Report of the 22nd Session of the IOTC Scientific Committee

Karachi, Pakistan, 2 – 6 December 2019

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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.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The 22nd Session of the Indian Ocean Tuna Commission (IOTC) Scientific Committee (SC) was held in Karachi, Pakistan, from 2 – 6 December 2019. A total of 43 delegates and other participants attended the Session (65 in 2018), comprised of 34 delegates from 15 Contracting Parties (23 in 2018), and 0 delegates from Cooperating Non-Contracting Parties (0 in 2018), and 9 participants from 2 observer organisations. The list of participants is provided at Appendix 1.

The opening of the meeting was attended by the Honourable Ali Haider Zaidi, Minister for Maritime Affairs, and the meeting was chaired by the Vice-Chairperson, Dr Shiham Adam (Maldives).

The following are the recommendations from the 22nd Session of the Scientific Committee, which are provided in Appendix 38.

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

Tuna – Highly migratory species

SC22.01 (para. 117) 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 2019 (Fig. 1):

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

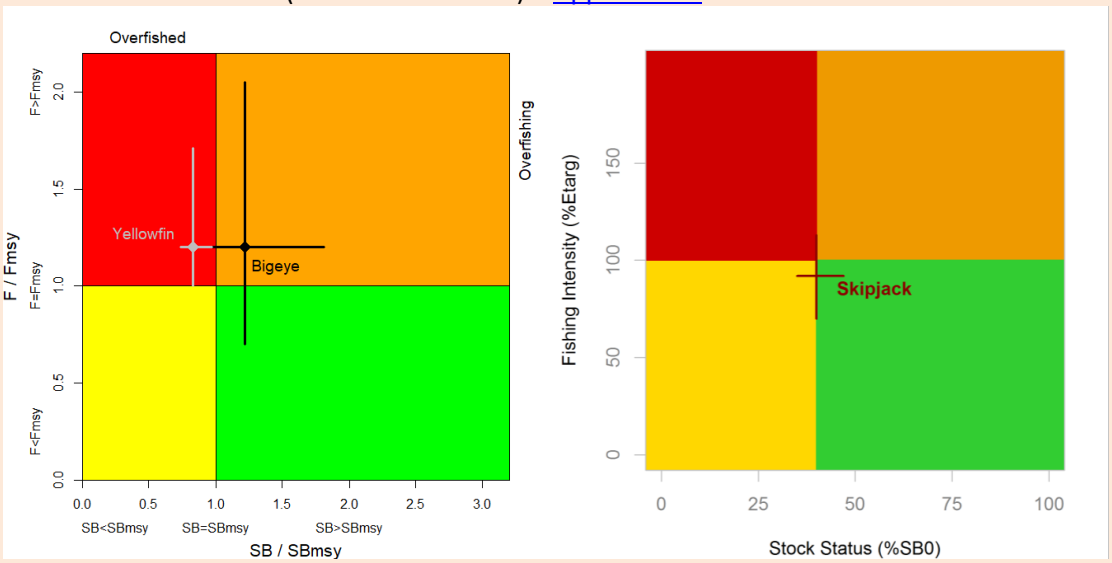

Fig. 1. (Left) Combined Kobe plot for bigeye tuna (black: 2019), and yellowfin tuna (grey: 2018) showing the estimates of current stock size (as SB) and current fishing mortality (F) in relation to optimal spawning stock size and optimal fishing mortality. (Right) Kobe plot for skipjack tuna showing the estimates of the current (2017) stock status. Cross bars illustrate the range of uncertainty from the model runs with a 80% CI.

Billfish

SC22.02 (para. 120) 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 2019 (Fig. 3):

- 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

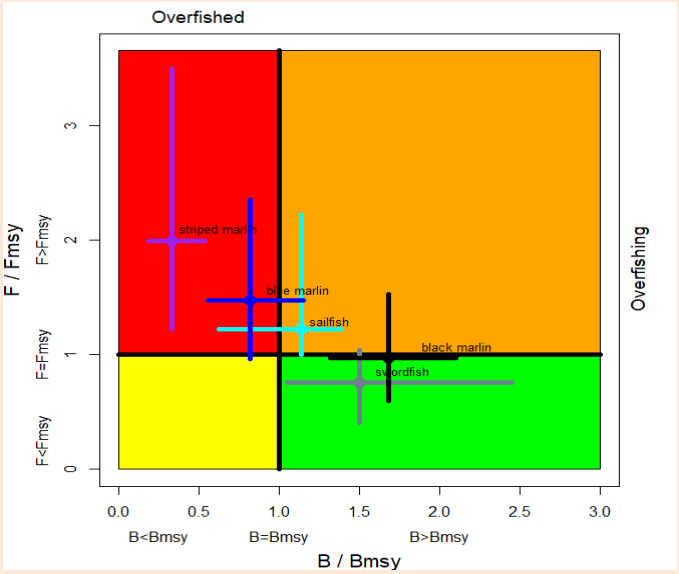

Fig. 3. Combined Kobe plot for swordfish (grey), indo-pacific sailfish (cyan), black marlin (black), blue marlin (blue) and striped marlin (purple) showing the 2017, 2018, and 2019 estimates of current stock size (SB or B, species assessment dependent) and current fishing mortality (F) in relation to optimal spawning stock size and optimal fishing mortality. Cross bars illustrate the range of uncertainty from the model runs.

Tuna and seerfish – Neritic species

SC22.03 (para. 119) 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 2019 (Fig. 2):

- 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

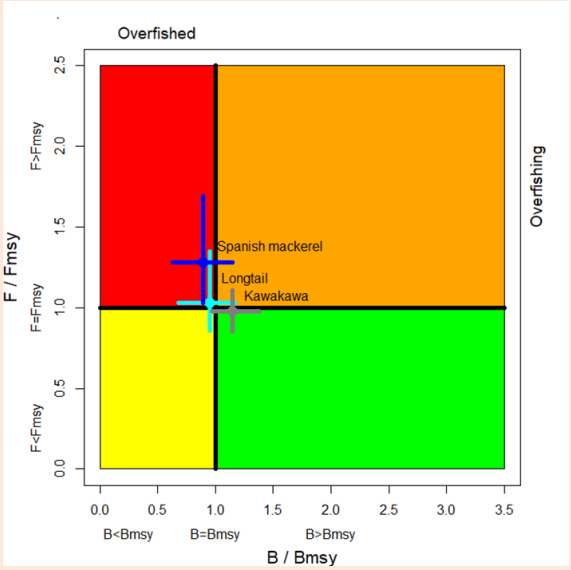

Fig. 2. Combined Kobe plot for longtail tuna, narrow-barred Spanish mackerel and kawakawa, showing the estimates of stock size (B) and current fishing mortality (F) in 2015 in relation to optimal spawning stock size and optimal fishing mortality. Cross bars illustrate the range of uncertainty from the model runs.

Sharks

SC22.04 (para. 121) 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

SC22.05 (para. 122) 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

SC22.06 (para. 123) 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

Marine Mammals

SC22.07 (para. 124) 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

SCIENCE RELATED ACTIVITIES OF THE IOTC SECRETARIAT IN 2019

SC22.08 (para. 17) The SC **NOTED** the recent departure of two scientific staff at the Secretariat and **ACKNOWLEDGED** that the Secretariat is in the process of recruiting two replacement staff members. Notwithstanding this replacement of staff, the SC **RECALLED** that in 2018 the Commission deferred the recruitment of a P4 officer for the IOTC Data and Science Section until 2020. Given the increased workload of the Secretariat, the SC **RECOMMENDED** that the Commission confirm the reinstatement of this position at its next meeting, so it can be advertised and filled as soon as possible.

NATIONAL REPORTS FROM CPCS

SC22.09 (para. 23) Noting that the Commission, at its 15th Session (in 2011), 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 2019, 23 reports were provided by CPCs (26 in 2018, 23 in 2017, 23 in 2016, 26 in 2015) (Table 2).

SC22.10 (para. 24) The SC **RECOMMENDED** that the Compliance Committee and Commission note the lack of compliance by 9 Contracting Parties (Members) and 2 Cooperating Non-Contracting Party (CNCPs) that did not submit a National Report to the Scientific Committee in 2019, noting that the Commission agreed that the submission of the annual reports to the Scientific Committee is mandatory

REPORT OF THE 17TH SESSION OF THE WORKING PARTY ON BILLFISH (WPB17)

SC22.11 (para. 42) The SC reiterated its previous **RECOMMENDATION** that on the next revision of the IOTC Agreement, that short bill spearfish (*Tetrapturus angustirostris*) be included as an IOTC species

Revision of catch levels of Marlins under Resolution 18/05

SC22.12 (para. 47) 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 reiterates its **RECOMMENDATION** 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 15TH SESSION OF THE WORKING PARTY ON ECOSYSTEMS AND BYCATCH (WPEB15)

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

SC22.13 (para. 54) 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.

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

SC22.14 (para. 55) The SC **ENDORSED** the advice of the WPEB regarding the need to improve data collection and reporting for shark species. To this end, the SC **RECOMMENDED** that several initiatives be implemented, including: (i) holding regional workshops to improve shark species identification, shark data sampling and collection (fisheries and biological) and IOTC data reporting requirements; (ii) data mining to fill historical data gaps; (iii) developing alternative tools to improve species identification (e.g. genetic analyses, machine learning, and artificial intelligence).

REPORT OF THE 21ST SESSION OF THE WORKING PARTY ON TROPICAL TUNAS (WPTT21)

Review of the statistical data available for skipjack tuna

SC22.15 (para. 76) The SC **NOTED** that total catches in 2018 (607,701 t) were 30% higher than the catch limit generated by the Harvest Control Rule (470,029 t) which applies to the years 2018–2020, and that catches have increased over the past 3 years. The SC reiterated its **RECOMMENDATION** that the Commission urgently consider the need to monitor catches of skipjack in the 2019–2020 period to ensure catches do not exceed the limit.

REPORT OF THE 7TH SESSION OF THE WORKING PARTY ON TEMPERATE TUNAS (WPTMT07)

Albacore Tuna stock assessment

SC22.16 (para. 80) The SC **NOTED** that the 2020 and draft 2021 calendars of working party meetings were approved by the Commission in June 2019, and the WPTmT is not scheduled to meet in either of these years. The SC **NOTED** the request by the chairs of the WPTmTs to hold an assessment meeting in April 2020 but **AGREED** that this would not be appropriate as the SC would not have an opportunity to review the WPTmT outputs prior to the Commission meeting in June 2020. The SC **AGREED** that it would be beneficial to hold an assessment preparatory meeting in 2020 or 2021; and to this end, the SC **RECOMMENDED** that the Commission consider approving an assessment preparatory meeting for the WPTmT in either of these years.

REPORT OF THE 15TH SESSION OF THE WORKING PARTY ON DATA COLLECTION AND STATISTICS (WPDCS15)

SC22.17 (para. 97) **NOTING** that the WPDCS highlighted several issues still affecting the quality of the information available for stock assessment purposes of tropical tunas, the SC **RECOMMENDED** that a data preparatory meeting be held prior to the Working Party on Tropical Tunas.

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

SC22.18 (para. 104) Given the importance of external independent review for working party meetings, the SC **RECOMMENDED** the Commission continues to allocate sufficient budget for invited scientific experts to be regularly invited to scientific working party meetings.

Meeting participation fund

SC22.19 (para. 105) 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

SC22.20 (para. 106) 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.

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

SC22.21 (para. 107) 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.

IMPLEMENTATION OF THE REGIONAL OBSERVER SCHEME

SC22.22 (para. 127) The SC **ACKNOWLEDGED** that estimation of ROS coverage for the purse seine fleets is adversely impacted by the lack of uniformity in reporting effort data to the IOTC Secretariat, and AGREED that this information, which is particularly useful to assess the performance of Resolution 11/04, should be further standardized. As such, the SC **RECOMMENDED** that all purse seine fleets reporting effort as fishing hours or fishing days begin to submit this information as 'number of sets' instead, in particular when fulfilling the reporting requirements of Resolution 15/02.

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

SC22.23 (para. 133) 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

SC22.24 (para. 150) 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.

REVIEW OF THE DRAFT, AND ADOPTION OF THE REPORT OF THE 22ND SESSION OF THE SCIENTIFIC COMMITTEE

SC22.25 (para. 160) The SC **RECOMMENDED** that the Commission consider the consolidated set of recommendations arising from SC22, provided at Appendix 38.

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		2015	2016	2017	2018	2019	Advice to the Commission
Albacore *Thunnus alalunga*	Catch 2018: Average catch 2014–2018: MSY (1000 t) (95% CI): F_{MSY} (95% CI): SB_{MSY} (1000 t) (95% CI): F_{2017}/F_{MSY} (95% CI): SB_{2017}/SB_{MSY} (95% CI): SB_{2017}/SB_{1950} (95% CI):	41,603 t 38,030 t 35.7 (27.3–44.4) 0.21 (0.195-0.237) 23.2 (17.6–29.2) 1.346 (0.588–2.171) 1.281 (0.574–2.071) 0.262 (-)						A new stock assessment was carried out for albacore in 2019 to update the assessment undertaken in 2016. Although considerable uncertainty remains in the SS3 assessment conducted in 2019, particularly due to the conflicts in key data inputs, a precautionary approach to the management of albacore tuna should be applied. The K2SM indicates that catch reductions are required in order to prevent the biomass from declining to below MSY levels in the short term, due to the low recent recruitment levels. Although there is considerable uncertainty in the projections, current catches are exceeding the estimated MSY level (35,700 t). The stock status in relation to the Commission's BMSY and FMSY target reference points indicates that the stock is **not overfished** but is **subject to overfishing** Click here for full stock status summary: Appendix 8
Bigeye tuna *Thunnus obesus*	Catch in 2018: Average catch 2014–2018: MSY (1000 t) (80% CI): F_{MSY} (80% CI): SB_{MSY} (1,000 t) (80% CI): F_{2018}/F_{MSY} (80% CI): SB_{2018}/SB_{MSY} (80% CI): SB_{2018}/SB_0 (80% CI):	93,515 t (81,413 t[1]) 92,140 t (89,720 t[1]) 87 (75 – 108) 0.24 (0.18 – 0.36) 503 (370 – 748) 1.20 (0.70 – 2.05) 1.22 (0.82 – 1.81) 0.31 (0.21 – 0.34)		**84%**			**38%**	In 2019 a new stock assessment was carried out for bigeye tuna in the IOTC area of competence to update the stock status undertaken in 2016. The stock status determination changed qualitatively in 2019 to **not overfished** but **subject to overfishing**. If catches remain at current levels there is a risk of breaching MSY reference points with 58.9% and 60.8% probability in 2021 and 2028. Reduced catches of at least 10% from current levels will likely reduce the probabilities of breaching reference levels to 49.1% in 2028. Continued monitoring and improvement in data collection, reporting and analyses is required to reduce the uncertainty in assessments. Click here for full stock status summary: Appendix 9
Skipjack tuna *Katsuwonus pelamis*	Catch in 2018: Average catch 2014–2018: $Yield_{40\%SSB}$ (1000 t) (80% CI): $C_{2016}/C_{40\%SSB}$ (80% CI): SB_{2016} (1000 t) (80% CI):	607,701 t (606,197 t[1]) 484,993 t (484,692 t[1]) 510.1 (455.9–618.8) 0.88 (0.72-0.98) 796.66 (582.65-1,059.29)		**47%**				No new stock assessment was carried out for skipjack tuna in 2019, thus, stock status is determined on the basis of the 2016 assessment and other indicators presented in 2019. On the weight-of-evidence available in 2019, the skipjack tuna stock is determined to be **not overfished** and is **not subject to overfishing**. Based on the results of the stock assessment

[1] Considering the alternative purse seine log-associated catch composition for the EU fleet in 2018 as per IOTC-2019-WPTT21-R[E]

	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):	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)						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 2018 (607,701 t) were 29% 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 future catches of skipjack do not exceed the agreed limit for the 2018-2020 period. Click here for full stock status summary: Appendix 10
Yellowfin tuna *Thunnus albacares*	Catch 2018: Average catch 2014–2018: MSY (1000 t) (80% CI): FMSY (80% CI): SBMSY (1,000 t) (80% CI): F2017/FMSY (80% CI): SB2017/SBMSY (80% CI): SB2017/SB0 (80% CI):	423,815 t (437,422 t[2]) 404,655 t (407,377 t[2]) 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%**		**94%**		No new stock assessment was carried out for yellowfin tuna in 2019, thus, stock status is determined on the basis of the 2018 assessment and other indicators presented in 2019. On the weight-of-evidence available in 2018 and 2019, the yellowfin tuna stock is determined to remain **overfished** and **subject to overfishing.** 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 SSBMSY levels. At this stage, no revised specific catch limits are recommended. In the 2018 Scientific Committee a Workplan was 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 started in January 2019 which aimed at addressing the issues identified by the WPTT and the external reviewer in 2018. 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. Despite the progress made to reduce the uncertainties inherent to this fishery, the WPTT agreed that no new advice could be provided in 2019. The Commission has an interim plan for the rebuilding the yellowfin stock, with catch limitations based on 2014/2015 levels (Resolution 19/01, which superseded 17/01 and 18/01). Some of the fisheries subject to catch reductions had fully achieved a decrease in catches in 2018 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 9 in IOTC-2019-WPTT21-R). Thus, the total

[2] Considering the alternative purse seine log-associated catches for the EU fleet in 2018 as per IOTC-2019-WPTT21-R

								catches of yellowfin in 2018 increased by around 9% 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. 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		2015	2016	2017	2018	2019	Advice to the Scientific Committee
Swordfish *Xiphias gladius*	Catch 2018: Average catch 2014-2018: 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):	31,628 t 31,343 t 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 2019, thus, the stock status is determined on the basis of the 2017 assessment and other indicators presented in 2019. On the weight-of-evidence available in 2019, the stock is determined to be **not overfished** and **not subject to overfishing**. The most recent catches (33,352 t in 2017) are higher than MSY (31,590 t) and should be reduced to the MSY level. Click here for full stock status summary: Appendix 12
Black marlin *Makaira indica*	Catch 2018: Average catch 2014–2018: 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):	18,180 t 18,074 t 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)						No new stock assessment for black marlin was carried out in 2019, thus, the stock status is determined on the basis of the 2018 assessment based on JABBA and other indicators presented in 2019. 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. Current catches (>14,600 t in 2017) are higher than MSY estimate (12,930 t), which is likely to associate with high uncertainty. The catch limits as stipulated in Resolution 18/05 have also 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. Click here for full stock status summary: Appendix 13

Blue marlin *Makaira nigricans*	Catch 2018: Average catch 2014-2018: MSY (1,000 t) (80% CI): F_{MSY} (80% CI): B_{MSY} (1,000 t) (80% CI): H_{2017}/H_{MSY} (80% CI): B_{2017}/B_{MSY} (80% CI): B_{2017}/B_0 (80% CI):	9,969 t 11,382 t 9.98 (8.18 –11.86) 0.21 (0.13 – 0.35) 47 (29.9 – 75.3) 1.47 (0.96 – 2.35) 0.82 (0.56 – 1.15) 0.41 (0.28 – 0.57)					**87%**	Stock status based on the Bayesian State-Space Surplus Production model JABBA suggests that there is an 87% probability that the Indian Ocean blue marlin stock in 2017 is in the red zone of the Kobe plot, indicating the stock is **overfished** and **subject to overfishing**. The current catches of blue marlin (average of 11,761 t in the last 5 years, 2013-2017) are higher than MSY (9,984 t) and the stock is currently overfished and subject to overfishing. In order to achieve the Commission objectives of being in the green zone of the Kobe Plot by 2027 (F2027 < FMSY and B2027 > BMSY) with at least a 60% chance, the catches of blue marlin would have to be reduced by 35% compared to the average of the last 3 years, to a maximum value of approximately 7,800 t. Click here for full stock status summary: Appendix 14
Striped marlin *Tetrapturus audax*	Catch 2018: Average catch 2014-2018: 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):	2,791 t 3,247 t 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%**		No new stock assessment for striped marlin was carried out in 2019, thus, the stock status is determined on the basis of the 2018 assessment and other indicators presented in 2019. On the weight-of-evidence available in 2019, 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 2018: Average catch 2014-2018: 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):	36,911 t 31,267 t 23.9 (16.1 – 35.4) 0.19 (0.14 - 0.24) 129 (81–206) 1.22 (1 – 2.22) 1.14 (0.63 – 1.39) 0.57 (0.31 – 0.70)						A new stock assessment was carried out for Indo-Pacific sailfish in 2019 using the C-MSY model. The data poor stock assessment techniques indicated that F was above F_{MSY} (F/F_{MSY}=1.22) and B above B_{MSY} (B/BMSY=1.14). On the weight-of-evidence available in 2019, the stock status **cannot be assessed** and is determined to be uncertain. 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. 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		2015	2016	2017	2018	2019	Advice to the Commission
Bullet tuna *Auxis rochei*	Catch 2018: Average catch 2014–2018: MSY (1,000 t) F_{MSY} : B_{MSY} (1,000 t): $F_{current}/F_{MSY}$: $B_{current}/B_{MSY}$: $B_{current}/B_0$:	31,615 t 16,364 t unknown unknown unknown unknown unknown unknown						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. Stock status in relation to the Commission's BMSY and FMSY reference points remains **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 FMSY and BMSY 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 2018: Average catch 2014–2018:	82,909 t 89,253 t						No quantitative stock assessment is currently available for frigate tuna in the Indian Ocean, and due to a lack of fishery data for

Stock	Indicators		2015	2016	2017	2018	2019	Advice to the Commission
	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						several gears, only preliminary stock status indicators can be used. Stock status in relation to the Commission's BMSY and FMSY reference points remains **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 FMSY and BMSY 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 2018: Average catch 2014-2018 MSY (1,000 t) [*] F_{MSY} [*] B_{MSY} (1,000 t) [*] F_{2013}/F_{MSY} [*] B_{2013}/B_{MSY} [*] B_{2013}/B_0 [*]	173,367 t 161,844 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]						A stock assessment was not undertaken for kawakawa in 2019 and the status is determined on the basis of the last assessment conducted in 2015, which used catch data from 1950 to 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**. 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>FMSY 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>FMSY 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 > SBMSY and F<FMSY) in 2023 are 100% for a future constant catch at 80% of 2013 catch levels. If catches are reduced by 20% based on 2013

Stock	Indicators		2015	2016	2017	2018	2019	Advice to the Commission
								levels at the time of the assessment (170,181 t) , 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 2018: Average catch 2014–2018: MSY (1,000 t) (*): F_{MSY} (*): B_{MSY} (1,000 t) (*): F_{2015}/F_{MSY} (*): B_{2015}/B_{MSY} (*): B_{2015}/B_0 (*):	136,906 t 138,352 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%**			No new stock assessment for Longtain tuna was carried out in 2019, thus, the stock status is determined on the basis of the 2017 assessment and other indicators presented in 2019. Based on the weight-of-evidence currently available, the stock is considered to be both **overfished** and **subject to overfishing.** There is a substantial risk of exceeding MSY-based reference points by 2018 if catches are maintained at current (2015) levels (63% risk that B2018<BMSY, and 55% risk that F2018>FMSY). If catches are reduced by 10% this risk is lowered to 33% probability B2018<BMSY and 28% probability F2018>FMSY). 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 2018: Average catch 2014-2018: MSY (1,000 t) F_{MSY} : B_{MSY} (1,000 t): $F_{current}/F_{MSY}$: $B_{current}/B_{MSY}$: $B_{current}/B_0$:	50,653 t 49,511 t Unknown Unknown Unknown Unknown Unknown Unknown						No new stock assessment for Indo-Pacific king mackerel was carried out in 2019, thus, the stock status is determined on the basis of the 2016 assessment and other indicators presented in 2019. Given that no new assessment was undertaken in 2019, the WPNT considered that stock status in relation to the Commission's BMSY and FMSY target reference points remains **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 FMSY and BMSY 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 between 2009 and 2011 estimated at the time of the assessment (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

Stock	Indicators		2015	2016	2017	2018	2019	Advice to the Commission
								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 2018: Average catch 2014-2018: MSY (1,000 t) [*]: F_{MSY} [*]: B_{MSY} (1,000 t) [*]: F_{2015}/F_{MSY} [*]: B_{2015} B_{MSY} [*]: B_{2015}/B_0 [*]:	149,263 t 163,209 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%**			No new stock assessment for Narrow-barred Spanish mackerel was carried out in 2019, thus, the stock status is determined on the basis of the 2017 assessment and other indicators presented in 2019. Based on the weight-of-evidence available, the stock appears to be **overfished** and **subject to overfishing.** 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		2015	2016	2017	2018	2019	Advice to the Commission
Blue shark *Prionace glauca*	Reported catch 2018: 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: 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) :	23,338 t 54,735 t 52,487 t 29,293 t 54,993 t 50,677 t 33.0 (29.5 - 36.6) 0.30 (0.30 - 0.31) 39.7 (35.5 - 45.4) 0.86 (0.67 - 1.09) 1.54 (1.37 - 1.72) 0.52 (0.46 - 0.56)			**72.6%**			No new stock assessment for blue sharks was carried out in 2019, thus, the stock status is determined on the basis of the 2017 assessment and other indicators presented in 2019. On the weight-of-evidence currently available, the stock status is determined to be **not overfished** and **not subject to overfishing**. 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. If the Commission wishes to maintain stocks above MSY reference levels ($B>B_{MSY}$ and $F<F_{MSY}$) with at least a 50% probability over the next 10 years, then a reduction of 20% in catches is advised. The stock should be closely monitored. Mechanisms need to be developed by the Commission to improve current statistics, by ensuring CPCs comply with their recording and reporting requirement on sharks, so as to better inform scientific advice in the future. Click below for a full stock status summary: • Blue sharks – Appendix 23
Oceanic whitetip shark *Carcharhinus longimanus*	Reported catch 2018: Not elsewhere included (nei) sharks: Average reported catch 2014–2018: Not elsewhere included (nei) sharks:	35 t 35,758 t 201 t 47,537 t						There is a paucity of information available for these species and this situation is not expected to improve in the short to medium term. There is no quantitative stock assessment and limited basic fishery indicators currently available. Therefore the stock status is highly uncertain. The available evidence indicates considerable risk to the stock status at current effort levels. The primary source of data that drive the assessment (total catches) is highly uncertain and should be investigated further as a priority. Click below for a full stock status summary: • Oceanic whitetip sharks – Appendix 24 • Scalloped hammerhead sharks – Appendix 25 • Shortfin mako sharks – Appendix 26 • Silky sharks– Appendix 27
Scalloped hammerhead shark *Sphyrna lewini*	Reported catch 2018: Not elsewhere included (nei) sharks: Average reported catch 2014–2018: Not elsewhere included (nei) sharks:	19 t 35,758 t 56 t 47,537 t						
Shortfin mako *Isurus oxyrinchus*	Reported catch 2018: Not elsewhere included (nei) sharks:	1,499 t 35,758t						

	Average reported catch 2014–2018: Not elsewhere included (nei) sharks:	1,582 t 47,537 t						• Bigeye thresher sharks– Appendix 28 • Pelagic thresher sharks– Appendix 29
Silky shark *Carcharhinus falciformis*	Reported catch 2018: Not elsewhere included (nei) sharks: Average reported catch 2014–2018: Not elsewhere included (nei) sharks:	1,503 t 35,758 t 2,162 t 47,537 t						
Bigeye thresher shark *Alopias superciliosus*	Reported catch 2018: Not elsewhere included (nei) sharks: Average reported catch 2014–2018: Not elsewhere included (nei) sharks:	2 t 35,758 t 0 t 47,537 t						
Pelagic thresher shark *Alopias pelagicus*	Reported catch 2018: Not elsewhere included (nei) sharks: Average reported catch 2014–2018: Not elsewhere included (nei) sharks:	1 t 35,758 t 0 t 47,537t						

*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 22nd Session of the Indian Ocean Tuna Commission (IOTC) Scientific Committee (SC) was held in Karachi, Pakistan, from 2 – 6 December 2019. A total of 43 delegates and other participants attended the Session (65 in 2018), comprised of 34 delegates from 15 Contracting Parties (23 in 2018), and 0 delegates from Cooperating Non-Contracting Parties (0 in 2018), and 9 participants from 2 observer organisations. The list of participants is provided at Appendix 1.

2. The opening of the meeting was attended by the Honourable Ali Haider Zaidi, Minister for Maritime Affairs, and the meeting was chaired by the Vice-Chairperson, Dr Shiham Adam (Maldives).

2. ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION

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

4. The SC **NOTED** the statements from Mauritius, France (OT) and UK(BIOT) (Appendix 4a).

3. ADMISSION OF OBSERVERS

5. The SC admitted the following observers, in accordance with Rule XIV of the IOTC Rules of Procedure (2014):

3.1 Non-governmental Organisations (NGOs)

- World Wide Fund for Nature (WWF)
- The Sustainable Indian Ocean Tuna Initiative (SIOTI)

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

4.1 Outcomes of the 23rd Session of the Commission

6. The SC **NOTED** paper IOTC–2019–SC22–03 which outlined the decisions and requests made by the Commission at its 23rd Session, held in June 2019, that related to the IOTC science processes, including the 7 Conservation and Management Measures as listed below:

Resolutions

- Resolution 19/01 *On an interim plan for rebuilding the Indian Ocean yellowfin tuna stock in the IOTC Area of competence*.
- Resolution 19/02 *Procedures on a fish aggregating devices (FADs) management plan, including a limitation on the number of fads, more detailed specifications of catch reporting from fad sets, and the development of improved fad designs to reduce the incidence of entanglement of non-target species*.
- Resolution 19/03 *On the conservation of mobulid species caught in association with fisheries in the IOTC Area of Competence*.
- Resolution 19/04 *Concerning the IOTC Record of Vessels Authorised to operate in the IOTC Area of Competence*.
- Resolution 19/05 *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*.
- Resolution 19/06 *On establishing a programme for transhipment by large-scale fishing vessels*.
- Resolution 19/07 *On vessel chartering in the IOTC Area of Competence*.

7. The SC **NOTED** that pursuant to Article IX.4 of the IOTC Agreement, the above-mentioned Conservation and Management Measures become binding on Members, 120 days from the date of the notification communicated by the Secretariat. 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 29 October 2019:
   - English: http://iotc.org/cmms
   - French: http://iotc.org/fr/mcgs

8. Noting that the 23rd session of the Commission also made a number of general comments and requests on the recommendations made by the Scientific Committee in 2018, the SC **AGREED** that any advice to the Commission would be provided in the relevant sections of this report. From the Commission's 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 6) and considered the recommendations made by the Scientific Committee to the Commission. The Commission ENDORSED the Scientific Committee's 2018 list of recommendations as its own. (para 29).

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 7 of the 2018 Scientific Committee Report. (para. 30).

IOTC Strategic Science Plan 2020 – 2024

The Commission NOTED the IOTC Strategic Science Plan for 2020-2024 (IOTC-2019-S23-11). This plan was first presented to the IOTC Scientific Committee in 2018, then distributed to IOTC Members for final comments during early 2019; before being presented to the Commission for it to consider its endorsement (para 33).

The Commission ADOPTED the IOTC Strategic Science Plan 2020-2024, but NOTED that it was extremely ambitious and that its implementation should be reviewed by the Scientific Committee in 2022 and if necessary, modified (para. 34).

The Commission NOTED that the adoption of the plan did not include a budget for each component of the plan. Budget allocations for the components of this plan would continue to be made on an annual basis, based on the requests and priorities identified by the Scientific Committee (para 35).

The status of tropical tuna

The Commission NOTED the uncertainty in the yellowfin tuna assessment and that the Scientific Committee had not recommended any concrete catch advice due to the uncertainty in the projections and the associated Kobe II strategy matrix (K2SM). The Commission was informed that uncertainty is inherent in all assessments, and is not specific to yellowfin tuna. The Commission NOTED that the Scientific Committee has developed a yellowfin tuna workplan which aims to address and reduce many of the uncertainties in the 2019 assessment. This is expected to result in the provision of more robust advice on stock status and catch forecasts for this species in the future (para. 37)

The status of billfish

The Commission EXPRESSED concern that catches for all billfish species (except striped marlin in 2017) in both 2016 and 2017 were higher than the limits outlined in Resolution 18/05 (para. 46).

4.2 Previous decisions of the Commission

9. The SC **NOTED** paper IOTC–2019–SC22–04 which outlined a number of Commission decisions, in the form of previous Resolutions that require a response from the SC in 2019 and **AGREED** to develop advice to the Commission in response to each request during the current Session.

5. SCIENCE RELATED ACTIVITIES OF THE IOTC SECRETARIAT IN 2019

5.1 Report of the Secretariat – Activities in support of the IOTC science process in 2019

10. The SC **NOTED** paper IOTC–2019–SC22–05 which provided an overview of the work undertaken by the IOTC Secretariat in 2019, and congratulated the IOTC Secretariat for its contributions to the science processes in 2019. These contributions included support to the Working Parties and Scientific Committee meetings; facilitation of the IOTC Meeting Participation Fund; assisting in improvements made 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,; recruitment and management of consultants; and facilitation of the attendance of the invited scientific experts that support IOTC technical meetings.

11. The SC **NOTED** the increasing workload of the SC and relevant working parties, as evidenced by the increasing number of papers submitted to scientific meetings. The large number of documents is difficult to facilitate their presentation during the meetings and this result in time constraints for the WPs to address the key objectives of their meetings.

12. The SC **SUGGESTED** that the Secretariat and Chairpersons of the respective technical bodies could be more active in informing CPCs of the specific work requirements each year to ensure papers are relevant and aligned to key priority areas. The SC **REQUESTED** that the Secretariat provide a list of the documents submitted for each meeting to the working party chairs in order to filter the papers and facilitate the presentation of only those papers that are of direct relevance to the meeting. The SC **AGREED** that this should not only be the case for papers submitted in relation to applications for MPF funding, but for all papers submitted to a working party meeting

13. The SC **NOTED** that there can be up to 9 IOTC scientific meetings each year. Several CPCs informed the SC that they are having difficulty committing scientists to each meeting and suggested that the meeting schedule be streamlined, to the extent possible, by combining meetings or combining Working Parties to reduce the number of annual meetings.

14. The SC **ACKNOWLEDGED** this issue as well as the current efforts to reduce the number of individual meetings by holding several working party meetings back to back (such as the WPM and WPTT). The suggestion to combine working parties was viewed as being contrary to the current requests from some working parties that are considering recommending splitting existing WPs into more specialized groupings.

15. The SC **NOTED** the complexity of neritic tuna populations and the possibility that assessment and management of neritic tuna populations may need to take place at regional levels rather than at the level of the Indian Ocean as a whole. The SC further **NOTED** that the current Stock Structure project which is due to finish in 2020, could provide guidance on this matter.

16. The SC **NOTED** that some CPCs may have delays in obtaining clearance from their administrations to participate in working party meetings and this could result in late submissions to the MPF. The SC **ACKNOWLEDGED** that this may be an issue, but stressed that an IOTC Circular noting the dates and locations of all IOTC scientific meetings (including MPF deadlines) is distributed in June of each year, and CPCs should use this information to obtain internal clearances well in advance of the meeting deadlines as the Secretariat cannot facilitate late applications according to the IOTC Commission rules of procedure.

17. The SC **NOTED** the recent departure of two scientific staff at the Secretariat and **ACKNOWLEDGED** that the Secretariat is in the process of recruiting two replacement staff members. Notwithstanding this replacement of staff, the SC **RECALLED** that in 2018 the Commission deferred the recruitment of a P4 officer for the IOTC Data and Science Section until 2020. Given the increased workload of the Secretariat, the SC **RECOMMENDED** that the Commission confirm the reinstatement of this position at its next meeting, so it can be advertised and filled as soon as possible.

6. NATIONAL REPORTS FROM CPCS

6.1 National Reporting to the Scientific Committee: overview

18. The SC **NOTED** that 23 National Reports were submitted to the IOTC Secretariat in 2019 by CPCs (22 Contracting Parties and the invited experts, Taiwan,China), the abstracts of which are provided at Appendix 4b.

19. 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.

20. 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 2019, of the 23 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)*].

21. 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.

22. 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.

23. Noting that the Commission, at its 15th Session (in 2011), 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 2019, 23 reports were provided by CPCs (26 in 2018, 23 in 2017, 23 in 2016, 26 in 2015) (Table 2).

24. The SC **RECOMMENDED** that the Compliance Committee and Commission note the lack of compliance by 9 Contracting Parties (Members) and 2 Cooperating Non-Contracting Party (CNCPs) that did not submit a National Report to the Scientific Committee in 2019, 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 2006 to 2019.

CPC	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Contracting Parties (Members)														
Australia														
Bangladesh	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.													
Iran, Islamic Rep. of														
Japan														
Kenya														
Korea, Republic of														
Madagascar														
Malaysia														
Maldives, Rep. of	n.a.	n.a.	n.a.											
Mauritius														
Mozambique	n.a.	n.a.	n.a.	n.a.	n.a.									
Oman, Sultanate of														
Pakistan														
Philippines														
Seychelles, Rep. of														
Sierra Leone	n.a.	n.a.												
Somalia	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.													
Thailand														
United Kingdom (OT)														
Yemen	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.					
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)

25. The SC **NOTED** that, with the exception of the EU and France(OT), the abstracts, figure and table captions of the Annual Reports were not available in both English and French as the translators had been fully occupied translating the other SC documents, Executive summaries and Working Party reports. The SC **ACKNOWLEDGED** that the Secretariat is exploring ways to ensure that these preliminary translation tasks could be performed more efficiently in future years.

26. The SC **REITERATED** its request from 2018 for CPCs to assist the Secretariat by providing translations of their executive summaries and figures and tables in both French and English are translated as well.

27. **NOTING** the 23 National Reports submitted to the IOTC Secretariat in 2019 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 SC **NOTED** that scientific and statistical information such as discard levels, observer coverage, fleet statistics etc., which are of particular relevance for several IOTC Resolutions (e.g. 15/02, 16/04, 17/05 etc.), is often only reported by CPCs in their national reports but not made available to the IOTC Secretariat in due time in accordance with the reporting requirements prescribed in the resolutions. For this reason, the SC **REQUESTED** all CPCs to ensure that the information presented in the respective national reports is in agreement with the official submissions available to the IOTC.

