Report of the 24th Session of the IOTC Scientific Committee

Held by video-conference, 6 – 10 December 2021

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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
SB	Spawning Biomass
SSB	Spawning stock biomass
TAC	Total allowable catch
TAE	Total allowable effort
Taiwan,China	Taiwan, Province of China
TCAC	Technical Committee on Allocation Criteria
TCMP	Technical Committee on Management Procedures
tRFMO	tuna Regional Fishery Management Organization
TRP	Target reference point
TrRP	Trigger reference point
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
UNGA	United Nations General Assembly
VMS	Vessel Monitoring System
WP	Working Party of the IOTC
WPB	Working Party on Billfish
WPEB	Working Party on Ecosystems and Bycatch
WPDCS	Working Party on Data Collection and Statistics
WPFC	Working Party on Fishing Capacity
WPM	Working Party on Methods
WPNT	Working Party on Neritic Tunas
WPTmT	Working Party on Temperate Tunas
WPTT	Working Party on Tropical Tunas

STANDARDISATION OF IOTC WORKING PARTY AND SCIENTIFIC COMMITTEE REPORT TERMINOLOGY

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

HOW TO INTERPRET TERMINOLOGY CONTAINED IN THIS REPORT

Level 1: From a subsidiary body of the Commission to the next level in the structure of the Commission:

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

Level 2: From a subsidiary body of the Commission to a CPC, the IOTC Secretariat, or other body (not the Commission) to carry out a specified task:

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

Level 3: General terms to be used for consistency:

AGREED: Any point of discussion from a meeting which the IOTC body considers to be an agreed course of action covered by its mandate, which has not already been dealt with under Level 1 or level 2 above; a general point of agreement among delegations/participants of a meeting which does not need to be considered/adopted by the next level in the Commission's structure.

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EXECUTIVE SUMMARY

The 24th Session of the Indian Ocean Tuna Commission (IOTC) Scientific Committee (SC) was held Online, from 6 – 10 December 2021. A total of 130 delegates and other participants attended the Session (141 in 2020), comprised of 107 delegates (112 in 2020) from 21 Contracting Parties, and no delegates from Cooperating Non-Contracting Parties (0 in 2020), and 23 participants from 15 observer organisations (including the invited experts). The meeting was chaired by the Chairperson, Dr Toshihide Kitakado (Japan). The list of participants is provided at Appendix 1.

The following are the recommendations from the 24th Session of the Scientific Committee, which are provided in Appendix 38.

Tuna – Highly migratory species

SC24.01 (para. 154) 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 2021 (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

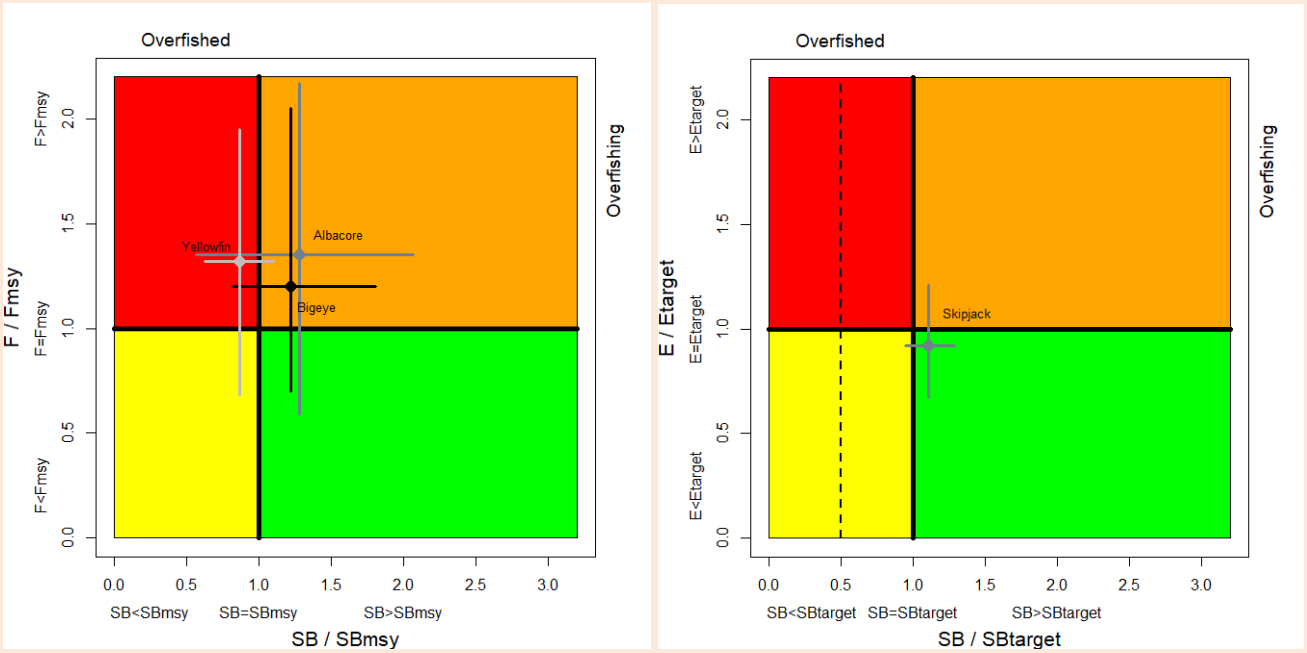

Fig. 1. (Left) Combined Kobe plot for bigeye tuna (black: status in 2018, based on the assessment conducted in 2019), and yellowfin tuna (light grey: 2020, with assessment conducted in 2021) and albacore (dark grey: 2017 with assessment conducted in 2019) showing the estimates of current spawning biomass (SB) and current fishing mortality (F) in relation to optimal spawning stock size and optimal fishing mortality. (Right) Kobe plot for skipjack tuna (status in 2019, based on the assessment conducted in 2020) showing the estimates of the current stock status (The dashed line indicates the limit reference point at 20%SB0 while SBtarget=0.4 SB0). Cross bars illustrate the range of uncertainty from the model runs with an 80% CI (95% CI for albacore).

Billfish

SC24.02 (para. 157) 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 2021 (Fig. 3):

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

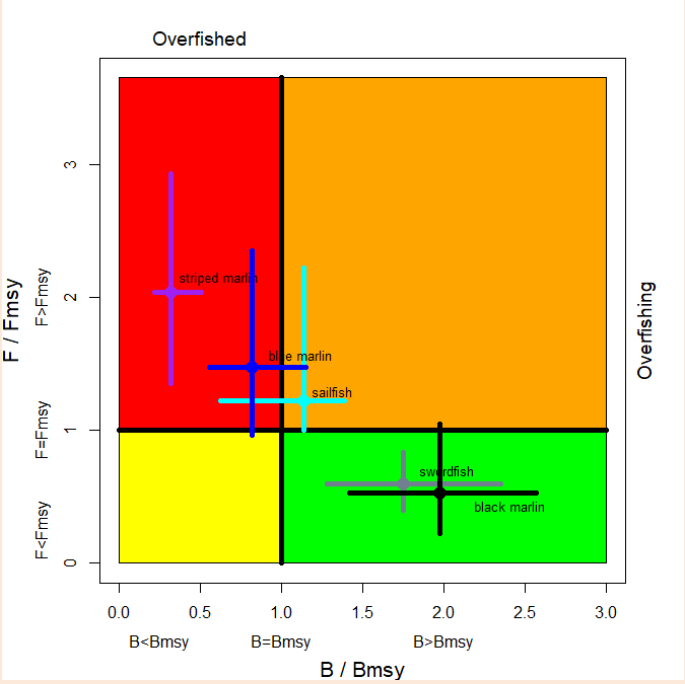

Fig. 3. Combined Kobe plot for swordfish (2018 with assessment conducted in 2020, grey), Indo-Pacific sailfish (2017 with assessment conducted in 2019, cyan), black marlin (2019 with assessment conducted in 2021, black), blue marlin (2017 with assessment conducted in 2019, blue) and striped marlin (2019 with assessment conducted in 2021, purple) showing the estimates of current stock size (SB or B, species assessment dependent) and current fishing mortality (F) in relation to optimal stock size and optimal fishing mortality. Cross bars illustrate the range of uncertainty from the model runs. Given unresolved uncertainty in the assessment, status for black marlin and sailfish should be interpreted with caution.

Tuna and seerfish – Neritic species

SC24.03 (para. 156) 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 2021 (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

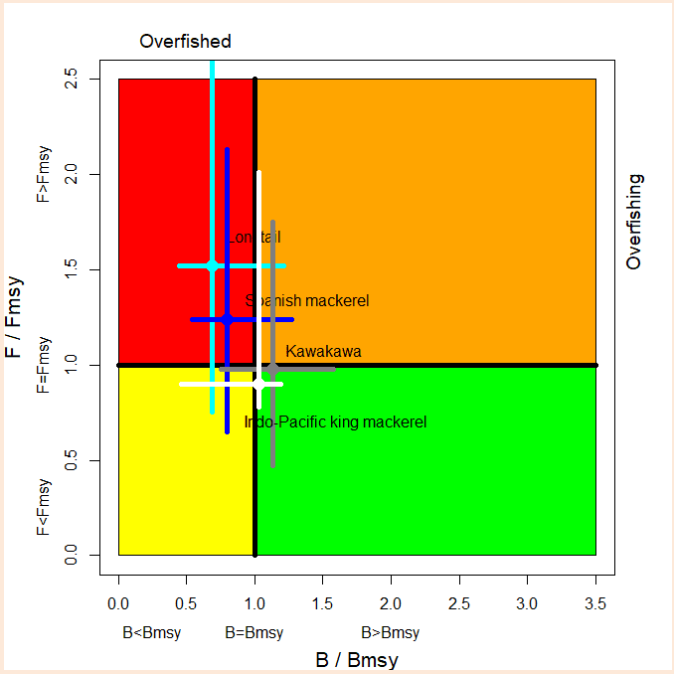

Fig. 2. Combined Kobe plot for longtail tuna (cyan), narrow-barred Spanish mackerel (blue), kawakawa (grey) (all for 2018 with assessment carried out in 2020) and Indo-Pacific king mackerel (2019 with assessment carried out in 2021, white), showing the

estimates of stock size (B) and current fishing mortality (F) in relation to optimal biomass and optimal fishing mortality. Cross bars illustrate the range of uncertainty from the model runs. Given unresolved uncertainty in the assessment, status for bullet tuna, frigate tuna and Narrow-barred Spanish mackerel should be interpreted with caution.

Sharks

SC24.04 (para. 158) 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

SC24.05 (para. 159) 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

SC24.06 (para. 160) 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

SC24.07 (para. 161) The SC **RECOMMENDED** that the Commission note the management advice developed for cetaceans, as provided in the newly developed Executive Summary encompassing all species commonly interacting with IOTC fisheries for tuna and tuna-like species:

Cetaceans – Appendix 32

GENERAL RECOMMENDATIONS TO THE COMMISSION

National Reports from CPCs

SC24.08 (para. 26) **NOTING** that the Commission, at its 25th Session (in 2021), noted that there was an improvement in submission of National reports in 2020 over the previous year, it also 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 and 15/02. The SC **RECOMMENDED** that the Commission note that there was a decrease in the Submission of National reports in 2021, as only 21 reports were provided by CPCs (25 in 2020, 23 in 2019, 26 in 2018, 23 in 2017 and 23 in 2016 (Table 2).

SC24.09 (para. 27) The SC **RECOMMENDED** that the Compliance Committee and Commission note the lack of compliance by 9 Contracting Parties (Members) and 1 Cooperating Non-Contracting Party (CNCPs) that did not submit a National Report to the Scientific Committee in 2021, noting that the Commission agreed that the submission of the annual reports to the Scientific Committee is mandatory.

Report of the 19TH Session of the Working Party on Billfish (WPB19)

SC24.10 (para. 42) **RECALLING** that one of the Indian Ocean billfish species (shortbill spearfish, *Tetrapturus angustirostris*) is currently not listed among the species managed by IOTC, and considering the ocean-wide distribution of this species, its highly-migratory nature, and that it is a common bycatch in IOTC managed

fisheries, the SC reiterated its previous **RECOMMENDATION** that shortbill spearfish be included as an IOTC species.

Revision of catch levels of Marlins under Resolution 18/05

SC24.11 (para. 56) The SC **NOTED** that catches in recent years for black marlin and Indo-Pacific sailfish have exceeded all recent MSY estimates and catch limits set by Resolution 18/05 (para 3), and that the current catch trends for the two species show no signs of decline - these catch limits will likely be exceeded again in 2021. Furthermore, results from the 2021 assessment of striped marlin provided certainty that the stock is overfished and subject to overfishing (100% probability) and that biomass has been below that which would produce MSY for over a decade. The biomass of striped marlin is considered severely depleted. As such, the SC **NOTED** the inadequacy of Resolution 18/05 in limiting the catches of billfishes and **RECOMMENDED** the Commission to review the Resolution to update catch limits and provide mechanisms to ensure these limits are adhered to.

REPORT OF THE 17TH SESSION OF THE WORKING PARTY ON ECOSYSTEMS AND BYCATCH (WPEB17)

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

SC24.12 (para. 60) 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.

Other matters

SC24.13 (para. 74) The SC **ACKNOWLEDGED** the proposed Letter of Intent between the IWC and IOTC and **NOTED** that this letter is based on the language used in the Letter of Intent between IOTC and ACAP which has been accepted by the Commission. The SC **RECOMMENDED** that the letter is presented at the Commission for further consideration.

SC24.14 (para. 77) The SC **NOTED** the use of subsurface gillnetting in the Indian Ocean may be an effective mitigation measure to reduce bycatch of cetaceans, sharks and sea turtles and that Resolution 19/01 already requests the utilization of subsurface gillnets by 2023 to mitigate ecological impacts of this gear. The SC **RECOMMENDED** that it be kept informed by the Commission on the current status of implementation of the relevant clause of Resolution 19/01.

REPORT OF THE 23RD SESSION OF THE WORKING PARTY ON TROPICAL TUNAS (WPTT23)

Yellowfin tuna Stock Assessment

SC24.15 (para. 103) The SC **NOTED** the importance of the peer review process and its role in providing improved scientific advice for management. The SC therefore **RECOMMENDED** that the Commission endorse the process for a YFT stock assessment review as well as the BET MSE review and provide the financial resources to conduct the work planned.

Update on the WGFAD02

SC24.16 (para. 107) The SC **RECOMMENDED** the Committee endorse the process to improve current definitions of FAD and FAD activities used by the IOTC, to be conducted by the WPTT and WGFAD.

REPORT OF THE 12TH SESSION OF THE WORKING PARTY ON METHODS (WPM12)

Management Strategy Evaluation Progress

SC24.17 (para. 114) The SC **NOTED** the guidelines included as Appendix 6a to this report to deal with exceptional circumstances in the MSE process. The SC further **NOTED** that these guidelines are a living document and revisions may still be required in the future. The SC **RECOMMENDED** that the Commission consider and endorse the guidelines.

SC24.18 (para. 115) The SC **NOTED** the revised schedule of MSE work included as Appendix 6b to this report to provide the timeframe for the development of management procedures for key IOTC species. The SC **NOTED** that

the revised MSE schedule is still ambitious but that the technical work could, in principle, be completed within the proposed timeframes with minor adjustments. The SC **RECOMMENDED** that the Commission consider and endorse the revised timetable.

REPORT OF THE 17TH SESSION OF THE WORKING PARTY ON DATA COLLECTION AND STATISTICS (WPDCS17)

SC24.19 (para. 136) **NOTING** that the WPDCS identified aspects of several data-related resolutions that are either unclear or inconsistent (15/01, 15/02 and 19/02) the SC **RECOMMENDED** that the Commission consider how to best address these issues at the next revision of each resolution.

SC24.20 (para. 139) **ACKNOWLEDGING** that the workload of the Secretariat data team has increased markedly in recent years to manage an increasing number of datasets, provide more data outputs, and improve data access. The SC **RECOMMENDED** that the Commission consider strengthening the capacity of the Secretariat's Data Group with the addition of an extra staff member**.**

SC24.21 (para. 140) The SC **ACKNOWLEDGED** the long-term relationship between the OFCF and the IOTC to improve the collection, management and reporting of fisheries statistics and **RECOMMENDED** the Commission consider the continuation of this collaboration through an appropriate arrangement.

Update on WGEMS01

SC24.22 (para. 143) The SC **NOTED** the outcomes of the 1st ad-hoc IOTC WGEMS and **RECOMMENDED** the Commission endorse its continuation in the future and for the Commission to discuss if the WGEMS should remain under the WPDCS or report directly to the SC or CoC. The SC **ENDORSED** the Terms of Reference and Plan of Work for the WGEMS.

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

SC24.23 (para. 145) Given the importance of external independent review for working party meetings, the SC **RECOMMENDED** the Commission continue to allocate sufficient budget for invited scientific experts to be regularly invited to scientific working party meetings.

Meeting participation fund

SC24.24 (para. 147) 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

SC24.25 (para. 148) 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 CPCscientific observers, both on board and at port, need to have hard copies.

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

SC24.26 (para. 150) 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.

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

Consultants

SC24.27 (para. 181) 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 24TH SESSION OF THE SCIENTIFIC COMMITTEE

SC24.28 (para. 190) The SC **RECOMMENDED** that the Commission consider the consolidated set of recommendations arising from SC24, 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. (NOTE: the year column indicates the year the stock status was determined, not the terminal year of the assessment model)

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		2017	2018	2019	2020	2021	Advice to the Commission
Albacore *Thunnus alalunga*	Catch 2020 Average catch 2016–2020 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)	38,082 t 38,781 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 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 B_{MSY} and F_{MSY} 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 2020 Average catch 2016–2020 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)	83,498 t 86,880 t 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)			**38%**			In 2019 a 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 2018 levels there is a risk of breaching MSY reference points with 58.9% and 60.8% probability in 2021 and 2028. Maintaining catches of at least 10% below 2018 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 2020 Average catch 2016-2020 $C_{40\%SB0}$ (t) (80% CI) C_{2019} / $C_{40\%SB0}$ (80% CI) $E_{40\%SB0}$ (80% CI) E_{2019} / $E_{40\%SB0}$ (80% CI) SB_0 (t) (80% CI)	555,211 t 546,095 t 535,964 (461,995–674,536) 1.02 (0.81–1.18) 0.59 (0.53–0.66) 0.92 (0.67-1.21) 1,992,089 (1,691,710–2,547,087)				**60%**		A stock assessment was carried out for skipjack tuna in 2020 using Stock Synthesis with data up to 2019. On the weight-of-evidence available in 2020, the skipjack tuna stock is determined to be: (i) above the adopted biomass target reference point; (ii) **not overfished** ($SB_{2019}>SB_{40\%SB0}$); (iii) with fishing mortality below the adopted target fishing mortality, and; (iv) **not subject to overfishing** ($E_{2019}<E_{40\%SB0}$). The catch limit calculated applying the HCR specified in Resolution 16/02 is 513,572 t for the period 2021 -2023. The SC noted that this catch limit is higher than for the

	SB_{2019} (t) (80% CI) $SB_{40\%SB0}$ (t) (80% CI) $SB_{20\%SB0}$ (t) (80% CI) SB_{2019} / SB0 (80% CI) SB_{2019} / $SB_{40\%SB0}$ (80% CI) SB_{2019} / SB_{MSY} (80% CI) MSY (t) (80% CI) E_{2019} / E_{MSY} (80% CI)	870,461 (660,411–1,253,181) 794,310 (672,825–1,019,056) 397,155 (336,412–509,528) 0.45 (0.38-0.5) 1.11 (0.95-1.29) 1.99 (1.47-2.63) 601,088 (500,131–767,012) 0.48 (0.35-0.81)						previous period notwithstanding regular overshooting of the previous established catch limit. This is attributed to the new stock assessment which estimates a higher productivity of the stock and a higher stock level relative to the target reference point, possibly due to skipjack life history characteristics and favourable environmental conditions. Thus, it is likely that the recent catches that have exceeded the limits established for the period 2018-2020 have been sustained by favourable environmental conditions. Therefore, the Commission needs to ensure that catches of skipjack tuna during this period (2021 – 2023) do not exceed the agreed limit. Click here for full stock status summary: Appendix 10
Yellowfin tuna *Thunnus albacares*	Catch 2020 Average catch 2016–2020 MSY (1000 t) (80% CI) F_{MSY} (80% CI) SB_{MSY} (1,000 t) (80% CI) F_{2020}/F_{MSY} (80% CI) SB_{2020}/SB_{MSY} (80% CI) SB_{2020}/SB_0 (80% CI)	432,624 t 434,569 t 349 (286–412) 0.18 (0.15–0.21) 1,333 (1,018–1,648) 1.32 (0.68–1.95) 0.87 (0.63–1.10) 0.31 (0.24 – 0.38)		**94%**			**68%**	A new stock assessment was carried out for yellowfin tuna in 2021. On the weight-of-evidence available since 2018, the yellowfin tuna stock is determined to remain **overfished** and **subject to overfishing** It is noted that the estimated productivity of the stock (MSY) was very low for some of the scenarios of the reference grid. Their plausibility and reasons for this low productivity are yet to be fully investigated. It is noted that there is also considerable uncertainty in the reported catches by some fisheries. In particular, several artisanal fisheries have increased their catches substantially in recent years, the implication of which should be further investigated. There was a lack of information to explain this sharp increase in catch. A number of additional uncertainties were identified that require further exploration, including those related to growth, natural mortality and longline catchability. Inconsistencies in the biomass trend by region also remain unresolved and this deserves further investigation. According to the K2SM, • if catches are reduced to 60% of 2020 levels[1] there is >50% probability of being above Bmsy levels by 2023. • if catches are reduced to < 80% of 2020 levels there is a >50% probability of being above BMSY in 2030. • if catches are reduced to less than 80% of 2020 levels there would be a >50% probability of ending overfishing (F<Fmsy) by 2023 and also by 2030. • The probability of breaching the biological limit reference point (0.4Bmsy) with 2020 catches is 7% by 2023 and 64% by 2030. The probability of breaching the F limit reference point (1.4 Fmsy) with 2020 catch is 52% by 2023 and 78% by 2030.

[1] 2020 catch levels indicate the nominal catch available to the WPTT at its session in October 2021 (WPTT23).

								The Commission has an interim plan for the rebuilding the yellowfin stock, with catch limitations based on 2014/2015 levels (Resolution 21/01which superseded 19/01, 18/01 and 17/01). Some of the fisheries subject to catch reductions have achieved a decrease in catches in 2020 in accordance with the levels of reductions specified in the Resolution; however, these reductions were offset by increases in the catches from CPCs exempt from and some CPCs subject to limitations on their catches of yellowfin tuna. 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 bycatch 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		2017	2018	2019	2020	2021	Advice to the Commission
Swordfish *Xiphias gladius*	Catch 2020 Average catch 2016-2020 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_{1950} (80% CI)	26,005 t 30,858 t 33 (27–40) 0.23 (0.15–0.31) 59 (41–77) 0.60 (0.40–0.83) 1.75 (1.28–2.35) 0.42 (0.36–0.47)				**98%**		An assessment was undertaken in 2020 using stock synthesis with fisheries data up to 2018. On the weight-of-evidence available in 2020, the stock is determined to be **not overfished** and **not subject to overfishing**. The most recent catches (32,671 t in 2019) are at approximately the MSY level (33,000 t). Under the current levels of catches, the spawning biomass is projected to remain relatively stable, with a high probability of maintaining at or above the SBMSY for the longer term. Nevertheless, the Commission should consider limiting the catches so as not to exceed the 2018 catch level (30,847 t) to ensure that the probability of exceeding the SBMSY target reference points in the long term remains minimal (2%). Projections indicate that an increase of 40% or more from 2018 catch levels will likely result in the biomass dropping below the SBMSY level for the longer term (>75% probability). Taking into account the updated information regarding swordfish stock structure (IOTC-2020-WPB18-09), as well as the differential CPUE and biomass trends between regions, the WPB should continue to discuss the swordfish stock assessment model specifications and consider the feasibility of including a multi-stock assessment in 2023. Recognising that there is recurring evidence for localised depletion in the southern regions (particularly the South West) the WPB expresses concern and suggests this should continue to be monitored. Click here for full stock status summary: Appendix 12

Black marlin *Istiompax indica*	Catch 2020 Average catch 2016–2020 MSY (1,000 t) (95% CI) F_{MSY} (95% CI) B_{MSY} (1,000 t) (95% CI) $F_{current}/F_{MSY}$ (95% CI) $B_{current}/B_{MSY}$ (95% CI) $B_{current}/B_0$ (95% CI)	16,977 t 18,289 t 17.30 (11.00-35.02) 0.20 (0.12-0.34) 87.39 (53.82-167.70) 0.53 (0.22 – 1.05) 1.98 (1.42 – 2.57) 0.73 (0.53 – 0.95)						A stock assessment based on JABBA, a Bayesian state-space production model (age-aggregated), was conducted in 2021 for black marlin. **Since 2018, there has been no discernable improvement in the data available for black marlin and the subsequent assessment outputs remain uncertain and should be interpreted with caution. As such, there is no reasonable justification to change the stock status from "Not assessed/Uncertain"**. The 2020 catches (16,977 t) (Fig. 1) were substantially higher than the MSY limits stipulated in Res (18/05) which is 9,932 t. 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 2020 Average catch 2016-2020 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)	6,958 t 8,701 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%**			No new stock assessment for blue marlin was carried out in 2021 so the stock status is based on the 2019 assessment conducted using the Bayesian State-Space Surplus Production model JABBA, which 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 8,701 t in the last 5 years, 2016-2020) are lower than MSY (9,984 t). The assessment conducted in 2017 indicated that the stock was 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 *Kajikia audax*	Catch 2020 Average catch 2016-2020 MSY (1,000 t) (JABBA) MSY (1,000 t) (SS3) F_{MSY} (JABBA) F_{MSY} (SS3) B_{MSY} (JABBA) SB_{MSY} (SS3) $F_{current}/F_{MSY}$ (JABBA) $F_{current}/F_{MSY}$ (SS3) $B_{current}/B_{MSY}$ (JABBA) $SB_{current}/SB_{MSY}$ (SS3)4 $B_{current}/B_0$(JABBA)	2,587 t 3,292 t 4.60 (4.12 - 5.08)3 4.82 (4.48 - 5.16) 0.26 (0.20–0.33) 0.23 (0.23 - 0.23) 17.89 (14.34 - 23.11) 6.162 (6.343, 5.837) 2.04 (1.35 - 2.93) 3.93 (2.30 - 5.31) 0.32 (0.22 - 0.51) 0.47 (0.35 - 0.63) 0.12 (0.10 – 0.19)		**99%**			100%	In 2021 a stock assessment was conducted based on two different models: JABBA, a Bayesian state-space production model (age-aggregated); and SS3, an integrated model (age-structured). Both models were generally consistent with regards to stock status and confirmed the results from 2012, 2013, 2015, 2017 and 2018 assessments. On the weight-of-evidence available in 2021, 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. The current 2020 catches (2,587 t) are lower than MSY (4,601 t) but the stock has been overfished for more than a decade 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

	$SB_{current}/SB_0$ (SS3)	0.06 (0.05 - 0.08)						ranging from 60% to 90% by 2026 as per Resolution 18/05, it needs to provide mechanisms to ensure the maximum annual catches remain between 900 t – 1,500 t. Click here for full stock status summary: Appendix 15
Indo-Pacific Sailfish *Istiophorus platypterus*	Catch 2020 Average catch 2016-2020 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)	26,890 t 29,897 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)						No new stock assessment for Indo-Pacific sailfish was carried out in 2021, thus, the stock status is determined on the basis of the 2019 assessment using the C-MSY model. The data poor stock assessment techniques indicated that F was above FMSY (F/FMSY=1.22) and B is above BMSY (B/BMSY=1.14). However, both assessment models rely on catch data only, and 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**. The catch limits as stipulated in Resolution 18/05 (25,000 t) 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		2017	2018	2019	2020	2021	Advice to the Commission
Bullet tuna *Auxis rochei*	Catch 2020 Average catch 2016–2020	32,251 t 22,690 t						A new assessment was carried out in 2021 using the data-limited techniques (CMSY and LB-SPR), however the catch data for bullet

	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						tuna are very uncertain given the high percentage of the catches that had to be estimated due to a range of reporting issues. 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 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 2020 Average catch 2016–2020 MSY (1,000 t) F_{MSY} B_{MSY} (1,000 t) $F_{current}/F_{MSY}$ $B_{current}/B_{MSY}$ $B_{current}/B_0$	98,875 t 98,017 t unknown unknown unknown unknown unknown unknown						A new assessment was carried out in 2021 using the data-limited techniques (CMSY and LB-SPR), however the catch data for frigate tuna are very uncertain given the high percentage of the catches that had to be estimated due to a range of reporting issues. 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 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 2020 Average catch 2016-2020 MSY (80% CI) F_{MSY} (80% CI) B_{MSY} (80% CI) $F_{current}/F_{MSY}$ (80% CI) $B_{current}/B_{MSY}$ (80% CI)	143,211 t 151,150 t 148,825 (124,114 – 222,505) t 0.44 (0.21–0.82) 355,670 (192,080 – 764,530) t 0.98 (0.85–1.11) 1.13 (0.75–1.58)				**50%**		No new stock assessment was conducted for kawakawa in 2021 and so the results are based on the assessment carried out in 2020 using data-limited assessment techniques. Based on the weight-of-evidence available, the kawakawa stock for the Indian Ocean is classified as **not overfished** and **not subject to overfishing.** However, the assessment models rely on catch data, which is considered to be highly uncertain. The catch in 2018 (173,367 t) was above the then estimated MSY (152,000 t). The available gillnet CPUE of kawakawa showed a somewhat increasing trend although the reliability of the index as abundance indices remains unknown. Despite the substantial uncertainties, the stock is probably very close to being fished at MSY levels and that higher catches may not be sustained in the longer term. A precautionary approach to management is recommended. Click here for a full stock status summary: Appendix 19
Longtail tuna *Thunnus tonggol*	Catch 2020 Average catch 2016–2020 MSY (80% CI) F_{MSY} (80% CI) B_{MSY} (80% CI) $F_{current}/F_{MSY}$ (80% CI) $B_{current}/B_{MSY}$ (80% CI)	132,529 t 133,584 t 128,750 (99,902 – 151,357) 0.32 (0.15 – 0.66) 395,460 (129,240 – 751,316) 1.52 (0.751 – 2.87) 0.69 (0.45 – 1.21)	**67%**			**76%**		No new assessment was conducted for longtail tuna in 2021 and so the results are based on the assessment carried out in 2020 using the Optimised Catch-Only Method (OCOM). Based on the weight-of-evidence currently available, the stock is considered to be both **overfished** and **subject to overfishing**. The catch in 2018 (136,906 t) was just below the estimated MSY (140,000 t) but the exploitation rate has been increasing over the last few years, as a result of the declining abundance. Despite the substantial uncertainties, this suggests that the stock is very close to being fished at MSY levels and that higher catches may not be sustained. A precautionary approach to management is recommended. Click here for a full stock status summary: Appendix 20
	Catch 2020	42,471 t						

Indo-Pacific king mackerel *Scomberomorus guttatus*	Average catch 2016-2020 MSY (1,000 t) F_{MSY} B_{MSY} (1,000 t) $F_{current}/F_{MSY}$ $B_{current}/B_{MSY}$ $B_{current}/B_0$	44,870 t 46.9 (37.7–58.4) 0.74 (0.56–0.99) 63.2 (42–94) 0.90 (0.78–2.01) 1.03 (0.46–1.19) 0.51 (0.23–0.60)					**35%**	A new assessment was carried out in 2021 using the data-limited techniques (CMSY and LB-SPR). The catch-only model has provided a more defensible approach in addressing the uncertainty of key parameters and the currently available catch data for the Indo-Pacific king mackerel appear to be of sufficiently improved quality for conducting an assessment albeit still with some uncertainty. Based on the weight-of-evidence currently available, the stock is considered to be **not overfished** and **not subject to overfishing.** Reported catches of Indo-Pacific king mackerel in the Indian Ocean has increased considerably since the late 2000s with recent catches fluctuating around estimated MSY, although the catch in 2019 was below the estimated MSY. This suggests that the stock is very close to being fished at MSY levels and that higher catches may not be sustained despite the substantial uncertainty associated with the assessment, a precautionary approach to management is recommended. Click here for a full stock status summary: Appendix 21
Narrow-barred Spanish mackerel *Scomberomorus commerson*	Catch 2020 Average catch 2016-2020 MSY (80% CI) F_{MSY} (80% CI) B_{MSY} (80% CI) $F_{current}/F_{MSY}$ (80% CI) $B_{current}/B_{MSY}$ (80% CI)	157,687 t 167,678 t 157,760 (132,140–187,190) 0.49 (0.25–0.87) 323,500 (196,260–592,530) 1.24 (0.65–2.13) 0.80 (0.54–1.27)	**89%**			**73%**		No new assessment was conducted for narrow-barred Spanish mackerel in 2021 and so the results are based on the assessment carried out in 2020 using the Optimised Catch-Only Method (OCOM). Based on the weight-of-evidence available, the stock appears to be **overfished** and **subject to overfishing.** The catch in 2019 was just below the estimated MSY and the available Gillnet CPUE show a somewhat increasing trend in recent years although the reliability of the Index as abundance indices remains unknown. Despite the substantial uncertainties, the stock is probably very close to being fished at MSY levels and that higher catches may not be sustained. 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		2017	2018	2019	2020	2021	Advice to the Commission
Blue shark *Prionace glauca*	Reported catch 2020 Estimated catch 2019 Not elsewhere included (nei) sharks 2020 Average reported catch 2016–20 Average estimated catch 2015–19 Ave. (nei) sharks 2016–20 MSY (1,000 t) (80% CI) F_{MSY} (80% CI) SB_{MSY} (1,000 t) (80% CI) F_{2019}/F_{MSY} (80% CI) SB_{2019}/SB_{MSY} (80% CI) SB_{2019}/SB_0 (80% CI)	21,344 t 43,240 t 20,552 t 25,144 t 48,781 t 30,277 t 36.0 (33.5 - 38.6) 0.31 (0.306 - 0.31) 42.0 (38.9 - 45.1) 0.64 (0.53 - 0.75) 1.39 (1.27 - 1.49) 0.46 (0.42 - 0.49)	**72.6%**				**99.9%**	A new stock assessment for blue sharks was carried out in 2021 using an integrated age-structured model (SS3). On the weight-of-evidence available in 2021, the stock status is determined to be **not overfished** and **not subject to overfishing**. Target and limit reference points have not yet been specified for pelagic sharks in the Indian Ocean. Even though the 2021 assessment indicates that Indian Ocean blue shark are not overfished nor subject to overfishing, increasing current catches is likely to result in decreasing biomass and the stock becoming overfished and subject to overfishing in the near future. If the catches are increased by over 20%, the probability of maintaining spawning biomass above MSY reference levels (SB>SBMSY) over the next 10 years will be decreased. 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. Click below for a full stock status summary: Blue sharks – Appendix 23
Oceanic whitetip shark *Carcharhinus longimanus*	Reported catch 2020 Not elsewhere included (nei) sharks Average reported catch 2016–2020 Ave. (nei) sharks 2016–20	30 t 20,552 t 129 t 30,277 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
Scalloped hammerhead shark *Sphyrna lewini*	Reported catch 2020 Not elsewhere included (nei) sharks Average reported catch 2016–2020 Ave. (nei) sharks 2016–20	38 t 20,552 t 67 t 30,277 t						
Shortfin mako *Isurus oxyrinchus*	Reported catch 2020 Not elsewhere included (nei) sharks Average reported catch 2016–2020	854 t 20,552 t 1,613 t						

	Ave. (nei) sharks 2016–20	30,277 t						Silky sharks– Appendix 27 Bigeye thresher sharks– Appendix 28 Pelagic thresher sharks– Appendix 29
Silky shark *Carcharhinus falciformis*	Reported catch 2020 Not elsewhere included (nei) sharks Average reported catch 2016–2020 Ave. (nei) sharks 2016–20	1,314 t 20,552 t 1,833 t 30,277 t						
Bigeye thresher shark *Alopias superciliosus*	Reported catch 2020 Not elsewhere included (nei) sharks Average reported catch 2016–2020 Ave. (nei) sharks 2016–20	<1 t 20,552 t <1 t 30,277 t						
Pelagic thresher shark *Alopias pelagicus*	Reported catch 2020 Not elsewhere included (nei) sharks Average reported catch 2016–2020 Ave. (nei) sharks 2016–20	176 t 20,552 t t 310 t 30,277 t						

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

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

1. OPENING OF THE SESSION

1. The 24th Session of the Indian Ocean Tuna Commission (IOTC) Scientific Committee (SC) was held Online, from 6 – 10 December 2021. A total of 130 delegates and other participants attended the Session (141 in 2020), comprised of 107 delegates (112 in 2020) from 21 Contracting Parties, and no delegates from Cooperating Non-Contracting Parties (0 in 2020), and 23 participants from 15 observer organisations (including the invited experts). The meeting was chaired by the Chairperson, Dr Toshihide Kitakado (Japan). The list of participants is provided at Appendix 1.

2. ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION

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

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

3. ADMISSION OF OBSERVERS

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

3.1 Non-governmental and Inter-governmental Organisations (NGOs)

- Agreement on the Conservation of Albatrosses and Petrels (ACAP)
- Blue Resources Trust
- Blue Marine Foundation
- Global Tuna Alliance (GTA)
- The Indian Ocean–South-East Asian (IOSEA) Marine Turtle memorandum of understanding (MoU)
- International Pole-and-line Foundation (IPNLF)
- International Seafood Sustainability Foundation (ISSF)
- Marine Stewardship Council (MSC)
- PEW Charitable Trusts
- Shark Project
- Sustainable Fisheries and Communities Trust (SFACT)
- Sustainable Fisheries Partnership (SFP)
- Sustainable Indian Ocean Tuna Initiative (SIOTI)
- World Wide Fund for Nature (WWF)
- Invited Experts

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

4.1 Outcomes of the 25th Session of the Commission

5. The SC **NOTED** paper IOTC–2021–SC24–03 which outlined the decisions and requests made by the Commission at its 25th Session, held in June 2021, that related to the IOTC science processes. The SC **NOTED** that 3 new CMMs were adopted in 2021 by the Commission.

6. The SC **NOTED** that the current *Compendium of Active Conservation and Management Measures for the Indian Ocean Tuna Commission* may be downloaded from the IOTC website at the following link:
   English: http://iotc.org/cmms
   French: http://iotc.org/fr/mcgs

7. Noting that the 25th session of the Commission also made a number of general comments and requests on the recommendations made by the Scientific Committee in 2020, the SC **AGREED** that any advice to the Commission would be provided in the relevant sections of this report.

8. The SC **NOTED** the concern expressed by the Commission regarding the current status of yellowfin tuna. The SC further **NOTED** that the Commission agreed on the critical importance of the new YFT assessment and the updated management advice that will be provided and urged the SC to discuss and advance this task as a priority.

4.2 Previous decisions of the Commission

9. The SC **NOTED** paper IOTC–2021–SC24–04 which outlined a number of Commission decisions, in the form of previous Resolutions that require a response from the SC in 2021 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 2021

5.1 Report of the Secretariat – Activities in support of the IOTC science process in 2021

10. The SC **NOTED** paper IOTC–2021–SC24–05 which provided an overview of the work undertaken by the IOTC Secretariat in 2021 and congratulated the IOTC Secretariat for its contributions to the science processes in 2021. These contributions included support to the Working Parties and Scientific Committee meetings; in most years, the 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; oversight of scientific projects and facilitation of the attendance of the invited scientific experts that support IOTC technical meetings.

11. The SC **CONGRATULATED** the Secretariat for the successful organization and completion of the different Working Party meetings in 2021 using Online meeting tools despite the technical challenges posed (internet connection, time zones and duration).

12. The SC **NOTED** although all meetings had been successful held virtually in 2021, they were shortened to facilitate the virtual platform. The SC **AGREED** that in the future virtual meetings may still be conducted for certain meetings (such as Data preparatory meetings) in order to reduce the expenses travel imposes on CPCs as well as the IOTC MPF, but for those meetings requiring closer collaborations in person, physical meetings will be continued as required.

13. The SC further **NOTED** the significant increase in the number of meetings facilitated by the Secretariat. The increase in meetings in this as well as other tuna RFMOs has placed an increased burden on the Secretariat as well as the participating CPC scientists and observers. The SC **AGREED** that there is a need to carefully review the number of meetings and streamline them so as to reduce this burden. The SC also **NOTED** that changes to any meeting dates after their proposal by the SC will need to be approved by the Commission.

14. The SC **REQUESTED** that the Secretariat investigate the most suitable options for hosting hybrid meetings in the future that would facilitate both in-person and virtual participation. This would alleviate some of the burden inherent in the increased number of meetings as well as reduce costs for both the Secretariat as well as perspective participants.

15. The SC **NOTED** paper IOTC–2021–SC24–INF11 which provided an overview of the development of a sampling scheme to support the collection of biological samples and their analysis to provide improved estimates of age, growth and reproduction of tropical tunas, swordfish and blue sharks for the IOTC, including the summary provided by the authors;

> *"This presentation describes the activities of GERUNDIO, the project for the "Development and Implementation of a sampling scheme to support the collection of biological samples and conduct analysis on these samples to provide improved estimates of age, growth and reproduction of tropical tunas, swordfish, and blue sharks for the Indian Ocean Tuna Commission (IOTC)" developed by a consortium of research institutions and funded by the EU, IOTC and FAO. We describe the sampling collection developed in the project, including information of the sampling design, sampling locations, period, types of samples collected, number of samples per species, sample storage, sampling methodology and other relevant information related to the sampling carried out for bigeye, yellowfin, skipjack, swordfish and blue shark. We also inform on the analyses made, the results obtained and discuss the limitations of this project with suggestions for improving the available information on tropical tunas, swordfish and blue shark in the future"*

16. The SC **THANKED** the authors and their collaborators for this important work and the improvement and updating of key information for inclusion in the assessments of IOTC stocks.

