probability by 2023.

The following should be also noted:

- The Maximum Sustainable Yield estimate for the Indian Ocean is estimated to be 152,000 with a range between 125,000 and 188,000 t and so catch levels should be reduced in future to prevent the stock becoming overfished.
- Further work is needed to improve the reliability of the catch series. Reported catches should be verified or estimated, based on expert knowledge of the history of the various fisheries or through statistical extrapolation methods.
- Improvement in data collection and reporting is required if the stock is to be assessed using integrated stock assessment models.
- Limit reference points: The Commission has not adopted limit reference points for any of the neritic tunas under its mandate.
- Research emphasis on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.) should be considered of high priority for the Commission.
- Given the limited information submitted by CPCs on total catches, catch and effort and size data for neritic tunas, despite their mandatory reporting status, the IOTC Secretariat was required to estimate 63% of the catches (in 2016), which increases the uncertainty of the stock assessments using these data. Therefore the management advice to the Commission includes the need for CPCs to comply with IOTC data requirements per Resolution 15/01 and 15/02.
- **Main fishing gear (average catches 2013–17)**: Kawakawa are caught mainly by gillnets (≈52%), handlines and trolling (≈17%), and coastal purse seiners, and may also be an important bycatch of the industrial purse seiners (Fig. 1).
- **Main fleets (average catches 2013–17)**: Catches are highly concentrated: Indonesia, India, and I.R. Iran account for over two thirds of catches in recent years.

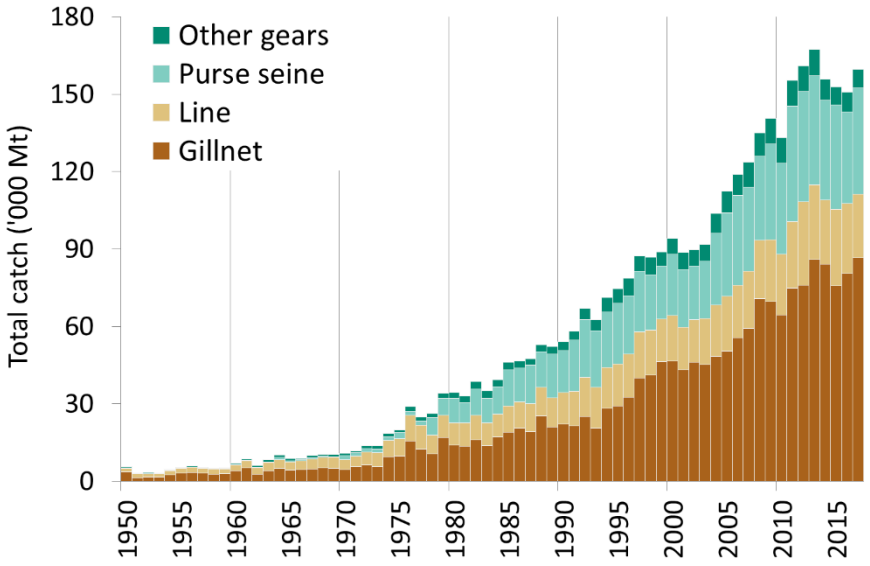


Fig.1. Kawakawa: Annual catches of kawakawa by gear recorded in the IOTC database (1950–2017)[29].

[28] as estimated in 2015

[29] **Definition of fishery:** Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, Danish seine, liftnet, longline, longline fresh, trawling.

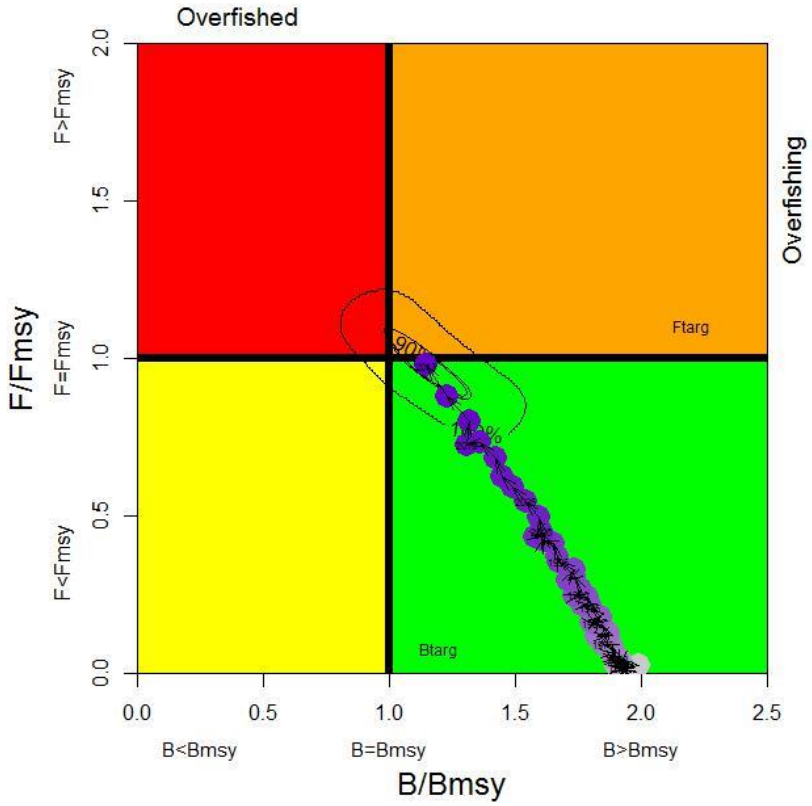


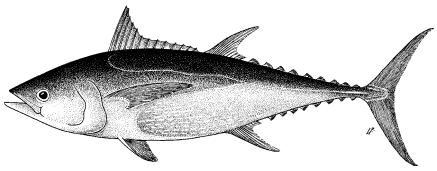
Fig.2. Kawakawa. OCOM aggregated Indian Ocean assessment. Blue circles indicate the trajectory of the point estimates for the B ratio and F ratio for each year between 1950 and 2013 (the black lines represent all plausible model runs shown around 2015 estimate).

Table 2. Kawakawa: OCOM Aggregated Indian Ocean assessment Kobe II Management Strategy Matrix. Probability (percentage) of plausible models violating the MSY-based reference points for five constant catch projections (2013 catch level, -10%, -20%, -30%, +10% and +20%) projected for 3 and 10 years. Note: from the 2015 stock assessment using catch estimates (i.e. 1950-2013) at that time.

Reference point and projection timeframe	**Alternative catch projections (relative to 2013) and weighted probability (%) scenarios that violate MSY-based reference points**					
	70% (119,126 t)	**80%** (136,144 t)	**90%** (153,162 t)	**100%** (170,181 t)	**110%** (187,199 t)	**120%** (204,216 t)
$B_{2016} < B_{MSY}$	0	1	37	96	n.a.	100
$F_{2016} > F_{MSY}$	0	18	87	100	100	100
$B_{2023} < B_{MSY}$	0	0	55	100	100	100
$F_{2023} > F_{MSY}$	0	0	91	100	100	100

APPENDIX 20
EXECUTIVE SUMMARY: LONGTAIL TUNA

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



Status of the Indian Ocean longtail tuna (LOT: *Thunnus tonggol*) resource

TABLE 1. Longtail tuna: Status of longtail tuna (*Thunnus tonggol*) in the Indian Ocean.

Area[1]	Indicators		2018 stock status determination
Indian Ocean	Catch 2017[2]: Average catch 2013–2017:	135,006 t 139,856 t	**67%**
	MSY (1,000 t) (*): F_{MSY} (*): B_{MSY} (1,000 t) (*): F_{2015}/F_{MSY} (*): B_{2015}/B_{MSY} (*): B_{2015}/B_0 (*):	140 (103–184) 0.43 (0.28–0.69) 319 (200–623) 1.04 (0.84–1.46) 0.94 (0.68–1.16) 0.48 (0.34–0.59)	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2] Proportion of catches estimated or partially estimated by IOTC Secretariat in 2017: 36%
Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.
*Range of plausible values of biologically realistic OCOM (Optimized Catch-Only Method) model realizations (IOTC-2017-WPNT07-R)

Colour key	Stock overfished($SB_{year}/SB_{MSY}< 1$)	Stock not overfished ($SB_{year}/SB_{MSY}\geq 1$)
Stock subject to overfishing($F_{year}/F_{MSY}> 1$)	67%	0%
Stock not subject to overfishing ($F_{year}/F_{MSY}\leq 1$)	6%	27%
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. Analysis using the Optimised Catch-Only Method (OCOM) indicates that the stock is being exploited at a rate that exceeded F_{MSY} in recent years and the stock appears to be below B_{MSY} and above F_{MSY} (67% of plausible models runs) (Fig. 2). Catches were above MSY between 2010 and 2014, however catches have decreased between 2012 and 2016 from ~175,000 to ~128,000 t (Fig. 1) and were below estimated MSY in 2017. The F_{2015}/F_{MSY} ratio is slightly lower than previous estimates, reflecting the decrease in catches reported in the last few years. Nevertheless, the estimate of the B_{2015}/B_{MSY} ratio (0.94) was also slightly lower than in previous years. An assessment using the revised Catch-MSY method was also undertaken in 2017 and results were consistent with OCOM in terms of status. Therefore, based on the weight-of-evidence currently available, the stock is considered to be both **overfished** and **subject to overfishing** (Table 1; Fig. 2).

Outlook. There remains considerable uncertainty about stock structure and the total catches in the Indian Ocean. The increase in annual catches to a peak in 2012 increased the pressure on the longtail tuna Indian Ocean stock, although the catch trend has reversed since then. As noted in 2015, the apparent fidelity of longtail tuna to particular areas/regions is a matter for concern as overfishing in these areas can lead to localised depletion. Research emphasis on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.) should be considered a high priority for the Commission.

Management advice. There is a substantial risk of exceeding MSY-based reference points by 2018 if catches are maintained at current (2015) levels (63% risk that $B_{2018}<B_{MSY}$, and 55% risk that $F_{2018}>F_{MSY}$) (Table 2). If catches are reduced by 10% this risk is lowered to 33% probability $B_{2018}<B_{MSY}$ and 28% probability $F_{2018}>F_{MSY}$). If catches are

capped at current (2015) levels at the time of the assessment (i.e. 136,849 t), the stock is expected to recover to levels above MSY reference points with at least a 50% probability by 2025. Catches have remained below estimated MSY since 2015.

The following should be also noted:

- The Maximum Sustainable Yield estimate of around 140,000 t was exceeded between 2010 and 2014. Limits to catches are warranted to recover the stock to the B_{MSY} level.
- Limit reference points: The Commission has not adopted limit reference points for any of the neritic tunas under its mandate.
- Further work is needed to improve the reliability of the catch series. Reported catches should be verified or estimated, based on expert knowledge of the history of the various fisheries or through statistical extrapolation methods.
- Improvements in data collection and reporting are required if the stock is to be assessed using integrated stock assessment models.
- Research emphasis on collating catch per unit effort (CPUE) time series for the main fleets (I.R.Iran, Indonesia, Pakistan, India and Oman), size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.) should be considered a high priority for the Commission.
- There is limited information submitted by CPCs on total catches, catch and effort and size data for neritic tunas, despite their mandatory reporting status. In the case of 2017 catches, 36% of the total catches were either fully or partially estimated by the IOTC Secretariat, which increases the uncertainty of the stock assessments using these data. Therefore the management advice to the Commission includes the need for CPCs to comply with IOTC data requirements per Resolution 15/01 and 15/02.
- **Main fishing gear (average catches 2013–17)**: Longtail tuna are caught mainly using gillnets and, to a lesser extent, coastal purse seine nets and trolling (Fig. 1).
- **Main fleets (average catches 2013–17)**: Over 44% of the catches of longtail in the Indian Ocean are accounted for by I.R. Iran, followed by Indonesia (≈16%), and Oman (≈11%).

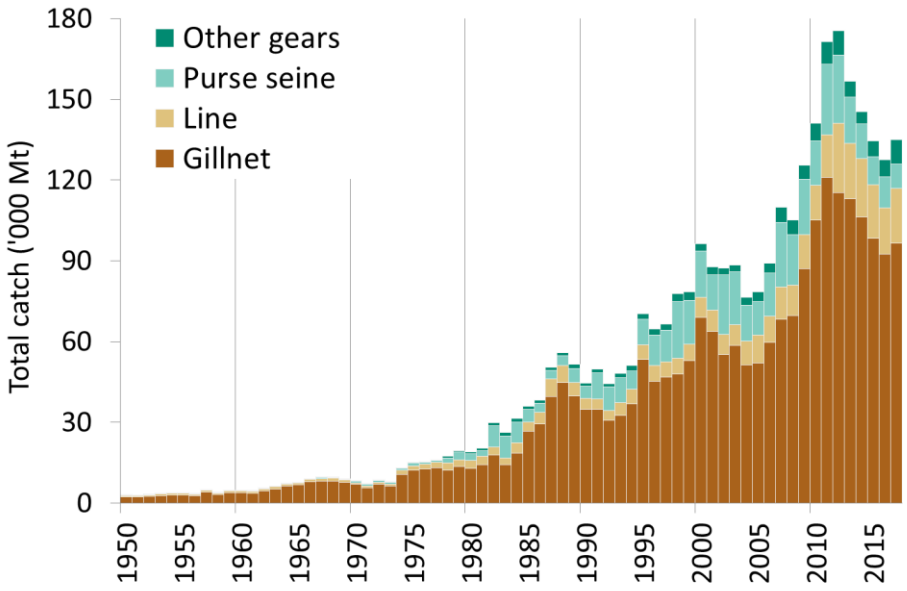


Fig. 1. Longtail tuna: Annual catches by gear recorded in the IOTC Database (1950–2017)[30].

[30] **Definition of fishery:** Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, danish seine, liftnet, longline, longline fresh, trawling.

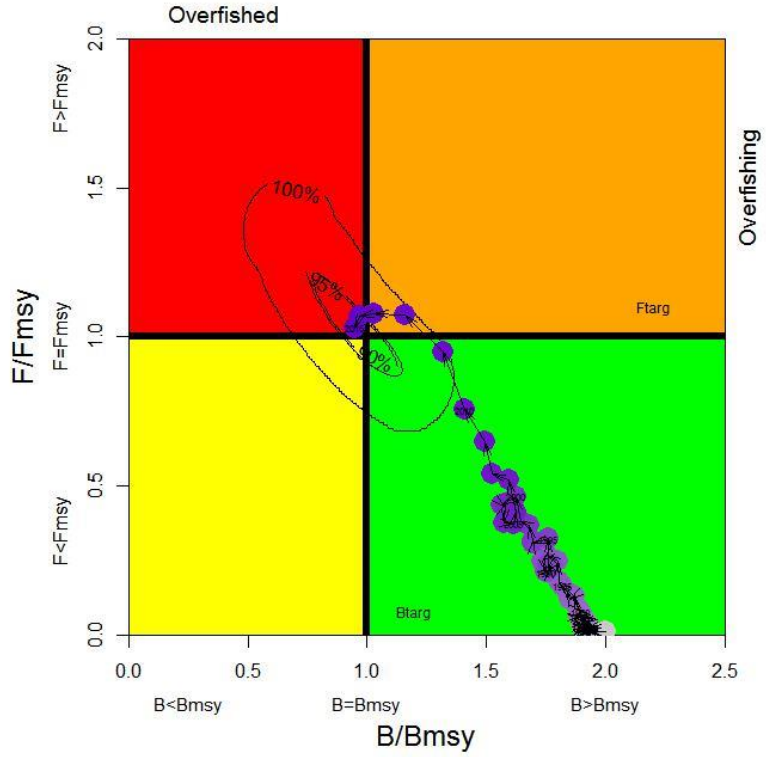


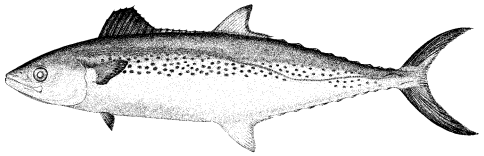
Fig. 2. Longtail tuna. OCOM Indian Ocean assessment Kobe plot. Blue circles indicate the trajectory of the point estimates for the B ratio and F ratio for each year between 1950 and 2015 (the black lines represent all plausible model runs shown around 2015 estimate).

Table 2. Longtail tuna: OCOM aggregated Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of violating the MSY-based reference points for constant catch projections (2015 +20%,+10%, -10%, -20%, -30% projected for 3 and 10 years). Note: from the 2017 stock assessment using catch estimates (i.e. 1950-2015) at that time.

Reference point and projection timeframe	**Alternative catch projections (relative to 2015) and weighted probability (%) scenarios that violate MSY-based reference points**					
	70 % (95,794 t)	80% (109,479 t)	90% (123,164 t)	100% (136,849 t)	110% (150,534 t)	120% (164,219 t)
$B_{2018} < B_{MSY}$	4	9	33	63	92	99
$F_{2018} > F_{MSY}$	2	7	28	55	86	98
$B_{2025} < B_{MSY}$	0	0	1	48	100	100
$F_{2025} > F_{MSY}$	0	0	1	41	100	100

APPENDIX 21
EXECUTIVE SUMMARY: INDO-PACIFIC KING MACKEREL

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



Status of the Indian Ocean Indo-Pacific king mackerel (GUT: *Scomberomorus guttatus*) resource

TABLE 1. Indo-Pacific king mackerel: Status of Indo-Pacific king mackerel (*Scomberomorus guttatus*) in the Indian Ocean.

Area[1]	**Indicators**		**2018 stock status determination**
Indian Ocean	Catch 2017[2]: Average catch 2013-2017:	49,905 t 46,814 t	
	MSY (1,000 t): F_{MSY}: B_{MSY} (1,000 t) : $F_{current}/F_{MSY}$: $B_{current}/B_{MSY}$: $B_{current}/B_0$:	Unknown Unknown Unknown Unknown Unknown Unknown	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2] Proportion of catch estimated or partially estimated by IOTC Secretariat in 2017: 68%
Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.

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		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. A preliminary assessment was undertaken for Indo-Pacific king mackerel using catch-only methods techniques (Catch-MSY and OCOM) in 2016. The OCOM model, which was considered the more robust of the two catch-only models in terms of assumptions and treatment of priors, indicated that overfishing was not occurring and the stock was not overfished. The continuing uncertainty in catches (68% estimated) for this species, coupled with the highly variable and uncertain estimates of growth parameters used to estimate model priors, warrant caution in interpreting model results for Indo-Pacific king mackerel. Given that no new assessment was undertaken in 2017, the WPNT considered that stock status in relation to the Commission's B_{MSY} and F_{MSY} target reference points remains **unknown** (Table1).

Outlook. Total annual catches for Indo-Pacific king mackerel have increased over time, reaching a peak of 53,000 t in 2009 and have since fluctuated between 42,000 and 52000 t. There is considerable uncertainty about stock structure and total catches. The lack of fisheries data for this species to apply more complex stock assessment models are a cause for concern. Although data-poor methods are yet to be used to provide stock status advice, further refinements to the catch-only methods and application of additional data-poor approaches may improve confidence in the results. Research emphasis on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.) should be considered a high priority for the Commission.

Management advice. For assessed species of neritic tunas in Indian Ocean (longtail tuna, kawakawa and narrow barred Spanish mackerel), the MSY was estimated to have been reached between 2009 and 2011 and both F_{MSY} and B_{MSY} were breached thereafter. Therefore, in the absence of a stock assessment of Indo-Pacific king mackerel a limit

to the catches should be considered by the Commission, by ensuring that future catches do not exceed the average catches estimated between 2009 and 2011 (46,787 t). The reference period (2009-2011) was chosen based on the most recent assessments of those neritic species in the Indian Ocean for which an assessment is available under the assumption that also for Indo-Pacific king mackerel MSY was reached between 2009 and 2011. This catch advice should be maintained until an assessment of Indo-Pacific king mackerel is available. Considering that MSY-based reference points for assessed species can change over time, the stock should be closely monitored. Mechanisms need to be developed by the Commission to improve current statistics by encouraging CPCs to comply with their recording and reporting requirements, so as to better inform scientific advice.