29. The following matters were raised in regard to the content of specific reports. CPCs that are not listed below, did not provide National reports and the SC expressed its disappointment that these reports were not available. The SC encouraged CPCs to provide their National Report in due time so that they can be discussed during the SC meetings. The SC also expressed its disappointment that a number of CPCs were not present and could not answer questions regarding their national reports.
    - **Australia**: The SC **NOTED** that while information on EMS-derived observer data is found in the National Report, no information on scientific observer data has been submitted to the IOTC Secretariat for the year 2018.
    - **China**: No Comments.
    - **Comoros:** the SC **NOTED** an improvement in the reporting of gear categorization for the national fleet, and that due to improved registration requirements, all vessels including small canoes have been appropriately categorized in 2019.
    - **European Union (EU):** No Comments.
    - **France (OT)**: No Comments.
    - **India**: The SC **NOTED** that India had submitted its National Report late during the meeting and therefore it could not be presented nor discussed.
    - **Indonesia**: The SC **ACKNOWLEDGED** the efforts made in recent years by Indonesia to comply with Resolution 15/02, and that catch-and-effort and size-frequency data from a number of coastal and industrial gears where reported according to IOTC requirements in 2019 for the first time, although the underlying logbook coverage was still low. The SC also **NOTED** that the decrease in the number of longline vessels reported as active by Indonesia is due to more stringent regulations to combat and deter IUU fishing, and that for this reason many of previously active vessels remained moored in port and did not resume operations. Finally, the SC **ENCOURAGED** Indonesia to continue improving its national data collection programmes and report a breakdown of historical catches from their purse-seine fleet by coastal / industrial component.) to the next SC.

- **Iran, Islamic Rep.**: The SC **ACKNOWLEDGED** the continued efforts from I.R. Iran to comply with the requirements of Resolution 15/02 in terms of the submission of time-area catch information, and **NOTED** that, since 2018, I.R. Iran has been providing yellowfin tuna catches split by their coastal / offshore (high-seas), although this classification will need to be refined to meet the needs of Resolution 19/01. The SC **NOTED** that time-area catches for the Iranian purse seine fisheries are available but are not currently provided to the IOTC Secretariat and **REQUESTED** I.R. Iran to provide this information in the future. The SC also **REQUESTED** that the contrasting catch trends recorded for yellowfin and skipjack tuna between 2017 and 2018 for the purse seine fishery be examined and verified.
- **Japan**: No Comments.
- **Kenya:** The SC **NOTED** that Kenya submitted observer data for 2018 and **ACKNOWLEDGED** that the level of observer coverage for the Kenyan longline fleet is expected to increase further as a result of Kenya's participation in the ROS Pilot Project training programme.
- **Korea, Rep. of**: No comments.
- **Madagascar**: The SC **RECALLED** the updates provided by Madagascar at the WPDCS15 on its efforts to improve the collection and reporting of coastal fisheries data, including through the recent adoption of the OpenArtFish platform. The SC **NOTED** that the level of spatial coverage is still very low and includes only 7 out of 11 provinces, and therefore **ENCOURAGED** Madagascar to continue with its work to improve the national data collection mechanism for the artisanal and small-scale fishery, and provide more comprehensive data in the near future. The SC also **NOTED** that the dramatic decrease in longline catchessince 2015 has occurred while the number of active industrial vessels was either stable or slightly decreasing, and given the spatial distribution of fishing zones (concentrated in an area of 200km in radius) this might indicate that local overexploitation is occurring.
- **Malaysia**: The SC was informed that, due to a lack of national staff, Malaysia is not currently able to fully implement the ROS requirements and therefore cannot participate in the ROS Pilot Project. The SC **ACKNOWLEDGED** that results on the improvements in data collection introduced by installing EMS equipment onboard (CCTV cameras) will be presented at the next SC meeting. The SC **NOTED** that e-logbooks and EMS implemented in Malaysia since 2017 should be useful tools to properly record these interactions, and these initiatives should result in improved species breakdown of catches for sharks and rays in the future. The SC **NOTED** that catches of neritic tunas from the coastal purse seine fleet of Malaysia are higher in the North part of the Malacca strait and in the Andaman sea, that all neritic species are considered to be bycatch, and that no spatial information for this fishery is currently available.
- **Maldives, Republic of**: The SC **ACKNOWLEDGED** that Maldives has an active ban on the retention of shark species, and for this reason (combined with the decrease in the number of national longliners) a constant decline in sharks interactions has been reported by the fleet since 2014. The SC also **NOTED** that all bycatch is currently recorded on logbooks by Maldivian vessels, that the government of Maldives has several programmes in place to better understand the impact of their fisheries on the ecosystems (including a specific bycatch sampling programme) and that 11 to 21% of pole and line catches over the last 5 years is yellowfin tuna which comprise mainly of juveniles.
- **Mauritius**: The SC **NOTED** a decrease in catches of Swordfish and a corresponding increase in catches of yellowfin from the longline fisheries of Mauritius operating inside its EEZ and it remained uncertain whether this situation is due to a change in targeting or other factors. **ACKNOWLEDGING** that species composition for the national purse seine fishery is derived from logbook data (which has limitations for accuracy), the SC **NOTED** that the fleet mostly lands in Seychelles and that corrective factors based on landing data are introduced to logbook data to get to the final raised catch estimates.
- **Mozambique**: The SC **NOTED** inconsistencies in the effort units, and between catch-and-effort and nominal catch levels reported by Mozambique for its artisanal and small-scale fisheries from 2016 onwards, and that, for these reasons the information is not currently included in the IOTC databases. The SC also **NOTED** the efforts put in place by Mozambique to resolve these issues through capacity building activities (including the delivery of technical training to national personnel) and **ENCOURAGED** Mozambique to revise their data and submit them to the IOTC Secretariat. The SC **NOTED** that recreational fisheries are an important component of Mozambican fisheries, and that currently there are ongoing regional projects in close collaboration with the African Billfish Foundation as an effort to improve the qulity of information related to those fisheries. **CONSIDERING** that blue shark is a commonly caught species by foreign fleets operating in Mozambican EEZ, which might be a potential nursing ground

for this species, and that a stock assessment for the species is scheduled for 2020, the SC **ENCOURAGED** these countries to ensure appropriate observer coverage including the collection of biological information. The SC also **ACKNOWLEDGED** that Mozambique will be one of the six pilot countries to actively participate to the ROS Pilot Project training programme.

- **Pakistan**: The SC **NOTED** that mitigation measures such as sub-surface setting have substantially reduced the number of interactions between Pakistani gillnetters and Endangered Threatened Protected (ETP) species such as turtles, dolphins and whale sharks reported by Pakistan since 2013, and that the crew-based data collection programme supported by WWF Pakistan has contributed to increase the number of safely released individuals from ETP species. The SC also **NOTED** that the government of Pakistan will, as per the requirements of Resolution 15/02, officially submit data about discards to the IOTC Secretariat soon. The SC **NOTED** that a socio-economic study on the impacts of Resolution 17/07 on Pakistani gillnetters may assist in understanding the effects and feasibility of switching from gillnets to coastal longlines during the next 5 years to reduce impact of the national fisheries on the ecosystems.
- **Seychelles, Republic of**: No Comments.
- **South Africa:** No Comments.
- **Sri Lanka:** The SC **NOTED** that the marked increases in effort reported for several Sri Lankan fisheries in 2018 have not resulted in increased catches, and that this might be explained by factors such as refinement of e-logbook data collection procedures as well as fleets shifting into coastal waters. The SC **ACKNOWLEDGED** that Sri Lanka is actively working to better understand the reasons for these changes.
- **Tanzania, United Republic of**: No Comments.
- **Thailand**: No Comments.
- **United Kingdom (OT)**: No Comments.

6.3 Cooperating Non-Contracting Parties (CNCPs)

30. The SC **NOTED** that no National Report was submitted to the IOTC Secretariat in 2019 by Cooperating Non-Contracting Parties (CNCPs).

6.4 Invited Experts

31. The SC **NOTED** the report provided by the Invited Experts from Taiwan,China which outlined fishing activities in the IOTC Area of Competence. In accordance with the SC request in 2018, the report from the Invited Experts is available on the IOTC website as document IOTC-2019-SC22-INF04.

7. REPORTS OF THE 2019 IOTC WORKING PARTY MEETINGS

7.1 Report of the 9th Session of the Working Party on Neritic Tunas (WPNT09)

32. The SC **NOTED** the report of the 9th Session of the Working Party on Neritic Tunas (IOTC–2019–WPNT09–R), including the consolidated list of recommendations provided as an appendix to the report. The meeting was attended by 18 participants (cf. 18 in 2018), including 6 recipients of the MPF (cf. 6 in 2018).

7.1.1 Data quality issues

33. The SC **NOTED** that the catches of most neritic species in the Indian Ocean have reached their highest reported levels, and neritic tunas currently account for around 40% of the total catches of IOTC species.

34. The SC **NOTED** that there are considerable uncertainties with the IOTC catch estimates of neritic species due to ongoing issues related to data collection and reporting; notwithstanding this, the nominal catches in the IOTC database are considered the best scientific estimates for stock assessment purposes. The SC further **NOTED** that compliance with data reporting obligations remains low for neritic tuna species, and **REQUESTED** CPCs do their best to collect data and comply with data reporting requirements adopted by the IOTC.

7.1.2 Assessment and status of neritic tunas

35. The SC **NOTED** the workshop for training national scientists on applications using the catch-only methods, which includes hands-on exercises on the use of the R Software. The SC **AGREED** that these capacity building workshops are very useful to assist national scientists improve their understanding of data-limited methodologies and encouraged CPCs to assess the data-poor stocks using suitable techniques.

36. The SC **NOTED** that work was conducted to revise the optimized catch only method (OCOM) and a undertake a preliminary exploration to apply the revised method to a suite of neritic tuna species. The SC **NOTED** that management advice for several neritic tuna species is currently based on assessments using the OCOM method. The SC **ACKNOWLEDGED** the importance of the work conducted to improve the OCOM method.

37. The SC **NOTED** the availability of CPUE standardizations of four neritic tuna species from Iranian drifting gillnet fleet. These are a first attempt to estimate a relative abundance index from Iranian gillnet fishery for potential consideration in the assessments of neritic tuna stocks.

38. The SC **NOTED** that longtail tuna and Spanish mackerel are the only species that are currently assessed to be in the red quadrant of the Kobe plot. The SC **NOTED** the 2017 assessment for longtail tuna and Spanish mackerel was conducted at the ocean-basin level combining all the catch data across all the CPCs (the same for other neritic tuna species). The SC **NOTED** the stock structure of Indian Ocean neritic tuna species remain unknown and it is possible that some coastal waters may support sub populations which experience different fishing pressure and population trends. The SC **AGREED** that a better knowledge of the stock structure will help determine the appropriate spatial units for assessing and managing these important coastal species.

7.1.3 Program and schedule of work

39. The SC **NOTED** the program of work has given high priorities to data mining, CPUE standardisation and stock assessment. The SC **AGREED** that stock assessments be conducted on a three years cycle and stock indicators be developed and used for monitoring the stocks in non-assessment years.

7.1.4 Working party attendance and the MPF

40. The SC **NOTED** that in response to the recommendation of the SC, the capacity building workshop on the 'optimized catch-only method' was conducted back-to-back with the working party meeting to encourage CPCs to send their most appropriate scientists to the meeting and the workshop.

7.2 Report of the 17th Session of the Working Party on Billfish (WPB17)

41. The SC **NOTED** the report of the 17th Session of the Working Party on Billfish (IOTC–2019–WPB17–R), including the consolidated list of recommendations provided as an appendix to the report. The meeting was attended by 25 participants (cf. 20 in 2018) including 9 recipients of the MPF (cf. 5 in 2018).

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

7.2.1 Indo Pacific Sailfish stock assessment

43. The SC **NOTED** the data poor stock assessment techniques indicated that F was above F_{MSY} (F/F_{MSY}=1.22) and B above B_{MSY} (B/B_{MSY}=1.14). Another alternative model using the Stock Reduction Analysis (SRA) techniques produced similar results. The stock appears to show a continued increase in catches which is a cause of concern indicating that fishing mortality levels may be becoming too high

44. The SC **NOTED** that both assessment models rely on catch data; however, the catch series is highly uncertain. In addition, 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.

7.2.2 Blue marlin stock assessment

45. The SC **NOTED** that stock status based on the Bayesian State-Space Surplus Production model JABBA suggests that there is an 87% probability that the Indian Ocean blue marlin stock in 2017 is in the red zone of the Kobe plot, indicating the stock is overfished and subject to overfishing (B2017/BMSY=0.82 and F2017/FMSY=1.47). The SC further **NOTED** that the current catches of blue marlin (average of 11,761 t in the last 5 years, 2013-2017) are higher than MSY (9,984 t).

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

46. The SC **RECALLED** 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".

47. 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 reiterates its **RECOMMENDATION** 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 15th Session of the Working Party on Ecosystems and Bycatch (WPEB15)

48. The SC **NOTED** the report of the 15th Session of the Working Party on Ecosystems and Bycatch (IOTC–2019–WPEB–R), including the consolidated list of recommendations provided as an appendix to the report. The meeting was attended by 41 participants (cf. 40 in 2018) including 13 recipients of the MPF (cf. 7 in 2018).

49. The SC **NOTED** that information on bycatch from FAD fisheries is only partially available for the major industrial fleets but that it can be extracted from regular ROS data submissions. The SC further **NOTED** that several papers by industry and national scientists have been presented during recent IOTC working parties, including documents analyzing a number of mitigation techniques to reduce the impact of FAD sets on bycatch species. The SC **RECALLED** that these documents are available on the specific IOTC web page of the meeting concerned.

50. The SC **NOTED** that the tables presented in Appendix VII of the WPEB report which provide information on the status of the ROS may no longer be fully up-to-date. The SC **ENCOURAGED** all CPCs that have submitted ROS data to the IOTC Secretariat to verify that the information contained within corresponds to what available at national level

51. The SC **ACKNOWLEDGED** that due to the general lack of catch data, size-frequency data and standardized CPUE series for silky shark, an assessment for this species was not able to be carried out in 2019.

52. The SC **REITERATED** the importance of having detailed information on climate indicators disseminated through the IOTC website as publicly available datasets, and **ACKNOWLEDGED** that the scoping study requested by the SC21 to create the platform for these data could not be conducted due to unforeseeable circumstances. Given this, the SC **REITERATED** its request to the Secretariat that this activity be implemented as soon as possible.

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

53. The SC **NOTED** paper IOTC–2019–SC22–06 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.

54. 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.

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

55. The SC **ENDORSED** the advice of the WPEB regarding the need to improve data collection and reporting for shark species. To this end, the SC **RECOMMENDED** that several initiatives be implemented, including: (i) holding regional workshops to improve shark species identification, shark data sampling and collection (fisheries and biological) and IOTC data reporting requirements; (ii) data mining to fill historical data gaps; (iii) developing alternative tools to improve species identification (e.g. genetic analyses, machine learning, and artificial intelligence).

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

56. The SC **NOTED** that progress has been made on addressing EAF in IOTC fisheries. In addition to a dedicated workshop prior to the WPEB meeting to define EcoRegions, several ecosystem report cards were presented to

the WPEB. The SC further **NOTED** that ecosystem models have a potential to contribute to the development of EAF, although data limitations in the IOTC to validate the models may be problematic. Nevertheless, as this expertise is not readily available in the IOTC community, the SC **ENCOURAGED** further participation of external modelling experts to future sessions of the WPEB.

7.4 Report of the 21st Session of the Working Party on Tropical Tunas (WPTT21)

57. The SC **NOTED** the report of the 21st Session of the Working Party on Tropical Tunas (IOTC–2019–WPTT21–R), including the consolidated list of recommendations provided as an appendix to the report. The meeting was attended by 68 participants (cf. 57 in 2018), including 13 recipients of the MPF (cf. 7 in 2018).

58. The SC **NOTED** that the change in the methodology used for the production of catch statistics by EU,Spain has resulted in a large increase in the reported bigeye catches in 2018. This increase was considered implausible by the WPTT. The SC **NOTED** that the WPTT adopted revised catch estimates for bigeye and yellowfin tuna in 2018 (based on the purse seine species composition in 2017) for use in the stock assessments for these species. The method for producing the revised catch estimates was fully documented and discussed by the WPDCS15.

7.4.1 Bigeye tuna stock assessment and development of management advice

59. The SC **NOTED** that the 2019 bigeye tuna assessment (using Stock Synthesis) concluded that the stock is not overfished but is subject to overfishing. The SC further **NOTED** that a continued decline of the CPUE from the main longline fleets and the recent increase in fishing pressure on the juvenile component of the population by the purse seine fleet have resulted in more pessimistic estimates of stock status compared to the previous assessment

60. The SC **NOTED** that the 2019 bigeye tuna stock assessment captured structural uncertainty through a grid of 18 models covering stock recruitment, tag weighting and selectivity assumptions, and statistical uncertainty was also incorporated into the estimates of stock status by utilising a resampling technique which was originally developed for the recent ICCAT bigeye tuna assessment.

61. The SC **NOTED** paper IOTC–2019–SC22–INF03 which provided a review by the invited scientific expert to WPTT21 of the 2019 bigeye and yellowfin tuna stock assessments, including the following abstract provided by the author:

"Different approaches were examined for assessing YFT & BET in 2019. A large effort was made to address issues identified in 2018 and the analysts should be commended on that. With respect to YFT, assessment examined in 2019, substantial issues relating to data quality were examined. Various assessment methodologies were examined and concluded that the stock continued to remain overfished; this includes a continuity analysis from 2018; however few models did not indicate overfishing trajectories were present, but more time needs to be spent examining these models, and weighting issues across models, and the most appropriate use of tagging information Some diagnostics indicate that information content in indices and length composition is limited and fail under numerous hypothesis examined (runs test and hindcasting tests)." See document for full abstract

62. The SC **NOTED** that the report by the invited scientific expert provides guidance on how future assessments for yellowfin and bigeye tunas might be improved. The SC **REQUESTED** the Secretariat to work with the Chair of the WPTT and the relevant assessment modellers to consider the salient points raised in the expert review for use in the next assessment for these species

7.4.2 Yellowfin tuna assessment update

63. The SC **NOTED** paper IOTC–2019–SC22–INF01 which provided an update on the state of the development of the workplan to improve the current assessment of yellowfin tuna, including the following abstract provided by the author:

"In 2018, the IOTC Scientific Committee (SC) adopted a workplan to reduce the uncertainties of the current stock assessment of Indian Ocean yellowfin tuna. In 2019, several tasks of the workplan have been addressed and reported to the 21st Working Party of Tropical Tunas (WPTT). However, the WPTT agreed that the progress on the workplan was insufficient to provide new management advice in 2019. The main reasons for this are the complexity of the endeavour, the lack of agreement on key model aspects and time constraints for a thorough examination of the new model during the WPTT meeting. However, the WPTT acknowledged the substantial amount of work conducted to improve the yellowfin assessment and requested that the Chair of the WPTT coordinates the full documentation of the work conducted inter-seasonally and during the WPTT and the tasks

that still need to be addressed, to be presented to the SC in 2019. In this document, we summarise the progress of the different tasks of the workplan and identify paths to continue reducing the existing uncertainties on the dynamics of Indian Ocean yellowfin tuna.)".

64. The SC **RECALLED** that the full yellowfin stock assessment conducted in 2018 concluded that the stock is overfished and is subject to overfishing. The SC further **RECALLED** that the assessment was considered insufficient to cover the full range of uncertainty inherent in the data as well as in the model assumptions. As such a yellowfin workplan was initiated to reduce the uncertainty and improve the predictive capability of the assessment model to allow the SC to make more robust management advice.

65. The SC **NOTED** that some aspects of the data uncertainty covered in the yellowfin workplan (e.g. historical catch by acritical fleets) can be applied to most IOTC species, while other aspects of uncertainty (e.g. the utility of IO-RTTP tagging data and the longline size frequency data) were mostly relevant to the tropical tuna.

66. The SC **NOTED** that the yellowfin workplan focused on improving the current SS3 model which was scrutinized in more detail by the WPTT. Although simpler biomass dynamic models (e.g. BDM) were also investigated, they were mainly used to explore alternative model options and have not been used by the WPTT for providing management advice. The SC further **NOTED** that in case of tropical tuna, some of the nuances of the populations or fishery dynamics (e.g. changes in selectivity over time) were better captured by models with a finer population structure.

67. The SC **NOTED** that although the considerable progress has been a made in advancing the array of tasks under the yellowfin workplan, the WPTT did not consider the revised model(s) was qualitatively different to the previous assessment, or sufficiently improved to justify its use for providing new management advice on catch limit.

68. The SC commended the yellowfin workplan steering committee and the assessment scientist for their efforts and excellent contributions to reduce the uncertainty of the yellowfin assessment model. The SC **WELCOMED** the future developments identified by the WPTT that are expected to improve the yellowfin assessment through intersessional work. The SC also **NOTED** that opportunities exist to further reduce data and parameter uncertainty, and to improve modelling choices, through internal IOTC projects (e.g. the EU funded projects on tag modelling and longline size review) and external workshops (e.g. 2020 Spatial Stock Assessment Methods workshop and CAPAM workshop on natural mortality). However, given the difficulty and scope of the work, there is no guarantee that a satisfactory full assessment can be achieved by 2020.

69. The SC **NOTED** that despite the progress that has been made to reduce the fishing pressure on the yellowfin stock, the gear groups that are subject to Resolution 18/01 (superseded by 1901) have not fully achieved the targeted catch reduction as set out by the resolution, and many of the fleets that are not subject to the catch reduction have increased their catches. The SC **AGREED** that one option to improve the reduction of yellowfin catches would be to apply the catch limit to all gears/fleets.

70. The SC **NOTED** that the implementation of a conservation and management measure on one species may have an adverse effect on other species e.g. the recent transition of fishing mode from free schools to FAD schools to avoid or reduce large yellowfin catches by the EU purse seine fleets have resulted in increased catches on juvenile bigeye and skipjack tuna. The SC **AGREED** that from the sustainability perspective, it is important that conservation and management measures should consider the overall effect on the impacted species as those fisheries are multi-species in nature.

71. The SC **NOTED** that the WPTT had begun preliminary discussions on alternative management options such as closed areas and closed season. The SC further **NOTED** although spatial catch-and-effort data (e.g. 5x5) are available to allow the effects of spatial/seasonal closure to be evaluated, the results will most likely depend on the accuracy of such data. Experiences from other t-RFMOs indicate that such studies were generally very difficult.

72. The SC **NOTED** that the IOTC Secretariat has implemented a detailed procedure to assist CPCs to calculate the fraction of the yellowfin catches that are subject to the catch reduction under Resolution 19/01 (documented in the WPDCS report). To this end, the SC **REQUESTED** CPCs to provide the fraction of their fleet catches that are subject to Resolution 19/01 when reporting yellowfin catches to the IOTC Secretariat.

7.4.3 Joint tuna RFMO FAD working party meeting

73. The SC **NOTED** document IOTC-2019-WPTT21-INF02 that provides the meeting report of the 2nd joint Tuna RFMO FAD working group meeting.

74. The SC **NOTED** that several important discussions took place at that meeting with regards to issues of common interest across the tuna RFMOs and that a list of recommendations to the RFMOs was discussed and adopted as in Appendix 6 of that report.

75. The SC **NOTED** that a primary concern for the IOTC is the definitions and terminology related to FAD fishing activities, and to work with other tRFMOs on a similar terminology for reporting purposes and to allow inter-ocean comparative analyses. The SC therefore **RECALLED** the recommendation made by the WPTT21 that the IOTC FAD Working Group, which to date has met only once, be reactivated with a clear mandate to discuss these and other IOTC FAD issues.

7.4.4 Review of the statistical data available for skipjack tuna

76. The SC **NOTED** that total catches in 2018 (607,701 t) were 30% higher than the catch limit generated by the Harvest Control Rule (470,029 t) which applies to the years 2018–2020, and that catches have increased over the past 3 years. The SC reiterated its **RECOMMENDATION** that the Commission urgently consider the need to monitor catches of skipjack in the 2019–2020 period to ensure catches do not exceed the limit.

7.4.5 WPTT priorities and Program of Work

77. The SC **NOTED** the WPTT Program of work, with high priorities being given to biological sampling, CPUE standardisations, fishery-independent monitoring including acoustic FAD monitoring, and MSE

78. Acknowledging that holding data preparatory meetings prior to stock assessments is generally considered to be best practice and in view of the success of the albacore tuna data preparatory meeting in 2019, the SC **AGREED** to explore the possibility of holding data preparatory meetings in addition to stock assessment meetings for the major IOTC species in 2020.

7.5 Report of the 7th Session of the Working Party on Temperate Tunas (WPTmT07)

7.5.1 Albacore Tuna stock assessment

79. The SC **NOTED** paper IOTC-2019-SC22-13 which provided information on uncertainties in the 2019 stock assessment for Indian Ocean albacore tuna and suggestions of further researches in 2020 for improving the assessment and providing management advice, including the following abstract provided by the author:

"The stock status of Indian Ocean albacore tuna was assessed in WPTmT07 held in July 2019, and the stock status was recognized as "not overfished" but "subject to overfishing". However, at the same time, the assessment result was regarded as subject to high uncertainties. By summarizing the main uncertainties in the assessment and observations of potential improvements both in fishery data and biological information, we strongly suggest conducting an assessment meeting for albacore tuna in 2020. This will not be a meeting for a new full assessment, but to update the 2019 assessments using new information on biology, most recent catch data, revised CPUE indices, improved recruitment estimates for projection and wider ranges of natural mortality and steepness".

80. The SC **NOTED** that the 2020 and draft 2021 calendars of working party meetings were approved by the Commission in June 2019, and the WPTmT is not scheduled to meet in either of these years. The SC **NOTED** the request by the chairs of the WPTmTs to hold an assessment meeting in April 2020 but **AGREED** that this would not be appropriate as the SC would not have an opportunity to review the WPTmT outputs prior to the Commission meeting in June 2020. The SC **AGREED** that it would be beneficial to hold an assessment preparatory meeting in 2020 or 2021; and to this end, the SC **RECOMMENDED** that the Commission consider approving an assessment preparatory meeting for the WPTmT in either of these years.

81. This meeting could, inter alia, consider how to reduce uncertainty in the assessment and prepare the albacore tuna assessment model for the inclusion of the most recent catch data, revised CPUE indices, improved recruitment estimates, and wider ranges of natural mortality and steepness. The SC **REQUESTED** the WPM, in 2020 and 2021 to provide any additional advice and guidance to the WPTmT on the nature and extent of the next assessment.

7.6 Report of the 10th Session of the Working Party on Methods (WPM10)

82. The SC noted the report of the 10th Session of the Working Party on Methods (IOTC–2019–WPM10–R), including the consolidated list of recommendations provided as an appendix to the report. The meeting was attended by 37 participants (cf. 23 in 2018), including 7 recipients of the MPF (cf. 2 in 2018).

83. The SC **NOTED** the good progress made in Management Strategy Evaluations exercises for IOTC species in 2019. The SC **NOTED** the results of the MSE development were extensively discussed and endorsed by TCMP and Commission in 2019.

84. The SC **NOTED** that the 8th workshop on MSE of IOTC WPM Scientists was held in ISPRA at the European Joint Research Centre in March 2019. The SC **NOTED** that the expert MSE workshops were very constructive and effective in discussing technical matters and the outcomes of the meetings were reflected in the MSE development.

7.6.1 Management Strategy Evaluation Progress

85. The SC **NOTED** paper IOTC–2019–SC22–14 which provided a proposal on a management procedure for yellowfin tuna in the IOTC Area of Competence.

86. The SC **ENCOURAGED** the proponents of the management procedure to resubmit the proposal to the TCMP and the Commission in 2020 for their consideration, with a view to adoption of a management procedure for yellowfin tuna by 2021 as per the proposed updated schedule of work in paper IOTC-2019-SC22-15.

87. The SC **NOTED** paper IOTC–2019–SC22–15 which provided an updated schedule of work for the development of management procedures for key species in the IOTC Area. The SC **AGREED** to the schedule of work (Appendix 6), noting it is a living document to provide an indicative timeframe to guide the IOTC MSE development and may subject to change. The SC **ENCOURAGED** the schedule to be resubmitted to TCMP and Commission for final endorsement.

7.6.2 Albacore MSE

88. The SC **NOTED** that the 2019 albacore stock assessment results fall outside the range of uncertainty captured by the current operating model (OM) and therefore reconditioning of the OM is required based on the 2019 assessment. The SC **AGREED** that if the proposed update of the assessment can be achieved in 2020, the new OMs may be conditioned on the new assessment.

7.6.3 Skipjack tuna MSE

89. The SC **NOTED** that catches of skipjack in 2018 and 2019 have both exceeded the catch limit established under Resolution 16/02 using the harvest control rule (HCR). The SC recalled that Resolution 16/02 included a provision to review the skipjack tuna harvest control rule. The SC **NOTED** that an MSE expert has been contracted to undertake review of the skipjack tuna harvest control rule with a view towards developing the management procedures. It is anticipated that current HCR will be replaced by the alternative MP subject the result of the review.

7.6.4 Yellowfin tuna MSE

90. The SC **NOTED** the attempt to conduct a full assessment of the yellowfin tuna has not been achieved this year and the current yellowfin OM is based on the 2018 yellowfin assessment. However, the SC **AGREED** that further OM development may take into consideration the progress made so far in addressing the yellowfin workplan.

7.6.5 Bigeye tuna MSE

91. The SC **NOTED** that the 2019 bigeye assessment results are more pessimistic than in previous assessments and that there were changes in the fishery characteristics, which are likely to have an impact on the evaluation of the management procedures performance. The SC **AGREED** that the bigeye OMs may need reconditioning on the new assessment.

7.6.6 Swordfish MSE

92. The SC **NOTED** that the initial OM conditioning and preliminary testing of MP performance have been started. The SC **ACKNOWLEDGED** the good progress made in the MSE exercises for swordfish.

7.6.1 Stock status guide and other business

93. The SC **NOTED** that many CPCs have regularly engaged in data preparation activities for IOTC stock assessment, such as CPUE standardizations; however, the level of their direct involvement in the assessment modelling has been relatively limited. The SC considered it to be a top priority to increase the level of participation of CPC scientists in the stock assessment process. The Secretariat informed the SC that specialized workshops have been held to build capacity amongst national scientists on fishery modelling techniques (e.g. CPUE standardizations, data-limited methods). The SC **NOTED** that the practice of stock assessment is highly technical in nature and requires years of experience to develop the necessary skills. As such, recent capacity building activities coordinated by IOTC have focused on enabling scientists to improve their understanding of stock assessment methodologies and outputs, with a view to increasing and further developing the skills and experiences to perform the actual assessments with ongoing training.

94. The SC **NOTED** the current research priority for neritic tunas is for CPUE standardisations and improvement of the stock assessment methods. The SC **SUGGESTED** that MSE framework can also be developed in the future to provide management advice for neritic tuna.

95. The SC **NOTED** that some CPCs are well advanced in the assessment and management of neritic tuna species in their coastal waters. The SC **ENCOURAGED** these CPCs to share their experience at the relevant IOTC working parties. The SC **AGREED** that improved knowledge and understanding of the stock structure of neritic species will enable the development of more appropriate assessment and management methods for these species.

7.7 Report of the 15th Session of the Working Party on Data Collection and Statistics (WPDCS15)

96. The SC **NOTED** the report of the 15th Session of the Working Party on Data Collection and Statistics (IOTC–2019–WPDCS15–R), including the consolidated list of recommendations provided as an appendix to the report. The meeting was attended by 41 participants (cf. 52 in 2018), including 9 recipients of the MPF (cf. 7 in 2018).

97. **NOTING** that the WPDCS highlighted several issues still affecting the quality of the information available for stock assessment purposes of tropical tunas, the SC **RECOMMENDED** that a data preparatory meeting be held prior to the Working Party on Tropical Tunas.

98. The SC **NOTED** that the WPDCS endorsed the methodologies used by Pakistan to revise their historical gillnet catch series for tuna and tuna-like species, and that the results presented are currently the best scientific estimates available for this fishery. Therefore, the SC **REQUESTED** that these reconstructed catches be incorporated in the IOTC nominal catch database.

99. The SC **REQUESTED** the WPDCS to further support studies aimed at evaluating possible combinations of alternative data collection systems and protocols as a replacement for scientific data collected by onboard observers (whenever the deployment of the latter is considered unfeasible).

100. **NOTING** that the quality of data available for artisanal fisheries in the Indian Ocean still needs to be greatly improved, the SC **REQUESTED** the WPDCS to continue assisting CPCs in improving the implementation of data collection and sampling activities for artisanal, coastal and small-scale fisheries.

101. One CPC questioned the priority assigned by WPDCS15 to work to better understand catch compositions and size distribution in the purse seine fisheries. The question raised by that CPC was to highlight the importance for the SC to have reported nominal catches estimated with the most robust approaches while ensuring consistency within an historical series of nominal catches.

102. The WPDCS15 Chair informed the SC that the priorities were agreed by the WPDCS and he would not support changing the agreed rankings. The SC **AGREED** that the above work is important, but on this occasion did not warrant revising the rankings agreed to by the WPDCS.

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

103. The SC **NOTED** that the ability to determine the 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

104. Given the importance of external independent review for working party meetings, the SC **RECOMMENDED** the Commission continues to allocate sufficient budget for invited scientific experts to be regularly invited to scientific working party meetings.

7.8.3 Meeting participation fund

105. 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

106. The SC reiterated its **RECOMMENDATION** that the Commission allocate 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 Chairpersons and Vice-Chairpersons of the SC and its subsidiary bodies

107. 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.

7.8.6 Development of management advice

108. 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 IOTC working parties.

109. 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 possibility of exceptional circumstances e.g. large increase in catches, or revisions to data, between assessment years.

110. 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.

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

111. The SC **NOTED** the presentation of the Report of the 3rd IOTC Technical Committee on Management Procedures (IOTC–2019–TCMP03–R).

112. 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.

113. The SC **NOTED** the TCMP agreement that work on reference points should continue intersessionally within a small working group and be presented to relevant working groups throughout the year, with a final presentation to the TCMP in 2020. The SC further **NOTED** that progress of this working group had been delayed due to the Chair of the SC (and proposed chair of this working group) being no longer available for the positions. Once a new SC chair is elected, he/she is expected to take over the guidance of the working group.

114. The SC **NOTED** that to date, only 9 CPCs and 3 observers had committed to participating in this group and **SUGGESTED** that CPCs and relevant observers be contacted again to encourage more participation.

115. The SC **NOTED** that several capacity building initiatives have been undertaken and planned (at the request of the Commission) to improve the understanding of the MSE/MP process in the IOTC. Future workshops are being planned and organised in cooperation with several partners (Australia, the PEW Charitable Trusts, IPNLF, ISSF, WWF and SIOTI) in coordination with the IOTC Secretariat. CPCs were **ENCOURAGED** to contact the Secretariat to obtain further information on these workshops.

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

9.1 Tuna – Highly migratory species

116. The SC URGED the Commission to note that yellowfin tuna is overfished and subject to overfishing and that bigeye tuna, though not overfished, is subject to overfishing.

117. 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 2019 (Fig. 1):
    - Albacore (*Thunnus alalunga*) – Appendix 8
    - Bigeye tuna (*Thunnus obesus*) – Appendix 9
    - Skipjack tuna (*Katsuwonus pelamis*) – Appendix 10
    - Yellowfin tuna (*Thunnus albacares*) – Appendix 11

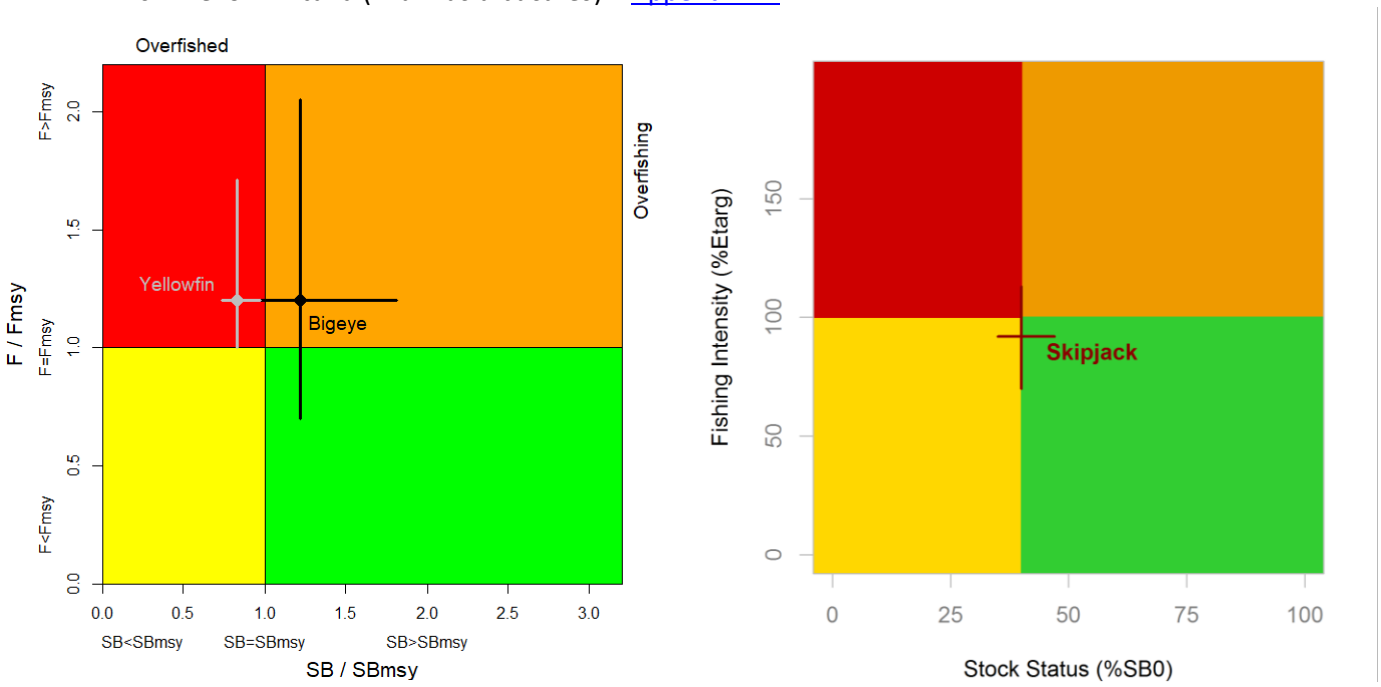

Fig. 1. (Left) Combined Kobe plot for bigeye tuna (black: 2019), and yellowfin tuna (grey: 2018) showing the estimates of current stock size (as SB) and current fishing mortality (F) in relation to optimal spawning stock size and optimal fishing mortality. (Right) Kobe plot for skipjack tuna showing the estimates of the current (2017) stock status. Cross bars illustrate the range of uncertainty from the model runs with a 80% CI.