17. The SC **SUPPORTED** a key recommendation from the study that proposed the development of a database and tissue bank for the biological information and samples collected during the study, to be added to and increased as additional studies are conducted in the future. The SC further **REQUESTED** that the project collaborators with assistance from the Secretariat and other interested CPC scientists and institutions provide a cost estimation for this activity so that the Commission could consider its viability.

6. NATIONAL REPORTS FROM CPCS

6.1 National Reporting to the Scientific Committee: overview

18. The SC **NOTED** that 21 National Reports were submitted to the IOTC Secretariat in 2021 by CPCs (as well as a report by the invited experts, Taiwan,China). The abstracts of CPC reports are provided in Appendix 4b.

19. The SC **RECALLED** 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 **RECALLED** 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 2021, of the 21 National Reports submitted, 2 were submitted after the deadline. The SC **NOTED** that 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. The SC **NOTED** that in 2021, no National Report was submitted using older reporting templates that do not include the latest requirements stipulated by the active CMMs. The Secretariat informed the SC that the latest template will continue to be published on the IOTC webpage (https://iotc.org/science), the SC meeting page as requested by the SC in 2020.

22. In addition, the SC **NOTED** that the availability for download of the revised National Report templates from the IOTC Website was announced through IOTC Circular 2021/41 sent on the 27th of July 2021 as well as through the IOTC Science mailing list.

23. The SC **NOTED** that current National Report templates include tables whose structure and purpose appear to overlap with similar requirements that CPCs have to fulfil to provide statistical data through official reporting channels, and **ACKNOWLEDGED** that this overlap is necessary to ensure that summary information on important aspects of the fisheries (e.g., interaction with bycatch species such as marine turtles) which is not regularly provided by CPCs, becomes available to the SC.

24. Also, the SC **RECALLED** that the National Reports contain different subsections that specifically cover all important reporting components from the various IOTC Resolutions and **CONFIRMED** that the format of National Reports is timely updated by the IOTC Secretariat to ensure full accordance with the Resolutions' requirements.

25. 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.

26. **NOTING** that the Commission, at its 25th Session (in 2021), noted that there was an improvement in submission of National reports in 2020 over the previous year, it also 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 and 15/02. The SC **RECOMMENDED** that the Commission note that there was a decrease in the Submission of National reports in 2021, as only 21 reports were provided by CPCs (25 in 2020, 23 in 2019, 26 in 2018, 23 in 2017 and 23 in 2016; see Table 2).

27. The SC **RECOMMENDED** that the Compliance Committee and Commission note the lack of compliance by 9 Contracting Parties (Members) and 1 Cooperating Non-Contracting Party (CNCPs) that did not submit a National Report to the Scientific Committee in 2021 (1 CPC provided in 2022), noting that the Commission agreed that the submission of the annual reports to the Scientific Committee is mandatory.

28. The SC **RECALLED** that an agenda item specifically dealing with discussions on the effect of piracy in the Indian Ocean has been removed from the SC agenda since 2018 in agreement with the former SC chair. This decision was made as the information was not changing from year to year as all indications lead to the conclusion that there was no real impact of piracy on IOTC fishing activities in recent years.

Table 2. CPC submission of National Reports to the SC from 2011 to 2021.

CPC	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Contracting Parties (Members)											
Australia											18 Nov
Bangladesh	n.a.	n.a.	n.a.	n.a.							18 Nov
China											21 Nov
Comoros											31 Jan 22
Eritrea											
European Union											1 Dec
France (OT)											15 Nov
India											5 Dec
Indonesia											21 Nov
Iran, Islamic Rep. of											21 Nov
Japan											19 Nov
Kenya											
Korea, Republic of											20 Nov
Madagascar											21 Nov
Malaysia											20 Nov
Maldives, Rep. of											21 Nov
Mauritius											21 Nov
Mozambique											
Oman, Sultanate of											21 Nov
Pakistan											
Philippines											21 Nov
Seychelles, Rep. of											21 Nov
Somalia	n.a.	n.a.	n.a.								
Sri Lanka											19 Nov
South Africa, Rep. of											12 Nov
Sudan											
Tanzania, United Republic of											
Thailand											21 Nov
United Kingdom ("BIOT")											20 Nov
Yemen	n.a.										
Cooperating Non-Contracting Parties											
Senegal											

Green = submitted. Red = not submitted. Orange = Submitted using an outdated template n.a. = not applicable (not a CPC in that year). For 2021, the date of submission of the report is included in the table (**Note**: the deadline for submission was the 21st of November 2021).

6.2 Contracting Parties (Members)

29. The SC **NOTED** that in 2021 the Secretariat provided translations of all the submitted National report summaries in both English and French in response to the SC request in 2018.

30. **NOTING** the 21 National Reports submitted to the IOTC Secretariat in 2021 (and 1 in 2022) by Contracting Parties (Members), the SC expressed concern about the difference between the catches submitted in some 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. An explanation of the technical differences between the IOTC nominal database and the scientific best estimates data base is provided in document IOTC-2021-WPTT23-03_Rev1.

31. 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 and the official submissions available to the IOTC are in agreement.

6.3 Cooperating Non-Contracting Parties (CNCPs)

32. The SC **NOTED** that no National Report was submitted to the IOTC Secretariat in 2021 by the Cooperating Non-Contracting Party (CNCP).

6.4 Invited Experts

33. The SC **NOTED** the report provided by the Invited Experts from Taiwan,China which outlined fishing activities in the IOTC Area of Competence. The report from the Invited Experts is document IOTC-2021-SC24-INF07 and is available upon request.

7. REPORTS OF THE 2021 IOTC WORKING PARTY MEETINGS

7.1 Report of the 11th Session of the Working Party on Neritic Tunas (WPNT11)

34. The SC **NOTED** the report of the 11th Session of the Working Party on Neritic Tunas (IOTC–2021–WPNT11–R), including the consolidated list of recommendations provided as an appendix to the report. The meeting was attended by 33 participants (cf. 43 in 2020). No MPF funding was provided as the meeting was held online.

35. The SC **NOTED** that the main outcomes from the 11th Session of the Working Party on Neritic Tunas highlight the level of non-reporting or partial reporting of Nominal catch, catch-and-effort and size data for many fisheries, and consequently the lack of reliable data to conduct the assessments of neritic species.

36. The SC **RECALLED** the need for all concerned CPCs to ensure that the catch, effort and size data for these fisheries are systematically reported to the Secretariat in accordance with Resolution 15/02.

7.1.1 Indo-Pacific King Mackerel stock assessment

37. The SC **NOTED** that a new assessment was carried on 2021 using the data limited techniques (CMSY and LB-SPR). The catch-only model (CMSY) that incorporated the uncertainty of key parameters has provided a defensible approach assessing the status of the stock and the currently available catch data for the Indo-Pacific king mackerel appear to be of sufficiently improved quality for conducting an assessment albeit still with some uncertainty. As such, the SC **NOTED** that the stock status for Indo-Pacific King Mackerel has been revised from Unknown, to not overfished and not subject to overfishing.

38. The SC **NOTED** that although the results indicate only a 35% probability of the stock being in the green, the WPNT were satisfied that this is a true reflection of the status of the stock based on the model outputs. Table 1 in the Executive summary (Appendix 21) shows the probabilities of the stock being in each of the Kobe plot quadrants, indicating that the highest probability coincides with the stock being in the green quadrant.

7.1.2 Frigate Tuna stock assessment

39. The SC **NOTED** that a new assessment was carried on 2021 using the data limited techniques (CMSY and LB-SPR). However, the catch data for frigate tuna are very uncertain given the high percentage of the catches that had to be estimated by the Secretariat. The SC **EXPRESSED** concern that the lack of data on which to base an assessment has resulted on the stock status for this species remaining unknown.

7.1.3 Bullet Tuna stock assessment

40. The SC **NOTED** that as with Frigate tuna, the stock status for Bullet tuna could not be determined due to the lack of suitable data. The SC **ENCOURAGED** CPCs to improve the data collection and submission for these important species, in order to be able to provide science-based management advice.

7.2 Report of the 19th Session of the Working Party on Billfish (WPB19)

41. The SC **NOTED** the report of the 19th Session of the Working Party on Billfish (IOTC–2021–WPB19–R), including the consolidated list of recommendations provided as an appendix to the report. The meeting was attended by 55 participants (cf. 55 in 2020). No MPF funding was provided as the meeting was held online.

42. **RECALLING** that one of the Indian Ocean billfish species (shortbill spearfish, *Tetrapturus angustirostris*) is currently not listed among the species managed by IOTC, and considering the ocean-wide distribution of this species, its highly-migratory nature, and that it is a common bycatch in IOTC managed fisheries, the SC reiterated its previous **RECOMMENDATION** that shortbill spearfish be included as an IOTC species.

43. The SC further **NOTED** that this would require the revision of the IOTC Agreement and the Commission to include some flexible mechanism to allow for changes in the list of species under the IOTC mandate in the future.

44. The SC **ACKNOWLEDGED** the potential interest of considering size limits (e.g., approximated by size at maturity) as a complementary management measure for billfish species but **NOTED** that this was not discussed at the WPB. As such, the SC **REQUESTED** the WPB to review the available information on size at its next session to be held in 2022, further **NOTING** that information on post-release mortality would be required for assessing the efficacy of such measures.

7.2.1 Black Marlin stock assessment

45. The SC **NOTED** that a single assessment model was applied to the Indian Ocean stock of black marlin (BLM) in 2021; the Bayesian State-Space Surplus Production Model (JABBA). Catch data were available up to 2019 and four time series of standardised CPUE derived from longline fisheries of Japan, Taiwan,China (NW and NE) and Indonesia ending in 2019.

46. The SC **NOTED** that the increasing trends in CPUE time series observed consistently over the four series throughout the 2000s and 2010s are inconsistent with the major increase in total catches of BLM reported during the same period, with the model showing some strong, systematic retrospective pattern, compensating for simultaneous increases in catch and relative abundance by inflating the pristine biomass estimate (parameter K of the model).

47. Consequently, the SC **ACKNOWLEDGED** the large uncertainties in the model and the little confidence in the model's predictive capabilities, **AGREEING** that the stock status should remain "Not assessed/Uncertain" and **NOTING** that CPUE indices from coastal gillnet fleets would be required to provide more accurate information on the temporal trends in BLM abundance.

48. The SC **NOTED** that the causes of conflicting information in the data could be due to (i) increased and/or improved reporting of catches by coastal CPCs over time and/or (ii) to the fact that catches mostly come from coastal gillnet fisheries while CPUE time series were derived from longline fisheries operating predominantly in the high seas.

7.2.2 Striped Marlin stock assessment

49. The SC **NOTED** that two assessment models were applied to the Indian Ocean stock of striped marlin (MLS) in 2021 using Stock Synthesis (SS3) and Bayesian State-Space Surplus Production Model (JABBA), with the catch data and the four time series of standardised CPUE derived from longline fisheries of Japan and Taiwan,China available up to 2019.

50. The SC **NOTED** that the two models (JABBA and SS3) applied to MLS both indicated that there is 100% probability that the stock was overfished and subject to overfishing in 2019 and **ENDORSED** the stock status determined by the WPB.

51. The SC **NOTED** that both surplus production models and age-structure models showed very similar results with low uncertainty, indicating that the estimate of stock status is robust.

52. The SC **NOTED** with concern the status of the stock of MLS which has been estimated to be in the red quadrant of the Kobe plot (i.e., overfished and subject to overfishing) for over 10 years, calling for management measures to be taken urgently.

53. The SC **QUERIED** whether there are any hotspots of catch that could be used to propose time-area closures and **NOTED** that most catches come from the coastal areas between Somalia and Indonesia, although a closer review of the catch data would be useful to provide more information on the matter.

54. The SC **NOTED** the mismatch in Catch and CPUE trends as well as the clarification that those trends are from different fleets (catch is mainly from gillnet) and CPUE from longline. The mismatch may result from improved catch reporting.

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

55. 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". The SC further **NOTED** that the MSY for several of these species was updated after the Resolution came into force based on the updated stock assessments for these species.

56. The SC **NOTED** that catches in recent years for black marlin and Indo-Pacific sailfish have exceeded all recent MSY estimates and catch limits set by Resolution 18/05 (para 3), and that the current catch trends for the two species show no signs of decline - these catch limits will likely be exceeded again in 2021. Furthermore, results from the 2021 assessment of striped marlin provided certainty that the stock is overfished and subject to overfishing (100% probability) and that biomass has been below that which would produce MSY for over a decade. The biomass of striped marlin is considered severely depleted. As such, the SC **NOTED** the inadequacy of Resolution 18/05 in limiting the catches of billfishes and **RECOMMENDED** the Commission to review the Resolution to update catch limits and provide mechanisms to ensure these limits are adhered to.

57. The SC further **NOTED** the major uncertainties associated with the catches of gillnet fisheries, which catch in particular black marlin, striped marlin and Indo-Pacific sailfish, and **RECALLED** the need for all concerned CPCs to ensure that the catch, effort and size data for these fisheries are systematically reported to the Secretariat in accordance with Resolution 15/02.

7.3 Report of the 17th Session of the Working Party on Ecosystems and Bycatch (WPEB17)

58. The SC **NOTED** the report of the 17th Session of the Working Party on Ecosystems and Bycatch (IOTC–2021–WPEB17(AS)–R), including the consolidated list of recommendations provided as an appendix to the report. The meeting was attended by 93 participants (cf. 108 in 2020). No MPF funding was provided as the meeting was held online.

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

59. The SC **NOTED** paper IOTC–2021–SC24–06 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.

60. 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.

61. The SC **RECALLED** the request from WPEB15 in 2019 for the Secretariat to provide links in the NPOA portal on the IOTC website (http://iotc.org/science/status-of-national-plans-of-action-and-fao-guidelines) to the actual

plan documents. The SC **NOTED** that work is being done to collect these documents from CPCs and thanked those who had already submitted them.

62. The SC **REQUESTED** that CPCs submit their NPOA to Secretariat for upload onto the NPOA portal.

63. The SC **NOTED** that there have been small revisions to the previous update on NPOAs in 2021 including the drafting of revisions of NPOAs by some CPCs and updates on the progress on the development of NPOAs by other CPCs.

7.3.2 Blue shark stock assessment

64. The SC **NOTED** that in 2021, a stock assessment was completed for blue sharks using an integrated age-structured model (SS3). The SC **NOTED** that uncertainty in data inputs and model configuration were explored through sensitivity analysis. All models produced similar results suggesting the stock is currently not overfished nor subject to overfishing (SB_{2019}/SB_{MSY} = 1.39 (1.27 - 1.49) and F_{2019}/F_{MSY} =0.64 (0.53 - 0.75)), but with the trajectories showing consistent trends towards the overfished and subject to overfishing quadrant of the Kobe plot.

65. The SC **NOTED** that the additional analysis using the JABBA model also suggested a relatively healthy population (B_{2019}/B_{MSY} estimates range 1.4–1.6 and F_{2019}/F_{MSY} estimates range 0.38–0.51 from a range of CPUE grouping scenarios).

66. The SC **NOTED** that all models (JABBA and SS3) and sensitivity runs produced similar results and that the major sources of uncertainty are the catches and CPUE series.

67. The SC **NOTED** the need for further research into the Japanese CPUE, particularly the pre-2000 period which exhibited high inter-annual variability which resulted in residual fit deviations at the beginning of the time series in both the SS3 and JABBA models.

68. The SC **NOTED** that there was a continual increase in catches derived from the miscellaneous states in coastal waters, however the majority of CPUE indices are derived from distant water fleets fishing the open ocean – the exception being South Africa and EU,France (La Réunion).

69. The SC **NOTED** that the current biological studies on blue shark are encouraging, however there are still gaps in important information sources for this species (i.e., fleet-specific size composition data).

70. The SC **NOTED** that despite recent catches remaining above MSY estimates, the decline in catches observed in 2019-2020 could potentially underestimate current fishing mortality and may have a disproportionate effect on model projections. This can be overcome by averaging catches over a longer timeframe.

71. The SC **NOTED** that target and limit reference points have not yet been specified for pelagic sharks in the Indian Ocean and **NOTED** that even though the 2021 assessment indicates that Indian Ocean blue shark are not overfished nor subject to overfishing, increasing current catches is likely to result in decreasing biomass and the stock becoming overfished and subject to overfishing in the near future.

72. The SC **NOTED** that if the catches are increased by over 20%, the probability of maintaining spawning biomass above MSY reference levels (SB>SBMSY) over the next 10 years will be decreased and so the stock should be closely monitored.

7.3.4 Other Matters

73. The SC **NOTED** the ongoing work on developing a series of eco-regions including an expert workshop to be held in January 2022 which will report to the WPEB data preparatory meeting with ideas on how various relevant parameters could contribute to IOTC stock assessments.

74. The SC **ACKNOWLEDGED** the proposed Letter of Intent between the IWC and IOTC and **NOTED** that this letter is based on the language used in the Letter of Intent between IOTC and ACAP which has been accepted by the Commission. The SC **RECOMMENDED** that the letter is presented at the Commission for further consideration.

75. The SC **NOTED** the high priority of work establishing stock structure as well as genetics research for sharks including Close Kin Mark Recapture (CKMR) techniques. The SC **AGREED** that funds in the IOTC main budget that were previously allocated to studying tropical tunas should now be allocated to funding CKMR studies in sharks. The SC **NOTED** that a feasibility study for conducting CKMR has already been carried out which provided recommendations on how best to proceed with this work for shark species including how the work

should be done and the best species to target, further **NOTING** that shortfin mako was recommended as a key species to target for research.

76. The SC **AGREED** with the recommendation from the WPEB that a multi-taxa bycatch mitigation workshop focused on drift gillnet fisheries in the Indian Ocean should be held, **NOTING** that bycatch is thought to be significant with this gear. The SC **NOTED** paper IOTC-2021-SC24-INF09 which provides a draft terms of reference for this workshop and **NOTED** that the expected results of such a workshop would be to provide a mitigation toolbox which can help to reduce bycatch in gillnet fisheries ensuring that these are replicable for gillnet fleets across all CPCs and to develop recommendations for consideration by the WPEB.

77. The SC **NOTED** the use of subsurface gillnetting in the Indian Ocean may be an effective mitigation measure to reduce bycatch of cetaceans, sharks and sea turtles and that Resolution 19/01 already requests the utilization of subsurface gillnets by 2023 to mitigate ecological impacts of this gear. The SC **RECOMMENDED** that it be kept informed by the Commission on the current status of implementation of the relevant clause of Resolution 19/01.

78. The SC **NOTED** that the WPEB discussed recent developments mitigation of seabird bycatch in relation to the development of new mitigation measures such as hook pods and underwater bait setters. The SC further **REQUESTED** that such mitigation measures be further explored and evaluated by the WPEB, along with seabird experts, as the potential inclusion of additional effective mitigation options in IOTC resolutions in future might provide greater flexibility for CPCs in how they reduce or avoid seabird interactions.

7.4 Report of the 23rd Session of the Working Party on Tropical Tunas (WPTT23)

79. The SC **NOTED** the report of the 23rd Session of the Working Party on Tropical Tunas (IOTC–2021–WPTT23–R), including the consolidated list of recommendations provided as an appendix to the report. The meeting was attended by 108 participants (cf. 111 in 2020). No MPF funding was provided as the meeting was held online.

7.4.1 Yellowfin tuna stock assessment

80. The SC **NOTED** that the 2021 yellowfin tuna assessment (using Stock Synthesis) concluded that the stock is overfished and is subject to overfishing. The SC further **NOTED** that the 2021 yellowfin tuna stock assessment captured structural uncertainty through a grid of 96 models covering alternative assumptions on spatial structure, tag data weighting, steepness, and longline catchability (single catchability vs independent catchabilities before and after the piracy period), growth, and natural mortality. Statistical uncertainty from individual models was incorporated into the estimates of stock status.

81. The SC **THANKED** the yellowfin assessment team and the WPTT participants that contributed to revising the assessment and to try and resolve the problems that have hindered this being revised for the past few years.

82. The SC **NOTED** that while the assessment captures a broad range of uncertainty across the model grid, it does not capture some additional uncertainties, some of these (e.g., those related to the newly available estimates of growth, natural mortality, longline catchability increases), which were explored by sensitivity runs indicate the potential for a more depleted stock, whilst others (eg. Using all available abundance indices, random walk estimation of deviations on selectivity) suggests a more optimistic status (IOTC-2021-WPTT23-12, Table B1). The SC **NOTED** that it is important to acknowledge the potential impact of the additional uncertainty on the management advice. The SC also **NOTED** that the sensitivity runs were carried out without the optimal recruitment bias correction used for the reference grid and projections upon which the Executive Summary and K2SM are based.

83. The SC **NOTED** the unresolved issue of the diverging recruitment trends in the east and west IO which are unlikely to be realistic. This pattern is thought to be related to the spatial distribution of the known catches being incompatible with the CPUE trend, potentially indicating possible spatial misspecification in the model.

84. The SC **NOTED** that there is also the indication that the regional biomass estimates are not entirely consistent with regional catches (e.g., that the density of YFT was much higher in the eastern equatorial region, but the biomass in this region has been showing a major decline despite relatively small catches). The SC **NOTED** that the regional biomass distribution was pre-provided to the assessment model through an external analysis that used historical longline catch rates to estimate regional density. Therefore, the model estimates of regional biomass are primarily determined by these "regional scaling factors" that are implicitly provided as model inputs. The SC further **NOTED** that there is ongoing study to further improve the regional scaling factor estimates.

85. The SC **NOTED** that some of the factors and their combinations (e.g., "Dortel" growth, "Low" natural morality, low steepness) in the uncertainty axes resulted in estimates of very low stock productivity and in those cases the model estimated low spawning biomass and highly depleted stock status. In these scenarios, a trend is detected in estimated recruitment deviations which means that they require above average recruitment in order to explain the recent catches. The SC **NOTED** that the trend in recruitment does not necessarily mean that the productivity parameters are incorrect, but only reflects signals in the data that need to be analyzed and understood. The SC **NOTED** that both the "Dortel" growth and "Low" natural mortality option are supported by the recent aging study.

86. The SC **NOTED** that stock biomass has been declining over the past decade. Total catches have increased through that time, despite decreases in the catches of some fleets, due to increasing catches of some artisanal fleets. Significant uncertainties in the fishing effort levels and trend over time from these artisanal fisheries needs to be further investigated, to better understand the reasons for reported catch increases. The relative impacts of these and other fisheries upon the stock over time also needs further investigation.

87. The SC **REQUESTED** that the Secretariat, with the assistance of the CPCs, provide a preliminary examination of the level and trend in fishing effort of the fishing fleets that captured YFT over the last 10 years. This analysis should look to utilise the best indicator of fishing effort for each fleet, including where actual fishing effort data is not available, proxy information such as the number of fishing vessels, their dimensions in length and tonnage or other information that can help estimate deployed fishing effort.

88. The Secretariat is also **REQUESTED** to identify the possible gaps in the reporting of the required information and to propose solutions to fill the most relevant gaps.

89. The SC **NOTED** that the stock reached the overfished status without going through the overfishing stage. The SC further **NOTED** this occurred around the period 2004-2006 when there were record catches of yellowfin which were thought to be potentially a result of oceanographic factors which increased productivity in the Indian Ocean. The SC **NOTED** that this period was immediately followed by a period of low productivity and deep thermoclines in the period 2007-2009 which may have led to the large decline in the CPUE series.

90. The SC **NOTED** a discrepancy between the decline in the longline CPUE index and the recent increase in average fish size for commercial longline catches. The SC further **NOTED** that the trend in fish sizes may be more linked to fleet composition changes in recent years (than changes in actual population size structure) with size data samples from non-Japanese fleets becoming dominant. Changes were taken into account in various hypothetical evaluations that explain changes in size data.

91. The SC **NOTED** the document IOTC-2021-SC24-INF08 that summarised the projection of the yellowfin model to estimate K2SM probabilities, including the following abstract provided by the authors:

> "*This document presents the projections and Kobe II Strategy Matrix (K2SM) for the 2021 Indian Ocean yellowfin Stock Synthesis assessment model. Deterministic projections for 2021-2030 were conducted for the 96 reference grid scenarios assuming a constant level of catch at 60%-120% of the 2020 catch. The projections incorporate the range of uncertainty among alternative model structures but do not describe uncertainty due to parameter estimation error or stochastic future recruitment variability.*
>
> *The present projections incorporate an explicit recruitment bias adjustment to avoid the likely overly optimistic results as identified by the Working Party on Tropical Tunas during the 23rd WPTT Stock Assessment meeting (WPTT, 2021, paragraph 125), if no explicit bias adjustment controls are used in the forecast. Also, as requested at the WPTT 23rd Stock Assessment meeting, we examine the effects of bias correction on the projection outputs*."

92. The SC **NOTED** that the projections were conducted intersessionally and the results were reviewed by a special meeting of the WPTT held on 24th November. The projection implemented the optimal bias correction on recruitment, instead of the full correction as in the assessment model reviewed by the WPTT. The optimal bias correction was applied to both model and projection period and, therefore, stock status slightly changed from the WPTT stock assessment. Thus, updated stock status estimates are provided in the Executive Summary.

93. The SC **THANKED** the assessment team for their hard work which has enabled them to provide projections for this important stock, and for refining, clarifying the report further and including the additional requested information in the revised paper.

94. The SC **NOTED** that the bias correction is to ensure that on average the recruitment did not deviate significantly from the stock-recruitment relationship and this process is important to ensure that the average recruitment estimate is unbiased, while considering recruitment variability. The SC further **NOTED** that the optimal method determines the bias correction based on the amount of variability described by the data. Optimal bias correction is considered a better practice and is currently implemented in SS3's advanced model settings.

95. The SC **NOTED** that the different bias correction methods will not have an appreciable impact on biomass estimation for the data-rich period because the bias correction is effectively a constant offset through the time series of recruitment which could be compensated by the R0 parameters. The SC further **NOTED** that the optimal bias correction made a smaller downward adjustment on the mean recruitment when compared to the full correction. This resulted in a lower estimate of R0 (or B0), and as a result lower estimates of Bmsy and MSY.

96. The SC **NOTED** as is the case for the assessment, while the projections incorporate uncertainty associated with different model structures across the 96 scenarios from the main model grid, the projections do not capture some of the uncertainties (associated with the sensitivity runs, catch uncertainty, spatial recruitment trends) and perhaps even more importantly, don't account for stochastic future recruitment variability. The SC **NOTED** that yellowfin exhibited high recruitment variability and it is quite possible that not accounting for this in the projections could bias the impact of projected catches. The SC further **NOTED** the very large confidence intervals (90%) estimated in the projections, particularly for F/Fmsy estimates.

97. The SC **NOTED** that it is important that these issues and additional uncertainties are clearly noted in the advice to the Commission. This will ensure full transparency to the Commission on the state of scientific understanding on the current status and the future potential state of the stock under the range of catch scenarios.

98. The SC **NOTED** that sensitivity runs conducted during the WPTT using a new growth curve developed in 2021 (Farley et al 2021[2]) and natural mortality estimated with an alternative method (Hoyle 2021[3]) led to a more pessimistic stock status than the average values estimated through the reference grid. The SC **NOTED** the statement by the EU that the stock status estimates from the sensitivity runs still fall within the range of uncertainty estimated by the reference model grid. The EU further stated that these sensitivity runs require further scrutiny and analyses.

99. In discussing and finalising the management advice for Yellowfin Tuna, the SC **NOTED** the statement by Australia that highlighted the set of sensitivity runs (exploring uncertainties in growth, natural mortality and longline catchability) that estimated the stock to be in a more depleted state than the average depletion estimated by the reference grid. While acknowledging that these sensitivity runs were preliminary and will receive further scientific evaluation in future, Australia stated that in its view, the Commission should be made aware of the additional uncertainty and potential risk indicated by these runs, to allow the Commission the opportunity to consider if it wished to apply, as a result, a more precautionary approach in its management response. Australia noted that the SC has provided similar advice on applying a precautionary approach when faced with significant data or model uncertainty, for other stocks including albacore tuna, longtail tuna, and KawaKawa..

100. The SC **NOTED** document IOTC-2021-SC24-INF05 that provides the terms of reference for the proposed external review of the yellowfin assessment.

101. The SC **NOTED** that the independent peer review is planned to take place in 2022-2023 and will consist of a series of activities including a review workshop led by an independent panel. The SC **AGREED** that the review panel should consist of leading stock assessment experts in the field who should have minimal or no involvement in the IOTC scientific process in order to provide a new perspective. The SC also **AGREED** that the panel will be elected via a direct selection process coordinated by the IOTC secretariat, the chairs of the SC

[2] Farley J, et al. 2021. Estimating the Age and Growth of Yellowfin Tuna (*Thunnus Albacares*) in the Indian Ocean from Counts of Daily and Annual Increments in Otoliths (IOTC-2021-WPTT23-05)

[3] Hoyle S. 2021. Approaches for Estimating Natural Mortality in Tuna Stock Assessments: Application to Indian Ocean Yellowfin Tuna (IOTC-2021-WPTT23-08)

and WPTT. The SC **AGREED** that the review is important to improve confidence in future yellowfin stock assessments and would also be relevant to the bigeye and skipjack assessments.

102. The SC **DISCUSSED** the timeframes and milestones of the review in the context of the assessment cycle of the yellowfin tuna, noting the particular economic importance of this stock and the need to ensure the review is comprehensive and useful. The SC also provided further refinement on the TOR (IOTC-2021-SC24-INF05_rev1) including the assessment of the plausibility of low productivity scenarios, and the implementation of stochastic projections. The updated Terms of Reference as **AGREED** by the SC are contained in Appendix 6c

103. The SC **NOTED** the importance of the peer review process and its role in providing improved scientific advice for management. The SC therefore **RECOMMENDED** that the Commission endorse the process for a YFT stock assessment review as well as the BET MSE review and provide the financial resources to conduct the work planned.

7.4.2 Update on the WGFAD02

104. The SC **NOTED** that the 2nd ad hoc working group meeting on FADs was held online from the 4-6 October. The SC **NOTED** the final report was not yet ready as consensus on the text had yet to be reached.

105. The SC **NOTED** that WGFAD is tasked with providing advice on FAD management, especially with respect to the impact of dFAD on tropical tuna stocks and the assessment of the optimal number of dFADs to deploy. The SC **NOTED** no such advice was provided. This was due to the lack of transparency to provide data that would allow for a qualitative or quantitative assessment to be conducted. The SC **REQUESTED** future WGFAD meetings to take a more pragmatic approach and focus more on technical issues on FAD management.

106. The SC **NOTED** Japan's proposal to request a study of the major impacts of fisheries (especially FAD fisheries) on tropical Tuna species using the stock assessment results. Such analysis can be used to provide the basis for determining the optimal number of dFADs. The study should be reviewed at the next WGFAD meeting. It was also proposed that the SC convene a special meeting to discuss the results in order to provide advice in time for the Commission meeting in May.

107. The SC **RECOMMENDED** the Commission endorse the process to improve current definitions of FAD types and FAD activities used by the IOTC, to be conducted by the WPTT and WGFAD.

7.4.3 Other Matters

108. The SC **NOTED** the importance of environmental data, particularly in relation to the understanding of the impact of climate change on tropical tuna fisheries. The SC **NOTED** the suggestion to investigate the potential incorporation of the climate change effect into the CPUE standardisation processes.

109. The SC **NOTED** the WPTT Program of work, with high priorities being given to stock assessment model data review (size and tagging data), development of fleet-specific standardised CPUE indices and fishery-independent indices including acoustic FAD monitoring, and fishery impact analysis.

110. 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 tropical tuna data preparatory meeting in 2021, the SC **AGREED** to continue to hold data preparatory meetings in addition to stock assessment meetings for the tropical tuna species in 2022.

7.5 Report of the 12th Session of the Working Party on Methods (WPM12)

111. The SC noted the report of the 12th Session of the Working Party on Methods (IOTC–2021–WPM12–R), including the consolidated list of recommendations provided as an appendix to the report. The meeting was attended by 55 participants (cf. 55 in 2020). No MPF funding was provided as the meeting was held online.

112. The SC **NOTED** that the WPM has reviewed and discussed a wide range of issues including MSE progress for IOTC species, general MSE issues, joint CPUE standardisations, science-based FAD management, and stock status determination guidance.

7.5.1 Management Strategy Evaluation Progress

113. The SC **NOTED** the good progress made in Management Strategy Evaluations exercises for IOTC species in 2021, and the useful discussions of MSE work at the MSE Task Force meeting (a technical expert group of the WPM) and the TCMP meeting in 2021.

114. The SC **NOTED** the guidelines included as Appendix 6a to this report to deal with exceptional circumstances in the MSE process. The SC further **NOTED** that these guidelines are a living document and revisions may still be required in the future. The SC **RECOMMENDED** that the Commission consider and endorse the guidelines.

115. The SC **NOTED** the revised schedule of MSE work included as Appendix 6b to this report to provide the timeframe for the development of management procedures for key IOTC species. The SC **NOTED** that the revised MSE schedule is still ambitious but that the technical work could, in principle, be completed within the proposed timeframes with minor adjustments. The SC **RECOMMENDED** that the Commission consider and endorse the revised timetable.

7.5.2 Albacore MSE

116. The SC **NOTED** that the ALB operating model (OM) has been constructed from the 2019 assessment model, using a partial factorial design approach. Two different MPs – one based on a surplus production model, and one based on an HCR employed by CCSBT for Southern bluefin tuna, have been tested. The SC also **NOTED** the proposal to test alternative methods in order to have an OM that is not dependent on the stock assessment.

7.5.3 Skipjack tuna MSE

117. The SC **NOTED** an MSE expert has been contracted in2020 to undertake review of the skipjack tuna harvest control rule with a view to review and provide advice on potential revisions to the HCR as required by Res 16/02. The work continued in 2021 including to (1) develop an OM based on Stock Synthesis III; (2) develop a simple stock assessment model that can be fitted to simulated data from the skipjack stock assessment grid, and (3) simulation test model-based Management Procedures (MPs) with input from stakeholders.

118. The SC **NOTED** that the WPM considered that presenting results on the performance of MPs against different reference points (i.e., MSY and depletion-based) is likely to make communication of the results more difficult but that information on MSY-based reference points could be included in the full table of performance statistics.

7.5.4 Yellowfin tuna MSE

119. The SC **NOTED** that there has been no further progress on the yellowfin MSE due to issues with the stock assessment model that have been encountered in recent years and which have not been resolved in time for the MSE work. The SC **NOTED** that these issues are also shared by the current OM which is based on the assessment model.

120. The SC **NOTED** that the WPM had suggested that if the 2021 stock assessment is endorsed by the Scientific Committee, and there are no obvious issues in the projections that appear likely to manifest in the OMs, then the OMs will be reconditioned and the testing of candidate MPs will resume.

121. However, although the SC considers the yellowfin tuna assessment to have been significantly improved , there are still some important and highlighted issues in the assessment and projection that may make it not feasible to further utilize the current OM. Therefore, alternative approaches for the redevelopment and reconditioning of the YFT-OM will be explored as part of the ongoing YFT-MSE work should be considered as an option. The SC **NOTED** that the proposed alternatives for OM development would be less dependent on historical data but would make heavy use of the current assessment model. The SC **AGREED** that a more detailed discussion of this approach should take place (at the MSE Working Group meeting earlier next year) before the best course of action was determined.

7.5.5 Bigeye tuna MSE

122. The SC **NOTED** that the bigeye tuna OM, which has been developed over the years, has proven to be relatively stable. The SC also **NOTED** that many candidate MPs have been thoroughly evaluated by MSE so far. Following the WPM' recommendation, the SC has determined that the bigeye OM and MSE has appropriately considered the key causes of uncertainty for this stock and that the conditions for applying the "Butterworth guillotine" (stop OM reconditioning) are met. The SC therefore **AGREED** to endorse the bigeye tuna OM.

123. The SC **NOTED** two MPs, specifically the Model-based hockey stick (PT-HS) and the Model-based Catch and CPUE projection (PT-PROJ), both tuned against two tuning criteria (60% and 70% probability of being in the Kobe green quadrant over the reference years) are recommended by the WPM, based on their

performance indicators. The SC **AGREED** to present the MPs together with their performance indicators to the TCMP/Commission. The SC **NOTED** it will be up to the TCMP/Commission to decide on the final MP.

124. The SC **THANKED** the developers of bigeye tuna MSE for their hard work in the development of OM and evaluations of candidate MP over the years, and everyone including the WPM participants that contributed to the revision of the bigeye tuna MSE. The SC further **CONGRATULATED** the developers for achieving key milestones towards the successful adoption of a management procedure for the bigeye tuna stock.

125. The SC **NOTED** document IOTC-2021-SC24-INF05 that provides the terms of reference for the proposed external review of the bigeye MSE, which is planned to take place 2022-2024. The SC discussed the timeframes, workplans and deliverables, and provided further refinement on the TOR. The SC **AGREED** that the process of the external review should not impede the adoption of an interim bigeye MP by the Commission prior to completion of the review. The SC also **AGREED** that the number of reviewers required will be determined at a later stage depending on the availability of funding (see also Para. 102 on the BET MSE review)

7.5.6 Swordfish MSE

126. The SC **NOTED** that limited progress had been made on the Swordfish MSE in 2020 but work resumed in early 2021, with good progress made throughout the rest of the year.

7.5.7 Update on TCMP04

127. The SC **NOTED** document IOTC-2021-TCMP04-R on the Report of the 4th session of the TCMP held in June 2021. The SC **NOTED** that the WPM had taken into consideration the recommendations and discussions held at that meeting.

7.6 Report of the 17th Session of the Working Party on Data Collection and Statistics (WPDCS17)

128. The SC **NOTED** the report of the 17th Session of the Working Party on Data Collection and Statistics (IOTC–2021–WPDCS17–R), including the consolidated list of recommendations provided as an appendix to the report. The meeting was attended by 94 participants (cf. 76 in 2020). No MPF funding was provided as the meeting was held online.

129. **NOTING** that the quality of data available for artisanal fisheries in the Indian Ocean still needs to be improved, and that statistical information (nominal catches, catch-and-effort, size-frequency) is particularly lacking or incomplete for neritic and billfish species, the SC reiterated its **REQUEST** that the WPDCS continue assisting CPCs in improving the implementation of data collection and sampling activities for small-scale fisheries in particular.

130. The SC **CONGRATULATED** Indonesia's progress adopting novel approaches to data collection and analysis at national level, **ACKNOWLEDGED** that the implementation of initiatives such as the e-logbook and streamlining of procedures for the collection and validation of data are expected to lead to long-term improvements in the quality of Indonesia's official fisheries statistics and **ENDORSED** the request that the IOTC Secretariat collaborate with Indonesia to reassess their official data and ensure consistency and coherence in the longer-term catch series for management and stock assessment purposes.

131. The SC **RECALLED** the importance that documentation on sampling design and raising procedures be provided by CPCs to the Secretariat in agreement with Res. 15/02 and **ACKNOWLEDGED** that the Secretariat is developing a template for the provision of such information, and that the activity has been included in the WPDCS Program of Work.

132. The SC **NOTED** that the WPDCS provided two separate tables with estimates of yellowfin tuna catch limits for 2022, one for CPCs bound to Res. 21/01 and one for those bound to Res. 19/01 or preceding Resolutions. The SC **NOTED** that the 2022 estimates were based on the assumption that yellowfin tuna catch levels for 2021, which are not yet available to the IOTC Secretariat, will be the same values those reported for 2020 (on a CPC and gear basis). The SC **NOTED** that the catch limits might need updating later in 2022 once information on actual yellowfin tuna catches for 2021 will be submitted by CPCs to the Secretariat.

133. The SC also **NOTED** that the tables present catch limits by CPC rather than by flag state and **RECALLED** that this approach was agreed by the S25 to avoid potential inconsistencies with the application of Res. 21/01

134. The SC **RECALLED** that catch limits estimated for CPCs bound by Res. 21/01 apply to all fisheries and gears, regardless of the nature of the fishing vessels involved, while catch limits estimated for CPCs bound by Res. 19/01 (or preceding) only apply to the fraction of catches for each fishery that are attributed to vessels of LoA > 24m, or less than 24m when fishing outside of their EEZ.

135. In accordance with Para 25 of Res 21/01 which requires the IOTC Secretariat to be advised by the SC on the table of allocated catch limits for yellowfin tuna, the SC **ENDORSED** the 2022 allocated catch limits and attached them to this report as Appendix 33.

136. **NOTING** that the WPDCS identified aspects of several data-related resolutions that are either unclear or inconsistent (15/01, 15/02 and 19/02), the SC **RECOMMENDED** that the Commission consider how to best address these issues at the next revision of each resolution.

137. In particular, the SC **NOTED** that the following specific clarifications required in the various Resolutions:

- that Silky shark (*Charcharinus falciformis*) be included in the list of "other" species appearing in the gillnet table in Section 2.3 of Annex II of Res. 15/01
- that the terms "*shall be submitted frequently*" appearing in para. 4.c of Res. 15/02 be further clarified
- That para 5 of Res. 15/02 be amended with the inclusion of "and baitboats" in addition to purse seiners already mentioned in this paragraph
- that para. 4.c of Res. 15/02 be amended with the inclusion of the request that "*Documents describing the extrapolation procedures (including raising factors corresponding to the logbook coverage) shall also be submitted routinely*" that already appears in both para. 4.a and 4.b of Res. 15/02
- that para. 26 of Res. 19/02 be amended to also allow the use of buoy position data for scientific purposes, and to further clarify how to protect business confidentiality aspects as per para. 24 of Res. 19/02

138. The SC **NOTED** that Japan expressed their interest to participate as reviewer in the peer-review process leading to the finalization of the ROS Observer Training Programme's outputs, in particular for what concerns the expected updates to the data collection and reporting requirements.