The following should be also noted:

- Limit reference points: The Commission has not adopted limit reference points for any of the neritic tunas under its mandate.
- Research emphasis on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.) should be considered of high priority for the Commission.
- Further work is needed to improve the reliability of the catch series. Reported catches should be verified or estimated, based on expert knowledge of the history of the various fisheries or through statistical extrapolation methods.
- Data collection and reporting urgently need to be improved.
- There is limited information submitted by CPCs on total catches, catch and effort and size data for neritic tunas, despite their mandatory reporting status. In the case of 2017 catches 68% of the total catches were either fully or partially estimated by the IOTC Secretariat, which increases the uncertainty of the stock assessments using these data. Therefore the management advice to the Commission includes the need for CPCs to comply with IOTC data requirements per Resolution 15/01 and 15/02.
- **Main fishing gear (average catches 2013-17)**: Indo-Pacific King mackerel are caught mainly by gillnets (≈66%), however significant numbers are also caught trolling (Fig. 1).
- **Main fleets (average catches 2013–17)**: Almost two-thirds of catches are accounted for by fisheries in India and Indonesia; with important catches also reported by I.R. Iran.

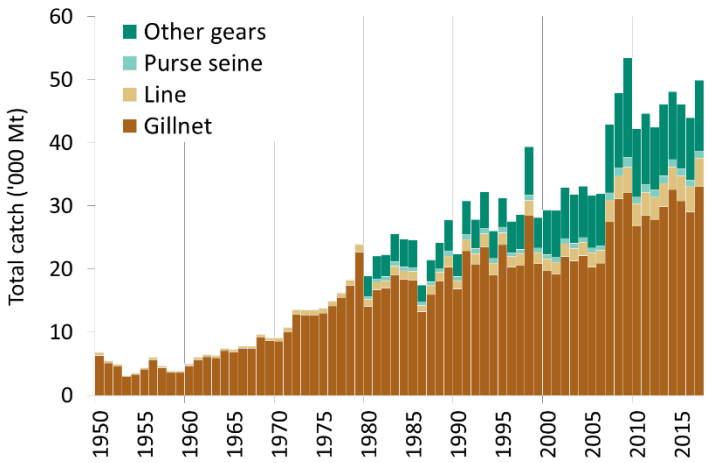
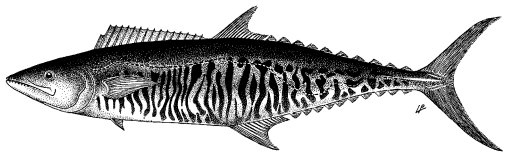


Fig. 1. Indo-Pacific king mackerel: Annual catches of Indo-Pacific king mackerel by gear recorded in the IOTC database (1950–2017)[31]

[31] **Definition of fishery:** Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, Danish seine, liftnet, longline, longline fresh, trawling.

APPENDIX 22
EXECUTIVE SUMMARY: NARROW-BARRED SPANISH MACKEREL

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



Status of the Indian Ocean narrow-barred Spanish mackerel (COM: *Scomberomorus commerson*) resource

TABLE 1. Narrow-barred Spanish mackerel: Status of narrow-barred Spanish mackerel (*Scomberomorus commerson*) in the Indian Ocean.

Area[1]	**Indicators**		**2018 stock status determination**
Indian Ocean	Catch 2017[2]: Average catch 2013-2017:	159,370 t 160,812 t	**89%**
	MSY (1,000 t) [*]: F_{MSY} [*]: B_{MSY} (1,000 t) [*]: F_{2015}/F_{MSY} [*]: B_{2015}/B_{MSY} [*]: B_{2015}/B_0 [*]:	131 [96–180] 0.35 [0.18–0.7] 371 [187–882] 1.28 [1.03–1.69] 0.89 [0.63–1.15] 0.44 [0.31–0.57]	

[1]Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2] Proportion of catch estimated or partially estimated by IOTC Secretariat in 2017: 76%
Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.
*Range of plausible values of biologically realistic OCOM (Optimized Catch-Only Method) model realizations (IOTC-2017-WPNT07-R)

Colour key	Stock overfished($SB_{year}/SB_{MSY}< 1$)	Stock not overfished ($SB_{year}/SB_{MSY}\geq 1$)
Stock subject to overfishing($F_{year}/F_{MSY}> 1$)	89%	11%
Stock not subject to overfishing ($F_{year}/F_{MSY}\leq 1$)	0%	0%
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. Analysis using the Optimised Catch-Only Method (OCOM) indicates that the stock is being exploited at a rate exceeding F_{MSY} in recent years, and the stock appears to be below B_{MSY}. An analysis undertaken in 2013 in the Northwest Indian Ocean (Gulf of Oman) indicated that overfishing is occurring in this area and that localised depletion may also be occurring[32], though the degree of connectivity of the stock remains unknown. Stock structure remains to be clarified for this stock. Based on the weight-of-evidence available, the stock appears to be **overfished** and **subject to overfishing** (Table 1, Fig. 2). Catches since 2009 and also recent average catches (2013-2017) are well above the current MSY estimate (131,000 t) (Fig. 1).

Outlook. There is considerable uncertainty about stock structure and the estimate of total catches. The continued increase in annual catches in recent years has further increased the pressure on the Indian Ocean narrow-barred Spanish mackerel stock. The apparent fidelity of narrow-barred Spanish mackerel to particular areas/regions is a matter for concern as overfishing in these areas can lead to localised depletion. Research emphasis on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.) should be considered of high priority for the Commission. There is a very high risk of exceeding MSY-based reference points by 2018 and 2025 if catches are maintained at or even reduced by 10 % from current (2015) levels at the time of the assessment (100% risk that $B_{2018}<B_{MSY}$, and 100% risk that $F_{2018}>F_{MSY}$) (Table 2).

[32] IOTC-2013-WPNT03-27

Management advice. There is a continued high risk of exceeding MSY-based reference points by 2025, even if catches are reduced to 80% of the 2015 levels (73% risk that $B_{2025}<B_{MSY}$, and 99% risk that $F_{2025}>F_{MSY}$). The modelled probabilities of the stock achieving levels consistent with the MSY reference levels (e.g. $B > B_{MSY}$ and $F<F_{MSY}$) in 2025 are 93% and 70%, respectively, for a future constant catch at 70% of current catch level. If catches are reduced by 30% of the 2015 levels at the time of the assessment, which corresponds to catches below MSY, the stock is expected to recover to levels above the MSY reference points with at least a 50% probability by 2025 (Table 2).

The following should also be noted:

- Maximum Sustainable Yield estimate for the Indian Ocean stock was estimated at 131,000 t, while 2017 catches (159,370 t) are exceeding this level.
- Limit reference points: The Commission has not adopted limit reference points for any of the neritic tunas under its mandate.
- Further work is needed to improve the reliability of the catch series. Reported catches should be verified or estimated, based on expert knowledge of the history of the various fisheries or through statistical extrapolation methods.
- Improvement in data collection and reporting is required if the stock is to be assessed using integrated stock assessment models.
- Given the increase in narrow-barred Spanish mackerel catch in the last decade, measures need to be taken to reduce catches in the Indian Ocean (Table 2).
- Research emphasis on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.) should be considered of high priority for the Commission.
- There is a lack of information submitted by CPCs on total catches, catch and effort and size data for neritic tunas, despite their mandatory reporting status. In the case of 2017 catches 76% of the total catches were either fully or partially estimated by the IOTC Secretariat, which increases the uncertainty of the stock assessments using these data. Therefore the management advice to the Commission includes the need for CPCs to comply with IOTC data requirements per Resolution 15/01 and 15/02.
- **Main fishing gear (average catches 2013-17)**: Narrow-barred Spanish mackerel are caught mainly using gillnet, however significant numbers are also caught using troll lines (Fig. 1).
- **Main fleets (average catches 2013-17)**: Fisheries in Indonesia, India, and I.R. Iran account for around two-thirds of catches. Spanish mackerel is also targeted throughout the Indian Ocean by artisanal and sports/recreational fisheries.

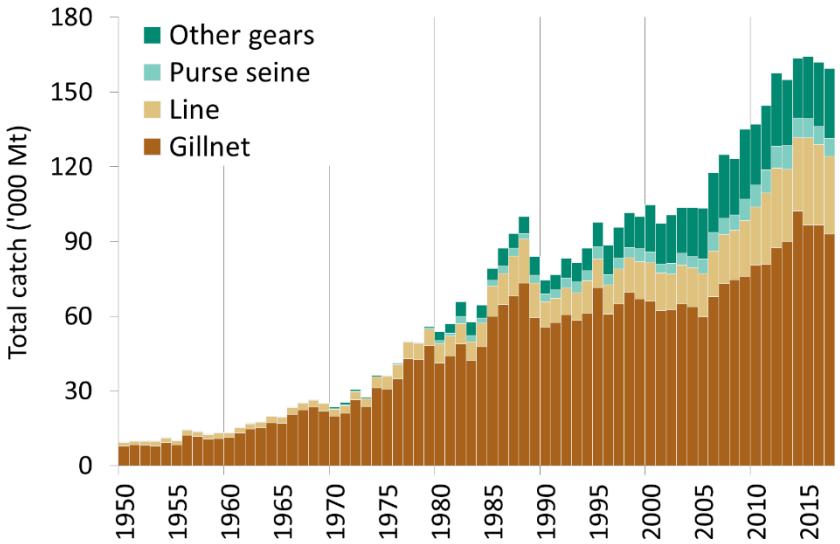


Fig. 1. Narrow-barred Spanish mackerel: Annual catches of narrow-barred Spanish mackerel by gear recorded in the IOTC database (1950–2017)[33].

[33] **Definition of fishery:** Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, Danish seine, liftnet, longline, longline fresh, trawling.

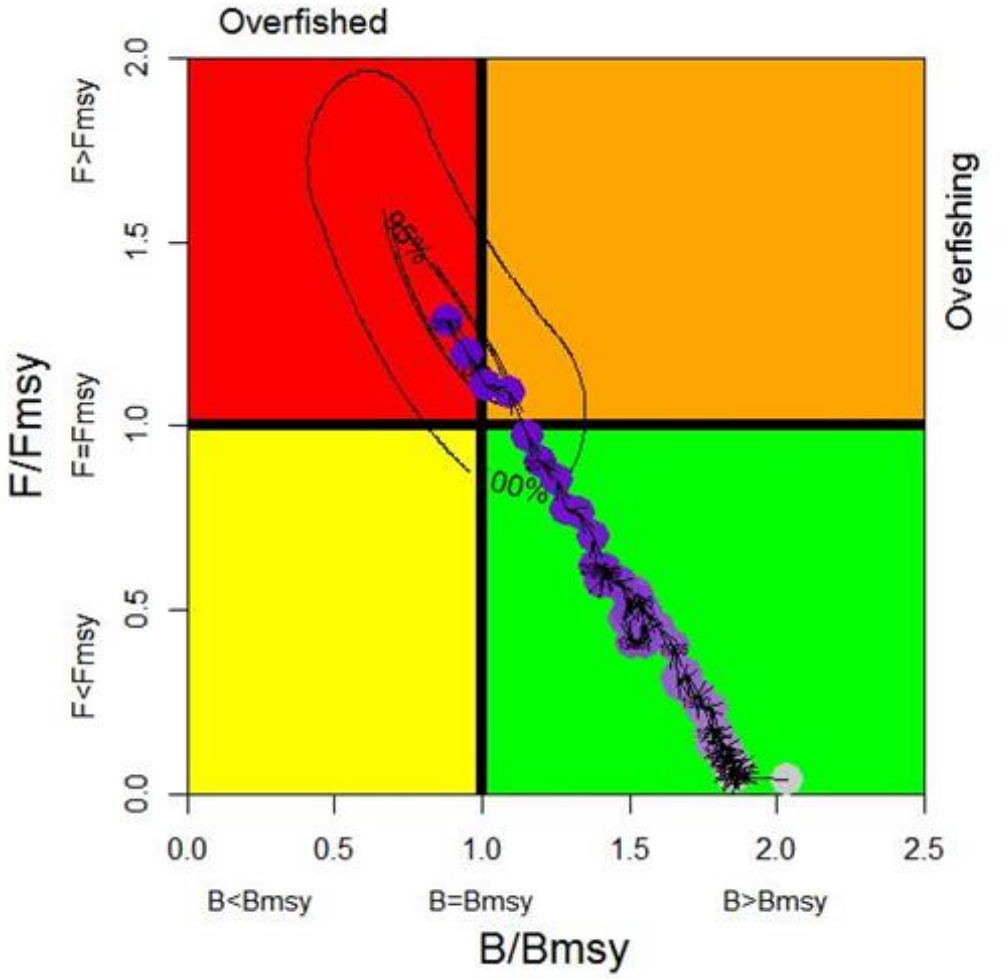


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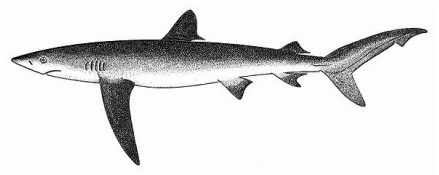
Fig. 2. Narrow-barred Spanish mackerel. OCOM Indian Ocean assessment Kobe plot. Blue circles indicate the trajectory of the point estimates for the B ratio and F ratio for each year between 1950 and 2015 (the black lines represent all plausible model runs shown around 2015 estimate).

Table 2. Narrow-barred Spanish mackerel: OCOM Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of violating the MSY-based reference points for five constant catch projections (2015 catch level, -10%, -20%, -30%, +10% and + 20%) projected for 3 and 10 years. Note: Results are from the 2017 assessment using data up to 2015, available at that time.

Reference point and projection timeframe	**Alternative catch projections (relative to 2015) and weighted probability (%) scenarios that violate MSY-based reference points**					
	70%	**80%**	**90%**	**100%**	**110%**	**120%**
	(107,924 t)	(123,342 t)	(138,759 t)	(154,177 t)	(169,595 t)	(185,012 t)
$B_{2018} < B_{MSY}$	71	90	99	100	100	100
$F_{2018} > F_{MSY}$	100	100	100	100	100	100
$B_{2025} < B_{MSY}$	7	73	100	100	100	100
$F_{2025} > F_{MSY}$	30	99	100	100	100	100

APPENDIX 23
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[34]	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[35] 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]:	33.1 (29.5 - 36.6)	
	F_{MSY} (80% CI) [3]:	0.30 (0.30 - 0.31)	
	SB_{MSY} (1,000 t) (80% CI) [3,4]:	38.9 (35.5 - 45.4)	
	F_{2015}/F_{MSY} (80% CI) [3]:	0.90 (0.67 - 1.09)	
	SB_{2015}/SB_{MSY} (80% CI) [3]:	1.50 (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 (SS3) 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 2018[36] 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. 6) in the ERA rank for longline gear because it was estimated as the most productive shark species, but was also characterised by the third 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 18/07), 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.

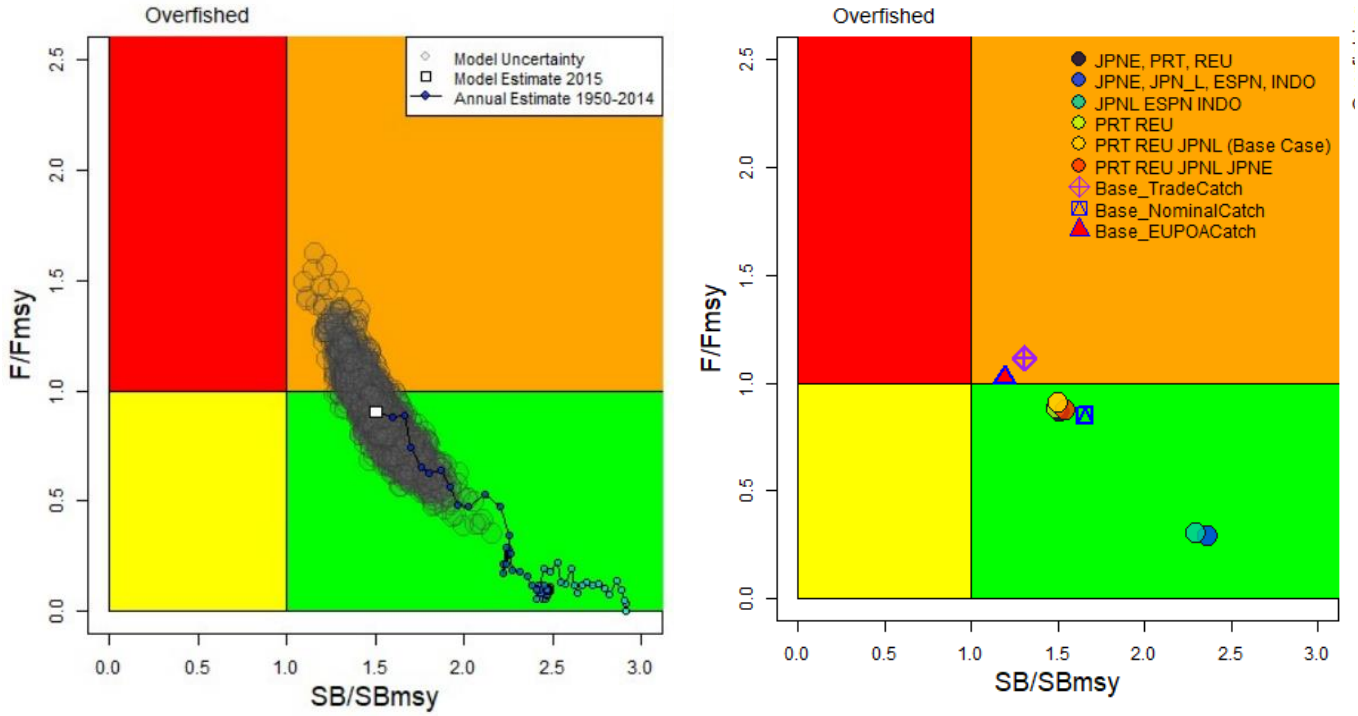


Fig. 1. Blue shark: Aggregated Indian Ocean stock assessment Kobe plot for the 2017 estimate based on the base case model and a range of sensitivity models explored with several catch reconstructions and fits to CPUE series. (Left panel: base case model with trajectory and MCMC uncertainties in the terminal 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)

LITERATURE CITED

Murua H, Santiago, J, Coelho, R, Zudaire I, Neves C, Rosa D, Semba Y, Geng Z, Bach P, Arrizabalaga, H., Baez JC, Ramos ML, Zhu JF and Ruiz J. (2018). Updated Ecological Risk Assessment (ERA) for shark species caught in fisheries managed by the Indian Ocean Tuna Commission (IOTC). IOTC–2018–SC21–14_Rev_1.

APPENDIX 24
EXECUTIVE SUMMARY: OCEANIC WHITETIP SHARK

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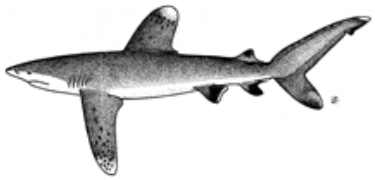

Status of the Indian Ocean oceanic whitetip shark (OCS: *Carcharhinus longimanus*)

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 2018[37] 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 medium vulnerability ranking (No.

9) in the ERA rank for longline gear because it was estimated as one of the least productive shark species, but was only characterised by a medium susceptibility to longline gear. Oceanic whitetip shark was estimated as being the 11th most vulnerable shark species to purse seine gear, as it was characterised as having a relatively low productive rate, and medium 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 relatively 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 18/07), 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. Given that some CPCs are still reporting oceanic whitetip shark as landed catch, there is a need to strengthen mechanisms to ensure CPCs comply with Resolution 13/06.

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).

LITERATURE CITED

Murua H, Santiago, J, Coelho, R, Zudaire I, Neves C, Rosa D, Semba Y, Geng Z, Bach P, Arrizabalaga, H., Baez JC, Ramos ML, Zhu JF and Ruiz J. (2018). Updated Ecological Risk Assessment (ERA) for shark species caught in fisheries managed by the Indian Ocean Tuna Commission (IOTC). IOTC–2018–SC21–14_Rev_1.

APPENDIX 25
EXECUTIVE SUMMARY: SCALLOPED HAMMERHEAD SHARK

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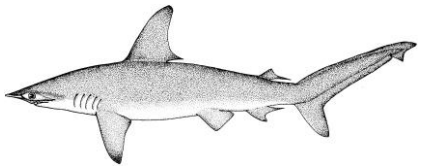

Status of the Indian Ocean Scalloped Hammerhead Shark (SPL: *Sphyrna lewini*)

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 2018[38] 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. 17) 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 twelfth most vulnerable shark species in the ERA ranking for purse seine gear, but with lower levels of vulnerability compared to longline gear, because the susceptibility was lower for purse seine gear. There is a paucity of information available on this species and this situation is not expected to improve in the short to medium term.