118. The SC **NOTED** paper IOTC–2019–SC22–ES05 which provided an overview of the biology, stock status and management of southern bluefin tuna (*Thunnus maccoyii*), and thanked CCSBT for providing it.

9.2 Tuna and mackerel – neritic species

119. 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 2019 (Fig. 2):
    - 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

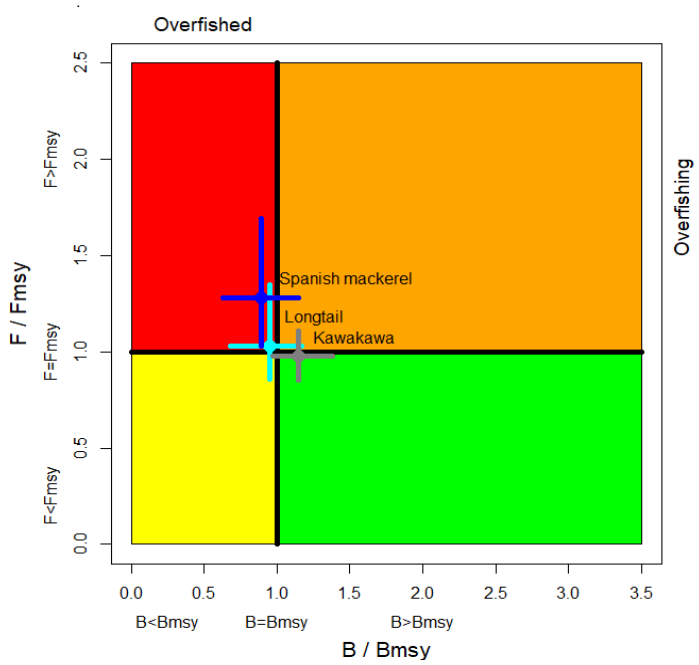

Fig. 2. Combined Kobe plot for longtail tuna, narrow-barred Spanish mackerel and kawakawa, showing the estimates of stock size (B) and current fishing mortality (F) in 2015 in relation to optimal spawning stock size and optimal fishing mortality. Cross bars illustrate the range of uncertainty from the model runs.

9.3 Billfish

120. 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. 3):
    - 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

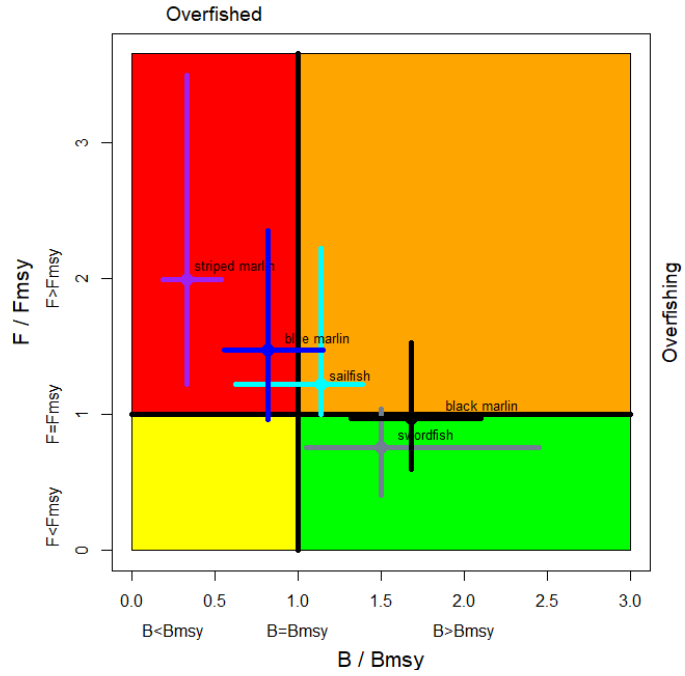

Fig. 3. Combined Kobe plot for swordfish (grey), indo-pacific sailfish (cyan), black marlin (black), blue marlin (blue) and striped marlin (purple) showing the 2017, 2018, and 2019 estimates of current stock size (SB or B, species assessment dependent) and current fishing mortality (F) in relation to optimal spawning stock size and optimal fishing mortality. 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

121. 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

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

10.3 Seabirds

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

10.4 Marine mammals

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

11. IMPLEMENTATION OF THE REGIONAL OBSERVER SCHEME

125. The SC **NOTED** paper IOTC–2019–SC22–07 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) including the coverage estimated for both the longline and purse seine large scale fisheries from concerned CPCs, and how these compare to the expected minimum coverage level.

126. The SC **ENCOURAGED** CPCs to validate the information provided in appendices A, B and C of paper IOTC-2019-SC22-07, and confirm that it correctly reflects the status of implementation of the ROS at the national level, and to liaise with the IOTC Secretariat should any discrepancy be identified.

127. The SC **ACKNOWLEDGED** that estimation of ROS coverage for the purse seine fleets is adversely impacted by the lack of uniformity in reporting effort data to the IOTC Secretariat, and **AGREED** that this information, which is particularly useful to assess the performance of Resolution 11/04, should be further standardized. As such, the SC **RECOMMENDED** that all purse seine fleets reporting effort as fishing hours or fishing days begin to submit this information as 'number of sets' instead, in particular when fulfilling the reporting requirements of Resolution 15/02.

128. The SC **SUPPORTED** the utilization of the ROS electronic tools for data collection and reporting, **NOTING** the effort made by the Secretariat in support of their adoption also by countries not directly participating to the implementation of the ROS training programme.

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

129. The SC **NOTED** that the ROS pilot project is planned to be initiated in six member countries, but that only four members had confirmed their participation prior to the SC22. The SC **WELCOMED** the confirmation by Mozambique and the offer by Maldives and Pakistan to join the project.

130. The SC **NOTED** the current membership of the ROS Pilot Project Steering Committee and **REQUESTED** that the Chairs of the SC and the WPDCS be added to the Committee.

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

131. The SC **NOTED** paper IOTC–2019–SC22–08 which provided an update on progress regarding Resolution 16/03 *On the second performance review follow-up*.

132. The SC **NOTED** that of the 17 actions allocated to the SC from the performance review, 15 have been completed and 2 are ongoing.

133. 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 2nd Technical Committee on Performance Review

134. The SC **NOTED** the report of the 2nd Technical Committee on Performance Review (paper IOTC–2019–TCPR02–R) which was held in Seychelles from 14 to 15 March 2019 and Chaired by Ms Riley Jung-re Kim. A total of 36 delegates attended the Session, comprising delegates from 17 IOTC Parties, 2 observer organisations, and 3 invited experts. This report includes updates from the IOTC scientific bodies.

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

13.1 Progress on previous recommendations from WPs and the SC

135. The SC **NOTED** paper IOTC–2019–SC22–11 which provided the SC with an update on the progress made on its 2018 recommendations (also available in Appendix 34).

136. The SC **THANKED** the Secretariat for the update on progress and **NOTED** that encouraging progress was being made.

13.2 Program of Work (2020–2024) and assessment schedule

13.2.1 Program of Work

137. The SC **NOTED** IOTC–2019–SC22–09 which provided the SC with a proposed Program of Work for each of its working parties, including prioritisation of the elements requested by each working party.

138. The SC **NOTED** the proposed Program of Work and priorities for the SC 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 will ensure that the efforts of their respective working party is focused on the core areas contained within the appendix, taking into account any new research priorities identified by the Commission at its next Session.

139. The SC recalled the process for developing the consolidated SC Program of work (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.

140. The SC **AGREED** on the consolidated table of priorities across all working parties, as developed by each working party Chairperson, and **REQUESTED** that the IOTC Secretariat, in consultation with the Chairpersons and vice-Chairpersons of the SC and relevant working parties, develop ToRs for the specific projects to be carried out.

141. 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 working party 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 working parties based on the objectives of the SC (as agreed in IOTC–2014–SC17–R, para. 179).

142. The SC **NOTED** that the WPM has selected five species for MSE (albacore, yellowfin, bigeye, skipjack and swordfish), as detailed in document IOTC-2019-SC22-15.

143. The SC **NOTED** Table 3 which outlines the highest priorities from each working party in terms of funding requirements. The complete set of research priorities identified (and ranked according their importance) by each working party are detailed more fully in Appendix 35a-g.

144. The SC **NOTED** paper IOTC-2019-SC22-INF05 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.

145. The SC **WELCOMED** this important study and congratulated the authors on the significant progress achieved during the project. The SC **ACKNOWLEDGED** the importance of the outcomes of this project to the understanding of the stock structure of IOTC species and **AGREED** that it will allow refining the spatial stratification in stock assessment analyses.

146. The SC **NOTED** that the results presented were very preliminary and the analysis of the data is ongoing and is expected to be finalised in March 2020. As such it was not possible to draw any substantive inferences and conclusions on stock structure at this stage. The SC **REQUESTED** that the provisional report be circulated by the Secretariat for feedback from Members by February 2020, to be considered for the final report.

147. The SC **NOTED** that the final report will include references to other similar studies in the region to ensure the most comprehensive possible information available on stock structure is available for the region.

Table 3. 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	**5.4.** Stock assessment priorities – 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), 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. Identify approaches for defining appropriate levels of M for inclusion in stock assessments.	**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	**6.1.** 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 with population size. It would be valuable to conduct a scoping exercise to evaluate the applicability to the tropical tuna species
WPEB	**2.** Post-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, and for marine turtles and rays (especially for gillnet and PS fisheries)	**1.** Connectivity, movements, and habitat use, including identification of hotspots and investigate associated environmental conditions (For rays and sharks (including whale shark) distribution (conventional and electronic tagging (PSAT))	**10.1.2** Workshop for CPCs on continuing efforts to the development of an EAF including delineation of candidate eco regions within IOTC**.**

WPNT	**2.** Develop standardised CPUE series for the main fisheries for longtail, kawakawa, 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.	**1.** Collate and characterize 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)). (Data support missions to priority countries: India, Oman, Pakistan)
WPTmT	**2.1.** Biological research (collaborative research to improve understanding of spatio-temporal patterns in age and growth and reproductive parameters).	**3.1.** Continue the development of standardized CPUE series for each albacore fishery for the Indian Ocean, with the aim of developing appropriate CPUE series for stock assessment purposes.	**5.1.** Further investigate the size information provided by CPCs in order to better understand the stock dynamics and inputs into the assessment models. This is particularly necessary for the purse seine data
WPB	**1.2** Tagging research (PSAT tags) to determine connectivity, movement rates and mortality estimates of billfish (Priority species: swordfish). Similar projects have been partially funded by EU, with a focus on epipelagic species. More tags are needed for swordfish	**2.2.** Reproductive biology study	**2.1.** Age and growth research

WPDCS	5.4 Evaluate the combination of alternative data collection systems and protocols for the collection of scientific observer data	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 I.R. Iran • Coastal fisheries of Pakistan • Coastal fisheries of Sri Lanka • Coastal fisheries of Kenya	4.2 Review of the extent of discarding practices in deep-freezing longline fleets
WPM	**1.5**. Swordfish MSE	**1.1.** Albacore MSE	**1.2.** Skipjack tuna MSE

13.2.2 Assessment schedule

148. The SC **ADOPTED** a revised assessment schedule, ecological risk assessment and other core projects for 2020–24, 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

149. The SC **REQUESTED** that at least one 'scientific expert' be invited to each of the 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

150. 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 2020 and 2021

151. The SC **NOTED** paper IOTC–2019–SC22–10 which outlined the proposed schedule for IOTC Working Parties and SC meetings for 2020 and 2021.

13.3.1 Increasing workload of science meetings

152. The SC **NOTED** the issue with increasing workload related to Working Party meetings. Many Working Parties have been receiving an increasing number of papers over time. For example, in 2019 there were 68 papers accepted for WPEB15, 60 for WPTT21 and 43 for WPTmT07.

153. 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, 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

154. Acknowledging that holding data preparatory meetings prior to stock assessments is considered to be best practice (as identified by the yellowfin stock assessment external reviewer,the WPTT and the WPDCS), the SC **AGREED** to explore the possibility of having data preparatory meetings in addition to stock assessment meetings for the major IOTC species.

13.3.3 WPTmT meeting schedule

155. Refer to the SC recommendation in section 7.5.1.

13.3.4 Final Meeting schedule

156. The SC **REQUESTED** that the schedule of Working Party and Scientific Committee meetings for 2020 and 2021 provided at Appendix 37 be communicated by the IOTC SC Chairperson to the Commission for its endorsement.

157. The SC unanimously **THANKED** the Government of Pakistan for hosting the 22nd Session of the Scientific Committee, and commended them and the local authorities of Karachi on the warm welcome, the excellent facilities and assistance provided to the IOTC Secretariat and SC in the organisation and running of the Session. The Government of Pakistan expressed its sincere thanks to WWF-Pakistan for their assistance in organising this meeting.

158. The SC **NOTED** that India offered to host the WPDCS and SC meetings in 2020. The Secretariat thanked India for the offer to host these meetings and agreed to investigate the logistics for this and discuss with India.

14. OTHER BUSINESS

14.1 Election of a Chair and a Vice-Chair for the next biennium

159. The SC **AGREED** that the Secretariat will facilitate the election of the Chair and Vice chair of the SC intersessionally.

15. ADOPTION OF THE REPORT OF THE 22ND SESSION OF THE SCIENTIFIC COMMITTEE

160. The SC **RECOMMENDED** that the Commission consider the consolidated set of recommendations arising from SC22, provided at Appendix 38.

161. The SC **ADOPTED** the report of the 22nd Session of the Scientific Committee (IOTC–2019–SC22–R) on 6 December 2019.

APPENDIX 1
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APPENDIX 2
AGENDA FOR THE 22ND SESSION OF THE SCIENTIFIC COMMITTEE

Date: 2 - 6 December 2019
Location: Karachi, Pakistan
Venue: Karachi Marriot Hotel
Time: 09:00 – 17:00 daily
Interim 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 23rd Session of the Commission.
   - 4.2 Previous decisions of the Commission

5. **SCIENCE RELATED ACTIVITES OF THE IOTC SECRETARIAT IN 2019** (IOTC Secretariat)
   - 5.1 Report of the Secretariat – Activities in support of the IOTC science process in 2019

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

7. **REPORTS OF THE 2019 IOTC WORKING PARTY MEETINGS**
   - 7.1 IOTC–2019–WPNT09–R Report of the 9th Session of the Working Party on Neritic Tunas
   - 7.2 IOTC–2019–WPB17–R Report of the 17th Session of the Working Party on Billfish
     - 7.2.1 Indo Pacific Sailfish stock assessment
     - 7.2.2 Blue marlin stock assessment
     - 7.2.3 Revision of catch levels of Marlins under Resolution 18/05
   - 7.3 IOTC–2019–WPEB15–R Report of the 15th 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 Resolution 17/05 and the conservation of sharks in IOTC fisheries - Response to Commissions request to improve shark data collection
     - 7.3.3 Progress towards Ecosystem Based Fisheries Management (EBFM) in IOTC (Chairperson)
   - 7.4 IOTC–2019–WPTT21–R Report of the 21st Session of the Working Party on Tropical Tunas
     - 7.4.1 Bigeye tuna stock assessment
     - 7.4.2 Yellowfin tuna assessment update
     - 7.4.3 Joint tuna RFMO FAD working party meeting
   - 7.5 IOTC-2019-WPTmT07-R Report of the 7th Session of the Working Party on Temperate Tunas
     - 7.5.1 Albacore Tuna stock assessment
   - 7.6 IOTC–2019–WPM10–R Report of the 10th Session of the Working Party on Methods
     - 7.6.1 Management Strategy Evaluation Progress (Chairperson)
   - 7.7 IOTC–2019–WPDCS15–R Report of the 15th 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 THIRD TECHNICAL COMMITTEE ON MANAGEMENT PROCEDURES (TCMP)**

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

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

10.1 Sharks
10.2 Marine turtles
10.3 Seabirds
10.4 Marine Mammals

11. IMPLEMENTATION OF THE REGIONAL OBSERVER SCHEME (IOTC Secretariat)

11.1 Consideration of Resolution 16/04 On the implementation of a Pilot Project in view of promoting the Regional Observer Scheme of IOTC
11.1.1 Update on the Pilot Project approved by the Commission in 2017

12. PROGRESS ON THE IMPLEMENTATION OF THE RECOMMENDATIONS OF THE PERFORMANCE REVIEW PANEL (IOTC Secretariat)

12.1 Outcomes from the 2nd Technical Committee on Performance Review

13. PROGRAM OF WORK AND SCHEDULE OF WORKING PARTY AND SCIENTIFIC COMMITTEE MEETINGS (IOTC Secretariat and Chairperson**)**

12.1 Progress on previous Recommendations from WPs and SC
12.2 Program of Work (2020–2024) and assessment schedule
12.3 Schedule of meetings for 2020 and 2021

13 OTHER BUSINESS (Chairperson)

13.1 Election of a Chair and a Vice-Chair for the next biennium (Chair and Secretariat)

14 REVIEW OF THE DRAFT, AND ADOPTION OF THE REPORT OF THE 22nd SESSION OF THE SCIENTIFIC COMMITTEE (Chairperson)

APPENDIX 3
LIST OF DOCUMENTS

Document	Title
IOTC–2019–SC22–01a	Draft: Agenda of the 22nd Session of the Scientific Committee
IOTC–2019–SC22–01b_Rev1	Draft: Annotated agenda of the 22nd Session of the Scientific Committee
IOTC–2019–SC22–02_Rev2	Draft: List of documents of the 22nd Session of the Scientific Committee
IOTC–2019–SC22–03	Outcomes of the 23rd Session of the Commission (IOTC Secretariat)
IOTC–2019–SC22–04	Previous decisions of the Commission (IOTC Secretariat)
IOTC–2019–SC22–05	Report of the Secretariat – Activities in support of the IOTC science process in 2019 (IOTC Secretariat)
IOTC–2019–SC22–06	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–2019–SC22–07	Update on the implementation of the regional observer scheme (IOTC Secretariat)
IOTC–2019–SC22–08	Update on progress regarding Resolution 16/03 – on the second performance review follow–up (IOTC Secretariat)
IOTC–2019–SC22–09_Rev1	Revision of the program of work (2020–2024) for the IOTC science process (IOTC Secretariat)
IOTC–2019–SC22–10	Proposed schedule of Working Party and Scientific Committee meetings for 2020 and 2021 (IOTC Secretariat)
IOTC–2019–SC22–11	Progress on SC21 recommendations (IOTC Secretariat)
IOTC–2019–SC22–13	Uncertainties in the 2019 stock assessment for Indian Ocean albacore tuna and suggestions of further researches in 2020 for improving the assessment and providing management advice (Zhu J and Kitakado T)
IOTC–2019–SC22–14	Proposal on a management procedure for yellowfin tuna in the IOTC Area of Competence (Australia, Indonesia, Maldives, South Africa, EU)
IOTC–2019–SC22–15	Schedule of work for the development of management procedures for key species in the IOTC Area – UPDATE (Australia)
IOTC–2019–SC22–ES01	Status of the Indian Ocean Albacore (ALB: *Thunnus alalunga*) resource
IOTC–2019–SC22–ES02	Status of the Indian Ocean bigeye tuna (BET: *Thunnus obesus*) resource
IOTC–2019–SC22–ES03	Status of the Indian Ocean skipjack tuna (SKJ: *Katsuwonus pelamis*) resource
IOTC–2019–SC22–ES04	Status of the Indian Ocean yellowfin tuna (YFT: *Thunnus albacares*) resource
IOTC–2019–SC22–ES05	Report on biology, stock status and management of southern bluefin tuna: 2019 (from CCSBT)
IOTC–2019–SC22–ES06	Status of the Indian Ocean bullet tuna (BLT: *Auxis rochei*) resource
IOTC–2019–SC22–ES07	Status of the Indian Ocean frigate tuna (FRI: *Auxis thazard*) resource
IOTC–2019–SC22–ES08	Status of the Indian Ocean kawakawa (KAW: *Euthynnus affinis*) resource
IOTC–2019–SC22–ES09	Status of the Indian Ocean longtail tuna (LOT: *Thunnus tonggol*) resource
IOTC–2019–SC22–ES10	Status of the Indian Ocean Indo-Pacific king mackerel (GUT: *Scomberomorus guttatus*) resource
IOTC–2019–SC22–ES11	Status of the Indian Ocean narrow-barred Spanish mackerel (COM: *Scomberomorus commerson*) resource
IOTC–2019–SC22–ES12	Status of the Indian Ocean black marlin (BLM: *Makaira indica*) resource
IOTC–2019–SC22–ES13	Status of the Indian Ocean blue marlin (BUM: *Makaira nigricans*) resource
IOTC–2019–SC22–ES14	Status of the Indian Ocean striped marlin (MLS: *Tetrapturus audax*) resource
IOTC–2019–SC22–ES15	Status of the Indian Ocean Indo-Pacific sailfish (SFA: *Istiophorus platypterus*) resource
IOTC–2019–SC22–ES16	Status of the Indian Ocean swordfish (SWO: *Xiphias gladius*) resource
IOTC–2019–SC22–ES17	Status of the Indian Ocean blue shark (BSH: *Prionace glauca*)
IOTC–2019–SC22–ES18	Status of the Indian Ocean oceanic whitetip shark (OCS: *Carcharhinus longimanus*)

Document	Title
IOTC–2019–SC22–ES19	Status of the Indian Ocean scalloped hammerhead shark (SPL: *Sphyrna lewini*)
IOTC–2019–SC22–ES20	Status of the Indian Ocean shortfin mako shark (SMA: *Isurus oxyrinchus*)
IOTC–2019–SC22–ES21	Status of the Indian Ocean silky shark (FAL: *Carcharhinus falciformis*)
IOTC–2019–SC22–ES22	Status of the Indian Ocean bigeye thresher shark (BTH: *Alopias superciliosus*)
IOTC–2019–SC22–ES23	Status of the Indian Ocean pelagic thresher shark (PTH: *Alopias pelagicus*)
IOTC–2019–SC22–ES24	Status of marine turtles in the Indian Ocean
IOTC–2019–SC22–ES25	Status of seabirds in the Indian Ocean
IOTC–2019–SC22–ES26	Status of cetaceans in the Indian Ocean
IOTC–2019–WPNT09–R	Report of the 9th Session of the Working Party on Neritic Tunas
IOTC–2019–WPB17–R	Report of the 17th Session of the Working Party on Billfish
IOTC–2019–WPEB15–R	Report of the 15th Session of the Working Party on Ecosystems and Bycatch
IOTC–2019–WPM10–R	Report of the 10th Session of the Working Party on Methods
IOTC–2019–WPDCS15–R	Report of the 15th Session of the Working Party on Data collection and Statistics
IOTC–2019–WPTT20–R	Report of the 21st Session of the Working Party on Tropical Tunas
IOTC-2019-TCMP03-R	Report of the 3rd Technical Committee on Management Procedures (TCMP)
IOTC–2019–TCPR02–R	Report for the 2nd Technical Committee on Performance Review
IOTC–2019–SC22–NR01	Australia
IOTC–2019–SC22–NR02	China
IOTC–2019–SC22–NR03	Comoros
IOTC–2019–SC22–NR05	European Union
IOTC–2019–SC22–NR06	France (OT)
IOTC–2019–SC22–NR08	India
IOTC–2019–SC22–NR09	Indonesia
IOTC–2019–SC22-NR10	Iran, Islamic Republic of
IOTC–2019–SC22–NR11_Rev1	Japan
IOTC–2019–SC22–NR12_Rev1	Kenya
IOTC–2019–SC22–NR13	Korea, Republic of
IOTC–2019–SC22–NR14	Madagascar
IOTC–2019–SC22–NR15	Malaysia
IOTC–2019–SC22–NR16	Maldives, Republic of
IOTC–2019–SC22–NR17	Mauritius
IOTC–2019–SC22–NR18	Mozambique
IOTC–2019–SC22–NR20	Pakistan
IOTC–2019–SC22–NR22	Seychelles, Republic of
IOTC–2019–SC22–NR25	Sri Lanka
IOTC–2019–SC22–NR26	South Africa, Republic of
IOTC–2019–SC22–NR28	Tanzania
IOTC–2019–SC22–NR29_Rev1	Thailand
IOTC–2019–SC22–NR30	United Kingdom (OT)
Other Documents	
Information Papers	

Document	Title
IOTC-2019-SC22-INF01	State of the development of the workplan to improve the current assessment of yellowfin tuna (Merino G, Adam MS, Murua H, Fu D and De Bruyn P))
IOTC-2019-SC22-INF02	Improving biological knowledge of albacore tuna, Thunnus alalunga, in the Indian Ocean: a scoping study (Moore B, Langley A, Farley J and Hoyle S)
IOTC-2019-SC22-INF03	Review of IOTC YFT & BET Assessment in 2019 (Sharma R)
IOTC-2019-SC22-INF04	Taiwan,China - National Report 2019
IOTC-2019-SC22-INF05_Rev1	Population Structure of IOTC species and sharks of interest in the Indian Ocean

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 Republic of Mauritius reiterates that the United Kingdom is not entitled to be a member of the Indian Ocean Tuna Commission (IOTC) as a "coastal State situated wholly or partly within the Area [of competence of the Commission]".*

The Republic of Mauritius also strongly objects to any document purportedly submitted by the United Kingdom in respect of the so-called "British Indian Ocean Territory" ("BIOT") to this meeting and to any reference to the so-called "BIOT", "UK (OT)", "United Kingdom (OT)" or to the Chagos Archipelago as a British territory in any document which has been circulated for this meeting.

The Republic of Mauritius further strongly objects to the participation of the United Kingdom in this meeting and in any future meetings of this Committee.

The Republic of Mauritius wishes to draw the attention of this Committee that on 22 May 2019, the United Nations General Assembly adopted Resolution 73/295 relating to the Advisory Opinion rendered on 25 February 2019 by the International Court of Justice (ICJ) on the legal consequences of the separation of the Chagos Archipelago from Mauritius in 1965. In this Resolution, the General Assembly has, inter alia, affirmed, in accordance with the Advisory Opinion of the ICJ, that the Chagos Archipelago forms an integral part of the territory of the Republic of Mauritius and that since the decolonization of the Republic of Mauritius was not lawfully completed, the continued administration of the Chagos Archipelago by the United Kingdom constitutes a wrongful act entailing the international responsibility of that State. The General Assembly has also demanded that the United Kingdom withdraw its colonial administration from the Chagos Archipelago unconditionally within a period of no more than six months. The Republic of Mauritius is deeply disappointed that the United Kingdom has failed to withdraw its administration from the Chagos Archipelago by 22 November 2019, as requested by the General Assembly.

The General Assembly has further called upon the United Nations and all its specialized agencies as well as all other international, regional and intergovernmental organizations to recognize that the Chagos Archipelago forms an integral part of the territory of the Republic of Mauritius, to support the decolonization of the Republic of Mauritius as rapidly as possible, and to refrain from impeding that process by recognizing, or giving effect to any measure taken by or on behalf of, the so-called "BIOT". Moreover, the General Assembly has affirmed that all Member States of the United Nations are under an obligation to cooperate with the United Nations in order to complete the decolonization of the Republic of Mauritius.

It follows that under the rules and principles of international law, the Republic of Mauritius is the sole State lawfully entitled to exercise sovereignty and sovereign rights over the Chagos Archipelago and its maritime zones. This position has been consistently maintained by the Republic of Mauritius.

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 is illegal in the light of the Award of the Arbitral Tribunal, the findings of the International Court of Justice (ICJ) of 25 February 2019 and the provisions of UN General Assembly Resolution 73/295, it cannot be enforced. Any reference to or consideration given by the IOTC, including this meeting, to the purported 'MPA' will be in

contradiction with international law. The Government of the Republic of Mauritius urges the Committee to ensure compliance with the Award of the Arbitral Tribunal, the findings of the ICJ and UN General Assembly Resolution 73/295.

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

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.

Consideration by this meeting of any document which purports to refer to the Chagos Archipelago as the so-called "BIOT" or as a British territory or to the Island of Tromelin as a French territory, as well as any action or decision that may be taken on the basis of any such documents, 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 is entitled to be a member of the IOTC as a coastal State situated wholly or partly within the area of competence of the Commission, or that France has sovereignty or analogous rights over the Island of Tromelin.

Subject to the foregoing, the delegation of the Republic of Mauritius has no objection to the adoption of the draft agenda.

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 and all documents of this meeting."

The SC noted the following statement made by the United Kingdom (British Indian Ocean Territory):
UK Right of Reply:

"<u>Sovereignty</u>
The UK has no doubt about its sovereignty over the British Indian Ocean Territory (BIOT), which has been under continuous British sovereignty since 1814.

Mauritius has never held sovereignty over the islands that now form the British Indian Ocean Territory and we do not recognise its claim. No international court or tribunal, including the March 2015 United Nations Convention on the Law of the Sea (UNCLOS) ad hoc arbitral tribunal, has ever found the United Kingdom's sovereignty to be in doubt.

However, we have a long-standing commitment, first made in 1965, to cede sovereignty of the territory to Mauritius when it is no longer required for defence purposes. We stand by that commitment.

<u>International Court of Justice and UNGA</u>
We were disappointed that this matter was referred to the International Court of Justice and the UN General Assembly, contrary to the principle that the Court should not consider bilateral disputes without the consent of both States concerned.

Nevertheless, the United Kingdom respects the ICJ and participated fully in the ICJ process at every stage and in good faith. An Advisory Opinion is advice provided to the United Nations General Assembly at its request; it is not a legally binding judgment. The UK Government has considered the content of the Opinion carefully, however we do not share the Court's approach.

<u>UK membership of the IOTC</u>

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.

The United Kingdom is a Party to the IOTC Agreement and a Member of the IOTC and deposited its instruments of acceptance of the IOTC Agreement on 31st March 1995 and has been a party to the agreement since it entered into force. The IOTC is not a forum to discuss issues of sovereignty. As such, we are full members of the IOTC and have every right to be here.

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.

<u>BIOT Marine Protected Area (MPA) and United Nations Convention on the Law of the Sea (UNCLOS) Arbitral Tribunal</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 Arbitral Tribunal was 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. 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 but the UK will continue to approach discussions with an open mind about the best way to ensure proper conservation management of this unique marine environment."

The SC noted the following Response by France-OT to Mauritius about Tromelin:

"France declares that it does not recognize the Mauritian declaration as having any legal value, because it ignores the fact that the island of Tromelin is a French territory over which France constantly exercises full and complete sovereignty.

Thus, France enjoys the sovereign rights or jurisdiction conferred on it by international law in the Exclusive Economic Zone adjacent to the island of Tromelin. Meetings of Indian Ocean RFMOs are not the place to discuss issues of territorial sovereignty, but France stresses that it will continue to maintain a constructive dialogue with the Republic of Mauritius on this subject"

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 Republic of Mauritius strongly believes that the work of this Committee and of the Indian Ocean Tuna Commission (IOTC) needs to be done in full respect of international law.

In this regard, my delegation wishes to draw the attention of this Committee to the fact that the International Court of Justice (ICJ) stated at paragraph 90 of its Advisory Opinion of 25 February 2019 that it "does not

consider that to give the opinion requested would have the effect of circumventing the principle of consent by a State to the judicial settlement of its dispute with another State."

The Advisory Opinion of the ICJ made it clear that the Chagos Archipelago is, and has always formed, an integral part of the territory of the Republic of Mauritius. The United Kingdom cannot and does not have sovereignty over the Chagos Archipelago. Pursuant to UN General Assembly Resolution 73/295, the IOTC cannot validly under international law recognize the so-called "British Indian Ocean Territory" ("BIOT").

The Republic of Mauritius reaffirms that in the light of the Advisory Opinion of the ICJ and UN General Assembly Resolution 73/295, the United Kingdom is not entitled to be a member of the IOTC as a "coastal State situated wholly or partly within the Area [of competence of the Commission]".

The Republic of Mauritius further maintains that in the light of the Award of the UNCLOS Arbitral Tribunal of 18 March 2015, the Advisory Opinion of the ICJ and UN General Assembly Resolution 73/295, the 'marine protected area' ('MPA') purportedly established by the United Kingdom around the Chagos Archipelago is illegal and cannot be enforced.

Moreover, the Republic of Mauritius reiterates that the Island of Tromelin forms an integral part of its territory 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 Republic of Mauritius reaffirms that it has full and complete sovereignty over the Island of Tromelin, including its maritime zones."

APPENDIX 4B
NATIONAL REPORT ABSTRACTS (2019)

Australia (IOTC-2019-SC22-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 are relatively low due to reduced profitability, primarily as a result of lower fish prices and higher operating costs. In 2018, two Australian longliners from the Western Tuna and Billfish Fishery and three longliners from the Eastern Tuna and Billfish Fishery operated in the IOTC Area of Competence. They caught 11.9 t of albacore (*Thunnus alalunga*), 45.7 t of bigeye tuna (*Thunnus obesus*), 37.8 t of yellowfin tuna (*Thunnus albacares*), 161.2 t of swordfish (*Xiphius gladius*) and 0.5 t of striped marlin (*Kajikia audax*). In 2018, 0.07 t of shark was landed by the Australian longline fleet operating in the IOTC Area of Competence and 6 599 sharks were discarded/released. In addition, 13.0% of hooks deployed in the WTBF were observed with electronic monitoring in the 2018 calendar year. The actual catch of southern bluefin tuna (*Thunnus maccoyii*) in the purse seine fishery was 5367 t in 2018. There was no skipjack tuna (*Katsuwonus pelamis*) caught by purse seine fishing.

China (IOTC-2019-SC22-NR02)

Deep-frozen longline targeting for tropical tuna and frozen longline targeting albacore 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 2018 was 85. The number of active deep-frozen longline vessels increased from 71 in 2017 to 75 in 2018. The tropical tunas catch (bigeye and yellowfin tuna) of Chinese longline fleet in 2018 was estimated at 8,697 MT, which was 817 MT higher than that in 2017(7,880MT). The number of frozen longline vessels in 2018 were the same as in 2017. The albacore longline catch for 2017 was estimated at 5,449 MT, higher than in 2017 (3,646 MT). Both the logbook and observer programs are being implemented for the Chinese longline fleets. In 2018, five scientific observers were deployed on board longline vessels to collect 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 l'enquête de 2018 est estimé à 13 070 tonnes toutes espèces confondues soit environ 9133 tonnes de thonidés sur un ensemble de 5006 embarcations. Pour le moment la pêche industrielle est inexistante au niveau national.

Eritrea (IOTC-2019-SC22-NR04)

National Report not submitted

European Union (IOTC-2019-SC22-NR05)

The EU fleet fishing in the waters of the Indian Ocean is composed of two main segments.
The first is an offshore segment including

- Purse seiners métiers targeting the three species of tropical tunas
    - Data 2018:
        - 27 active vessels
        - 35.777 m^3.j transport capacity
        - 5.585 searching days and 6.243 days at sea
        - 293.277 t of catch

        - • YFT 26,7 %
          • SKJ 62,2 %
          • BET 10,7 %
- Longliners targeting swordfish with significant associated catches of some pelagic shark species
    - Data 2018
        - 16 active vessels
        - 4.213 * 106 hooks
        - 7.628 t of catch
        - • SWO 41,9 %
          • BSH 43,2 %
          • SMA 8,5 %
- Longliners targeting swordfish with significant associated catches of tunas (La Réunion)
    - Data 2018
        - 19 active vessels (≥12m)
        - 3,300 * 106 hooks
        - 1.282 t of catch
        - • SWO 42,0 %
          • YFT & BET 32,0 %
          • ALB 15,0 %

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 2018
        - 21 vessels at Reunion Island (<12 m)
            - 0,688 * 106 hooks
            - 407 t of catch
                - SWO 35,4 %
                - YFT & BET 28,0 %
                - ALB 16,0 %
        - 3 vessels at Mayotte Island
            - 70 fishing days
            - 111,6 *103 hooks
            - 75,7 t of catch (SWO-YFT-BET)
- Trolling line and hand-lines
    - Data 2018
        - Reunion :131 vessels
            - 12.925 fishing days
            - 781,2 t of catch (YFT-BUM-DOX 76%)
            - Mayotte : 141yoles in the formal professional sector, 400 boats and 794 canoes in the non-professional sector (2016 data; 2017 N/A). Total production estimated at
            - 1.044 t in 2018 (2,050 t in 2006 and between 965 and 1421 t in 2013/2016). The provisional estimate for 2018, only for professional boats, is 217t against 646 t in 2017.

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 15/02, flag EU Member States (Spain, France, Italy, Portugal and United Kingdom) have submitted scientific data characterizing the activity of the EU fleet fishing in 2018 in the IOTC area of competence and enabling the IOTC Scientific Committee to conduct its work.

France-territories (IOTC-2019-SC22-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 été formés l' programme observateur embarqué accompagne l'octroi de ces licences. En 2018, l'administration des TAAF a accueilli 7 nouveaux observateurs pour la formation Obspec, alors que 2 autres avaient déjà été formés et avaient déjà embarqués sur des thoniers senneurs l'année précédente. Les embarquements des 9 observateurs scientifiques disponibles ont concerné onze (11) senneurs de pavillon français, espagnol, italien et seychellois, un (1) bateau assistance de pavillon seychellois et un (1) palangrier de pavillon français entre le 28 février et le 20 Août 2018. Les embarquements sur les senneurs ont totalisé 357 jours d'observations, 23 jours pour le baliseur et 46 jours pour le palangrier soit un total de 426 jours de mer. La distribution géographique des activités montre que les jours de mer observés ont été distribués majoritairement et en proportion équivalente dans les eaux internationales (40%) et dans la ZEE seychelloise (40%). Seuls 4 jours de mer (0,9% de la totalité des jours observés) ont été localisés dans la ZEE des Iles Eparses. Un total de 350 coups de pêche a été observé pour les senneurs durant cette campagne. Lors de la marée de 23 jours sur le baliseur, 72 objets flottants dont 2 naturels ont été rencontrés et 38 radeaux ont été déployés. Lors de la marée de 45 jours sur le palangrier 35 opérations de pêche ont été observées.