139. **ACKNOWLEDGING** that the workload of the Secretariat data team has increased markedly in recent years to manage an increasing number of datasets, provide more data outputs, and improve data access, the SC **RECOMMENDED** that the Commission consider strengthening the capacity of the Secretariat's Data Group with the addition of an extra staff member.

140. The SC **ACKNOWLEDGED** the long-term relationship between the OFCF and the IOTC to improve the collection, management and reporting of fisheries statistics and **RECOMMENDED** the Commission consider the continuation of this collaboration through an appropriate arrangement.

7.6.1 Update on WGEMS01

141. The SC **NOTED** that the 1st meeting of the ad hoc Working Group on the Development of Electronic Monitoring Programme Standards (WGEMS) took place from the 15 – 17 November 2021.

142. The SC **NOTED** the outcomes and recommendations from the WPDCS specifically regarding the WGEMS, **ACKNOWLEDGED** that the nature and scope of the Working Group include also elements of compliance, and **DISCUSSED** whether to maintain the Working Group under direct responsibility of the WPDCS.

143. The SC **NOTED** the outcomes of the 1st ad-hoc IOTC WGEMS and **RECOMMENDED** the Commission endorse its continuation in the future and for the Commission to discuss if the WGEMS should remain under the WPDCS or report directly to the SC or CoC. The SC **ENDORSED** the Terms of Reference and Plan of Work for the WGEMS.

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

7.7.1 Data collection and capacity building

144. 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.

7.7.2 Invited Expert(s) at the WP meetings

145. 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.

7.7.3 Meeting participation fund

146. The SC **NOTED** that in 2021, no MPF funding was provided as all meetings were held online.

147. 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.

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

148. 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 CPC scientific observers, both on board and at port need to have hard copies.

149. The SC **NOTED** that short term funding for the shipment of ID Guides had also been provided by the Japanese OFCF. The Secretariat therefore requested that all CPCs requiring ID guides should contact the Secretariat before the end of 2021 and state the number of guides per language that they require, so that these can be sent while the budget is available. The SC expressed its gratitude to the OFCF for providing this important funding.

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

150. 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.

7.7.6 Advice on the Standardisation of the Presentation of Projection Results

151. The SC **NOTED** that there may be a need to provide advice on how projections from assessment models are presented, as currently this is not consistent across species and assessment models, and this could be creating confusion.

152. The SC **NOTED** that this is a relatively complex issue and that although all efforts should be made to reduce inconsistencies, some measure of flexibility would be required between species and models to incorporate their different characteristics. The SC therefore **REQUESTED** that this issue be further discussed by the relevant Working Parties at their data preparatory meetings as well as by the WPM.

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

8.1 Tuna – Highly migratory species

153. The SC **STRESSED** that yellowfin tuna is overfished and subject to overfishing and that bigeye tuna and albacore tuna, though not overfished, are subject to overfishing.

154. 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 2021 (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

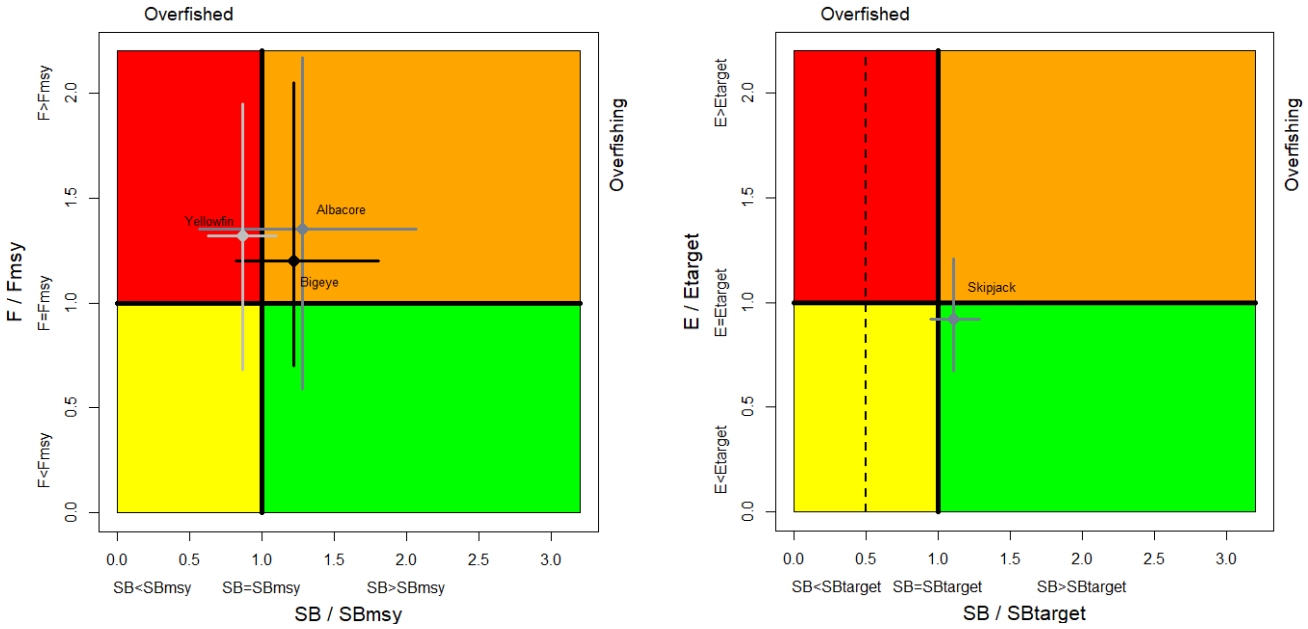

Fig. 1. (Left) Combined Kobe plot for bigeye tuna (black: status in 2018, based on the assessment conducted in 2019), and yellowfin tuna (light grey: 2020, with assessment conducted in 2021) and albacore (dark grey: 2017 with assessment conducted in 2019) showing the estimates of current spawning biomass (SB) and current fishing mortality (F) in relation to optimal spawning stock size and optimal fishing mortality. (Right) Kobe plot for skipjack tuna (2019 with assessment conducted in 2020) showing the estimates of the current stock status (The dashed line indicates the limit reference point at 20%SB0 while SBtarget=0.4 SB0). Cross bars illustrate the range of uncertainty from the model runs with an 80% CI (95% CI for albacore).

155. The SC **NOTED** paper IOTC–2021–SC24–ES05 which provided an overview of the biology, stock status and management of southern bluefin tuna (*Thunnus maccoyii*), and thanked CCSBT for its provision.

8.2 Tuna and mackerel – neritic species

156. 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 2021 (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

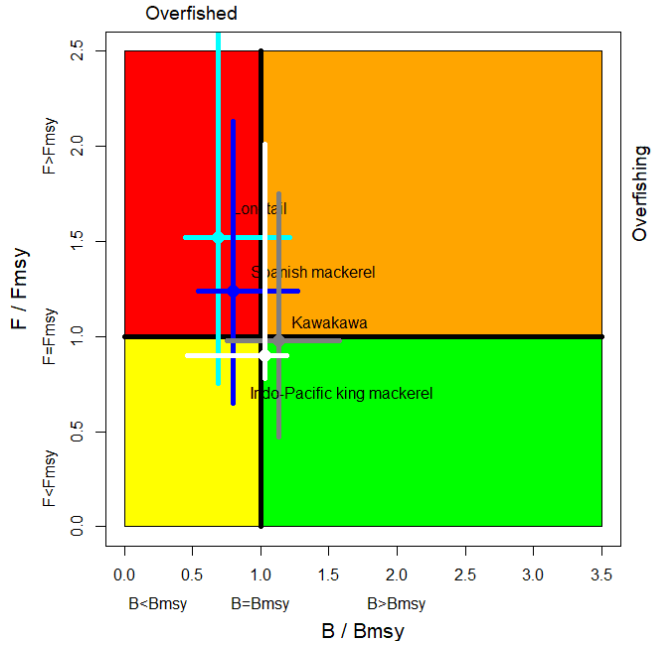

Fig. 2. Combined Kobe plot for longtail tuna (cyan), narrow-barred Spanish mackerel (blue), kawakawa (grey) (all for 2018 with assessment carried out in 2020, white) and Indo-Pacific king mackerel (2019 with assessment carried out in 2021), showing the estimates of stock size (B) and current fishing mortality (F) in relation to optimal biomass and optimal fishing mortality. Cross bars illustrate the range of uncertainty from the model runs. Given unresolved uncertainty in the assessment, status for bullet tuna, frigate tuna and Narrow-barred Spanish mackerel should be interpreted with caution.

8.3 Billfish

157. 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 2021 (Fig. 3):

Swordfish (*Xiphias gladius*) – Appendix 12

Black marlin (*Istiompax indica*) – Appendix 13

Blue marlin (*Makaira nigricans*) – Appendix 14

Striped marlin (*Kajikia audax*) – Appendix 15

Indo-Pacific sailfish (*Istiophorus platypterus*) – Appendix 16

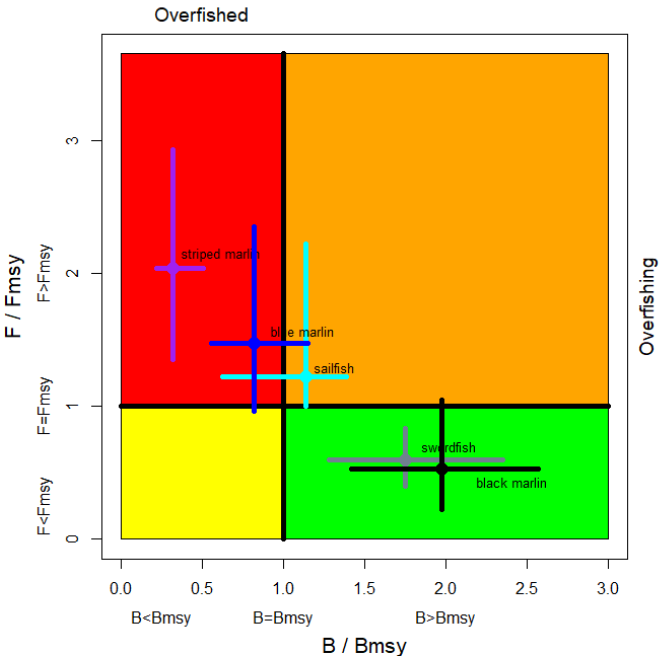

Fig. 3. Combined Kobe plot for swordfish (2018 with assessment conducted in 2020, grey), Indo-Pacific sailfish (2017 with assessment conducted in 2019, cyan), black marlin (2019 with assessment conducted in 2021, black), blue marlin (2017 with assessment conducted in 2019, blue) and striped marlin (2019 with assessment conducted in 2021, purple) showing the estimates of current stock size (SB or B, species assessment dependent) and current fishing mortality (F) in relation to optimal stock size and optimal fishing mortality. Cross bars illustrate the range of uncertainty from the model runs. Given unresolved uncertainty in the assessment, status for black marlin and sailfish should be interpreted with caution.

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

9.1 Sharks

158. 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

9.2 Marine turtles

159. 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

9.3 Seabirds

160. 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

9.4 Marine mammals

161. 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.

10. IMPLEMENTATION OF THE REGIONAL OBSERVER SCHEME

162. The SC **NOTED** paper IOTC–2021–SC24–07 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.

163. The SC **CONGRATULATED** the Secretariat for the compilation of the data which provide a comprehensive view of the status of the ROS.

164. The SC **ENCOURAGED** CPCs to validate the information provided in appendices A, B and C of paper IOTC-2021-SC24-07, 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.

165. The SC **NOTED** that the annual observer coverage estimated by the Secretariat for longline fisheries (Appendices B1-B2 of paper IOTC-2021-SC24-07 is calculated as the proporiton of hooks observed with respect to the total number of hooks deployed by the fleet while the second paragraph of the IOTC Resolution 11/04

mentions a coverage of "at least 5% of the number of operations/sets", further **NOTING** that the number of fishing sets is also used in ICCAT, IATTC and WCPFC for deriving observer coverage and that harmonisation in methods should be sought across tuna RFMOs.

166. The SC **NOTED** that that the matter has been extensively discussed during the WPDCS and that the effort expressed in number of hooks is the only information on fishing effort reported to the Secretariat for most longline fisheries as per the mandatory requirements of IOTC Resolution 15/02 (para 4b).

167. In absence of data on the total number of sets, the SC **ENDORSED** the methodology of the Secretariat for estimating the observer coverage for longline fleets from the effort expressed in hooks and **AGREED** that the number of fishing sets shall be considered for submission as part of the data requirements for longline fisheries, further **NOTING** that this would require to amend the IOTC Resolutions 15/01 and 15/02.

168. To fulfill the official coverage rates stipulated in 11/04, Japan requested to compute the coverage rates using data on sets, available in all Japanese National Reports in the past and to revise the validation Table from this year.

169. The SC **NOTED** that the observers on longliners may not observe all the hooks on a line and **QUERIED** whether the coverage should be estimated from the hooks observed or from all the hooks deployed during an operation observed by the observer, i.e., considering that the hooks observed on a line are a representative sample of the whole line. Japan noted their preference to use the term "deployed" as they expressed it is difficult to interpret "observed number of hooks". The latter term is therefore applied differently amongst CPCs/RFMOs. Japan further noted that to avoid ambiguity, CCSBT uses "deployed number of hooks". Japan expressed its opinion that the best solution is to use sets to compute the official coverages stipulated in 11/04

170. The SC **NOTED** the request of the WPDCS that when finer-grained information is available to the ROS (e.g., the number of observed hooks in the case of longline fisheries) this should be provided to the IOTC Secretariat and preferred for the estimation of the actual level of coverage of ROS data submissions. Japan noted that to apply this method officially, Res 11/04 needs to be revised

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

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

171. The SC **NOTED** that the ROS pilot project had been paused throughout 2020 and most of 2021 due to the inability of the Contractors to travel to the participating countries and provide the necessary training.

172. The Secretariat informed the SC that the project had subsequently resumed, with additional training documentation being developed by the contractors as well as virtual training sessions being conducted for the target countries.

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

11.1 Progress on previous recommendations from WPs and the SC

173. The SC **NOTED** paper IOTC–2021–SC24–10 which provided the SC with an update on the progress made on its 2020 recommendations (also available in Appendix 34).

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

11.2 Program of Work (2022–2026) and assessment schedule

11.2.1 Program of Work

175. The SC **NOTED** IOTC–2021–SC24–08 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.

176. 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 and in accordance with the IOTC Strategic Science Plan 2020-2024. The Chairpersons and Vice-Chairpersons of each working party will ensure that the efforts of their respective working parties are focused on the core areas contained within the appendix, taking into account any new research priorities identified by the Commission at its next Session.

177. 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.

178. 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.

179. 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 3 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).

Table 3. Priority topics for obtaining the information necessary to develop stock status indicators for all Working Parties. Further details can be found in Appendix 35a-g.

Priority	1	2	3
WPTT	Stock assessment priorities – detailed review of the assessment and its existing data sources, including: • Peer review of YFT stock assessment as per the SC endorsed ToRs • Size frequency data: Evaluation of the reliability of length composition from the longline fisheries (including recent and historical data), • Tagging data: Further analysis of the tag release/recovery data set. • Organisation of expert group to investigate tagging mortality • Re-estimation of M using updated tagging data. • Additional growth and other biological studies for Tropical tunas	CPUE standardisation • Develop standardised CPUE series for each tropical tuna fleet/fishery for the Indian Ocean • Review period where stock was assessed as being overfished without experiencing overfishing. • Regional scaling parameters • Effect of piracy on CPUE after piracy period	Fisheries impact analysis Impact of individual fisheries on stock parameters.
WPEB	Stock structure (connectivity and diversity): 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. This may include Next Generation Sequencing (NGS), Nuclear markers (i.e., microsatellite) as well as other components of close-kin mark recapture studies (CKMR).	Biological and ecological information (incl. parameters for stock assessment) 2.1 Age and growth research (Priority species: blue shark (BSH), shortfin mako shark (SMA) and oceanic whitetip shark (OCS); silky shark (FAL)) 2.2 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	Connectivity, movements, habitat use and post release mortality Electronic tags (PSATs, SPOT, Splash MiniPAT) to assess the efficiency of management resolutions on non-retention species (BSH in LL, marine turtles and rays in GIL and PS, whale sharks) and to determine connectivity, movement rates and mortality estimates.

		2.3 Reproduction research Priority species: blue shark (BSH), shortfin mako shark (SMA) and oceanic whitetip shark (OCS), and silky shark (FAL) 2.4 Ecological Risk Assessment (cetaceans)	
WPNT	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. Sri Lanka (priority species: Frigate tuna, Kawakawa, bullet tuna) Indonesia (priority species: Kawakawa, Bullet tuna, Frigate tuna) Pakistan (priority species: Longtail tuna, Kawakawa, narrow-barred Spanish mackerel) Iran gillnet CPUEs for all species India available CPUEs to be provided to next assessment session Capacity building support for CPCs to develop standardised CPUEs for their fisheries	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. Exploration of priors and how these can be quantifiably and transparently developed Take into consideration the outputs of genetic studies to investigate stock structure and regional differences in populations 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.	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: catch and effort by species and gear by landing site; operational data: stratify this by vessel, month, and year for the development as an indicator of CPUE over time; and 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)). Re-estimation of historic catches for assessment purposes (taking into account updated identification of uncertainties and knowledge of the history of the fisheries) • (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	Data mining and processing – (Development of subsequent CPUE indices) Data on gillnet fisheries are available in Pakistan (and potentially other CPCs) and the recovery of this information and the development of gillnet CPUE indices would improve species assessments, particularly for: • Black marlin • Sailfish.	Biological and ecological information (incl. parameters for stock assessment and provide answers to the Commission) 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 inter-sessionally 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).	Stock structure (connectivity and diversity) Continue work on determining stock structure of Swordfish, using complimentary data sources, including genetic and microchemistry information as well as other relevant sources/studies.
WPDCS	Artisanal fisheries data collection 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 India • Coastal fisheries of Bangladesh • Coastal fisheries of Pakistan • Coastal fisheries of I.R. Iran • Coastal fisheries of Kenya • Coastal fisheries of Somalia • Coastal fisheries of Sri Lanka	Enhance the use of electronic tools to support data collection in artisanal fisheries	Review of historical catch data for all stocks being assessed in the following year to determine the level of uncertainty to be used for stock assessment and management procedures

WPM	Management Strategy Evaluation Continuation of Management Strategy Evaluation for Albacore, Skipjack, Yellowfin, Bigeye tunas as well as Swordfish	Peer review of BET MSE as per the ToRs endorsed by the SC	

11.2.2 Assessment schedule

180. The SC **ADOPTED** a revised assessment schedule, ecological risk assessment and other core projects for 2022–26, 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.

11.2.3 Consultants

181. 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.

11.3 Schedule of meetings for 2022 and 2023

182. The SC **NOTED** paper IOTC–2021–SC24–09 which outlined the proposed schedule for IOTC Working Parties and SC meetings for 2022 and 2023.

11.3.1 Data preparatory meetings and Hybrid meetings

183. 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) and noting that in 2019, 2020 and 2021 data preparatory meetings were successfully held for the WPTmT, WPTT and WPEB, the SC **AGREED** to continue the practice of having data preparatory meetings in addition to stock assessment meetings for the major IOTC species. The SC **SUGGESTED** that data preparatory meetings could continue to be held virtually so as not to increase the travel and costs required for the already full IOTC timetable of meetings.

184. The SC once again **NOTED** the need to assess the best means of supporting Hybrid meetings in the future, to facilitate both in-person and virtual participation at all future meetings. The Secretariat will look into options for facilitating this request.

11.3.2 Final Meeting schedule

185. The SC **REQUESTED** that the schedule of Working Party and Scientific Committee meetings for 2022 and 2023 provided at Appendix 37 be communicated by the IOTC SC Chairperson to the Commission for its endorsement.

12. OTHER BUSINESS

12.1 Election of the Chairperson and Vice Chairperson of the SC for the next biennium

Chairperson

186. The SC **NOTED** that the first term of the current Chairperson, Dr Toshihide Kitakado (Japan) expired at the close of the SC24 meeting and, as per the IOTC Rules of Procedure, participants are required to elect a new Chairperson of the SC for the next biennium.

187. **NOTING** the Rules of Procedure, the SC **CALLED** for nominations for the position of Chairperson of the IOTC SC for the next biennium. Dr Kitakado was nominated, seconded and re-elected as Chairperson of the SC for the next biennium.

Vice-Chairperson

188. The SC **NOTED** that the first term of the current Vice-Chairperson, Dr Denham Parker (South Africa) expired at the close of the SC24 meeting and, as per the IOTC Rules of Procedure, participants are required to elected a new Vice-Chairperson of the SC for the next biennium.

189. **NOTING** the Rules of Procedure, the SC **CALLED** for nominations for the position of Vice-Chairperson of the IOTC SC for the next biennium. Dr Parker was nominated, seconded and re-elected as Vice-Chairperson of the SC for the next biennium.

13. ADOPTION OF THE REPORT OF THE 24TH SESSION OF THE SCIENTIFIC COMMITTEE

190. The SC **RECOMMENDED** that the Commission consider the consolidated set of recommendations arising from SC24, provided at Appendix 38.

191. The report of the 24th Session of the Scientific Committee (IOTC–2021–SC24–R) was **ADOPTED** by correspondence.

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APPENDIX 2
AGENDA FOR THE 24TH SESSION OF THE SCIENTIFIC COMMITTEE

Date: 6 - 10 December 2021
Location: Virtual
Time: 12:00 – 16:00 daily
Chair: Dr Toshihide Kitakado (Japan)
Vice-Chair: Dr Denham Parker (South Africa)

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 25th Session of the Commission.
   - 4.2 Previous decisions of the Commission

5. **SCIENCE RELATED ACTIVITES OF THE IOTC SECRETARIAT IN 2021** (IOTC Secretariat)
   - 5.1 Report of the Secretariat – Activities in support of the IOTC science process in 2021

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

7. **REPORTS OF THE 2021 IOTC WORKING PARTY MEETINGS**
   - 7.1 IOTC–2021–WPNT11–R Report of the 11th Session of the Working Party on Neritic Tunas
     - 7.1.1 Indo-Pacific King Mackerel stock assessment
     - 7.1.2 Frigate Tuna stock assessment
     - 7.1.3 Bullet Tuna stock assessment
   - 7.2 IOTC–2021–WPB19–R Report of the 19th Session of the Working Party on Billfish
     - 7.2.1 Black Marlin stock assessment
     - 7.2.2 Striped Marlin stock assessment
     - 7.2.3 Revision of catch levels of Marlins under Resolution 18/05
   - 7.3 IOTC–2021–WPEB17–R Report of the 17th 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 Blue shark stock assessment
     - 7.3.3 Other Matters
   - 7.4 IOTC–2021–WPTT23–R Report of the 23rd Session of the Working Party on Tropical Tunas
     - 7.4.1 Yellowfin tuna stock assessment
     - 7.4.2 Update on the WGFAD02
     - 7.4.3 Other Matters
   - 7.5 IOTC–2021–WPM12–R Report of the 12th Session of the Working Party on Methods
     - 7.5.1 Management Strategy Evaluation Progress
     - 7.5.2 Update on TCMP04
   - 7.6 IOTC–2021–WPDCS17–R Report of the 17th Session of the Working Party on Data Collection and Statistics
     - 7.6.1 Update on WGEMS01
   - 7.7 Summary discussion of matters common to Working Parties (capacity building activities; connecting science and management, etc.)
     - 7.7.1 Data collection and capacity building

7.7.2 Invited Expert(s) at the WP meetings
7.7.3 Meeting participation fund
7.7.4 IOTC species identification guides: Tuna and tuna-like species
7.7.5 Chairpersons and Vice-Chairpersons of the SC and its subsidiary bodies
7.7.6 Advice on the Standardisation of the Presentation of Projection Results

8. STATUS OF TUNA AND TUNA-LIKE RESOURCES IN THE INDIAN OCEAN (Chairperson)
8.1 Tuna – Highly migratory species
8.2 Tuna and mackerel – Neritic species
8.3 Billfish

9. STATUS OF SHARKS, MARINE TURTLES, SEABIRDS AND MARINE MAMMALS IN THE INDIAN OCEAN (Chairperson)
9.1 Sharks
9.2 Marine turtles
9.3 Seabirds
9.4 Marine Mammals

10. IMPLEMENTATION OF THE REGIONAL OBSERVER SCHEME (IOTC Secretariat)
10.1 Consideration of Resolution 16/04 On the implementation of a Pilot Project in view of promoting the Regional Observer Scheme of IOTC
10.1.1 Update on the Pilot Project approved by the Commission in 2017

11. PROGRAM OF WORK AND SCHEDULE OF WORKING PARTY AND SCIENTIFIC COMMITTEE MEETINGS (IOTC Secretariat and Chairperson**)**
11.1 Progress on previous Recommendations from WPs and SC
11.2 Program of Work (2022–2026) and assessment schedule
11.2.1 Program of Work
11.2.2 Assessment schedule
11.2.3 Consultants
11.3 Schedule of meetings for 2022 and 2023
11.3.1 Data preparatory meetings
11.3.2 Final Meeting schedule

12 OTHER BUSINESS (Chairperson)
12.1 Election of the Chair and Vice Chair of the SC for the next biennium

13 REVIEW OF THE DRAFT, AND ADOPTION OF THE REPORT OF THE 24th SESSION OF THE SCIENTIFIC COMMITTEE (Chairperson)

APPENDIX 3
LIST OF DOCUMENTS

Document	Title
IOTC–2021–SC24–01a	Draft: Agenda of the 24th Session of the Scientific Committee
IOTC–2021–SC24–01b	Draft: Annotated agenda of the 24th Session of the Scientific Committee
IOTC–2021–SC24–02	Draft: List of documents of the 24th Session of the Scientific Committee
IOTC–2021–SC24–03	Outcomes of the 25th Session of the Commission (IOTC Secretariat)
IOTC–2021–SC24–04	Previous decisions of the Commission (IOTC Secretariat)
IOTC–2021–SC24–05	Report of the Secretariat – Activities in support of the IOTC science process in 2021 (IOTC Secretariat)
IOTC–2021–SC24–06	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–2021–SC24–07	Update on the implementation of the regional observer scheme (IOTC Secretariat)
IOTC–2021–SC24–08	Revision of the program of work (2022–2026) for the IOTC science process (IOTC Secretariat)
IOTC–2021–SC24–09	Proposed schedule of Working Party and Scientific Committee meetings for 2022 and 2023 (IOTC Secretariat)
IOTC–2021–SC24–10	Progress on SC23 recommendations (IOTC Secretariat)
Executive Summaries	
IOTC–2021–SC24–ES01	Status of the Indian Ocean Albacore (ALB: *Thunnus alalunga*) resource
IOTC–2021–SC24–ES02	Status of the Indian Ocean bigeye tuna (BET: *Thunnus obesus*) resource
IOTC–2021–SC24–ES03	Status of the Indian Ocean skipjack tuna (SKJ: *Katsuwonus pelamis*) resource
IOTC–2021–SC24–ES04	Status of the Indian Ocean yellowfin tuna (YFT: *Thunnus albacares*) resource
IOTC–2021–SC24–ES05	Report on biology, stock status and management of southern bluefin tuna: 2019 (from CCSBT)
IOTC–2021–SC24–ES06	Status of the Indian Ocean bullet tuna (BLT: *Auxis rochei*) resource
IOTC–2021–SC24–ES07	Status of the Indian Ocean frigate tuna (FRI: *Auxis thazard*) resource
IOTC–2021–SC24–ES08	Status of the Indian Ocean kawakawa (KAW: *Euthynnus affinis*) resource
IOTC–2021–SC24–ES09	Status of the Indian Ocean longtail tuna (LOT: *Thunnus tonggol*) resource
IOTC–2021–SC24–ES10	Status of the Indian Ocean Indo-Pacific king mackerel (GUT: *Scomberomorus guttatus*) resource
IOTC–2021–SC24–ES11	Status of the Indian Ocean narrow-barred Spanish mackerel (COM: *Scomberomorus commerson*) resource
IOTC–2021–SC24–ES12	Status of the Indian Ocean black marlin (BLM: *Makaira indica*) resource
IOTC–2021–SC24–ES13	Status of the Indian Ocean blue marlin (BUM: *Makaira nigricans*) resource
IOTC–2021–SC24–ES14	Status of the Indian Ocean striped marlin (MLS: *Tetrapturus audax*) resource
IOTC–2021–SC24–ES15	Status of the Indian Ocean Indo-Pacific sailfish (SFA: *Istiophorus platypterus*) resource
IOTC–2021–SC24–ES16	Status of the Indian Ocean swordfish (SWO: *Xiphias gladius*) resource
IOTC–2021–SC24–ES17	Status of the Indian Ocean blue shark (BSH: *Prionace glauca*)
IOTC–2021–SC24–ES18	Status of the Indian Ocean oceanic whitetip shark (OCS: *Carcharhinus longimanus*)
IOTC–2021–SC24–ES19	Status of the Indian Ocean scalloped hammerhead shark (SPL: *Sphyrna lewini*)
IOTC–2021–SC24–ES20	Status of the Indian Ocean shortfin mako shark (SMA: *Isurus oxyrinchus*)
IOTC–2021–SC24–ES21	Status of the Indian Ocean silky shark (FAL: *Carcharhinus falciformis*)

Document	Title
IOTC–2021–SC24–ES22	Status of the Indian Ocean bigeye thresher shark (BTH: *Alopias superciliosus*)
IOTC–2021–SC24–ES23	Status of the Indian Ocean pelagic thresher shark (PTH: *Alopias pelagicus*)
IOTC–2021–SC24–ES24	Status of marine turtles in the Indian Ocean
IOTC–2021–SC24–ES25	Status of seabirds in the Indian Ocean
IOTC–2021–SC24–ES26	Status of cetaceans in the Indian Ocean
Other meeting reports	
IOTC–2021–WPNT11–R	Report of the 11th Session of the Working Party on Neritic Tunas
IOTC–2021–WPB19–R	Report of the 19th Session of the Working Party on Billfish
IOTC–2021–WPEB17(AS)–R	Report of the 17th Session of the Working Party on Ecosystems and Bycatch (Assessment Meeting)
IOTC–2021–WPM12–R	Report of the 12th Session of the Working Party on Methods
IOTC–2021–WPDCS17–R	Report of the 17th Session of the Working Party on Data collection and Statistics
IOTC–2021–WPTT23–R	Report of the 23rd Session of the Working Party on Tropical Tunas
IOTC-2021-TCMP04-R	Report of the 4th Session of the Technical Committee on Management Procedures
National Reports	
IOTC–2021–SC24–NR01	Australia
IOTC–2021–SC24–NR02	Bangladesh
IOTC–2021–SC24–NR03	China
IOTC–2021–SC24–NR06	European Union
IOTC–2021–SC24–NR07	France (OT)
IOTC–2021–SC24–NR08	India
IOTC–2021–SC24–NR09	Indonesia
IOTC–2021–SC24–NR10	Iran
IOTC–2021–SC24–NR11	Japan
IOTC–2021–SC24–NR13	Korea, Republic of
IOTC–2021–SC24–NR14	Madagascar
IOTC–2021–SC24–NR15	Malaysia
IOTC–2021–SC24–NR16	Maldives, Republic of
IOTC–2021–SC24–NR17	Mauritius
IOTC–2021–SC24–NR19	Oman
IOTC–2021–SC24–NR21	Philippines
IOTC–2021–SC24–NR22	Seychelles, Republic of
IOTC–2021–SC24–NR24	Sri Lanka
IOTC–2021–SC24–NR25	South Africa, Republic of
IOTC–2021–SC24–NR28	Thailand
IOTC–2021–SC24–NR29	United Kingdom
Information Papers	
IOTC–2021–SC24-INF01	Preliminary estimates of sex ratio, spawning season, batch fecundity, length at maturity for Indian Ocean yellowfin tuna. (Zudaire I, Artetxe-Arrate I, Farley J, Murua H, Kukul D, Vidot A, Abdul Razzaque S, Ahusan M, Romanov E, Eveson P, Clear N, Luque P, Fraile I, Bodin N, Chassot E, Govinden R, Ebrahim A, Shahid U, Marsac F and Merino G)

Document	Title
IOTC–2021–SC24-INF02	Preliminary estimates of sex ratio, spawning season, batch fecundity and length at maturity for Indian Ocean skipjack tuna. (Zudaire I, Artetxe-Arrate I, Farley J, Murua H, Kukul D, Vidot A, Abdul Razzaque S, Ahusan M, Romanov E, Eveson P, Clear N, Luque P, Fraile I, Bodin N, Chassot E, Govinden R, Ebrahim A, Shahid U, Marsac F and Merino G)
IOTC–2021–SC24-INF03	Preliminary estimates of sex ratio, spawning season, batch fecundity, length at maturity for Indian Ocean bigeye tuna. (Zudaire I, Artetxe-Arrate I, Farley J, Murua H, Kukul D, Vidot A, Abdul Razzaque S, Ahusan M, Romanov E, Eveson P, Clear N, Luque P, Fraile I, Bodin N, Chassot E, Govinden R, Ebrahim A, Shahid U, Marsac F and Merino G)
IOTC–2021–SC24-INF04	A comparison of direct age estimates from otolith and fin spine sections of skipjack tuna (*Katsuwonus pelamis*) in the Indian Ocean (Luque L, Artetxe-Arrate I, Farley J, Krusic-Golub K, Eveson P, Fraile I, Clear N, Zudaire I, Ahusan M, Abdul Razzaque S, Aisha H, Vidot A, Fily T, Ebrahim A, Govinden R, Chassot E, Bodin N, Onandia I, Krug I, Murua H, Marsac F and Merino G.)
IOTC–2021–SC24-INF05	Draft terms of reference for an independent peer review of the 2021 Indian Ocean yellowfin tuna assessment (Anon)
IOTC–2021–SC24-INF06	Draft terms of reference for an independent peer review of the IOTC's stocks Management Strategy Evaluation (Bigeye) (Murua H)
IOTC–2021–SC24-INF07	Taiwan,China Report 2021
IOTC–2021–SC24-INF08	Indian Ocean Yellowfin Tuna SS3 Model projections (Merino G et al)
IOTC–2021–SC24-INF09	Terms of Reference for a workshop on multi-taxa bycatch mitigation measures focused on drift/gillnet fisheries in the Indian Ocean (Shahid U, Nelson L, Tarzia M, Anderson C, Holmes G, Martin S, Wanless R, Frisch-Nwakanma H, Kophamel S, Fernando D, Kiszka J, Juan Jorda M-J and Sutaria S)
IOTC–2021–SC24-INF10	Proposed Letter of Intent between IOTC and IWC (IWC)
IOTC–2021–SC24-INF11	Development and Implementation of a sampling scheme to support the collection of biological samples and conduct analysis on these samples to provide improved estimates of age, growth and reproduction of tropical tunas, swordfish and blue sharks for IOTC (Project Gerundio)

APPENDIX 4A
NATIONAL STATEMENTS

24th Session of IOTC Scientific Committee
6-10 December 2021

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

Statement by the Republic of Mauritius

The Republic of Mauritius reiterates its long-standing position 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]" and wishes to place on record its objection to the participation of the United Kingdom in the 24th Session of the IOTC Scientific Committee as a coastal State purporting to represent the Chagos Archipelago.

In addition to the reasons provided in the past to support its stand, the Republic of Mauritius wishes to draw the attention of the Committee to the Judgment delivered on 28 January 2021 in the case of *Mauritius v. Maldives* by a Special Chamber of the International Tribunal for the Law of the Sea (ITLOS). This Judgment ruled that the Republic of Mauritius has undisputed sovereignty over the Chagos Archipelago, thereby further confirming that the United Kingdom cannot be recognized as a member of the IOTC as a coastal State.

In its Judgment, the Special Chamber also held that:

(a) the determinations made by the International Court of Justice (ICJ) in its Advisory Opinion of 25 February 2019 on the *Legal Consequences of the Separation of the Chagos Archipelago from Mauritius in 1965* have legal effect and clear implications for the legal status of the Chagos Archipelago;

(b) the United Kingdom's continued claim to sovereignty over the Chagos Archipelago is contrary to the determinations made by the ICJ that the detachment of the Chagos Archipelago by the United Kingdom from Mauritius was unlawful and that the United Kingdom's continued administration of the Chagos Archipelago constitutes an unlawful act of a continuing character;

(c) the fact that the time-limit of 22 November 2019 set by the UN General Assembly for the withdrawal of the United Kingdom's administration from the Chagos Archipelago has passed without the United Kingdom complying with that demand further strengthens the Special Chamber's finding that its

claim to sovereignty over the Chagos Archipelago is contrary to the authoritative determinations made in the Advisory Opinion of the ICJ;

(d) while the process of decolonization of the Republic of Mauritius has yet to be completed, the Republic of Mauritius' sovereignty over the Chagos Archipelago can be inferred from the ICJ's determinations;

(e) the continued claim of the United Kingdom to sovereignty over the Chagos Archipelago cannot be considered anything more than "a mere assertion" and such assertion does not prove the existence of a dispute;

(f) the Republic of Mauritius is to be regarded as the coastal State in respect of the Chagos Archipelago.

More recently, on 24 August 2021, the Universal Postal Union (UPU) adopted a resolution for the implementation of UN General Assembly Resolution 73/295. This resolution, *inter alia*, provides that:

(a) the UPU formally acknowledges that, for the purposes of its activities, the Chagos Archipelago forms an integral part of the territory of the Republic of Mauritius;

(b) the International Bureau of the UPU should cease the registration, distribution and forwarding of any and all postage stamps issued by the so-called "British Indian Ocean Territory" ("BIOT");

(c) the International Bureau of the UPU should ensure that UPU documentation does not include any references to the so-called "BIOT" or to the Chagos Archipelago as part of the member country of the UPU known as the "Overseas Territories of the United Kingdom of Great Britain and Northern Ireland".

It is crystal clear that as a matter of international law, the Republic of Mauritius is the only State lawfully entitled to exercise sovereignty and sovereign rights over the Chagos Archipelago and its maritime zones, as the coastal State and that the United Kingdom is not in a position to claim any rights over the Chagos Archipelago. The so-called "BIOT" which the United Kingdom purported to create by illegally excising the Chagos Archipelago from the territory of the Republic of Mauritius prior to its accession to independence is an illegal entity.

On 26 November 2021, the National Assembly of the Republic of Mauritius adopted an amendment to the Criminal Code. With that amendment, any person who acting under the instructions of, or with the financial support

of, a foreign State as defined in the Criminal Code (Amendment) Act or any organ or agency of such a State produces, distributes, supplies or markets any coin, stamp, official map or other official object or document which, in any manner, misrepresents, or conveys misleading information to, the public about the sovereignty of the Republic of Mauritius over the Chagos Archipelago commits an offence under the laws of the Republic of Mauritius.

Since the United Kingdom is not entitled to be a member of the IOTC as a coastal State, the Republic of Mauritius objects to any documents purportedly submitted by the United Kingdom in respect of the so-called "BIOT" and to the use of terms such as "British Indian Ocean Territory", "British Indian Ocean Territories" and "UK (OT)" in documents circulated for this meeting.

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. The Island of Tromelin forms an integral part of the territory of the Republic of Mauritius. The Republic of Mauritius has full and complete sovereignty over that island, including its maritime zones.

Consideration by this meeting of any document which purports to refer 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 document, cannot and should not be construed in any way whatsoever as implying that France has sovereignty or analogous rights over the Island of Tromelin.

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

This statement is applicable to all agenda items and all documents of this meeting.

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.

The Republic of Mauritius requests that this statement be annexed to the report of this meeting.

24th Session of IOTC Scientific Committee
6-10 December 2021

Agenda Item 6: National Reports from CPCs

Statement by the Republic of Mauritius

(a) National Report submitted by the United Kingdom

The delegation of the Republic of Mauritius is deeply concerned that the United Kingdom has been allowed to submit a National Report in respect of the so-called "British Indian Ocean Territory" ("BIOT") to this meeting. This is in total contradiction with UN General Assembly Resolution 73/295 and in violation of international law.

In Resolution 73/295, the UN General Assembly has called upon the United Nations and all its specialized agencies as well as all other international, intergovernmental and regional 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". The Scientific Committee which is a sub-body of the IOTC – itself a project of FAO which is a specialized institution of the UN – should accordingly not consider the part of the United Kingdom's National Report which relates to the so-called "BIOT".

The National Report of the United Kingdom also refers to the 'marine protected area' ('MPA') which was purportedly established by the United Kingdom around the Chagos Archipelago on 1 April 2010. As is well known, following proceedings initiated by Mauritius against the United Kingdom under Article 287 of, and Annex VII to, the United Nations Convention on the Law of the Sea (UNCLOS), the Arbitral Tribunal constituted under Annex VII to UNCLOS to hear the dispute ruled in its Award of 18 March 2015 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.

In the light of the Award of the Arbitral Tribunal, the Advisory Opinion of the International Court of Justice of 25 February 2019, UN General Assembly Resolution 73/295 and the Judgment of the Special Chamber of the International Tribunal for the Law of the Sea of 28 January 2021 which ruled that Mauritius is to be regarded the coastal state in respect of the Chagos Archipelago, it is clear that the 'MPA' purportedly established by the United Kingdom around the Chagos Archipelago is illegal and 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 delegation of the Republic of Mauritius further wishes to point out that marine scientific research referred to in the United Kingdom's National Report as having been carried out in the Chagos Archipelago was conducted without the approval of the Republic of Mauritius and therefore all such research is in breach of Mauritian laws. It

wishes to emphasize that any person who has been engaged in such research is liable to prosecution under section 28 of the Maritime Zones Act of the Republic of Mauritius.

The Republic of Mauritius reiterates that it is firmly committed to the protection of the marine environment and to the promotion of marine scientific research and, provided that its laws are respected, welcomes collaboration with researchers, universities and research institutions towards these ends.