Scalloped hammerhead sharks are commonly taken by a range of fisheries in the Indian Ocean. They are extremely vulnerable to gillnet fisheries. Furthermore, pups occupy shallow coastal nursery grounds, often heavily 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 18/07), 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).

LITERATURE CITED

Murua H, Santiago, J, Coelho, R, Zudaire I, Neves C, Rosa D, Semba Y, Geng Z, Bach P, Arrizabalaga, H., Baez JC, Ramos ML, Zhu JF and Ruiz J. (2018). Updated Ecological Risk Assessment (ERA) for shark species caught in fisheries managed by the Indian Ocean Tuna Commission (IOTC). IOTC–2018–SC21–14_Rev_1.

APPENDIX 26
EXECUTIVE SUMMARY: SHORTFIN MAKO SHARK

Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien
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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 ($SB_{year}/SB_{MSY}\geq 1$)
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. 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 2018[39] 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 fourth 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 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 18/07), 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).

LITERATURE CITED

Murua H, Santiago, J, Coelho, R, Zudaire I, Neves C, Rosa D, Semba Y, Geng Z, Bach P, Arrizabalaga, H., Baez JC, Ramos ML, Zhu JF and Ruiz J. (2018). Updated Ecological Risk Assessment (ERA) for shark species caught in fisheries managed by the Indian Ocean Tuna Commission (IOTC). IOTC–2018–SC21–14_Rev_1.

APPENDIX 27
EXECUTIVE SUMMARY: SILKY SHARK

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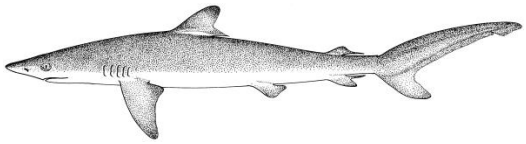

Status of the Indian Ocean silky shark (FAL: *Carcharhinus falciformis*)

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 2018[40] 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. 2) 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 fifth 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 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 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 18/07), 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.

LITERATURE CITED

Murua H, Santiago, J, Coelho, R, Zudaire I, Neves C, Rosa D, Semba Y, Geng Z, Bach P, Arrizabalaga, H., Baez JC, Ramos ML, Zhu JF and Ruiz J. (2018). Updated Ecological Risk Assessment (ERA) for shark species caught in fisheries managed by the Indian Ocean Tuna Commission (IOTC). IOTC–2018–SC21–14_Rev_1.

APPENDIX 28
EXECUTIVE SUMMARY: BIGEYE THRESHER SHARK

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

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 2018[41] 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. 4) 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 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 18/07), 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[42].

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..
- **Main reporting fleets** (2013–17): ~~Sri Lanka~~ (reported as discarded/released alive: South Africa, Sri Lanka, Japan, Korea, EU,FRA, Indonesia).

LITERATURE CITED

Murua H, Santiago, J, Coelho, R, Zudaire I, Neves C, Rosa D, Semba Y, Geng Z, Bach P, Arrizabalaga, H., Baez JC, Ramos ML, Zhu JF and Ruiz J. (2018). Updated Ecological Risk Assessment (ERA) for shark species caught in fisheries managed by the Indian Ocean Tuna Commission (IOTC). IOTC–2018–SC21–14_Rev_1

[42]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 29
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 2018[43] 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 medium vulnerability ranking (No. 12) in the ERA for longline gear because it was characterised as one of the least productive shark species, and with a medium susceptibility to longline gear. Due to its low productivity, pelagic thresher shark has a high vulnerability ranking (No. 2) to purse seine gear due to its high availability 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 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 18/07), 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[44].

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).

LITERATURE CITED

Murua H, Santiago, J, Coelho, R, Zudaire I, Neves C, Rosa D, Semba Y, Geng Z, Bach P, Arrizabalaga, H., Baez JC, Ramos ML, Zhu JF and Ruiz J. (2018). Updated Ecological Risk Assessment (ERA) for shark species caught in fisheries managed by the Indian Ocean Tuna Commission (IOTC). IOTC–2018–SC21–14_Rev_1.

[44]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 30
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[45]
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 Ecological Risk Assessment (ERA)[46] presented in 2018. Stock assessments of all species of marine turtles in the Indian Ocean are limited due to data insufficiencies as well as limited data quality[47]. 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[48]. Population levels of impacts of leatherback turtles caught in longline gear in the Southwest Indian Ocean were also identified as a conservation priority.

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IUCN, 2017. The process of the threat assessment from IUCN is independent from the IOTC and is presented for information purpose only
46

A.J. Williams, L. Georgeson, R. Summerson, A. Hobday, J. Hartog, M. Fuller, Y. Swimmer, B. Wallace, and S.J. Nicol 2018 Assessment of the vulnerability of sea turtles to IOTC tuna fisheries. WPEB14-40.
47

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
48

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. So far, reporting of sea turtle interactions are not described at the species level. It is recommended that CPCs now declare interactions indicating the sea turtle species. Guides for species identification are available at http://iotc.org/science/species-identification-cards. 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[49] 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[6] 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[7]. 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.

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)
[49]

IOTC-2017-WPEB13-18

[6] 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

APPENDIX 31
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[50]
Albatross		
Atlantic Yellow-nosed Albatross	*Thalassarche chlororynchos*	Endangered
Black-browed albatross	*Thalassarche melanophris*	Least Concern
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*	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*	Endangered
Flesh-footed shearwater	*Puffinus carneipes*	Near Threatened

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.

[50] 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 32
EXECUTIVE SUMMARY: CETACEANS

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

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. The current[51] 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[52]. Many reports[53] 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[54], 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

[51] October 2017

[52] Anderson 2014

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

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

that CPCs 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[55].
- 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.

REFERENCES

Allen, S.J., Cagnazzi, D.D., Hodgson, A.J., Loneragan, N.R. and Bejder, L., 2012. Tropical inshore dolphins of north-western Australia: Unknown populations in a rapidly changing region. *Pacific Conservation Biology*, 18: 56-63.

Amir, O.A., 2010. *Biology, ecology and anthropogenic threats of Indo-Pacific bottlenose dolphins in East Africa* (Doctoral Dissertation, Department of Zoology, Stockholm University).

Anderson C.R. 2014. Cetaceans and tuna fisheries in the western and central Indian Ocean. *IOTC-2014-WPEB10-31*.

Atkins, S., Cliff, G. and Pillay, N., 2013. Humpback dolphin bycatch in the shark nets in KwaZulu-Natal, South Africa. *Biological Conservation*, 159: 442-449.

Beasley, I., Jedensjö, M., Wijaya, G.M., Anamiato, J., Kahn, B. and Kreb, D., 2016. Chapter Nine-Observations on Australian Humpback Dolphins (*Sousa sahulensis*) in Waters of the Pacific Islands and New Guinea. *Advances in Marine Biology*, 73: 219-271.

Braulik, G.T., Findlay, K., Cerchio, S. and Baldwin, R., 2015. Assessment of the Conservation Status of the Indian Ocean Humpback Dolphin (*Sousa plumbea*) Using the IUCN Red List Criteria. *Advances in Marine Biology* 72: 119-141.

Braulik, G.T., Ranjbar, S., Owfi, F., Aminrad, T., Dakhteh, S.M.H., Kamrani, E. and Mohsenizadeh, F. 2010. Marine mammal records from Iran. *Journal of Cetacean Research and Management*, 11:49-63.

Collins, T., Minton, G., Baldwin, R., Van Waerebeek, K., Hywel-Davies, A. and Cockcroft, V., 2002. A preliminary assessment of the frequency, distribution and causes of mortality of beach cast cetaceans in the Sultanate of Oman, January 1999 to February 2002. *IWC Scientific Committee document SC/54 O*, *4*.

Collins, T., Preen, A., Willson, A., Braulik, G. and Baldwin, R. M. 2005. Finless porpoise (*Neophocaena phocaenoides*) in waters of Arabia, Iran and Pakistan. Scientific Committee document SC/57/SM6. International Whaling Commission, Cambridge, UK.

Escalle, L., Capietto, A., Chavance, P., Dubroca, L., De Molina, A.D., Murua, H., Gaertner, D., Romanov, E., Spitz, J., Kiszka, J.J., Floch, L., Damiano, D. and Merigot, B., 2015. Cetaceans and tuna purse seine fisheries in the Atlantic and Indian Oceans: interactions but few mortalities. *Marine Ecology Progress Series*, 522: 255-268.

Hamer, D.J., Childerhouse, S.J. and Gales, N.J., 2012. Odontocete bycatch and depredation in longline fisheries: a review of available literature and of potential solutions. *Marine Mammal Science*, 28: 345-374.

Kiszka, J., Pelourdeau, D. and Ridoux, V., 2008. Body Scars and Dorsal Fin Disfigurements as Indicators Interaction Between Small Cetaceans and Fisheries Around the Mozambique Channel Island of Mayotte. *Western Indian Ocean Journal of Marine Science*, 7: 185-193.

Kiszka, J., Bein, A., Bach, P., Jamon, A., Layssac, K., Labart, S. and Wickel, J., 2010. Catch and bycatch in the pelagic longline fishery around Mayotte (NE Mozambique Channel), July 2009-September 2010. *IOTC WPEB-19*.

[55] Anderson 2014

Kiszka, J., Muir, C., Poonian, C., Cox, T.M., Amir, O.A., Bourjea, J., Razafindrakoto, Y., Wambitji, N. and Bristol, N., 2009. Marine mammal bycatch in the southwest Indian Ocean: review and need for a comprehensive status assessment. *Western Indian Ocean Journal Marine Science*, 7: 119-136.

Kruse, S., Leatherwood, S., Prematunga, W.P., Mendes, C. and Gamage, A., 1991. Records of Risso's dolphins, *Grampus griseus*, in the Indian Ocean, 1891–1986. *Cetaceans and Cetacean Research in the Indian Ocean Sanctuary. UNEP Marine Mammal Technical Report*, 3: 67-78.

Leatherwood, S., McDonald, D., Prematunga, W.P., Girton, P., Ilangakoon, A. and McBrearty, D., 1991. Recorded of the" Blackfish" (Killer, False Killer, Pilot, Pygmy Killer and Melon-headed whales) in the Indian Ocean, 1772-1986. *Cetaceans and Cetacean Research in the Indian Ocean. UNEP Marine Mammal Technical Report*, 3: 33-65.

Meÿer, M.A., Best, P.B., Anderson-Reade, M.D., Cliff, G., Dudley, S.F.J. and Kirkman, S.P., 2011. Trends and interventions in large whale entanglement along the South African coast. *African Journal of Marine Science*, 33: 429-439.

Razafindrakoto, Y., Andrianarivelo, N., Cerchio, S., Rasoamananto, I. and Rosenbaum, H., 2008. Preliminary assessment of cetacean incidental mortality in artisanal fisheries in Anakao, southwestern region of Madagascar. *Western Indian Ocean Journal of Marine Science*, 7: 175-184.

Reeves, R.R., McClellan, K. and Werner, T.B., 2013. Marine mammal bycatch in gillnet and other entangling net fisheries, 1990 to 2011. *Endangered Species Research*, 20: 71-97.

Romanov, E.V., 2002. Bycatch in the tuna purse-seine fisheries of the western Indian Ocean. *Fishery Bulletin*, 100: 90-105.

Sabarros, P.S., Romanov, E., Le Foulgoc, L., Richard, E., Lamoureux, J.P. and Bach, P., 2013. Commercial catch and discards of pelagic longline fishery of Reunion Island based on the self-reporting data collection program. *9th IOTC Working Party on Ecosystems and Bycatch, La Réunion, France*.

Slooten, E., Wang, J.Y., Dungan, S.Z., Forney, K.A., Hung, S.K., Jefferson, T.A., Riehl, K.N., Rojas-Bracho, L., Ross, P.S., Wee, A. and Winkler, R., 2013. Impacts of fisheries on the Critically Endangered humpback dolphin *Sousa chinensis* population in the eastern Taiwan Strait. *Endangered Species Research*, 22: 99-114.

APPENDIX 33
UPDATE ON PROGRESS REGARDING RESOLUTION 16/03 – ON THE SECOND PERFORMANCE REVIEW FOLLOW–UP

(NOTE: NUMBERING AND RECOMMENDATIONS AS PER APPENDIX I OF RESOLUTION 16/03)

REFERENCE #	RECOMMENDATION	RESPONSIBILITY	UPDATE/STATUS	TIMELINE	PRIORITY
PRIOTC02.02 (para. 86)	***Status of living marine resources*** The PRIOTC02 **RECOMMENDED** that: a) while continuing to work on improving data collection and reporting, the Scientific Committee should continue to utilise qualitative stock assessment methodologies for species where these is limited data available, including ecological risk based approaches, and support the development and refinement of data poor fisheries stock assessment techniques to support the determination of stock status.	*Scientific Committee*	**Ongoing:** Since 2013, data-poor approaches to determining stock status have been applied to a range of billfish and neritic tuna species. The WPM has an item in their programme of work specifically related to this: 2.1 Explore potential methods of presenting stock status advice to managers from a range of data limited scenarios, e.g. through the development of a 'Tier' approach for providing stock status advice, based on the type of indicators used to determine stock status (e.g. CPUE series, stock assessment model) A project has been developed with EU funding to further this work and it will be conducted and presented in 2019. A capacity-building workshop was held in collaboration with ABNJ in 2017 on the DLMtool. Ecological risk assessments have been conducted in 2018 for the main shark species as well as for marine turtles in the Indian Ocean.	Ongoing	Medium

	b) confidentiality provisions and issues of accessibility to data by the scientists involved needs to be clearly delineated, and/or amended if necessary, so that stock assessment analysis can be replicated.	*Scientific Committee & Commission*	**Ongoing**: Input, output and executable files for the assessment of major stocks are archived with the Secretariat to allow replication of analyses. Access to operational data under cooperative arrangements, and those subject to confidentiality rules is still limited. In some cases, the Secretariat is bound by the domestic data confidentiality rules of Members and Cooperating Non–Contracting Parties. Ongoing developments to the new integrated IOTC database are improving the accessibility of IOTC data sets for users outside the Secretariat, while ensuring that confidentiality rules are fully respected. IOTC has contributed and provided support to the BlueBridge initiative for the development and implementation of a collaborative environment to be used by scientists to replicate and execute stock assessments within the BlueBridge distributed infrastructure. . The outputs of CPUE standardisation are available but access to the raw data may not be provided.	Ongoing	Medium
	c) chairpersons and Vice-Chairpersons of the Scientific Committee and respective Working Parties, in conjunction with the IOTC Secretariat, develop guiding principles for the provision of papers to ensure that they are directly related to the Program of Work of the respective Working Party and/or Scientific Committee, as endorsed by the Commission, while still encouraging for new and emerging issues to be presented.	*Scientific Committee & Working Party Chairs and Vice-Chairs*	**Ongoing:** Given the substantial increase in the quantity of documents submitted for WP meetings in recent years (often reaching 60) the IOTC Secretariat is working closely with Chairs to filter through the papers of most relevance to the agreed agenda items based on the priorities of the SC and Commission for that year, and requesting authors to resubmit their paper for an alternative meeting or as a reference “information” document.	Ongoing	Medium

	d) ongoing peer review and input by external scientific experts should be incorporated as standard best practice for Working Parties and included in the Commission's regular budget.	*Scientific Committee & Commission*	253. **Ongoing**: External experts (Invited Experts) are regularly invited to provide additional expertise at Working Party meetings. 254. The SC requested that at least one 'Invited Expert' be brought to each of the science Working Parties in 2017 and in each subsequent year, so as to further increase the capacity of the Working Parties to undertake the work detailed in the Program of Work (para 178 IOTC-2016-SC19-R) In 2018 an Invited Expert attended all the WP meetings except for the WPDCS. The budget allocated to this by the Commission has been doubled as it is considered a priority. The SC agreed that once stock assessment models were considered robust, that peer review would be advantageous and funds will be requested to undertake peer reviews of stock assessments.	Ongoing	High
PRIOTC02.03 (para. 96)	***Data collection and reporting*** The PRIOTC02 **RECOMMENDED** that: a) the Commission make further investments in data collection and targeted capacity building, which is necessary for further improvement in the provision and quality of data in support of the Commission's objectives, as well as to identify the sources of the uncertainty in data and work towards reducing that uncertainty.	*Commission*	**Ongoing:** There are multiple opportunities and sources of funding for capacity building on data collection and scientific analyses, both within the IOTC budget and in the context of other partnerships.	Ongoing	High

	b) while there are budgetary implications, the IOTC Secretariat staffing dedicated to data collection and data capacity building activities should be increased from 3 to 5 full-time data staff.	*Commission*	**Pending:** Recruitment of a P1 (Fisheries Officer) began in late-2017 and is still ongoing. However, the IOTC Data Section still remains severely understaffed given the increasing work loads. These include monitoring data compliance and technical support missions, support to the implementation of the Regional Observer Scheme, development of the IOTC database and dissemination systems, and new work streams taking place in 2018 (e.g., E-monitoring, ROS Pilot Project, support for implementation of skipjack HCR [Res 16/02], and yellowfin catch reduction [Res.17/01].	Ongoing	High
	c) the IOTC Secretariat should facilitate discussions with coastal State non-CPCs and other non-CPCs fishing within the IOTC area of competence to formalise long-term strategies for data submission to the IOTC Secretariat, including all relevant historical data sets.	*IOTC Secretariat*	**Ongoing:** This is partially being addressed by the programme of work allocated to the IOTC Data Compliance and Support missions.	Ongoing	High
	d) steps to gain access to fine-scale data to be used in joint analysis, with sufficient protection of confidentiality, should be taken.	*IOTC Secretariat*	**Ongoing:** This capability will be partially addressed through the functionalities provided by the new IOTC database, depending on the quality of these fine-scale data and confidentiality restrictions. The collaborative longline CPUE (involving Japan, Rep. of Korea, and Taiwan,China and an independent fisheries consultant) has involved the sharing of operational level data. While the results of analyses, and joint-CPUE, have been published, the fine-scale data remains confidential. In 2017, the collaborative workshop explored the feasibility of including data from other CPCs (i.e. Seychelles Industrial longline) and discussed the possibilities and potential options of allowing more flexibility in data access (e.g. the possibility of remote access).	Ongoing	High
	e) where budgets and other resources permit, to encourage data preparatory meetings preceding stock assessment review meetings (Working Parties).	*Scientific Committee*	**Ongoing:** The SC has considered this in previous years and for WPTmT a preparatory meeting in 2019 will be held before the stock assessment update later in the year.	Ongoing	Medium

	f) innovative and/or alternative means of data collection and reporting should be explored and, as appropriate, implemented, including a move towards electronic data collection and reporting for all fleets.	*Scientific Committee*	**Ongoing:** The IOTC Secretariat has developed an electronic tool for the Regional Observer Scheme to facilitate collection and reporting of ROS data. A pilot E-monitoring project was initiated in 2018, focused on small-scale fisheries (e.g., gillnet, gillnet-longline multi-gear vessels) for which there are practical difficulties placing on-board observers, and for which there is currently little or no data reported to the IOTC Secretariat. In October 2017 a consultation and validation workshop was held in South Africa to discuss with CPCs the future implementation of e-MARIS, an electronic Monitoring And Reporting Information System that will streamline - among others - the submission of mandatory statistical data to the Secretariat. As of November 2018, three international teams have submitted their expression of interest for the implementation of the system, and the selection process is under way with the expected start of development scheduled for Q1 2019. The Scientific Committee is developing minimum standards for the implementation of electronic observation systems and determining how they can be used to increase levels of observer coverage for Indian Ocean fisheries as requested by Res. 16/04	2018	High