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 2018. La France a participé activement à tous les groupes de travail organisés par la CTOI, et a présenté 27 contributions scientifiques en 2018 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.

India (IOTC-2019-SC22-NR08)

The total landings of tuna and tuna-like species (hereinafter referred to as tuna fishery) in India for 2018 was estimated at 208 928 tonnes, showing a marginal increase of 3.46 percent over the previous year (201,942 tonnes in 2017). Gillnets contributed 40.45 percent to the total landings of tuna fishery, followed by small purse/ring seines (12.42%) and trawls (10.01%). Pole and line fishing, practiced exclusively in the waters of the Lakshadweep Group of Islands, contributed 6.03 percent to the total tuna landings. Other gears like small longline and gillnet-cum-longline also contributed to tuna landings in small quantities during the year.

Considerable spatial variation was observed in the tuna landings along the mainland coastline. The western coast of India (FAO area 51) contributed the major share to the landings (64%) and the balance 36 percent landings took place on the east coast (FAO area 57). Tuna landings in 2018 were supported by seven species, four representing the neritic (27.76%) and three from the oceanic group (35.65%). Yellowfin tuna (*Thunnus albacares*) contributed the maximum (17.94%), followed by Skipjack (*Katsuwonus pelamis*) (17.42%) and Kawakawa (*Euthynnus affinis*) (15.89%).

There was no reporting of sea bird interactions with the tuna fishery during the reporting period. Similarly, there was no reporting of mortality of sea turtles, marine mammals and whale sharks, which are protected under Schedule 1 of the Wildlife (Protection) Act of 1972 of India. The Central Marine Fisheries Research Institute of the Indian Council of Agricultural Research (ICAR-CMFRI), Fishery Survey of India (FSI) of the Department of Fisheries, Ministry of Fisheries, Animal Husbandry & Dairying, Government of India and the Department of Fisheries of the coastal States and Union Territories (UTs) are the main agencies responsible for data collection and collation on tuna fishery.

Indonesia (IOTC-2019-SC22-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 571 (Malacca Strait and Andaman Sea), FMA 572 (Western Sumatera and Sunda Strait), and FMA 573 (South of Java to East Nusa Tenggara, Sawu Sea and western part of Timor Sea). Indonesian fishers operate 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 fishing vessel operated in 2018 was 326 vessels dominated by longline vessels followed by purse seine vessel. Total catch of main species of tunas in 2018 was estimated around 151,592 tons which composed of albacore (5,604 mt), bigeye tuna (20,404 mt), skipjack tuna (85,277 mt) and yellowfin tuna (40,306 mt). Nominal hook rates derived from logbook data 2018 for albacore, bigeye and yellowfin in kg/1000 hooks were 46.96, 33.10, and 65.28 respectively. Meanwhile, nominal hook rates for swordfish and blue marlin were increased compared than previous years, while hook rates for black marlin, striped marlin, indo-pacific sailfish and short-billed spearfish continued to depleted. Observer coverage 2018 was reported 3.85% decreased from previous year in term proportion number of vessel observed. Interaction longline fishery with ERS still dominated by blue sharks. Interaction with seabird reported decreased due to shifting fishing area while interaction with marine turtle reported slightly increased from previous years, however mitigation measures for those ERS has taken in account by fishermen.

Iran (Islamic Republic of) (IOTC-2019-SC22-NR10)
Iran (Islamic Republic of) fishing grounds in Northern and southern waters of the country are located in the Caspian Sea and Persian Gulf and Oman Sea. Fishery for tuna and tuna-like species is a major component in large pelagic fisheries in Iran and one of the most important activities in the Persian Gulf, Oman Sea and offshore waters. The long Iranian coastline about 193 port and landing places and about 143 thousand fishermen individuals which are directly engaged in fishing activities and more than 11 thousand fishing crafts consist of fishing boats, Dhows and vessels using different fisheries including: Gillnet, Purse seine Trolling, Trawl and Wire-trap which are engaged in fishing operation according to a time schedule during different fishing seasons in the coastal and offshore waters. Gillnet and purse seine are two main fishing methods used by Iranian vessels to target large pelagic species (especially tuna and tuna-like) in the IOTC area competency and also some of small boats used trolling in coastal fisheries.
The Catch quantity of large pelagic in Iran was 314000 Mt in 2018 reported to the IOTC Secretariat and around 275000Mt belongs to tuna and tuna-like fishes in the Indian Ocean areas. This amount of catch contains 70% (220000 Mt) of Tunas, 11.1% (35000 Mt) of Seerfish, 6.5% (21000Mt) of billfish, 0.9% (2900 Mt) different species of shark and 11.5% (36000 Mt) other species.

Japan (IOTC-2019-SC22-NR11)
This Japanese national report describes following 8 issues in recent five years (2014-2018), 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-2019-SC22-NR12)
The Kenyan tuna and tuna-like fishing fleets comprise of the artisanal, semi-industrial, industrial and recreational fisheries which have an impact on IOTC’s priority species. The commercial artisanal fishing fleet is composed of a multi-gear and multi-species fleet operating in the territorial waters. The artisanal 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 2016 within the coastal waters. The main gears used are artisanal long line hooks, gillnets, monofilament nets and artisanal trolling lines.
In 2018, three (3) Kenya pelagic longline vessels operated in the IOTC area of competence. The IOTC species landed during the year included swordfish (294 tons), yellowfin tuna (108 tons) Bigeye tuna (28 tons) while other species combined (99 tons).
Catches of scombrids from artisanal fisheries were 3,476 tons, which is an increase from 1,931 tons recorded in 2017. Other IOTC species landed during the year were sailfish (427 tons), Swordfish (216 tons), Sharks (536 tons), Rays and Skates (879 tons) and hammerhead sharks (26 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-2019-SC22-NR13)

The number of active vessels in 2018 was 12 for longline fishery and 2 for purse seine fishery. With this fishing capacity, Korean tuna longline fishery caught 2,815 ton in 2018, which was 7% lower than that of 2017. The fishing efforts in 2018 were 6,052 thousand hooks and distributed in only the western Indian Ocean, while the fishing efforts averaged for 5 recent years (2014-2018) were 6,348 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. Korean tuna purse seine fishery in the Indian Ocean recorded 19,259 ton in 2018. In 2018, 2 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 2018 were 522 sets, which mainly distributed in the western and central tropical areas around 40°E-70°E. In 2018, 3 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 4.0% and 17.0% of observer coverage in terms of the number of hooks and sets, respectively.

Madagascar (IOTC-2019-SC22-NR14)

A Madagascar, la pêche thonière industrielle est assurée par des palangriers de moins de 24 mètres (entre 14 et 17 mètres) qui opèrent sur la côte Est. L'année 2018 a été marquée par la diminution du nombre des palangriers à 5 s'ils étaient au nombre de 7 ces 4 dernières années. 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 oeuvre depuis 2014 pour Sainte Marie et depuis aout 2016 pour Toamasina, nous permet de visualiser la distribution de taille des espèces capturées.

Les prises des palangriers varient suivant les années et tendent à diminuer de 2010 à 2018. Cette variation est légèrement proportionnelle à celle de l'effort de pêche (exprimé en nombre d'hameçons déployés) qui en 2018 a beaucoup diminué. Influencée par la diminution du nombre de navire en activité et évidemment par l'effort de pêche en 2018, la capture moyenne annuelle des palangriers est en baisse avec 355 tonnes. 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.

En ce qui concerne le suivi de débarquement des poissons pélagiques issus de la petite pêche et de la pêche artisanale dans le Nord de Madagascar, outre les 19 sites de débarquement couverts en 2017, 10 autres sites de débarquements sont ajoutés au suivi en 2018. Les engins de pêche utilisés sont principalement le filet maillant, la ligne et la palangre. En effet, la capture totale annuelle est estimée à 5000 tonnes dont les thons et espèces apparentées constituent les 30% de la capture. Les détails de capture et données de taille relatifs à cette filière sont figurés dans ce rapport.

Malaysia (IOTC-2018-SC21-NR15)

Total catch of marine fish from Malaysian waters in 2018 were 1.48 million mt, a slide increased 1% compared to 1.46 million in 2017. The total landing in 2018 were attributed to the catch from 52,556 registered vessels with trawlers, purse seines, drift nets contributed large percentage of the catches. In 2018, marine fish production from the west coast of Peninsular Malaysia (Malacca Straits) contribute 787,738.27 mt (54.3%) 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 83% (1,224,707.77 mt) and 17% (262,006.32 mt) from deep-sea 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 end of 2013.

During the early 1980s, small tuna (as neritic tuna were called then) were only caught as by-catch by gill nets and purse seines. When tuna purse seines were introduced in 1987, the neritic tuna fisheries started to develop. A tagging experiment on neritic tuna carried out in South China Sea showed that 50% of the recaptured tuna came from the purse seine operators. Initially purse seine operators visually searched for tuna schools. Gradually, some of these operators started to use lights to aggregate fish. Following complaints from other fishermen, the use of lights was regulated and limited to less than 30 kilowatts, although there have been incidences of non- compliance. Neritic tuna contribute 4.6% of Malaysia's marine fish landings in 2018. Purse seiners 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 86% 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 kawa kawa and frigate tuna. In the year 2018, neritic tuna landings in west coast Peninsular Malaysia amounted to 14,745.2 mt; increasing by 18.24% compared to 12,470.21 mt in 2017. Meanwhile landings of neritic tuna in Malaysia ranged from 50,000 mt to 70,000 mt. The highest catch was recorded in 2016 and 2017 with 70,000 mt and 75,000 mt respectively. There was a decreasing trend in landings from 2002 to 2005 before an increasing trend until 2008. Landings of neritic tuna in Malaysia appear to have stabilized from 2010 to 2018.

The catch of oceanic tuna in 2018 increased significantly by 12.08% from 2,682.55 mt in 2017 to 3006.65 mt in 2018. Albacore showed an increasing from 1,607.24 mt in 2017 to 1792.46 mt in 2018. The fleet which consisted of six (6) fishing vessels and one (1) carrier, unloaded and exported the catches at the Port Louis, Mauritius. Albacore tuna formed nearly 60% of the catches in the form of frozen tuna. Another 13 vessels were unloaded at Penang Port mostly are yellowfin and bigeye tuna in frozen and gutted forms.

For domestic vessels operating beyond 30 nm offshore, there are plan by the DoF Malaysia to implement observer on board and logbook system. The revised NPOA- Sharks II is published in 2014 and sharks and endangered species listed in the CITES also listed in Malaysia CITES Act 2008. On sea turtle, four (4) turtle conservation and information centres have regularly implementing awareness program for student and fishermen communities in the states of N.Sembilan, Perak, Penang and Melaka. Hatching program at these centers 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.

Malaysia have updated the national logbook to include all the species as requested in Resolution 15/01, and monitor tuna landing and inspection at port by Port Inspector. Dof Malaysia also monitoring and tracking the deep-sea and tuna vessels using National VMS.

Under resolution 18/06, Malaysia longliners transhipped at sea monitor by the IOTC observer under ROP. Malaysia participated in the Regional Observer Program in 2018 for carrier vessel and fishing vessel to monitor transhipment at sea.

Maldives (IOTC-2019-SC22-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. 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 now well-established as a major component, which targets large yellowfin tuna (> 70 cm FL) from the surface (<10m). Following termination joint-venture licensing in 2010, a small domestic longline fleet operated from 2011 until early 2019. 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 Longline Regulation which came in force in 2011 restricted its operation from within 100 from the shore to protect the pole-and-line and handline operations

Maldives reported a total of 1448,171 t of tunas in 2018, comprising of skipjack, yellowfin, bigeye, frigate and kawakawa. Pole-and-line fishery landed 99% (99,886 t) of skipjack tuna in 2018, and was the second most important gear for yellowfin tunas, landing 37% (17,600 t) f all yellowfin tuna caught in 2018. Handline gear almost exclusively lands yellowfin tuna (28,960 t in 2018) which represented 99% of all species landed by the gear. Longline catch of tunas decreased by 59% from 2017, landing 799 t comprising of 633 t of yellowfin tuna and 163 t of bigeye tuna.

Catches of skipjack registered an increase in 2018 relative to 2017, by about 12%. Recent catches have been of the order of 68,000 – 100,000 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. Shark 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. Maldives Marine Research Institute currently conducts scientific observations of fishing trips in accordance with the relevant IOTC Conservation and Management Measures.

Collection of data from logbooks is now fully established. A revision to the Regulation enforced early in 2019 requires mandatory reporting of logbook before the catches are sold for processors and exporters. An electronic logbook is being trialled which will become fully rolled out by the end of 2019. A new vessel monitoring system is being

procured which will replace the old VMS on the vessels. It is expected by the end of 2021 nearly all tuna fishing vessels will be equipped with VMS.
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 2018, Mauritius had 2 purse seiners, 1 supply vessel and 13 semi-industrial longliners operating in the tuna fishery. The two purse seiners are large freezer vessels having an overall length of 89.4 M each. The longliners are semi-industrial boats less than 24 Metres in length. 8 out of the 13 semi-industrial longliners operated outside the Mauritius EEZ and the remaining 5 longliners operated exclusively inside the EEZ.
The semi-industrial longline fleet operating exclusively inside the EEZ of Mauritius comprised 5 boats which undertook 23 fishing trips for a total of 213 fishing days and a deployment of 296620 hooks. The majority of the catch consisted of yellowfin (35.5%), albacore (28.4%) and swordfish (16%). Their total catch amounted to 130 tonnes. The CPUE was 0.43kg/ hook.
Eight semi-industrial longliners operated outside the EEZ carried out 118 trips for a total of 899 fishing days. They landed 691t of fish with a deployment of 1148857 hooks. The CPUE was 0.6kg/hook. Majority of their catch consisted of swordfish (44%) followed by yellowfin (30%). The area of operation was between latitudes13oS and 27oS and longitudes 34oE and 42oE.
The Mauritian purse seiners operated between latitudes 13oN to 15oS and longitudes 43o to 80oE. Total catch of the two purse seiners amounted to 22,529t comprising of 50% yellowfin, 41% skipjack and 8% bigeye tuna for 612 positive sets out of a total of 650 sets. Observers were deployed on the two Mauritian purse seiners for a total of 139 days at sea.
Sampling exercises were carried out on local semi-industrial longliners. 783 fish were sampled from the semi-industrial longliners operating outside the EEZ and 1891 fishes were sampled on the semi-industrial longliners operating inside the EEZ. 262 fishes were sampled in the artisanal fishery for length frequency. Sampling exercises were also carried out on the Mauritian purse seiners.

Mozambique (IOTC-2019-SC22-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 2018 the total catch of IOTC species within Mozambique EEZ was 7583 tons of which 37% came from Foreign fleet and 63% came from domestic fisheries.
The total catch of distant water fishing nations composed of 32 longliners and four purse seiners in 2018, estimated at 2805 tons, was similar to the previous year figure. Yellowfin represented 56% of the catch followed by bigeye 13% and swordfish 7%. Shark species reported by this fleet represented about 1% of total catch, composed by blue shark.
The national industrial tuna fleet licensed two longline vessels, which produced a total catch of 135 tons (3% of the total domestic production for IOTC species). Compared to the catch of the year 2017 the production achieved by this fleet represented a signigficant redution of -47%. Cathes composition were dominated by yellowfin (46%) and swordfish (34%) acompanished by bigeye and dourado with 6% each. Sharks were not retained by this fleet with all being safe realised. The semi-industrial linefishery fleet of 33 vessels (14m-19m LOA) targeting primarily rocky bottom demersal fish, landed about 90 tons Narrow-barred Spanish mackerel, representing 2% of the domestic catches of IOTC species . The multi-gears and multi-species artisanal sector landed 4513 tons of IOTC primary species, contributing with 94% of total IOTC species domestic landings. The 2018 prodution of this sector represented a slight reduction of -6% compared to the catch of IOTC species in the year 2017. Catch composition was dominated by Narrow-barred Spanish mackerel (37%) and by frigate and bullet tunas with 44% followed by kawakawa 14%. The capture of sharks (IOTC and non IOTC sharks) by this sector is considerable and in the year 2017 was estimated at 2336 ton of which hammerhead sharks represented 71%. No update was made in 2018. The recreational and sport fishing sector, which also catches IOTC primary species, issued 3343 individual licenses in 2018. Similarlly to previous years about 90% of the licenses were issued in the southern coastal provinces where the activity is more intense. The total catch of IOTC primary species by this sector was roughly estimated around 39 tons in 2018. 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 2018, 16 % of the total fishing days were covered by scientific observers on-board national longline vessels. Improvements in the observer program are being expected in the following years as Mozambique is willing to participate in the pilot project on regional observer scheme. 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 2018 Mozambique continued with elaboration of the NPOA-sharks, with a first draft to be delivered in 2019 throuthout a coolaboration between Mozambique government and WWF, WCS, TRAFFIC and other national agencies. 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-2019-SC22-NR19)

National Report not submitted.

Pakistan (IOTC-2019-SC22-NR20)

Tuna and tuna like fishes are one of the components of pelagic resources. In Pakistan, mainly neritic and oceanic species are caught 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 2018 was 70,569 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 Maritime Affairs.

Tuna and allied resources called as large pelagic resources. The large pelagic resources contributed 70,569 ton, accounting for 21% of the marine capture fish production. Major share of the landing was by tunas (72%) followed by seerfishes (17.65%), dolphinfish (5.0%) and billfish (4.99%). Among the tunas, yellowfin was dominating with 32%, followed by longtail (23), frigate (21.50%), tuna-nei (10%), kawakawa (8%) and skipjack (4.5%). There were 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 years from 2016-2018, for the conservation of bycatch species which include promulgation of fisheries legislations by both provinces of Sindh and Balochistan. These legislations 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 guitarfishes and wedgefishes 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-2019-SC22-NR21)

National Report not submitted.

Seychelles (IOTC-2019-SC22-NR22)

The Seychelles National Report summarizes activities of the Seychelles' fishing fleet targeting tuna and tuna-like species in the WIO for the year 2018 in comparison with previous years. It also summarizes research, and data collection related activities as well as actions undertaken in 2018 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 2018. The number of supply vessels also increased from 4 to 8 vessels in 2017 and was then reduced to 7 vessels in 2018. In 2018 the nominal effort decreased by 485 days (15%) when compared to the previous year to reach a total of 2,786 days fished whilst the catches increased by % from 122,202 MT in 2017 to 123,310 MT in 2018 resulting in a mean catch rate of 44.25 MT/Fishing day. Skipjack was the dominant caught species, accounting for 66% of the total catch whilst yellowfin tuna made up 28% of the total catch of the Seychelles flagged purse seiners in WIO. Catches of yellowfin tuna and bigeye tuna decreased by 16% and 34% respectively whilst catches of skipjack increased by 16% when compared to the previous year.

The Seychelles Industrial longline fleet comprised of 54 vessels in 2018 like 2017. The total catch reported by the industrial longline fleet for 2018 was estimated at 11,066 MT representing a decrease of 25% in catches, when compared to 2017 corresponding to the 28% decrease in fishing effort.

In term of species composition, yellowfin tuna and the NEI category comprising of mostly 'oilfish' were the dominant species caught by this fleet in 2018 accounting for 29% and 24% respectively, followed by bigeye tuna and swordfish, representing 20% and 13% respectively. The estimated catch rate has remained more or less similar to the previous year estimated at 0.43 Mt/1000 hooks for the year 2018.
In 2018, the Semi industrial fishery recorded the highest catch since the beginning of the fishery with a reported total catch of 1,266 Mt representing an 9% increase compared to the previous year catches. The fishing effort also increased by 5% from 2.05 million hooks set in 2017 to 2.15 million hooks in 2018. The catch rate decreased from 0.57 MT/1000 hooks in the previous year to 0.59 MT/1000 hooks.
Similar to previous years, the SFA is implementing 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 and implementation of National Scientific Observer Programme, including piloting Electronic Monitoring system and Electronic Reporting.

Sierra Leone (IOTC-2019-SC22-NR23)
National Report not submitted.

Somalia (IOTC-2019-SC22-NR24)
National Report not submitted.

Sri Lanka (IOTC-2019-SC22-NR25)
The total production of tuna and tuna like species of Sri Lanka in year 2018 was 114,374t. 82% of the catch was from the EEZ. 70% of the total catch was Skipjack tuna and Yellow fin tuna in equal shares, the catch amounting to 40,000t each. 3% of the catch was bigeye tuna. The bill fish were the second most group and it was 15% to the catch. Sword fish dominate in the bill fish catch. The shark catch was 1804t. Enforcement of shark management regulations and discouraging of gill net operations has drop the shark catches. Over 4000 multi day boats engaged in large pelagic fishing both high seas and within EEZ. 1337 vessels were authorised for high seas and only 1164 vessels active in 2018. 99% of the high seas operating vessels are less than 24m. VMS is mandatory for high seas operating vessels. Major fishing gears are long line and gill net. In 2018, 28%, 14% and 16% of vessels exclusively operated for longline, gill net and for Ring nets. 42% of the vessels used multi-gear of more or less combinations of these gears. Multi-gear vessels are being promoted to long line by introducing mechanised line haulers and the upgrading of vessel conditions to accommodate better cooling systems to improve the quality of the fish and reduce the post economic loss. High fuel cost has restricted the year round vessel operations and most vessels are being kept anchored. Electronic means of fish catch data collection is being implemented and carried out parallel to the paper log books. On board observers were deployed in all large vessels. Port State Measures are being implemented and E-PSM application is followed. Coastal data collection system is being improved by introducing better sampling techniques.

South Africa (IOTC-2019-SC22-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 2018, a total of 25 longline vessels were active in the IOTC area of competence, which is more than in 2017. Effort increased marginally - the number of hooks set in 2018 was 1 325 446, compared to 1 284 160 in 2017. Catches also increased from 2017 for swordfish (53%), blue shark (41%), yellowfin tuna (25%) and southern bluefin tuna (19%). The 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 450 tons in 2017/2018. For the same period, decreases in catch were observed in albacore (48%), bigeye tuna (23%) and shortfin mako shark (15%). The high inter-annual variability in catches for species can largely be attributed to a high proportion of longline vessels fishing close to the IOTC/ICCAT boundary line. Skipjack catches continue to be negligible (0.1 metric tons) and the catch of all other species (NEI) also declined from 2017 to 2018.
There were three Japanese foreign-flagged joint-venture vessels that fished in the IOTC area of competence in 2018, all with 100% observer coverage - a combined total of 243 observer days. Nine trips from a local longline vessel were observed, with a combined total of 75 observer days. Observer coverage exceeded all RFMO requirements and 56% (744 415) of hooks set in the IOTC area of competence were set while an observer was onboard.

Approximately 37% of all hooks set in the IOTC area of competence were actively observed. There was zero effort in the IOTC area of competence by the South African Tuna Pole-Line fleet in 2018; only a single trip occurred in 2017.

Sudan (IOTC-2019-SC22-NR27)
National Report not submitted.

Tanzania (IOTC-2019-SC22-NR28)
The tuna and tuna-like fishing in Tanzanian are dominated by artisanal fleets, which use local multi-gears landing multi-species catch. Most of the fishing vessels range from 3 to 11 meters long. The main gears are manually handled drift nets and anchored gillnets, ring nets, hand line, purse seiner and long lines. Industrial fishery in the Tanzanian Exclusive Economic Zone (EEZ) are conducted by Distant Water Fishing Nations (DWFNs) using large scale purse seiner and long line vessels targeting tropical tuna such as skipjack, yellowfin and bigeye tuna. Artisanal fishery statistics from Tanzania for the year 2018 shows a nominal catch of 22,171 tons for tuna and tuna like species which is higher compared to 5,410.2 tons reported in 2015. The total number of vessels targeting tuna and tuna like in Tanzania is 6,336. The fishery is comprised of different number of fishing gears including 15,428 longline, 32,772 hand line, 3,677 anchored gill nets, 66,679 drift gillnet and 743 ring nets. The survey report shows that the weight of Skipjack was 1,292.73 tons, Kanadi 3,175.73 tons, Bigeye 593.68 tons, Swordfish 2,592.73 tons, Kawakawa 3,121.03 tons and Shark 3,087.03 tons. The Deep Sea Fishing Authority has been sign a LoU with IOTC regarding the implementation of the Regional Observer Scheme (ROS) in the United Republic of Tanzania. Under National Observer Program (NPO), observations for artisanal tuna and tuna-like and shark fisheries have been conducted in seven major landing sites in the country. However, there are no port observations or sampling recorded in year 2018 as there are no industrial fishing vessel licensed, trans-shipping or offloading fish at port. Tanzania has developed "EEZ Fisheries Research Agenda 2018-2027" to guide research that will support development and management of tuna and tuna-like fishery in Tanzanian waters. The agenda is implemented with a number of research areas, namely Biological research of tuna, tuna-like species, sharks and other living resources; Environmental research; Fishery related research; Stock assessment research; Business planning and social and economic research; and Monitoring, Control and Surveillance. Furthermore, Tanzania has drafted a National Plan of Action for the conservation and management of sharks and rays that is expected to be endorsed by 2020.

Thailand (IOTC-2019-SC22-NR29)
Thailand has advance for implementing a comprehensive system to combat IUU fishing. It started to take a reforms 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. Thailand has implemented PSM and assigned 19 PSM ports for port entry of foreign vessel. 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.
In 2018, Thailand had no fishing vessel operated in high sea of IOTC competent. Thailand had only domestic purse seiner fishery in the Andaman sea. Their operated the fishing from shores are 10 to 30 nautical miles and depth of water range from 20-80 m. The average catch rate was 31.16 ton/day. The average percentage composition of Round scads 31.34 %, followed by Indian mackerel 13.04%, Neritic tuna 11.14%, Big-eye scad 9.36%, King mackerel 0.35% and other species 34.78%. The average CPUE were 0.99, 0.41, 0.35, 0.30, 0.01 and 1.10 ton/day, respectively. For average percentage composition of Neritic tuna were Eastern little tuna 46.80 %, Longtail tuna 26.16%, Frigate tuna 16.82% and Bullet tuna 10.22%, respectively.
Foreign tuna fleets unloaded at 4 province of Thailand (Phuket, Samut Prakarn, Bangkok, Samut Sakhon). The annual catches were estimated 57,897.35 tonnes. All of them were caught by foreign fishing vessel those operated in the Indian Ocean. The main species composition were Skipjack tuna included yellowfin tuna, bigeye tuna, Swordfish, Blue marlin and other species which were 69.05%, 23.32%, 6.52%, 0.56%, 0.20% and 034%, respectively.
At Present, DOF is launch authorizing Thai-flagged overseas fishing vessels. Currently, there has been applications from begin with Thai-flagged overseas fishing fleet. These vessels operate in SIOFA area and target demersal fish species. No application has been submitted for vessels operating in the IOTC area.

United Kingdom (OT) (IOTC-2019-SC22-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 2018 and provides details of research activities undertaken to date within the MPA.
The recreational fishery landed 11.3 tonnes of tuna and tuna like species on Diego Garcia in 2018. Principle target tuna species of the industrial fisheries (yellowfin and skipjack tunas, no bigeye were caught) contributed 39.8% 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 19/01 seeks to address this, UK(BIOT) have been taking action to reduce the number of yellowfin tuna caught in the BIOT recreational fishery and encouraging their live-release. Length frequency data were recorded for a sample of 464 yellowfin tuna from this fishery. The mean length was 79.95cm. 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 2018 the BIOT Environment Officer continued to take forward the BIOT Interim Conservation Management Framework which has been replaced with a set of current conservation priorities. In 2018/19 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-2019-SC22-NR31)
National Report not submitted

Bangladesh (IOTC-2019-SC22-NR32)
National Report not submitted

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 (2019)

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 developed in 2018, 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. Australia is developing an NPOA to address the potential risk posed to seabirds by other fishing methods, including longline fishing in state and territory waters, which are not covered by the current threat abatement plan. **Marine turtles:** Australia's current marine turtle bycatch management and mitigation measures fulfill Australia's obligations under the FAO-Sea turtles Guidelines.
Bangladesh							**Sharks:** No information received by the Secretariat. **Seabirds:** No information received by the Secretariat. **Marine turtles:** No information received by the Secretariat.
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.
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.

APPENDIX 6

SCHEDULE OF WORK FOR THE DEVELOPMENT OF MANAGEMENT PROCEDURES FOR KEY SPECIES IN THE IOTC AREA

Year	Albacore	Skipjack	Yellowfin	Bigeye	Swordfish
2020	**WPs/SC**: Consider recommendations from the Commission and undertake MSE to provide advice on the performance of candidate MPs.	**WPs/SC**: Apply harvest control rule (HCR) using results from 2020 stock assessment to calculate total annual catch limit. (Secretariat to advise CPCs of catch limit.) Extend the HCR to develop full candidate MPs and undertake MSE to provide advice on the performance of candidate MPs.	**WPs/SC**: Consider recommendations from the Commission and undertake MSE to provide advice on the performance of candidate MPs.	**WPs/SC**: Consider recommendations from the Commission and undertake MSE to provide advice on the performance of candidate MPs.	**WPs/SC**: Consider recommendations from the Commission and undertake MSE to provide advice on the performance of candidate MPs.
2021	**TCMP**: Provide advice to Commission on elements of candidate MPs, and any proposed Resolutions for an MP, that require a decision by the Commission, including the performance of candidate MPs against Commission objectives.	**TCMP**: Provide advice to the Commission on outcomes from the application of the HCR. Provide advice to Commission on elements of candidate MPs, and any proposed Resolutions for an MP, that require a decision by the Commission, including the performance of candidate MPs against Commission objectives.	**TCMP**: Provide advice to Commission on elements of candidate MPs, and any proposed Resolutions for an MP, that require a decision by the Commission, including the performance of candidate MPs against Commission objectives.	**TCMP**: Provide advice to Commission on elements of candidate MPs, and any proposed Resolutions for an MP, that require a decision by the Commission, including the performance of candidate MPs against Commission objectives.	**TCMP**: Provide advice to Commission on elements of candidate MPs, and any proposed Resolutions for an MP, that require a decision by the Commission, including the performance of candidate MPs against Commission objectives.
	Commission: Consider work and advice from subsidiary bodies. Decision and adoption of an MP or provide direction to the WPs/SC on the need for	**Commission**: Consider work and advice from subsidiary bodies. Decision and adoption of an MP or provide direction to the WPs/SC on the need for	**Commission**: Consider work and advice from subsidiary bodies. Decision and adoption of an MP.	**Commission**: Consider work and advice from subsidiary bodies. Decision and adoption of an MP or provide direction to the WPs/SC on the need to	**Commission**: Consider work and advice from subsidiary bodies and provide direction to the WPs/SC on the need to undertake further MSE of candidate or alternative MPs.

	further MSE of candidate or alternative MPs.	further MSE of candidate or alternative MPs.		undertake further MSE of candidate or alternative MPs.	
	WPs/SC: Consider recommendations from the Commission and undertake MSE to provide advice on the performance of candidate MPs.	**WPs/SC**: Consider recommendations from the Commission and undertake MSE to provide advice on the performance of candidate MPs.		**WPs/SC**: Consider recommendations from the Commission and undertake MSE to provide advice on the performance of candidate MPs.	**WPs/SC**: Consider recommendations from the Commission and undertake MSE to provide advice on the performance of candidate MPs.
2022	**TCMP**: Provide advice to Commission on elements of candidate MPs, and any proposed Resolutions for an MP, that require a decision by the Commission, including the performance of candidate MPs against Commission objectives.	**TCMP**: Provide advice to Commission on elements of candidate MPs, and any proposed Resolutions for an MP, that require a decision by the Commission, including the performance of candidate MPs against Commission objectives.		**TCMP**: Provide advice to Commission on elements of candidate MPs, and any proposed Resolutions for an MP, that require a decision by the Commission, including the performance of candidate MPs against Commission objectives.	**TCMP**: Provide advice to Commission on elements of candidate MPs, and any proposed Resolutions for an MP, that require a decision by the Commission, including the performance of candidate MPs against Commission objectives.
	Commission: Consider work and advice from subsidiary bodies. Decision and adoption of an MP or provide direction to the WPs/SC on the need for further MSE of candidate or alternative MPs.	**Commission**: Consider work and advice from subsidiary bodies. Decision and adoption of an MP or provide direction to the WPs/SC on the need for further MSE of candidate or alternative MPs.		**Commission**: Consider work and advice from subsidiary bodies. Decision and adoption of an MP.	**Commission**: Consider work and advice from subsidiary bodies. Decision and adoption of an MP or provide direction to the WPs/SC on the need to undertake further MSE of candidate or alternative MPs.
	WPs/SC: Consider recommendations from the Commission and undertake MSE to provide advice on the performance of candidate MPs.	**WPs/SC**: Consider recommendations from the Commission and undertake MSE to provide advice on the performance of candidate MPs.			**WPs/SC**: Consider recommendations from the Commission and undertake MSE to provide advice on the performance of candidate MPs.
2023	**TCMP**: Provide advice to Commission on elements of candidate MPs, and any proposed Resolutions for an MP, that require a decision by the Commission, including the performance of	**TCMP**: Provide advice to Commission on elements of candidate MPs, and any proposed Resolutions for an MP, that require a decision by the Commission, including the performance of			**TCMP**: Provide advice to the Commission on elements of candidate MPs, and any proposed Resolutions for an MP, that require a decision by the Commission, including the performance of

	candidate MPs against Commission objectives.	candidate MPs against Commission objectives.			candidate MPs against Commission objectives.
	Commission: Consider work and advice from subsidiary bodies. Decision and adoption of an MP.	**Commission**: Consider work and advice from subsidiary bodies. Decision and adoption of an MP.			**Commission**: Consider work and advice from subsidiary bodies. Decision and adoption of an MP or provide direction to the WPs/SC on the need for further MSE of candidate or alternative MPs.
					WPs/SC: Consider recommendations from the Commission and undertake MSE to provide advice on the performance of candidate MPs,

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	Interim Chair	Dr Shiham Adam	Maldives, Rep. of	28–Nov–15	End of SC in 2019	2nd term
	Vice-Chair	Vacant	Vacant			
WPB	Chair	Dr Denham Parker	South Africa	12–Sept–19	End of WPB in 2021	1st term
	Vice-Chair	Dr Jie Cao	China	12–Sep–19	End of WPB in 2021	1st term
WPTmT	Chair	Dr Jiangfeng Zhu	China	26–July–19	End of WPTmT in 2022	2nd term
	Vice-Chair	Dr Toshihide Kitakado	Japan	26–July–19	End of WPTmT in 2022	2nd 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 2021	2nd term
	Vice-Chair	Dr Mohamed Koya; Dr Mariana Tolotti	India / EU France	7–Sept–19	End of WPEB in 2021	1st term
WPNT	Chair	Ms Ririk Sulistyaningsih	Indonesia	5–July–19	End of WPNT in 2019	1st term
	Vice-Chair	Dr Farhad Kaymaram	I.R. Iran	5–July–19	End of WPNT in 2021	1st 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 Hilario Murua	ISSF	19–Oct–19	End of WPM in 2021	1st term
	Vice-Chair	Ms Daniela Rosa	EU,Portugal	19–Oct–19	End of WPM in 2021	1st term

APPENDIX 8
EXECUTIVE SUMMARY: ALBACORE

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

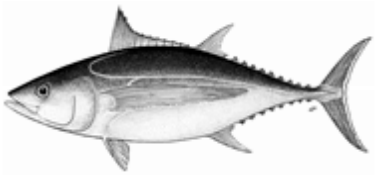


TABLE 1. Albacore: Status of albacore (*Thunnus alalunga*) in the Indian Ocean.

Area[1]	Indicators – 2019 assessment		2019 stock status[3] determination
Indian Ocean		SS3	
	Catch 2018[2]:	41,603 t	
	Average catch 2014–2018:	38,030 t	
	MSY (1000 t) (95% CI):	35.7 (27.3–44.4)	
	F_{MSY} (95% CI):	0.21 (0.195-0.237)	
	SB_{MSY} (1000 t) (95% CI):	23.2 (17.6–29.2)	
	F_{2017}/F_{MSY} (95% CI):	1.346 (0.588–2.171)	
	SB_{2017}/SB_{MSY} (95% CI):	1.281 (0.574–2.071)	
	SB_{2017}/SB_{1950} (95% CI):	0.262 (-)	

[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 2019: 12%
[3] The stock status refers to the most recent years' data used in the last assessment conducted in 2019.

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. A new stock assessment was carried out for albacore in 2019 to update the assessment undertaken in 2016. The stock assessment was carried out using Stock Synthesis III (SS3), a fully integrated model that is currently also used to provide scientific advice for the three tropical tunas stocks in the Indian Ocean. The model used in 2019 is based on the model developed in 2016 with a series of revisions that were noted during the WPTmT data preparatory meeting held in January 2019. There are some noticeable changes in spatial distribution of Longline catches compared to the previous assessment data set, with historical catch shifted to equatorial regions (LL1 and LL2) from southern fisheries (LL3 and LL4). This is due to revisions in the historical catch data carried out since the last assessment.

The current assessment has utilised CPUE series that are significantly different from the last assessment. In particular a revised approach to the analysis of the joint LL CPUE series was conducted and the resulting indices were included in the SS3 model. The final set of model options included alternative models using the northwest and southwest CPUE indices. Both sets of indices show a considerable decline from 1979 to current. The two sets of indices effectively monitor different components of the albacore stock. The CPUE in the southwest area (LL3) is mostly likely to represent the abundance of albacore tuna at the time, as the indices were primarily based on a main target fishery with more consistent fishing operations. The southwest area also represents a significant proportion of the albacore biomass in the Indian Ocean. The LL1 CPUE indices largely represent bycatch of the tropical tuna fisheries. The assessment results were sensitive to the influence of the length composition data sets in the models. There is concern regarding the information content of these data. Consequently, the final set of model options included alternative treatments of these data including down-weighting or excluding these data.