(b) National Report submitted by France

The delegation of the Republic of Mauritius also wishes to point out that the Island of Tromelin is not a French territory, as claimed by France in its National Report.

The Republic of Mauritius reiterates that the Island of Tromelin forms an integral part of its territory and rejects France's sovereignty claim over that island as well as France's claim to any sovereign right or jurisdiction over the Exclusive Economic Zone adjacent to that island.

Moreover, 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 Republic of Mauritius requests that this statement be annexed to the report of this meeting.

The SC noted the following statement made by the United Kingdom:

Note Number: **OTD/009/2021**

The Overseas Territories Directorate of the Foreign, Commonwealth and Development Office presents its compliments to the Secretariat of the Indian Ocean Tuna Commission (IOTC) and the 24th Session of its Scientific Committee from 6-10 December 2021. For the benefit of the delegates the United Kingdom wishes to restate its position on the British Indian Ocean Territory (BIOT) and membership of the IOTC. This is with reference to Mauritius's statements submitted for agenda items 2 & 6 of the Scientific Committee.

The United Kingdom has no doubt about its sovereignty over the Chagos Archipelago, which has been under continuous British sovereignty since 1814. Mauritius has never held sovereignty over the Archipelago and we do not recognise its claim. 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.

The United Kingdom was disappointed that this matter was referred to the International Court of Justice (ICJ), 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.

UN Resolution 73/295, adopted following the ICJ's Advisory Opinion, does not and cannot create any legal obligations for UN Member States. Neither the non-binding Advisory Opinion nor the non-binding General Assembly resolution alter the legal situation, namely that of a sovereignty dispute between the United Kingdom and Mauritius. The General Assembly is not the appropriate forum to resolve such a bilateral dispute.

The United Kingdom is aware of the judgment delivered on 28 January by the Special Chamber of the International Tribunal for the Law of the Sea (ITLOS) formed to deal with the Dispute concerning delimitation of a maritime boundary claimed by Mauritius to exist between Mauritius and Maldives in the Indian Ocean. The UK is not a party to these proceedings, which can have no effect for the UK or for maritime delimitation between the UK (in respect of BIOT) and the Republic of the Maldives.

The United Kingdom is a full member of the IOTC. The United Kingdom deposited instruments of acceptance to the IOTC Agreement on 31st March 1995 and 22nd December 2020 and has been a party to the Agreement since

it entered into force. 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 BIOT is situated wholly within the IOTC's Area of Competence, there can therefore be no doubtthat the United Kingdom, as the State with sovereignty over BIOT as aforementioned, is entitled to be a member of IOTC.

The United Kingdom requests that this statement be annexed to the report of the Scientific Committee and posted on the IOTC's website.

The Overseas Territories Directorate of the Foreign, Commonwealth and Development Office avails itself of the opportunity to renew to the Secretariat of the Indian Ocean Tuna Commission the assurances of its highest consideration.

FOREIGN, COMMONWEALTH AND DEVELOPMENT OFFICE LONDON

03 December 2021

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

24th Session of IOTC Scientific Committee
6-10 December 2021
Statement by the FRANCE Overseas Territories

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.

APPENDIX 4B
NATIONAL REPORT EXECUTIVE SUMMARIES (2021)

Australia (IOTC-2021-SC24-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 2020, one Australian longliner from the Western Tuna and Billfish Fishery and one longliner from the Eastern Tuna and Billfish Fishery operated in the IOTC Area of Competence. They caught 18.3 t of albacore (*Thunnus alalunga*), 26.3 t of bigeye tuna (*Thunnus obesus*), 15.8 t of yellowfin tuna (*Thunnus albacares*), 92.3 t of swordfish (*Xiphius gladius*) and 0.1 t of striped marlin (*Kajikia audax*). In 2020, no sharks were landed by the Australian longline fleet operating in the IOTC Area of Competence and 3,603 sharks were discarded/released. In addition, 11.6% of hooks deployed in the WTBF were observed with electronic monitoring in the 2020 calendar year. The actual catch of southern bluefin tuna (*Thunnus maccoyii*) in the purse seine fishery was 3906 t in 2020. There was no skipjack tuna (*Katsuwonus pelamis*) caught by purse seine fishing.

Bangladesh (IOTC-2021-SC24-NR02)

Tuna and tuna like other highly migratory species have become high pace in the priority list to the government of Bangladesh for a couple of years especially being after demarcation of sea boundary with the neighbours that lead to open up the access of Bangladeshi fishers to the Area Beyond National Jurisdiction (ABNJ) of high seas. But, it is not possible yet to take this opportunity by harnessing tuna and tuna like bill fishes from expanded high seas because of initiation stage of such fishing industry. Simultaneously, the study of tuna and tuna like fishes of Bangladesh marine waters are one of the most poorly studied areas of the world although it possesses high potentiality. Proper attention is needed in every aspects of exploitation, handling and processing, export and marketing as well as in biological and institutional management strategies. Therefore, a pilot project has been launched to harness tuna and tuna like fishes from Bangladesh marine waters and ABNJ of high seas. Basically, there is no specific tuna fishery in Bangladesh. Tunas are by catch of industrial trawlers, as well as artisanal and mechanized gill netters. Statistically it shows that neritic tunas comprises about 3.17% (3,661.168 t) and 4.68% (5,399.176 t) of catch is mackerels of the industrial catch in the year 2019-20 where industrial sector contributes only 17.19 % of total marine catch. Right now, there is no catch and effort data of tuna and tuna like fishes of artisanal sector but the sector contributes 82.81% of total marine catch. Nowadays, the land based catch and effort data system for artisanal sector is being developed by our Sustainable Coastal and Marine Fisheries Project and we hope that after few years we will be able to provide the tuna and tuna like fishes (mackerel and billfish) date from our artisanal sector. This report, thereby tried to articulate in a frame as per format of commission incorporating a salient feature of the marine fisheries of Bangladesh. Besides, there was no reporting of sea bird interactions with the both industrial and artisanal fishery during the reporting period. Similarly, there was no reporting of mortality of sea turtles, marine mammals and whale sharks, which are protected under existing rules and regulations.

China (IOTC-2021-SC24-NR03)

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 2020 was 80. The number of active deep-frozen longline vessels decreased from 74 in 2019 to 72 in 2020. The tropical tunas catch (bigeye and yellowfin tuna) of Chinese longline fleet in 2020 was estimated at 7,293 t, which was 2,244 t higher than that in 2019 (5,049 t). The number of frozen longline decreased from 14 in 2019 to 8 in 2020. The albacore longline catch for 2020 was estimated at 3,763 t, higher than in 2019 (2,489 t). Both the logbook and observer programs are being implemented for the Chinese longline fleets. In 2020, three scientific observers were deployed on board longline vessels to collect data for both target and bycatch species as required.

Comoros (No National Report Submitted)

Eritrea (No National Report Submitted)

European Union (IOTC-2021-SC24-NR06)

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 2020:
    - 26 active vessels
    - 37104 m^3.j transport capacity
    - 4.242 searching days and 5.608 days at sea
    - 204202 t of catch
    - • YFT 34,3 %
      • SKJ 57,6 %
      • BET 7,9 %
      • Others 0,2%

- Longliners targeting swordfish with significant associated catches of some pelagic shark species
  - Data 2020
    - 14 active vessels
    - 3.246 * 10^6 hooks
    - 5.625 t of catch
    - • SWO 36,4 %
      • BSH 51,8 %
      • SMA 8,0 %
      • Others 3,8%

- Longliners targeting swordfish with significant associated catches of tunas (La Réunion)
  - Data 2020
    - 17 active vessels (≥12m)
    - 3,69 * 10^6 hooks
    - 1.613 t of catch
    - • SWO 48,0 %
      • YFT & BET 30,0 %
      • ALB 13,0 %
      • Others 9,0%

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 2020
    - 20 vessels at Reunion Island (<12 m)
      - 0,488 * 10^6 hooks
      - 388,6 t of catch
        - SWO 32,3 %
        - YFT & BET 30,0 %
        - ALB 15,5 %

        - Others 22,2%
    - 2 vessels at Mayotte Island
        - Catch and effort data not available
- Trolling line and hand-lines
    - Data 2020
        - Reunion :124 vessels
            - fishing days not available
            - 539,0 t of catch (YFT- -DOX-WAH-BIL 92%)
            - Mayotte : 111 active out of 143 yoles in the formal professional sector; 400 boats and 762 canoes in the non-professional sector . Total production estimated for 2020, only for professional boats, is 189t.

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 2019 in the IOTC area of competence, and enabling the IOTC Scientific Committee to conduct its work.

France-territories (IOTC-2021-SC24-NR07)

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 Iles 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 Iles Eparses et s'étend sur l'ensemble de la ZEE des Glorieuses.

Les Iles Eparses (France Territoires) ne disposent pas de flottilles thonières immatriculées pour ce territoire. Néanmoins, l'administration des TAAF délivre des licences de pêche à des palangriers et senneurs français et étrangers souhaitant pêcher dans les eaux administrées par France Territoires, et un programme "observateur" accompagne l'octroi de ces licences. En 2020, l'administration des TAAF n'a pas embarqué d'observateur sur les thoniers senneurs.

Le dispositif de recherche actuel de la France (IRD & Ifremer principalement) sur les grands pélagiques recouvre le suivi des activités de pêche, des débarquements et de la biométrie des espèces cibles et des rejets, l'étude des comportements migratoires des grands pélagiques, des études sur les dispositifs de concentration de poissons, la collecte de données "observateur" (incluant le suivi électronique), des études génétiques et microchimiques pour la délimitation des stocks, la mise au point de mesures d'atténuations des prises accessoires et de la déprédation, l'étude de la mortalité après rejet des pêcheries européennes à la senne et palangrière du requin pointe blanche océanique, ainsi que le développement d'une innovation pour faciliter une libération rapide de la mégafaune marine capturé à la palangre et améliorer la survie des individus. La plupart des projets sont financés sur appels d'offres internationaux, européens ou nationaux. On trouvera dans ce rapport la liste des différents projets qui se sont poursuivis ou ont débuté en 2020. On trouvera de plus des projets impliquant directement la CTOI même si ces projets sont en cours de lancement.

France-Territoires a participé activement à tous les groupes de travail organisés par la CTOI. En association avec UE-France, 20 contributions scientifiques ont été produites en 2020, incluant le rapport national présenté par France-Territoires au Comité Scientifique de la Commission.

India (IOTC-2021-SC24-08)

The total landings of tuna and tuna-like species along Indian coasts had been showing a decreasing trend in the recent past. The total landings of tuna and tuna-like species for 2020 is estimated at 1,52,593.16 tonnes, showing a decrease of 23.66 percent over the previous year. Gillnets remained the major gear contributing to the tuna and tuna like fish catch during 2020 also, however, the percentage contribution of this gear to the catch recorded

reducing trend in comparison to the previous year (27.92% in 2020 against 37.19% in 2019). Trawl and ring seine (17.82% and 17.57% respectively), followed by small longline (8.50%) where the principle gears contributing the catch. Pole and line fishing, practiced exclusively in the waters of the Lakshadweep Group of Islands, contributed 7.21 percent to the total tuna landings. Other gears like Drift longline, small purse seines, Small purse seines, Handline, Troll lines also contributed to the tuna landings in small quantities during the year. Considerable spatial variation was observed in the tuna landings during 2020. The western coast of India (FAO area 51) contributed the larger share to the landings (61.11%) and the balance 38.89 percent landings came from the east coast (FAO area 57). Tuna landings in 2020 comprised seven species, four representing the neritic (32.51%) and three from the oceanic group (27%). Kawakawa (Euthynnus affinis, 33.18%) and Yellowfin tuna (Thunnus albacares) (22.90%) contributed the maximum tuna catch, followed by Skipjack (Katsuwonus pelamis; 21.35%). There was no reporting of sea bird interactions with the tuna fishery during the reporting period. Similarly, there was no reporting of the 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-2021-SC24-NR09)

For fisheries management purposes, Indonesian waters are divided into eleven Fisheries Management Areas (FMA). Three of them are located within the IOTC area of competence, namely FMA 572 (Western Sumatera and Sunda Strait), FMA 573 (South of Java to East Nusa Tenggara, Sawu Sea and western part of Timor Sea), and 571 (Malacca Strait and the Andaman Sea). Indonesian fishers operate various fishing gears such as longline, purse seine, handline, and gillnet to catch large pelagic fishes like tuna, skipjack, marlins, etc. Longline is the primary fishing gear type targeting tunas that operate in those FMAs. The total catch of the main species of tunas in 2020 was estimated at around 205,582 tons1 which are composed of yellowfin tuna (44,471 tons), bigeye tuna (21,556 tons), skipjack tuna (134,455 tons), and albacore (5,099 tons). Landing ports, both artisanal and industrial, are still consistently monitored through various projects and scientific observer programs conducted altogether by the Research Institute for Tuna Fisheries (RITF) and Directorate General of Capture Fisheries (DGCF).

Iran (Islamic Republic of) (IOTC-2021-SC24-NR10)

Iran fishing grounds in southern part of the country is the most important resources for large pelagic species. There are 4 coastal provinces (Khozeastan, Boshehr, Hormozgan and Sistan& Blochestan Provinces) beside the Persian Gulf and Oman Sea where they are located between the longitudes from 48° 30' north to 61° 25' east. Iran, with an interest in fisheries has concluded a number of bilateral agreements that regulate fishing in the area (through RECOFI and bilateral agreement e.g. Iraq, Oman, Kuwait and etc.) For Iranian fishermen the Arabian Sea is the gateway to the northwest Indian Ocean and the opportunity to harvest tuna and other highly migratory large pelagic species. It has been a tradition for Iranian fishers to fish offshore and in the last few decades gillnet and purse seine fisheries have become the established fishing method for Iranian fishers in the international waters of the northwest of the Indian Ocean. So, Iran joint to the Indian Ocean Tuna Commission (IOTC) in 2002 and it has been one of the active countries in the commission. In a briefed view the total amount of fish production including catch and aquaculture has been 1268719 tons in 2020, which around 715401 tons came from catch and 553318 tons from aquaculture. Around On this way around 140000 fishermen with 11500 different type of vessels including fishing boats, dhows, Purse seine, Trolling, Trawl and Wire-trap which are engaged in fishing operation according to time schedule during different fishing seasons in the coastal and offshore waters and landed their fish in 130 fishing harbors and landing centers. On this way, large pelagic species catch is one of the most important group of fish that are caught by Iranian fishermen. There are four fishing gear types which targeting large pelagic species in the IOTC area of competence, included gillnet, purse seine, long line (by traditional boats) and also some of small trolling boats in coastal fisheries.

The main fishing grounds for large pelagic species in southern part of the country are located in the coastal area of the Persian Gulf and Oman Sea. Total production of tuna and tuna like species (including by-catch and discards) was 285,780 t in 2020. This amount of catch contains 69.6% (198,792 t) of Tunas, 12,9% (36,944 t) of Seerfish, 7.7% (21,995 t) of Billfish, 1.2% (3,595 t) different species of shark and 8.6% (25,453 t) other species.

Japan (IOTC-2021-SC24-NR11)
This Japanese national report describes following eight relevant topics stipulated in the 2021 national report guideline mainly in recent five years (2016-2020) (2020 is provisional) , i.e. (1) Fishery information (longline and purse seine fishery), (2) fleet information, (3) catch and effort by species and gear, (4) ecosystem and bycatch (sharks, seabirds, marine turtles), (5) national data collection and processing systems including "logbook data collection and verification", "vessel monitoring system", "observer scheme", "port sampling programs" and "unloading and transshipment", "Monitoring billfish catch", and sampling plans for mobulid rays", (6) national research programs, (7) Implementation of Scientific Committee recommendations and resolutions of the IOTC relevant to the Scientific Committee", and (8) "literature cited". Highlights from the eight topics are described as follows: Japan is currently operating longline and purse seine fisheries in the Indian Ocean. Catch and effort data are collected mainly through logbooks. Bigeye, yellowfin, albacore, southern bluefin tuna are main components of the catch by longliners, while three species (skipjack, yellowfin and bigeye tuna) are exploited by purse seiners. In recent years, catch and effort by longliners are in a low level mainly because of piracy activities off Somalia. Japan has been dispatching scientific observers in accordance with the Resolution 11/04, whose coverage has been more than the 5% compliance level in recent years except for 2020 (provisional) due to COVID-19 pandemic. A number of information including bycatch and biological data, has been collected through the observer program. Japan has been conducting several research activities.

Kenya (No National Report Submitted)

Republic of Korea (IOTC-2021-SC24-NR13)
The number of active vessels in 2020 was 10 for longline fishery and 2 for purse seine fishery. With this fishing capacity, Korean tuna longline fishery caught 3,025 ton in 2020, which was 6% lower than that of 2019. The fishing efforts in 2020 were 4,981 thousand hooks. The fishing efforts averaged for 5 recent years (2016-2020) were 5,851 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. In 2020, Korean longline vessels moved again to the eastern Indian Ocean to operate southern bluefin tuna. Korean tuna purse seine fishery in the Indian Ocean recorded 13,877 ton in 2020. In 2020, 2 vessels of Korean tuna purse seine fishery operated mainly in the western and central tropical areas around 10°N-10°S. The fishing efforts in 2020 were 610 sets, which mainly distributed in the western and central tropical areas around 40°E-70°E. In 2020, national scientific observers for longline fishery were not dispatched onboard for implementing observer program due to the worldwide spread of the COVID-19. Regarding purse seine fishery, regional scientific observers were dispatched onboard.

Madagascar (IOTC-2021-SC24-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 2020, le nombre des palangriers nationaux s'est maintenu au nombre de 5 comme celui de l'année 2019. 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 d'avoir des données sur la distribution de taille des espèces capturées.
Les prises des palangriers varient suivant les années et tendent à diminuer de 2010 à 2020. Cette variation est légèrement proportionnelle à celle de l'effort de pêche (exprimé en nombre d'hameçons déployés) qui en 2020 a beaucoup diminué. Influencée par la diminution du nombre de navire en activité depuis 2018 et évidemment par l'effort de pêche en 2020, la capture moyenne annuelle des palangriers est en baisse avec 318 tonnes. Elle est constituée de 50% 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, 31 sites de débarquement de capture sont actuellement couverts depuis

2017. Les engins de pêche utilisés sont principalement le filet maillant, la ligne et la palangre. A titre d'information, la capture moyenne annuelle de la petite pêche est estimée à 6 200 tonnes ces trois dernières années dont les thons et espèces apparentées constituent les 25% de la capture.

Malaysia (IOTC-2021-SC24-NR15)

Total catch of marine fish from Malaysian waters in 2020 were 1.38 million t, a slight decreased 5.48% compared to 1.46 million in 2019. The total landing in 2020 were attributed to the catch from 48,826 registered vessels with trawlers, purse seines, drift nets contributed large percentage of the catches. In 2020, marine fish production from the west coast of Peninsular Malaysia (Malacca Straits) contributed 777,365 t (56.20%) 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 84% (1,169,200 t) and 16% (214,098 t) 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 Industries 2012-2020 was launched end of 2013. Draft of the third Strategic Development Plan for Tuna Industries 2021-2030 are being developed.

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.

Neritic tuna contributes 76,396.27 t (5.54%) of Malaysia's marine fish landings in 2020. Purse seiners are the most important fishing gear in neritic tuna fisheries, especially the 40-69.9 GRT (Zon C) and >70 GRT (Zon C2) vessel size, with longtail tuna dominated the landings followed by kawa kawa and frigate tuna. In the year 2020, neritic tuna landings in west coast Peninsular Malaysia amounted to 12,633.13 t; decreasing by 27.81% compared to 17,500 t in 2019. Meanwhile landings of neritic tuna in Malaysia ranged from 60,000 t to 80,000 t (2016-2020). The highest catch was recorded in 2019 with 87,400 t 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 2020 from the Indian Ocean showed a 6.43% increased from 2,289.30 t in 2019 to 2,446.73 t in 2020. Albacore showed an increasing of 11.13% from 1,618.65 t in 2019 to 1821.41 t in 2020. Albacore tuna formed nearly 75% of the total catches in the form of whole frozen tuna meanwhile, Yellowfin contributed 15.3% and Bigeye 10.25% of total catches in frozen and gutted forms.

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 19/04 for longliners and purse seiners, 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 19/06, 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. DOF Malaysia also have installed CCTV on every vessel as a tool for EMS as an alternative for observer on board.

Maldives (IOTC-2021-SC24-NR16)

Maldives is a tuna fishing nation with a history dating back hundreds of years. Tuna fishery was the mainstay of the Maldivian economy, providing employment and income, until the establishment of the tourism industry.

The Maldives enacted a new fisheries act in 2019 which superseded the Fisheries Act of 1987. The new Act strengthened fisheries management and governance within the Maldivian waters and Maldives flagged vessels as well as personnel on board these vessels. The Act requires all commercial fisheries, including tuna and non-tuna fisheries, to be managed through respective management plans which have been gazetted.

The tuna fishing fleet has undergone several changes following mechanization that began in 1974. The current fleet is a mixed of wooden and fibre reinforced plastic (FRP) vessels. Majority of the tuna fishing vessels range from 12.5 - 32.5 m in length. Trip lengths for pole and line trip may last between a single day and a week while handline trips are generally 10-15 days long and may depend on the catch and bait availability. The longline fleet that operated in the outer waters of the Maldives EEZ, beyond 100 miles and the high seas, that was suspended in June of 2019 remained as such and therefore did not operate in 2020.

Maldives tuna catches peaked in 2006, reaching about 167,000 t, after which the catches declined by 53% by 2010. Tuna catches have been recovering since with 2020 recording about 146,800 t. In terms of species, skipjack and yellowfin are the two main species in the Maldives tuna fisheries with 70% and 26% contribution respectively.

Skipjack tuna catch from all gears increased by 49% in the last five years (from 69,587t to 103,870t). In contrast, yellowfin tuna catch continues to decline and observed a 19% drop within the last five years (53,264 t to 42,703 t). With the absence of the longline fishery and a decline in reported catches from the pole-and-line fishery, bigeye tuna observed a reduction in catch from 396 t in 2019 to 87 t in 2020. Over the past 5 years, this decline is at 96%. Neritic tunas, frigate and kawakawa remain minor components, contributing about 1% of all tunas.

Pole and line gear landed nearly all of skipjack tuna in 2020 (103,195 t), representing 99% of skipjack tuna landed. Yellowfin tuna contribution from the pole and line gear was at 36% (15,651 t) with the remaining 63% (27,053 t) from the handline fishery. The trolling fleet catch was a negligible amount of 5.6 t of tuna. The longline fishery did not operate in 2020 reporting zero catch.

The two primary gears of the Maldivian tuna fisheries, pole-and-line and handline are highly selective with virtually no bycatch and discards. Observation of over 161 pole-and-line trips by Miller et al, (2017) reported an amount of 0.65% of total tuna catch by weight. Being surface gears, the pole and line and handline gears do not interact or record bycatch of blue sharks, thresher sharks and marine turtles.

Almost all of the important bycatch and other species that interact with commercial tuna fisheries are protected in the Maldives. These include sharks, whalesharks, marine turtles, marine mammals and seabirds inter alia.

Logbooks for the pole and line and handline tuna fisheries were introduced in 2010 and revised in 2012. To improve logbook reporting, modifications to the regulatory framework as well as the fishery licensing conditions were brought about in 2019, which required the submission of the log sheet for the trip prior to unloading the catch. As a results, the logbook coverage has increased substantially.

The web-enabled fishery information system, “Keyolhu” serve as the central system to house and report the fishery catch and effort data. The system also facilitates issuing of fishing and fish processing licenses, entry of fish purchase data by the exporters. A mobile-phone based catch reporting application has also been developed for the tuna fisheries which would allow electronic reporting. Full roll-out of the electronic reporting was hampered due to the COVID crisis.

The vessel monitoring system continues to be improved by replacing the old units with newer models with additional features. Installation of VMS systems onboard the required 373 vessels is expected to be complete within the first quarter of 2022.

A program to implement electronic monitoring of fishing activities is ongoing with the system being installed on 14 vessels. The activities of the program has been delayed due to delays in training staff and customization of the software.

National fishery monitoring programs and research activities for the species of importance in the tuna fisheries are implemented. However, as most species, e.g. mobulids, thresher sharks, blue shark, whale sharks and marine turtles, have zero interactions and bycatch, systemic sampling and monitoring programs for such species do not exist. Further, various national legislations protect these species within the Maldivian waters.

Maldives strived to implement the various requirements from IOTC Conservation and Management Measures, including those that came into effect in 2020. Utmost importance of these are the mandatory statistical data recording and reporting. Several measures have been taken to improve the quality and quantity of catch and effort data from the tuna fisheries. Most of the measures relating to sharks, marine turtles, marine mammals and seabirds

are not applicable to the Maldives due to the absence in the tuna fisheries and virtually non-existent interactions (noting the longline fishery did not operate in 2020).

Mauritius (IOTC-2021-SC24-NR17)

In 2020, the Mauritian tuna fleet consisted of 3 purse seiners, 1 supply vessel and 2 semi-industrial longliners. The three purse seiners are large freezer vessels having an overall length of 89.4 M each while the longliners are semi-industrial boats less than 24 Metres in length. The two semi-industrial longliners operated exclusively inside the Mauritius EEZ.

The two semi-industrial longliners undertook 10 fishing trips and a total of 129500 were deployed for 141 fishing days. The majority of the catch consisted of yellowfin (58%) and albacore (31%). Their total catch amounted to 58.2 tonnes with a CPUE of 0.45kg/ hook. It is to be noted that there has been a decrease in the number of longliners involved in the semi-industrial longline fishery from 15 in 2019 to only 2 in 2020.

The Mauritian purse seiners operated between latitudes 19oN to 11oS and longitudes 43o to 80oE. Total catch of the three purse seiners amounted to 20549t comprising of 47.4% yellowfin, 45.1% skipjack and 4% bigeye tuna for 668 positive sets out of a total of 692 sets. The Observer Programme was not conducted in 2020 as to abide to the precautionary measures put into place with regards to the COVID-19 pandemic.

Sampling exercises were carried out on the catch unloaded from the semi-industrial, artisanal and purse seine fishery. A total of 3175 fishes were sampled for length frequency namely 296 for the artisanal fishery, 341 for the semi-industrial and 2538 for the purse seine fishery. Sampling exercises could be carried out on the Mauritian purse seiners only during their callings at Port Louis which explained the quantity of fish sampled.

Mozambique (No National Report Submitted)

Oman (IOTC-2021-SC24-NR19)

The total production of the Omani fishery sector in 2020 reached a total of 840,000 Tons. Artisanal fisheries contributes 94% of the total fish landings compared to 5% from the industrial fishing sector. The coastal fleet contributed with only 1% of the total landings by four thousand tons. The fisheries sector provides direct employment for 61000 fishermen plus the working force in the related sectors. Tuna species considered as highly valuable products for Omani consumers, have experienced significant increases in the total annual production with about 118000 ton. Artisanal and coastal fleets have, however, increased slightly in the number of vessels and fishermen. Fleet structure can be known from the big landing from the artisanal sector with small fiberglass skifs and dhaows.

Pakistan (No National Report Submitted)

Philippines (IOTC-2021-SC24-NR21)

There were no active Philippines Vessels on the IOTC Convention Area (from 2018 to present). In 2017 (07 October to 19 December), the Philippines had only one active vessel in the IOTC Convention Area (10^{o} S to 5^{o} N – 075^{o} E to 090^{o} E), the FV Marilou 888, a purse seiner, with a GT of 349. During the fishing operations, a total of 25,551 kg bigeye, 72,680 kg yellow fin and 144,566 kg skipjack were caught and all catches landed in General Santos City Fish Port, Philippines. There were also 34 Silky Sharks (FAL) encountered during the trip, 12 of which were released alive and 22 released dead (no sharks were retained in the vessel). In addition, one olive ridley turtle (LKV) which was released alive and one smooth tail mobula (RMO) which was released dead were recorded. The entire trip of the FV Marilou 888 was 100% observer covered and the vessel was VMS equipped. As with previous operations of the Philippines Fishing Fleet, the mandatory application of the conservation and management measures for sharks and other species was observed during the operations of the vessel.

Seychelles (IOTC-2021-SC24-NR22)

The Seychelles National Report summarizes activities of the Seychelles' fishing fleet targeting tuna and tuna-like species in the WIO for the year 2020 in comparison with previous years. It also summarizes research, and data collection related activities as well as actions undertaken in 2020 to implement Scientific Committee recommendations and IOTC Conservation and Management Measures.

Over the past five years, the Seychelles purse seine fleet has remained the same comprising of 13 vessels. The number of supply vessels has decreased from 9 vessel is 2016 to 4 vessels in 2020. The nominal effort increased slightly by 299 days (10%) in 2020, when compared to the previous year, and reach a total of 3,221 days fished whilst the catches remained constant estimated at 112,231 t in 2020 (112,621 t in 2019). The CPUE measured as t/Fishing day reduced to 34.84, compared to 38.54 t/ fishing day during the previous year. Catches of yellowfin tuna and bigeye tuna decreased by 8% and 10% respectively whilst catches of skipjack tuna increased by 4% over the period under review.

The Seychelles Industrial longline fleet comprised of 62 fishing vessels in 2020 compared to 57 vessels in 2019. The total catch reported by this fleet for the year 2020 was like the previous year estimated at 22,469 t of which 7,775 t consisted of yellowfin tuna. The estimated catch rate has remained constant as per the previous year, estimated at 0.55 t/1000 hook.

In 2020, the total catches by the Semi industrial vessels decreased by 26% to reached 1,485t compared to 2,008 t for the previous year. This corresponds to a drop of 41% in fishing effort thus giving a mean catch rate of 0.73 t/ 1000 hooks for the year 2020.

Similarly, to previous years, Seychelles, through 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 IOTC area of competence. Due to technical problems, we are unable to provide statistics for observer programme at this point. Update will be provided to the secretariat in due course.

It should be highlighted that major effort were made in the year 2021 to clear the backlog in longline fishery for years 2019 and 2020 resulted from technical and administrative related issues in late 2019 and impact of the Covid-19 pandemic in early 2020. Seychelles is moving forward with the implementation of EMS and ERS system onboard its fishing fleet targeting tuna and tuna-like species, following successful completion of pilot projects in 2021. The roll-out is expected to be completed by mid 2022.

Somalia (No National Report Submitted)

South Africa (IOTC-2021-SC24-NR25)

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 right holders. The Japanese-flagged vessels typically target tropical tunas and southern bluefin tuna (*Thunnus maccoyii*) with their effort focused in the Indian Ocean. In 2020, a total of 15 longline vessels were active in the IOTC area of competence, which is less than in 2019. Effort decreased substantially - the number of hooks set in 2020 was 572 461, which is less than half that of number set in 2019 (1 355 677). Consequently, catches decreased from 2019 to 2020 for all species; albacore (23%), southern bluefin tuna (27%), bigeye tuna (49%), yellowfin tuna (56%), blue shark (58%), swordfish (74%) and shortfin mako shark (96%). There was no Tuna Pole-line effort in the Indian Ocean area of competence in 2020. Observer coverage exceeded IOTC requirements as 18% (100 179 hooks) of hooks set in the IOTC area of competence in 2020 were observed.

Sri Lanka (IOTC-2021-SC24-NR24)

The total production of tuna and tuna like species of Sri Lanka in year 2020 was 114,638t. 84 % of the catch was from the EEZ. 36% of the total catch was Yellow fin tuna, 38% Skipjack tuna and 5% was bigeye tuna. 13% of the catch was bill fish while Sword fish dominate in the catch. The total shark catch was 721t. The YFT catch reductions adhered as per 19/01. Large scale Gill net are being surveyed and reduced in number and length as per resolution 17/07.

Over 5000 multi day boats engaged in large pelagic fishing in both high seas and within EEZ. 1118 vessels were authorized to fish in high seas and only 927 vessels were active. 99% of the high seas operating vessels are less than 24m. VMS is mandatory for high seas operating vessels. Major fishing gears used were long line and gill net. The gill nets are being discouraged and transformed to selective gears. 34% , 20% and 19% of vessels were exclusively

operated for longline, gill net and ring net respectively. 27% of the vessels used multi-gear of more or less combinations of the above gears in seasonal or incidental manner.
Multi-gear vessels are being promoted to long line by introducing mechanized line haulers and the upgrading of vessel conditions to accommodate better cooling systems to improve the fish quality and reduce the post economic loss. High fuel cost has restricted the year round vessel operations and most vessels are being kept anchored. Electronic catch data collection system is being implemented and carried out parallel to the paper log books. On board observers were deployed in all vessels >24m and pilot project on EMS is ongoing. Port State Measures are being implemented through e-PSM application. Coastal data collection is being improved by introducing better sampling techniques and to achieve the length frequency data in required proportions.

Sudan (No National Report Submitted)

Tanzania (No National Report Submitted)

Thailand (IOTC-2021-SC24-NR28)
Thailand has advance for implementing a comprehensive system to combat IUU fishing. It has taken 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 since 2015 to present. Thailand has implemented PSM and assigned 26 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. Thailand has implemented NPOA-Sharks, Thailand: Plan 1, 2020-2024. In 2020, Thailand had no fishing vessel operated in high sea of IOTC competent. Thailand had only domestic purse seiner fishery in the Andaman Sea, the number of fishing vessel was registered 228 in 2020. Their operated the fishing from shores is 10 to 30 nautical miles and depth of water range from 20-80 m. In 2020, Bullet tuna (50.40%) is the main composition, followed by Kawakawa 31.51%, Longtail tuna 11.32%, Frigate tuna 3.24% Skipjack tuna 2.00%, King mackerel 1.49% and Indo-Pacific sailfish 0.04%. The CPUE of 5 species in 2020 showed 381.14 kg/day, 238.31 kg/day, 85.59 kg/day, 24.49 kg/day, 15.16 kg/day, 11.30 kg/day and 0.28 kg/day, 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 of Great Britain and Northern Ireland (IOTC-2021-SC24-NR29)
This report is for the UK commercial fleet and recreational fisheries in the British Indian Ocean Territories (BIOT). Prior to its exit from the European Union the UK in January 2021 the UK's commercial fleet operated under EU regulations. However for ease of reference both UK EU and UK (BIOT) are presented in this report.
The UK had just one commercial long liner operating in the IOTC Convention area in 2020 of 45 metres overall length. This operated mostly in the south western area of the Indian Ocean on high seas, targeting large pelagic species (blue shark, swordfish and tunas). The UK's scientific observer programme started in mid-2017 and the first full year of sampling data, covering around 11 percent of fishing days, was reported in 2019. No sampling was carried out in 2020 due to issues around Covid 19. The vessel had also left the area before the end of the year when sampling would have been scheduled to take place. 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.
The recreational fishery landed 6.5 tonnes of tuna and tuna like species on Diego Garcia in 2020. Principle target tuna species of the industrial fisheries (yellowfin and skipjack tunas, no bigeye were caught) contributed 50.20% 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, the UK have been taking action to reduce the number of yellowfin tuna caught in the recreational fishery and encouraging their live-release. Length frequency data were recorded for a sample of 211 yellowfin tuna from this fishery. The mean length was 79cm. Sharks caught in the recreational fishery are released alive.

Illegal unreported and unregulated (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 2020 the BIOT Environment Officer continued to take forward the current conservation priorities. In 2020/21 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 (No National Report Submitted)

Senegal (No National Report Submitted)

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 (2021)

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 fulfilled 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. In 2018 Australia finalised, 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 fulfil Australia's obligations under the FAO-Sea turtles Guidelines.

Bangladesh							**Sharks:** Bangladesh currently do not have a NPOA for sharks but a working group has been formed to update the draft NPOA sharks which was developed in 2014 during the BOBLME Phase 1 programme. The Wildlife Conservation and Security Act introduced in 2012 lays out general rules on requirements for hunting wild animals but no specific mention of sharks. The Wildlife Conservation and Security Act was introduced in 2012 states: No person shall hunt any wild animal without license, or import or export any wild animal without a CITES certificate **Seabirds:** Bangladesh currently do not have a NPOA for seabirds. The Wildlife Conservation and Security Act introduced in 2012 lays out general rules on permits required to hunt wild animals but no specific mention of seabirds **Marine turtles:** Bangladesh currently have no information on their implementation of FAO guidelines on sea turtles. The Wildlife Conservation and Security Act introduced in 2012 lays out general rules on requirements for hunting wild animals but no specific mention of turtles
China **–Taiwan,China**		– 1st: May 2006 2nd: May 2012		– 1st: May 2006 2nd: Jul 2014			**Sharks:** China is currently considering developing an NPOA for sharks. **Seabirds:** China is currently considering developing an NPOA for seabirds **Marine turtles:** No information received by the Secretariat. **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 imbricata, Lepidochelys olivacea* and *Dermochelys coriacea* are listed into List of Protected Species. Domestic Fisheries Management Regulation on Far Sea Fisheries request all fishing vessels must carry line cutters, de-hookers and hauling nets in order to facilitate the appropriate handling and prompt release of marine turtles caught or entangled.

Comoros		–		–			**Sharks:** No NPOA has been developed. Shark fishing is prohibited but measures are difficult to enforce due to the artisanal nature of the fisheries. A campaign to raise awareness of measures is being implemented to improve compliance. Shark catches and size frequency data are submitted to IOTC **Seabirds:** No NPOA has been developed. There is no fleet in operation south of 25 degrees south and no long-line fleet. The main fishery is artisanal operating within 24 miles of the coast where there is low risk of interactions with seabirds. **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 2012 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 2019 for Amsterdam albatross which will be in force from 2018-2027. **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, 2016		03-Dec-2009, 2016			**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 2022. **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 plans to develop a NPOA for seabirds after the NPOA Sharks has been finalised. **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. Kenya plans to develop a NPOA for turtles after the NPOA Sharks has been finalised.
Korea, Republic of		08-Aug-11		2019		–	**Sharks:** Currently being implemented. **Seabirds:** NPOA seabirds was submitted to FAO in 2019. **Marine turtles:** All Rep. of Korea vessels fully implement Res 12/04.
Madagascar		–		–			**Sharks:** Madagascar has developed a NPOA for sharks which is awaiting final ministerial approval. **Seabirds:** Development has not begun. Note: A fisheries monitoring system is in place in order to ensure compliance by vessels with the IOTC's shark and seabird conservation and management measures. **Marine turtles:** There is zero capture of marine turtle recorded in logbooks. All longliners use circle hooks. This has been confirmed by onboard observers and port samplers.

Malaysia		2008 2014		–		2008	**Sharks:** A revised NPOA-sharks was published in 2014. **Seabirds:** To be developed **Marine turtles:** A NPOA For Conservation and Management of Sea Turtles had been published in 2008. A revision will be published in 2017.
Maldives, Republic of		Apr 2015	n.a.	–			**Sharks:** Maldives has developed the NPOA-Sharks with the assistance of Bay of Bengal Large Marine Ecosystem (BoBLME) Project. A stakeholder consultation for the NPOA-Sharks was held in April of 2014. The NPOA-Sharks is in the finalization process and is expected to be published in November of 2014. The longline logbooks ensure the collection of shark bycatch data to genus level. Maldives would be reporting on shark bycatch to the appropriate technical Working Party meetings of IOTC. **Seabirds:** Maldives is in the final stages of developing an action plan on seabird nesting sites. Article 12 of IPOA states that if a 'problem exists' CPCs adopt an NPOA. IOTC Resolution 05/09 suggests CPCs to report on seabirds to the IOTC Scientific Committee if the issue is appropriate'. Maldives considers that seabirds are not an issue in the Maldives fisheries, both in the pole-and-line fishery and in the longline fishery. The new longline fishing regulations has provision on mitigation measures on seabird bycatch. **Marine turtles:** Standards of code and conduct for managing sea turtles have been developed by the Environmental Protection Agency in the drafted National sea turtle management plan under the protected species regulation. Longline regulation has provisions to reduce marine turtle bycatch. The regulation urges longline vessels to have dehookers for removal of hook and a line cutter on board, to release the caught marine turtles as prescribed in Resolution 12/04.
Mauritius		2016					**Sharks:** The NPOA-sharks has been finalised; it focuses on actions needed to exercise influence on foreign fishing through the IOTC process and licence conditions, as well as improving the national legislation and the skills and data handling systems available for managing sharks. **Seabirds:** Mauritius does not have national vessels operating beyond 25^0S. However, fishing companies have been requested to implement all mitigation measures as provided in the IOTC Resolutions. **Marine turtles:** Marine turtles are protected by the national law. Fishing companies have been **requested** to carry line cutters and de-hookers in order to facilitate the appropriate handling and prompt release of marine turtles caught or entangled.

Mozambique		–		–			**Sharks**: Drafting of the NPOA-Shark started in 2016. At this stage, a baseline assessment was performed and the relevant information of coastal, pelagic and demersal shark species along the Mozambican coast was gathered. The ongoing process is expected to be completed by the end of 2018. **Seabirds**: Mozambique is regularly briefing the Masters of their fishing vessels on the mandatory requirement to report any seabird interaction with longliner fleet. **Marine turtles**: see above.
Oman, Sultanate of							**Sharks:** An NPOA-sharks is currently being drafted and is due to be finalized in 2017 **Seabirds:** Not yet initiated. **Marine turtles:** The law does not allow the catch of sea turtles, and the fishermen are requested to release any hooked or entangled turtle. The longline fleet are required to carry out the line cutters and de-hookers.
Pakistan							**Sharks:** A stakeholder consultation workshop was conducted from 28-30 March 2016 to review the actions of the draft NPOA - Sharks. The draft NPOA was circulated to the key stakeholders and comments were received with an end-date of 30 June 2016. The final version of the NPOA - Sharks has been submitted to the provincial fisheries departments for endorsement. Meanwhile, the provincial fisheries departments have passed notification on catch, trade and/or retention of sharks including Thresher sharks, hammerheads, oceanic whitetip, whale sharks, guitarfishes, sawfishes, wedgefishes and mobulids. Sharks are landed with the fins attached and each and every part of the body of sharks are utilised. **Seabirds:** Pakistan considers that seabird interactions are not a problem for the Pakistani fishing fleet as the tuna fishing operations do not include longline vessels. **Marine turtles:** Pakistan has already framed Regulations regarding the prohibition of catching and retaining marine turtles. As regards to the reduction of marine turtle bycatch by gillnetters; presently Marine Fisheries Department (MFD) in collaboration with International Union for Conservation of Nature (IUCN) Pakistan, is undertaking an assessment. Stakeholder Coordination Committee Meeting was conducted on 10th September 2014. The "Turtle Assessment Report (TAR)" will be finalized by February 2015 and necessary guidelines / action plan will be finalized by June 2015. As per clause-5 (c) of Pakistan Fish Inspection & Quality Control Act, 1997, "Aquatic turtles, tortoises, snakes, mammals including dugongs, dolphins, porpoises and whales etc" are totally forbidden for export and domestic consumption. Pakistan is also in the process of drafting a NPOA for cetaceans.