PRIOTC02.05 (para. 104)	***Capacity building (Data Collection)*** The PRIOTC02 **RECOMMENDED** that: a) the Commission expand its current data support and data compliance missions and that the IOTC Secretariat should be granted increased autonomy to seek and attract external donor funds to support the work approved by the Commission, including supporting actions and/or capacity building initiatives from Compliance Missions that are applicable to more than two CPCs.	*Commission*	**Ongoing:** The IOTC Secretariat is actively engaged in a programme of data compliance and support missions, but is constrained by current staffing resources within the Data Section. During 2018, data compliance and support missions were conducted in Sri Lanka (February and ongoing for e-monitoring), Indonesia (April/May), Indonesia/Bali (July). and a trip to Pakistan is planned for December. The trip to Sri Lanka included a second (follow-up) training workshop for the adoption of the ROS electronic tools to facilitate the data entry, validation and reporting of observer data to the IOTC Secretariat. External funding for the missions was provided by EU DG-MARE.	Ongoing	High
	b) the IOTC should continue the workshop series aimed at Connecting the IOTC Science and Management processes. The aims of the workshop series should be to: 1) improve the level of comprehension among IOTC CPCs on how the scientific process informs the management process for managing of IOTC species and ecosystem-based management; 2) increase the awareness of IOTC Contracting Parties to their obligations, as stipulated in the Commissions' Conservation and Management Measures which are based on rigorous scientific advice; 3) improve the decision making process within the IOTC; and 4) to provide direct assistance in the drafting of proposals for Conservation and Management Measures.	*Commission & Secretariat*	**Ongoing:** Although this has been replaced by the IOTC Technical Committee on Management Procedures which met for first time in May 2017, TCMP recommended that this meeting is extended from its current one-day format and that more time is spent developing appropriate science-related capacity to facilitate mutual understanding. An ABNJ-funded capacity building workshops took place in 2017 and another was planned for 2018 to support the TCMP with more direct capacity building for managers from developing CPCs.	Ongoing	High
PRIOTC02.06 (para. 106)	***Non-target species*** The PRIOTC02 **RECOMMENDED** that the Commission should continue to improve upon the requirements of data collection and reporting mechanisms of non-IOTC species that interact with IOTC fisheries.	*Commission and Scientific Committee*	**Ongoing:** A new discard data reporting form, which allows the reporting of discards with spatial information and by month, has been established for the collection of data on non-retained bycatch species. Various aspects of the Pilot Project under Res 16/04 also intend to address this issue, including a workshop held in 2018 to review the data collection and reporting standards.	Ongoing	High

PRIOTC02.07 (para. 112)	***Quality and provision of scientific advice*** The PRIOTC02 **RECOMMENDED** that: a) the Scientific Committee should continue the good work undertaken since the PRIOTC01 and strive to make further improvements in the way it communicates information about stock status and future prospects for the stocks to the Commission.	*Scientific Committee & Working Parties*	**Ongoing:** Revisions and amendments to the Species Executive Summaries are ongoing through various proposals from the WPs and SC that are intended to improve communication. These have been discussed at every SC meeting for the last few years and changes to the documents have been made accordingly. This issue will be further addressed by a project in 2019 specifically addressing the way the uncertainty in stock assessment advice based on data-limited methods is presented.	Ongoing	Medium
	b) an independent peer review process (and budgeting mechanism) for stock assessments should be implemented if IOTC science is to be considered to be in line with best practice and to maintain a high standard of quality assurance.	*Scientific Committee & Commission*	**Ongoing:** Invited external experts are routinely invited to participate in the meetings of the WP to provide additional expertise.	Ongoing	High
	c) the Scientific Committee, through its Working Party on Ecosystems and Bycatch should pursue the application of ecosystem modelling frameworks.	*Scientific Committee & Working Party on Ecosystems and Bycatch*	**Ongoing**: The WPEB has recently added an item into its Program of Work on the development for a plan for ecosystem based fisheries management approaches in the IOTC and has requested the development of a preliminary ecosystem report card template. SC representatives and the Secretariat participated in the tRFMO joint workshop on operationalisation of the EAFM in 2017 and are planning to do so in 2019 and at future meetings. The ecosystem report card methodology was discussed during the 2018 meeting of the WPEB and subsequent workshops to advance the process are being planned for 2019.	Ongoing	Low

	d) continue to develop and adopt robust target and limit reference points, and species or fishery specific harvest control rules through management strategy evaluations, noting that this process has commenced for several species and is specified in IOTC Resolution 15/10 *on target and limit reference points and a decision framework*. The mandated Resolution 14/03 [superseded by Resolution 16/09] *on enhancing the dialogue between fisheries scientists and managers*, will benefit from having communication between the Scientific Committee and the Commission more formally structured, facilitated dialogue to enhance understanding and inform decision making.	*Scientific Committee & Commission*	**Ongoing:** The 2nd Meeting of the Technical Committee on Management Procedures took place in 2018 and is due to continue to take place prior to each Commission meeting with the discussion of reference points on the agenda	Ongoing	High
	e) the Commission and its subsidiary bodies continue to ensure that meeting schedules and activities are rationalised so that the already heavy workload of those involved, and budgeting constraints, are taken into account.	*Commission & Scientific Committee*	**Ongoing**: All Working Parties have ranked the activities in their respective programs of work as high, medium or low and allocated a numerical ranking within the high priority category. These are further prioritised and summarised in paper IOTC-2018-SC21-09. The Scientific Committee will also discuss the potential to reduce the heavy yearly meeting schedule (by combining intersessional meetings with stock assessment meetings) to reduce the workload of the Secretariat and WPs.	Ongoing	Medium
	f) the Commission fully implements Resolution 12/01 *On the implementation of the precautionary approach*, so as to apply the precautionary approach, in accordance with relevant internationally agreed standards, in particular with the guidelines set forth in the UNFSA, and to ensure the sustainable utilisation of fisheries resources as set forth in Article V of the IOTC Agreement, including ensuring that a lack of information or increased uncertainty in datasets/stock assessment, is not used as a justification to delay taking management actions to ensure the sustainability of IOTC species and those impacted by IOTC fisheries.	*Commission*	**Ongoing:** The precautionary approach is used by SC in the provision of the scientific advice for fishery management. A harvest control rule was adopted for skipjack tuna, and work is progressing on yellowfin, bigeye and albacore tunas, with support of external funding (FAO ABNJ Tuna Project) An MSE for swordfish is considered a high priority by the Commission (para. 40, IOTC-2017-S21-R).	Ongoing	High

	g) while there are budgetary implications, the IOTC Secretariat staffing dedicated to scientific analysis should be increased from 2 to 4 full-time science staff.	*Commission*	**Ongoing:** The IOTC science staff section has now increased to 3 persons as the science manager position has been filled since July 2018. A further science coordinator position will be discussed and presented to the 2019 meeting of the Commission.	Ongoing	High
PRIOTC02.08 (para. 123)	***Adoption of Conservation and Management Measures*** The PRIOTC02 **RECOMMENDED** that: b) as the IOTC has faced the management of the main targeted stock under its purview only through a regulation of the fishing effort; other approaches should be explored, such as those envisioned in Resolutions 05/01 and 14/02, including catch limits, total allowable catch (TAC) or total allowable effort (TAE).	*Commission & Scientific Committee*	**Pending:** While TCAC has progressed this work, WPTT agenda has also included the option of alternative management tools. This should be continued in light of Res 17/01 and 16/02 revisions.	Pending	High
	c) the Science-Management Dialogue is strengthened to improve understanding of modern approaches to fisheries management, including the implementation of Harvest Strategies through the use of Management Strategy Evaluation. The Commission adopt a formal process of developing and implementing Harvest Strategies within a prescribed timeframe.	*Commission & Scientific Committee*	**Completed:** The Commission adopted Resolution 16/09, establishing a Technical Committee on Management Procedures, formalising a process to facilitate discussion and adoption of harvest strategies. The first meeting of the TCMP took place in May 2017 with a second meeting taking place in May 2018. The Commission adopted the schedule of work of TCMP including the timelines and process for the development of MSE and adoption of HCR for IOTC Species (Appendix 9 of IOTC-2017-S21-R[E])	Done	High
PRIOTC02.21 (para. 204)	b) The IOTC should develop cooperative mechanisms, such as MoUs, to work in a coordinated manner on issues of common interest, in particular non-target species and an ecosystem approach with other RFMOs especially with SIOFA.	*Commission*	**Ongoing**: The IOTC is currently working with other tRFMOs, within the framework of the Kobe process, through joint meetings on the MSE, ecosystem approaches to management, harmonisation of observer schemes and a joint working group on FADs. A porbeagle risk assessment (southern hemisphere) was presented at WPEB in 2017. The IOTC Secretariat, the SC chair and the chair of WPEB all participated in the tRFMO joint meeting on EBFM (FAO, Rome) and the FAD Working Group (Madrid) in 2017.	Ongoing	Medium

PRIOTC02.22 (para. 211)	***Special requirements of developing States*** The PRIOTC02 **RECOMMENDED** that: a) the continuation and optimisation of the IOTC Meeting Participation Fund indefinitely as part of the IOTC Regular Budget, and that the MPF is used to support participation of all eligible Contracting Parties in order to create a more balanced attendance to both science and non-science meetings of the Commission.	*Commission*	**Ongoing:** In 2018, 46 MPF applications were accepted by the IOTC Secretariat – although a significant proportion of applicants were funded through external funding sources rather than the IOTC regular budget.	Ongoing	High
	b) the IOTC Secretariat in partnership with development agencies and organisations, should develop a five year regional fisheries capacity development program to ensure coordinated capacity building activities across the region.	*Secretariat & Commission*	**Ongoing:** A draft Science Strategic Plan has been developed and will be presented to the SC21 as document IOTC–2018–SC21–18. This plan includes the development plan for capacity building. A capacity-building workshop was held in 2018 on CPUE standardisation.	Ongoing	Medium

APPENDIX 34
PROGRESS MADE ON THE RECOMMENDATIONS OF SC20

SC20 Report	SC recommendations	Update/Progress
SC20.08 Para. 13	***Previous Decisions of the Commission*** The SC **RECOMMENDED** that Resolution 15/02 Mandatory statistical reporting requirements for IOTC Contracting Parties and Cooperating Non-Contracting Parties (CPCs) be reviewed to include the mandatory reporting of zero catches for all species under the mandate of IOTC, in order to support the implementation of IOTC Resolution 16/06 On measures applicable in case of non fulfilment of reporting obligations in the IOTC.	**Update:** In 2018, the Commission reiterated its concerns about the lack and poor quality of data, and again strongly **RECOMMENDED** that CPCs take immediate steps to review, and where necessary, improve their performance with respect to the provision of data through improved compliance with Resolutions 15/01 On the recording of catch and effort data by fishing vessels in the IOTC area of competence, and 15/02 Mandatory statistical reporting requirements for IOTC contracting parties and cooperating non-contracting parties. Moreover, the Commission in 2018 adopted Resolution 18/07 On Measures Applicable in Case of Non-Fulfilment of Reporting Obligations in the IOTC including the mandatory reporting of zero catches.
SC20.09 Para. 24	***National Reports from CPCs*** Noting that the Commission, at its 15th Session, expressed concern regarding the limited submission of National Reports to the SC, and stressed the importance of providing the reports by all CPCs, the SC **RECOMMENDED** that the Commission note that in 2017, 22 reports were provided by CPCs (23 in 2016, 26 in 2015, 26 in 2014) (Table 2).	**Update:** In 2018, the Commission **NOTED** that 10 Contracting Parties and 2 Cooperating Non-Contracting Parties did not submit a National Report to the Scientific Committee in 2017, and issues with lack of data and poor quality data persist.
SC20.10 Para. 25	The SC **RECOMMENDED** that the Compliance Committee and Commission note the lack of compliance by 10 Contracting Parties (Members) and 2 Cooperating Non-Contracting Parties (CNCPs) that did not submit a National Report to the Scientific Committee in 2017, noting that the Commission agreed that the submission of the annual reports to the Scientific Committee is mandatory	**Update:** See above
SC20.11 Para. 32	***WPNT Data Quality Issues*** The SC noted that compliance with data reporting obligations is particularly low for neritic tuna species, despite the importance of scientific data for stock assessment, and **REQUESTED** CPCs do their best to collect data and comply with data reporting requirements adopted by the IOTC. The SC further **RECOMMENDED** that mechanisms are developed by the Commission to improve current scientific advice by encouraging CPCs to comply with their data recording and reporting requirements.	**Update:** At its 22nd session, the Commission **EXPRESSED** further concern about the overall lack of information on neritic tunas, strongly **ENCOURAGED** the coastal States to improve data collection and reporting, and develop measures to underpin sustainable management of IOTC neritic species.
SC20.12 Para. 33	Noting a number of long-standing data reporting or data quality issues that severely impact the assessment of neritic species, the SC **RECOMMENDED** that funds be made available to the IOTC Secretariat (either through the IOTC Regular Budget or from external sources) dedicated to capacity building activities, or data compliance and support missions, aimed at improving the availability of data for those countries identified as a priority for neritic species in terms of importance of catches. Specifically:	**Update:** : Ongoing i.) I.R. Iran: A Data Compliance and Support mission was conducted by the IOTC Secretariat in September 2017 to assist SHILAT with the reporting of mandatory statistical data (i.e., particularly catch-and-effort and size frequency data), and also assess the availability of datasets for standardization of a CPUE series for gillnet fisheries.

SC20.13 Para. 34	i. when sufficient data is recovered, or made available, that the IOTC Secretariat allocates funds to assist with the development of a standardized CPUE series for gillnets, in collaboration with IOTC members, including organization of a joint-workshop or hiring of an international consultant; ii. that the IOTC Secretariat formally communicates to India requesting the submission of mandatory datasets according to the requirements of IOTC Resolution 15/02 and, if necessary, conducts a Data Compliance and Support mission to facilitate the reporting of data to the IOTC; iii. that the IOTC Secretariat continues to support the work of WWF-Pakistan and the Government of Pakistan in the evaluation and reporting of the crew-based observer program, and facilitate the reporting of length data and catch-and-effort collected by the observer log-books The SC **AGREED** that a new item on data mining and collation of historical and current catch data for these species should be added as a fundamental piece of work to be undertaken as a priority and **RECOMMENDED** that this work is supported by the IOTC Secretariat.	The mission resolved a number of long-standing issues with deficiencies in Iran's IOTC data submissions. Submission of catch-and-effort, size data, and nominal catches for the period 2014 - 2017 to IOTC by I.R. Iran, (and according to IOTC data reporting standards), has recently been received and is being processed. Agreement was also reached in terms of collaboration between the IOTC Secretariat and SHILAT in exploring the potential for a standardized gillnet series for the main neritic tunas (e.g., kawakawa and longtail tuna). ii.) India: A formal letter was sent from the IOTC Executive to the IOTC representative of India requesting the timely, and complete, submission of the mandatory data required by IOTC Resolution 15/02; also that data for previous years' also be submitted as a matter of priority. iii.) Pakistan: a Data Compliance and technical assistance mission is planned by the IOTC Secretariat for December 2019 to Pakistan to provide technical assistance on the validation of the revised historical catch series submitted by Pakistan, and also evaluation of the crew-based observer scheme. The IOTC Secretariat to provide a more comprehensive update during the WPNT08 meeting. **Update:** Ongoing as above
SC20.14 Para. 35	***WPNT CPUE Standardisation*** Acknowledging the importance of indices of abundance for future stock assessments, the SC **RECOMMENDED** that the development of standardised CPUE series is explored, based on the guidelines developed by the SC in 2015 (*Guidelines for the presentation of CPUE standardisations and stock assessment models*[56]), with priority given to fleets which account for the largest catches of neritic tuna and tuna-like species (e.g., I.R. Iran, Indonesia, India, Pakistan, and Sri Lanka)..	**Update:** Following the Data Compliance and Support mission in September 2017 to I. R. Iran, the IOTC Secretariat planned a follow-up mission for May 2018 dedicated to exploring options for developing a standardised gillnet CPUE series (for neritic tunas). Unfortunately the mission was deferred until a later date, due to issues beyond the control of the IOTC Secretariat and I.R. Iran
SC20.15 Para. 42	***WPNT Working party attendance and the MPF*** The SC **RECOMMENDED** that the Commission note the following: 1) The participation of developing coastal state scientists to the WPNT has been consistently high following the adoption and implementation of the IOTC Meeting Participation Fund adopted by the Commission in 2010 (Resolution 10/05 On the establishment of a Meeting Participation Fund for developing IOTC Members and Non-Contracting Cooperating Parties),	**Update:** Ongoing

[56] http://iotc.org/documents/guidelines-presentation-cpue-standardisations-and-stock-assessment-models-1

	now incorporated into the IOTC Rules of Procedure (2014), as well as though the hosting of the WPNT in developing coastal State Contracting Parties (Members) of the Commission (Table 8). 2) The continued success of the WPNT, at least in the short term, appears heavily reliant on the provision of support via the MPF which was established primarily for the purposes of supporting scientists to attend and contribute to the work of the Scientific Committee and its Working Parties. 3) The MPF should be utilised so as to ensure that all developing Contracting Parties of the Commission are able to attend the WPNT meeting, as neritic tunas are very important resources for many of the coastal countries of the Indian Ocean..	
SC20.16 Para. 44	***Billfish IOTC Resolutions*** The SC recalled its previous **RECOMMENDATION** that on the next revision of the IOTC Agreement, the shortbill spearfish (*Tetrapturus angustirostris*) be included as an IOTC species.	**Update:** Ongoing 2018 WPB16 repeated this **RECOMMNEDATION** as no actions were taken by Commission in its 2018 meeting.
SC20.17 Para. 49	***Billfish species identification*** The SC **AGREED** on the importance of the hard, waterproof copies of the billfish IOTC species identification guides for observers and port samplers, and again **RECOMMENDED** that funds are allocated for further printing of the species ID guides for distribution to sports fishing clubs and recreational fisheries to improve the quality of data reported, and that additional funds be provided for the translation of these into the priority languages identified by the SC.	Update: Ongoing Funds from the IOTC regular budget and external sources have been obtained, however, printing has been delayed due the new requirement to process the document through the FAO publications approval system and an issue that subsequently arose on image ownership. The latter issue has been resolved and work is proceeding.
SC20.18 Para. 55	***Swordfish stock assessment and MSE*** The SC noted that the next step of the swordfish MSE is to finalize the OM and present the results to the TCMP02 within the current resource constraints (e.g., staff time and travelling). Noting that the Commission considers the development of an MSE for swordfish to be a high priority activity, the SC **RECOMMENDED** that this is reflected in the 2019 budget of the Commission.	**Update:** Funds were allocated to the Swordfish MSE through an EU grant. This facilitated a workshop and an SC document (IOTC-2018-SC21-12)
SC20.19 Para. 58	***Resolution 15/05 conservation measures for billfish*** The SC noted that catches for Black Marlin, Blue Marlin, and Striped Marlin have increased in 2016 (and 2015) from the average level of 2009-2014 as observed in Appendix VIa. The catch in 2016 for Blue marlin was 3,510 t higher (27 % larger) than the average 2009-2014, 4,286 t larger (32 %) for Black marlin and 1,398 (36 %) for Striped marlin. Considering the status of these stocks the SC urgently **RECOMMENDED** that measures are agreed to recover the status of the stock of the three marlin species covered by Resolution 15/05 as per the management advice given in the Executive Summaries.	**Update:** The Commission adopted resolution 18/05 *On management measures for the conservation of billfish, striped marlin, black marlin, blue marlin and Indo-Pacific sailfish.*
SC20.20 Para. 61	***Evaluation of the mitigation measures contained in Resolution 13/06 for Oceanic whitetip shark*** The SC noted the ongoing compliance issue for those CPCs reporting nominal catch of oceanic whitetip sharks and **RECOMMENDED** that the Compliance Committee investigate these reported catches further and report the findings to the Commission.	**Update:** The Commission **NOTED** the information provided by the SC that there continues to be catches of oceanic whitetip shark in the IOTC Area, although prohibited as per Resolution 13/06
SC20.21 Para. 62	***Longline hook identification guide*** **NOTING** the continued confusion in the terminology of various hook types being used in IOTC fisheries, (e.g. tuna hook vs. J-hook; definition of a circle hook), the SC reiterated its previous **RECOMMENDATION** (SC19.16; para. 55 of IOTC-2016-SC19-R) that the Commission	**Update: Ongoing** US$15,000 in the IOTC Research Budget for identification cards has been allocated to this activity.