Trends in the CPUE series suggest that the longline vulnerable biomass has declined to around 45 - 50% 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 above the MSY level of the SS3 model. Fishing mortality represented as F_{2017}/F_{MSY} is 1.346 (0.588–2.171). Biomass is estimated to be above the SB_{MSY} level (1.281 (0.574–2.071)) from the SS3 model (**Table 1**, **Fig. 2**). These changes in stock status since the previous assessment are possibly due to decreases in the CPUE in recent years, while catches have remained relatively stable. Also, there has been a large redistribution of catch to the southern regions which impacts on small fish (and therefore influences the computation of FMSY). In addition, the latest assessment uses a revised growth curve which also impacts FMSY. 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** but is **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 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. However, in recent years the effort distribution in the Indian Ocean has been rather dynamic. Projections indicate that under current catch assumptions, the biomass will continue to decline as recent recruitment levels are estimated to be low. The recruitment in the terminal years of the assessment model are estimated to be well below average levels and this is projected to cause the stock to decline considerably over the short term. However, these recruitment estimates are poorly determined. Therefore it is cautioned that the short term projections are more influenced by the recent low recruitment levels, whereas the long term projections are more determined by the assumptions of average recruitment levels over the longer term period.

Management advice. Although considerable uncertainty remains in the SS3 assessment conducted in 2019, particularly due to the conflicts in key data inputs, a precautionary approach to the management of albacore tuna should be applied. The K2SM indicates that catch reductions are required in order to prevent the biomass from declining to below MSY levels in the short term, due to the low recent recruitment levels. Although there is considerable uncertainty in the projections, current catches are exceeding the estimated MSY level (35,700 t; **Table 2**).

The following should be noted:

- The primary sources of data that drive the assessment, total catches, CPUE and length data, are highly uncertain and should be developed further as a priority.
- The catch estimates for 2017 (38,713t) are above 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 above the provisional target reference point of F_{MSY}, but below 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 2014–18)**: 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 2014–18)**: 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.

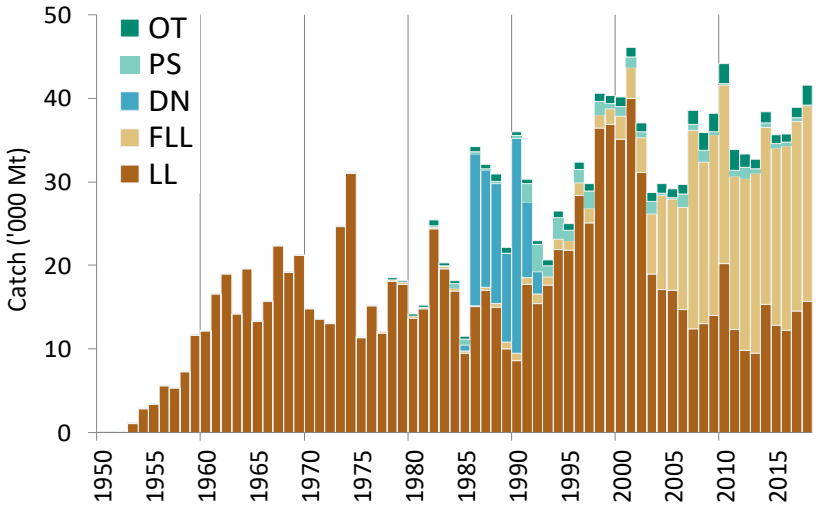
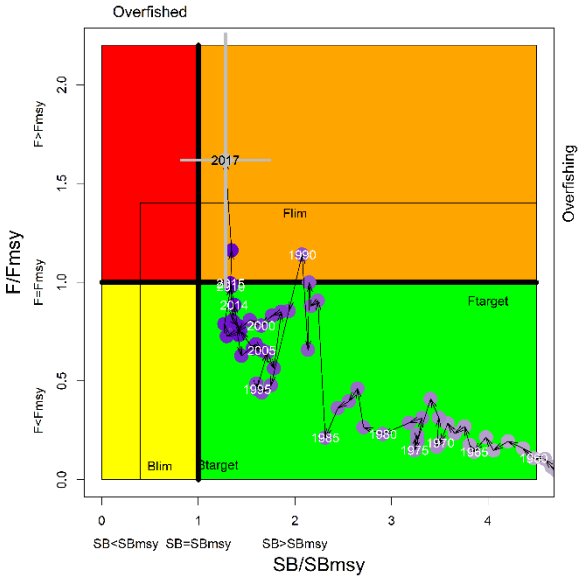


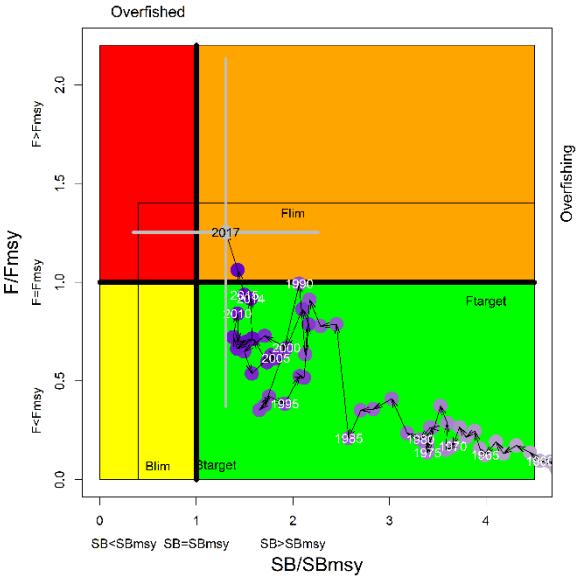
Fig. 1. Albacore: Catches of albacore by gear (1950-2018)[3].

(i) Model 1



(ii) Model 2

(iii) Model 3



(iv) Model 4

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

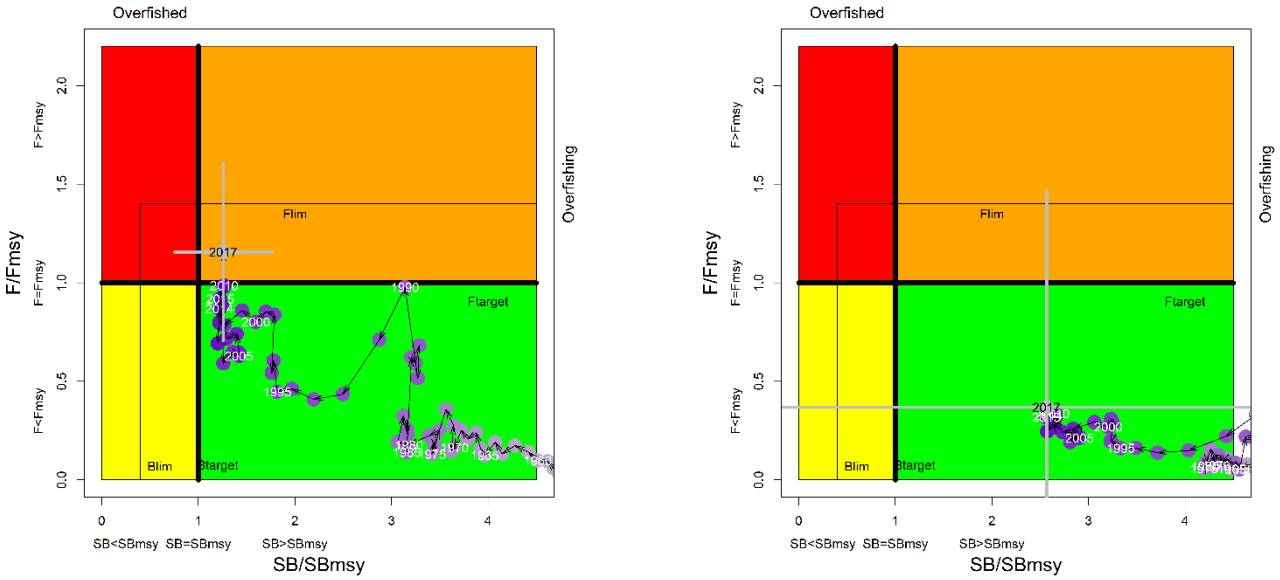


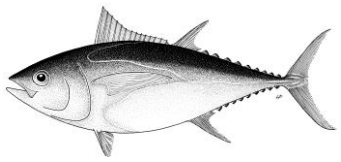
Fig. 2. Albacore: SS3 Indian Ocean assessment Kobe plot for the four model options considered: (i) Model 1 (ii) Model 2 (iii) Model 3 (iv) Model 4. Blue circles indicate the trajectory of the point estimates for the SB ratio and F ratio for each year 1950–2017 (the grey lines represent the 95 percentiles of the 2017 estimate). Target (Ftarg and SBtarg) and limit (Flim and SBlim) reference points are shown.

Table 2. Albacore: SS3 aggregated Indian Ocean assessment Kobe II Strategy Matrix based on the model options (i) Model 1 (ii) Model 2 (iii) Model 3 (Model 4 was not used for management advice). Probability (percentage) of violating the MSY-based target (top) and limit (bottom) reference points for constant catch projections (2017 catch level, ± 10%, ± 20%, ± 30% ± 40%) projected for 3 and 10 years.

Reference point and projection timeframe	**Alternative catch projections (relative to the catch level for 2017) and probability (%) of violating MSY-based target reference points ($SB_{targ} = SB_{MSY}$; $F_{targ} = F_{MSY}$)**								
	60% (22,901)	70% (26,718)	80% (30,534)	90% (34,351)	100% (38,168)	110% (41,985)	120% (45,802)	130% (49,618)	140% (53,435)
$SB_{2020} < SB_{MSY}$	0.614	0.678	0.715	0.769	0.818	0.828	0.87	0.883	0.898
$F_{2020} > F_{MSY}$	0.074	0.224	0.4	0.556	0.654	0.731	0.766	0.788	0.782
$SB_{2027} < SB_{MSY}$	0.176	0.307	0.456	0.572	0.713	0.823	0.898	1	1
$F_{2027} > F_{MSY}$	0.002	0.085	0.287	0.473	0.718	0.878	1	1	1
Reference point and projection timeframe	**Alternative catch projections (relative to the catch level for 2017) and probability (%) of violating MSY-based target reference points ($SB_{targ} = SB_{MSY}$; $F_{targ} = F_{MSY}$)**								
	60% (22,901)	70% (26,718)	80% (30,534)	90% (34,351)	100% (38,168)	110% (41,985)	120% (45,802)	130% (49,618)	140% (53,435)
$SB_{2020} < SB_{Lim}$	0.039	0.065	0.084	0.124	0.161	0.19	0.253	0.314	0.373
$F_{2020} > F_{Lim}$	0.003	0.037	0.129	0.277	0.414	0.537	0.629	0.696	0.712
$SB_{2027} < SB_{Lim}$	0.059	0.12	0.22	0.325	0.462	0.648	0.749	1	1
$F_{2027} > F_{Lim}$	0	0.006	0.127	0.309	0.622	0.843	1	1	1

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		2019 stock status[3] determination
Indian Ocean[5]	Catch in 2018[2]: Average catch 2014–2018:	93,515 t (81,413 t)[4] 92,140 t (89,720 t)[4]	**38.2%***
	MSY (1,000 t) (80% CI): F_{MSY} (80% CI): SB_{MSY} (1,000 t) (80% CI): F_{2018}/F_{MSY} (80% CI): SB_{2018}/SB_{MSY} (80% CI): SB_{2018}/SB_0 (80% CI):	87 (75-108) 0.24 (0.18-0.36) 503 (370-748) 1.20 (0.70-2.05) 1.22 (0.82-1.81) 0.31 (0.21. – 0.34)	

[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 2018: 28%
[3] The stock status refers to the most recent years' data used in the last assessment conducted in 2019.
[4] Considering the alternative purse seine log-associated catch composition for the EU fleet in 2018 as per IOTC-2019-WPTT21-R[E].
[5] Results of management quantities presented here are for the revised catches – see footnote 4.
* 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}≥ 1)
Stock subject to overfishing(F_{year}/F_{MSY}> 1)	34.6	38.2%
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)	0%	27.2%
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. In 2019 a new stock assessment was carried out for bigeye tuna in the IOTC area of competence to update the stock status undertaken in 2016. Two models were applied to the bigeye stock (JABBA and Stock Synthesis (SS3)). The stock assessment selected to provide scientific advice was carried out using SS3, a fully integrated model used to provide scientific advice for the three tropical tunas stocks in the Indian Ocean. The reported stock status is based on the SS3 model formulation using a grid of 18 model configurations designed to capture the uncertainty on stock recruitment relationship, the influence of tagging information and selectivity of longline fleets. Due to concerns on the reported catch data for 2018, the stock status is based on SS3 model formulations using the best catch estimate by the Scientific Committee (for details see WPTT report). Spawning stock biomass in 2018 was estimated to be 31% of the unfished levels in 2018(Table 1) and 122% (82–181%) of the level that can support MSY. The assessment outcome is qualitatively different to the stock assessment conducted in 2016 due to the increase of catch of small size, changes in modelling assumptions about longline selectivity, and the abundance index developed in 2019. Considering the characterized uncertainty, the assessment indicates that SB_{2018} is above SB_{MSY} with high probability (65.4%) and that fishing mortality is above F_{MSY} also with high probability (72.8%). The median value of MSY from the model runs presented with SS3 was 87,000 t with a range between 75,000 and 108,000 t (a median level 16% lower than the estimate in 2016). Catches in 2018 (≈81,413 t) remain lower than the estimated median MSY values from the stock assessment conducted in 2019 but within the range of

estimated MSY. The average catch over the previous five years (2014–18; ≈89,717 t) is just above the estimated median MSY and within the range of estimated values. Thus, on the weight-of-evidence available in 2019, the bigeye tuna stock is determined to be **not overfished** but **subject to overfishing** (**Table 1**).

Outlook. Declines in longline effort since 2007, particularly from the Japanese, Taiwanese and Rep. of Korea longline fleets lowered the pressure on the Indian Ocean bigeye tuna stock since 2007. However, recent increase in catch from purse seine fleets have increased this pressure and the stock is estimated to be subject to overfishing. The estimated MSY has declined significantly (16%) from the previous estimate (from 2016) due to the increase of purse seine catch in the overall change in catch composition, changes in modelling assumptions about longline selectivity, and the inclusion of a more pessimistic abundance index in the western tropical region. The Kobe strategy matrix (K2SM) based on the plausible model runs from SS3 in 2019 illustrates the levels of quantified risk associated with varying catch levels over time that could be used to inform future management actions (**Table 2**). The projections produced to estimate the K2SM (Table 2) are, in the short term, driven by the below average recruitment estimated for the recent years. The SS3 projections from the 2019 assessment show that there is a risk of breaching MSY-based reference points by 2021, and 2028 if catches are maintained at 2018 levels at the current selectivity and therefore size distribution of catch (Table 2). Should the management objective of maintaining biomass at levels higher than SB_{MSY} with more than 50% probability in 2028 be pursued, the overall catch should be reduced 10% from current levels (73,272 t).

Management advice. The stock status determination changed qualitatively in 2019 to **not overfished** but **subject to overfishing**. If catches remain at current levels there is a risk of breaching MSY reference points with 58.9% and 60.8% probability in 2021 and 2028. Reduced catches of at least 10% from current levels will likely reduce the probabilities of breaching reference levels to 49.1% in 2028. Continued monitoring and improvement in data collection, reporting and analyses 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 87,000 t with a range between 75,000–108,000 t for SS3 (**Table** 1). The average 2014-2018 catches of ≈89,717 t, and catches for each year since 2012 are within the range of the estimated 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 120% of the interim target reference point of F_{MSY}, and 92% of the interim limit reference point of 1.3*F_{MSY} (**Fig. 2**).
    - **Biomass**: Current spawning biomass is considered to at 122% 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 2014–18): Longline ≈42%; Purse seine ≈31% (FAD associated school (LS) ≈24%; free swimming school (PS) ≈7%); All other (artisanal) gears ≈27% (**Fig 1**).
- **Main fleets** (Average catch 2014–18): Indonesia ≈25%; Taiwan,China ≈16%; European Union ≈20% (EU-Spain: ≈15%; EU-France: ≈5%); Seychelles ≈13%.

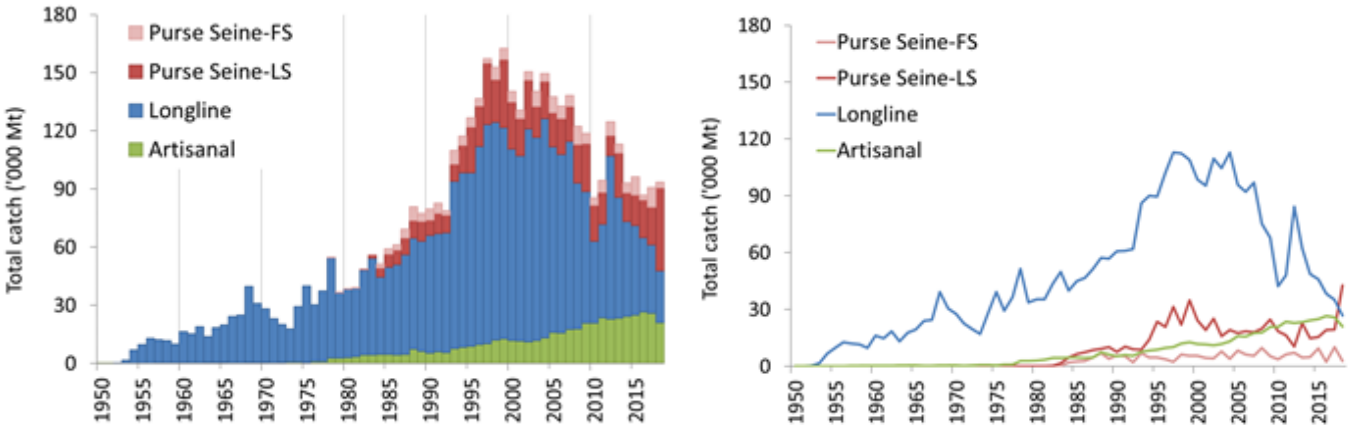


Fig. 1(a-b). Annual catches of bigeye tuna by gear (1950–2018). Data as of October 2019.

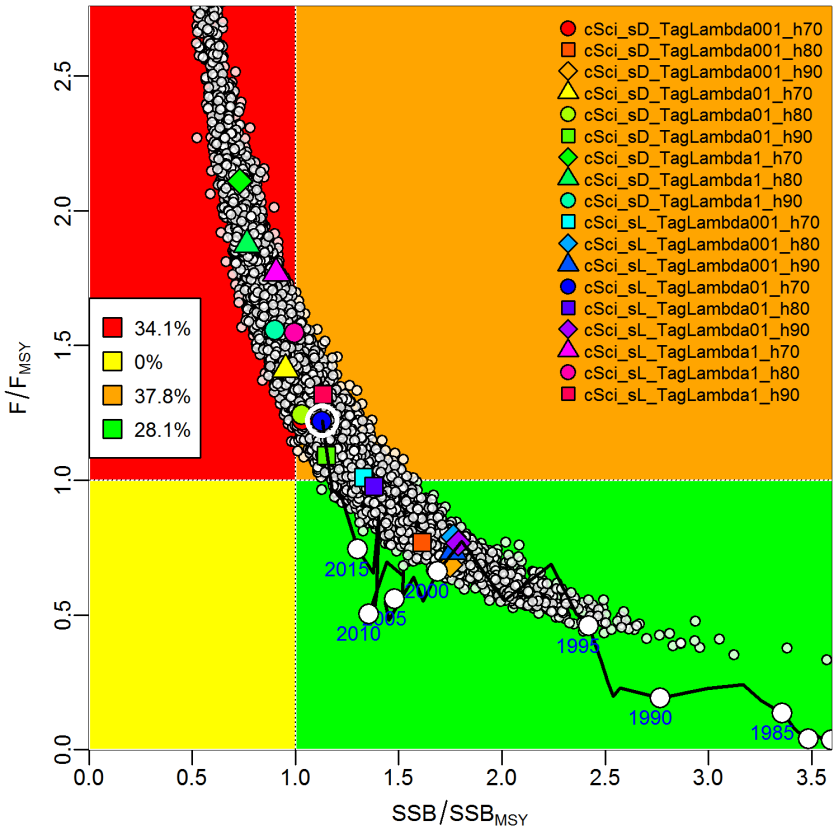


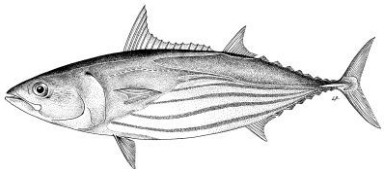
Fig. 2. Bigeye tuna: SS3 Aggregated Indian Ocean assessment Kobe plot. The coloured points represent stock status estimates from the 18 model options. The grey dots represent 5000 estimates of 2018 stock status from the multivariate normal approximation from the mean and variance-covariance of the 18 model options. The legend indicates the estimated probability of the stock status being in each of the Kobe quadrant. The white circle (around the purple dot) represents the median stock status in 2018.

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 average catch level from 2018 (81,413 t); -10%, -20%, -30%, -40%) projected for 3 and 10 years.

Reference point and projection timeframe	**Alternative catch projections (relative to the catch level from 2018) and weighted probability (%) scenarios that violate reference point**				
	60% (48,848t)	**70%** (56,990t)	**80%** (65,130t)	**90%** (73,272t)	**100%** (81,413t)
$B_{2021} < B_{MSY}$	51.1	53.3	54.2	57.1	58.9
$F_{2021} > F_{MSY}$	7.3	17.8	32	47.9	62.8
$B_{2028} < B_{MSY}$	8	19.5	35.1	49.1	60.8
$F_{2028} > F_{MSY}$	1.1	6.9	19.8	37.7	55.6
Reference point and projection timeframe	**Alternative catch projections (relative to the catch level from 2018) and probability (%) of violating MSY-based limit reference points (B_{lim} = 0.5 B_{MSY}; F_{Lim} = 1.3 F_{MSY})**				
	60% (48,848t)	**70%** (56,990t)	**80%** (65,130t)	**90%** (73,272t)	**100%** (81,413t)
$B_{2021} < B_{LIM}$	0	0	0	0	0
$F_{2021} > F_{LIM}$	6.0	11.0	17.0	28.0	39.0
$B_{2028} < B_{LIM}$	0.0	0.0	6.0	11.0	22.0
$F_{2028} > F_{LIM}$	0.0	6.0	17.0	22.0	39.0

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		2017 stock status[4] determination
Indian Ocean	Catch 2018[2]: Average catch 2014–2018:	607,701 t (606,197 t)[5] 484,993 t (484,692 t)[5]	**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 2018: 12%
[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.
[5] Considering the alternative purse seine log-associated catches composition for the EU fleet in 2018 as per IOTC-2019-WPTT21-R[E].
* 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 2019, thus, stock status is determined on the basis of the 2017 assessment and other indicators presented in 2019. 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 2018 (≈607,401 t) is in the upper range of the estimated range of $C_{SB40\%}$ (**Table 1**). The average catch over the previous five years (2014–18; ≈ 484,993 t) is at the lower range of 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 2018 were 29% 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 2017 to 2018 (+43% for purse seine (log-associated), +13% for gillnet and +13% for baitboats). In particular, due to Resolution 19/01, an increase in fishing operations on FADs by purse seine fleets has been increased, with the associated increase in skipjack catch. CPUE fluctuations coincide with environmental signals at inter-annual timescale (e.g., Indian Ocean Dipole). Due to its specific life history attributes, 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 2018 (607,701 t) were 29% 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 future catches of skipjack do not exceed the agreed limit for the 2018-2020 period.

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. The aim of this programme of work is to develop the fully specified management procedure (harvest strategy) for Skipjack including the revision of the HCR as may be required.

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 2014-18): Purse seine ≈40% (FAD associated school ≈39% and free swimming school ≈1%); Gillnet ≈21%; Pole-and-line ≈19%; Other ≈20% (**Fig. 1(a-c)**);

Main fleets (average catches 2014-18): Indonesia ≈17%; European Union ≈24% (EU-Spain: ≈17%; EU-France: ≈6%); ≈Maldives 16%; Seychelles ≈12%; Sri Lanka ≈10%; ≈I.R. Iran 9%.

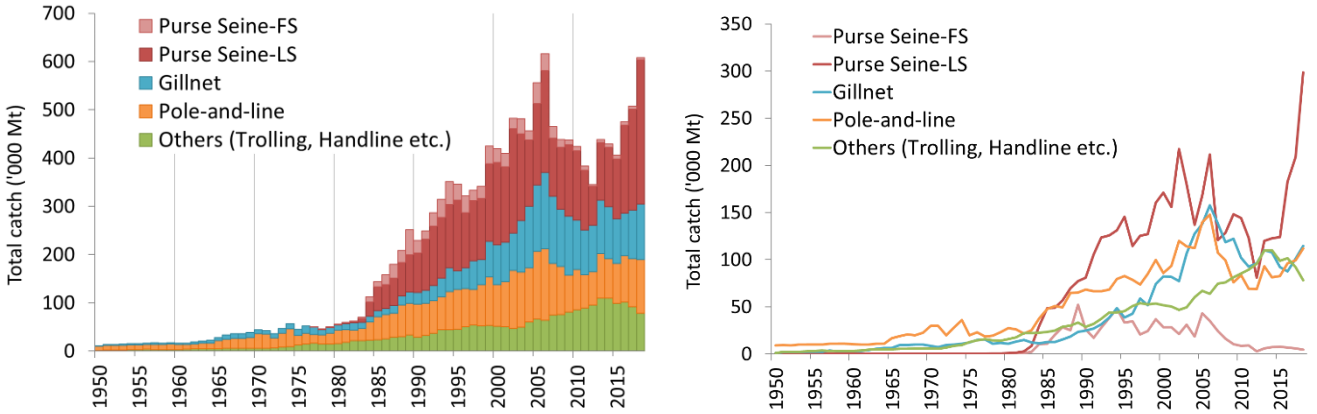


Fig. 1(a-b). Annual catches of skipjack tuna by gear (1950–2018). Data as of October 2019.

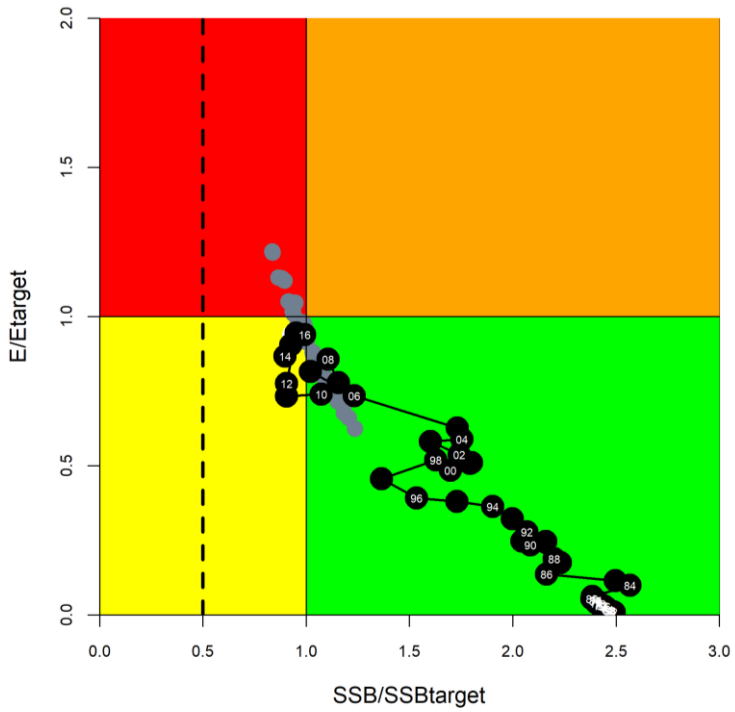


Fig. 2. Skipjack tuna: SS3 Aggregated Indian Ocean assessment Kobe plot of the 2017 uncertainty grid. Black circles indicate the trajectory of the median estimates for the SB/SB_{target} ratio and E/E_{target} ratio across all models of the 2017 uncertainty grid for each year 1950–2016; grey dots are 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

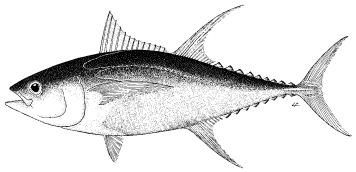


TABLE 1. Yellowfin tuna: Status of yellowfin tuna (*Thunnus albacares*) in the Indian Ocean.

Area[1]	Indicators		2018 stock status[3] determination
Indian Ocean	Catch 2018[2]: Average catch 2014–2018:	423,815 t (437,422 t)[4] 404,655 t (407,377 t)[4]	94%
	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 2018: 11%
[3] Median and quantiles calculated from the uncertainty grid taking into account of weighting on models
[4] Considering the alternative purse seine log-associated catches for the EU fleet in 2018 as per IOTC-2019-WPTT21-R.

Colour key	Stock overfished ($SB_{year}/SB_{MSY}< 1$)	Stock not overfished ($SB_{year}/SB_{MSY}\geq 1$)
Stock subject to overfishing($F_{year}/F_{MSY}> 1$)	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. No new stock assessment was carried out for yellowfin tuna in 2019, thus, stock status is determined on the basis of the 2018 assessment and other indicators presented in 2019. The 2018 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 2018 assessment results were 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-composition) and lack of considering model statistical uncertainty. Some of these uncertainties have were explored in 2019 following the Workplan the Scientific Committee adopted in 2018. However, due to the complexity of the work, lack of agreement on key model aspects and time constraints, no new management advice is provided in 2019. According to the 2018 stock assessment, spawning stock biomass in 2017 was estimated to be 30.0% of the unfished levels (**Table 1**). According to the information available in 2019, the total catch has remained relatively stable at levels around the estimated MSY since 2012 (i.e., between 390,000 t and 436,000 t), with the 2018 catch being the largest since 2010 (437,422 t), and exceeding the MSY range considering the best catch estimate by the Scientific Committee (for details see WPTT report). 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 and 2019, the yellowfin tuna stock is determined to remain **overfished** and subject to **overfishing** (**Table 1** and **Figure. 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 2017 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, no revised specific catch limits are recommended.

In the 2018 Scientific Committee a Workplan was 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 started in January 2019 which aimed at addressing the issues identified by the WPTT and the external reviewer in 2018. 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. Despite the progress made to reduce the uncertainties inherent to this fishery, the WPTT agreed that no new advice could be provided in 2019.

The Commission has an interim plan for the rebuilding the yellowfin stock, with catch limitations based on 2014/2015 levels (Resolution 19/01, which superseded 17/01 and 18/01). Some of the fisheries subject to catch reductions had fully achieved a decrease in catches in 2018 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 9 in IOTC-2019-WPTT21-R). Thus, the total catches of yellowfin in 2018 increased by around 9% 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 2014-2018 average catches (404,655 t) were just above the estimated MSY level. The last year (2018), catch has been substantially 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 2014-18): Purse seine ≈35% (FAD associated school ≈24%; free swimming school ≈11%); Longline ≈17%; Gillnet ≈18%; All other gears ≈30% (**Fig. 1**).
- **Main fleets** (average catches 2014-18): European Union ≈21% (EU-Spain ≈13%; EU-France ≈8%); Maldives ≈13%; I.R. Iran ≈12%; Seychelles ≈10%; Sri Lanka ≈9%; All other fleets ≈35%.

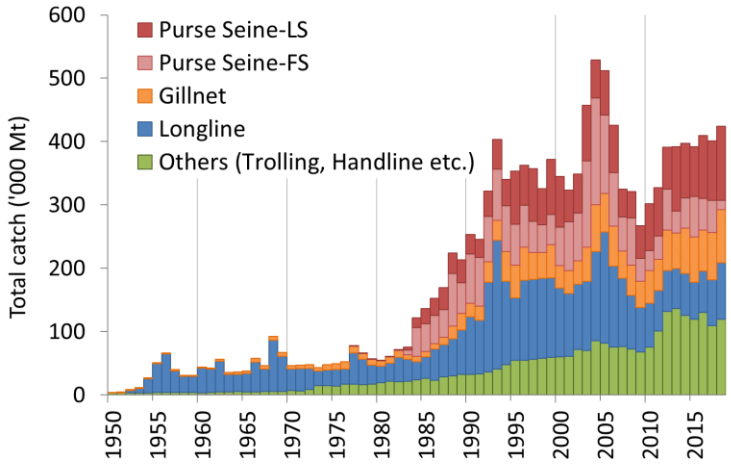


Fig. 1. Annual catches of yellowfin tuna by gear (1950–2018) .

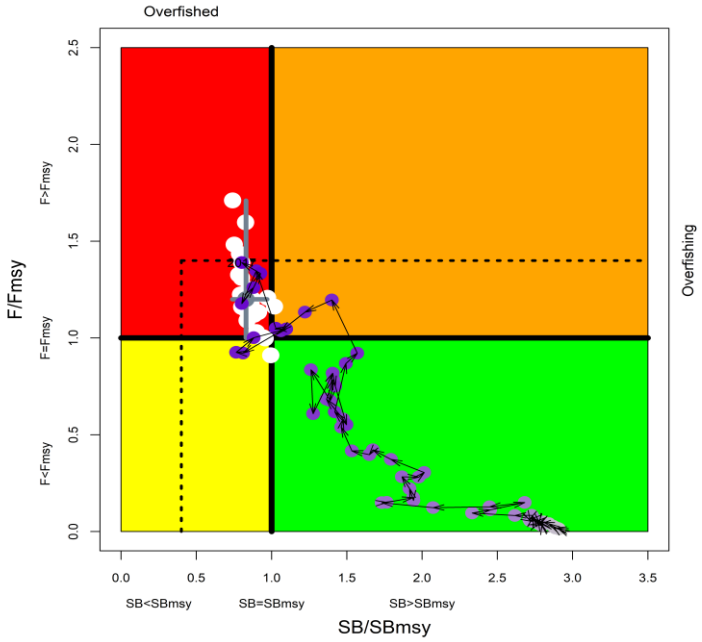


Fig. 2. Yellowfin tuna: Stock synthesis Kobe plot. Blue dots indicate the trajectory of the point estimates for the SB/SB_{MSY} ratio and F/F_{MSY} ratio for each year 1950–2017. The grey line represents the 80% confidence interval associated with the 2017 stock status. Dotted black lines are the interim 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.

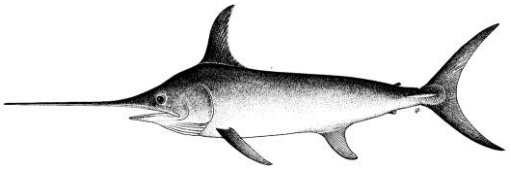
Reference point and projection timeframe	**Alternative catch projections (relative to the catch level from 2017) and probability (%) of violating MSY-based target reference points ($B_{targ} = B_{MSY}$; $F_{targ} = F_{MSY}$)**								
	65% (266,218t)	70% (286,697t)	75% (307,175t)	80% (327,654t)	85% (348,132t)	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		2019 stock status determination
Indian Ocean	Catch 2018[2]: Average catch 2014-2018:	31,628 t 31,343 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 2019: 6%

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 2019, thus, the stock status is determined on the basis of the 2017 assessment and other indicators presented in 2019. 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. The spawning stock biomass in 2015 was estimated to be 26%–43% of the unfished levels. The latest year's catches are higher than the MSY level (31,590 t). On the weight-of-evidence available in 2019, 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 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 (33,352 t in 2017) are higher than MSY (31,590 t) and should be reduced to the MSY level.

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 2014-18)**: Longline catches are currently estimated to comprise approximately 70% of total swordfish catches in the Indian Ocean (Fig. 1).
- **Main fleets (average catches 2014-18):**
  Taiwan,China (longline): 21%; Sri Lanka (longline-gillnet): 20%; EU,Spain (swordfish targeted longline): 10%**;** Indonesia (fresh longline): 7%.

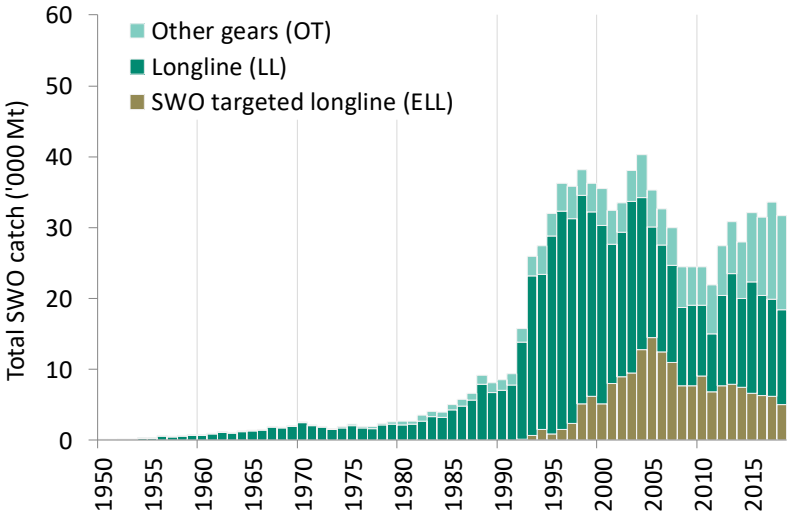


Fig. 1. Swordfish catches by gear and year recorded in the IOTC database (1950–2018);
***Note**: Other gears (OT) includes: longline-gillnet, handline, gillnet, coastal longline, troll line, sport fishing, and all other gears.*

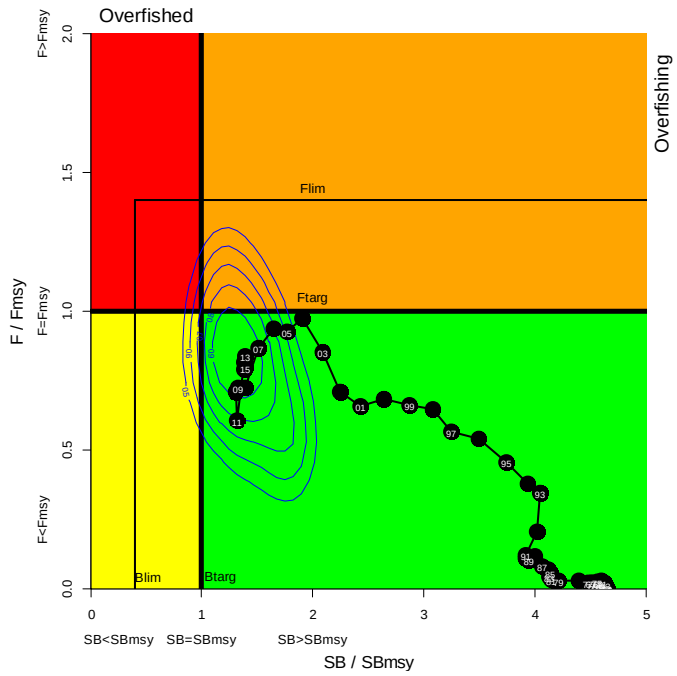


Fig. 2. Swordfish: SS3 Aggregated Indian Ocean assessment Kobe plot (contours are the 50, 60, 70, 80 and 90 percentiles of the 2015 estimate). Blue circles indicate the trajectory of the point estimates for the SB ratio and F ratio for each year 1950–2015. Interim target (F_{targ} and SB_{targ}) and 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		2019 stock status determination
Indian Ocean	Catch 2018[2]: Average catch 2014–2018:	18,180 t 18,074 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 2019: 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. No new stock assessment for black marlin was carried out in 2019, thus, the stock status is determined on the basis of the 2018 assessment based on JABBA and other indicators presented in 2019. 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 13,000 t in 2012 to over 21,000 t by 2016), 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 (>14,600 t in 2017) (Fig. 1) are higher than MSY estimate (12,930 t), which is likely to associate with high uncertainty. The catch limits as stipulated in Resolution 18/05 have also 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 2014-18)**:
  Black marlin are largely considered to be a non-target species of industrial and artisanal fisheries. Gillnets account for around 52% of total catches in the Indian Ocean, followed by longlines (12%), with remaining catches recorded under troll and handlines (Fig. 1).
- **Main fleets (average catches 2014-18):**
  Around 75% of the total catches of black marlin are accounted for by three fleets:
  I.R. Iran (gillnet): 31%; India (gillnet and trolling): 24%; Sri Lanka (gillnet and fresh longline): 21%.