Philippines		Sept. 2009		–			**Sharks:** Under periodic review. **Seabirds:** Development has not begun. **Marine turtles:** No information received by the Secretariat.
Seychelles, Republic of		Apr-2007		–			**Sharks:** Seychelles has developed and is implementing a new NPOA for Sharks for years 2016-2020 **Seabirds:** SFA is collaborating with Birdlife South Africa to develop an NPOA for sea bird. A consultant will be recruited to start development in December 2017 **Marine turtles:** An NPOA for turtles is planned to start in 2018.
Somalia							**Sharks:** Somalia is currently revising its fisheries legislation (current one being from 1985) and has completed the necessary steps for required for the consultative process to begin in order to develop these NPOA. **Seabirds:** See above. **Marine turtles:** The Somali national fisheries law and legislation was reviewed and approved in 2014. This includes Articles on the protection of marine turtles. Further review of the National Law is underway to harmonize this with IOTC Resolutions and is expected to be presented to the new parliament for endorsement in 2017.

South Africa, Republic of		–		2008			**Sharks**: The NPOA-sharks was first approved and published in 2013. A review is now being undertaken with cooperation from several International and National experts in order to update the NPOA. **Seabirds**: Published in August 2008 and fully implemented. The NPOA-seabirds has been earmarked for review. **Marine turtles**: The South African permit conditions for the large pelagic longline fishery prohibits landing of turtles. All interactions with turtles are recorded, by species, within logbooks and in observer reports, including data on release condition. Vessels are required to carry a de-hooker on board and instructions on turtle handling and release in line with the FAO guidelines are included in the South African Large Pelagic permit conditions. All turtle interactions in respective areas of competence are reported to the respective RFMOs. Recent South African led studies on impact of marine debris on turtles have been published in the scientific literature (Ryan et al. 2016). Marine turtle nesting sites in South Africa are protected by coastal MPAs since 1963.
Sri Lanka							**Sharks:** An NPOA-sharks has been finalized and is currently being implemented. **Seabirds:** Sri Lanka has determined that seabird interactions are not a problem for their fleets. However, a formal review has not yet been provided to the WPEB and SC for approval. **Marine turtles:** Implementation of the FAO Guideline to Reduce Sea Turtle Mortality in Fishing Operation in 2015 was submitted to IOTC in January 2016. Marine turtles are legally protected in Sri Lanka. Longliner vessels are required to have dehookers for removal of hooks and a line cutter on board, to release the caught marine turtles. Gillnets longer than 2.5 km are now prohibited in domestic legislation. Reporting of bycatch has made legally mandatory and facilitated via logbooks.
Sudan							**Sharks:** No information received by the Secretariat. **Seabirds:** No information received by the Secretariat. **Marine turtles:** No information received by the Secretariat.
Tanzania, United Republic of		–		–			**Sharks:** Initial discussions have commenced. **Seabirds:** Initial discussions have commenced. Note: Terms and conditions related to protected sharks and seabirds contained within fishing licenses. **Marine turtles:** Sea turtles are protected by law. However, as there is a national turtle and Dugong conservation committee that oversee all issues related to sea turtles and dugongs. There is no information so far with regards to interaction between sea turtles and long line fishery.

Thailand		2020		–			**Sharks:** An updated NPOA Sharks has been developed for the years 2020-2024 and has been submitted to the Secretariat and FAO. **Seabirds:** Development of NPOA seabirds has not begun. Thailand does not have longliners operating in the southern region of the Indian Ocean far from Thailand or large purse seine vessels operating in the Indian Ocean as a whole and has no record of incidental catches of seabirds in Thailand's tuna fisheries. The Notification of the Department of fishing vessels operating in Indian Ocean Tuna Commission Competence Area B.E.2561 has been in force since 2018 and includes requirements for line-cutters and dehookers to be carried for releasing marine animals and for any fishing vessel operating south of 25^{o}S to follow the measures for mitigating capture of seabirds **Marine turtles:** Thailand reports on progress of the implementation of FAO guidelines on turtles in their National Report to IOTC. Laws relating to conservation of marine turtles include: a prohibition on catching marine turtles; discarding of any marine turtles caught and recording details on catches; and a requirement to take care of injured marine turtles that have been caught.
United Kingdom	n.a.	–	n.a.	–		–	British Indian Ocean Territory (Chagos Archipelago) waters are a Marine Protected Area closed to fishing except recreational fishing in the 3nm territorial waters around Diego Garcia. Separate NPOAs have not been developed within this context. **Sharks/Seabirds:** For sharks, UK is the 24th signatory to the Convention on Migratory Species 'Memorandum of Understanding on the Conservation of Migratory Sharks' which extends the agreement to UK Overseas Territories including British Indian Ocean Territories; Section 7 (10) (e) of the *Fisheries (Conservation and Management) Ordinance* refers to recreational fishing and requires sharks to be released alive. No seabirds are caught in the recreational fishery. **Marine turtles:** No marine turtles are captured in the recreational fishery. A monitoring programme is taking place to assess the marine turtle population in UK (OT).
Yemen							**Sharks:** No information received by the Secretariat. **Seabirds:** No information received by the Secretariat. **Marine turtles:** No information received by the Secretariat.

COOPERATING NON-CONTRACTING PARTIES							
Senegal		25-Sept-2006		–			**Sharks:** The Sub-Regional Fisheries Commission supported the development of a NPOA-sharks for Senegal in 2005. Other activities conducted include the organization of consultations with industry, the investigation of shark biology and social -economics of shark fisheries). The NPOA is currently being revised. Consideration is being made to the inclusion of minimum mesh size, minimum shark size, and a ban on shark finning. **Seabirds:** The need for a NPOA-seabirds has not yet been assessed. **Marine turtles:** No information received by the Secretariat.

Colour key	
Completed	
Drafting being finalised	
Drafting commenced	
Not begun	

APPENDIX 6A
GUIDELINES FOR THE PROVISIONS OF EXCEPTIONAL CIRCUMSTANCES FOR IOTC SPECIES MPS

[*This is a living document with generic guidelines that could apply for any MP adopted and implemented by the IOTC.]*

When a Management Procedure (MP) is adopted, a set of checks are essential to ensure that unexpected events do not result in MP advice that is risky for the stock and fisheries. These checks are part of these guidelines that provide a structure for providing management advice when there are concerns about implementing an MP. The guidelines provide a scientific process for developing appropriate management responses to exceptional circumstances and, hence, provide transparency in TAC decision making by the Commission.

Exceptional circumstances are defined in the IOTC as "… circumstances (primarily related to future monitoring data falling outside the range covered by Management Strategy Evaluation (MSE) simulation testing) where overriding of the output from a Management Procedure should be considered…". Exceptional circumstance can include:

- New knowledge about the stock, population dynamics or biology
- Changes in fisheries or fishing operations
- Changes to input data to the MP, or missing data, or
- Inconsistent implementation of the MP advice (e.g. total catch is greater than the Total Allowable Catch (TAC)).

Management responses to exceptional circumstances can include review of additional information or new research, review of the performance of the MP (via reconditioned Operating Models), or management advice to precautionarily revise the TAC. These guidelines provide broad principles to govern the research or management actions to take in such an event.

The process has three stages: 1) determine whether any exceptional circumstances exist, 2) determine the severity and impact of the exceptional circumstances on achieving the objectives of the MP, and 3) if necessary, identify the research or management actions that could be taken by the IOTC.

Stage 1: When an MP is adopted, the IOTC Scientific Committee (SC) will annually review the following items for evidence of exceptional circumstances:

1. Information on the stock, fishing operations, population dynamics parameters, or biology that is outside the range (90% probability interval from MSE projections – or % to be decided by the SC) considered during MSE of the adopted MP.
2. Input data to the MP that are missing, have changed, or outside the range (90% – or % to be decided by the SC) simulated in the MSE.
3. Implementation of the MP that is inconsistent with the MP advice (e.g. total catch is greater than the TAC recommended by the MP).

Stage 2: If there is evidence for exceptional circumstances the SC will review the potential impact and severity on implementation and performance of the MP.

Stage 3: Depending on the impact of the exceptional circumstance, the SC will provide advice on the action required, such as a collection of ancillary data to be reviewed, review of the MP and, if necessary, provide updated management advice (e.g. TAC advice). As a guide, the SC could consider the following:

If there is a very high potential impact the SC will consider TAC changes. TAC change can be determined by an x% change to the TAC, where the x% is based on an urgently updated assessment and projections and is consistent with meeting the objectives of the MP.

APPENDIX 6B

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

Year	Albacore	Skipjack	Yellowfin	Bigeye	Swordfish
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 and 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 and provide direction to the WPs/SC on the need to undertake further MSE of candidate or alternative MPs	**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.	**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.	**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.
	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.	**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.	**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 and 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 and provide direction to the WPs/SC on the need to undertake further MSE of candidate or alternative MPs.	**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.	**Commission**: Consider work and advice from subsidiary bodies. Decision and adoption of an MP.	**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.
	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**: Process and application of the adopted MP.	**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	**TCMP**: Provide advice to Commission on elements of candidate MPs, and any proposed Resolutions for an MP, that require a decision by the	**TCMP**: Provide advice to Commission on elements of candidate MPs, and any proposed Resolutions for an MP, that require a decision by the	**TCMP**:	**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.	Commission, including the performance of candidate MPs against Commission objectives.	Commission, including the performance of candidate MPs against Commission objectives.		Commission, including the performance of candidate MPs against Commission objectives.
	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.	**Commission:** Consider work and advice from subsidiary bodies. Decision and adoption of an MP.	**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.	**Commission**:	**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.
	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,
2024	**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.	**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.

APPENDIX 6C
DRAFT TERMS OF REFERENCE FOR AN INDEPENDENT PEER REVIEW OF THE 2021 INDIAN OCEAN YELLOWFIN TUNA ASSESSMENT

Introduction

The 2021 yellowfin tuna assessment in the IOTC (Fu et al., 2021) using the Stock Synthesis (Methot Jr and Wetzel, 2013) was adopted by the 23rd Working Party of Tropical Tunas to inform the IOTC Commission of stock status and management advice (until discussion and endorsement by the 24th Scientific Committee). However, the IOTC's WPTT and SC has noted (in this and previous assessments of this stock) that areas of uncertainty of the assessment require follow-up investigation and expert advice, and that the assessment outcomes may be affected by alternative model configurations, data streams, biological parameters, assumptions and other sources of uncertainty. WPTT23 recommended a follow-up work, including an independent peer review, is important to improve confidence in future yellowfin stock assessments in the IOTC. Given the similarities in model structure and data inputs, the follow-up work and peer review of the yellowfin assessment would also be relevant to the bigeye and skipjack assessments.

This document outlines the Terms of Reference (ToR) for the peer review of the yellowfin assessment to be considered by 24th Session of the IOTC SC, which will guide the external review panel in their work. See **Table I** for the relevant extract relating to the WPTT23 recommendation for this peer review and suggested timelines.

Background

The yellowfin assessment uses catch, catch per unit of effort, size frequency and tagging data. A general concern is that there is conflict among data sources in the assessment and that stock assessment key management quantities are sensitive to the amount of weight placed on different data sources. The model structure (spatially disaggregated and in quarterly time steps) may be overly complex given the available data and biological information.

Additionally, recent studies suggest that the biological information (growth, fecundity and natural mortality) used in the stock assessment may need to be updated and the model configuration may need to be adapted to these changes too. Also, alternative CPUE data are available but haven't been used in the assessments due to different reasons (pole and line, purse seine from FADs, buoy derived indices).

The Scientific Committee also noted that to date, projections have been carried out deterministically which may be underestimating the uncertainty in the management advice. Future work would benefit from the exploration of stochastic projections which should be thoroughly reviewed and evaluated. Further work should also be conducted to investigate the spatial recruitment trends and how these can be accounted for in the assessment model.

The general configuration of the model and the abovementioned issues require follow-up investigations and advice. These considerations for the basis for the scope of this review.

Objectives

1. Undertake, in consultation with the stock assessment expert from the IOTC as well as IOTC WPTT, WPM and SC chairs and vice-chairs, a peer review of the 2021 yellowfin stock assessment in the Indian Ocean (IOTC).
2. Based on the review work provide recommendations for improving the assessment, including data inputs, model configuration, biological parameters, modelling approaches and treatment of uncertainty.
3. In conjunction with the IOTC Working Party on Tropical Tunas scientists, identify improvement options that are feasible for application to the 2024 yellowfin assessment and how these can also be applied in the assessments of bigeye, skipjack and other IOTC stocks.

Scope

The key areas for consideration by the peer review panel based on the recommendations of the YFT stock assessment paper (IOTC-2021-WPTT23-12), WPTT stock assessment report and follow-up considerations of the assessment team are listed below:

1. Model inputs, commenting on the adequacy and appropriateness of data sources and data inputs to the stock assessment, with particular attention to:
   a. Growth: review the approach to estimation of growth parameters and consider the implications of the new growth curves developed in 2021 (Farley et al., 2021).
   b. Natural mortality: review the approach used to determine M-at-age and implications of alternative M assumptions (Hoyle, 2021).
   c. Tagging data: review the approach used to treat tagging data as model inputs, and how the tagging data are used within the model, including an evaluation of their use in the stock assessment.
   d. Catch and Size composition: review the approach for pre-treatment of size composition data (i.e., re-weighting) and how size composition is weighted for the likelihood function.
   e. Catch per unit of effort: Review the standardization of the joint longline CPUE (Kitakado et al., 2021) and of the EU purse seine (free school) index (Guéry et al., 2021) developed in 2021. Also, evaluate alternative fishery dependent CPUEs and buoy derived indices available for the assessment and its potential use.
   f. Data inputs: identify and provide recommendations on the key areas for improvement in data collection (both fishery data and biological information).

2. Model configuration, assumptions and settings, with particular attention to:
   a. Model complexity: review the appropriateness of the model complexity, including spatial and fishery structure, in relation to data inputs and other available information.
   b. Selectivity: review selectivity assumptions and settings.
   c. Uncertainty: review the approach used to represent uncertainty in model-derived management quantities, considering structural, model and input data uncertainty as well as development of criteria to select the final models in the grid.

3. Model diagnostics, with particular attention to:
   a. Review the suitability of the diagnostics used and reported for the assessment.
   b. Consider the diagnostics provided for the 2021 yellowfin assessment and provide guidance on follow-up work where the diagnostics suggest issues, i.e., data conflicts.

4. Future research areas, with the identification of priorities to improve future assessments.

While these key topics will be a focus of the peer review, other aspects of the assessment and data inputs may become focus areas as the review progresses.

Table 1: Key activities and outputs from peer review (Process should be discussed in the SC):

Activity	**Output**	**Timeframe**	**Possible dates**
Review of the 2021 yellowfin stock assessment document and report of the 2021 WPTT	Summary paper of general comments and suggestions for any pre-workshop modelling or further information/data required by the review panel (To be reviewed by the WPTT in 2022)	In the year following the assessment	August 2022
Pre-workshop planning meeting. (Online)	Plan for the workshop developed	At least 1 month prior to the workshop	January 2023
Review workshop at a location to be decided	Completion of 5 day + travel in-person modelling workshop to	**To be discussed**	**February 2023**

	be moderated by the chair of the WPTT		
Review outcomes of modelling workshop	Draft workshop report coordinated by the WPTT chair, SC chair and Secretariat to IOTC WPTT/SC for review and response (to be reviewed by WPTT data prep meeting in 2023)	With 2 weeks of the end of the modelling workshop	March 2023
Finalise peer review report	Final report provided to IOTC WPTT for review	**To be discussed**	**October 2023**
Report finalised	Deliver final report including WPTT comments to IOTC SC	**To be discussed**	**December 2023**

Logistics

The SC24 will review and finalize these ToRs for the expert peer review. The starting dates of the peer review will be agreed with the experts with the aim of informing the development of the 2024 assessment of yellowfin. One workshop will be prepared that will involve the IOTC analyst and participants identified by the SC, including the Chair (and vicechair) of the SC, the Chair (and vicechair).

References

Farley et. al (2021) Preliminary estimation of growth parameters for yellowfin tuna (Thunnus albacares) in the Indian Ocean from otolith-based age estimates (Farley et al), IOTC-2021-WPTT23-05.

Farley, J.H., Krusic-Golub, K., Eveson, J.P., Luque, P.L., Clear, N., Fraile, I., et al. (2021). Estimating the age and growth of yellowfin tuna (Thunnus albacares) in the Indian Ocean from counts of daily and annual increments in otoliths. IOTC-2021-WPTT23-05_Rev1.

Fu, D., A., U., Cardinale, M., Methot Jr, R.D., Hoyle, D.S., and Merino, G. (2021). Preliminary Indian Ocean yellowfin tuna stock assessment 1950-2020 (Stock Synthesis).

Guéry, L., Kaplan, D., Marsac, F., Grande, M., Abascal, F., Baez, J.C., et al. (2021). Standardized purse seine CPUE of Yellowfin tuna in the Indian Ocean for the European fleet. IOTC-2021-WPTT23-10.

Hoyle, D.S. (2021). Approaches for estimating natural mortality in tuna stock assessments: application to Indian Ocean yellowfin tuna. IOTC-2021-WPTT23-08_Rev1.

Kitakado, T., Wang, S.P., Satoh, K., Lee, S.I., Tsai, W., Matsumoto, T., et al. (2021). Updated report of trilateral collaborative study among Japan, Korea and Taiwan for producing joint abundance indices for the yellowfin tunas in the Indian Ocean using longline fisheries data up to 2020. IOTC–2021- WPTT23-11.

Methot Jr, R.D., and Wetzel, C.R. (2013). Stock synthesis: A biological and statistical framework for fish stock assessment and fishery management. Fisheries Research, 142(0): 86-99.

APPENDIX 7

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

Group	Chair/Vice-Chair	Chair	CPC/Affiliation	1st Term commencement date	Term expiration date (End date is until replacement is elected)	Comments
SC	Chair	Dr Toshihide Kitakado	Japan	10–Dec–19	End of SC in 2023	2nd term
	Vice-Chair	Dr Denham Parker	South Africa	10–Dec–19	End of SC in 2023	2nd term
WPB	Chair	Dr Denham Parker	South Africa	12–Sept–19	End of WPB in 2023	2nd term
	Vice-Chair	Dr Jie Cao	China	12–Sep–19	End of WPB in 2023	2nd 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 2023	2nd term
	Vice-Chair	Dr Shiham Adam	Maldives, Rep. of	13–Nov–18	End of WPTT in 2023	2nd term
WPEB	Chair	Dr Mariana Tolotti	EU,France	10–Sept–21	End of WPEB in 2023	1st term
	1st Vice-Chair	Dr Mohamed Koya	India	10–Sept–21	End of WPEB in 2023	1st term
	2nd Vice-Chair	Dr Charlene da Silva	South Africa	10–Sept–21	End of WPEB in 2023	1st term
WPNT	Chair	Ms Ririk Sulistyaningsih	Indonesia	5–July–19	End of WPNT in 2023	2nd term
	Vice-Chair	Dr Farhad Kaymaram	I.R. Iran	5–July–19	End of WPNT in 2023	2nd term
WPDCS	Chair	Dr Julien Barde	EU,France	3–Dec–21	End of WPDCS in 2023	1st term
	Vice-Chair	Mr Nuwan Gunawardane	Sri Lanka	3–Dec–21	End of WPDCS in 2023	1st term
WPM	Chair	Dr Hilario Murua	ISSF	19–Oct–19	End of WPM in 2023	2nd term
	Vice-Chair	Vacant	Vacant	NA	NA	NA
WGFAD	Co-Chair	Dr Gorka Merino	EU,Spain	06-Oct-21	End of WGFAD in 2023	1st term
	Co-Chair	Mr Abdirahim Sheik Heile	Somalia	06-Oct-21	End of WGFAD in 2023	1st term
WGEMS	Chair	Dr Hilario Murua	ISSF	17-Nov-21	End of WGEMS in 2023	1st term
	Vice-Chair	Dr Don Bromhead	Australia	17-Nov-21	End of WGEMS in 2023	1st term

APPENDIX 8
EXECUTIVE SUMMARY: ALBACORE

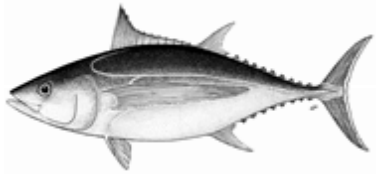


Table 1. Status of albacore (*Thunnus alalunga*) in the Indian Ocean

Area	Indicators – 2019 assessment		Status[3]
Indian Ocean[1]	Catch 2020[2] (t)	38,082	
	Average catch 2016–2020 (t)	38,781	
	MSY (1,000 t) (95% CI)	35.7 (27.3–44.4)	
	F_{MSY} (95% CI)	0.21 (0.195-0.237)	
	SB_{MSY} (1,000 tt) (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}	0.262	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence
[2] Proportion of 2020 catch fully or partially estimated by IOTC Secretariat: 15%
[3] The stock status refers to the most recent years' data used in the last assessment conducted in 2019. i.e., 2017

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 ($F_{year}/F_{MSY}\leq 1$)		

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 F_{MSY}). 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 is 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 2019 (39,876 t) 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 fisheries (mean annual catch 2016-2020):** albacore are caught using longline (88.5%), followed by line (9.1%) and purse seine (1.3%) (**Fig. 1**). The remaining catches taken with other gears contributed to 1.1% of the total catches in recent years.

- **Main fleets (mean annual catch 2016-2020)**: the majority of albacore catches are attributed to vessels flagged to Taiwan,China (58.6%) followed by Indonesia (17.4%) and China (8.9%). The 28 other fleets catching albacore contributed to 15% of the total catch in recent years.

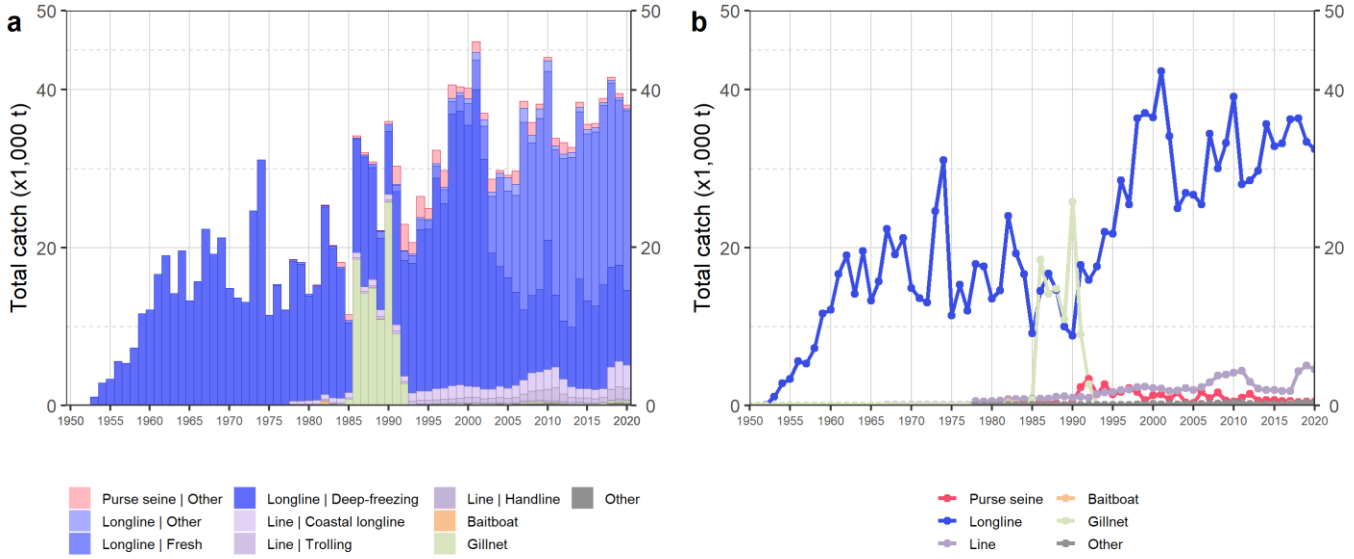


Fig. 1. Annual time series of (a) cumulative nominal catches (t) by fishery and (b) individual nominal catches (t) by fishery for albacore during 1950–2020; Other: all remaining fishing gears

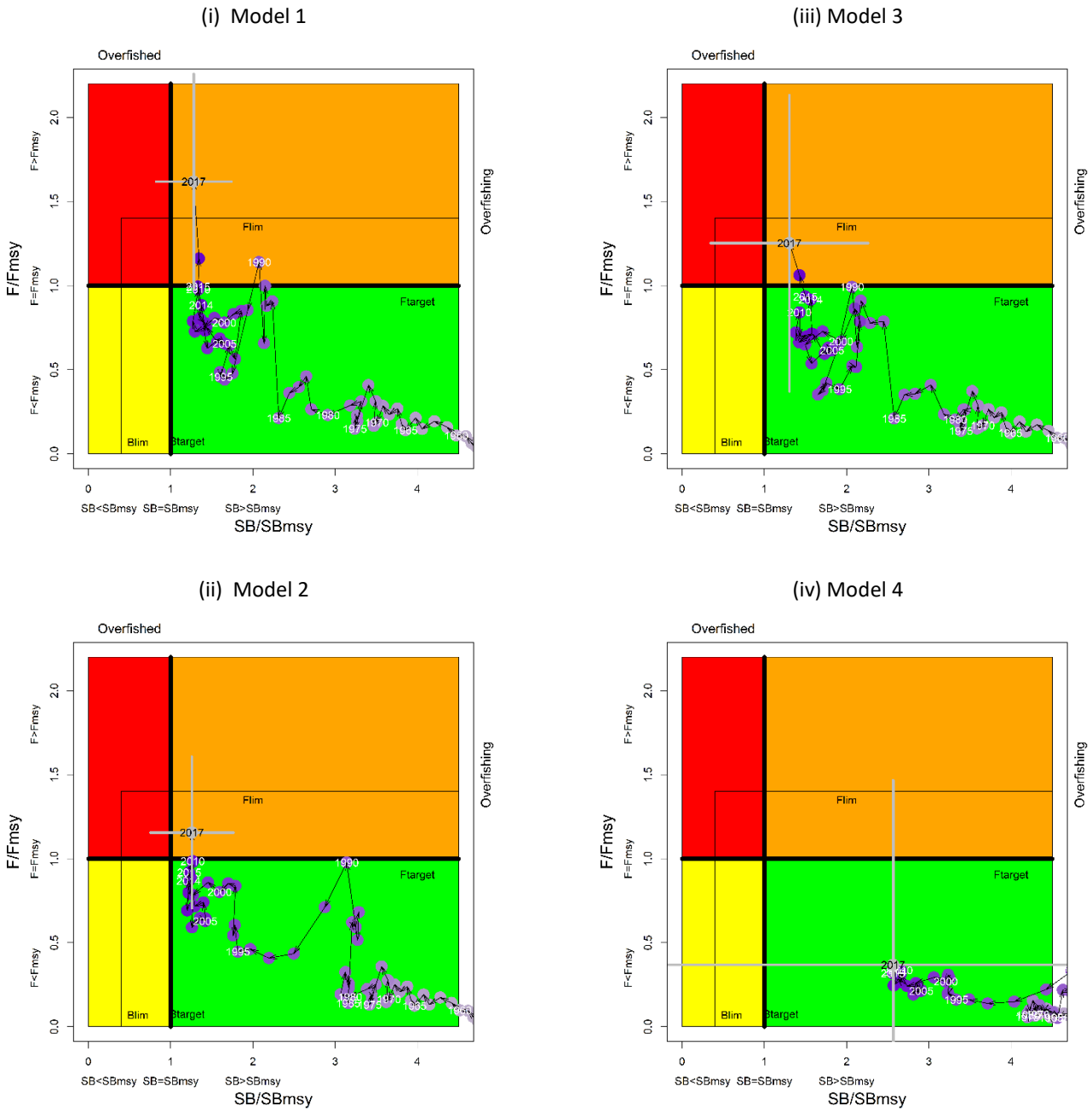


Fig. 2. Albacore: SS3 Indian Ocean assessment Kobe plot for the four model options considered: (i) Model 1 (ii) Model 2 (iii) Model 3 (iv) Model 4. Purple circles indicate the trajectory of the point estimates for the spawning biomass (SB) ratio and fishing mortality (F) ratio for each year 1950–2017 (the grey lines represent the 95 percentiles of the 2017 estimate). Target (F_{target} and SB_{target}) and limit (F_{lim} and SB_{lim}) 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

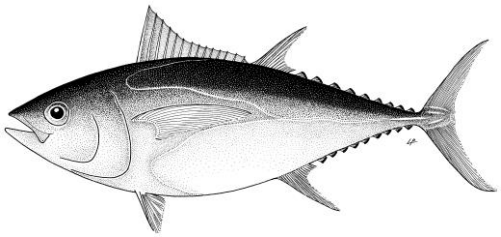


Table 1. Status of bigeye tuna (*Thunnus obesus*) in the Indian Ocean

Area[1]	Indicator	Value	Status[3]
Indian Ocean[1]	Catch in 2020 (t)[2]	83,498	38.2%*
	Average catch 2016-2020 (t)	86,880	
	MSY (1,000 t) (80% CI)	87 (75-108)	
	F_{MSY} (80% CI)	0.24 (0.18-0.36)	
	SB_{MSY} (1,000 t) (80% CI)	503 (370-748)	
	F_{2018} / F_{MSY} (80% CI)	1.20 (0.70-2.05)	
	SB_{2018} / SB_{MSY} (80% CI)	1.22 (0.82-1.81)	
	SB_{2018} / SB_0 (80% CI)	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 2020 catch fully or partially estimated by IOTC Secretariat : 16.3%
[3]The stock status refers to the most recent years' data used in the assessment conducted in 2019, i.e., 2018
*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_{2018} / SB_{MSY}<1)	Stock not overfished (SB_{2018} / SB_{MSY}≥ 1)
Stock subject to overfishing (F_{2018} / F_{MSY}≥ 1)	34.6%	38.2%
Stock not subject to overfishing (F_{2018} / F_{MSY}≤ 1)	0%	27.2%
Not assessed / Uncertain		

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

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. In 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 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 the2018 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 2018 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 2018 levels there is a risk of breaching MSY reference points with 58.9% and 60.8% probability in 2021 and 2028. Maintaining catches of at least 10% below 2018 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 fisheries** (mean annual catch 2016-2020): purse seine (41.4%) (Log/FAD schools = 28.6%; free school = 6.4%), deep-freezing longline (27.5%), fresh longline (9.5%), coastal longline (9.3%) (**Fig. 1**);
- **Main fleets** (mean annual catch 2016-2020): EU (45%) (Spain (16.9%), France (4.5%), Italy (0.5%), Indonesia (23.1%), Taiwan,China (15.7%), Seychelles (13.6%), Sri Lanka (5.7%).

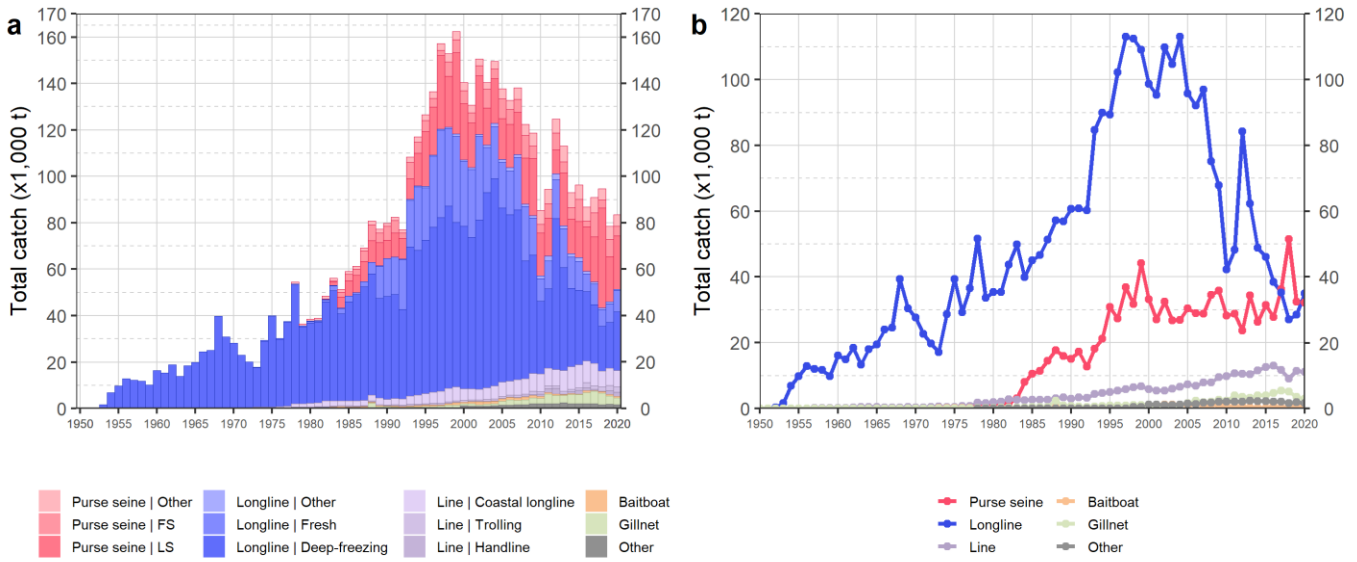


Fig. 1. Annual time series of (a) cumulative nominal catches (t) by fishery group and (b) individual nominal catches (t) by fishery for bigeye tuna during 1950–2020. FS = free-swimming school; LS = drifting log/FAD-associated school; Purse seine | Other: coastal purse seine, purse seine of unknown school association type, ring net; Other: all remaining fishing gears

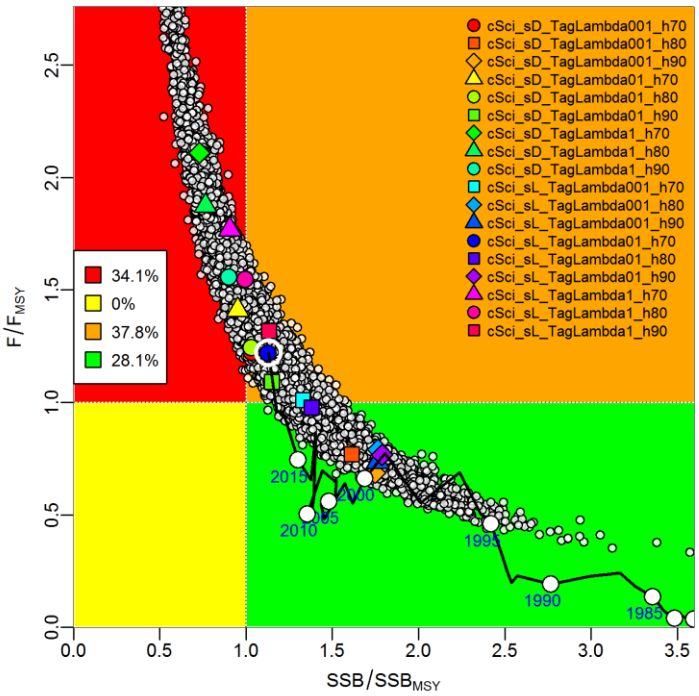


Fig. 2. Bigeye tuna: SS3 Aggregated Indian Ocean assessment Kobe plot. The coloured points represent stock status estimates from the 18 model options. The grey dots represent 5,000 estimates of 2018 stock status from the multivariate normal approximation from the mean and variance-covariance of the 18 model options. The legend indicates the estimated probability of the stock status being in each of the Kobe quadrant. The white circle (around the blue 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 exceed reference point				
	60% (48,848 t)	**70%** (56,990 t)	**80%** (65,130 t)	**90%** (73,272 t)	**100%** (81,413 t)
$SB_{2021} < SB_{MSY}$	51.1	53.3	54.2	57.1	58.9
$F_{2021} > F_{MSY}$	7.3	17.8	32	47.9	62.8
$SB_{2028} < SB_{MSY}$	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 ($SB_{Lim} = 0.5\ SB_{MSY}$; $F_{Lim} = 1.3\ F_{MSY}$)				
	60% (48,848 t)	**70%** (56,990 t)	**80%** (65,130 t)	**90%** (73,272 t)	**100%** (81,413 t)
$SB_{2021} < SB_{Lim}$	0	0	0	0	0
$F_{2021} > F_{Lim}$	6.0	11.0	17.0	28.0	39.0
$SB_{2028} < SB_{Lim}$	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

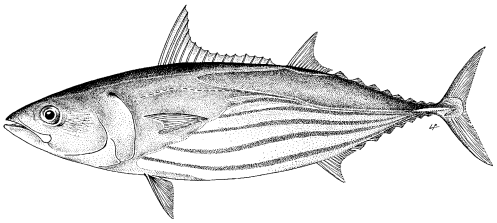


Table 1. Status of skipjack tuna (*Katsuwonus pelamis*) in the Indian Ocean

Area[1]	Indicator	Value	Status[23]
Indian Ocean	Catch in 2020 (t)[2]	555,211	60.4%*
	Average catch 2016-2020 (t)	546,095	
	$C_{40\%SB0}$ (t) (80% CI)	535,964 (461,995–674,536)	
	C_{2019} / $C_{40\%SB0}$ (80% CI)	1.02 (0.81–1.18)	
	$E_{40\%SB0}$ [4] (80% CI)	0.59 (0.53–0.66)	
	E_{2019} / $E_{40\%SB0}$ (80% CI)	0.92 (0.67-1.21)	
	SB_0 (t) (80% CI)	1,992,089 (1,691,710–2,547,087)	
	SB_{2019} (t) (80% CI)	870,461 (660,411–1,253,181)	
	$SB_{40\%SB0}$ (t) (80% CI)	794,310 (672,825–1,019,056)	
	$SB_{20\%SB0}$ (t) (80% CI)	397,155 (336,412–509,528)	
	SB_{2019} / SB_0 (80% CI)	0.45 (0.38-0.5)	
	SB_{2019} / $SB_{40\%SB0}$ (80% CI)	1.11 (0.95-1.29)	
	SB_{2019} / SB_{MSY} (80% CI)	1.99 (1.47-2.63)	
	MSY (t) (80% CI)	601,088 (500,131–767,012)	
	E_{2019} / E_{MSY} (80% CI)	0.48 (0.35-0.81)	

[1]Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence
[2] Proportion of 2020 catch fully or partially estimated by IOTC Secretariat: 14.5%
[3]The status refers to the most recent years' data used in the assessment conducted in 2020, i.e., 2019
[4] $E_{40\%SB0}$ is the equilibrium annual exploitation rate (Etarg) associated with the stock at Btarg, and is a key control parameter in the skipjack harvest control rule as stipulated in Resolution 16/02. Note that Resolution 16/02 did not specify the exploitation rate associated with the stock at Blim
*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_{2019} / $SB_{40\%SB0}$<1)	Stock not overfished (SB_{2019} / $SB_{40\%SB0}$≥ 1)
Stock subject to overfishing (E_{2019} / $E_{40\%SB0}$≥ 1)	19.5%	19.5%
Stock not subject to overfishing (E_{2019} / $E_{40\%SB0}$≤ 1)	0.6%	60.4%
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. A new stock assessment was carried out for skipjack tuna in 2020 using Stock Synthesis with data up to 2019. The outcome of the 2020 stock assessment model does not differ substantially from the previous assessment (2017) despite the large catches recorded in the period 2018-2019, which exceeded the catch limits established in 2017 for this period.

The final overall estimate of stock status indicates that the stock is above the adopted target for this stock and that the current exploitation rate is just below the target. Also, the models estimate that the spawning biomass remains above its SB_{MSY} and the fishing mortality remains below E_{MSY} with very high probability. Over the history of the fishery, biomass has been well above the adopted limit reference point ($0.2*SB_0$). The recent catches have been within the range of estimated target yield (see $C_{40\%SB0}$). Current spawning biomass relative to unexploited levels is estimated at 45% (**Table 1**). Thus, on the weight-of-evidence available in 2020, the skipjack tuna stock is determined to be: (i) above the adopted biomass target reference point; (ii) **not overfished** ($SB_{2019}>SB_{40\%SB0}$); (iii) with fishing mortality below the adopted target fishing mortality, and (iv) **not subject to overfishing** ($E_{2019}<E_{40\%SB0}$).

Outlook. Total catches in 2018 were 30% larger than the resulting catch limit from the skipjack HCR for the period 2018-2020 (470,029 t), which raises concern in the WPTT. It is important to note that reaching the management objectives defined in Resolution 16/02 requires that the catch limits adopted by the skipjack HCR are implemented effectively. It should be noted that skipjack catches for most gears have increased from 2017 to 2018 (+44% for purse seine (log/FAD-associated), +12% for gillnet and +13% for pole-and-line). In 2019, catch was reduced considerably compared to 2018. Due to its specific life history attributes, skipjack can respond quickly to ambient foraging conditions driven by ocean productivity, which seem to have been favourable in recent years. Environmental indicators should be closely monitored to inform on the potential increase/decrease of stock productivity. There remains considerable uncertainty in the assessment: The assumption of two hypotheses for the effort creep since 1995 for the standardized European purse seine CPUE was included in the model grid. The range of runs analysed illustrate a range of stock status to be between 36% and 51% of SB_{2019} / SB_0 based on all runs examined. It is important to note the differences between the runs that apply an additional effort creep parameter to the standardized series of CPUE (median $SB_{2019}/SB_0=0.44$) and those that do not (median SB_{2019} / $SB_0=0.45$). Also, there was contrast between runs that fully weighted tagging information (median SB_{2019} / $SB_0=0.42$) and those that reduced their influence (median $SB_{2019}/SB_0=0.48$).