	allocate funds in the 2018 IOTC Budget to develop an identification guide for fishing hooks and pelagic fishing gears used in IOTC fisheries	
SC20.22 Para. 63	***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. A consultant should be considered to conduct such work for a budget of around EUR45, 000.	**Update:** Pending. The consultant specializing in joint CPUE analysis is not available for the 2019 period, but will be engaged in the future.
SC20.23 Para. 67	***Review of mitigation measures in Resolution 12/04*** Noting the findings of the Pacific workshop regarding the effectiveness of large circle hooks, finfish bait and the removal of the first and/or second hooks next to the floats for mitigating sea turtle interactions and mortalities in Pacific longline fisheries, the SC **AGREED** that further consideration of these mitigation techniques for Indian Ocean fisheries is warranted. Such a study should attempt to develop findings regarding the consequences of various mitigation techniques, primarily with regard to impacts on target and non-turtle bycatch species catch rates, to the extent possible based on data availability and quality. The SC therefore **RECOMMENDED** that the potential for a similar workshop to be held in the Indian Ocean is explored with potential funding from the Commission and/or from the Common Oceans ABNJ Tuna Project. The SC noted this is included in the WPEB workplan and **REQUESTED** the WPEB Chairperson work with the Secretariat to pursue this idea further with potential participants and funding sources.	**Update:** Pending. This is included in the workplan of the WPEB but no definitive steps?? are specified. This is being taken up with the Common Oceans ABNJ Tuna Project
SC20.24 Para. 69	***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*** The SC **RECOMMENDED** that the Commission note the current status of development and implementation of National Plans of Action (NPOAs) for sharks and seabirds, and the implementation of the FAO guidelines to reduce marine turtle mortality in fishing operations, by each CPC as provided in Appendix V, recalling that the IPOA-Seabirds and IPOA-Sharks were adopted by the FAO in 1999 and 2000, respectively, and required the development of NPOAs.	**Update:** Presented to and Noted at the S22 Commission meeting.
SC20.25 Para. 70	***Update: Ecosystem Based Fisheries Management (EBFM) joint meeting of tRFMOs in 2016*** The SC noted the need for training and capacity building as the first step to moving forward with developing goals and strategies for the implementation of EBFM and therefore **RECOMMENDED** that a workshop is held to explain the key elements of EBFM so that a plan for implementation of EBFM in the IOTC Area of Competence can be developed by 2019.	**Update:** There is a possibility that a joint tRFMO meeting will be held in 2019 or 2020. This will be clarified with the Common Oceans ABNJ Tuna Project who funded the last meeting, and with ICCAT, who chaired it. 2018 WPEB included in its workplan the organization of a workshop to progress on EBFM for early 2019.
SC20.26 Para. 78	***Review of new information on the status of bigeye tuna: Nominal and standardised CPUE indices*** The SC acknowledged the efficiency value of making the operational logbook data available to appropriate analysts outside of the responsible CPCs, and **RECOMMENDED** that high level arrangements for sharing and confidentiality should be pursued. Noting the confidentiality issues with some of the datasets, the SC **REQUESTED** that the IOTC Secretariat and main stakeholders	**Update**: The IOTC Secretariat explored with Japan the possibilities of using data access methods that maintain confidentiality and allow for more substantial analyses of the operational-level longline data held by Japan (a formal letter was communicated to Fisheries Agency of Japan in February 2018, IOTC REF: 6871). Japan has subsequently indicated that they would like to maintain the current arrangement of the data-sharing for the collaborative CPUE analysis.

SC20.27 Para. 79	explore options to facilitate future data sharing agreements which, once in place, may not necessitate face-to-face meetings and could instead include remote processes The SC **RECOMMENDED** that the joint longline CPUE standardization for tropical tunas should continue, and that further development work should be assigned a high priority. Acknowledging that the law of diminishing returns will affect similar future analyses, the SC suggested that immediate priorities should focus on the following areas: • develop joint CPUE indices for other IOTC species (i.e., billfish and sharks); • explore possibilities for including CPUE data provided by other IOTC CPCs (particularly coastal fisheries); • identify a unified approach for species targeting using simulation testing (for example, the value of cluster analysis is clear in the temperate regions, but less so in tropical regions); • recover vessel identification details from historical data; • further develop the work on time-area interactions. Include a detailed examination of catch rates and related data in the piracy area, comparing pre-piracy and post-piracy effects. Potentially also consider the effects of localised depletion and renewal processes on catch rates. • conduct further analyses to explore 1977 discontinuity (other oceans); • develop an Indian Ocean CPUE reference manual for practitioners to use explore other density probability functions to improve model fit.	**Update:** This is being addressed through an expert consultancy and the update on this work was presented to the WPTT20 (IOTC–2018–WPTT20–35)
SC20.28 Para. 88	***Skipjack stock assessment*** The SC noted that catches of skipjack in recent years are close to the recommended annual catch limit from the HCR, and **RECOMMENDED** that the Commission encourage CPCs to closely monitor catches of skipjack tuna to ensure that the integrity of the catch limit is maintained.	**Update:** Ongoing 2018 WPTT made a similar **RECOMMENDATION** to ensure that 2018-2020 catches do not exceed the catch limit.
SC20.29 Para. 91	***Review of data available at the IOTC Secretariat for temperate tuna species*** The SC **RECOMMENDED** that funding be allocated for the further development of the combined joint CPUE series which incorporates the standardized indices of abundance for Japan, Republic of Korea, and Taiwan,China, and that an update is provided at the next WPTmT meeting prior to the next stock assessment of albacore.	**Update:** A consultant is being engaged to provide this analysis to the 2019 WPTmT data preparatory meeting.
SC20.30 Para. 92	***New information on biology, ecology, fisheries and environmental data relating to temperate tunas*** Noting the general paucity of biological indicators available from the Indian Ocean, and particularly the lack of age-specific maturity as a primary source of uncertainty in the stock assessment of albacore tuna, the SC recalled its previous **RECOMMENDATION** that a study on the growth curve of albacore tuna in the Indian Ocean be given a high priority in the SC Program of Work and that the study is completed prior to the next meeting of the WPTmT scheduled for 2019.	**Update:** This is being addressed through an EU Grant and the results of the analysis will be provided to the 2019 WPTmT data preparatory meeting.
SC20.31 Para. 100	***Update on the status of the joint CPUE indices (yellowfin tuna, bigeye tuna & albacore)*** The SC recognized the importance of normalizing these procedures and approaches into the various Working Party stock assessments making use of longline catch rate indices, **ENDORSED**	

	such joint analyses and **RECOMMENDED** these continue into the future as a normal course of business. It was noted that additional time for more detailed analysis is still needed and SC **REQUESTED** that methods to increase analysis time, such as the use of secure, cloud-based data exchange and increased use of electronic communication between analysts be investigated. The SC congratulated the WPM for the investigation of catchability/selectivity changes and spatial size patterns of bigeye and yellowfin tuna in the early years of the Japanese longline fishery and **AGREED** that this work is important in terms of improving understanding of the trends in CPUE. Noting that various issues have been identified that could be explored further, the SC **RECOMMENDED** that this work is continued	**Update**: This is being addressed through an expert consultancy and the update on this work was presented to the WPTT20 (IOTC–2018–WPTT20–35).
SC20.32 Para. 101		**Update: [Ongoing]** This work could be continued by the national scientists.
SC20.33 Para. 102	***Priorities for future development of the joint CPUE indices*** The SC noted that a substantial amount of work has already been completed for the tropical tunas and that it may be more worthwhile to focus on some other species for which this approach would be useful. The SC therefore **RECOMMENDED** that a similar joint analysis approach is explored for key IOTC billfish and shark species.	**Update**: This was discussed at both the WPB and WPEB and the work is scheduled for the future pending the availability of the independent expert
SC20.34 Para. 106	***Presentation of stock status advice for data limited stocks*** (para. 106) The SC **AGREED** that work on the presentation of stock status advice for data limited stocks will need to be carried out inter-sessionally, and that this will require some level of preparation and planning. The SC **REQUESTED** the WPM Chairperson liaise with the Chairs of the species WPs (WPNT and WPB) in order to draft a study proposal on this issue and **RECOMMENDED** the Commission allocates funding to this project.	**Update**: Funding has been secured for the proposed study from an EU grant and it will commence in 2019.
SC20.35 Para. 112	***WPDCS ROS E-reporting and E-monitoring projects*** The SC **RECOMMENDED** that a data exchange be implemented between existing software formats used for the collection of observer data by CPCs (e.g., ObServe), and the IOTC Regional Observer Database, to facilitate the transfer of historical observer data to the IOTC database for future dissemination and analysis.	**Update:** Ongoing, see paper IOTC-2018-WPDCS-33
SC20.36 Para. 115	Resolution 11/04 On a Regional Observer Scheme requests the submission of a report after each trip but the SC **RECOMMENDED** that on the next revision of the Resolution, this should be amended to request the submission of data in an electronic format suitable for automated data extraction (including historic data) with a given deadline so that information from multiple trips can be provided.	**Update:** Ongoing. A proposal including the requirement to submit observer data in an electronic format was presented to 2018 Commission meeting but was not adopted.

SC20.37 Para. 118	***WPDCS General discussion on data issues*** Acknowledging the substantial gaps in reporting of mandatory IOTC datasets by many CPCs to the IOTC Secretariat, which increases the uncertainty of stock assessments and management advice based on these data, the SC strongly **RECOMMENDED** the Commission strengthen the penalty mechanisms adopted in Resolution 16/06 On measures applicable in case of non-fulfilment of reporting obligations in the IOTC to improve compliance by CPCs in terms of the submission of basic fishery data in accordance with Resolution 15/01 and 15/02..	**Update:** The Commission in 2018 adopted Resolution 18/07 *On measures applicable in case of non-fulfilment of reporting obligations in the IOTC*
SC20.38 Para. 119	The SC noted the issues with the lack of data and problems of poor data quality that were identified throughout the Working Party reports and strongly **RECOMMENDED** that these issues are addressed through improved compliance with Resolutions *15/01 On the recording of catch and effort data by fishing vessels in the IOTC area of competence, and 15/02 Mandatory statistical reporting requirements for IOTC contracting parties and cooperating non-contracting parties.*	**Update:** In 2018, the Commission reiterated its concerns about the lack and poor quality of data, and again strongly **RECOMMENDED** that CPCs take immediate steps to review, and where necessary, improve their performance with respect to the provision of data through improved compliance with Resolutions 15/01 On the recording of catch and effort data by fishing vessels in the IOTC area of competence, and 15/02 Mandatory statistical reporting requirements for IOTC contracting parties and cooperating non-contracting parties
SC20.39 Para. 122	***General - Data collection and capacity building*** The SC **AGREED** that, while external funding is helping the work of the Commission, funds allocated by the Commission to capacity building are still too low, considering the range of issues identified by the SC and its Working Parties, particularly in relation to the implementation of the Regional Observer Scheme and data collection and reporting for artisanal fisheries and **RECOMMENDED** that the Commission further increases the IOTC Capacity Building budget to fund these activities in the future..	**Update:** The Capacity Building fund was increased in 2018 from 2017.
SC20.40 Para. 124	***General - Invited Expert(s) at the WP meetings*** Given the importance of external peer review for working party meetings, the SC **RECOMMENDED** that the Commission continues to allocate sufficient budget for an invited expert to be regularly invited to all scientific WP meetings.	**Update:** Invited experts attended all SC WP meetings in 2018
SC20.41 Para. 126	***General - Meeting participation fund*** The SC reiterated its **RECOMMENDATION** that the IOTC Rules of Procedure (2014), for the administration of the Meeting Participation Fund be modified so that applications are due not later than 60 days, and that the full Draft paper be submitted no later than 45 days before the start of the relevant meeting. The aim is to allow the Selection Panel to review the full paper rather than just the abstract, and provide guidance on areas for improvement, as well as the suitability of the application to receive funding using the IOTC MPF. The earlier submission dates would also assist with visa application procedures for candidates.	**Update:**.No progress

SC20.42 Para. 127	***General – IOTC species identification guides: Tuna and tuna-like species*** The SC reiterated its **RECOMMENDATION** that the Commission allocates budget towards continuing the translation and printing of the IOTC species ID guides so that hard copies of the identification cards can continue to be printed as many CPCs scientific observers, both on board and port, still do not have smart phone technology/hardware access and need to have hard copies on board.	**Update:**.Ongoing
SC20.43 Para. 128	***General - IOTC Secretariat staffing*** Noting the very heavy workload at the IOTC Secretariat and the ever increasing demands by the Commission and the Scientific Committee, and also the capacity to respond to requests for assistance by countries, the SC **RECOMMENDED** that the recommendation from the Performance Review PRIOTC02.07(g) is implemented, and that permanent staff of the IOTC Data and Science Section be increased by two (2) (1 x P4 and 1 x P3 level positions), supplemented by additional short-term consultants, to commence work by late-2018 or earlier, and that funding for these new positions should come from both the IOTC regular budget and from external sources to reduce the financial burden on the IOTC membership	**Update**: The Science Manager joined the secretariat in July 2018 and a further P1 position is expected in January of 2019. A P4 science coordinator position was approved by the commission in 2018, but no budget was set aside for it during the 2018-2019 funding cycle.
SC20.45 Para. 150	***General - Outcomes of the IOTC and Joint T-RFMO FAD Working Group*** Noting that Resolution 17/08 provides a start date for the implementation of non-entangling FADs, but no end date, the SC RECOMMENDED that this Resolution is revised to include a date by which non-entangling FADs should be fully implemented. *"To reduce the entanglement of sharks, marine turtles or any other species, the design and deployment of FADs shall be based on the principles set out in Annex III, which will be applied gradually from 2014" (Resolution 17/08, para. 13).*	**Update**: Ongoing
SC20.46 Para. 163	***General – Biodegradable FAD (BIOFAD) Project*** The SC noted the challenges in conducting studies on biodegradable FADs (for example the limit on the number of active FADs per purse seine vessel in the Indian Ocean that may hinder the deployment of BIOFADs following experimental sampling designs, and also engagement with the fleet to deploy BIOFADs that may not be successful for fishing). Thus, the SC **RECOMMENDED** the Commission consider special allocations for experimental FADs deployed for the collection of scientific data for vessels willing to participate in biodegradable FAD testing under protocols reviewed and endorsed by the Scientific Committee.	**Update**: The Commission adopted Resolution 18/04 *On bioFAD experimental project* without special allocations for experimental FADs deployed.
SC20.47 Para. 197	***General – Implementation of the Regional Observer Scheme*** The SC therefore **RECOMMENDED** that the EMS standards presented for purse seine fisheries (IOTC-2016-SC19-15) are adopted and **REQUESTED** that draft standards are similarly proposed for the longline fleets by CPCs currently trialling and implementing EMS on these vessels and that draft standards are also developed for gillnet fleets through the ROS Pilot Project.	**Update:** In 2018 the Commission **AGREED** to defer IOTC-2018-S22-PropD and PropJ On a Regional Observer Scheme. However, work on minimum standards has continued and a workshop was held in 2018 and a document presented to the WPDCS (IOTC-2018-WPDCS14-35)

SC20.48 Para. 201	***General – Progress on the Implementation of the Performance Review Panel*** The SC **RECOMMENDED** that the Commission note the updates on progress regarding Resolution 16/03, as provided at Appendix XXXIII.	**Update:** This is presented in document IOTC–2018–SC21–08
SC20.49 Para. 212	***General – Consultants*** Noting the highly beneficial and relevant work done by IOTC stock assessment consultants in 2016 and in previous years, the SC **RECOMMENDED** that the engagement of consultants be continued for each coming year based on the Program of Work. Consultants will be hired to supplement the skill set available within the IOTC Secretariat and CPCs.	**Update:** Ongoing and this is being achieved through EU grants and the IOTC regular budget.
SC20.50 Para. 237	***General – Template for Invited Experts*** Noting the recommendation of the IOTC Performance Review (PRIOTC02.02d), the SC **AGREED** that a comprehensive, formal external peer review is sometimes important for important or contentious assessments. Thus, the SC **RECOMMENDED** that a process is established and that the Commission allocates funding for external peer review of stock assessments to take place periodically, based on priorities identified by the SC, and **REQUESTED** that the Secretariat develop ToRs for these, with input from the SC Chair and Vice-Chair, and potentially based on a framework similar to that established for the Center for Independent Experts.	**Update:** Ongoing. This is being discussed between the SC chair and secretariat

APPENDIX 35A
WORKING PARTY ON NERITIC TUNAS PROGRAM OF WORK (2019 – 2023)

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

Topic	Sub-topic and project	Priority	Est. budget and/or potential source	Timing				
				2019	2020	2021	2022	2023
1. Data mining and collation	Collate and characterise operational level data for the main neritic tuna fisheries in the Indian Ocean to investigate their suitability to be used for developing standardised CPUE indices. The following data should be collated and made available for collaborative analysis: 1) catch and effort by species and gear by landing site; 2) operational data: stratify this by vessel, month, and year for the development as an indicator of CPUE over time; and 3) operational data: collate other information on fishing techniques (i.e. area fished, gear specifics, depth, environmental condition (near shore, open ocean, etc.) and vessel size (length/horsepower)).	High (1)	CPCs directly					
2. CPUE standardisation	Develop standardised CPUE series for the main fisheries for longtail, kawakawa, Indo-Pacific King mackerel and Spanish mackerel in the Indian Ocean, with the aim of developing CPUE series for stock assessment purposes.	High (2)						
	➢ Sri Lanka (priority species: Frigate tuna, Kawakawa, bullet tuna)		Consultant with CPCs					
	I.R. Iran (priority species: Longtail tuna, Kawakawa, narrow-barred Spanish mackerel, Frigate tuna)		Consultant with CPCs					
	Indonesia (priority species: narrow-barred Spanish mackerel, Kawakawa, longtail tuna, Frigate tuna)		Consultant with CPCs					
	Pakistan (priority species: Longtail tuna, Kawakawa, narrow-barred Spanish mackerel)		Consultant with CPCs					

3. Stock assessment / Stock indicators	Explore alternative assessment approaches and develop improvements where necessary based on the data available to determine stock status for longtail tuna, kawakawa and Spanish mackerel The Weight-of-Evidence approach should be used to determine stock status, by building layers of partial evidence, such as CPUE indices combined with catch data, life-history parameters and yield-per recruit metrics, as well as the use of data poor assessment approaches. Improve the presentation of management advice from different assessment approaches to better represent the uncertainty and improve communication between scientists and managers in the IOTC.	High (3)	IOTC Regular Budget/ EU grant 305					
4. Biological information (parameters for stock assessment)	Quantitative biological studies are necessary for all neritic tunas throughout their range to determine key biological parameters including age-at-maturity, and fecundity-at-age/length relationships, age-length keys, age and growth, longevity which will be fed into future stock assessments.	High (4)	CPCs directly					
5. Stock structure (connectivity)	Genetic research to determine the connectivity of neritic tunas throughout their distributions (LOT, KAW, COM)	High (5)	1.3 m Euro: European Union					
	➢ Determine the degree of shared stocks for all neritic tunas under the IOTC mandate in the Indian Ocean, so as to better equip the SC in providing management advice based on unit stocks delineated by geographic distribution and connectivity. ➢ Genetic research to determine the connectivity of neritic tunas throughout their distributions		TBD					

APPENDIX 35B
WORKING PARTY ON TEMPERATE PROGRAM OF WORK (2017 – 2021)

Table 1. Priority topics for obtaining the information necessary to develop stock status indicators for albacore in the Indian Ocean (2017-2021).