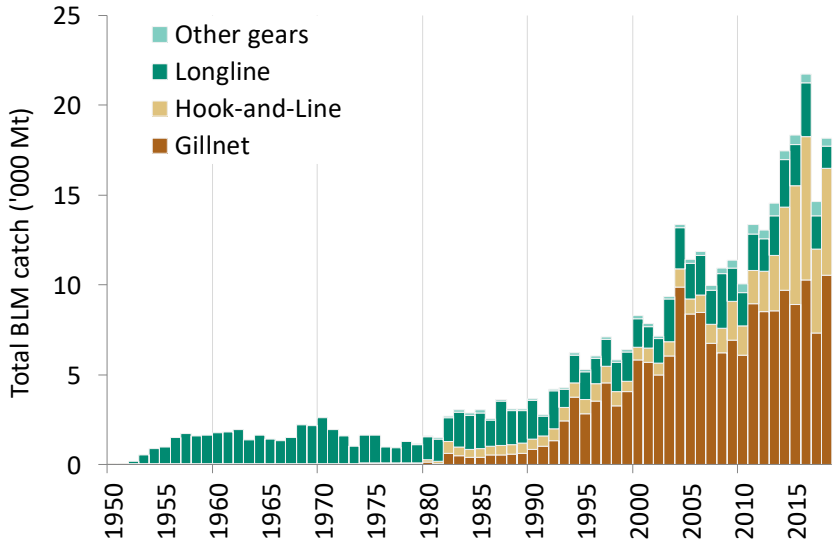


Fig. 1a-b. Black marlin catches by gear and year recorded in the IOTC database (1950–2018):
***Notes**: Other gears (OT) includes: longline-gillnet, handline, gillnet, coastal longline, troll line, sport fishing, and all other gears.*

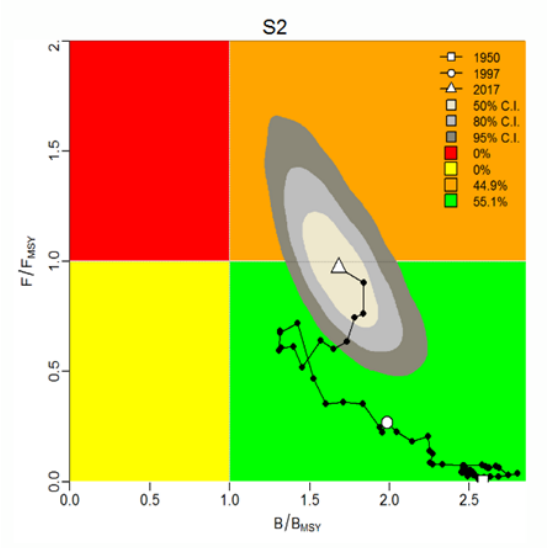


Fig. 2. Black marlin: JABBA Indian Ocean assessment Kobe plots for black marlin (contours are the 50, 80 and 95 percentiles of the 2017 estimate). Black line indicates the trajectory of the point estimates for the total biomass (B) ratio and F ratio for each year 1950–2017.

APPENDIX 14
EXECUTIVE SUMMARY: BLUE MARLIN

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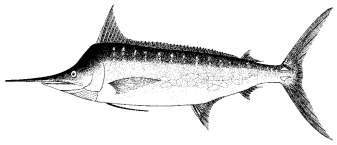


Status of the Indian Ocean blue marlin (BUM: *Makaira nigricans*) resource

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

Area[1]	Indicators		2019 stock status determination
Indian Ocean	Catch 2018[2]:	9,969 t	87%*
	Average catch 2014-2018:	11,382 t	
	MSY (1,000 t) (80% CI):	9.98 (8.18 –11.86)	
	F_{MSY} (80% CI):	0.21 (0.13 – 0.35)	
	B_{MSY} (1,000 t) (80% CI):	47 (29.9 – 75.3)	
	H_{2017}/H_{MSY} (80% CI):	1.47 (0.96 – 2.35)	
	B_{2017}/B_{MSY} (80% CI):	0.82 (0.56 – 1.15)	
	B_{2017}/B_0 (80% CI):	0.41 (0.28 – 0.57)	

[1] Boundaries for the Indian Ocean = IOTC area of competence.
[2] Proportion of catch estimated or partially estimated by IOTC Secretariat in 2019: 24%.
* 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)	87%	10%
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)	0%	3%
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. Stock status based on the Bayesian State-Space Surplus Production model JABBA suggests that there is an 87% probability that the Indian Ocean blue marlin stock in 2017 is in the red zone of the Kobe plot, indicating the stock is **overfished** and **subject to overfishing (**B_{2017}/BMSY=0.82 and F_{2017}/FMSY=1.47) as shown in Table 1 and Figure 1. The most recent catch exceeds the estimate of MSY ($catch_{2017}$ = 12,796; MSY = 9,984). The previous assessment of blue marlin (Andrade 2016) concluded that in 2015 the stock was subject to overfishing but not overfished. The change in stock status can be attributed to increased catches for the period 2015-2017 as well as improved standardisation of CPUE indices, which includes the area disaggregation of JPN and TWN indices to account for fleet dynamics.

Outlook. The B_{2017}/B_{MSY} trajectory declined from the mid 1980s to 2008 and a steady increase of F/F_{MSY} since the mid-1980s has continued unabated. Periodic data conflict between the CPUE indices included in the assessment, particularly JPN and TWN, inflate uncertainty in B_{2017}/B_{MSY} and F_{2017}/F_{MSY} point estimates. However, a 'drop one' sensitivity analysis indicated that omitting any of the CPUE time-series would not alter the stock status.

Management advice. The current catches of blue marlin (average of 11,761 t in the last 5 years, 2013-2017) are higher than MSY (9,984 t) and the stock is currently overfished and subject to overfishing. In order to achieve the Commission objectives of being in the green zone of the Kobe Plot by 2027 ($F_{2027} < F_{MSY}$ and $B_{2027} > B_{MSY}$) with at least a 60% chance, the catches of blue marlin would have to be reduced by 35% compared to the average of the last 3 years, to a maximum value of approximately 7,800 t.

The following key points should also be noted:

- **Maximum Sustainable Yield (MSY)**: estimate for the Indian Ocean blue marlin stock is 9,980 t (estimated range 8,180–11,860 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 2014-18)**: Blue marlin are largely considered to be a non-target species of industrial and artisanal fisheries. Longline catches account for around 56% of total catches in the Indian Ocean, followed by gillnets (32%), with remaining catches recorded under troll and handlines (Fig. 1).
- **Main fleets (average catches 2014-18):**
  Around 80% of the total catches of blue marlin are accounted for by four fleets:
  Taiwan,China (longline): 44%; Pakistan (gillnet): 14%; I.R. Iran (gillnet): 11%, and Sri Lanka (14%) (**Fig.1**).

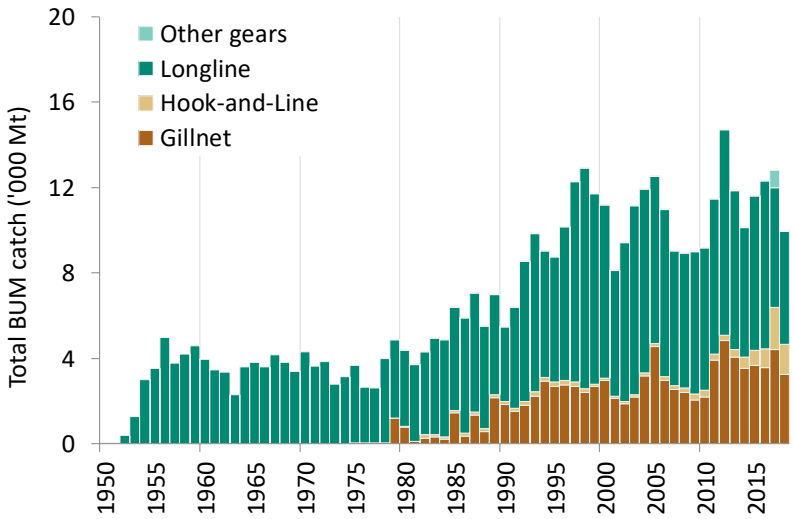


Fig. 1. Blue marlin catches by gear and year recorded in the IOTC database (1950–2018).
***Notes**: Other gears (OT) includes: longline-gillnet, handline, gillnet, coastal longline, troll line, sport fishing, and all other gears.*

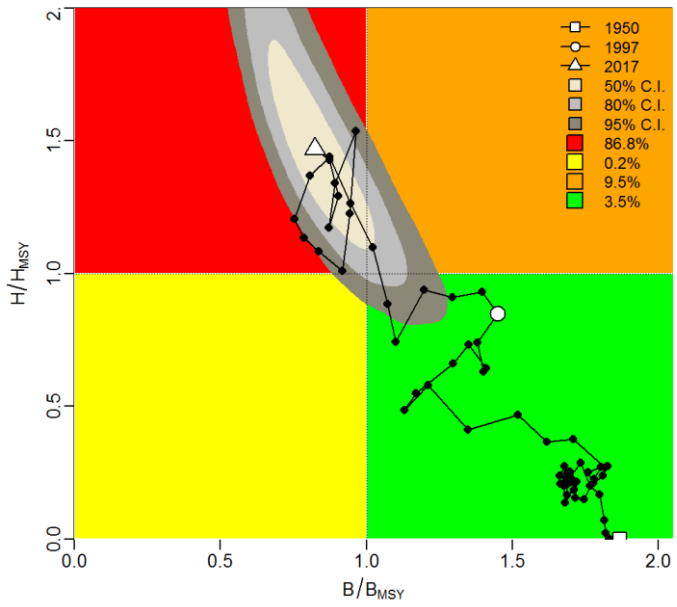


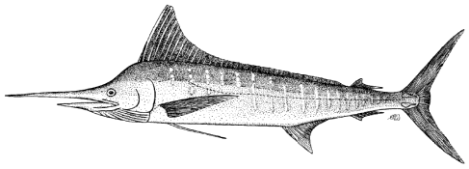
Fig. 2. Blue marlin: Kobe stock status plot for the Indian Ocean for black marlin, from the final JABBA base case (the black line traces the trajectory of the stock over time. Contours represent the smoothed probability distribution for 2018 (isopleths are probability relative to the maximum)).

Table 2. Blue Marlin: Indian Ocean JABBA Kobe II Strategy Matrix. Probability (percentage) of achieving the green quadrant of the KOBE plot nine constant catch projections, with future catch assuming to be 30–110% (in increments of 10%) of the 2017 catch level (12,029 t).

TAC | Year	2019	2020	2021	2022	2023	2024	2025	2026	2027
30% (3609)	20	39	58	71	81	87	91	93	95
40% (4812)	20	36	51	63	72	79	83	87	90
50% (6014)	21	33	44	54	62	68	73	77	81
60% (7217)	20	29	38	45	51	56	60	64	67
70% (8420)	20	26	32	37	41	45	47	50	52
80% (9623)	20	23	26	28	30	31	33	34	35
90% (10826)	17	18	19	19	20	20	20	20	20
100% (12029)	11	11	11	10	10	10	10	9	9
110% (13232)	7	6	6	6	5	5	4	4	4

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		2019 stock status determination
Indian Ocean	Catch 2018[2]:	2,791 t	99.8%*
	Average catch 2014-2018:	3,247 t	
	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 2019: 32%
[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. No new stock assessment for striped marlin was carried out in 2019, thus, the stock status is determined on the basis of the 2018 assessment and other indicators presented in 2019. In 2018 a stock assessment was conducted 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 2019, 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 2014-18)**: Striped marlin are largely considered to be a non-target species of industrial fisheries. Longlines account for around 50% of total catches in the Indian Ocean with remaining catches recorded gillnets, and troll and handlines (Fig. 1).
- **Main fleets (average catches 2014-18):**
  I.R. Iran (gillnet): 25%Taiwan,China (drifting longline): 20%; Indonesia (longline): 19%;; and Pakistan (gillnet): 11%.

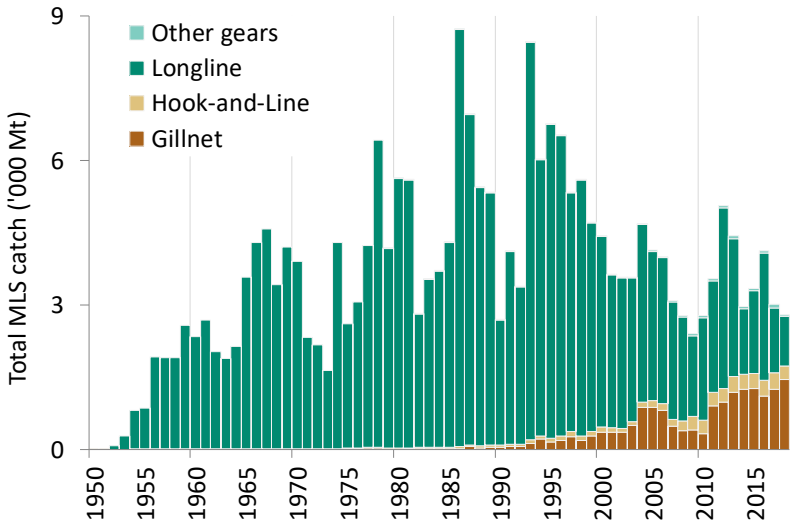


Fig. 1. Striped marlin catches by gear and year recorded in the IOTC database (1950–2018).
Notes*: Other gears (OT) includes: longline-gillnet, handline, gillnet, coastal longline, troll line, sport fishing, and all other gears.*

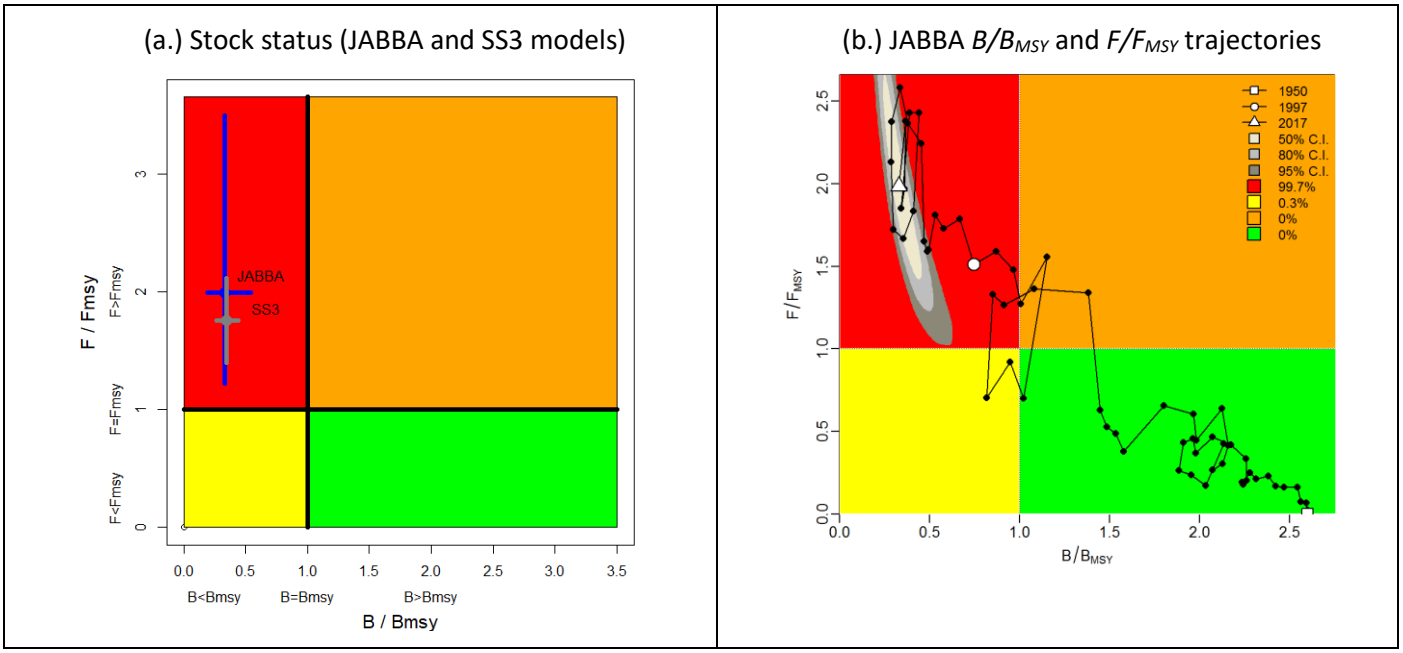


Fig. 2. (a): Striped marlin: Stock status from the Indian Ocean assessment JABBA (Bayesian State Space Surplus Production Model) and SS3 models with the confidence intervals (left); (b): Trajectories (1950-2017) of B/B_{MSY} *and* F/F_{MSY} from the JABBA model. NB: SS3 refers to SB/SB_{MSY} while the 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
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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		2019 stock status determination
Indian Ocean	Catch 2018[2]: Average catch 2014-2018:	36,911 t 31,267 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):	23.9 (16.1 – 35.4) 0.19 (0.14 - 0.24) 129 (81–206) 1.22 (1 – 2.22) 1.14 (0.63 – 1.39) 0.57 (0.31 – 0.70)	

[1] Boundaries for the Indian Ocean = IOTC area of competence.
[2] Proportion of catches estimated or partially estimated by IOTC Secretariat in 2019: 28%.

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)	17%	60%
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)	5%	16%
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. A new stock assessment was carried out for Indo-Pacific sailfish in 2019 using the C-MSY model. The data poor stock assessment techniques indicated that F was above F_{MSY} (F/F_{MSY}=1.22) and B is above B_{MSY} (B/B_{MSY}=1.14). Another alternative model using the Stock Reduction Analysis (SRA) techniques produced similar results. 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**). However both assessment models relies on catch data, however the catch series is highly uncertain. In addition 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 2019, the stock status cannot be assessed and is determined to be uncertain.

Outlook. Catches since 2009 have exceeded the estimated MSY, and have also increased by 58% between 2008 and 2017. This increase in coastal gillnet catches and fishing 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 (33,136 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 23,900 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 2014-18)**: gillnets account for around 74% of total catches in the Indian Ocean, followed by troll and hand lines (23%), with remaining catches recorded under longlines and other gears (Fig. 1).
- **Main fleets (average catches 2014-18):**
  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): 33%; India (gillnets and trolling): 22%; Pakistan (gillnets): 14%; and Sri Lanka (gillnets and fresh longline): 7%.

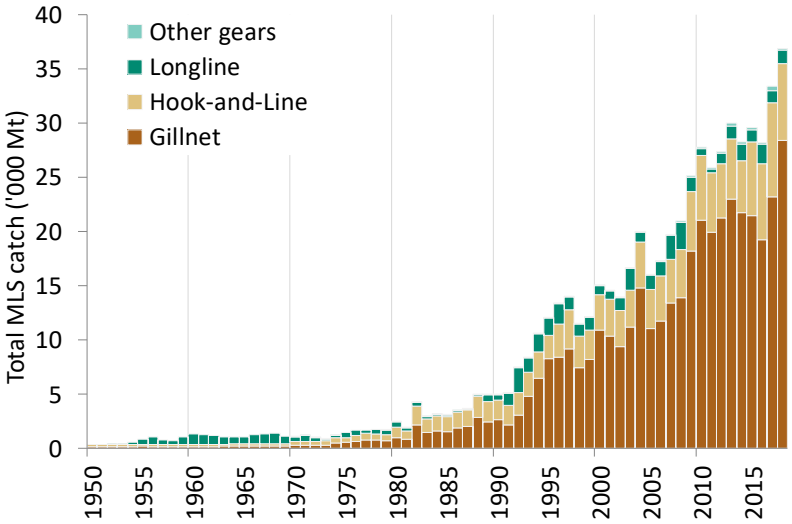

Fig. 1. Indo-Pacific sailfish: catches by gear and year recorded in the IOTC Database (1950–2018).
***Notes**: Other gears (OT) includes: longline-gillnet, handline, gillnet, coastal longline, troll line, sport fishing, and all other gears*

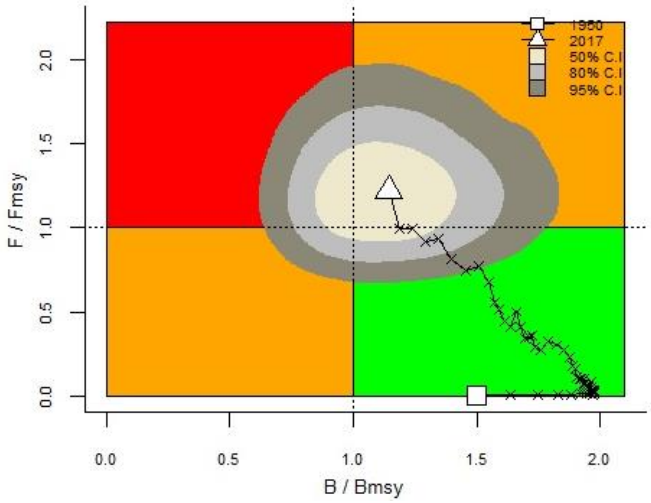

Fig.2. Indo-Pacific sailfish: Stock reduction analysis (C-MSY Method) of aggregated Indian Ocean assessment Kobe plot (contours are the 50, 65 and 90 percentiles of the 2017 estimate). Black lines indicate the trajectory of the point estimates (blue circles) for the B ratio and F ratio for each year 1950–2017.

APPENDIX 17
EXECUTIVE SUMMARY: BULLET TUNA

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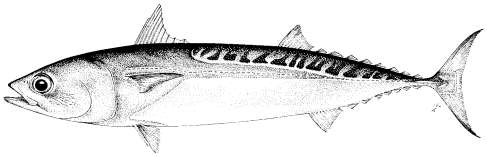


Status of the Indian Ocean bullet tuna (BLT: *Auxis rochei*) resource

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

Area[1]	Indicators		2019 stock status determination
Indian Ocean	Catch 2018[2]: Average catch 2014–2018:	31,615 t 16,364 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 2019: 10%
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}≥ 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. 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. Until recently annual catches for bullet tuna have fluctuated but remained around 10,000 t. However in 2018 catches increased from 16,000t to 32,000t – mostly due to an increase in catches reported by Indonesia purse seine fisheries) (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 should be focused 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.).

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 should be focused 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.).
- 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, 20% 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 2014-18)**: bullet tuna is mainly caught using coastal purse seine (40%), handlines and trolling (≈29%), and gillnets (≈21%). (Fig. 1).
- **Main fleets (average catches 2014-18)**: Catches are highly concentrated: in recent years over 90% of catches in the Indian Ocean have been accounted for by fisheries in India, Indonesia and Sri Lanka,.

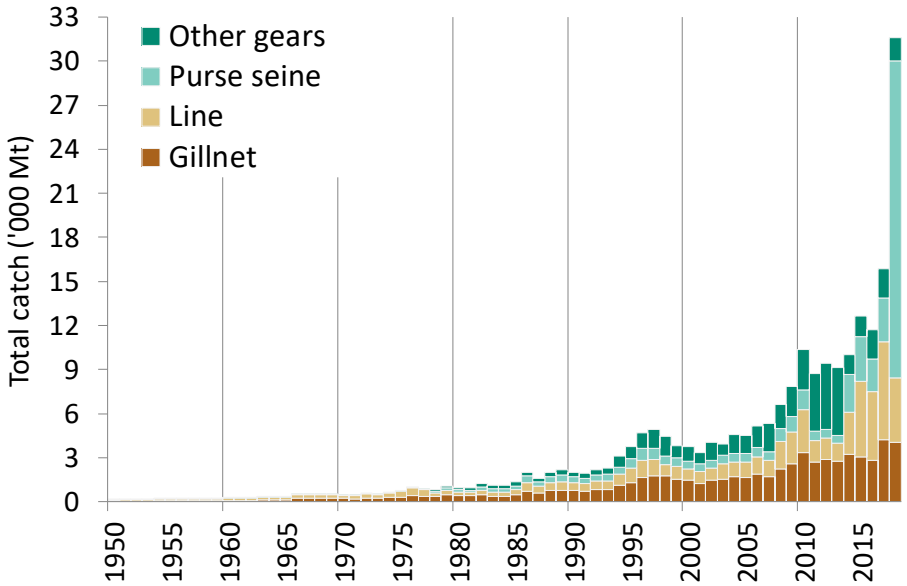
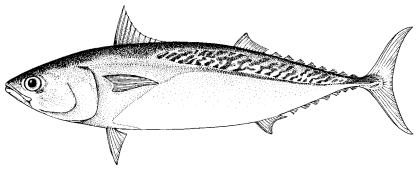


Fig. 1. Bullet tuna: Annual catches of bullet tuna by gear recorded in the IOTC Database (1950–2018)[4].

[4] **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		2019 stock status determination
Indian Ocean	Catch 2018[2]:	82,909 t	
	Average catch 2014–2018:	89,253 t	
	MSY (1,000 t) (80% CI):	unknown	
	F_{MSY} (80% CI):	unknown	
	B_{MSY} (1,000 t) (80% CI):	unknown	
	$F_{current}/F_{MSY}$ (80% CI):	unknown	
	$B_{current}/B_{MSY}$ (80% CI):	unknown	
	$B_{current}/B_0$ (80% CI):	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 2019: 65%
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}≥ 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. 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. Estimated catches have increased steadily since the late-1970's, reaching around 30,000 t in the late-1980's, to between 55,000 and 60,000 t by the mid-1990's, and remaining at the same level in the following ten years. Between 2010 and 2014 catches have increased to over 95,000 t, rising to the highest levels recorded; although catches have since decline marginally to between 85,000 – 90,000 t since 2014. 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 should be focused 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.).

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 should be focused 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.).
- 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, 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 2014-18)**: frigate tuna is mainly caught using gillnets (≈34%), 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 the target of some ring net fisheries.
- **Main fleets (average catches 2014–18)**: Catches of frigate tuna are highly concentrated: Indonesia accounts for around two-thirds of catches, while over 85% of catches are accounted for by four countries (Indonesia, India, Sri Lanka and I.R. Iran).

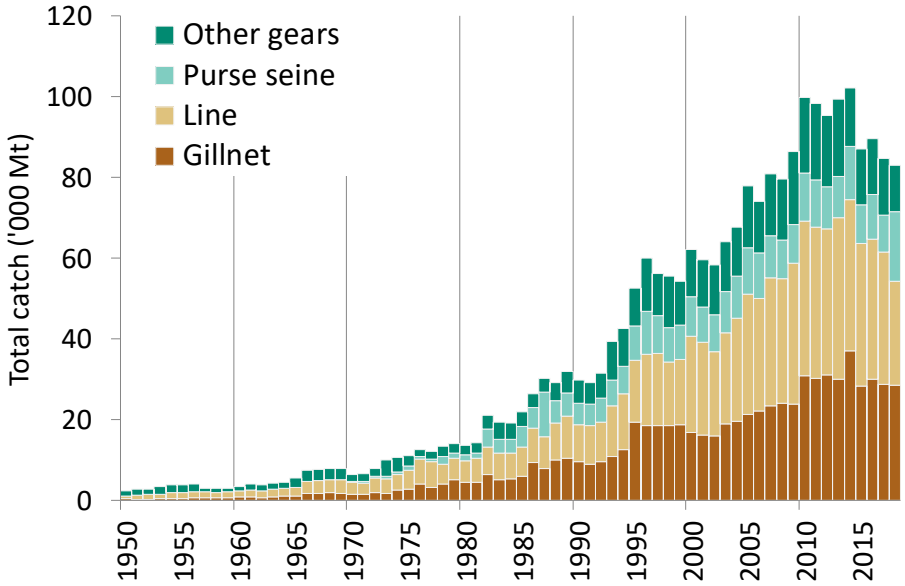


Fig.1. Frigate tuna: Annual catches of frigate tuna by gear recorded in the IOTC Database (1950–2018)[5].

[5] **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
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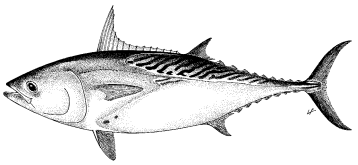

Status of the Indian Ocean kawakawa (KAW: *Euthynnus affinis*) resource

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

Area[1]	Indicators		2019 stock status determination
Indian Ocean	Catch 2018[2]: Average catch 2014-2018:	173,367 t 161,844 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 2019: 33%
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 model realizations (see IOTC-2015-WPNT05-R)

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

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. A stock assessment was not undertaken for kawakawa in 2019 and the status is determined on the basis of the last assessment conducted in 2015, 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 reduce the level of catches which have surpassed the estimated MSY levels for all years since 2011 – despite the decrease in catches from their peak 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., 33% of catches partially or fully estimated by the IOTC Secretariat in 2018) 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. Continued increase in the annual catches for kawakawa is also likely to further increase the pressure on the Indian Ocean stock. Research emphasis should be focused 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.). 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, it should be noted that catches have since declined from 168,174 t (2013) to 159,121 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)[6], 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 should be focused 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.).
- 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 41% of the catches (in 2019), 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 2014–18)**: Kawakawa are caught mainly by gillnets (≈51%), 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 2014–18)**: Catches are highly concentrated: Indonesia, India, and I.R. Iran account for over two thirds of catches in recent years.

[6] as estimated in 2015

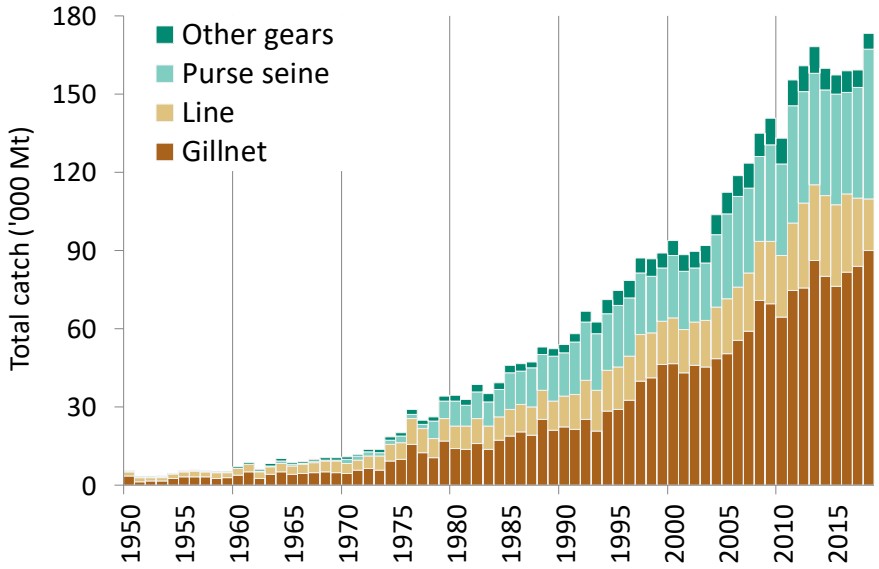

Fig.1. Kawakawa: Annual catches of kawakawa by gear recorded in the IOTC database (1950–2018)[7].

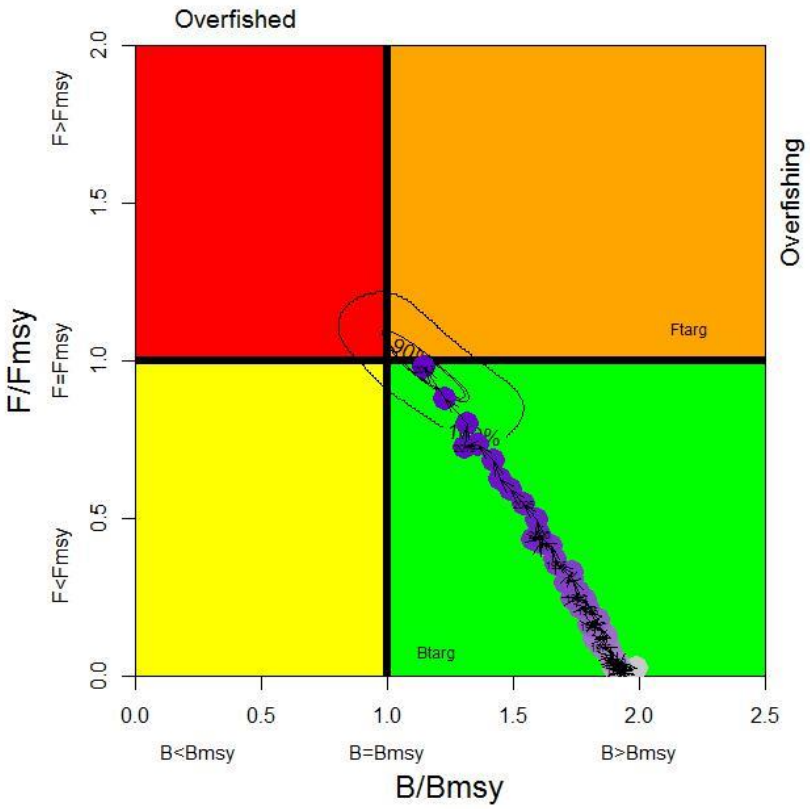

Fig.2. Kawakawa. OCOM aggregated Indian Ocean assessment. Blue circles indicate the trajectory of the point estimates for the B ratio and F ratio for each year between 1950 and 2013 (the black lines represent all plausible model runs shown around 2015 estimate).

[7] **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.

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. Data taken from the 2015 stock assessment using catch estimates (i.e. 1950-2013) available at that time.

Reference point and projection timeframe	**Alternative catch projections (relative to 2013) and weighted probability (%) scenarios that violate MSY-based reference point**					
	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
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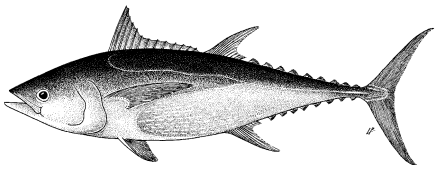


Status of the Indian Ocean longtail tuna (LOT: *Thunnus tonggol*) resource

TABLE 1. Longtail tuna: Status of longtail tuna (*Thunnus tonggol*) in the Indian Ocean.

Area[1]	Indicators		2019 stock status determination
Indian Ocean	Catch 2018[2]:	136,906 t	67%
	Average catch 2014–2018:	138,352 t	
	MSY (1,000 t) (*):	140 (103–184)	
	F_{MSY} (*):	0.43 (0.28–0.69)	
	B_{MSY} (1,000 t) (*):	319 (200–623)	
	F_{2015}/F_{MSY} (*):	1.04 (0.84–1.46)	
	B_{2015}/B_{MSY} (*):	0.94 (0.68–1.16)	
	B_{2015}/B_0 (*):	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 2019: 28%
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 model realizations (IOTC-2017-WPNT07-R)

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)	67%	0%
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 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 that 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 since 2015 catches have marginally decreased (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 of longtail tuna 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 should be focused 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.).

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 should be focused 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.).
- 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, 37% 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 2014–18)**: Longtail tuna are caught mainly using gillnets (≈71% of catches) and, to a lesser extent, coastal purse seine nets and trolling (Fig. 1).
- **Main fleets (average catches 2014–18)**: 44% of the catches of longtail in the Indian Ocean are accounted for by I.R. Iran, followed by Indonesia (≈18%), and Oman (≈11%).

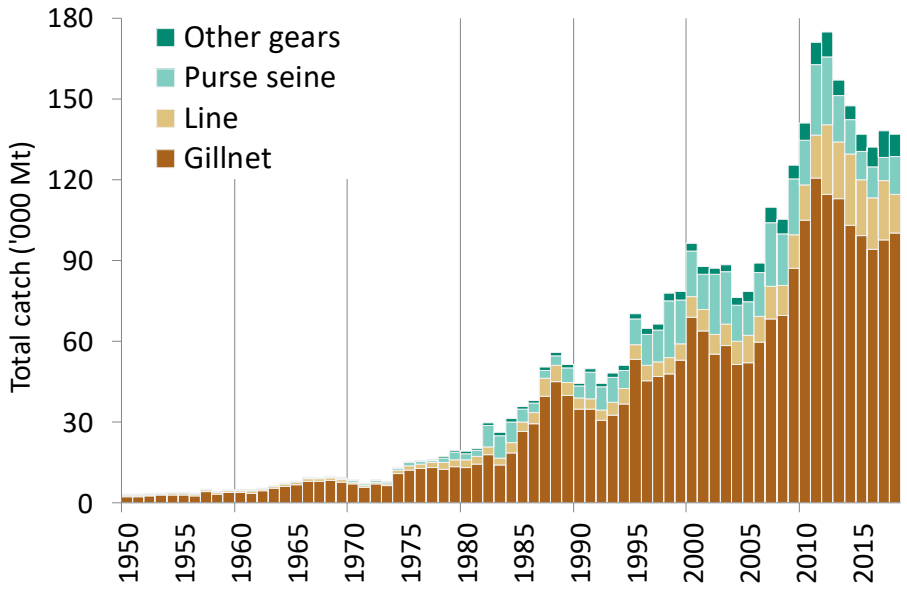


Fig. 1. Longtail tuna: Annual catches by gear recorded in the IOTC Database (1950–2018)[8].