Management advice. The catch limit calculated applying the HCR specified in Resolution 16/02 is 513,572 t for the period 2021-2023. The SC noted that this catch limit is higher than for the previous period. This is attributed to the new stock assessment which estimates a higher productivity of the stock and a higher stock level relative to the target reference point, possibly due to skipjack life history characteristics and favourable environmental conditions. Thus, it is likely that the recent catches that have exceeded the limits established for the period 2018-2020 have been sustained by favourable environmental conditions. Therefore, the Commission needs to ensure that catches of skipjack tuna during this period do not exceed the agreed limit.

The following key points should also be noted:

- **Reference points**: Commission in 2016 agreed to Resolution 16/02 on *harvest control rules for skipjack tuna in the IOTC area of competence*;
- **Biomass**: Current spawning biomass was considered to be above the target reference point of 40% of SB_0, and above the limit reference point of $0.2*SB_0$ as per Resolution 16/02 (**Fig. 2**);
- **Main fisheries** (average catches 2016-20): Purse seine ~55% (FAD/log associated school ~45%; free-swimming school ~2.3%; other ~7,5%); Pole-and-line ~19%; Gillnet ~17%; Other gears ~9% (**Fig. 1**);
- **Main fleets** (average catches 2016-20): European Union ~26% (EU-Spain: ~18.2%; EU-France: ~6.7%; EU-Italy: 0.5%); Indonesia ~18%; Maldives ~16.5%; Seychelles ~13%; I.R. Iran ~8%; Sri Lanka ~7.4%.

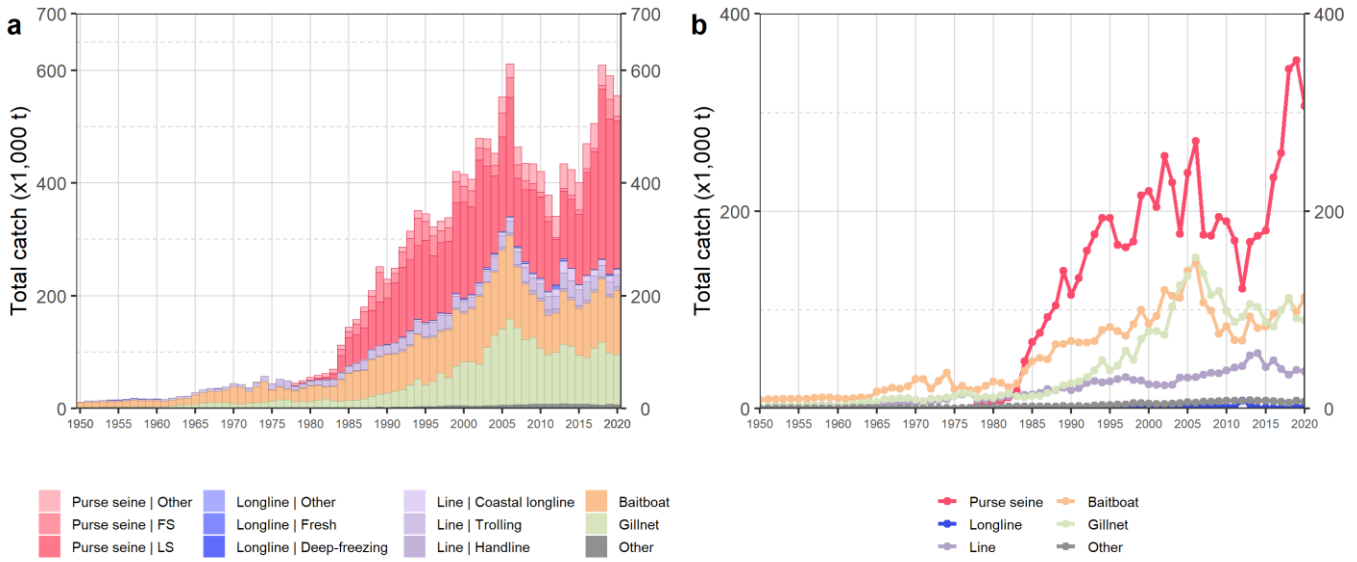


Fig. 1. Annual time series of (a) cumulative nominal catches (t) by fishery and (b) individual nominal catches (t) by fishery group for skipjack tuna during 1950–2020. FS = free-swimming schools; LS = drifting log/ FAD-associated school. Purse seine | Other: coastal purse seine, purse seine of unknown association type, ring net; Other: all remaining fishing gears

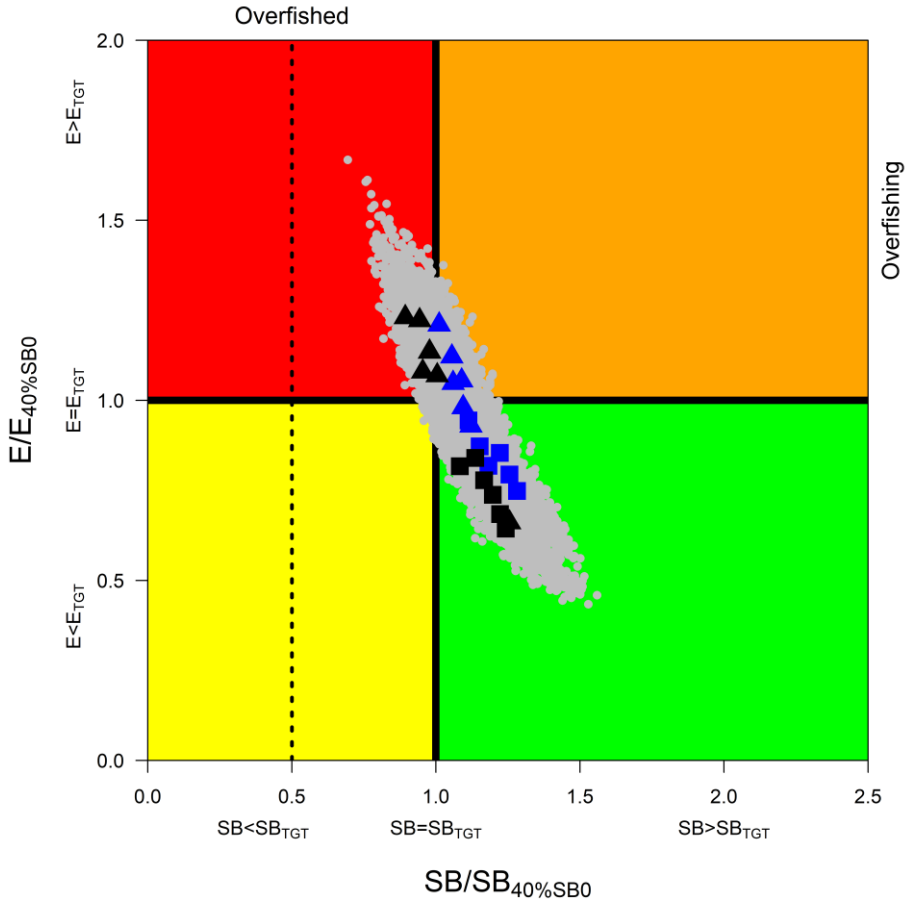


Fig. 2. Skipjack tuna: SS3 Aggregated Indian Ocean assessment Kobe plot of the 2020 uncertainty grid. Symbols represent MPD estimates of current stock status relative to $SB_{40\%SB0}$ (x-axis) and $E_{40\%SB0}$ (y-axis) for the individual models (blue, no effort creep; black, additional effort creep; triangle, full weighting of tagging data; square, tagging data downweighted). Grey dots represent uncertainty from individual models. The vertical dashed line represents the limit reference point for Indian Ocean skipjack tuna (SB_{lim} = 20%SB_0)

APPENDIX 11
EXECUTIVE SUMMARY: YELLOWFIN TUNA

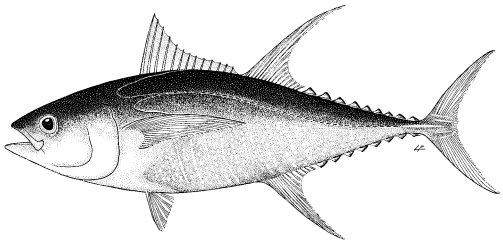


Table 1. Status of yellowfin tuna (*Thunnus albacares*) in the Indian Ocean

Area[1]	Indicator	Value	Status[3]
Indian Ocean	Catch in 2020 (t)[2]	430,956	68%*
	Average catch 2016-2020 (t)	434,235	
	MSY (1,000 t) (80% CI)	349 (286-412)	
	F_{MSY} (80% CI)	0.18 (0.15-0.21)	
	SB_{MSY} (1,000 t) (80% CI)	1,333 (1,018-1,648)	
	F_{2020} / F_{MSY} (80% CI)	1.32 (0.68-1.95)	
	SB_{2020} / SB_{MSY} (80% CI)	0.87 (0.63-1.10)	
	SB_{2020} / SB_0 (80% CI)	0.31 (0.24-0.38)	

[1]Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence
[2]Proportion of 2020 catch fully or partially estimated by IOTC Secretariat: 12.5%
[3]The stock status refers to the most recent years' data used in the assessment conducted in 2021, i.e., 2020

*Estimated probability that the stock is in the respective quadrant of the Kobe Plot (shown below). Median and quantiles calculated from the uncertainty grid taking into account of weighting on models

Colour key	Stock overfished (SB_{2020} / SB_{MSY}<1)	Stock not overfished (SB_{2020} / SB_{MSY}≥ 1)
Stock subject to overfishing (F_{2020} / F_{MSY}≥ 1)	68%	2%
Stock not subject to overfishing (F_{2020} / F_{MSY}≤ 1)	13%	17%
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. A new stock assessment was carried out for yellowfin tuna in 2021. The 2021 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 2021 is based on the model developed in 2018 with a series of revisions that were noted during the WPTT in 2018, 2019 and 2020. The model uses four types of data: catch, size frequency, tagging and CPUE indices. The proposed final assessment model options correspond to a combination of model configurations, including alternative assumptions about the spatial structure (2 options), longline CPUE catchability (2 options on the effect of piracy), weighting of the tagging dataset (lambda =0.1 or 1), steepness values (0.7, 0.8, and 0.9), natural mortality values (2 options), and growth parameters (2 options). The model ensemble (a total of 96 models) encompasses a range of stock dynamics.

A number of sensitivity runs were conducted to address additional uncertainty, including two new natural mortalities (based on maximum age of 10.9 and 18, respectively), a new growth curve (based on the most recent aging study), an assumed longline catchability increase (1% per year), as well as a model that includes only the Japanese size data for the Longline fishery. The results of these models generally indicate a more pessimistic stock status and would lower the estimated median biomass if included in the final grid of models. However, the results from the sensitivity runs were within the range of uncertainty estimated by the model grid. The sensitivity models still require further exploration to ensure uncertainty is being captured appropriately and models are not mis-specified. Other key uncertainties (for example, catch levels) were not explored.

The new model grid represents a marked improvement over the previous results available in 2018 and incorporates a far wider range of uncertainty. According to the information available in 2021, the total catch has remained above the estimated MSY since 2012 (i.e., between 399,000 t and 448,642 t), with the 2019 catch (448,642 t) being the largest since 2010 (for details see WPTT23 report).

Overall stock status estimates do not differ substantially from the previous assessment. Spawning biomass in 2020 was estimated to be 31% on average of the unfished (1950) levels (**Table 1**). Biomass estimates have been generally declining over time and particularly since 2011 (**Fig 2)**. Spawning biomass in 2020 was estimated to be 87% of the level that supports the maximum sustainable yield (SB_{2020}/ SB_{MSY} = 0.87). Current fishing mortality is estimated to be 32% higher than F_{MSY} (F_{2020}/ F_{MSY} = 1.32). The probability of the stock being in the red Kobe quadrant in 2020 is estimated to be 68%. On the weight-of-evidence available since 2018, the yellowfin tuna stock is determined to remain **overfished** and **subject to overfishing** (**Table 1** and **Fig. 1**).

It is noted that the estimated productivity of the stock (MSY) was very low for some of the scenarios of the reference grid. Their plausibility and reasons for this low productivity are yet to be fully investigated. It is noted that there is also considerable uncertainty in the reported catches by some fisheries. In particular, several artisanal fisheries have increased their catches substantially in recent years, the implication of which should be further investigated. There was a lack of information to explain this sharp increase in catch. Inconsistencies in the biomass trend by region also remain unresolved and this also deserves further investigation.

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 critical errors in the projections and estimations for computing probabilities in the K2SM developed in 2018 have been addressed and the updated projections no longer suffer from the issues previously experienced.

Management advice

For each catch scenario, the probability of the biomass being below the SB_{MSY} level and the probability of fishing mortality being above F_{MSY} were determined over the projection horizon using the delta-MVLN estimator (Walter & Winker 2019), based on the variance-covariance derived from estimates of SB/SB_{MSY} and F/F_{MSY} across the model grid. According to the K2SM (**Table 2**),

- if catches are reduced to 60% of 2020 levels[4] there is >50% probability of being above Bmsy levels by 2023.
- if catches are reduced to < 80% of 2020 levels there is a >50% probability of being above BMSY in 2030.
- if catches are reduced to less than 80% of 2020 levels there would be a >50% probability of ending overfishing (F<Fmsy) by 2023 and also by 2030.
- The probability of breaching the biological limit reference point (0.4Bmsy) with 2020 catches is 7% by 2023 and 64% by 2030. The probability of breaching the F limit reference point (1.4 Fmsy) with 2020 catch is 52% by 2023 and 78% by 2030.

The Commission has an interim plan for the rebuilding the yellowfin stock, with catch limitations based on 2014/2015 levels (Resolution 21/01which superseded 19/01, 18/01 and 17/01). Some of the fisheries subject to catch reductions have achieved a decrease in catches in 2020 in accordance with the levels of reductions specified

[4] 2020 catch levels indicate the nominal catch available to the WPTT at its session in October 2021 (WPTT23).

in the Resolution; however, these reductions were offset by increases in the catches from CPCs exempt from and some CPCs subject to limitations on their catches of yellowfin tuna.

The following key points should also be noted:

- **Maximum Sustainable Yield (MSY)**: estimate for the Indian Ocean stock is 349,000 t with a range between 286,000-412,000 t (**Table 1**). The 2016-2020 average catches (434,383 t) were above the estimated MSY level. The last year (2020), 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**: 2020 fishing mortality is considered to be 32% above the interim target reference point of F_{MSY}, and below the interim limit reference point of $1.4*F_{MSY}$ (**Fig. 3**).
- **Biomass**: 2020 spawning biomass is considered to be 13 % below the interim target reference point of SB_{MSY} and above the interim limit reference point of $0.4*SB_{MSY}$ (**Fig. 3**).
- **Catch data uncertainty:** the overall quality of the nominal catches of yellowfin tuna shows some large variability between 1950 and 2020. In some years, a large portion of the nominal catches of yellowfin tuna had to be estimated, and catches reported using species or gear aggregates had to be further broken down. The data quality was particularly poor between 1994 and 2002 when less than 70% of the nominal catches were fully or partially reported, with most reporting issues coming from coastal fisheries. The reporting rate has generally improved over the last decade however detailed information on data collection procedures, which determines the quality of fishery statistics, is still lacking.
- **Main fisheries** (mean annual catch 2016-20): purse seine ~34.3% (FAD associated school ~24%; free swimming school ~8.6%; unclassified ~1.7%); Line: 33.5%; Gillnet ~19.1%; Longline ~8.5%; All other gears ~4.6% (**Fig. 1**).
- **Main fleets** (mean annual catch 2016-20): European Union ~18.2% (EU-Spain ~11%; EU-France ~6.7%, EU-Italy ~5%); I.R. Iran ~12.3%; Maldives ~10.9%; Seychelles ~9.7%; Sri Lanka ~8.9%; All other fleets ~40%.

References

Walter, J., Winker, H., 2019. Projections to create Kobe 2 Strategy Matrices using the multivariate log-normal approximation for Atlantic yellowfin tuna. ICCAT-SCRS/2019/145 1–12

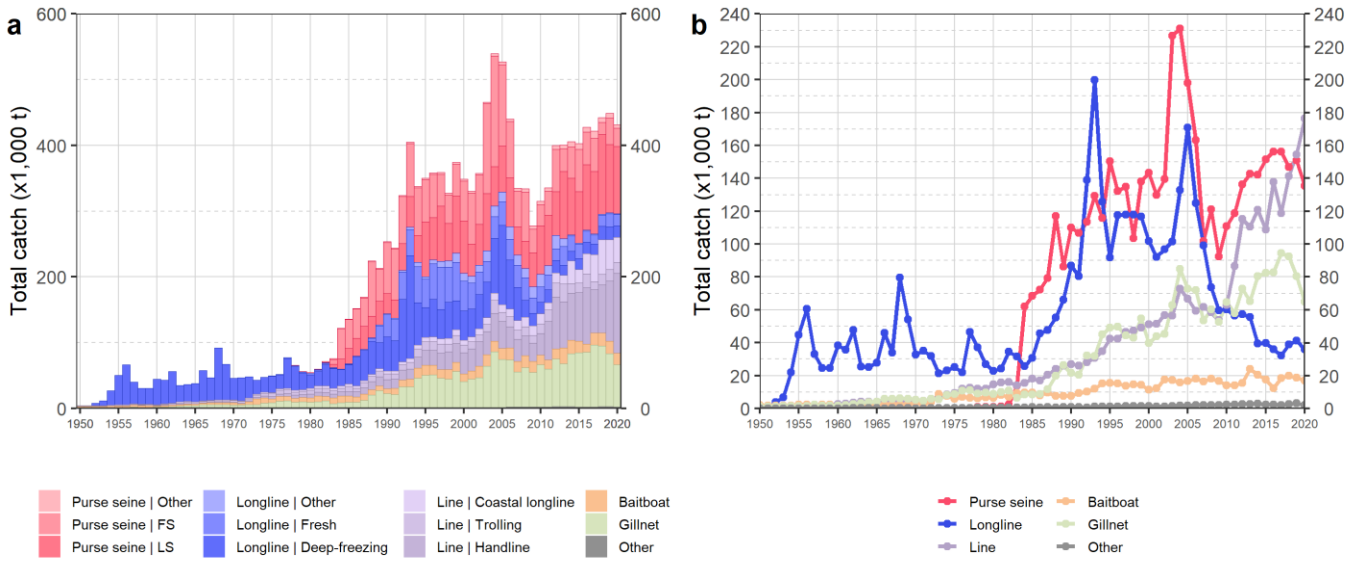


Fig. 1. Annual time series of (a) cumulative nominal catches (t) by fishery and (b) individual nominal catches (t) by fishery group for yellowfin tuna during 1950–2020. FS = free-swimming school; LS = drifting log/FAD-associated school. Purse seine | Other: coastal purse seine, purse seine of unknown association type, ring net; Other: all remaining fishing gears

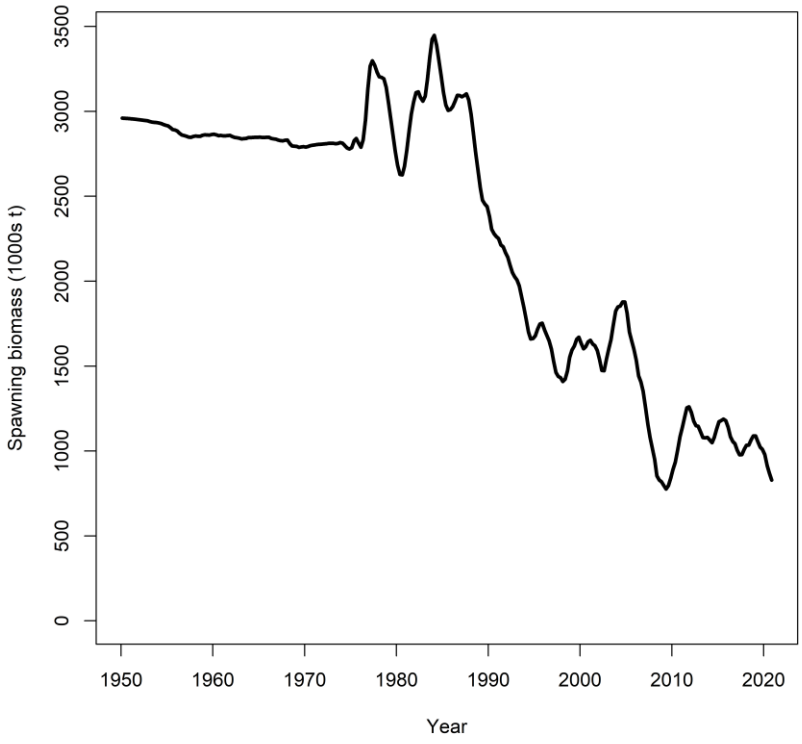


Figure 2: Estimated time series (1950-2020) of total spawning biomass of yellowfin tuna (left) from the reference model of the 2020 assessment.

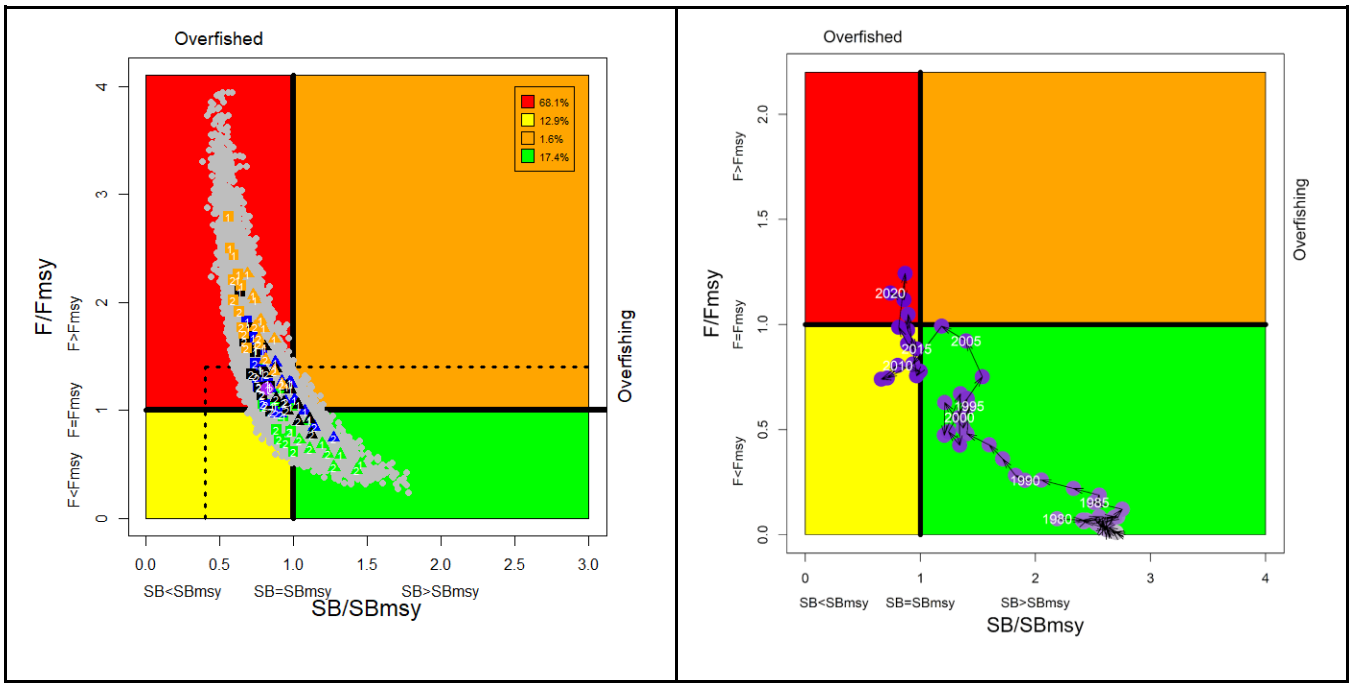


Fig. 3. Yellowfin tuna: SS3 Indian Ocean assessment Kobe plot: (left): current stock status, relative to SB_{MSY} (x-axis) and F_{MSY} (y-axis) reference points for the final model options. Coloured symbols represent Maximum posterior density (MPD) estimates from individual models: square and Triangles and represents LL CPUE catchability options q1 and q2 respectively; green, blue, black, and orange represents growth and natural mortality option combination Gbase_Mbase, GDortel_Mbase, Gbase_Mlow, and GDortel_Mlow respectively; 1,2, represents spatial structure option io and sp respectively. The purple dot represents the base model. Grey dots represent uncertainty from individual models. The dashed lines represent limit reference points for IO yellowfin tuna (SBlim = 0.4 SB_{MSY} and Flim = 1.4 F_{MSY}); (right) stock trajectory from the base model

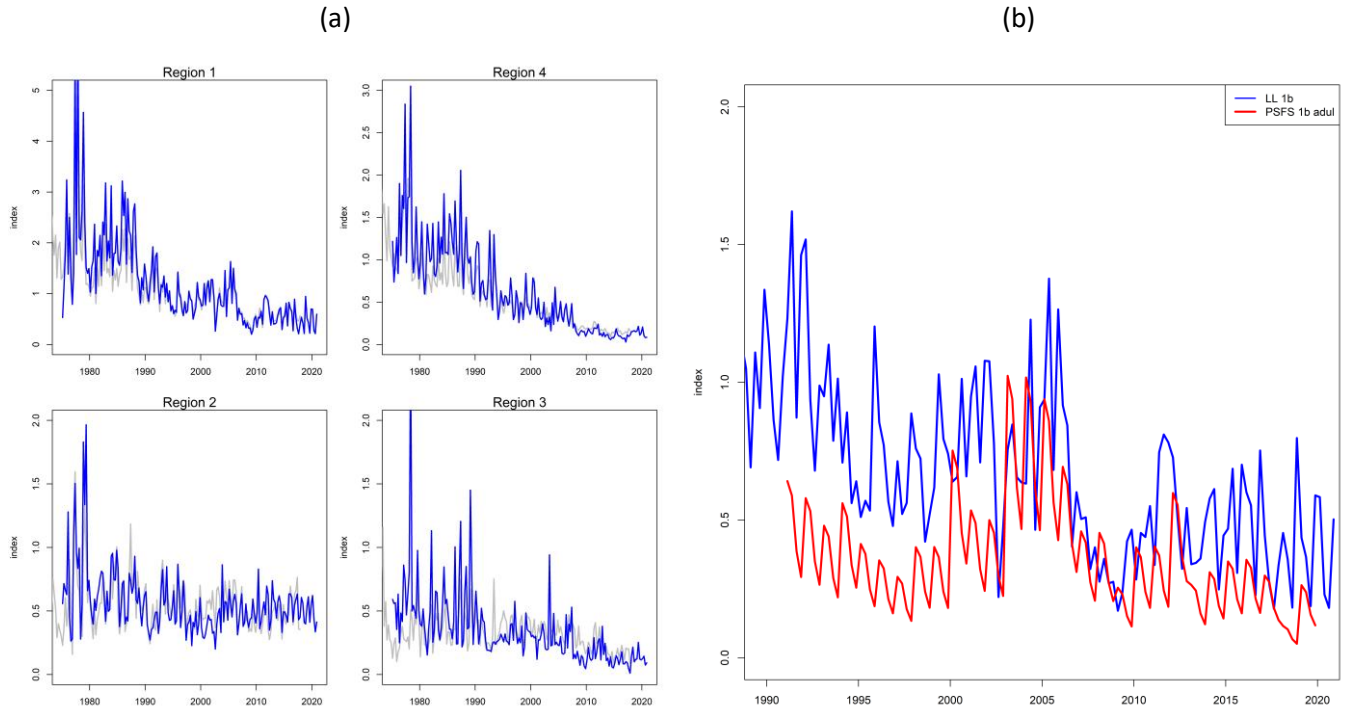


Fig 4. Standardised CPUE indices used in the final assessment models: (a) Joint longline CPUE indices by region 1975-2020 (The grey lines are indices used in 2018 assessment 1972 – 2017), and (b) EU Purse seine free school CPUE on adults (≥10 kg) (overlaid with the longline CPUE in region 1

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 2020 -40%, - 30%, -20%, -10%, 0%, +10%, +20%) projected for 3 and 10 years

Alternative catch projections (relative to the catch level from 2020) and probability of violating MSY-based target reference points ($SB_{targ} = SB_{MSY}$; $F_{targ} = F_{MSY}$)							
Reference point and projection timeframe	60%	70%	80%	90%	100%	110%	120%
$SB_{2023} < SB_{MSY}$	0.45	0.56	0.68	0.74	0.76	0.82	0.88
$F_{2023} > F_{MSY}$	0.13	0.30	0.53	0.63	0.72	0.82	0.91
$SB_{2030} < SB_{MSY}$	0.1	0.33	0.54	0.76	0.93	0.99	1
$F_{2030} > F_{MSY}$	0.07	0.31	0.49	0.69	0.84	0.97	0.99
Alternative catch projections (relative to the catch level from 2020) and probability of violating MSY-based limit reference points ($SB_{lim} = 0.4\ SB_{MSY}$; $F_{Lim} = 1.4\ F_{MSY}$)							
Reference point and projection timeframe	60%	70%	80%	90%	100%	110%	120%
$SB_{2023} < SB_{Lim}$	0	0	0	0.05	0.07	0.1	0.16
$F_{2023} > F_{Lim}$	0.03	0.11	0.25	0.43	0.52	0.63	0.78
$SB_{2030} < SB_{Lim}$	0	0	0.01	0.18	0.64	1	1
$F_{2030} > F_{Lim}$	0.02	0.19	0.33	0.60	0.78	0.98	0.98

APPENDIX 12
EXECUTIVE SUMMARY: SWORDFISH

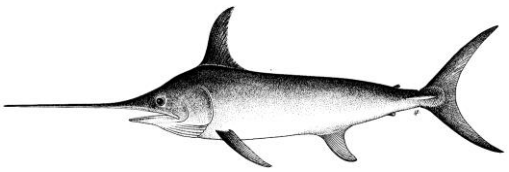


TABLE 1. Status of swordfish (*Xiphias gladius*) in the Indian Ocean

Area[1]	Indicators		2021 stock status determination
Indian Ocean	Catch 2020[2] (t)	26,005	**98%**
	Average catch 2016-2020 (t)	30,858	
	MSY (1,000 t) (80% CI)	33 (27–40)	
	F_{MSY} (80% CI)	0.23 (0.15–0.31)	
	SB_{MSY} (1,000 t) (80% CI)	59 (41–77)	
	F_{2018}/F_{MSY} (80% CI)	0.60 (0.40–0.83)	
	SB_{2018}/SB_{MSY} (80% CI)	1.75 (1.28–2.35)	
	SB_{2018}/SB_{1950} (80% CI)	0.42 (0.36–0.47)	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence
[2] Proportion of 2020 catch fully or partially estimated by IOTC Secretariat: 4.3%

Colour key	Stock overfished ($SB_{year}/SB_{MSY} < 1$)	Stock not overfished ($SB_{year}/SB_{MSY} \geq 1$)
Stock subject to overfishing ($F_{year}/F_{MSY} > 1$)	0.005	0.005
Stock not subject to overfishing ($F_{year}/F_{MSY} \leq 1$)	0.01	0.98
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. A new assessment was undertaken in 2020 using stock synthesis with fisheries data up to 2018. 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 as a whole ($F_{2018}/F_{MSY} < 1$; $SB_{2018}/SB_{MSY} > 1$). The two alternative models (ASPIC and JABBA) applied to swordfish also indicated that the stock was above a biomass level that would produce MSY. Spawning biomass in 2018 was estimated to be 40-83% of the unfished levels. Most recent catches of 33,590 t in 2019 are approximately at the *MSY* level (33,000 t). On the weight-of-evidence available in 2020, the stock is determined to be ***not overfished*** and ***not subject to overfishing*** (**Table 1**, **Fig. 2**).

Outlook. The decrease in longline catch and effort from 2005 to 2011 lowered the pressure on the Indian Ocean stock as a whole, and despite the recent increase in total recorded catches, current fishing mortality is not expected to reduce the population to an overfished state over the next decade. There is a very low risk of exceeding MSY-based reference points by 2028 if catches are maintained at 2018 levels (<5% risk that $SB_{2028} < SB_{MSY}$, and <10% risk that $F_{2028} > F_{MSY}$) (**Table 1**). However, the Southern regions exhibit declining biomass trends which indicate higher depletion in these regions, compared to northern regions.

***Management advice*.** The most recent catches (33,590 t in 2019) are at approximately the MSY level (33,000 t). Under the current levels of catches, the spawning biomass is projected to remain relatively stable, with a high probability of maintaining at or above the SB_{MSY} for the longer term. Nevertheless, the Commission should consider limiting the catches so as not to exceed the 2018 catch level (30,847 t at the time of the assessment) to ensure that the probability of exceeding the SB_{MSY} target reference points in the long term remains minimal (2%). Projections indicate that an increase of 40% or more from 2018 catch levels will likely result in the biomass dropping below the

SB_{MSY} level for the longer term (>75% probability). Taking into account the updated information regarding swordfish stock structure (IOTC-2020-WPB18-09), as well as the differential CPUE and biomass trends between regions, the WPB should continue to discuss the swordfish stock assessment model specifications and consider the feasibility of including a multi-stock assessment in 2023. Recognising that there is recurring evidence for localised depletion in the southern regions (particularly the South West) the WPB expresses concern and suggests this should be further monitored.

The following key points should also be noted:

- **Maximum Sustainable Yield (MSY)**: estimate for the Indian Ocean is 33,000 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 fisheries (mean annual catch 2016-20)**: offshore longline catches, including sharks and swordfish-targeted longlines, comprised more than 60% of total swordfish catches in the Indian Ocean in recent years. The remaining catches mainly came from coastal longline (~22%) and gillnets (~13%) (**Fig. 1**).
- **Main fleets (mean annual catch 2016-20):** about 65% of swordfish catches are accounted for by four fleets: Sri Lanka (longline-gillnet): ~28%; Taiwan,China (longline): ~21%; India (coastal longline):~8%; EU,Spain (swordfish-targeted longline): ~8%.

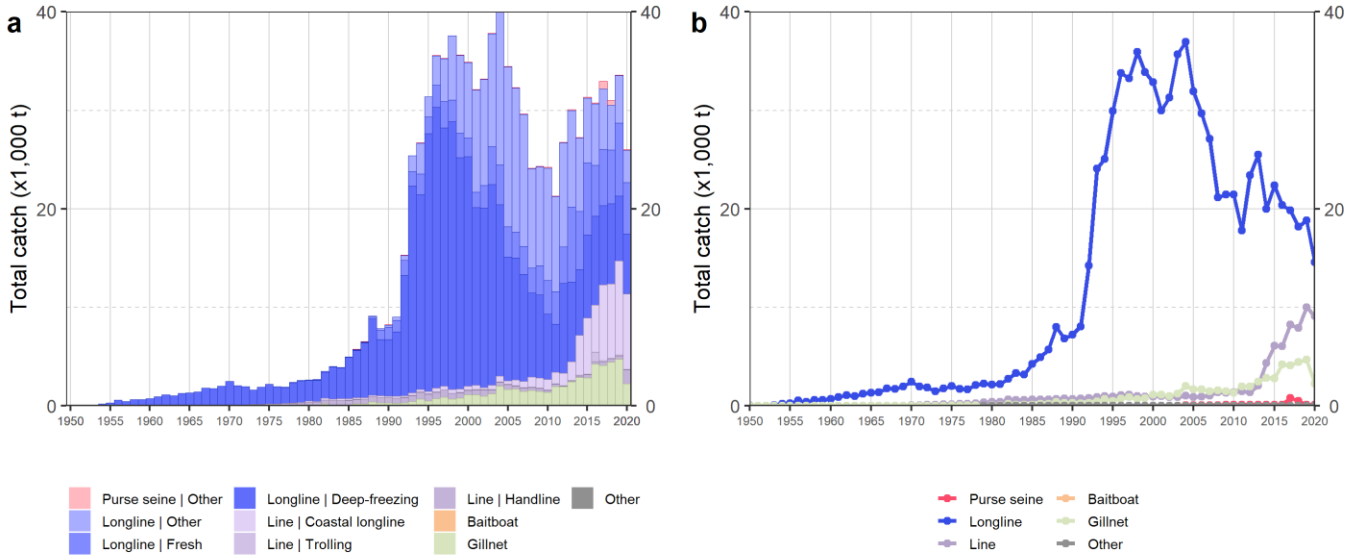


Fig. 1. Annual time series of (a) cumulative nominal catches (t) by fishery and (b) individual nominal catches (t) by fishery group for swordfish during 1950–2020. Longline|Other: swordfish and sharks-targeting longlines; Other: all remaining fishing gears

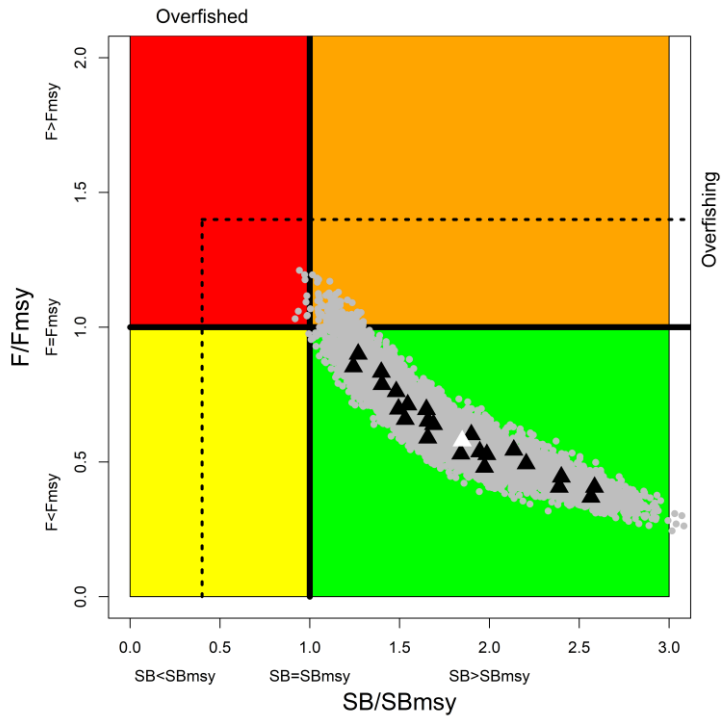


Fig. 2. Swordfish: current stock status, relative to SB_{MSY} (x-axis) and F_{MSY} (y-axis) reference points for the final model grid. Triangles represent MPD estimates from individual models (white triangle represent the estimate from the basic model). Grey dots represent uncertainty from individual models. The dashed lines represent limit reference points for Indian Ocean swordfish (SB_{lim} = 0.4 SB_{MSY} and F_{lim} = 1.4*FMSY)

Table 2. Swordfish: SS3 aggregated Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of exceeding the MSY-based target reference points for five constant catch projections relative to 2018* catch level (30,847 t), 0%, ± 20%, ± 40%) projected for 10 years

Pr ($SB<SB_{MSY}$)

Catch	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
60%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100%	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02
120%	0.00	0.00	0.01	0.02	0.03	0.06	0.08	0.11	0.13	0.18
140%	0.00	0.01	0.01	0.04	0.10	0.17	0.25	0.32	0.40	0.47

Pr ($F>F_{MSY}$)

Catch	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
60%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100%	0.02	0.03	0.04	0.04	0.04	0.05	0.06	0.07	0.06	0.07
120%	0.10	0.13	0.18	0.21	0.26	0.30	0.32	0.35	0.38	0.42
140%	0.25	0.34	0.44	0.51	0.57	0.62	0.66	0.70	0.73	0.78

** 2018 catches, at the time of the last swordfish assessment conducted in 2020.*

APPENDIX 13
EXECUTIVE SUMMARY: BLACK MARLIN

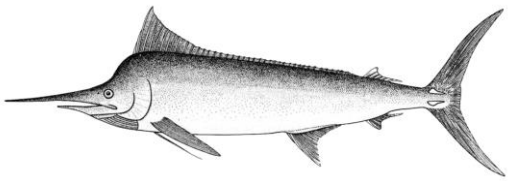


TABLE 1. Status of black marlin (*Istiompax indica*) in the Indian Ocean

Area[1]	Indicators		2021 stock status determination
Indian Ocean	Catch 2020 (t)[2]	16,977	
	Average catch 2016–2020 (t)	18,289	
	MSY (1,000 t) (95% CI)	17.30 (11.00 – 35.02)	
	F_{MSY} (95% CI)	0.20 (0.12 - 0.34)	
	B_{MSY} (1,000 t) (95% CI)	87.39 (53.82-167.70)	
	F_{2019}/F_{MSY} (95% CI)	0.53 (0.22 – 1.05)	
	B_{2019}/B_{MSY} (95% CI)	1.98 (1.42 – 2.57)	
	B_{2019}/B_0 (95% CI)	0.73 (0.53 – 0.95)	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence
[2] Proportion of 2020 catch fully or partially estimated by IOTC Secretariat: 35.4%

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

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. A stock assessment based on JABBA, a Bayesian state-space production model (age-aggregated), was conducted in 2021 for black marlin. The relative point estimates for this assessment are F/F_{MSY}=0.53 (0.22-1.05) and B/B_{MSY}=1.98 (1.42-2.57). The Kobe plot (Fig. 2) indicated that the stock is not **subject to overfishing** and is currently not **overfished** (Table A8; 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 22,000 t by 2016), and conflicts in information between CPUE and catch data lead to large uncertainties in the assessment outputs. Similar uncertainties were observed in the 2018 assessment of black marlin, which caused the point estimate of the stock status to change from the red (2016) to the green (2018) zone of the Kobe plot without any evidence of a rebuilding trend. **Since 2018, there has been no discernable improvement in the data available for black marlin and the subsequent assessment outputs remain uncertain and should be interpreted with caution**. **As such, there is no reasonable justification to change the stock status from "Not assessed/Uncertain".**

Outlook. While the recent high catches seem to be mainly due to developing coastal fisheries operating in the core habitat of the species (mainly I.R. Iran, India and Sri Lanka), the CPUE indicators are from industrial fleets operating mostly offshore on the edges of the species' distribution. The outlook is likely to remain uncertain in the absence of CPUE indices from gillnet and coastal longline fleets to inform stock assessment models. Moreover, catches remain substantially higher than the limits stipulated in Res 18/05 and are a cause for concern as this will likely continue to drive the population towards overfished status.