Topic	Sub-topic and project	Priority	Est. budget and/or potential source	Timing				
				2017	2018	2019	2020	2021
1. Stock structure (connectivity and diversity)	1.1 Genetic research to determine the connectivity of albacore throughout its distribution and the effective population size.	High (3)	1.3 m Euro: European Union					
	1.1.1 Determine albacore stock structure, migratory range and movement rates in the Indian Ocean.		TBD					
	1.1.2 Determine the degree of shared stocks for albacore in the Indian Ocean with the southern Atlantic Ocean.		Ifremer					
	1.1.3 Population genetic analyses to decipher inter- and intraspecific evolutionary relationships, levels of gene flow (genetic exchange rate), genetic divergence, and effective population sizes.		TBD					
2. Biological information (parameters for stock assessment)	2.1 Age and growth research (collaborative research to estimate ages across research facilities; stratification of sampling across fishery and stock)	High (1)	TBD					
	2.1.1 China and other CPCs to provide further research reports on albacore biology, including through the use of fish otolith studies, either from data collected through observer programs or other research programs, at the next WPTmT meeting.		CPCs directly					
	2.1.2 Growth curve analysis: Uncertainty about the growth curve is a primary source of uncertainty in the stock assessment. Depending on the shape of the growth curve, it is likely that only limited information about total mortality can be obtained from catch-at-size data. As an additional information source, data on the age structure of the catch may be very informative about total mortality and may considerably reduce uncertainty in the assessment. Research needs to be undertaken to investigate the potential and the best approaches to be used. MSE process will look at improvement in precision of estimates given different amounts of age structure data, depending on fishery, growth curve, and effective sample sizes.		TBD					

		2.2 Age-at-Maturity	High (4)							
		2.2.1 Quantitative biological studies are necessary for albacore throughout its range to determine key biological parameters including age-at-maturity and fecundity-at-age/length relationships, age-length keys, age and growth, which will be fed into future stock assessments.		CPCs directly						
3	Ecological information	3.1 Spawning time and locations	Medium (5)							
		3.1.1 Collect gonad samples from albacore to confirm the spawning time and location of the spawning area that are presently hypothesized for albacore.		CPCs directly						
4	CPUE standardisation	4.1 Develop standardized CPUE series for each albacore fishery for the Indian Ocean, with the aim of developing a single CPUE series for stock assessment purposes (either a combined or single fleet series approved by the WPTmT).	High (2)	CPUE Workshop (TBD)						
		4.1.1 Changes in species targeting is the most important issue to address in CPUE standardizations.		CPCs directly						
		4.1.2 Appropriate spatial structure needs to be considered carefully as fish density (and targeting practices) can be highly variable on a fine spatial scale, and it can be misleading to assume that large areas are homogenous when there are large shifts in the spatial distribution of effort.		CPCs directly						
		4.1.3 If there are many observations with positive effort and zero catch, it is worth considering models which explicitly model the processes that lead to the zero observations (e.g. negative binomial, zero-inflated or delta-lognormal models). Adding a small constant to the lognormal model may be fine if there are few zero's, but may not be appropriate for areas with many zero catches (e.g. north of 10oS). Sensitivity to the choice of constant should be tested.		CPCs directly						
		4.1.4 The appropriate inclusion of environmental variables in CPUE standardization is an ongoing research topic. Often these variables do not have as much explanatory power as, or may be confounded with, fixed spatial effects. This may indicate that model-derived environmental fields are not accurate enough at this time, or there may need to be careful consideration of the mechanisms of interaction to include the variable in the most informative way.		CPCs directly						

		4.1.5 It is difficult to prescribe analyses in advance, and model building should be undertaken as an iterative process to investigate the processes in the fishery that affect the relationship between CPUE and abundance.		CPCs directly					
5	Target and Limit reference points	5.1 To advise the Commission, by end of 2016 at the latest on Target Reference Points (TRPs) and Limit Reference Points (LRPs).	High (WPM)						
		5.1.1 Assessment of the interim reference points as well as alternatives: Used when assessing the albacore stock status and when establishing the Kobe plot and Kobe matrices. Agreed to pass this task temporarily to WPM.							
6	Management measure options	6.1 To advise the Commission, by end of 2016 at the latest, on potential management measures having been examined through the Management Strategy Evaluation (MSE) process. Agreed to pass this task temporarily to WPM.	High (WPM)						

APPENDIX 35C
WORKING PARTY ON BILLFISH PROGRAM OF WORK (2019 – 2023)

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

Topic	Sub-topic and project	Priority ranking	Est. budget and/or potential source	Timing				
				2019	2020	2021	2022	2023
1. Stock structure (connectivity and diversity)	1.1 Genetic research to determine the connectivity of billfish throughout their distribution (including in adjacent Pacific and Atlantic waters as appropriate) and the effective population size.		1.3 m Euro: (European Union)					
	1.1.1 Next Generation Sequencing (NGS) and nuclear markers (i.e. microsatellites) to determine the degree of shared stocks for billfish within the Indian Ocean and 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. Highest priority species: blue, black, striped marlin and sailfish.	High (15)						
	1.1.2 Initiate discussion (e.g., small workshop for CSIRO or request to present results in WPB) on the possibility to develop a close-kin mark recapture method (see *Bravington et al.* 2016) on marlins to estimates population size and other important demographic parameters..	High (14)						
	1.2 Tagging research (PSAT tags) to determine connectivity, movement rates and mortality estimates of billfish (Priority species: swordfish).	High (1)	US$400,000					
2. Biological and ecological information (incl. parameters for stock assessment and provide answers to the Commission)	2.1 Age and growth research	High (2)						
	2.1.1 CPCs to provide further research on billfish biology, namely age and growth studies including through the use of fish otolith or other hard parts, either from data collected through observer programs, port sampling or other research programs. (Priority: all billfishes: swordfish, marlins and sailfish)		(CPCs: age & growth study = 50,000)					
	2.2 Reproductive biology study	High (3)						
	2.2.1 CPCs to conduct reproductive biology studies, which are necessary for billfish throughout its range to determine key		(CPCs: Maturity					

		biological parameters including length-at-maturity, age-at-maturity and fecundity-at-age, which will be fed into future stock assessments, as well as provide advice to the Commission on the established Minimum Retention Sizes (Res 18-05, paragraphs 5 and 14c). (Priority: marlins and sailfish)		study = 30,000)					
		2.3 Spawning time and locations	High (4)						
		2.3.1 Collect gonad samples from billfish to confirm the spawning time and location of the spawning area that are presently hypothesized for each billfish species. This will also provide advice to the Commission on the request for alternative management measures (Res. 18-05, paragraph 6)		(CPCs: Spawning study =30,000)					
3.	Historical data review	3.1 Changes in fleet dynamics							
		3.1.1 Continue the work with coastal countries to address recent changes and/or increases of marlins catches especially in some coastal fleets. The historical review should include as much explanatory information as possible regarding changes in fishing areas, species targeting, gear changes and other fleet characteristics to assist the WPB understand the current fluctuations observed in the data and very high increases in some species (e.g., black marlin mainly due to very high catches reported by India in recent years). Priority countries: India, Pakistan, Iran, I.R., Indonesia.	High (5)	WPDCS					
		3.2 Species identification							
		3.2.1 The quality of the data available at the IOTC Secretariat on marlins (by species) is likely to be compromised by species miss-identification. Thus, CPCs should review their historical data in order to identify, report and correct (if possible) potential identification problems that are detrimental to any analysis of the status of the stocks.	High (6)	(CPCs directly)					
4.	CPUE standardization	4.1 Develop and/or revise standardized CPUE series for each billfish species and major fisheries/fleets for the Indian Ocean.							
		4.1.1 Swordfish: Priority LL fleets: Taiwan,China, EU(Spain, Portugal, France), Japan, Indonesia	High (12)	(CPCs directly)					
		4.1.2 Striped marlin: Priority fleets: Japan, Taiwan,China	High (13)	(CPCs directly)					

		4.1.3 Black marlin: Priority fleets: Longline: Taiwan,China; Gillnet: I.R. Iran, Sri Lanka	High (10)	(CPCs directly)					
		4.1.4 Blue marlin: Priority fleets: Japan, Taiwan,China	High (11)	(CPCs directly)					
		4.1.5 I.P. Sailfish: Priority fleets: Priority gillnet fleets: I.R. Iran and Sri Lanka; Priority longline fleets: EU(Spain, Portugal, France), Japan, Indonesia;	High (9)	(CPCs directly)					
		4.1.6 Joint analysis of operational catch and effort data from Indian Ocean longline fleets as recommended by WPM	High (8)	Consultant/ US$40K					
5.	Stock assessment / Stock indicators	5.1 Workshops on techniques for assessment including CPUE estimations for billfish species in 2019 and 2020. Priority fleets: Gillnet fisheries	High (7)	Consultant US$11,750					
6	Target and Limit reference points	6.1 To advise the Commission, by end of 2016 at the latest on Target Reference Points (TRPs) and Limit Reference Points (LRPs).	High (16)						
		6.1.1.Assessment of the interim reference points as well as alternatives: Used when assessing the Swordfish stock status and when establishing the Kobe plot and Kobe matrices.		WPM					
7	Management measure options	7.1 To advise the Commission, on potential management measures having been examined through the Management Strategy Evaluation (MSE) process.	High (17)						
		7.1.1 These management measures will therefore have to ensure the achievement of the conservation and optimal utilization of stocks as laid down in article V of the Agreement for the establishment of the IOTC and more particularly to ensure that, in as short a period as possible and no later than 2020, (i) the fishing mortality rate does not exceed the fishing mortality rate allowing the stock to deliver MSY and (ii) the spawning biomass is maintained at or above its MSY level.		WPM					

APPENDIX 35D
WORKING PARTY ON ECOSYSTEMS AND BYCATCH PROGRAM OF WORK (2019 – 2023)

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 catch, effort and spatial distribution of those species and fleets catching them			CPCs with assistance from secretariat	TBD					
	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 resolution of non-intentioned encirclement on purse seine			IRD/AZTI	Funded (EU/DCF)					
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 species catch rates, marine turtle mortalities and other bycatch species.	CPCs directly	US$?? (TBD)					
	6.1.3 Res. 12/04 (para. 17) The IOTC Scientific Committee shall annually review the information reported by CPCs pursuant to this measure and, as necessary, provide recommendations to the 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			ACAP, Birdlife						
	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.									
	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			Consultant – status to be checked	US$?? (TBD)				

species that are usually discarded on all major gears (i.e., purse-seines, longlines and gillnets), and fisheries that take place on the high seas and in coastal countries EEZs:					
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.	High	15	WPEB	US$?? (TBD)	
		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.					
		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	

APPENDIX 35E
WORKING PARTY ON TROPICAL TUNAS PROGRAM OF WORK (2019 – 2023)

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
1. Stock structure (connectivity and diversity)	1.1 Genetic research to determine the connectivity of tropical tuna species throughout their distribution (including in adjacent Pacific Ocean waters as appropriate) and the effective population size.	Ongoing	CSIRO/AZTI/IRD/RITF	1.3 m Euro: (European Union; 20% additional co-financing)					
	1.1.3 Next Generation Sequencing (NGS) to determine the degree of shared stocks for tropical tuna species in the Indian Ocean. Population genetic analyses to decipher inter- and intraspecific evolutionary relationships, levels of gene flow (genetic exchange rate), genetic divergence, and effective population sizes.								
	1.1.4 Nuclear markers (i.e. microsatellite) to determine the degree of shared stocks for tropical tuna species in the Indian Ocean with the Pacific Ocean, as appropriate.								
	1.2 Connectivity, movements and habitat use								
	1.2.1 Connectivity, movements, and habitat use, including identification of hotspots and investigate associated environmental conditions affecting the tropical tuna species distribution, making use of conventional and electronic tagging (P-SAT).	Medium		US$?? (TBD)					
	1.2.2 Investigation into the degree of local or open population in main fishing areas (e.g,, the Maldives and Indonesia – archipelagic and open ocean) by using techniques such flux in FAD arrays or used of morphological features such as shape of otoliths.	Medium		Some work ongoing –					

Topic	Sub-topic and project	Priority ranking	Lead	Est. budget (potential source)	TIMING				
					2019	2020	2021	2022	2023
				MDV, IDN					
2. Biological and ecological information (incl. parameters for stock assessment)	2.1 Biological sampling								
	2.1.1 Design and develop a plan for a biological sampling program to support research on tropical tuna biology. The plan would consider the need for the sampling program to provide representative coverage of the distribution of the different tropical tuna species within the Indian Ocean and make use of samples and data collected through observer programs, port sampling and/or other research programs. The plan would also consider the types of biological samples that could be collected (e.g. otoliths, spines, gonads, stomachs, muscle and liver tissue, fin clips etc), the sample sizes required for estimating biological parameters, and the logistics involved in collecting, transporting and processing biological samples. The specific biological parameters that could be estimated include, but are not limited to, estimates of growth, age at maturity, fecundity, sex ratio, spawning season, spawning fraction and stock structure.	High	CPCs directly with secretariat	US$?? (TBD)					
	2.1.2 Collect gonad samples from tropical tunas to confirm the spawning periods and location of the spawning area that are presently hypothesised for each tropical tuna species.	High		US$?? (TBD)					
3. Historical data review	3.1 Changes in fleet dynamics need to be documented by fleet								
	3.1.1 Provide an evaluation of fleet-specific fishery impacts on the stock of bigeye tuna, skipjack tuna and yellowfin tuna. Project potential impact of realizing fleet development plans on the status of tropical tunas based upon most recent stock assessments.	Medium	CPCs and secretariat	US$TBD					
4 CPUE standardisation	4.1 Develop standardised CPUE series for each tropical tuna fleet/fishery for the Indian Ocean								

Topic	Sub-topic and project	Priority ranking	Lead	Est. budget (potential source)	TIMING				
					2019	2020	2021	2022	2023
	4.1.1 Further development and validation of the collaborative longline CPUE indices using the data from multiple fleets and to provide joint CPUE series for longline fleets where possible	Ongoing	SC and consultants	US$40K (IOTC)					
	4.1.2 That standardised CPUE index for juvenile yellowfin tuna and bigeye tuna caught by the EU purse seiner fleets, be estimated and submitted to the WPTT before the next round of stock assessments of tropical tunas.	Ongoing	CPCs directly	US$?? (EU Grant)					
	4.1.3 Development of minimum criteria (e.g. 10% using a simple random stratified sample) for logbook coverage to use data in standardisation processes; and 2) identifying vessels through exploratory analysis that were misreporting, and excluding them from the dataset in the standardisation analysis.	Ongoing	CPCs directly	US$?? (TBD)					
	4.1.4 Vessel identity information for the Japanese fleets for the period prior to 1979 should be obtained either from the original logbooks or from some other source, to the greatest extent possible to allow estimation of catchability change during this period and to permit cluster analysis using vessel level data.	Ongoing	Japan	US$?? (TBD)					
	Bigeye tuna: High priority fleets	High	CPCs directly						
	Skipjack tuna: High priority fleets	High	CPCs directly						
	Yellowfin tuna: High priority fleets	High	CPCs directly						
	4.1.5 Gillnet CPUE standardization including further investigate and use of gillnet CPUE series from Sri Lankan gillnet fishery	High	CPCs directly	TBD					
	4.2 That methods be developed for standardising purse seine catch species composition using operational data, so as to provide	High	Consultant and CPCs directly	US$?? (TBD)					

Topic	Sub-topic and project	Priority ranking	Lead	Est. budget (potential source)	TIMING				
					2019	2020	2021	2022	2023
	alternative indices of relative abundance (see Terms of Reference, Appendix IXb IOTC-2017-WPTT19-R).								
	4.3 Investigate the potential to use the Indian longline survey as a fishery-independent index of abundance for tropical tunas.	High	Consultant And CPCs directly	US$30K (TBD)					
5 Stock assessment / stock indicators	5.1 Develop and compare multiple assessment approaches to determine stock status for tropical tunas	Medium	Consultant and CPCs directly						
	5.2 Scoping of ongoing age composition data collection for stock assessment	Medium							
	5.3 Develop a high resolution age structured operating model that can be used to test the spatial assumptions including potential effects of limited tags mixing on stock assessment outcomes (see Terms of Reference, Appendix IXa IOTC-2017-WPTT19-R).	Ongoing	CPC directly						
	5.4 Stock assessment priorities – detailed review of the existing data sources, including*:*	High	Consultant and secretariat						
	i. Size frequency data: Evaluation of the reliability of length composition from the longline fisheries (including recent and historical data), and the need for a thorough review of the size frequency data held by IOTC, in collaboration with the fleets involved, to improve the utilization of these data in tropical tuna stock assessments.								
	ii. Tagging data: Further analysis of the tag release/recovery data set.								
	iii. Organisation of expert group to investigate tagging mortality								
	iv. Re-estimation of M using updated tagging data.								
6 Fishery independent monitoring	6.1 Develop fishery independent estimates of stock abundance to validate the abundance estimates of CPUE series.		Consultant and CPCs directly	US$?? (TBD)					
	All of the tropical tuna stock assessments are highly dependent on relative abundance estimates derived from commercial fishery catch rates, and these could be substantially biased despite efforts to standardise for operational variability (e.g.			US$60K					

Topic	Sub-topic and project	Priority ranking	Lead	Est. budget (potential source)	TIMING				
					2019	2020	2021	2022	2023
	spatio-temporal variability in operations, improved efficiency from new technology, changes in species targeting). Accordingly, the IOTC should continue to explore fisheries independent monitoring options which may be viable through new technologies. There are various options, among which some are already under test. Not all of these options are rated with the same priority, and those being currently under development need to be promoted, as proposed below:	Ongoing		US$?? (TBD)					
	i. Acoustic FAD monitoring, with the objective of deriving abundance indices based on the biomass estimates provided by echo-sounder buoys attached to FADs	High							
	ii. Longline-based surveys (expanding on the Indian model) or "sentinel surveys" in which a small number of commercial sets follow a standardised scientific protocol	Medium							
	iii. Aerial surveys, potentially using remotely operated or autonomous drones	Medium							
	iv. Studies (research) on flux of tuna around anchored FAD arrays to understand standing stock and independent estimates of the stock abundance.	High							
	v. Scoping study to investigate genetics-based tagging techniques using recaptured individuals or identification of close-related pairs. Use of Close Kin Mark Recapture (CKMR) methods to study fishery independent methods of generating spawner abundance estimates based on genotyping individuals to a level that can identify close relatives (e.g. parent-offspring or half-siblings). The method avoids many of the problems of conventional tagging, e.g. live handling is not required (only catch needs to be sampled), tag shedding, tag-induced mortality and recovery reporting rates are irrelevant. It has been cost-effective in a successful application to southern bluefin tuna, but it remains unknown how the cost scales								

Topic	Sub-topic and project	Priority ranking	Lead	Est. budget (potential source)	TIMING				
					2019	2020	2021	2022	2023
	with population size. It would be valuable to conduct a scoping exercise to evaluate the applicability to the tropical tuna species vi. Investigate the possibility of conducting ongoing ad hoc, low level tagging in the region								
7 Target and Limit reference points	7.1 To advise the Commission, on Target Reference Points (TRPs) and Limit Reference Points (LRPs). 8.1.1 Used when assessing tropical tuna stock status and when establishing the Kobe plot and Kobe matrices	High	CPC's directly	US$?? (TBD)					

APPENDIX 35F
WORKING PARTY ON DATA COLLECTION AND STATISTICS PROGRAM OF WORK (2019 – 2023)

Table 1. Priority topics for obtaining the information necessary to deliver the necessary advice to the Commission.