[8] **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.

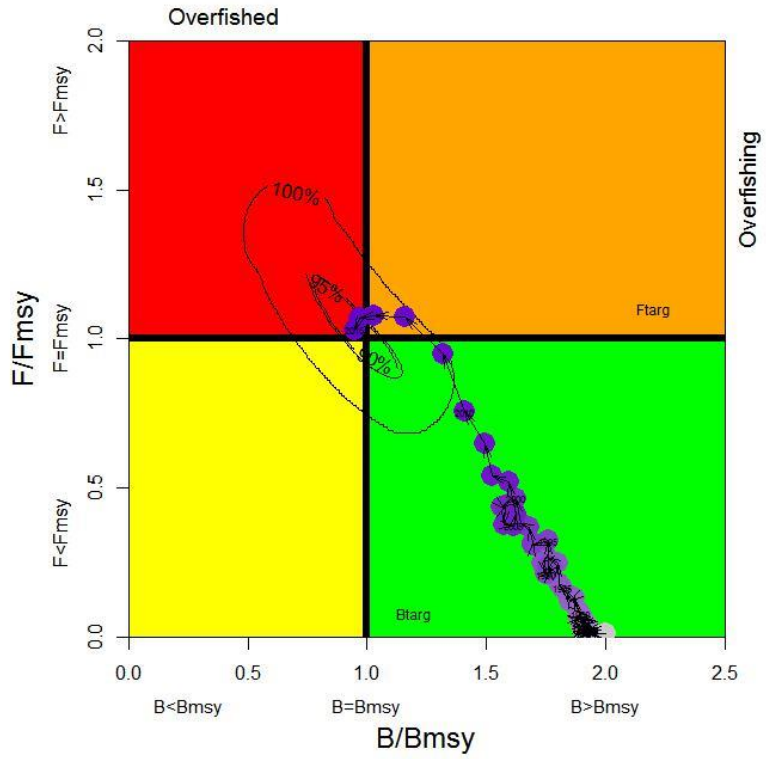


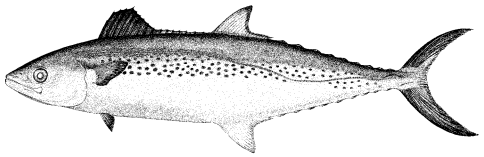
Fig. 2. Longtail tuna. OCOM Indian Ocean assessment Kobe plot. Blue circles indicate the trajectory of the point estimates for the B ratio and F ratio for each year between 1950 and 2015 (the black lines represent all plausible model runs shown around 2015 estimate).

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). Data taken from the 2017 stock assessment using catch estimates (i.e., 1950-2015) 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 % (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		2019 stock status determination
Indian Ocean	Catch 2018[2]:	50,653 t	
	Average catch 2014-2018:	49,511 t	
	MSY (1,000 t):	Unknown	
	F_{MSY}:	Unknown	
	B_{MSY} (1,000 t) :	Unknown	
	$F_{current}/F_{MSY}$:	Unknown	
	$B_{current}/B_{MSY}$:	Unknown	
	$B_{current}/B_0$:	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 2019: 34%
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}≥ 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 preliminary assessment was undertaken in 2016 for Indo-Pacific king mackerel using catch-only methods techniques (Catch-MSY and OCOM). 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 (37% estimated) for this species, combined with the highly variable and uncertain estimates of growth parameters used to estimate model priors, warrant caution in interpreting the model results for Indo-Pacific king mackerel. Given that no new assessment was undertaken in 2019, 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 steadily over time, reaching a peak of 53,000 t in 2009 and have since fluctuated between 42,000 t and 53,000 t. There is considerable uncertainty about stock structure and total catches. Aspects of the fisheries for this species, combined with the limited data on which to base a more complex assessment (e.g., integrated 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 should be focused 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.).

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 between 2009 and 2011 estimated at the time of the assessment (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.

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 should be focused 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.).
- 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 needed to be improved, given the 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 37% 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 2014-18)**: Indo-Pacific King mackerel are caught mainly by gillnets (≈67%), however significant numbers are also caught trolling (Fig. 1).
- **Main fleets (average catches 2014–18)**: Almost two-thirds of catches are accounted for by fisheries in India and Indonesia; with important catches also reported by I.R. Iran.

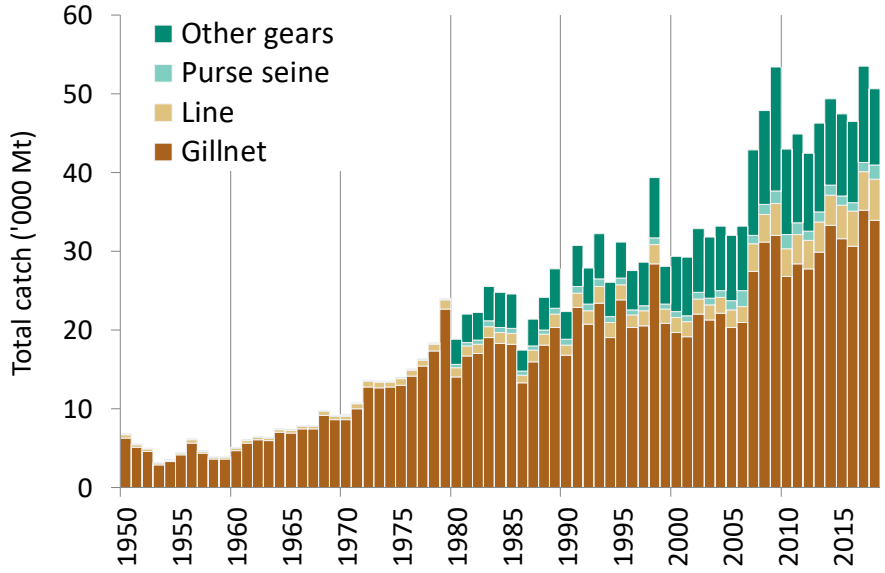
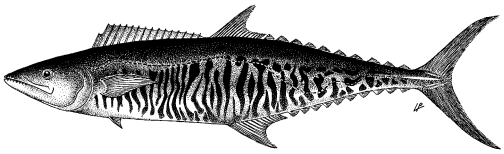


Fig. 1. Indo-Pacific king mackerel: Annual catches of Indo-Pacific king mackerel by gear recorded in the IOTC database (1950–2018)[9].

[9] **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		2019 stock status determination
Indian Ocean	Catch 2018[2]: Average catch 2014-2018:	149,263 t 163,209 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 2019: 55%
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 model realizations (IOTC-2017-WPNT07-R)

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)	89%	11%
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 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[10], 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 for 2013-2017 are well above the current MSY estimate of 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 should be focused 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.). 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).

[10] 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 (158,920 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 should be focused 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.).
- 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 57% 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 2014-18)**: Narrow-barred Spanish mackerel are caught mainly using gillnet (≈59%), however significant numbers are also caught using troll lines (Fig. 1).
- **Main fleets (average catches 2014-18)**: Fisheries in Indonesia, India, and I.R. Iran account for around two-thirds of catches of Spanish mackerel, while the species is also targeted throughout the Indian Ocean by artisanal and sports/recreational fisheries.

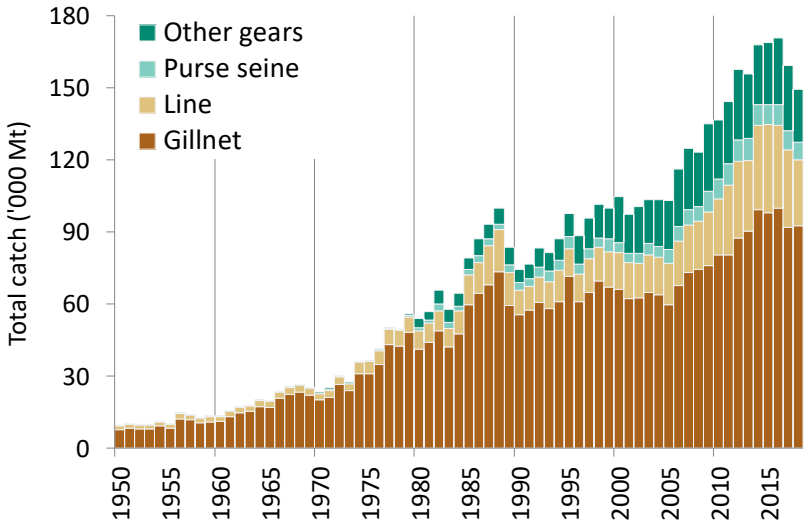


Fig. 1. Narrow-barred Spanish mackerel: Annual catches of narrow-barred Spanish mackerel by gear recorded in the IOTC database (1950–2018)[11].

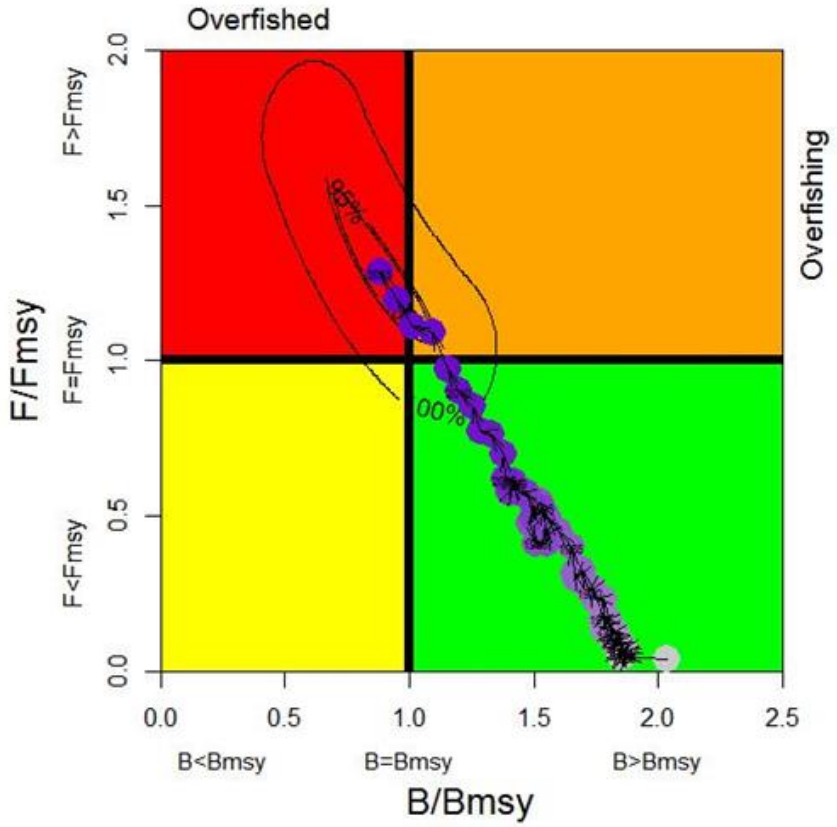


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Fig. 2. Narrow-barred Spanish mackerel. OCOM Indian Ocean assessment Kobe plot. Blue circles indicate the trajectory of the point estimates for the B ratio and F ratio for each year between 1950 and 2015 (the black lines represent all plausible model runs shown around 2015 estimate).

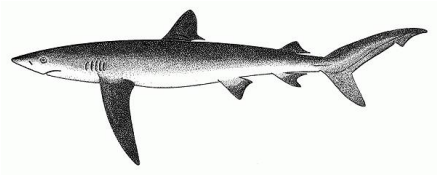
Table 2. Narrow-barred Spanish mackerel: OCOM Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of violating the MSY-based reference points for five constant catch projections (2015 catch level, -10%, -20%, -30%, +10% and + 20%) projected for 3 and 10 years. Results are taken from the 2017 assessment using data up to 2015, available at the time of the assessment.

Reference point and projection timeframe	**Alternative catch projections (relative to 2015) and weighted probability (%) scenarios that violate MSY-based reference point**					
	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

[11] **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 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	Indicators		2018 stock status determination
Indian Ocean	Reported catch 2018:	23,338 t	72.6%
	Estimated catch 2015:	54,735 t	
	Not elsewhere included (nei) sharks 2018:	35,758 t	
	Average reported catch 2014-18:	27,757 t	
	Average estimated catch 2011–15:	54,993 t	
	Ave. not elsewhere included (nei) sharks[2] 2014-18:	47,537 t	
	MSY (1,000 t) (80% CI)[3]:	33.0 (29.5 - 36.6)	
	F_{MSY} (80% CI) [3]:	0.30 (0.30 - 0.31)	
	SB_{MSY} (1,000 t) (80% CI) [3,4]:	39.7 (35.5 - 45.4)	
	F_{2015}/F_{MSY} (80% CI) [3]:	0.86 (0.67 - 1.09)	
	SB_{2015}/SB_{MSY} (80% CI) [3]:	1.54 (1.37 - 1.72)	
	SB_{2015}/SB_0 (80% CI) [3]:	0.52 (0.46 - 0.56)	

[1]Boundaries for the Indian Ocean = IOTC area of competence
[2]Includes all other shark catches reported to the IOTC Secretariat, which may contain this species (i.e., SHK: sharks various nei; RSK: requiem sharks nei).
[3]Estimates refer to the base case model using estimated catches.
[4]Refers to fecund stock biomass

Colour key	Stock overfished (SB_{2015}/SB_{MSY}< 1)	Stock not overfished (SB_{2015}/SB_{MSY}≥ 1)
Stock subject to overfishing(F_{2015}/F_{MSY}> 1)	0%	27.4%
Stock not subject to overfishing (F_{2015}/F_{MSY}≤ 1)	0%	72.6%
Not assessed/Uncertain		

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

Common name	Scientific name	IUCN threat status[3]		
		Global status	WIO	EIO
Blue shark	*Prionace glauca*	Near Threatened	–	–

IUCN = International Union for Conservation of Nature; WIO = Western Indian Ocean; EIO = Eastern Indian Ocean

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

Sources: IUCN 2007, Stevens 2009

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

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

standardized relative abundance series, model fits and spatial extent of the data (Fig. 1, Table 1). The major change in biological parameters since the previous stock assessment is the stock recruitment relationship, i.e., steepness = 0.79 due to the update of the key biological parameters calculated specific to the Indian Ocean. The major axes of uncertainties identified in the current model are catches and CPUE indices of abundance. Model results were explored with respect to their sensitivity to the major axes of uncertainty identified. If the alternative CPUE groupings were used then the stock status was somewhat more positive (B>>Bmsy and F<<Fmsy), while if the alternative catch series (trade and EUPOA) were used then the estimated stock status resulted in F>Fmsy. The ecological risk assessment (ERA) conducted for the Indian Ocean by the WPEB and SC in 2018 (Murua et al. 2018) consisted of a semi-quantitative risk assessment analysis to evaluate the resilience of shark species to the impact of a given fishery by combining the biological productivity of the species and its susceptibility to each fishing gear type. Blue sharks received a medium vulnerability ranking (No. 10) in the ERA rank for longline gear because it was estimated as the most productive shark species, but was also characterised by the second highest susceptibility to longline gear. Blue shark was estimated as not being susceptible thus not vulnerable to purse seine gear. The current IUCN threat status of 'Near Threatened' applies to blue sharks globally (Table 2). Information available on this species has been improving in recent years. Blue sharks are commonly taken by a range of fisheries in the Indian Ocean and in some areas they are fished in their nursery grounds. Because of their life history characteristics – they live until at least 25 years, mature at 4–6 years, and have 25–50 pups every year – they are considered to be the most productive of the pelagic sharks. On the weight-of-evidence available in 2017, the stock status is determined to be **not overfished** and **not subject to overfishing** (Table 1).

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

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

The following key points should also be noted:

- **Maximum Sustainable Yield (MSY)**: estimate for the Indian Ocean stock is 33,000 t.
- **Reference points**: The Commission has not adopted reference points or harvest control rules for any shark species.
- **Main fishing gear** (2014–18): Coastal longline; longline targeting swordfish; longline (deep-freezing).
- **Main fleets** (2014–18): Indonesia; EU,Spain; Taiwan, China; Japan; EU,Portugal.

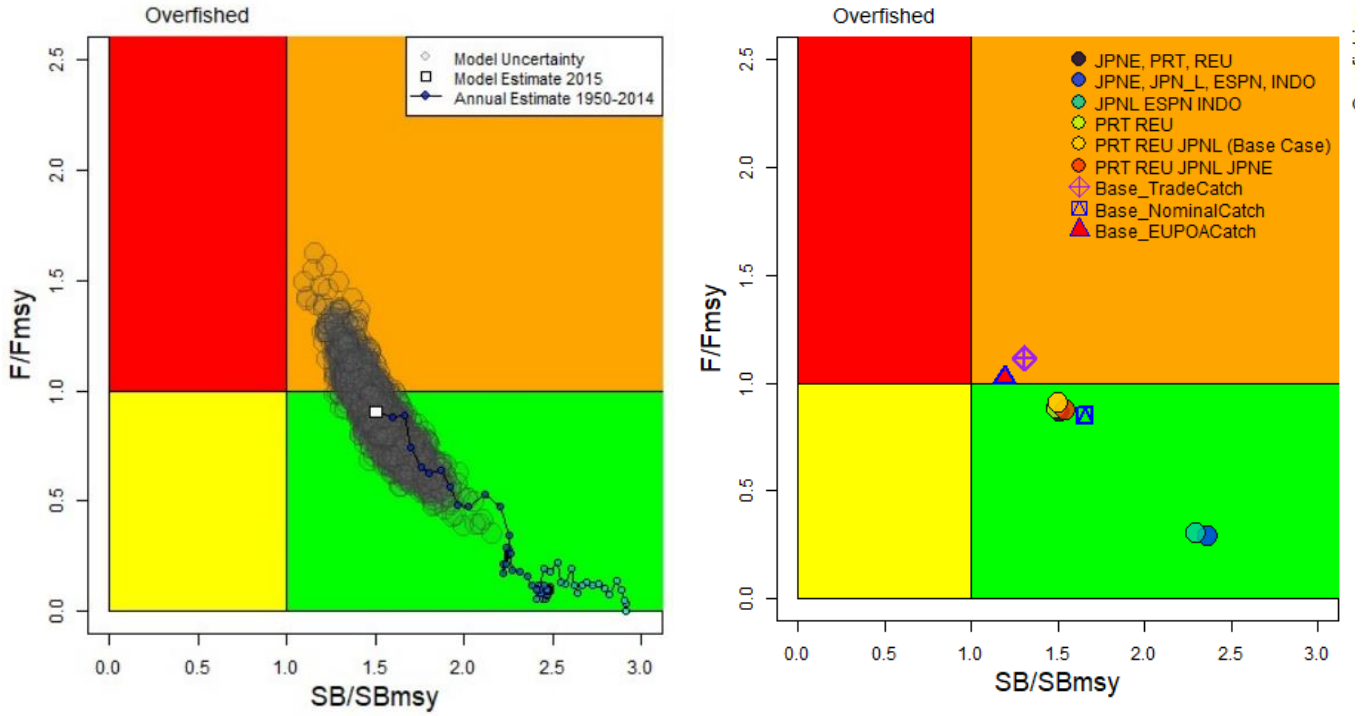


Fig. 1. Blue shark: Aggregated Indian Ocean stock assessment Kobe plot for the 2017 estimate based on the base case model and a range of sensitivity models explored with several catch reconstructions and fits to CPUE series. (Left panel: base case model with trajectory and MCMC uncertainties in the terminal 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)

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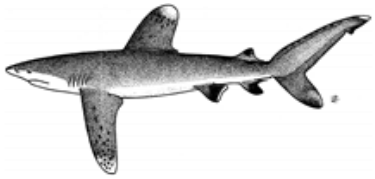
APPENDIX 24
EXECUTIVE SUMMARY: OCEANIC WHITETIP SHARK

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



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

CITES APPENDIX II species

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

Area[1]	Indicators		2018 stock status determination
Indian Ocean	Reported catch 2018:	35 t	
	Not elsewhere included (nei) sharks[2] 2018:	35,758 t	
	Average reported catch 2014-18:	201 t	
	Av. not elsewhere included 2013-2017 (nei) sharks[2]:	47,537 t	
	MSY (1,000 t) (80% CI):	unknown	
	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):		

[1]Boundaries for the Indian Ocean = IOTC area of competence
[2]Includes all other shark catches reported to the IOTC Secretariat, which may contain this species(i.e., SHK: sharks various nei; RSK: requiem sharks nei)

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

TABLE 2. 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 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** (2014-18): Gillnet; gillnet-longline.
- **Main fleets** (2014-2018): 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, Kenya, Indonesia).

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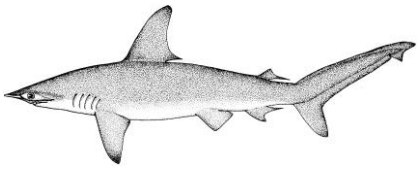
Murua H, Santiago, J, Coelho, R, Zudaire I, Neves C, Rosa D, Semba Y, Geng Z, Bach P, Arrizabalaga, H., Baez JC, Ramos ML, Zhu JF and Ruiz J. (2018). Updated Ecological Risk Assessment (ERA) for shark species caught in fisheries managed by the Indian Ocean Tuna Commission (IOTC). IOTC–2018–SC21–14_Rev_1.

APPENDIX 25
EXECUTIVE SUMMARY: SCALLOPED HAMMERHEAD SHARK

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



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

CITES APPENDIX II species

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

Area[1]	Indicators		2018 stock status determination
Indian Ocean	Reported catch 2018:	19 t	
	Not elsewhere included (nei) sharks[2] 2017:	35,758 t	
	Average reported catch 2013-17:	56 t	
	Av. not elsewhere included (nei) sharks[2] 2013-2017:	47,537 t	
	MSY (1,000 t) (80% CI):	unknown	
	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):		

[1]Boundaries for the Indian Ocean = IOTC area of competence
[2]Includes all other shark catches reported to the IOTC Secretariat, which may contain this species (i.e., SHK: sharks various nei; RSK: requiem sharks nei).

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

TABLE 2. 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 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** (2014-2018): Ringnet, Gillnet, longline (fresh), longline-coastal.
- **Main fleets** (2014-18): Sri Lanka; Seychelles; NEI-Fresh (report as released alive/discarded by EU-France, South Africa, Indonesia, Japan, Kenya).

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APPENDIX 26
EXECUTIVE SUMMARY: SHORTFIN MAKO SHARK

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

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

CITES APPENDIX II species

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 2018: Not elsewhere included (nei) sharks[2] 2018: Average reported catch 2014-18: Av. not elsewhere included (nei) sharks[2] 2014-18:	1,499 t 35,758t 1,582 t 47,537 t	
	MSY (1,000 t) (80% CI): F_{MSY} (80% CI): SB_{MSY} (1,000 t) (80% CI): $F_{current}/F_{MSY}$ (80% CI): $SB_{current}/SB_{MSY}$ (80% CI): $SB_{current}/SB_0$ (80% CI):	unknown	

[1]Boundaries for the Indian Ocean = IOTC area of competence
[2]Includes all other shark catches reported to the IOTC Secretariat, which may contain this species (i.e., SHK: sharks various nei; RSK: requiem sharks nei).

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

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

Common name	Scientific name	IUCN threat status[3]		
		Global status	WIO	EIO
Shortfin mako shark	*Isurus oxyrinchus*	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, 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 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 ''Endangered' 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** (2014-18): Longline targeting swordfish; longline (fresh); longline (targeting sharks); gillnet.
- **Main fleets** (2014-18): EU,Spain; South Africa; EU,Portugal; Japan, Iran, China, Sri Lanka, (Reported as discarded/released alive: Australia, EU-France, Indonesia, Japan, Korea, South Africa).

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APPENDIX 27
EXECUTIVE SUMMARY: SILKY SHARK

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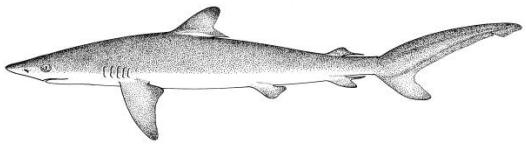

Status of the Indian Ocean silky shark (FAL: *Carcharhinus falciformis*)

CITES APPENDIX II species

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 2018: Not elsewhere included (nei) sharks[2] 2018: Average reported catch 2014-18: Av. not elsewhere included (nei) sharks[2] 2014-18:	1,503 t 35,758 t 2,162 t 47,537 t	
	MSY (1,000 t) (80% CI): F_{MSY} (80% CI): SB_{MSY} (1,000 t) (80% CI): $F_{current}/F_{MSY}$ (80% CI): $SB_{current}/SB_{MSY}$ (80% CI): $SB_{current}/SB_0$ (80% CI):	unknown	

[1]Boundaries for the Indian Ocean = IOTC area of competence
[2]Includes all other shark catches reported to the IOTC Secretariat, which may contain this species (i.e., SHK: sharks various nei; RSK: requiem sharks nei).

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

TABLE 2. 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 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. CPUE derived from longline fishery observations indicated a decrease from 2009 to 2011 with a stable pattern onward. A preliminary stock assessment was run in 2018 but could not be updated in 2019. This assessment is extremely uncertain, however, and so the population status of silky sharks in the Indian Ocean is considered uncertain. Silky sharks are commonly taken by a range of fisheries in the Indian Ocean. Because of their life history characteristics – they are relatively long lived (over 20 years), mature relatively late (at 6–12 years), and have relativity few offspring (<20 pups every two years), the silky shark can be vulnerable to overfishing. Despite the lack of data, there is some anecdotal information suggesting that silky shark abundance has declined over recent decades, including from Indian longline research surveys, which are described in the IOTC Supporting Information for silky shark sharks. There is no quantitative stock assessment or basic fishery indicators currently available for silky shark in the Indian Ocean therefore the stock status is **unknown**.

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

Management advice. Despite the absence of stock assessment information, the Commission should consider taking a cautious approach by implementing some management actions for silky sharks. While mechanisms exist for encouraging CPCs to comply with their recording and reporting requirements (Resolution 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** (2014-18): Gillnet; longline (fresh), longline-coastal, longline (deep-freezing)
- **Main fleets** (2014-18): Sri Lanka; I.R. Iran; Taiwan,China.

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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*)

CITES APPENDIX II species

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 2018:	2 t	
	Not elsewhere included (nei) sharks[2] 2018:	35,758 t	
	Average reported catch 2014–18:	0 t	
	Av. not elsewhere included (nei) sharks[2] 2014–18:	47,537 t	
	MSY (1,000 t) (80% CI):	unknown	
	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):		

[1]Boundaries for the Indian Ocean = IOTC area of competence

[2]Includes all other shark catches reported to the IOTC Secretariat, which may contain this species (i.e., SHK: sharks various nei; RSK: requiem sharks nei).

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

TABLE 2. 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 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[12].

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): Longline. (reported as discard from gillnet and longline).
- **Main reporting fleets** (2013–17): India (reported as discarded/released alive: South Africa, Sri Lanka, Japan, Korea, EU,France, Indonesia).

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[12] 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*)

CITES APPENDIX II species

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 2018:	1 t	
	Not elsewhere included (nei) sharks[2] 2018:	35,758 t	
	Average reported catch 2014-18:	0 t	
	Av. not elsewhere included (nei) sharks[2] 2014-18:	47,537t	
	MSY (1,000 t) (80% CI):	unknown	
	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):		

[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 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[13].

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): Longline(reported as discard/ released from gillnet and longline.
- **Main fleets** (2013-17): India, Sri Lanka (reported as discarded/released alive: Japan, Korea, Sri Lanka, South Africa, Indonesia, Kenya,).

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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.

[13]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[14]
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)[15] 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[16]. 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[17]. Population levels of impacts of leatherback turtles caught in longline gear in the Southwest Indian Ocean were also identified as a conservation priority.

[14] IUCN, 2017. The process of the threat assessment from IUCN is independent from the IOTC and is presented for information purpose only
[15] 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.
[16] 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
[17] Wallace, B. P., C. Y. Kot, A. D. DiMatteo, T. Lee, L. B. Crowder, and R. L. Lewison. 2013. Impacts of fisheries bycatch on marine turtle populations worldwide: toward conservation and research priorities. Ecosphere 4(3):40. http:// dx.doi.org/10.1890/ES12-00388.1 (figure 13)

Outlook. Resolution 12/04 *On the conservation of marine turtles* includes an annual evaluation requirement (para. 17) by the Scientific Committee (SC). However, given the lack of reporting of marine turtle interactions by CPCs to date, such an evaluation cannot be undertaken. Unless IOTC CPCs become compliant with the data collection and reporting requirements for marine turtles, the WPEB and the SC will continue to be unable to address this issue. 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.

1. Given the high mortality rates associated with marine turtle interactions with gillnet fisheries and the increasing use of gillnets in the Indian Ocean[18] there is a need to both assess and mitigate impacts on threatened and endangered marine turtle populations.
2. 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.
3. Current reported interactions are known to be a severe underestimate.
4. The Ecological Risk Assessment[19] 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.
5. 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.
6. Efforts should be undertaken to encourage CPCs to investigate means to reduce marine turtle bycatch and mortality in IOTC fisheries.
7. That appropriate mechanisms are developed by the Compliance Committee to ensure CPCs comply with their data collection and reporting requirements for marine turtles.

[18] IOTC-2017-WPEB13-18

[19] 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[20]
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

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

South Africa), very high seabird incidental catches rates have been recorded in the absence of a suite of proven incidental catches mitigation measures.

Outlook. Resolution 12/06 *On Reducing the Incidental Bycatch of Seabirds in Longline Fisheries* includes an evaluation requirement (para. 8) by the Scientific Committee in time for the 2016 meeting of the Commission. The level of compliance with 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[21] 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[22]. Many reports[23] 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[24], but should be further monitored.

[21] October 2017

[22] Anderson 2014

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

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

Outlook. Resolution 13/04 *On the conservation of cetaceans* highlights the concerns of the IOTC regarding the lack of accurate and complete data collection and reporting to the IOTC Secretariat of interactions and mortalities of cetaceans in association with tuna fisheries in the IOTC Area of Competence. In this resolution, the IOTC have agreed that CPCs 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 drifting gillnets[25].
- 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 drifting gillnet fisheries has been reported to the IOTC, which is a major cause of concern for a number of species, particularly in the northern Indian Ocean.
- Appropriate mechanisms should be developed by the Compliance Committee to ensure CPCs comply with their data collection and reporting requirements for cetaceans.

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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 was developed with EU funding to further this work and was presented to the WPNT 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.	Completed and 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.	Completed and 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.	Completed and 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*	8. **Ongoing**: External experts (Invited Experts) are regularly invited to provide additional expertise at Working Party meetings. 9. 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, while in 2019, invited experts attended the WPNT, WPEB and WPTT meetings. 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.	Completed and 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.	Completed and 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*	**Ongoing:** Recruitment of a P1 (Fisheries Officer) began in late-2017 and has been completed in 2019. However, the IOTC Data Section still remains severely understaffed given the increasing work loads. In addition, the departure of the Fisheries Statistician in late 2019 has further reduced the number of staff in this department although the recruitment of a new Fisheries Statistician has begun and should be completed in early 2020. 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 2019 (e.g., E-monitoring, ROS Pilot Project, support for implementation of skipjack HCR [Res 16/02], and yellowfin catch reduction [Res.19/01].	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.	Completed and 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). This was further explored in 2018 and 2019.	Completed and 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. The WPTT in 2019 also recommended that these data preparatory meetings be implemented for tropical tuna assessments in the future.	Completed and 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	Completed and ongoing	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 2019, data compliance and support missions were conducted in Mauritius (April, observer data collection), Tanzania (July, artisanal fisheries project), Indonesia (September, CITES artisanal fisheries project), Oman (September, IOTC data reporting standards workshop, artisanal fisheries sampling assessment) while a mission to Pakistan is planned for November (at the same time of the WPDCS and SC days) to further provide support to the WWF-funded crew-based data collection scheme. The trip to Mauritius included a 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.	Completed and 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, 2018 and 2019(with support from ISSF) to support the TCMP with more direct capacity building for managers from developing CPCs.	Completed and 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.	Completed and 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 the project in 2019 specifically addressing the way the uncertainty in stock assessment advice based on data-limited methods is presented.	Completed and 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.	Completed and 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 2019 and at future meetings. The ecosystem report card methodology was discussed during the 2018 meeting of the WPEB and a subsequent workshop to advance the process was held in 2019.	Completed and 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 3rd Meeting of the Technical Committee on Management Procedures took place in 2019 and is due to continue to take place prior to each Commission meeting with the discussion of reference points on the agenda	Completed and 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-2019-SC22-09. 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.	Completed and 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 as well as Swordfish, with support of external funding (Australia, EU and FAO ABNJ Tuna Project).	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 had increased to 3 persons when the science manager position was filled in July 2018. Staff departures (a fisheries officer) in mid-2019 have reduced the section back to 2 people although recruitment of a new fisheries officer is in the final stages and should be completed in early 2020.	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 the TCAC has progressed this work, the WPTT agenda has also included the option of alternative management tools. This should be continued in light of Res 19/01 and 16/02 revisions.	Ongoing	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]). This schedule may need to be revised in 2019.	Completed and ongoing	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 and (San Diego) 2019. The secretariat participated in the tRFMO joint meeting on MSE in (Seattle (2018) and will be chairing the tRFMO joint meeting on bycatch to be held in (Porto) 2019.	Ongoing	Medium

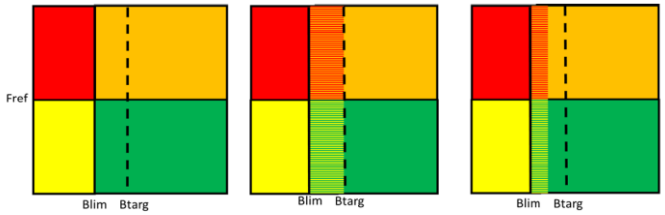
PRIOTC02.22 (para. 211)	***Special requirements of developing States*** The PRIOTC02 **RECOMMENDED** that: a) the continuation and optimisation of the IOTC Meeting Participation Fund indefinitely as part of the IOTC Regular Budget, and that the MPF is used to support participation of all eligible Contracting Parties in order to create a more balanced attendance to both science and non-science meetings of the Commission.	*Commission*	**Ongoing:** In 2019, 77 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.	Completed and 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 Science Strategic Plan has been developed and was presented and tentatively endorsed by the Commission in 2019. This plan includes the development plan for capacity building. A capacity-building workshop was held in 2018 and 2019 on CPUE standardisation and a capacity building workshop on data poor methods was held in 2019.	Completed and ongoing	Medium

APPENDIX 34
PROGRESS MADE ON THE RECOMMENDATIONS OF SC21

SC21 Report	SC recommendations	Update/Progress
SC21.08 Para. 22	***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 2018, 26 reports were provided by CPCs (23 in 2017, 23 in 2016, 26 in 2015) (Table 2).	**Update:** Ongoing. CPCs are encouraged to provide national reports whether or not they are attending the SC meeting
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	**Update:** Commission report Para 28. The Commission **NOTED** that 7 Contracting Parties and 1 Cooperating Non-Contracting Party did not submit a National Report to the Scientific Committee in 2018, and issues with lack of data and poor-quality data persist. The Commission **REITERATED** its concerns about the lack and poor quality of data, and again, strongly **ENCOURAGED** CPCs to 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
SC21.10 Para. 39	***Assessment and status of neritic tunas*** 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.	**Update:** The WPNT further noted that, in response to a recommendation from the SC that that the Commission allocates funds to support CPCs to develop CPUE standardisation for priority species, a Data Support mission was conducted by the IOTC Secretariat in June 2019. The aim of this mission was to collaborate with the Iranian Fisheries Organisation (SHILAT) in order to assess the suitability of their datasets for use in developing a standardised CPUE series for gillnet fisheries. The mission was funded by the EU-DG Mare Science Grant.
SC21.11 Para. 42	***Working party attendance and the MPF*** 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.	**Update:** In 2019 the WPNT was held back to back with a workshop on data poor assessment methods.
SC21.12 Para. 44	***Report of the 16th Session of the Working Party on Billfish (WPB16)*** 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:** No progress
SC21.13 Para. 66	***Swordfish MSE*** 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	**Update:** The requested funding was provided to the analyst. In addition, the Commission approved funds for MSE (including Swordfish) under its regular budget for 2020.

	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.	
SC21.14 Para. 69	***Revision of catch levels of Marlins under Resolution 18/05*** 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.	**Update:** Ongoing Commission report Para 46. The Commission **EXPRESSED** concern that catches for all billfish species (except striped marlin in 2017) in both 2016 and 2017 were higher than the limits outlined in Resolution 18/05.
SC21.15 Para. 71 SC21.16 Para. 72	***Report of the 14th session of the working party on ecosystems and bycatch (WPEB14)*** 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. 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	Update: In 2019 the Commission adopted Resolution 19/03 *On the conservation of mobulid species caught in association with fisheries in the IOTC Area of Competence*. this Resolution aims to mitigate the interactions between mobulid rays and all fishing vessels flying the flag of a Contracting Party or Cooperating Non-Contracting Party. The Resolution prohibits the targeting of these rays and prohibits all vessels retaining onboard, transhipping, landing, storing, any part or whole carcass of mobulid rays caught in the IOTC Area of Competence apart from subsistence vessels. CPCs shall report the information and data collected on interactions (i.e. number of discards and releases) with mobulid rays by vessels through logbooks and/or through observer programs.
SC21.17 Para. 76	***Bycatch species identification and data issues*** 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.	**Update:** No progress. The WPEB noted that this issue was not addressed by the Commission in 2019 and could be reiterated to the SC
SC21.18 Para. 85	***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 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	**Update:** Ongoing.