Management advice. The 2020 catches (16,977 t) (**Fig. 1**) were substantially higher than the MSY limits stipulated in Res (18/05) which is 9,932 t. 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 17,300 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 fisheries (mean annual catch 2016-20)**: black marlin are largely considered to be a non-target species of industrial and artisanal fisheries. Gillnets account for about 56% of total catches in the Indian Ocean, followed by coastal longline, troll and handlines (31.2%), and longline (9.8%) (**Fig. 1**). The remaining catches taken with other gears contributed to 3.1% of the total catches in recent years.
- **Main fleets (mean annual catch 2016-20):** more than 75% of the total catches of black marlin are accounted for by three fleets: I.R. Iran (gillnet): 34%; India (gillnet and coastal longline): 24%; Sri Lanka (gillnet and fresh longline): 18%. The 27 other fleets catching black marlin contributed to 23.9% of the total catch in recent years.

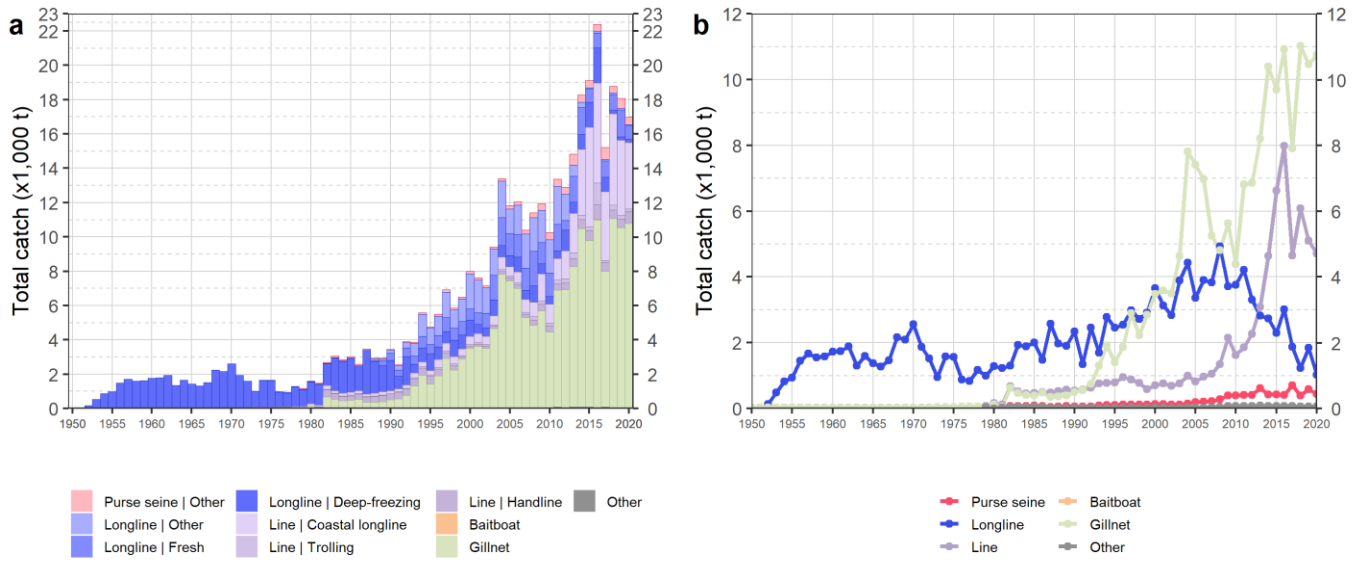


Fig. 1. Annual time series of (a) cumulative nominal catch (t) by fishery and (b) individual nominal catches (t) by fishery group for black marlin during 1950–2020. Longline | Other: swordfish and sharks-targeted longlines; Other: all remaining fishing gears

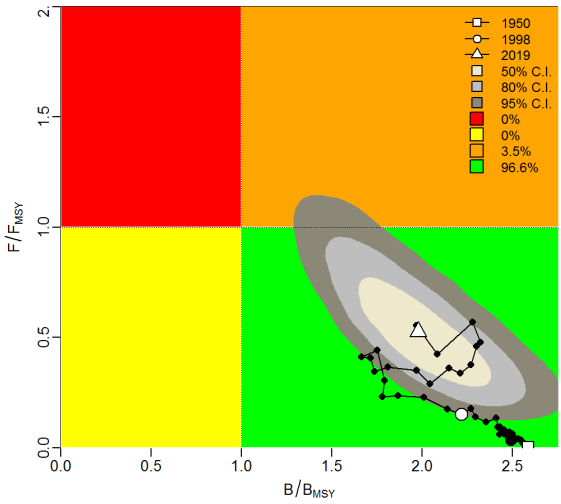


Fig. 2. Black marlin: JABBA Indian Ocean assessment Kobe plots for black marlin (contours are the 50, 80 and 95 percentiles of the 2019 estimate). Black line indicates the trajectory of the point estimates for the total biomass ratio (B/B_{MSY}) and fishing mortality ratio (F/F_{MSY}) for each year 1950–2019.

APPENDIX 14
EXECUTIVE SUMMARY: BLUE MARLIN

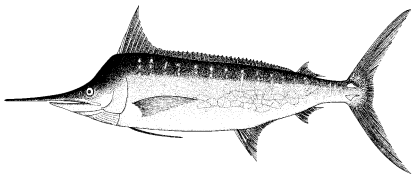


Table 1. Status of blue marlin (*Makaira nigricans*) in the Indian Ocean

Area[1]	Indicators		2021 stock status determination
Indian Ocean	Catch 2020[2] (t)	6,958	87%*
	Average catch 2016-2020 (t)	8,701	
	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)	
	F_{2017}/F_{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 are defined as the IOTC area of competence
[2] Proportion of 2020 catch fully or partially estimated by IOTC Secretariat: 23.2%
* Estimated probability that the stock is in the respective quadrant of the Kobe plot (shown below), derived from the confidence intervals associated with the current stock status

Colour key	Stock overfished ($B_{year}/B_{MSY}< 1$)	Stock not overfished ($B_{year}/B_{MSY}\geq 1$)
Stock subject to overfishing ($F_{year}/F_{MSY}> 1$)	**87%**	**10%**
Stock not subject to overfishing ($F_{year}/F_{MSY}\leq 1$)	**0%**	**3%**
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 for blue marlin was carried out in 2021 so the stock status is based on the 2019 assessment conducted using the Bayesian State-Space Surplus Production model JABBA which 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}/B_{MSY}=0.82 and F_{2017}/F_{MSY}=1.47) as shown in **Table 1** and **Fig. 2**. The most recent catch is lower than the estimate of MSY ($Catch_{2019}$ = 8,486 t; MSY = 9,984 t). The previous assessment of blue marlin 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 8,701 t in the last 5 years, 2016-2020) are lower than MSY (9,984 t). The assessment conducted in 2017 indicated that the stock was 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 9,984 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 (mean annual catch 2016-20)**: blue marlin are largely considered to be a non-target species of industrial and artisanal fisheries. Longline catches account for around 61% of total catches in the Indian Ocean, followed by lines (18.6%) and gillnets (18%) (**Fig. 1**). The remaining catches taken with other gears contributed to 2.4% of the total catches in recent years.
- **Main fleets (mean annual catch 2016-2020):** around 70% of the total catches of blue marlin are accounted for by three fleets: Taiwan,China (longline): 36.1%; Sri Lanka (gillnet, hook and line and longline): 23.4% and India (coastal longline and gillnet): 9.7%.

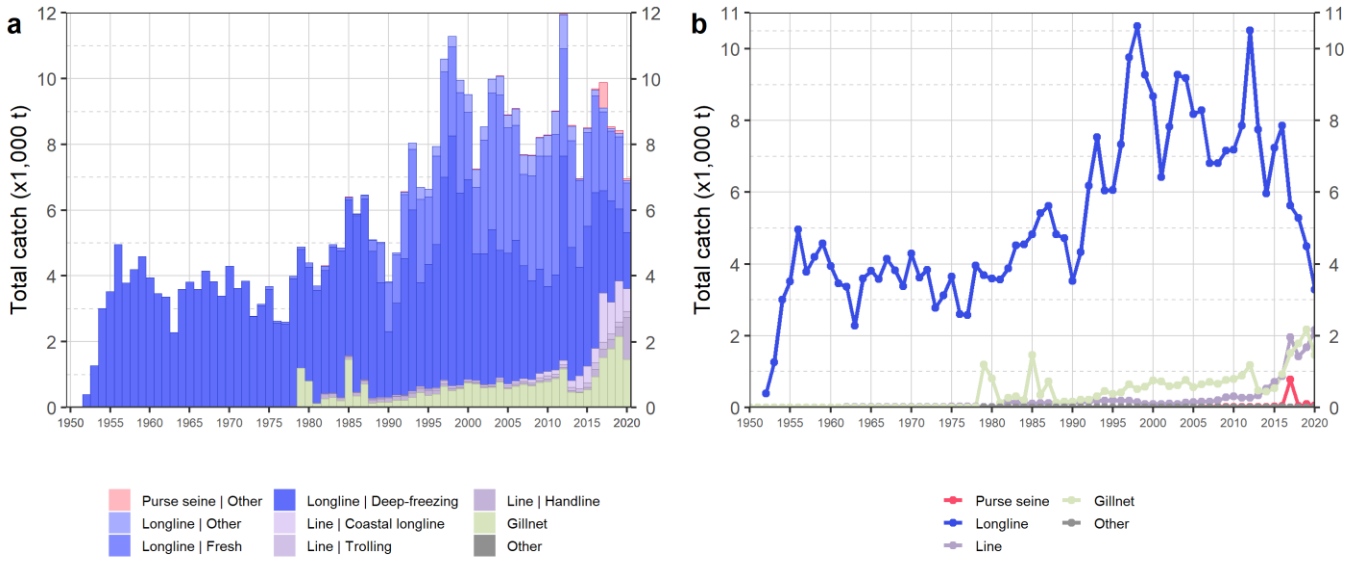


Fig. 1. Annual time series of (a) cumulative nominal catch (t) by fishery and (b) individual nominal catch (t) by fishery group for blue marlin during 1950–2020. Longline | Other: swordfish and sharks-targeted longlines; Other: all remaining fishing gears

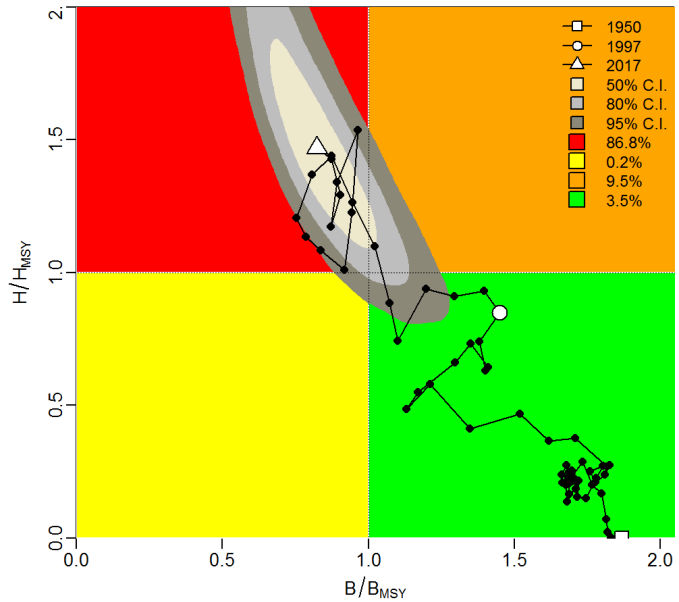


Fig. 2. Kobe stock status plot for the Indian Ocean stock of blue marlin, from the final JABBA base case (the black line traces the trajectory of the stock over time. Contours represent the smoothed probability distribution for 2018 (isopleths are probability relative to the maximum)

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

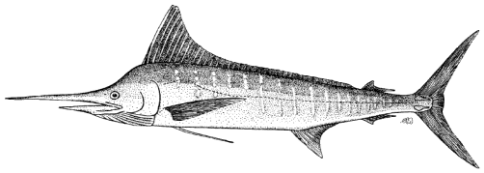


Table 1. Status of striped marlin (*Kajikia audax*) in the Indian Ocean

Area[1]	Indicators		2021 stock status determination
Indian Ocean	Catch 2020[2] (t)	2,587	100%*
	Average catch 2016-2020 (t)	3,292	
	MSY (1,000 t) (JABBA)	4.60 (4.12 - 5.08)[3]	
	MSY (1,000 t) (SS3)	4.82 (4.48 - 5.16)	
	F_{MSY} (JABBA)	0.26 (0.20–0.33)	
	F_{MSY} (SS3)	0.23 (0.23 - 0.23)	
	B_{MSY} (JABBA)	17.89 (14.34 - 23.11)	
	SB_{MSY} (SS3)	6.162 (6.343, 5.837)	
	F_{2019}/F_{MSY} (JABBA)	2.04 (1.35 - 2.93)	
	F_{2019}/F_{MSY} (SS3)	3.93 (2.30 - 5.31)	
	B_{2019}/B_{MSY} (JABBA)	0.32 (0.22 - 0.51)	
	SB_{2019}/SB_{MSY} (SS3)[4]	0.47 (0.35 - 0.63)	
	B_{2019}/B_0(JABBA)	0.12 (0.10 – 0.19)	
	SB_{2019}/SB_0 (SS3)	0.06 (0.05 - 0.08)	

[1] Boundaries for the Indian Ocean are defined as IOTC area of competence
[2] Proportion of 2020 catch fully or partially estimated by IOTC Secretariat: 14.5%
[3] JABBA estimates are the range of central values shown in Fig. 2
[4] 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)	**100%**	**0.0%**
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)	**0.0%**	**0.0%**
Not assessed/Uncertain		

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

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. In 2021 a stock assessment was conducted based on two different models: JABBA, a Bayesian state-space production model (age-aggregated); and SS3, an integrated model (age-structured). Both models were generally consistent with regards to stock status and confirmed the results from 2012, 2013, 2015, 2017 and 2018 assessments, indicating that the stock is subject to overfishing ($F>F_{MSY}$) and is overfished, with the biomass being below the level which would produce MSY ($B<B_{MSY}$) for over a decade. On the weight-of-evidence available in 2021, the stock status of striped marlin is determined to be ***overfished*** and ***subject to overfishing*** (**Table 1**; **Fig. 1**).

Outlook. Biomass estimates of the Indian Ocean striped marlin stock have likely been below BMSY since the late 90's – the stock has been severely depleted (B/B_0 = 0.12; JABBA model). The outlook is pessimistic, and a substantial decrease in fishing mortality is required to ensure a reasonable chance of stock recovery in the

foreseeable future (**Table 2**). It should be noted that point estimates from SS3 indicate that F_{curr}/F_{MSY} are higher than those estimated by JABBA.

Management advice. Current or increasing catches have a very high risk of further decline in the stock status. The current 2020 catches (2,587 t; **Fig. 1**) are lower than MSY (4,601 t) but the stock has been overfished for more than a decade 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 as per Resolution 18/05, it needs to provide mechanisms to ensure the maximum annual catches remain between 900 t – 1,500 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 fisheries (mean annual catch 2016-20)**: striped marlin is largely considered to be a non-target species of industrial fisheries. Gillnets account for ~51% of total catches in the Indian Ocean, followed by longlines (~38%) and lines (9.2%) (**Fig. 1**). The remaining catches taken with other gears contributed to 1.4% of the total catches in recent years.
- **Main fleets (mean annual catch 2016-20):** around 78% of the total catches of striped marlin are accounted for by four fleets: I.R. Iran (gillnet): 25.8%; Pakistan (gillnet): 22%; Taiwan,China (longline): 15.8% and Indonesia (coastal and offshore longline): 14.7%.

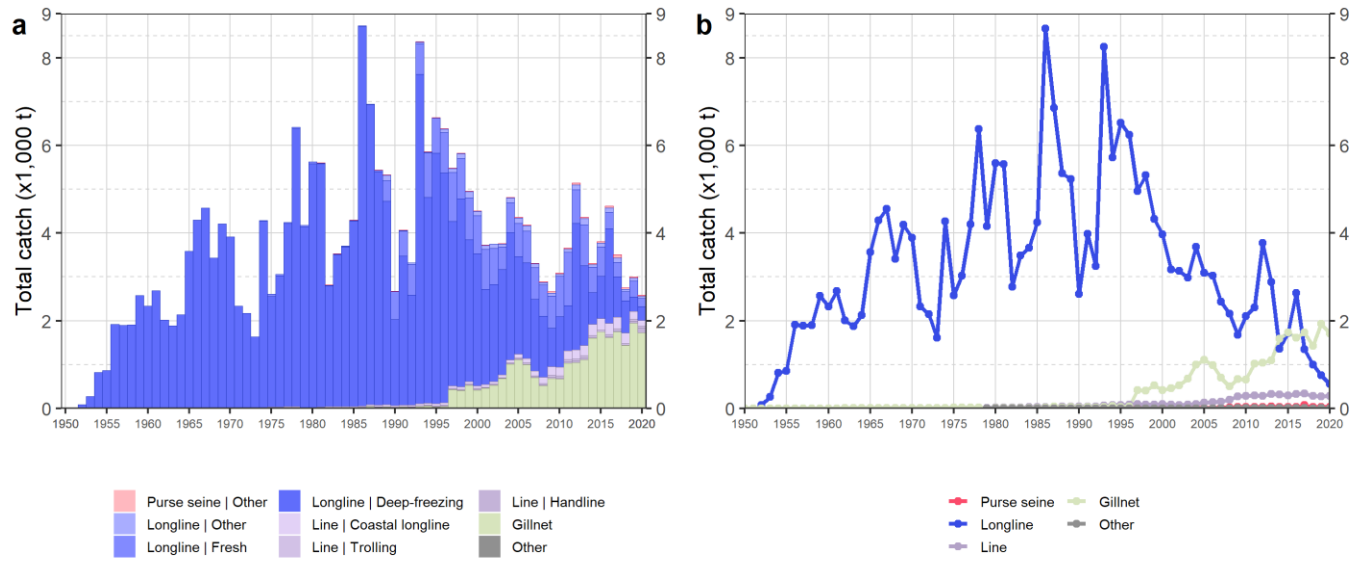


Fig. 1. Annual time series of (a) cumulative nominal catch (t) by fishery and (b) individual nominal catch (t) by fishery group for striped marlin during 1950–2020. Longline | Other: swordfish and sharks-targeted longlines; Other: all remaining fishing gears

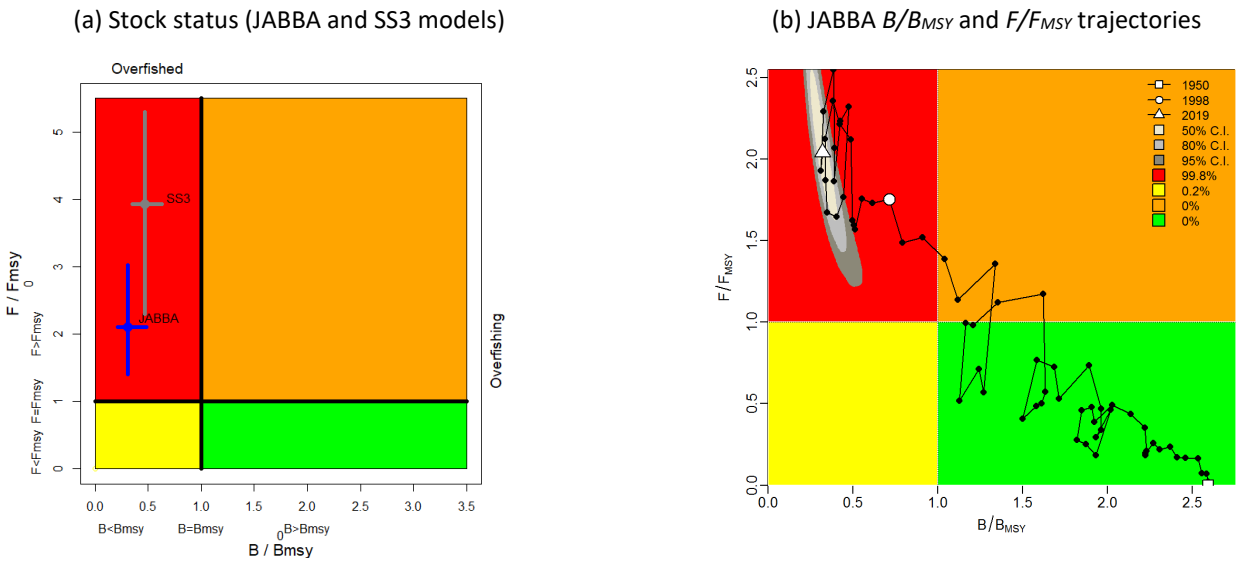


Fig. 2. (a) Striped marlin: Stock status from the Indian Ocean assessment JABBA (Bayesian State Space Surplus Production Model) and SS3 models with the confidence intervals (left); (b) Trajectories (1950-2019) of B/B_{MSY} *and* F/F_{MSY} from the JABBA model. NB: SS3 refers to SB/SB_{MSY} while the JABBA model's output refers 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 2019 catch level (3,001 t)*, ± 10%, ± 20%, ± 30% ± 40%) projected for 3 and 10 years

Reference point and projection timeframe	**Alternative catch projections (relative to the 2019 catch of 3,001 t) and probability (%) of violating MSY-based target reference points (Btarg = B_{MSY}; Ftarg = F_{MSY})**								
	60% (1,801 t)	**70%** (2,101 t)	**80%** (2,401 t)	**90%** (2,701 t)	**100%** (3,001 t)	**110%** (3,301 t)	**120%** (3,602 t)	**130%** (3,902 t)	**140%** (4,202 t)
$B_{2022} < B_{MSY}$	100	100	100	100	100	100	100	100	100
$F_{2022} > F_{MSY}$	21	49	75	90	97	99	100	100	100
$B_{2029} < B_{MSY}$	6	18	39	62	82	93	98	100	100

$F_{2029} > F_{MSY}$	0	2	9	29	57	81	94	99	100

Table 3. Striped marlin: Probability (percentage) of achieving the KOBE green quadrat from 2022-2029 for a range of constant catch projections (JABBA).

TAC | Year	2022	2023	2024	2025	2026	2027	2028	2029
300	4	31	75	95	99	100	100	100
600	2	22	62	89	98	100	100	100
900	1	15	48	79	94	98	100	100
1201	1	9	33	65	87	96	99	100
1501	1	6	22	49	73	89	96	98
1801	0	3	13	32	55	75	87	94
2101	0	2	7	19	37	55	71	82
2401	0	1	3	10	21	35	49	61
2701	0	0	2	5	10	18	28	38
3001	0	0	1	2	4	8	13	18

APPENDIX 16
EXECUTIVE SUMMARY: INDO-PACIFIC SAILFISH

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

Area[1]	Indicators		2021 stock status determination
Indian Ocean	Catch 2020[2] (t)	26,890	
	Average catch 2016-2020 (t)	29,897	
	MSY (1,000 t) (80% CI)	23.9 (16.1 – 35.4)	
	F_{MSY} (80% CI)	0.19 (0.14 - 0.24)	
	B_{MSY} (1,000 t) (80% CI)	129 (81–206)	
	F_{2017}/F_{MSY} (80% CI)	1.22 (1 – 2.22)	
	B_{2017}/B_{MSY} (80% CI)	1.14 (0.63 – 1.39)	
	B_{2017}/B_0 (80% CI)	0.57 (0.31 – 0.70)	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence
[2] Proportion catch estimated or partially estimated by IOTC Secretariat for 2020: 30.8%

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		

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 for Indo-Pacific sailfish was carried out in 2021, thus, the stock status is determined on the basis of the 2019 assessment 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 in 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 rely on catch data only, and 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 in 2010 and since 2013 have exceeded the estimated MSY, and have also increased by 62% between 2007 and 2019. 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 2019 catches (29,635 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 Indo-Pacific sailfish.
- **Main fisheries (mean annual catch 2016-20)**: gillnets account for around 70% of total catches in the Indian Ocean, followed by lines (coastal longline, troll and hand lines) (24%), with remaining catches recorded under longlines and other gears (**Fig. 1**).
- **Main fleets (mean annual catch 2016-20):** if we exclude the Republic of Tanzania (whose catch data have been repeated in recent years by the Secretariat, due to the lack of explicit reporting from the country), then 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): 35.7%; India (gillnets and coastal longline): 24.1%; Sri Lanka (gillnets and longlines): 8.4%, and Pakistan (gillnets): 7.3%.

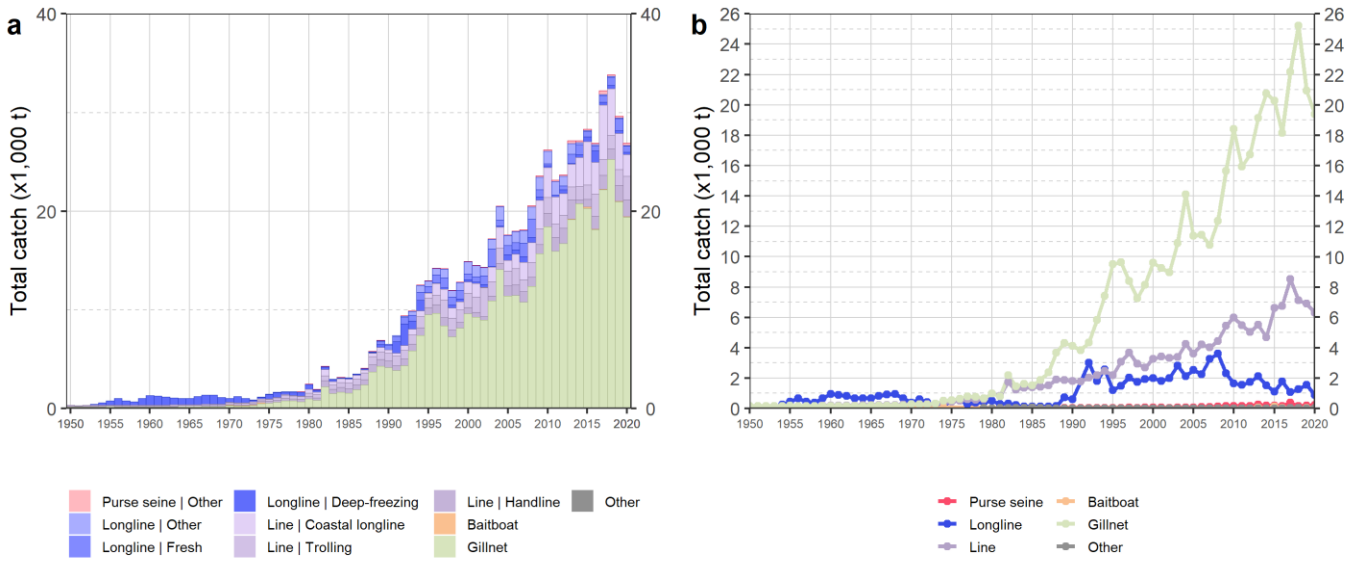


Fig. 1. Annual time series of (a) cumulative nominal catch (t) by fishery and (b) individual nominal catch (t) by fishery group for Indo-Pacific sailfish during 1950–2020. Longline | Other: swordfish and sharks-targeted longlines; Other: all remaining fishing gears

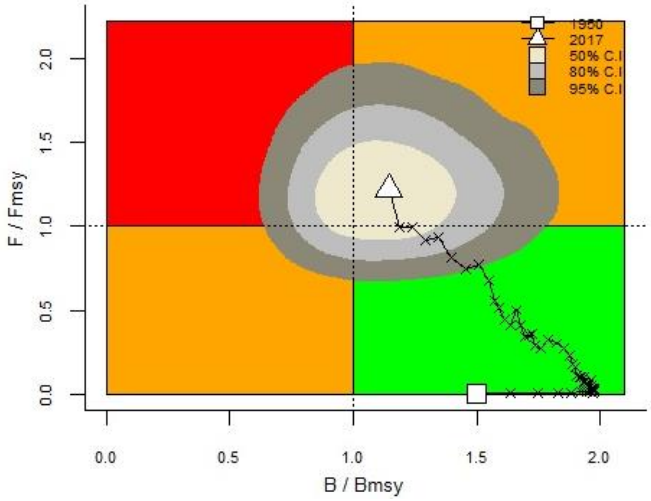


Fig. 2. Indo-Pacific sailfish: Kobe plot derived from the stock reduction analysis (C-MSY method) (contours are the 50, 65 and 90 percentiles of the 2017 estimate). Black lines indicate the trajectory of the point estimates (black crosses) for the biomass ratio (B/B_{msy}) and fishing mortality ratio (F/F_{msy}) for each year 1950–2017

APPENDIX 17
EXECUTIVE SUMMARY: BULLET TUNA

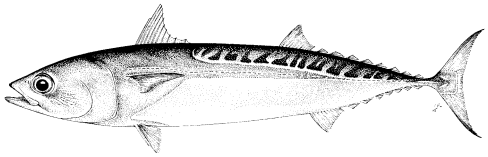


Table 1. Status of bullet tuna (*Auxis rochei*) in the Indian Ocean

Area[1]	Indicators		2021 stock status determination
Indian Ocean	Catch 2020[2] (t) Average catch 2016–2020 (t)	32,251 22,690	
	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 2020 catch fully or partially estimated by IOTC Secretariat: 25.6%

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. A new assessment was carried out in 2021 using the data-limited techniques (CMSY and LB-SPR), however the catch data for bullet tuna are very uncertain given the high percentage of the catches that had to be estimated due to a range of reporting issues. Due to a lack of fishery data for several gears, only preliminary stock status indicators can be used. The lack of data on which to base an assessment of the stock is a cause for concern. Stock status in relation to the Commission's B_{MSY} and F_{MSY} reference points remains unknown (**Table 1**).

Outlook. Annual catches of bullet tuna have steadily increased from around 2,000 t in the early 1990s to around 13,000 t in 2015-2017. In 2018, catches sharply increased to 33,000 t – mostly due to an increase in catches reported by Indonesian industrial purse seine fisheries (**Fig. 1**). In 2019, the catches of bullet tuna decreased to less than 24,000 t despite a major increase in the number of Indonesian industrial purse seiners in operation. There is considerable uncertainty around bullet tuna catches and insufficient information to evaluate the effect that these catch levels may have on the resource. Research emphasis should be focused on improving the data collection and reporting systems in place and 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 and seerfish in the 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 (8,547 t). 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 (Management advice is based on a proxy from the 3 assessed species).
- **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 2020 catches (reference year 2019), 40% of the total catches was 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 fisheries (mean annual catch 2016-2020)**: bullet tuna are caught using purse seine (58.1%), followed by line (20.5%) and gillnet (14.5%) (**Fig. 1**). The remaining catches taken with other gears contributed to 6.9% of the total catches in recent years.
- **Main fleets (mean annual catch 2016-2020)**: most bullet tuna catches are attributed to vessels flagged to India (36.2%) followed by Indonesia (33.7%), and Thailand (22.1%). The 15 other fleets catching bullet tuna contributed to 8% of the total catch in recent years.

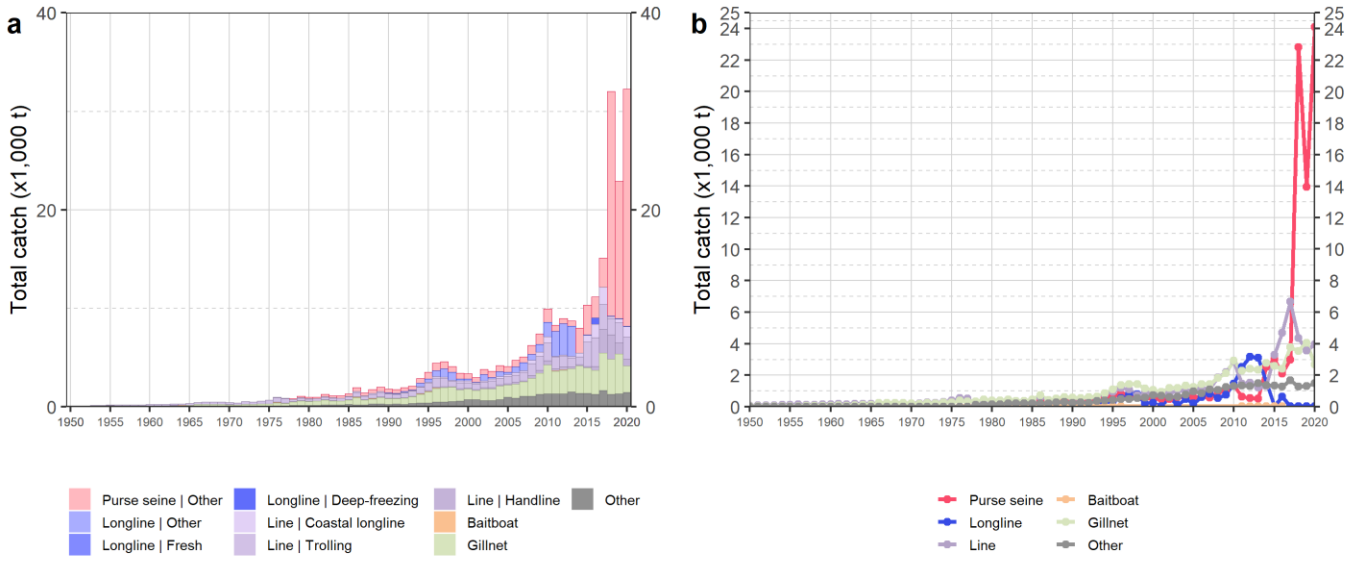


Fig. 1. Annual time series of (a) cumulative nominal catch (t) by fishery and (b) individual nominal catch (t) by fishery group for bullet tuna during 1950–2020. Longline | Other: swordfish and sharks-targeted longlines; Other: all remaining fishing gears

APPENDIX 18
EXECUTIVE SUMMARY: FRIGATE TUNA

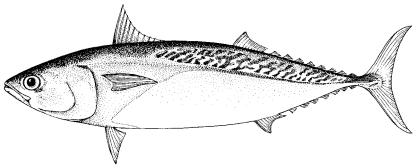


Table 1. Status of frigate tuna (*Auxis thazard*) in the Indian Ocean

Area[1]	Indicators		2021 stock status determination
Indian Ocean	Catch 2020[2] (t)	98,875	
	Average catch 2016–2020 (t)	98,017	
	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 2020 catch fully or partially estimated by IOTC Secretariat: 64.3%

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 new assessment was carried out in 2021 using the data-limited techniques (CMSY and LB-SPR), however the catch data for frigate tuna are very uncertain given the high percentage of the catches that had to be estimated due to a range of reporting issues. Due to a lack of fishery data for several gears, only preliminary stock status indicators can be used. The lack of data on which to base an assessment of the stock is 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-1970s, reaching around 30,000 t in the late-1980s, to between 51,000 and 58,000 t by the mid-1990s, and steadily increasing to over 90,000 t in the following ten years. Between 2010 and 2014 catches have increased to over 105,000 t, rising to the highest levels recorded; although catches have since decline marginally to between 90,000 – 102,000 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 (101,260 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 frigate 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 (Management advice is based on a proxy from the 3 assessed species).
- **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 2020 catches (reference year 2019), 40% 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 fisheries (mean annual catch 2016-2020)**: frigate tuna is mainly caught using gillnets (~40%), coastal longline and trolling, handlines and trolling (~32%), and to a lesser extent coastal purse seine nets (15%)
- **Main fleets (mean annual catch 2016-2020)**: catches of frigate tuna are highly concentrated, with 90% of catches accounted for by four countries in recent years: Indonesia (57.5%), Pakistan (12.8%), I.R. Iran (10.4%) and India (7.9%).

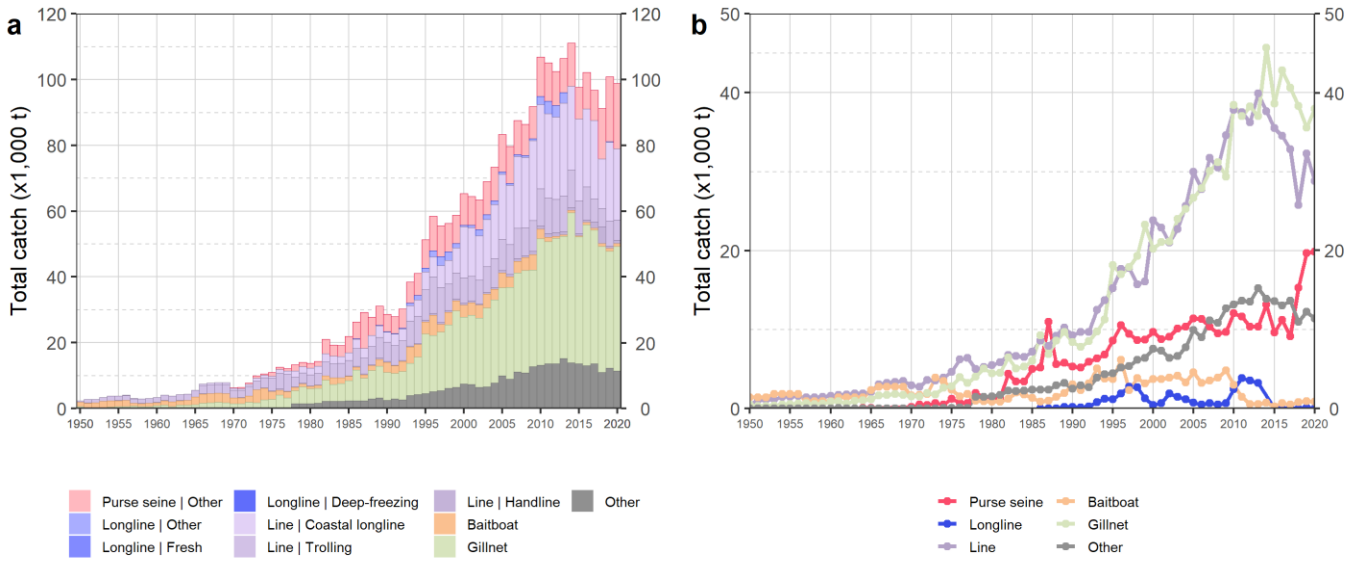


Fig. 1. Annual time series of (a) cumulative nominal catch (t) by fishery and (b) individual nominal catch (t) by fishery group for frigate tuna during 1950–2020. Longline | Other: swordfish and sharks-targeted longlines; Other: all remaining fishing gears

APPENDIX 19
EXECUTIVE SUMMARY: KAWAKAWA

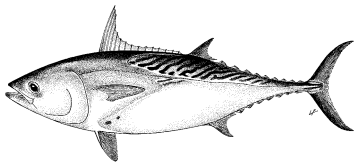


Table 1. Status of kawakawa (*Euthynnus affinis*) in the Indian Ocean

Area[1]	Indicators		2021 stock status determination
Indian Ocean	Catch 2020[2] (t) Average catch 2016-2020 (t)	143,211 151,150	**50%**
	MSY (t) (80% CI) F_{MSY} (80% CI) B_{MSY} (t) (80% CI) $F_{current}/F_{MSY}$ (80% CI) $B_{current}/B_{MSY}$ (80% CI)	148,825 (124,114 – 222,505) 0.44 (0.21–0.82) 355,670 (192,080 – 764,530) 0.98 (0.85–1.11) 1.13 (0.75–1.58)	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence
[2] Proportion of 2020 catch fully or partially estimated by IOTC Secretariat: 49.7%

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)	35%	15%
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)	0%	50%
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. No new stock assessment was conducted for kawakawa in 2021 and so the results are based on the assessment carried out in 2020 using data-limited assessment techniques. The OCOM model indicated that the fishing mortality F was very close to F_{MSY} (F/F_{MSY}=0.98) and the B above B_{MSY} (B/B_{MSY}=1.13). The estimated probability of the stock currently being in green quadrant of the Kobe plot is about 50%. Due to the quality of the data being used, the simple modelling approach employed in 2020, 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. 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., 53% of catches partially or fully estimated by the IOTC Secretariat in 2019) 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.).

Management Advice. The assessment models rely on catch data, which are considered to be highly uncertain. The catch in 2019 was equal to the estimated MSY. The available gillnet CPUE of kawakawa showed a somewhat

increasing trend although the reliability of the index as abundance indices remains unknown. Despite the substantial uncertainties, the stock is probably very close to being fished at MSY levels and that higher catches may not be sustained in the longer term. A precautionary approach to management is recommended.

The following should be also noted:

- The Maximum Sustainable Yield estimate for the Indian Ocean is estimated to be 148,825 t with a range between 124,114 and 222,505 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 53% of the catches (in 2020, with reference year 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 fisheries (mean annual catch 2016-2020)**: kawakawa are caught mainly by gillnets (~50%), followed by purse seines (including coastal ones, ~30%) and lines (~16%) (**Fig. 1**).
- **Main fleets (mean annual catch 2016-2020)**: catches of kawakawa are highly concentrated, with most catches attributed to vessels flagged to Indonesia (28.3%) followed by I. R. Iran (23.6%) and India (21.4%). The 32 other fleets catching kawakawa contributed to 26.3% of the total catch in recent years.