Topic	Sub-topic and project	Priority ranking	Est. budget (potential source)	Timing				
				2019	2020	2021	2022	2023
1. Artisanal fisheries data collection	1.1 Assist the implementation of data collection and sampling activities of coastal fisheries in countries/fisheries insufficiently sampled in the past; priority to be given to the following fisheries: • Coastal fisheries of Indonesia • Coastal fisheries of Pakistan • Coastal fisheries of Sri Lanka • Coastal fisheries of Kenya • Coastal fisheries of I.R. Iran	HIGH	US$??? (Co-funding IOTC)					
	1.2 Scoping study on monitoring of artisanal fisheries in the Indian Ocean • Evaluation of the status of coastal fisheries data collection for priority CPCs identified as important for catches of artisanal fisheries (i.e., IOTC species and CITES species) • Best practice flow diagram for artisanal port sampling data collection • Develop general guidelines for data collection from artisanal fisheries at the landing place • Recommendations on short term and long term strategies for obtaining data and capacity building for artisanal fisheries in the IOTC Area of Competence	HIGH / MED	US$ 30K (FAO / CITES with possibility of extra funds from WWF – TORs for consultancies available as paper INF04)					
4. Assistance to CPCs for the fulfillment of Resolution 18/01 mandate	2.1 Provide support to requesting CPCs to increase their level of monitoring and reporting in accordance with paragraph 8 of Resolution 18/01	MED / LOW	US$ 30K (EU cofund.)					
3. Review Size Data Longline Fisheries	3.1 Assistance to historical review of length frequency data for longline fisheries, in particular longliners from Taiwan,China and Japan	MED	US$ 48K (EU cofund.)					
	4.1 Data support missions							

4.	Compliance with IOTC Data Requirements	4.1.1 Identification of indicators to assess performance of IOTC CPCs against IOTC Data Requirements; evaluation of performance of IOTC CPCs with those Requirements; development of plans of action to address the issues identified, including timeframe of implementation and follow-up activities required. Priority to be given to the following fisheries:	HIGH	US$ 5-10K each (EU cofund.)						
		• Indonesia			■					
		• Pakistan			■					
		• Sri Lanka			■					
		• India			■	■				
		• Yemen					■			
		4.2 Analyzing the impact and requirements for the harmonization of terminology and data collection / reporting requirements for FOB and instrumented buoys	HIGH		■					
5.	IOTC Data Access	5.1 Establishment of a public repository of historical CPUE series to be made accessible under a dedicated section of the IOTC website	MED	US$??? (TBD – Consultant ?)	■					
		5.2 Assessing the requirements needed for an automated incorporation of environmental information under the IOTC website	HIGH / MED	US$??? (TBD)	■					
		5.3 Enrichment of IOTC data sets and documents with standard metadata for improved access and dissemination	HIGH	US$??? (INTERREG funds?)	■	■				
6.	ROS – Support for the implementation of the IOTC Regional Observer Scheme	6.1 ROS tools								
		6.1.1 Support the adoption of the ROS e-tools for CPCs not having any existing observer data collection and management system in place	HIGH	US$??? (TBD)	■	■				
		6.2 ROS Regional Database								
		6.2.1 Finalize the development of automated mechanisms for the exchange of information between the ROS database and other well-established scientific observer data collection systems (e.g. *ObServe*, *SWIOFP*, custom databases)	HIGH	US$??? (Already funded - Consultant)	■					

6.2.2	Implement dissemination best-practices for data collected by the ROS Regional Database	HIGH	US$??? (TBD - Consultant)					
6.3	ROS Electronic Monitoring Systems							
6.3.1	Implement pilot EMS system on gillnet / coastal longline vessels for fleets insufficiently covered by on-board observers (noting that work has started already in LKA)	HIGH	US$ 150k (CPCs, EU cofunded)					
6.3.2	Collaborate with CPCs for the development of standards for EMS data collection and reporting applicable to different gear types	HIGH	US$??? (TBD)					
6.4	Scoping study to assess and endorse the feasibility of using crew-based observer programmes for ROS purposes	HIGH	US$??? (TBD)					

APPENDIX 35G
WORKING PARTY ON METHODS PROGRAM OF WORK (2019 – 2023)

Table 1. Priority topics for obtaining the information necessary to deliver the necessary advice to the Commission. Resolution 15/10 elements have been incorporated as required by the Commission.

Topic	Sub-topic and project	Research Priority	Funding Priority	Lead	Est. budget (potential source)	Timing				
						2019	2020	2021	2022	2023
1. Management Strategy Evaluation	1.1 Albacore	High	1	EU (JRC)	Funded (EC JRC)					
	1.1.1 Revision of Operating Models based on WPM and SC feedback, including possible robustness tests									
	1.1.2 Implementation of initial set of simulation runs and results									
	1.1.3 Revision of Management Procedures and Indicators after presentation of initial set to TCMP and Commission									
	1.1.4 External peer review (2018 or date TBD)				US$15,000					
	1.1.5 Evaluation of new set of Management Procedures (if required)									
	1.2 Skipjack tuna	High	5	Maldives						
	1.2.1 Review of model implementation and participation in MSE process				US$75,000 (EC) to be finalised					
	1.3 Bigeye tuna	High	3							
	1.3.1 Update OM & present preliminary MP results to TCMP, WPTT/WPM review of new OM			Australia (CSIRO)	$75,000 (ABNJ/CSIRO) pending					
	1.3.2 External peer review (2018 or date TBC)				US$15,000					
					$30,000					

	1.3.3 Present revised MP results to TCMP with target adoption date of 2019				(Jan - Jun 2018)	
	1.3.4 Additional iterations if required				(TBD)	
	1.4 Yellowfin tuna	High	2			
	1.4.1 Update OM & present preliminary MP results to TCMP, WPTT/WPM review of new OM			Australia (CSIRO)	$75,000 (ABNJ/CSIRO) pending)	
	1.4.2 External peer review (2018 or date TBD)				US$15,000	
	1.4.3 Present revised MP results to TCMP with target adoption date of 2018; iteratively update development if required)				US$30,000 (Jan-Jun 2018)	
	1.4.4 additional iterations if required				(TBD)	
	1.5 Swordfish	High	4	TBD	USD$2,500 (EC)	
	1.5.1 Initial OM					
	1.5.2 Conditioning and OM set up					
	1.5.3 Generic MP tests					
	1.5.4 Final Model with MPs					
	1.5.5 External peer review				US$15,000	
2. Presentation of stock status advice for data limited stocks	2.1 Explore potential methods of presenting stock status advice to managers from a range of data limited scenarios, e.g. through the development of a 'Tier' approach for providing stock status advice, based on the type of indictors used to determine stock status (e.g. CPUE series, stock assessment model)	Medium	7	Consult.	US$30,000 (EC)	

3. Multiple stock status derived from different model structures	3.1 Develop specific guidance for the most appropriate models to be used or how to synthesize the results when multiple stock assessment models are presented. (*see IOTC-2016-WPTT18-R, para.91*)	Medium	6		$?? (TBD)					

APPENDIX 36
SCHEDULE OF STOCK ASSESSMENTS FOR IOTC SPECIES AND SPECIES OF INTEREST FROM 2019–2023, AND FOR OTHER WORKING PARTY PRIORITIES

Working Party on Neritic Tunas					
Species	**2019****	**2020***	**2021*****	**2022**	**2023***
Bullet tuna	Data preparation	**Assessment**	Data preparation	Data preparation	**Assessment**
Frigate tuna	Data preparation	**Assessment**	Data preparation	Data preparation	**Assessment**
Indo-Pacific king mackerel	Data preparation	**Assessment**	Data preparation	Data preparation	**Assessment**
Kawakawa	Data preparation	**Assessment**	Data preparation	Data preparation	**Assessment**
Longtail tuna	Data preparation	**Assessment**	Data preparation	Data preparation	**Assessment**
Narrow-barred Spanish mackerel	Data preparation	**Assessment**	Data preparation	Data preparation	**Assessment**

* Including data-limited stock assessment methods;
** Including species-specific catches, CPUE, biological information and size distribution;
*** Identification of data gaps and discussion of improvements to the assessments (stock structure);
Note: the assessment schedule may be changed dependent on the annual review of fishery indicators, or SC and

Working Party on Billfish					
Species	**2019**	**2020**	**2021**	**2022**	**2023**
Black marlin			**Full assessment**		
Blue marlin	**Full assessment**			**Full assessment**	
Striped marlin			**Full assessment**		
Swordfish	**Indicators**	**Full assessment**		**Indicators**	**Full assessment**
Indo-Pacific sailfish	**Full assessment***			**Full assessment***	

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

Working Party on Tropical Tunas					
Species	**2019**	**2020**	**2021**	**2022**	**2023**
Bigeye tuna	**Full assessment**	Indicators	Indicators	**Full assessment**	Indicators
Skipjack tuna	Indicators	**Full assessment**	Indicators	Indicators	**Full assessment**
Yellowfin tuna	**Full Assessment***	Indicators	**Full assessment**	Indicators	Indicators

* According to the details provided by the workplan in Appendix 38 of the SC report

Working Party on Ecosystems and Bycatch					
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
Marine turtles		Interactions/Indicators			
Seabirds	–	Review of mitigation measures in Res. 12/04	–	–	Indicators
Marine Mammals	ERA; Review of mitigation measures in Res. 12/06	–	-	Review of mitigation measures in Res. 12/06	–
Ecosystem Based Fisheries Management (EBFM) approaches	Report from the IWC	–	ERA	–	–

*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.

Working Party on Temperate					
Species	**2017**	**2018**	**2019**	**2020**	**2021**
Albacore	–		Data preparatory meeting **and Stock assessment**	–	Data preparatory meeting

* This Working Party did not meet in 2017 or 2018.

APPENDIX 37
SCHEDULE OF IOTC WORKING PARTY AND SCIENTIFIC COMMITTEE MEETINGS
(2019 and 2020)

	2019			2020		
Meeting	**No.**	**Date**	**Location**	**No.**	**Date**	**Location**
Working Party on **Neritic**	9th	1 – 5 July	Sri Lanka	10th	TBD	Kenya
Working Party on **Temperate Tunas (WPTmT)**		Data Preparatory meeting 14 – 17 January (4d)	Malaysia	8th	TBD	TBD
	7th	Stock Assessment 22 – 25 July (4d)	Japan			
Working Party on **Billfish** (WPB)	17th	9-12 September (4d)	La Réunion	18th	1-5 September (5d)	TBD
Working Party on **Ecosystems and Bycatch** (WPEB)	15th	2-6 September (5d)	La Réunion	16th	7-11 September (5d)	TBD
Working Party on **Methods**	10th	17 – 19 October (3d)	San Sebastian, Spain	11th	Third week in October (3d) (with WPTT)	Maldives
Working Party on **Tropical Tunas**	21st	21 – 26 October (6 d)	San Sebastian, Spain	22nd	Third week in October (3d) (with WPM)	Maldives
Working Party on **Data Collection and Statistics**	15th	27 – 30 November (4d)	Pakistan	16th	November (3d)	Seychelles
Scientific Committee	22nd	2 – 6 December (5d)	Pakistan	23rd	November (5d)	Seychelles

APPENDIX 38
WORKPLAN TO IMPROVE CURRENT ASSESSMENT OF YELLOWFIN TUNA

The assessment of three Indian Ocean tropical tuna stocks faces common problems and complexities. Their stock assessment deal with comparable issues; uncertainty in data, in model specification and of reliable estimation of parameters.

Here, we propose a work-plan to facilitate harmonization of modelling choices and practices in the stock assessment with view of improving the latest stock assessment for yellowfin tuna but also for skipjack and bigeye tuna.

This workplan has two main components: uncertainty on data and modelling choices. The first is proposed to review the data sets currently in use for tropical tuna stock assessments and to redefine options for model inputs.

The second component aims at agreeing different steps and practices for stock assessment. For example, on alternative models to add contrast to results. This is currently done in *ad-hoc* fashion with little attention paid to the approaches and they are often presented as very preliminary and they are not refined during the meeting or inter-sessionally. Also, the use of alternative spatial structures for each stock should be revisited. The models currently being used are complex in their spatial and temporal resolution and this may be adapted to accommodate with the information available (e.g. tagging data). Finally, of utmost importance is to standardize a set of diagnostic checks that will be done for the models used to provide scientific advice. Although the practice is followed, individually by the stock assessment scientists there is no standardized and agreed series of diagnostic protocols to follow.

Item	Options	Responsibility	Timeline*	Budget
Uncertainty in Data				
Catch	Explore scenarios of alternative time series/catch histories	Secretariat in collaboration with Chair/Vice-Chair	Short term	
Tagging Data	Evaluate alternative use of tagging data	Secretariat for SA	Short term	
Size data	Review of size frequency data	Secretariat through a consultancy	Short term	
CPUE	Alternative series (EU, Maldives)	CPCs	Short term	
	Options for LL CPUE • Joint • Clustering to identify targeting • Long series	CPCs, Consultant identified by IOTC	Short term	
Model Uncertainty				
Alternative models	• Biomass dynamic (JABBA, mpb) • Age/size structured (VPA) • Fully integrated (SS3)	CPCs, modelers, WPTT contractor, Secretariat	Short term	
Spatial and stock structure	1, 2, 4 areas?	CPCs, modelers, WPTT, contractor, Secretariat	Short, mid-term	

Key uncertainty inputs • Weighting of data sources • Key parameters (Growth, tag mortality, steepness) • Catch reporting scenarios	• Weighting of data sources • Decision on options for parameters and seek agreement to reduce options	• Group of experts • data prep • workshop	Short to mid-term	
Statistical uncertainty	Bootstraps, Delta methods (Ref case), others…	Modelers, contractor, Secretariat	Short, mid-term	
Characterization of uncertainty	• Across models • Across scenarios • Statistical analyses	Modelers, contractor, Secretariat	Short, mid-term	
Agreed set of diagnostics (compulsory)	• Retrospectives, likelihoods, jitter analysis hindcasting… similar to the stock assessment, at least on a proposed Reference Case. • Develop protocol for retrospectives correction in stock status	Modelers, contractor, Secretariat, WPTT, WPM	Short, mid-term	
Management Strategy Evaluation (contribution to SA)	• Evaluate influence of data • Characterize sources of uncertainty • Improve fits	Contractor, modeler, WPTT, WPM	Short, mid-term	

* Short term – Pre WPTT21, Mid-term – Pre SC22

APPENDIX 39
LETTER FROM JAPAN REGARDING THE USE OF TRANSSHIPMENT INFORMATION

FISHERIES AGENCY

MINISTRY OF AGRICULTURE . FORESTRY AND FISHERIES , GOVERNMENT OF JAPAN
1-2-1, Kasumigaseki, Chiyoda-ku, Tokyo 100-8907, Japan

TEL: +81-3-3502-8460 FAX: +81-3-3502-0571

November 30, 2018

Mr. Christopher O'Brien
Executive Secretary

Indian Ocean Tuna Commission

Dear Mr. O'Brien

I am writing regarding your response letter (IOTC REF: 4073) to Mr. Ara, which explains how to improve the process of data from the regional observer program. While I appreciate your response -to the questions, I am still unclear about the actions taken by the IOTC secretariat against Birdlife's request and the current practice in collection and management of transshipment observer data.

First, according to the agreement made in advance between Birdlife and the IOTC (Transshipment Data Users Application Form, approved 14/07/2017), the Secretariat had to circulate the draft project report to all relevant CPCs in order to provide the opportunity for comments before the report was finalized: It was unfortunate that the IOTC secretariat did not follow this procedure and allowed Birdlife to make a presentation at WPEB. It was regrettable that-the Secretariat posted this presentation report on the IOTC homepage after the WPEB. Although the report has been recently deleted from the homepage, it was open to the public for several months.

Another problematic point is that this report ignored the agreed condition that no photographs of vessels shall be published, and that all photos, including photos of logbook pages, shall be used only for scientific purposes and not be perceived as the evidence indicating any infraction about seabird bycatch mitigation measures. We see this case very seriously since the Secretariat did not follow the agreed procedure.

Secondly, some of the data collected by transshipment observers and used to publish the report are outside the duty of observers. The duty of observers is clearly set by Annex III of Resolutions 17/06 and we cannot overlook violation thereto. In this regard, we are concerned about your response letter (IOTC REF: 4073), which said that there were some ROP observers collecting and submitting unpermitted

information on the logbook and as an unfortunate consequence those data can be released to Birdlife together with permitted information. As you know, the logbook data are confidential information. It would be a serious problem if: (i) the Secretariat allowed the collection of unpermitted data by observers; (ii) the Secretariat released those data to others without proper check; and (iii) the Secretariat or the Consortium still holds such data.

You may be already aware that at the CCSBT annual meeting last October, Birdlife made a presentation, exactly the same as the one made in WPEB. Birdlife is now publishing reports and making presentations even in other international organizations, as if their reports and presentations were officially permitted and allowed by IOTC. Although they withdrew this report and presentation afterwards, Japan cannot accept this kind of inappropriate methods to spread reports and presentations that use unpermitted data and that are not shared beforehand to all relevant CPCs.

We believe that this case concerns not only longline countries but also other CPCs in terms of how to handle data. Therefore, I would like to request the Secretariat to investigate the case and explain the results to all CPCs. Such explanation should include, in particular, (i) what happened; (ii) why happened; (iii) what responsive actions have been taken; and (iv) what have been done or will be done to prevent the same thing from happening in the future.

I would appreciate it if you could circulate this letter to CPCs.

Sincerely yours,

Shingo Ota

Japanese Commissioner to IOTC

APPENDIX 40
CONSOLIDATED SET OF RECOMMENDATIONS OF THE 21ST SESSION OF THE SCIENTIFIC COMMITTEE (3 – 7 DECEMBER 2018) TO THE COMMISSION

STATUS OF TUNA AND TUNA-LIKE RESOURCES IN THE INDIAN OCEAN AND ASSOCIATED SPECIES

Tuna – Highly migratory species

SC21.01 (para. 197) The SC **RECOMMENDED** that the Commission note the management advice developed for each tropical and temperate tuna species as provided in the Executive Summary for each species, and the combined Kobe plot for the four species assigned a stock status in 2018 (Fig. 2):

- Albacore (*Thunnus alalunga*) – Appendix 8
- Bigeye tuna (*Thunnus obesus*) – Appendix 9
- Skipjack tuna (*Katsuwonus pelamis*) – Appendix 10
- Yellowfin tuna (*Thunnus albacares*) – Appendix 11

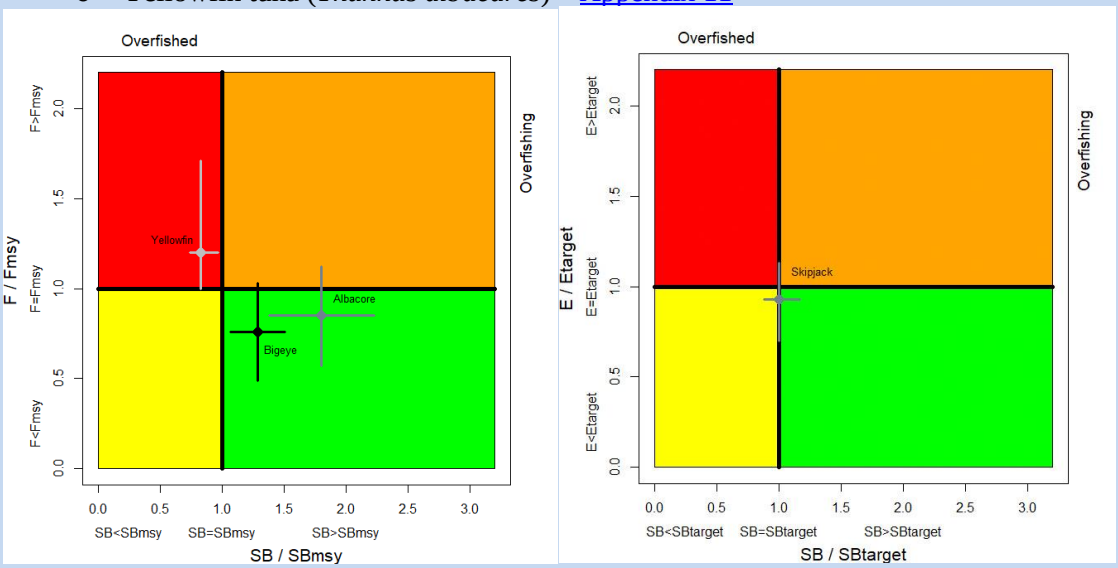

Fig. 2. (Left) Combined Kobe plot for bigeye tuna (black: 2015), yellowfin tuna (grey: 2017), and albacore tuna (dark grey: 2014) showing the estimates of current spawning stock size (SB) and current fishing mortality (F) in relation to SBtarget and Ftarget. (Right) Kobe plot for skipjack tuna (2016) showing the estimates of the current spawning stock status (SB) and exploitation rate in relation to SBtarget and Etarget. Numbers in brackets indicate the last year of data available at the time of the assessment. Cross bars illustrate the range of uncertainty from the model runs with 80% CI.