SC21.19 Para. 101	***Progress towards Ecosystem Based Fisheries Management (EBFM) in IOTC – Preliminary Ecosystem Report Cards*** 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.	**Update:** Ongoing. **NOTING** the request from the SC that the Secretariat dedicates a section of the IOTC website to the dissemination of oceanographic data (provided by third parties) the WPEB **AGREED** that the exact content of the section as well as its updating and maintenance would need to be further discussed and planned.
SC21.20 Para. 103	***Yellowfin tuna stock assessment and development of management advice*** 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.	**Update:** Completed The yellowfin tuna workplan was funded by the EU and significant progress was made in 2019.
SC21.21 Para. 123	***Future yellowfin tuna assessments: issues for consideration*** 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.	**Update:** Ongoing The WPTT noted the substantial work conducted to address the yellowfin tuna workplan, but that there was still work to be completed. As such the WPTT requested that the authors fully document the work conducted prior to, during as well as the work still to be addressed after the meeting, in an information document to be provided to the SC in 2019. This work will be coordinated by the chair of the WPTT.
SC21.22 Para. 127	***Review of the statistical data available for skipjack tuna*** 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.	**Update:** Ongoing The Commission noted the advice from the SC regarding skipjack tuna but no actions were taken. In 2019 the WPTT noted that total catches in 2018 (607,701 t) were about 30% higher than the catch limit generated by the Harvest Control Rule2 (470,029 t, which applies to the years 2018–2020), and that there has been an increasing trend in catches over the past 4 years, including a sudden increase in catches in 2018 (compared to 2017, by over 20% or around 100,000 t).
SC21.23 Para. 148	***Skipjack tuna MSE*** 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.	**Update:** Presented to and Noted at the S23 Commission meeting. The Secretariat is in the advanced stages of contracting an expert to develop the skipjack tuna MP using funds from an EU Grant.

SC21.24 Para. 156	***Stock Status Guidance*** 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).	**Update:** Commission report Para 66. The Commission **NOTED** that further work is required on understanding the determination of stock status relative to Reference Points, and endorsed the TCMP request to form an ad-hoc working group to continue to work on this matter intersessionally in preparation for the TCMP in 2020.
SC21.25 Para. 166	***Report of the 14th session of the working party on data collection and statistics (WPDCS14)*** 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.	**Update**: Completed. The Commission approved request from the SC and in 2019, the WPDCS meeting was four days in duration.
SC21.26 Para. 168	***Electronic monitoring systems*** 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.	**Update:** No Progress
SC21.27 Para. 169	***Regional Observer Scheme Minimum Standard Data Fields*** The SC **RECOMMENDED** that the ROS Minimum Standard Data Fields in Appendix 6a are adopted by the Commission.	**Update:** Ongoing. The Commission **ENDORSED** the IOTC Regional Observer Scheme (ROS) standards in principle in order for the Secretariat to implement the ROS (Para 120). Minimum data collection fields were not discussed.

SC21.28 Para. 174	***ROS draft programme standards*** 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.	**Update:** Commission report Paras 118 – 120. The Commission **NOTED** that several CPCs had provided the Secretariat with comments which were used to develop a revised document, although some CPCs expressed their concern that not all their comments had been taken into consideration. The Commission **RECOGNISED** the need to have standards for the IOTC observer scheme, but that the standards for similar schemes being implemented by other tuna RFMOs should also be acceptable to IOTC. The Commission **AGREED** that the standards required for vessels operating under the Western Central Pacific Fisheries Commission (WCPFC) Regional Observer Programme meet IOTC standards, and therefore those CPCs whose observer programs have been already accredited by WCPFC are exempted from the application of the IOTC standards. The Commission **ENDORSED** the IOTC Regional Observer Scheme (ROS) standards in principle in order for the Secretariat to implement the ROS, on the understanding that further comments can be made, and that the standards will be reviewed based on these comments and other feedback made during the implementation phase.
SC21.29 Para. 177	***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**: Ongoing. The Commission has provided budget for invited experts for 2019 and 2020.
SC21.30 Para. 178	***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
SC21.31 Para. 179	***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. Budget has been made available through the IOTC main budget and an EU grant to continue the printing of ID cards,

SC21.32 Para. 180	***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. 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:** Ongoing. A P1 position was added to the secretariat staff in 2019, but subsequently two P3 fishery officers have left the secretariat. These positions are in the process of being recruited and this process should be completed in early 2020.
SC21.33 Para. 181	***General - Chairpersons and Vice-Chairpersons of the SC and its subsidiary bodies*** 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.	**Update:** Completed
SC21.34 Para. 214	***General - Progress on the implementation of the recommendations of the performance review panel*** The SC **RECOMMENDED** that the Commission note the updates on progress regarding Resolution 16/03, as provided at Appendix 33.	**Update:** Completed.
SC21.35 Para. 234	***General - Consultants*** 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.	**Update:** Ongoing. Several consultants were contracted in 2019.
SC21.36 Para. 247	***General - IOTC scientific strategic plan*** 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.	**Update:**. Commission report Paras 34 and 35. The Commission **ADOPTED** the IOTC Strategic Science Plan 2020-2024, but **NOTED** that it was extremely ambitious and that its implementation should be reviewed by the Scientific Committee in 2022 and if necessary, modified. The Commission **NOTED** that the adoption of the plan did not include a budget for each component of the plan. Budget allocations for the components of this plan would continue to be made on an annual basis, based on the requests and priorities identified by the Scientific Committee.

APPENDIX 35A
WORKING PARTY ON NERITIC TUNAS PROGRAM OF WORK (2020 – 2024)

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				
				2020	2021	2022	2023	2024
1. Data mining and collation	Collate and characterize 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)). (Data support missions to priority countries: India, Oman, Pakistan)	High (3)	Commission					
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 (1)						
	➢ Sri Lanka (priority species: Frigate tuna, Kawakawa, bullet tuna)		Consultant with CPCs					
	Indonesia (priority species: Kawakawa, Bullet 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 (2)	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	CPCs directly					
5. Stock structure (connectivity)	Genetic research to determine the connectivity of neritic tunas throughout their distributions (LOT, KAW, COM)	High (4)	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.		TBD					
	➢ Genetic research to determine the connectivity of neritic tunas throughout their distributions							
5. Social economic study	➢ Undertake quantitative studies on socio-economic aspects of all neritic tunas throughout their range, to determine and explore other sources of data, such as but not limited to trade data from individual countries, nominal catch or other catch data on neritic tuna, information on important and significance of neritic for food security (animal protein), nutrition, contribution to national GDP. (priority countries, Indonesia, Iran, India, Malaysia, Thailand, Pakistan)	High (5)						
	➢ Identify and utilise other sources of information, by engaging with other bodies such as SEAFDEC, SEAFO, RECOFI, BOBLME, SWIOFC, IOC, among others.							

➢ Integrate or evaluate market support and recognition for neritic tuna (sub-regional markets) with a focus on data acquisition ➢ Explore alternate sources of data collection, including the rapid use of citizen science based approaches which are reliable and verified by the SC. ➢ Assess/scope/explore the significance and importance of neritic species for food security, nutrition and contribution to national GDP. ➢ Strengthen the data collection of catches and species complexes and develop socio-economic indicators of neritic species, related to the national and regional livelihoods and economics of coastal CPCs. ➢ Collate information and address data gaps and challenges by taking advantage of regional programmes or joint collaboration with NGOs/CPCs in order to support and facilitate data collection for neritic species.					

APPENDIX 35B
WORKING PARTY ON TEMPERATE PROGRAM OF WORK (2020 – 2024)

Table 1. Priority topics for obtaining the information necessary to develop stock status indicators for albacore in the Indian Ocean (2020-2024).

Topic	Sub-topic and project	Priority	Est. budget and/or potential source	Timing				
				2020	2021	2022	2023	2024
1. Stock structure (connectivity and diversity)	1.1 Genetic research to determine the connectivity of albacore throughout its distribution and the effective population size.	Low (5)	1.3 m Euro: European Union					
2. Biological information (parameters for stock assessment)	2.1 Biological research (collaborative research to improve understanding of spatio-temporal patterns in age and growth and reproductive parameters)	High (1)	TBD					
	2.1.1 Age and growth studies: Uncertainty about the growth curve is a primary source of uncertainty in the stock assessment. A preliminary growth curve was developed in 2019, but there is substantial work to be done to ensure that growth curves include data from smaller size classes, and that spatio-temporal patterns in growth are quantified for use in the stock assessment. Collaborative sampling programs, involving a combination of observer- and port-based sampling, are required to ensure that adequate samples are collected.		TBD					
	2..1.2 Quantitative biological studies are necessary for albacore throughout its range to determine spatio-temporal patterns in key reproductive parameters including sex ratio; female length- and age-at-maturity; spawning location, periodicity and frequency; batch fecundity at length and age; spawning fraction		TBD					

		and overall reproductive potential, to inform future stock assessments.								
2	CPUE standardisation	3.1 Continue the development of standardized CPUE series for each albacore fishery for the Indian Ocean, with the aim of developing appropriate CPUE series for stock assessment purposes.	High (2)	CPUE Workshop (TBD)						
		3.1.1 Spatio-temporal structure and target changes need to be considered carefully, as fish density and targeting practices can vary in ways that affect CPUE indices. Developments may include changes to fishery spatial structure, new approaches for area weighting, time-area interactions in the model, and/or indices using VAST.		CPCs directly						
3	Size frequency data	5.1 Further investigate the size information provided by CPCs in order to better understand the stock dynamics and inputs into the assessment models. This is particularly necessary for the purse seine data.	High (3)	TBD						
5	Management strategy evaluation	6.1 Continue to collaborate with the WPM on input to the Management Strategy Evaluation (MSE) process.	High (4)	TBD						

APPENDIX 35C
WORKING PARTY ON BILLFISH PROGRAM OF WORK (2020 – 2024)

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				
				2020	2021	2022	2023	2024
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). Similar projects have been partially funded by EU, with a focus on epipelagic species. More tags are needed for swordfish.	High (1)	US$400,000					
2. Biological and ecological information (incl. parameters for stock assessment and	2.1 Age and growth research	High (3)						
	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)					

provide answers to the Commission)	2.2 Reproductive biology study CPCs to conduct reproductive biology studies, which are necessary for billfish throughout its range to determine key 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). Propose to have a two-day workshop to discuss the standard of billfish maturity staging intersessionally prior to the next WPB. Funding are needed to support the workshop participation of CPCs and expert(s) on billfish reproduction (expecting to have confirmation from the host organization).	High (2)	(CPCs: Maturity study = 30,000)					
	2.3 Spawning time and locations 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). Partially supported by EU, on-going support and collaboration from CPCs are required.	High (4)	(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). The possibility of producing alternative catch histories should also be explored. 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. Consider the application of DNA-Barcoding technology for billfish species identification.	High	(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, South African	High	(CPCs directly)					
		4.1.2 Striped marlin: Priority fleets: Japan, Taiwan,China	High	(CPCs directly)					
		4.1.3 Black marlin: Priority fleets: Longline: Taiwan,China; Gillnet: I.R. Iran, Sri Lanka, Indonesia	High	(CPCs directly)					
		4.1.4 Blue marlin: Priority fleets: Japan, Taiwan,China, Indonesia	High	(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	(CPCs directly)					
		4.1.6 Joint analysis of operational catch and effort data from Indian Ocean longline fleets as recommended by WPM	High	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	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						
		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						

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 (2020 – 2024)

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				
						2020	2021	2022	2023	2024
	Connectivity, movements, habitat use, and post-release (tagging activities)									
1. Connectivity, movements, and habitat use, including identification of hotspots and investigate associated environmental conditions	For rays and sharks (including whale shark) distribution (conventional and electronic tagging (PSAT))	High	2	AZTI, IRD, Others	Partially funded (for PTH, SMA) (153,000€ IOTC + 100.000€ EU/DCF) Funded for RHN (50,000€ EU/DCF) Further funding needed for other shark species and rays					
2. Post-release mortalities of by-catch species	Post-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, and for marine turtles and rays	High	1	IRD/ NRIFSF / AZTI / IPMA/ CITEB	Partially funded for BTH and OCS (IOTC + EU/DCF) TBD for SMA and PTH					

	(especially for gillnet and PS fisheries)		Funded for OCS and RHN (EU/DCF) TBD for marine turtles and rays					
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.	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.							

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 (Workshops – leader?):	High	4							
	2.1.1 Capacity building of fisheries observers (including the provision of ID guides, training, etc. Fishing gear guides from SPC)			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									
	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. ID guides to be updated with help of CPC scientists (Daniel/manta trust)	High	5	Manta Trust MSc student with support required for attending WP	US$?? (TBD)					
3. Biological and ecological information (incl. parameters for stock assessment)	3.1 Age and growth research (Priority species: blue shark (BSH), shortfin mako shark (SMA) and oceanic whitetip shark (OCS); Silky shark (FAL))				US$?? (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. Research started in Sri Lanka. Could look at IOTC priority species			CPCs directly (led by Sri Lanka?)	US$?? (TBD)	OCS				
	3.3 Reproduction research Priority species: blue shark (BSH), shortfin mako shark (SMA) and oceanic whitetip shark (OCS), and silky shark (FAL))			CPCs directly	US$??(TBF)					
	3.4 Ecological Risk Assessment (sharks & rays)			AZTI	Funded (EU/DCF)					
	3.5 Close kin feasibility study for sharks			AZTI/CSIRO	TBD					
4. Shark bycatch mitigation measures	4.1 Develop studies on shark mitigation measures (operational, technological aspects and best practices)									
	4.1.1 Longline selectivity, to assess the effects of hooks styles, bait types and trace materials on				US$?? (TBD)					

	shark catch rates, hooking-mortality, bite-offs and fishing yield (socio-economics)							
	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$?? (ABNJ funding to WWF)					
	4.1.3 Develop guidelines and protocols for safe handling and release of sharks and rays caught on longlines and gillnets fisheries							
	4.1.4 Biodegradable FADs testing and implementing biodegradable FADs in the IO Purse Seine fleet to reduce environmental footprint of the gear	EU Consortium + ISSF	Funded					
5. CPUE standardisation / Stock Assessment / Other indicators	5.1 Develop standardised CPUE series for each key shark species and fishery in the Indian Ocean	CPCs directly	US$?? (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	Consult.	30,000 €					
	5.3 Stock assessment and other indicators							
	MARINE TURTLES							
6. Marine turtle bycatch mitigation measures	6.1 Review of bycatch mitigation measures							
	6.1.1 Res. 12/04 (para. 11) Part I. The IOTC Scientific Committee shall request the IOTC Working Party on Ecosystems and Bycatch to:	CPCs directly	US$??					
	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	CPCs directly						
	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					
	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		TBD				

	mitigation measures (Recommendation SC20.23)							
	SEABIRDS							
7. Seabird bycatch mitigation measures	7.1 Review of bycatch mitigation measures							
	7.1.1 Res. 12/06 (para. 8) The IOTC Scientific Committee, based notably on the work of the WPEB and information from CPCs, will analyse the impact of this Resolution on seabird bycatch no later than for the 2016 meeting of the Commission. It shall advise the Commission on any modifications that are required, based on experience to date of the operation of the Resolution and/or further international studies, research or advice on best practice on the issue, in order to make the Resolution more effective.	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.	CPCs/ACAP						
	CETACEANS							
8.Bycatch assessment and mitigation	8.1 Review and development of cetacean bycatch mitigation measures	Liaise with IWC						

	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/CPCs/Other organisations	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							
	9.1.1 The Commission requested that the Scientific Committee review proposal IOTC–2014– S18–PropL Rev_1, and to make recommendations on the benefits of retaining non-targeted species catches, other than those prohibited via IOTC Resolutions, for consideration at the 19th Session of the Commission. (S18 Report, para. 143). Noting the lack of expertise and resources at the WPEB and the short timeframe to fulfil this task, the SC RECOMMENDED that a consultant be hired to conduct this work and present the results at the next							

	WPEB meeting. The following tasks, necessary to address this issue, should be considered for the terms of reference, taking into account all species that are usually discarded on all major gears (i.e., purse-seines, longlines and gillnets), and fisheries that take place on the 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 Approach to Fisheries (EAF) approaches in the IOTC, in conjunction with the Common Oceans Tuna Project.			WPEB	US$?? (TBD)					
		10.1.2 Workshop for CPCs on continuing efforts to the development of an EAF including delineation of candidate eco regions within IOTC.	High	3	Workshop (2020)	TBD					
		10.1.3 Practical Implementation of EBFM with the development and testing of ecosystem report cards.									
		10.1.4 Evaluation of EBFM plan in IOTC area of competence by the WPEB to review its elements components and make any corrective measures.									

10.2 Assessing the impacts of climate change and socio-economic factors on IOTC fisheries	CPCs (possible end to end models)	TBD					
10.3 Evaluate alternative approaches to ERAs to assess ecological risk	Australia (contact to be made)	TBD					

APPENDIX 35E
WORKING PARTY ON TROPICAL TUNAS PROGRAM OF WORK (2020 – 2024)

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	TIMING				
				2020	2021	2022	2023	2024
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.	(Low) to be finished in 2020	CSIRO/AZTI/IRD/RITF					
	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						
	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						
2. Biological and ecological information	2.1 Biological sampling							
	2.1.1 Design and develop a plan for a biological sampling program to support research on tropical tuna biology.	Funding secured	CPCs directly with secretariat					

Topic	Sub-topic and project	Priority ranking	Lead	TIMING				
				2020	2021	2022	2023	2024
(incl. parameters for stock assessment)	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.							
	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						
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					
4 CPUE standardisation	4.1 Develop standardised CPUE series for each tropical tuna fleet/fishery for the Indian Ocean							
	4.1.1 Further development and validation of the collaborative longline CPUE indices using the data from	2	SC and consultants					

Topic	Sub-topic and project	Priority ranking	Lead	TIMING				
				2020	2021	2022	2023	2024
	multiple fleets and to provide joint CPUE series for longline fleets where possible							
	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					
	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					
	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					
	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					
	4.2 That methods be developed for standardising purse seine catch species composition using operational data, so as to provide alternative indices of relative abundance (see Terms of Reference, Appendix IXb IOTC-2017-WPTT19-R).	High	Consultant and CPCs directly					

Topic	Sub-topic and project	Priority ranking	Lead	TIMING				
				2020	2021	2022	2023	2024
	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					
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 Consultant and secretariat					
	5.4 Stock assessment priorities – 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), 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. *Identify approaches for defining appropriate levels of M for inclusion in stock assessments.*	1						
6 Fishery independent monitoring	6.1 Develop fishery independent estimates of stock abundance to validate the abundance estimates of CPUE series. 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. spatio-temporal variability in operations, improved efficiency from new technology,		Consultant and CPCs directly					

Topic	Sub-topic and project	Priority ranking	Lead	TIMING				
				2020	2021	2022	2023	2024
	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						
	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 (3 for point v.)						
	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							

Topic	Sub-topic and project	Priority ranking	Lead	TIMING				
				2020	2021	2022	2023	2024
	cost-effective in a successful application to southern bluefin tuna, but it remains unknown how the cost scales 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 Under Technical WG					

APPENDIX 35F
WORKING PARTY ON DATA COLLECTION AND STATISTICS PROGRAM OF WORK (2020 – 2024)

Table 1. Priority topics for obtaining the information necessary to deliver the necessary advice to the Commission.

Topic	Sub-topic and project	Priority ranking	Timing				
			2020	2021	2022	2023	2024
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:	2					
	• Coastal fisheries of Indonesia						
	• Coastal fisheries of I.R. Iran[26]						
	• Coastal fisheries of Pakistan						
	• Coastal fisheries of Sri Lanka						
	• Coastal fisheries of Kenya						
3. Compliance with IOTC Data Requirements	3.1 Data support missions						
	3.1.1 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:						
	• Pakistan						

[26] See document IOTC-2019-WPDCS15-INF07

	• Indonesia						
	• Sri Lanka						
	• India						
	• Yemen						
4. IOTC Data access	4.1 Improving discoverability of IOTC scientific assets through standard metadata and DOIs						
5. Improvement of scientific data for stock assessment purposes	5.1 Revision of PS size frequency and species composition data	4					
	5.2 Review of the extent of discarding practices in deep-freezing longline fleets	3					
6. ROS – Support for the implementation of the IOTC Regional Observer Scheme	6.1 ROS tools						
	5.1.1 Support the adoption of the ROS e-Reporting and ROS national database tools by countries not having any existing observer data collection and management system in place						
	5.2 ROS Regional Database						
	5.2.1 Incorporate all historical observer data currently available in other proprietary data formats (e.g. ObServe database dumps, ICCAT ST09 and other custom observer forms)						
	5.2.2 Implement dissemination best-practices for all data collected by the ROS Regional Database						
	5.3 ROS Electronic Monitoring Systems						
	1.1.1 Implement pilot EMS system on gillnet / coastal longline vessels for fleets insufficiently covered by on-board observers						

1.2	Evaluate the combination of alternative data collection systems and protocols for the collection of scientific observer data	1				

APPENDIX 35G
WORKING PARTY ON METHODS PROGRAM OF WORK (2020 – 2024)

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	Timing				
					2020	2021	2022	2023	2024
1. Management Strategy Evaluation	1.1 Albacore	High	2	Consultant					
	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 (2022 or date TBD)								
	1.1.5 Evaluation of new set of Management Procedures (if required)								
	1.2 Skipjack tuna	High	3	Consultant					
	1.2.1 Review of model implementation and participation in MSE process								
	1.3 Bigeye tuna	High	5						
	1.3.1 Update OM & present preliminary MP results to TCMP, WPTT/WPM review of new OM			Australia (CSIRO)					

	1.3.2 External peer review (2021 or date TBC)				
	1.3.3 Present revised MP results to TCMP with target adoption date of 2022				
	1.3.4 Additional iterations if required				
	1.4 Yellowfin tuna	High	4		
	1.4.1 Update OM & present preliminary MP results to TCMP, WPTT/WPM review of new OM			Australia (CSIRO)	
	1.4.2 External peer review (2020 or date TBD)				
	1.4.3 Present revised MP results to TCMP with target adoption date of 2021; iteratively update development if required)				
	1.4.4 additional iterations if required				
	1.5 Swordfish	High	1	EU/IPMA	
	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				
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	Medium	7	Consultant	

	stock status (e.g. CPUE series, stock assessment model)							
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	Consultant				

APPENDIX 36

SCHEDULE OF STOCK ASSESSMENTS FOR IOTC SPECIES AND SPECIES OF INTEREST FROM 2020–2024, AND FOR OTHER WORKING PARTY PRIORITIES

Working Party on Neritic Tunas					
Species	**2020***	**2021****	**2022*****	**2023***	**2024**
Bullet tuna	**Assessment**	Data preparation	Data preparation	**Assessment**	Data preparation
Frigate tuna	**Assessment**	Data preparation	Data preparation	**Assessment**	Data preparation
Indo-Pacific king mackerel	**Assessment**	Data preparation	Data preparation	**Assessment**	Data preparation
Kawakawa	**Assessment**	Data preparation	Data preparation	**Assessment**	Data preparation
Longtail tuna	**Assessment**	Data preparation	Data preparation	**Assessment**	Data preparation
Narrow-barred Spanish mackerel	**Assessment**	Data preparation	Data preparation	**Assessment**	Data preparation

* 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 Commission requests

Working Party on Billfish					
Species	**2020**	**2021**	**2022**	**2023**	**2024**
Black marlin		**Full assessment**			**Full assessment**
Blue marlin			**Full assessment**		
Striped marlin		**Full assessment**			**Full assessment**
Swordfish	**Full assessment**		**Indicators****	**Full assessment**	
Indo-Pacific sailfish			**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.
** Including biological parameters, standardized CPUE, and other fishery trends

Working Party on Tropical Tunas					
Species	**2020**	**2021**	**2022**	**2023**	**2024**
Bigeye tuna	Indicators	Indicators	**Full assessment**	Indicators	Indicators
Skipjack tuna	**Full assessment**	Indicators	Indicators	**Full assessment**	Indicators
Yellowfin tuna	Indicators	**Full assessment**	Indicators	Indicators	**Full Assessment**

Working Party on Ecosystems and Bycatch					
Species	**2020**	**2021**	**2022**	**2023**	**2024**
Blue shark	Data preparation	Full assessment	-	–	–
Oceanic whitetip shark	Indicator analysis	–	-	–	Data preparation
Scalloped hammerhead shark	–	–	Assessment*	–	–
Shortfin mako shark	Full assessment	–	–	Data preparation	Full assessment
Silky shark	-	Assessment*;	-	–	Assessment*;
Bigeye thresher shark	–	–	–	Assessment*	–
Pelagic thresher shark	–	–	–	Assessment*	–
Porbeagle shark	–	–	–	Assessment*	–
Mobulid Rays	Interactions/Indicators				Interactions/Indicators
Marine turtles	Review of mitigation measures in Res. 12/04	–	–	Indicators	–
Seabirds	–	–	Review of mitigation measures in Res. 12/06	–	–
Marine Mammals	–	ERA	–	–	–
Ecosystem Based Fisheries Management (EBFM) approaches	ongoing	ongoing	ongoing	ongoing	ongoing

*Method to be determined; Note: the assessment schedule may be changed dependent on the annual review of fishery indicators, or SC and Commission requests.

NOTE: (i) the "indicator analysis" is a simple analysis to provide guidance on the stock status based on fishery data such as CPUE, catch, and size frequency data ;(ii) the "full stock assessment" is an assessment to provide the stock status and fishing pressure based on a stock assessment model such as stock synthesis or production model; (iii) the "data preparatory" is a the submission and review by the WP of the fishery data as well as biological parameters for the upcoming stock assessment.

Working Party on Temperate Tunas					
Species	**2020**	**2021**	**2022**	**2023**	**2024**
Albacore	Meeting		Data preparatory Meeting (4 days) (April/May/June) Stock assessment meeting (5 days) (August/September)	–	–

APPENDIX 37
SCHEDULE OF IOTC WORKING PARTY AND SCIENTIFIC COMMITTEE MEETINGS
(2020 and 2021)

	2020			2021		
Meeting	**No.**	**Date**	**Location**	**No.**	**Date**	**Location**
Working Party on Neritic Tunas (WPNT)	10th	6 – 10 July	Kenya (TBC)	11th	TBC	Sri Lanka/Malaysia (TBC)
Working Party on Temperate Tunas (WPTmT)	8th	Requested for 2020	NA	NA	No meeting scheduled	NA
Working Party on Billfish (WPB)	18th	2-5 September (4d)	China (TBC)	19th	TBC	TBC
Working Party on Ecosystems and Bycatch (WPEB)	16th	7-11 September (5d)	China (TBC)	17th	TBC	TBC
Working Party on Methods (WPM)	11th	17 – 19 October (3d) (with WPTT)	Maldives (TBC)	12th	Third week in October (3d) (with WPTT)	TBC
Working Party on Tropical Tunas (WPTT)	22nd (DP)	17 – 21 February (TBC)	Seychelles	TBC	TBC	TBC
	22nd (AS)	21 – 26 October (6d) (with WPM)	Maldives (TBC)	23rd	Third week in October (6d) (with WPM)	TBC
Working Party on Data Collection and Statistics (WPDCS)	16th	30 November – 3 December (4d)	Seychelles	17th	November (3d)	Seychelles
Scientific Committee (SC)	23rd	5 - 9 December (5d)	Seychelles	24th	December (5d)	Seychelles

APPENDIX 38
CONSOLIDATED SET OF RECOMMENDATIONS OF THE 22ND SESSION OF THE SCIENTIFIC COMMITTEE (2 – 6 DECEMBER 2019) TO THE COMMISSION

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

Tuna – Highly migratory species

SC22.01 (para. 117) 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 2019 (Fig. 1):

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

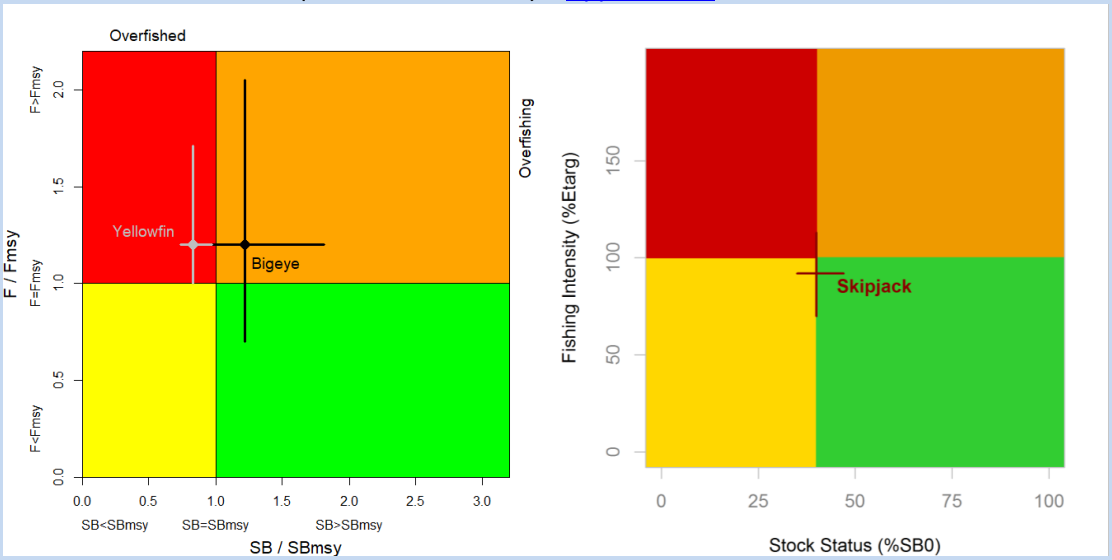


Fig. 1. (Left) Combined Kobe plot for bigeye tuna (black: 2019), and yellowfin tuna (grey: 2018) showing the estimates of current stock size (as SB) and current fishing mortality (F) in relation to optimal spawning stock size and optimal fishing mortality. (Right) Kobe plot for skipjack tuna showing the estimates of the current (2017) stock status. Cross bars illustrate the range of uncertainty from the model runs with a 80% CI.

Billfish

SC22.02 (para. 120) 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 2019 (Fig. 3):

- 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

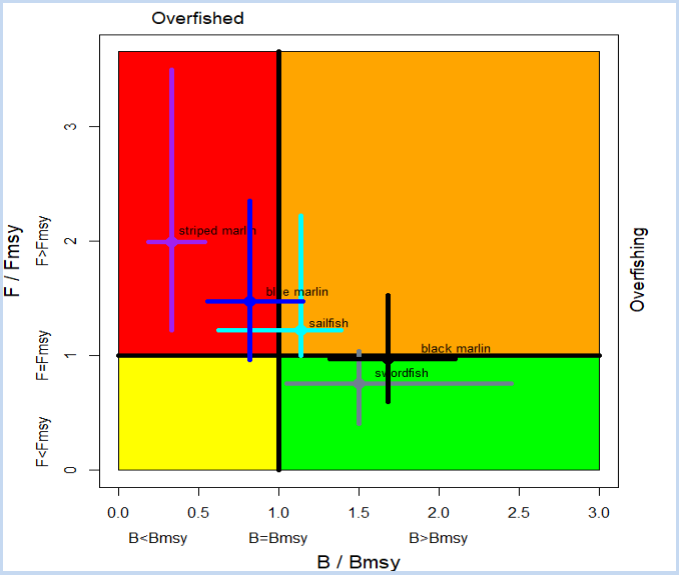


Fig. 3. Combined Kobe plot for swordfish (grey), indo-pacific sailfish (cyan), black marlin (black), blue marlin (blue) and striped marlin (purple) showing the 2017, 2018, and 2019 estimates of current stock size (SB or B, species assessment dependent) and current fishing mortality (F) in relation to optimal spawning stock size and optimal fishing mortality. Cross bars illustrate the range of uncertainty from the model runs.

Tuna and seerfish – Neritic species

SC22.03 (para. 119) 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 2019 (Fig. 2):

- 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

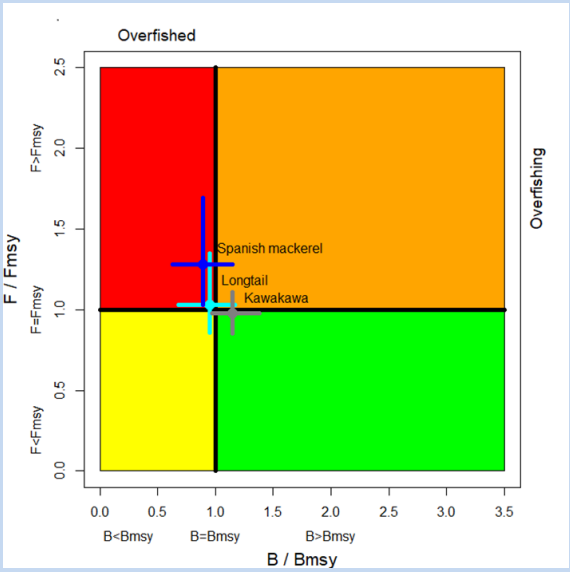


Fig. 2. Combined Kobe plot for longtail tuna, narrow-barred Spanish mackerel and kawakawa, showing the estimates of stock size (B) and current fishing mortality (F) in 2015 in relation to optimal spawning stock size and optimal fishing mortality. Cross bars illustrate the range of uncertainty from the model runs.

Sharks

SC22.04 (para. 121) 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

SC22.05 (para. 122) 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

SC22.06 (para. 123) 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

Marine Mammals

SC22.07 (para. 124) 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

SCIENCE RELATED ACTIVITIES OF THE IOTC SECRETARIAT IN 2019

SC22.08 (para. 17) The SC **NOTED** the recent departure of two scientific staff at the Secretariat and **ACKNOWLEDGED** that the Secretariat is in the process of recruiting two replacement staff members. Notwithstanding this replacement of staff, the SC **RECALLED** that in 2018 the Commission deferred the recruitment of a P4 officer for the IOTC Data and Science Section until 2020. Given the increased workload of the Secretariat, the SC **RECOMMENDED** that the Commission confirm the reinstatement of this position at its next meeting, so it can be advertised and filled as soon as possible.

NATIONAL REPORTS FROM CPCS

SC22.09 (para. 23) Noting that the Commission, at its 15th Session (in 2011), 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 2019, 23 reports were provided by CPCs (26 in 2018, 23 in 2017, 23 in 2016, 26 in 2015) (Table 2).

SC22.10 (para. 24) The SC **RECOMMENDED** that the Compliance Committee and Commission note the lack of compliance by 9 Contracting Parties (Members) and 2 Cooperating Non-Contracting Party (CNCPs) that did not submit a National Report to the Scientific Committee in 2019, noting that the Commission agreed that the submission of the annual reports to the Scientific Committee is mandatory

REPORT OF THE 17TH SESSION OF THE WORKING PARTY ON BILLFISH (WPB17)

SC22.11 (para. 42) The SC reiterated its previous **RECOMMENDATION** that on the next revision of the IOTC Agreement, that short bill spearfish (*Tetrapturus angustirostris*) be included as an IOTC species

Revision of catch levels of Marlins under Resolution 18/05

SC22.12 (para. 47) 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 reiterates its **RECOMMENDATION** 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 15TH SESSION OF THE WORKING PARTY ON ECOSYSTEMS AND BYCATCH (WPEB15)

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

SC22.13 (para. 54) 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.

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

SC22.14 (para. 55) The SC **ENDORSED** the advice of the WPEB regarding the need to improve data collection and reporting for shark species. To this end, the SC **RECOMMENDED** that several initiatives be implemented, including: (i) holding regional workshops to improve shark species identification, shark data sampling and collection (fisheries and biological) and IOTC data reporting requirements; (ii) data mining to fill historical data gaps; (iii) developing alternative tools to improve species identification (e.g. genetic analyses, machine learning, and artificial intelligence).

REPORT OF THE 21ST SESSION OF THE WORKING PARTY ON TROPICAL TUNAS (WPTT21)

Review of the statistical data available for skipjack tuna

SC22.15 (para. 76) The SC **NOTED** that total catches in 2018 (607,701 t) were 30% higher than the catch limit generated by the Harvest Control Rule (470,029 t) which applies to the years 2018–2020, and that catches have increased over the past 3 years. The SC reiterated its **RECOMMENDATION** that the Commission urgently consider the need to monitor catches of skipjack in the 2019–2020 period to ensure catches do not exceed the limit.

REPORT OF THE 7TH SESSION OF THE WORKING PARTY ON TEMPERATE TUNAS (WPTMT07)

Albacore Tuna stock assessment

SC22.16 (para. 80) The SC **NOTED** that the 2020 and draft 2021 calendars of working party meetings were approved by the Commission in June 2019, and the WPTmT is not scheduled to meet in either of these years. The SC **NOTED** the request by the chairs of the WPTmTs to hold an assessment meeting in April 2020 but **AGREED** that this would not be appropriate as the SC would not have an opportunity to review the WPTmT outputs prior to the Commission meeting in June 2020. The SC **AGREED** that it would be beneficial to hold an assessment preparatory meeting in 2020 or 2021; and to this end, the SC **RECOMMENDED** that the Commission consider approving an assessment preparatory meeting for the WPTmT in either of these years.

REPORT OF THE 15TH SESSION OF THE WORKING PARTY ON DATA COLLECTION AND STATISTICS (WPDCS15)

SC22.17 (para. 97) **NOTING** that the WPDCS highlighted several issues still affecting the quality of the information available for stock assessment purposes of tropical tunas, the SC **RECOMMENDED** that a data preparatory meeting be held prior to the Working Party on Tropical Tunas.

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

SC22.18 (para. 104) Given the importance of external independent review for working party meetings, the SC **RECOMMENDED** the Commission continues to allocate sufficient budget for invited scientific experts to be regularly invited to scientific working party meetings.

Meeting participation fund

SC22.19 (para. 105) 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

SC22.20 (para. 106) 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.

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

SC22.21 (para. 107) 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.

IMPLEMENTATION OF THE REGIONAL OBSERVER SCHEME

SC22.22 (para. 127) The SC **ACKNOWLEDGED** that estimation of ROS coverage for the purse seine fleets is adversely impacted by the lack of uniformity in reporting effort data to the IOTC Secretariat, and AGREED that this information, which is particularly useful to assess the performance of Resolution 11/04, should be further standardized. As such, the SC **RECOMMENDED** that all purse seine fleets reporting effort as fishing hours or fishing days begin to submit this information as 'number of sets' instead, in particular when fulfilling the reporting requirements of Resolution 15/02.

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

SC22.23 (para. 133) 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

SC22.24 (para. 150) 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.

REVIEW OF THE DRAFT, AND ADOPTION OF THE REPORT OF THE 22ND SESSION OF THE SCIENTIFIC COMMITTEE

SC22.25 (para. 160) The SC **RECOMMENDED** that the Commission consider the consolidated set of recommendations arising from SC22, provided at Appendix 38.