Billfish

SC21.02 (para. 200) The SC **RECOMMENDED** that the Commission note the management advice developed for each billfish species under the IOTC mandate, as provided in the Executive Summary for each species, and the combined Kobe plot for the five species assigned a stock status in 2018 (Fig. 4):

- Swordfish (*Xiphias gladius*) – Appendix 12
- Black marlin (*Makaira indica*) – Appendix 13
- Blue marlin (*Makaira nigricans*) – Appendix 14
- Striped marlin (*Tetrapturus audax*) – Appendix 15
- Indo-Pacific sailfish (*Istiophorus platypterus*) – Appendix 16

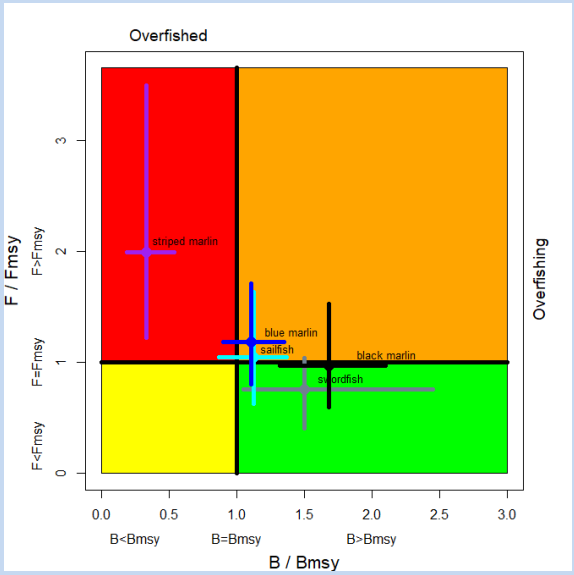

Fig. 4. Combined Kobe plot for swordfish (grey: 2015), indo-pacific sailfish (cyan: 2014), black marlin (black: 2018), blue marlin (blue: 2015) and striped marlin (purple: 2018) showing the estimates of stock size (SB or B, species assessment dependent) and fishing mortality (F) in relation to MSY-based reference points. Numbers in brackets indicate the last year of data available at the time of the assessment. Cross bars illustrate the range of uncertainty from the model runs.

Tuna and seerfish – Neritic species

SC21.03 (para. 199) The SC **RECOMMENDED** that the Commission note the management advice developed for each neritic tuna (and mackerel) species under the IOTC mandate, as provided in the Executive Summary for each species, and the combined Kobe plot for the three species assigned a stock status in 2018 (Fig. 5):

- Bullet tuna (*Auxis rochei*) – Appendix 17
- Frigate tuna (*Auxis thazard*) – Appendix 18
- Kawakawa (*Euthynnus affinis*) – Appendix 19
- Longtail tuna (*Thunnus tonggol*) – Appendix 20
- Indo-Pacific king mackerel (*Scomberomorus guttatus*) – Appendix 21
- Narrow-barred Spanish mackerel (*Scomberomorus commerson*) – Appendix 22

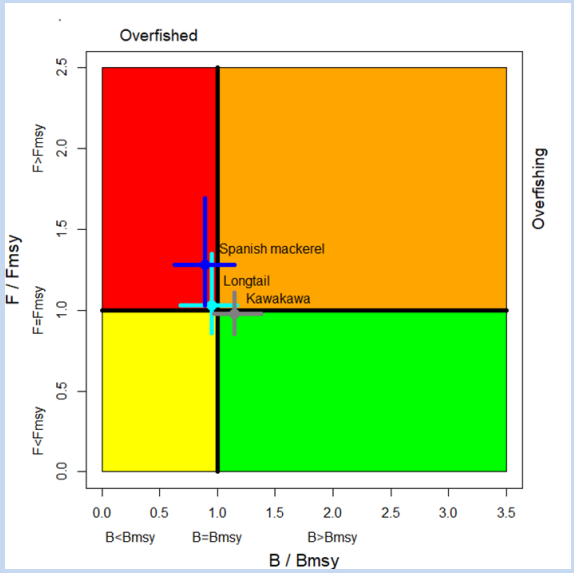

Fig. 3+. Combined Kobe plot for longtail tuna (cyan: 2015), narrow-barred Spanish mackerel (dark blue: 2016), and kawakawa (white: 2013) showing the estimates of stock size (B) and current fishing mortality (F) in relation to MSY-based reference points. Numbers in brackets indicate the last year of data available at the time of the assessment. Cross bars illustrate the range of uncertainty from the model runs.

Sharks

SC21.04 (para. 201) The SC **RECOMMENDED** that the Commission note the management advice developed for a subset of shark species commonly caught in IOTC fisheries for tuna and tuna-like species:

- Blue shark (*Prionace glauca*) – Appendix 23
- Oceanic whitetip shark (*Carcharhinus longimanus*) – Appendix 24
- Scalloped hammerhead shark (*Sphyrna lewini*) – Appendix 25
- Shortfin mako shark (*Isurus oxyrinchus*) – Appendix 26
- Silky shark (*Carcharhinus falciformis*) – Appendix 27
- Bigeye thresher shark (*Alopias superciliosus*) – Appendix 28
- Pelagic thresher shark (*Alopias pelagicus*) – Appendix 29

Marine turtles

SC21.05 (para. 202) The SC **RECOMMENDED** that the Commission note the management advice developed for marine turtles, as provided in the Executive Summary encompassing all six species found in the Indian Ocean:

- Marine turtles – Appendix 30

Seabirds

SC21.06 (para. 203) The SC **RECOMMENDED** that the Commission note the management advice developed for seabirds, as provided in the Executive Summary encompassing all species commonly interacting with IOTC fisheries for tuna and tuna-like species:

- Seabirds – Appendix 31

Cetaceans

SC21.07 (para. 204) The SC **RECOMMENDED** that the Commission note the management advice developed for cetaceans, as provided in the newly developed Executive Summary encompassing all species commonly interacting with IOTC fisheries for tuna and tuna-like species:

- Cetaceans – Appendix 32

GENERAL RECOMMENDATIONS TO THE COMMISSION

NATIONAL REPORTS FROM CPCS

SC21.08 (para. 22) Noting that the Commission, at its 15th Session, expressed concern regarding the limited submission of National Reports to the SC, and stressed the importance of providing the reports by all CPCs, the SC **RECOMMENDED** that the Commission note that in 2018, 26 reports were provided by CPCs (23 in 2017, 23 in 2016, 26 in 2015) (Table 2).

SC21.09 (para. 23) The SC **RECOMMENDED** that the Compliance Committee and Commission note the lack of compliance by 7 Contracting Parties (Members) and 1 Cooperating Non-Contracting Party (CNCPs) that did not submit a National Report to the Scientific Committee in 2018, noting that the Commission agreed that the submission of the annual reports to the Scientific Committee is mandatory.

REPORT OF THE 8TH SESSION OF THE WORKING PARTY ON NERITIC TUNAS (WPNT08)

Assessment and status of neritic tunas

SC21.10 (para. 39) The SC **RECOMMENDED** that the Commission allocates funding for a consultancy to support the CPCs identified in Appendix VI of the report of the 8th session of the Working Party on Neritic Tunas (IOTC–2018–WPNT08–R[E]) with CPUE standardisation for the priority species identified.

Working party attendance and the MPF

SC21.11 (para. 42) Noting the low number of participants from CPCs at the 2018 WPNT meeting (six excluding the Chair and Vice-Chair), the SC **RECOMMENDED** that future capacity building actions and specialised workshops are conducted back-to-back with the regular Working Party meetings so that each CPC can send their most appropriate scientists to the meetings and workshops.

REPORT OF THE 16TH SESSION OF THE WORKING PARTY ON BILLFISH (WPB16)

SC21.12 (para. 44) The SC recalled its previous **RECOMMENDATION** that on the next revision of the IOTC Agreement, the shortbill spearfish (*Tetrapturus angustirostris*) be included as an IOTC species.

Swordfish MSE

SC21.13 (para. 66) The SC noted that one of the team members involved in the development of the swordfish OM is starting a PhD in 2019 with IO Swordfish MSE included as one objective. The SC noted that salaries are already covered for next years for that team member, but further funding is required to support the travelling and time for two short-term visits to the JRC, as well as to attend IO MSE-technical workshops and WPM meeting in 2019. The SC therefore **RECOMMENDED** to fund this work during 2019 in order to progress the work on the IOTC MSE for SWO, with a total of 10.000€ requested for 2019, further noting that part of the funds (around 3.000€) should be available earlier in the year to start the work no later than March 2019.

Revision of catch levels of Marlins under Resolution 18/05

SC21.14 (para. 69) The SC noted that catches in recent years for Black Marlin, Blue Marlin, Striped Marlin and Indo-Pacific Sailfish have all exceeded the catch limits set by Resolution 18/05, and that current catch trends for all four species show no signs of decline in line with meeting the catch limits by 2020. As such, the SC urgently **RECOMMENDED** that measures are agreed to reduce current catches to the limits set for all four species covered by Resolution 18/05 as per the management advice given in the Executive Summaries.

REPORT OF THE 14TH SESSION OF THE WORKING PARTY ON ECOSYSTEMS AND BYCATCH (WPEB14)

SC21.15 (para. 71) The SC **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.

SC21.16 (para 72) The SC 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 SC **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

Bycatch species identification and data issues

SC21.17 (para. 76) Despite identification cards being available, the SC noted ongoing issues around species identification data for sea turtles, sharks, cetaceans and other bycatch species and **AGREED** that improvements to the collection of data for all bycatch species is required. The Secretariat noted that these data are currently collected through national reports and observer data submissions, but were often limited. Consequently, the SC **RECOMMENDED** to the Commission that the species reporting of turtles (as a first step) is improved through an amendment to Annexes II and III in Resolution 15/01.

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

SC21.18 (para. 85) The SC **RECOMMENDED** that the Commission note the current status of development and implementation of National Plans of Action (NPOAs) for sharks and seabirds, and the implementation of the FAO guidelines to reduce marine turtle mortality in fishing operations, by each CPC as provided in Appendix 5, recalling that the IPOA-Seabirds and IPOA-Sharks were adopted by the FAO in 1999 and 2000, respectively, and recommended the development of NPOAs.

Progress towards Ecosystem Based Fisheries Management (EBFM) in IOTC – Preliminary Ecosystem Report Cards

SC21.19 (para. 101) Acknowledging the potential benefits of a climate-ocean web portal and regular updates on these influences to the SC and WPs, the SC **RECOMMENDED** a scoping study into how ocean-climate information as described in the proposal could be made available through the IOTC webpage and how this information would be presented to the WPs and SC. The scoping study should also consider the currency and quality of the information sources to be used.

REPORT OF THE 20TH SESSION OF THE WORKING PARTY ON TROPICAL TUNAS (WPTT20)

Yellowfin tuna stock assessment and development of management advice

SC21.20 (para. 103) The SC noted that the 2018 yellowfin tuna assessment indicates that the species is overfished and subject to overfishing and catch reductions required as part of Resolution 18/01 have not been met. The SC further noted that there remain significant uncertainties around the stock assessment inputs and assumptions, such that caveats are required in the interpretation of management advice developed for the species. Acknowledging these concerns, the SC **RECOMMENDED** that funding be allocated for a workplan (Appendix 38) to systematically address these issues, beginning in January 2019.

Future yellowfin tuna assessments: issues for consideration

SC21.21 (para. 123) The SC **RECOMMENDED** that development of the next stock assessment of yellowfin tuna should include, or be associated with, a detailed review of the existing data sources, including:

iv. Size frequency data: Evaluation of the reliability of length composition from the longline fisheries (including recent and historical data), review of anomalies in the (EU) PS length composition data, and the need for a thorough review of the size frequency data held by IOTC, in collaboration with the fleets involved, to improve the utilization of these data in tropical tuna stock assessments.

v. Tagging data: Further analysis of the tag release/recovery data set.

vi. Alternative CPUE series: a review of the available data from the Indian tuna longline survey data.

Review of the statistical data available for skipjack tuna

SC21.22 (para. 127) The SC noted that total catches in 2017 (524,282 t) were 12% higher than the catch limit generated by the Harvest Control Rule (470,029 t) which applies to the years 2018–2020, and that there has been an increasing trend in catches over the past 3 years. The SC **RECOMMENDED** that the Commission consider the urgent need to monitor catches of skipjack in the 2018–2020 period to ensure catches do not exceed the limit.

REPORT OF THE 9TH SESSION OF THE WORKING PARTY ON METHOD (WPM09)

Skipjack tuna MSE

SC21.23 (para. 148) Noting that the skipjack tuna harvest control rule is not a fully specified management procedure, the SC **RECOMMENDED** that a workplan and budget should be developed to undertake review and possible revision of the skipjack tuna harvest control rule under Resolution 16/02.

Stock Status Guidance

SC21.24 (para. 156) The SC noted that IOTC provide stock status relative to target reference points or MSY-based reference points. The SC further noted that WCPFC only considers a stock "overfished" when biomass falls below limit reference points, not the target reference point. The SC **RECOMMENDED** to consider alternative formulations of the Kobe plot to indicate an appropriate buffer zone below BMSY to account for natural variations in biomass. A plot such as that included in figure 1 was **SUGGESTED** to be discussed by the Working Parties and the SC as a possibility for formulating the scientific management advice to the Commission.

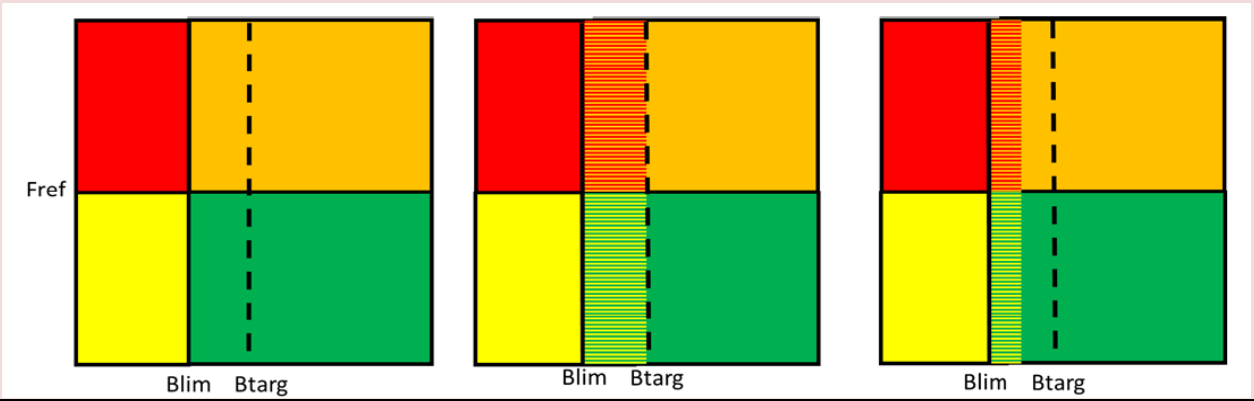

Figure 1 Three examples of modified Kobe Plots in which there is a target biomass, Btarg, and a reference F (Fref) such as FMSY. In each plot. The red quadrant is based on biomass being below the limit (Blim) rather than below a target biomass. The plot in the middle retains the four colours, but contains red-orange and yellow-green "buffer zones" between the target and limit. In the plot on the right, the buffer zone starts somewhat below the target biomass to account for natural fluctuations of the stock around the target. Note: This figure is from the ISSF Stock Assessment Workshop report (IOTC-2018-WPM09-INF06).

REPORT OF THE 14TH SESSION OF THE WORKING PARTY ON DATA COLLECTION AND STATISTICS (WPDCS14)

SC21.25 (para. 166) The SC noted that there has been an increase in participation and submission of documents to the WPDCS in recent years. The SC acknowledged that the current duration of the meeting (3 days) is not sufficient to facilitate the presentation and discussion of these documents. The SC therefore **RECOMMENDED** that future sessions of the WPDCS be extended to four days.

Electronic monitoring systems

SC21.26 (para. 168) The SC **RECOMMENDED** the development of minimum standards for EMS (including, for example, cameras) for IOTC. The SC noted that the WCPFC are currently drafting standards on EM and acknowledged that it would be pertinent for the IOTC to follow this process and utilise the outcomes where relevant.

Regional Observer Scheme Minimum Standard Data Fields

SC21.27 (para. 169) The SC **RECOMMENDED** that the ROS *Minimum Standard Data Fields* in Appendix 6a are adopted by the Commission.

ROS draft programme standards

SC21.28 (para. 174) Noting concerns with the overlap between scientific, compliance and legal issues in relation to the *draft programme standards*, the SC **RECOMMENDED** that the Commission form an ad hoc technical committee representing the breadth of mandates to specifically address this issue to ensure the relevant expertise is available to discuss scientific and operational aspects of the *draft Programme Standards and Guidelines* to be presented to the SC and Ccompliance Committee before it is provided to the Commission for endorsement.

SUMMARY DISCUSSION OF MATTERS COMMON TO WORKING PARTIES (CAPACITY BUILDING ACTIVITIES – STOCK ASSESSMENT COURSE; CONNECTING SCIENCE AND MANAGEMENT, ETC.)

Invited Expert(s) at the WP meetings

SC21.29 (para. 177) Given the importance of external peer review for working party meetings, the SC **RECOMMENDED** that the Commission continues to allocate sufficient budget for an invited expert to be regularly invited to all scientific WP meetings.

Meeting participation fund

SC21.30 (para. 178) The SC reiterated its **RECOMMENDATION** that the IOTC Rules of Procedure (2014), for the administration of the Meeting Participation Fund be modified so that applications are due not later than 60 days, and that the full Draft paper be submitted no later than 45 days before the start of the relevant meeting. The aim is to allow the Selection Panel to review the full paper rather than just the abstract, and provide guidance on areas for improvement, as well as the suitability of the application to receive funding using the IOTC MPF. The earlier submission dates would also assist with visa application procedures for candidates.

IOTC species identification guides: Tuna and tuna-like species

SC21.31 (para. 179) The SC reiterated its **RECOMMENDATION** that the Commission allocates budget towards continuing the translation and printing of the IOTC species ID guides so that hard copies of the identification cards can continue to be printed as many CPCs scientific observers, both on board and port, still do not have smart phone technology/hardware access and need to have hard copies on board.

IOTC Secretariat staffing

SC21.32 (para. 180) Noting the very heavy workload at the IOTC Secretariat and the ever increasing demands by the Commission and the Scientific Committee, and also the capacity to respond to requests for assistance by countries, the SC **RECOMMENDED** that the recommendation from the Performance Review PRIOTC02.07(g) is implemented, and that permanent staff of the IOTC Data and Science

Section be increased by two (2) (1 x P4 and 1 x P3 level positions), supplemented by additional short-term consultants. Funding for these new positions should come from both the IOTC regular budget and from external sources to reduce the financial burden on the IOTC membership.

Chairpersons and Vice-Chairpersons of the SC and its subsidiary bodies

SC21.33 (para. 181) The SC **RECOMMENDED** that the Commission note and endorse the Chairpersons and Vice-Chairpersons for the SC and its subsidiary bodies for the coming years, as provided in Appendix 7.

PROGRESS ON THE IMPLEMENTATION OF THE RECOMMENDATIONS OF THE PERFORMANCE REVIEW PANEL

SC21.34 (para. 214) The SC **RECOMMENDED** that the Commission note the updates on progress regarding Resolution 16/03, as provided at Appendix 33.

PROGRAM OF WORK AND SCHEDULE OF WORKING PARTY AND SCIENTIFIC COMMITTEE MEETINGS

Consultants

SC21.35 (para. 234) Noting the highly beneficial and relevant work done by IOTC stock assessment consultants in previous years, the SC **RECOMMENDED** that the engagement of consultants be continued for each coming year based on the Program of Work. Consultants will be hired to supplement the skill set available within the IOTC Secretariat and CPCs.

IOTC SCIENTIFIC STRATEGIC PLAN

SC21.36 (para. 247) The SC **AGREED** that the draft IOTC Strategic Science Plan 2020–2024 will be distributed to Heads of Delegation from each CPC for comment during early 2019, following which time comments will be collated and consolidated and another version sent to CPCs for final review. Pending agreement of CPCs, and noting that the IOTC Strategic Science Plan would be a dynamic document that would change over time, the SC **RECOMMENDED** that the revised draft of the IOTC Strategic Science Plan 2020–2024 be tabled at the Commission meeting in 2019.

REVIEW OF THE DRAFT, AND ADOPTION OF THE REPORT OF THE 18TH SESSION OF THE SCIENTIFIC COMMITTEE

SC21.37 (para. 250) The SC **RECOMMENDED** that the Commission consider the consolidated set of recommendations arising from SC21, provided at Appendix 40.