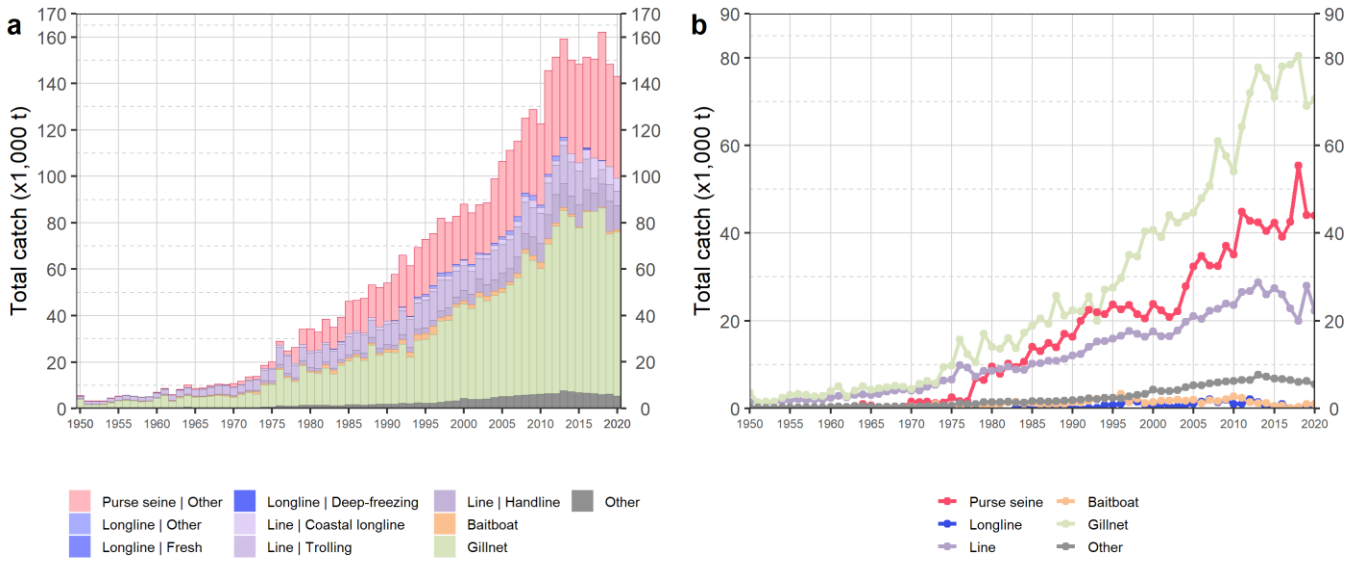


Fig. 1. Annual time series of (a) cumulative nominal catch (t) by fishery and (b) individual nominal catches (t) by fishery group for kawakawa during 1950-2020. Longline | Other: swordfish and sharks-targeted longlines; Other: all remaining fishing gears

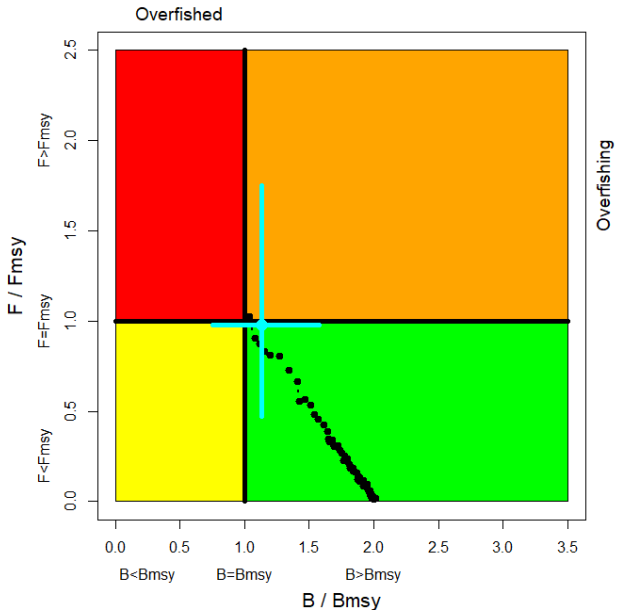


Fig. 2. OCOM Indian Ocean assessment Kobe plot for kawakawa. The Kobe plot presents the trajectories (geometric mean) for the range of plausible model options included in the formulation of the final management advice. The blue cross represents the estimate of stock status in 2018 (median and 80% confidence interval)

APPENDIX 20
EXECUTIVE SUMMARY: LONGTAIL TUNA

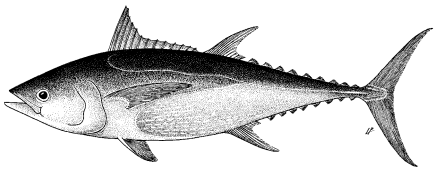


Table 1. Status of longtail tuna (*Thunnus tonggol*) in the Indian Ocean

Area[1]	Indicators		2020 stock status determination
Indian Ocean	Catch 2020[2] (t) Average catch 2016–2020 (t)	132,529 133,584	76%
	MSY (t) (80% CI) F_{MSY} (80% CI) B_{MSY} (t) (80% CI) $F_{current}/F_{MSY}$ (80% CI) $B_{current}/B_{MSY}$ (80% CI)	128,750 (99,902 – 151,357) 0.32 (0.15 – 0.66) 395,460 (129,240 – 751,316) 1.52 (0.751 – 2.87) 0.69 (0.45 – 1.21)	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence
[2] Proportion of 2020 catches fully or partially estimated by IOTC Secretariat in 2020: 27%

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)	76%	2%
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)	2%	20%
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. No new assessment was conducted for longtail tuna in 2021 and so the results are based on the assessment carried out in 2020 using the Optimised Catch-Only Method (OCOM). Analysis using the 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} (76% of plausible models runs) (**Fig. 2**). Catches were above MSY between 2010 and 2018 but steadily declined from 2012 to were less than 113,000 t in 2019, below the estimated MSY (**Fig. 1**). The F_{2018}/F_{MSY} ratio is slightly higher than previous estimates. The estimate of the B_{2018}/B_{MSY} ratio (0.69) was lower than in previous years, reflecting declining abundance. An assessment using a biomass dynamic model incorporating gillnet CPUE indices was also undertaken in 2020 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 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. The catch in 2019 was below the estimated MSY but the exploitation rate has been increasing over the last few years, as a result of the declining abundance. Despite the substantial uncertainties, this suggests

that the stock is very close to being fished at MSY levels and that higher catches may not be sustained. A precautionary approach to management is recommended.

The following should be also noted:

- The Maximum Sustainable Yield estimate of around 128,750 t was exceeded between 2011 and 2018. 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, Sultanate of Oman and India), 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 2020 catches (reference year 2019) 30% 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 fisheries (mean annual catch 2016-2020)**: longtail tuna are caught mainly using gillnets (~70.6% of catches) and, to a lesser extent, handline and trolling (~13.5%) and coastal purse seines (9.6%) (**Fig. 1**). The remaining catches taken with other gears contributed to 6.4% of the total catches in recent years.
- **Main fleets (mean annual catch 2016-2020)**: about 42% of the catches of longtail in the Indian Ocean are accounted for by I.R. Iran, followed by Indonesia (~19%), Sultanate of Oman (~14%), and Pakistan (~10%).

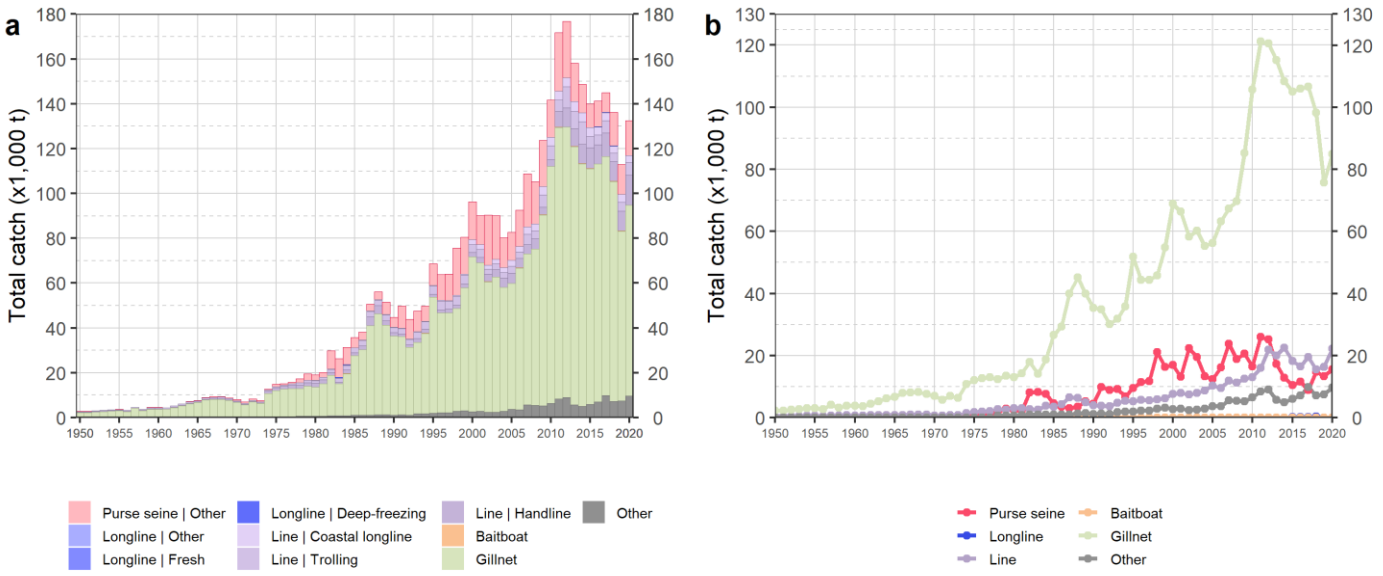


Fig. 1. Annual time series of (a) cumulative nominal catch (t) by fishery and (b) individual nominal catch (t) by fishery group for longtail tuna during 1950–2020. Longline | Other: swordfish and sharks-targeted longlines; Other: all remaining fishing gears

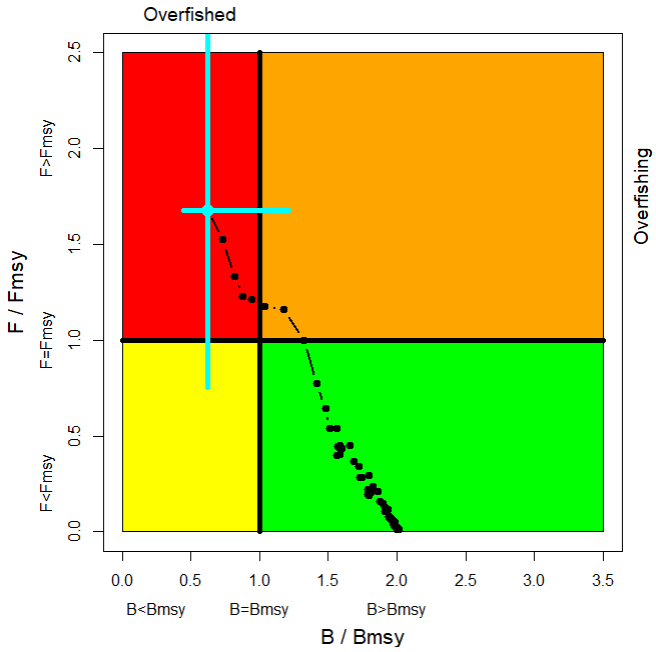


Fig. 2. Longtail tuna OCOM Indian Ocean assessment Kobe plot. The Kobe plot presents the trajectories (geometric mean) for the range of plausible model options included in the formulation of the final management advice. The blue cross represents the estimate of stock status in 2018 (median and 80% confidence interval)

APPENDIX 21
EXECUTIVE SUMMARY: INDO-PACIFIC KING MACKEREL

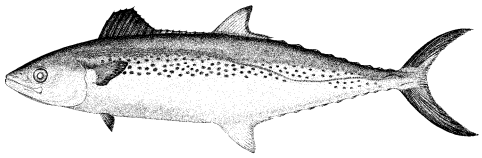


Table 1. Status of Indo-Pacific king mackerel (*Scomberomorus guttatus*) in the Indian Ocean

Area[1]	Indicators		2021 stock status determination
Indian Ocean	Catch 2020[2] (t) Average catch 2016-2020 (t)	42,471 44,870	35%
	MSY (1,000 t) F_{MSY} B_{MSY} (1,000 t) $F_{current}/F_{MSY}$ $B_{current}/B_{MSY}$ $B_{current}/B_0$	46.9 (37.7–58.4) 0.74 (0.56–0.99) 63.2 (42–94) 0.90 (0.78–2.01) 1.03 (0.46–1.19) 0.51 (0.23–0.60)	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence
[2] Proportion of 2020 catch fully or partially estimated by IOTC Secretariat: 72%

Colour key	Stock overfished (B_{year}/SB_{MSY}< 1)	Stock not overfished (B_{year}/SB_{MSY}≥ 1)
Stock subject to overfishing (F_{year}/F_{MSY}> 1)	16%	19%
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)	30%	35%
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. A new assessment was carried out in 2021 using the data-limited techniques (CMSY and LB-SPR). Analysis using the catch only method CMSY indicates the stock is being exploited at a rate that is below F_{MSY} in recent years and that the stock appears to be above B_{MSY}, although the estimates would be more pessimistic if the stock productivity is assumed to be less resilient. The analysis using the length-based approach (LB-SPR) was also undertaken in 2021 and the results are not conflicting with CMSY in terms of status. The catch-only model has provided a more defensible approach in addressing the uncertainty of key parameters and the currently available catch data for the Indo-Pacific king mackerel appear to be of sufficiently improved quality for conducting an assessment albeit still with some uncertainty. Based on the weight-of-evidence currently available, the stock is considered to be not overfished and not subject to overfishing (**Table 1**; **Fig. 2**).

Outlook. Total annual catches for Indo-Pacific king mackerel have increased steadily over time, reaching a peak of 51,600 t in 2009 and have since fluctuated between around 40,000 t and 48,000 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 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. Reported catches of Indo-Pacific king mackerel in the Indian Ocean has increased considerably since the late 2000s with recent catches fluctuating around estimated MSY, although the catch in 2020 was below the estimated MSY. This suggests that the stock is very close to being fished at MSY levels and that higher catches

may not be sustained despite the substantial uncertainty associated with the assessment, a precautionary approach to management is recommended.

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 species, despite their mandatory reporting status. In the case of 2020 catches more than 70% of the total catches was 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 fisheries (mean annual catch 2016-2020)**: Indo-Pacific king mackerel are mainly caught by gillnets (~66%), however significant numbers are also caught by trawling (~18%) and trolling (7%) (**Fig. 1**).
- **Main fleets (mean annual catch 2016-2020)**: almost two-thirds of catches are accounted for by fisheries in India (35.9%) and Indonesia (27.3%); with important catches also reported by I.R. Iran (~21.5%).

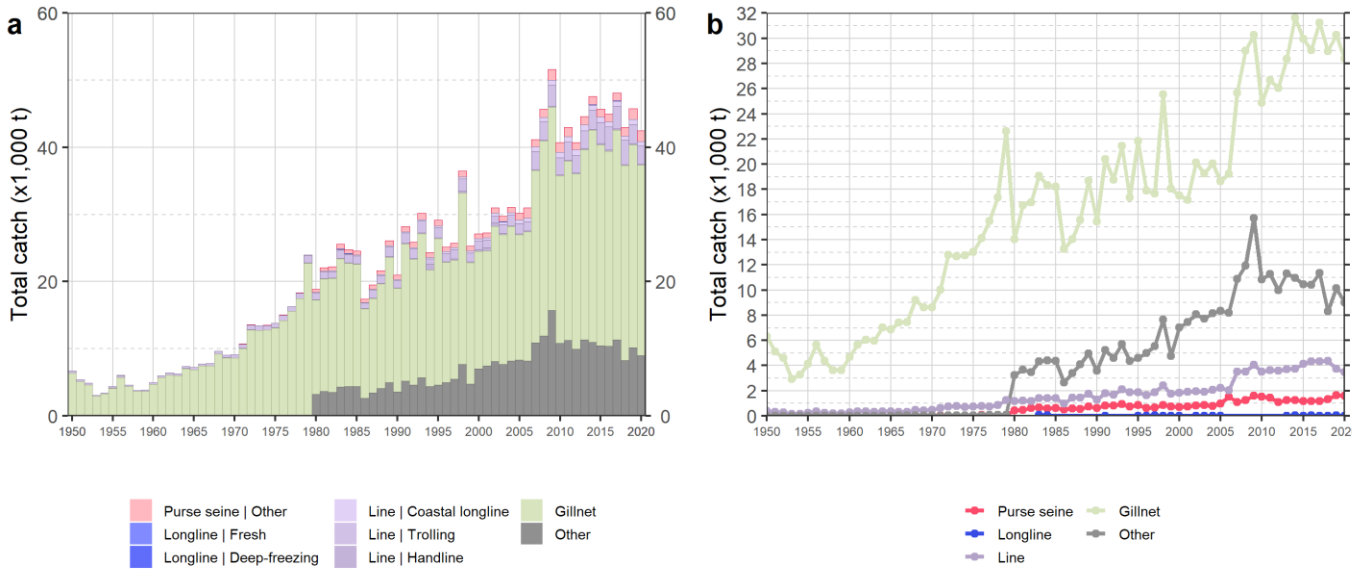


Fig. 1. Annual time series of (a) cumulative nominal catch (t) by fishery and (b) individual nominal catch (t) by fishery group for Indo-Pacific king mackerel during 1950–2020. Longline | Other: swordfish and sharks-targeted; Other: all remaining fishing gears

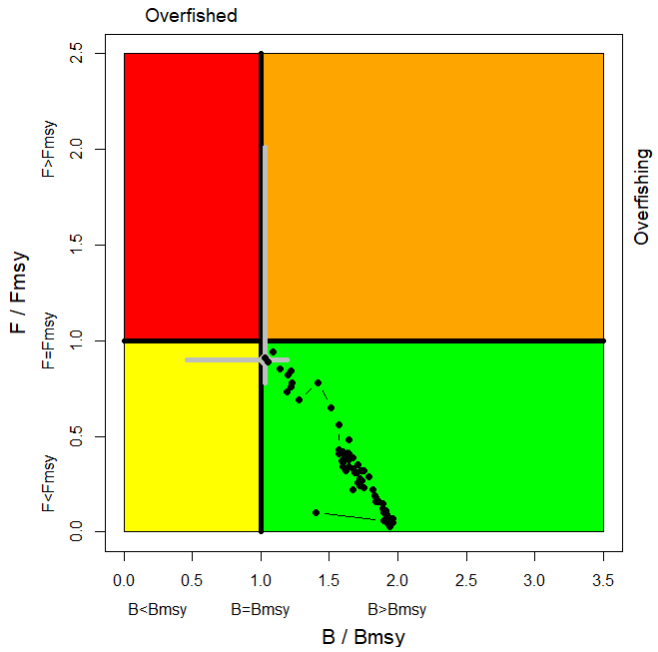


Fig. 2. Indo-Pacific king mackerel CMSY Indian Ocean assessment Kobe plot. The Kobe plot presents the trajectories (geometric mean) for the range of plausible model options included in the formulation of the final management advice. The grey cross represents the estimate of stock status in 2021 (median and 80% confidence interval)

APPENDIX 22
EXECUTIVE SUMMARY: NARROW-BARRED SPANISH MACKEREL

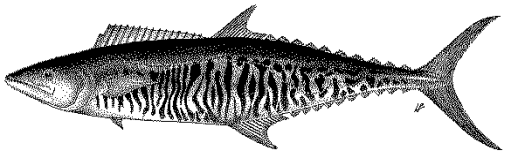


Table 1. Status of narrow-barred Spanish mackerel (*Scomberomorus commerson*) in the Indian Ocean

Area[1]	Indicators		2021 stock status determination
Indian Ocean	Catch 2020[2] (t) Average catch 2016-2020 (t)	157,687 167,678	73%
	MSY (t) (80% CI) F_{MSY} (80% CI) B_{MSY} (t) (80% CI) $F_{current}/F_{MSY}$ (80% CI) $B_{current}/B_{MSY}$ (80% CI)	157,760 (132,140–187,190) 0.49 (0.25–0.87) 323,500 (196,260–592,530) 1.24 (0.65–2.13) 0.80 (0.54–1.27)	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence
[2] Proportion of 2020 catch fully or partially estimated by IOTC Secretariat: 67.3%

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)	73%	3%
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)	3%	22%
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. No new assessment was conducted for narrow-barred Spanish mackerel in 2021 and so the results are based on the assessment carried out in 2020 using the Optimised Catch-Only Method (OCOM). The OCOM model 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[5]. Based on the weight-of-evidence available, the stock appears to be **overfished** and **subject to overfishing** (**Table 1**, **Fig. 2**). Catches since 2012 and also recent average catches for 2015-2019 have been above or close to the current MSY estimate of 157,760 t in recent years (**Fig. 1**).

Outlook. There is considerable uncertainty about 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.).

Management advice. The catch in 2019 was just below the estimated MSY and the available gillnet CPUE shows a somewhat increasing trend in recent years although the reliability of the index as an abundance index remains

[5] IOTC-2013-WPNT03-27

unknown. Despite the substantial uncertainties, the stock is probably very close to being fished at MSY levels and higher catches may not be sustained.

The following should also be noted:

- Maximum Sustainable Yield for the Indian Ocean stock was estimated at 157,760 t, with catches for 2019 (159,457 t) exceeding this level.
- **Limit reference points:** The Commission has not adopted limit reference points for any of the neritic species 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.
- 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 2020 catches more than 65% 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 fisheries (mean annual catch 2016-2020)**: narrow-barred Spanish mackerel are caught mainly using gillnet (~62%), however significant numbers are also caught using troll lines (~9.4%) and trawling (~8.4%) (**Fig. 1**).
- **Main fleets (mean annual catch 2016-2020)**: fisheries in Indonesia (23.2%), India (18.4%), I.R. Iran (14.7), and United Arab Emirates (10.3%) account for around two-thirds of catches of narrow-barred Spanish mackerel, while the species is also targeted throughout the Indian Ocean by artisanal and recreational fisheries.

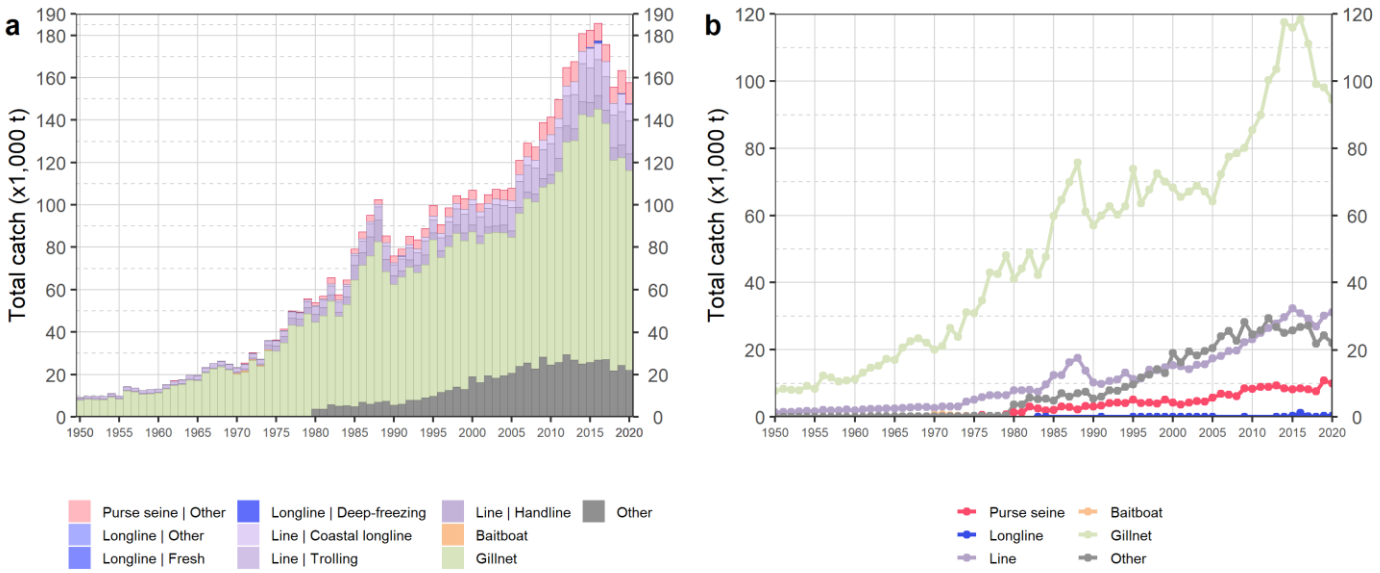


Fig. 1. Annual time series of (a) cumulative nominal catch (t) by fishery and (b) individual nominal catch (t) by fishery group for narrow-barred Spanish mackerel during 1950–2020. Longline | Other: swordfish and sharks-targeted; Other: all remaining fishing gears

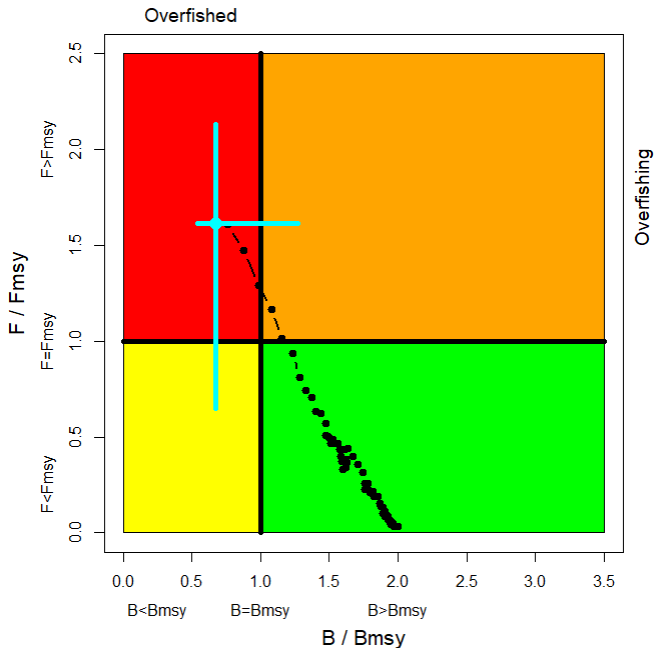


Fig. 2. Narrow-barred Spanish Mackerel OCOM Indian Ocean assessment Kobe plot. The Kobe plot presents the trajectories (geometric mean) for the range of plausible model options included in the formulation of the final management advice. The blue cross represents the estimate of stock status in 2018 (median and 80% confidence interval)

APPENDIX 23
EXECUTIVE SUMMARY: BLUE SHARK

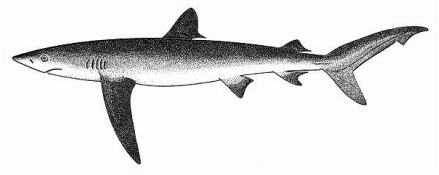


Table 1. Status of blue shark (*Prionace glauca*) in the Indian Ocean

Area	Indicators		2021 stock status determination
Indian Ocean	Reported catch 2020 (t)	21,344	99.9%
	Estimated catch 2019 (t)	43,240	
	Not elsewhere included (nei) sharks[1] 2020 (t)	20,552	
	Average reported catch 2016-20 (t)	25,144	
	Average estimated catch 2015-19 (t)	48,781	
	Avg. not elsewhere included (nei) sharks[1] 2016-20 (t)	30,277	
	MSY (1,000 t) (80% CI)[2]	36.0 (33.5 - 38.6)	
	F_{MSY} (80% CI) [2]	0.31 (0.306 - 0.31)	
	SB_{MSY} (1,000 t) (80% CI) [2,3]	42.0 (38.9 - 45.1)	
	F_{2019}/F_{MSY} (80% CI) [2]	0.64 (0.53 - 0.75)	
	SB_{2019}/SB_{MSY} (80% CI) [2]	1.39 (1.27 - 1.49)	
	SB_{2019}/SB_0 (80% CI) [2]	0.46 (0.42 - 0.49)	

Boundaries for the Indian Ocean are defined as the IOTC area of competence

[1] 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)

[2] Estimates refer to the base case model using estimated catches

[3] Refers to fecund stock biomass

Colour key	Stock overfished (SB_{2019}/SB_{MSY}< 1)	Stock not overfished (SB_{2019}/SB_{MSY}≥ 1)
Stock subject to overfishing(F_{2019}/F_{MSY}> 1)	0%	0.1%
Stock not subject to overfishing (F_{2019}/F_{MSY}≤ 1)	0%	99.9%
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	–	–

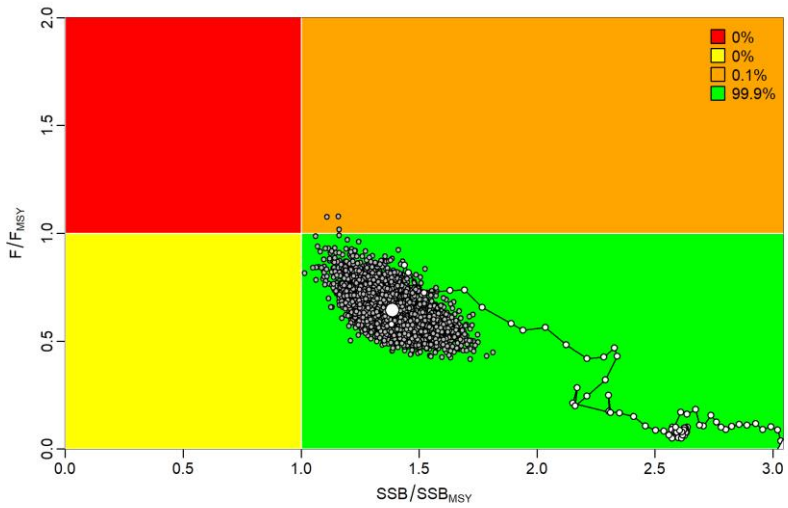
IUCN = International Union for Conservation of Nature; WIO = Western Indian Ocean; EIO = Eastern Indian Ocean

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

Sources: IUCN Red List 2019Rigby et al 2019

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. A new stock assessment for blue sharks was carried out in 2021 using an integrated age-structured



model (SS3) (

Fig. 1). Uncertainty in data inputs and model configuration were explored through sensitivity analysis. 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 (**Figure 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 (Figure **1, Table 1**). In particular, the base case model used the GAM-based catch history estimates and CPUE series from South Africa, EU-Portugal, EU-France (Reunion), EU-Spain, Taiwan and Japan. The major sources of uncertainty 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, however the ratio-based and nominal catches were considered unrealistic. If the alternative CPUE groupings were used, then the stock status was somewhat more positive.

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. 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 2021, 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. Target and limit reference points have not yet been specified for pelagic sharks in the Indian Ocean. Even though the 2021 assessment indicates that Indian Ocean blue shark are not overfished nor subject to overfishing, increasing 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 increased by over 20%, the probability of maintaining spawning biomass above MSY reference levels ($SB>SB_{MSY}$) over the next 10 years will be decreased (

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 approximately 36,000 t.
- **Reference points**: the Commission has not adopted reference points or harvest control rules for any shark species.
- **Main fisheries** (2016–2020): coastal longline; longline (deep-freezing); longline targeting swordfish.
- **Main fleets** (2016–2020): Indonesia; Taiwan,China; EU,Spain; EU,Portugal; Japan, Sri Lanka, Seychelles.

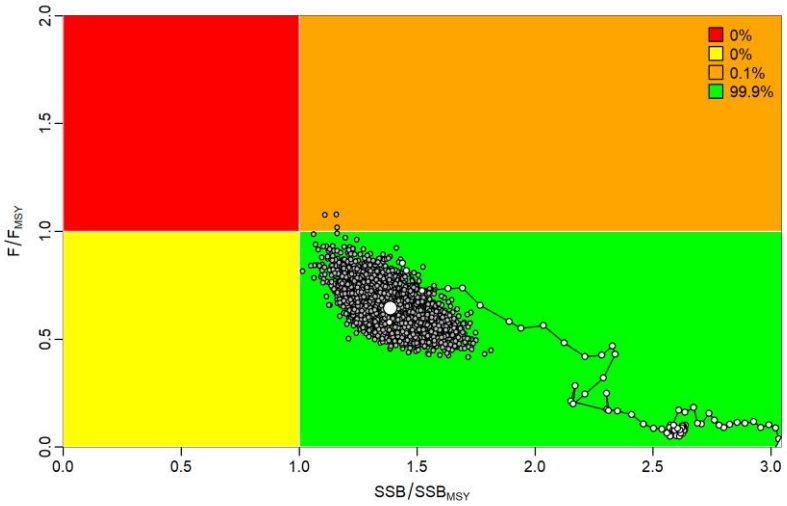


Fig. 1. Blue shark: Aggregated Indian Ocean stock assessment Kobe plot for the 2021 assessment base case model. (base case model with trajectory and uncertainty in the terminal year

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 2019* (43,240 t), ± 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 2019) and probability (%) of exceeding MSY-based reference points**								
Catch Relative to 2019	60%	70%	80%	90%	100%	110%	120%	130%	140%
Catch (t)	(25,944)	(30,267)	(34,592)	(38,916)	(43,240)	(47,564)	(51,888)	(56,212)	(60,535)
$SB_{2022} < SB_{MSY}$	0%	0%	0%	0%	0%	0%	0%	0%	0%
$F_{2022} > F_{MSY}$	0%	0%	0%	0%	0%	1%	5%	16%	36%
$SB_{2029} < SB_{MSY}$	0%	0%	0%	0%	0%	2%	9%	25%	48%
$F_{2022} > F_{MSY}$	0%	0%	0%	0%	1%	13%	44%	75%	90%

*: average catch level and respective % changes refer to the estimated catch series used in the final base case model (IOTC-2021-WPEB17(AS)-15)

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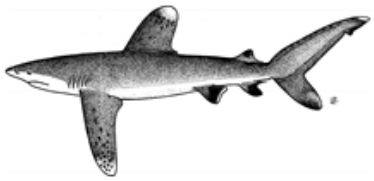
APPENDIX 24
EXECUTIVE SUMMARY: OCEANIC WHITETIP SHARK



CITES APPENDIX II species

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

Area[1]	Indicators		2018 stock status determination
Indian Ocean	Reported catch 2020	30 t	
	Not elsewhere included (nei) sharks[2] 2020	20,552 t	
	Average reported catch 2016-20	129 t	
	Av. not elsewhere included 2015-2019 (nei) sharks[2]	30,277 t	
	MSY (1,000 t) (80% CI) F_{MSY} (80% CI) SB_{MSY} (1,000 t) (80% CI) $F_{current}/F_{MSY}$ (80% CI) $SB_{current}/SB_{MSY}$ (80% CI) $SB_{current}/SB_0$ (80% CI)	unknown	

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

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

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

Table 2. IUCN threat status of 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*	Critically 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 Red List 2020, 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 (Murua *et al.* 2018). 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 'Critically Endangered' 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 fisheries** (2016-2020): Troll line; Gillnet; offshore gillnet.
- **Main fleets** (2016-2020): Comoros; I.R. Iran; Sri Lanka; Indonesia; and India; (Reported as discarded/released alive by China, Korea, France, Australia, South Africa, Sri Lanka, Japan).

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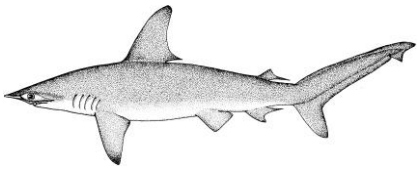
APPENDIX 25
EXECUTIVE SUMMARY: SCALLOPED HAMMERHEAD SHARK



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 2020	38 t	
	Not elsewhere included (nei) sharks[2] 2020	27,205 t	
	Average reported catch 2016-20	67 t	
	Av. not elsewhere included 2016-2020 (nei) sharks[2]	35,595 t	
	MSY (1,000 t) (80% CI) F_{MSY} (80% CI) SB_{MSY} (1,000 t) (80% CI) $F_{current}/F_{MSY}$ (80% CI) $SB_{current}/SB_{MSY}$ (80% CI) $SB_{current}/SB_0$ (80% CI)	unknown	

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

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

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

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

Common name	Scientific name	IUCN threat status[3]		
		Global status	WIO	EIO
Scalloped hammerhead shark	*Sphyrna lewini*	Critically 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 Red List 2020, Baum 2007

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. The current IUCN threat status of 'Critically Endangered' applies to scalloped hammerhead sharks globally but specifically for the western Indian Ocean the status is 'Endangered' (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 (Murua *et al.* 2018). 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 fisheries** (2016-2020): Ringnet; Gillnet; longline-coastal; longline (fresh) and offshore gillnet.
- **Main fleets** (2016-2020): Sri Lanka; Kenya; Seychelles; NEI-Fresh (report as released alive/discarded by EU-France, South Africa, Indonesia, Japan).

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APPENDIX 26
EXECUTIVE SUMMARY: SHORTFIN MAKO SHARK

CITES APPENDIX II species

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

Area[1]	Indicators		2020 stock status determination
Indian Ocean	Reported catch 2020	854 t	
	Not elsewhere included (nei) sharks[2] 2020	22,429 t	
	Average reported catch 2016-20	1,613 t	
	Av. not elsewhere included (nei) sharks[2] 2016-20	32,481 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 ($SB_{year}/SB_{MSY} \geq 1$)
Stock subject to overfishing ($F_{year}/F_{MSY} > 1$)		
Stock not subject to overfishing ($F_{year}/F_{MSY} \leq 1$)		
Not assessed/Uncertain		

Table 2. IUCN threat status of 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 Red List 2020, 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 (Murua *et al.* 2018). 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 has declined from 1999 to 2004 but has remained relatively stable since 2005. Conversely, trends in EU,Portugal longline standardised CPUE series have been increasing since 2008 as has the trends in the EU,Spain and Taiwanese longline series (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 is vulnerable to overfishing. Although an attempt was made to assess the shortfin mako stock in 2020, there is no quantitative stock assessment currently available for shortfin mako shark in the Indian Ocean. Therefore, the stock status is **unknown**. This highlights the need for further work on data improvement and provision of abundance indices as well as utilizing complimentary approaches (e.g., genetic tools) to inform the trends in abundance of the stock.

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 global catch and effort on shortfin mako shark has declined in the southern and eastern areas and may have resulted in localised depletion there. It should be noted that subsequent to the past assessment, shortfin mako has been placed on CITES Appendix II and therefore this may influence the landings in the future.

Management advice. In the absence of a stock assessment and noting conflicting information, the Commission should take a cautious approach by implementing management actions that reduce fishing mortality on 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 fisheries** (2016-2020): Longline targeting swordfish; longline (fresh); longline (targeting sharks); gillnet.
- **Main fleets** (2016-2020): EU,Spain; South Africa; EU,Portugal; Japan, I.R. 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

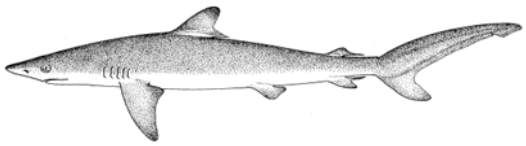

Table 1. Status of silky shark (*Carcharhinus falciformis*) in the Indian Ocean

Area[1]	Indicators		2018 stock status determination
Indian Ocean	Reported catch 2020 Not elsewhere included (nei) sharks[2] 2020 Average reported catch 2016-20 Av. not elsewhere included (nei) sharks[2] 2016-20	1,314 t 20,552 t 1,833 t 30,277 t	
	MSY (1,000 t) (80% CI) F_{MSY} (80% CI) SB_{MSY} (1,000 t) (80% CI) $F_{current}/F_{MSY}$ (80% CI) $SB_{current}/SB_{MSY}$ (80% CI) $SB_{current}/SB_0$ (80% CI)	unknown	

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

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

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

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

Common name	**Scientific name**	**IUCN threat status[3]**		
		Global status	**WIO**	**EIO**
Silky shark	*Carcharhinus falciformis*	Vulnerable	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 Red List 2020

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 (Murua *et al.* 2018). 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 but globally the status is 'Vulnerable' (**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 fisheries** (2016-2020): gillnet; offshore gillnet; longline-coastal; longline (fresh), longline
- **Main fleets** (2016-2020): I.R. Iran; Sri Lanka; Taiwan,China; Pakistan

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APPENDIX 28
EXECUTIVE SUMMARY: BIGEYE THRESHER SHARK

Table 1. Status bigeye thresher shark (*Alopias superciliosus*) in the Indian Ocean

Area[1]	Indicators		2018 stock status determination
Indian Ocean	Reported catch 2020	< 1 t	
	Not elsewhere included (nei) sharks[2] 2020	24,254 t	
	Average reported catch 2016-20	< 1 t	
	Av. not elsewhere included (nei) sharks[2] 2016-20	34,343 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 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 Red List 2020, 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 (Murua *et al.* 2018). 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 3–9 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 live 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*[6].

The following key points should also be noted:

- **Maximum Sustainable Yield (MSY)**: Not applicable. Retention prohibited.
- **Reference points**: Not applicable.
- **Main fisheries**: No report after 2012 (reported previously as discard from gillnet and longline).
- **Main reporting fleets** (2016–2020): India; (reported as discarded/released alive by South Africa, Sri Lanka, Japan, Korea, EU,France, Indonesia).

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[6] 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

Table 1. Status pelagic thresher shark (*Alopias pelagicus*) in the Indian Ocean

Area[1]	Indicators		2018 stock status determination
Indian Ocean	Reported catch 2020	176 t	
	Not elsewhere included (nei) sharks[2] 2020	24,254 t	
	Average reported catch 2016-20	310 t	
	Av. not elsewhere included (nei) sharks[2] 2016-20	34,343 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 ($SB_{year}/SB_{MSY}\geq 1$)
Stock subject to overfishing ($F_{year}/F_{MSY}> 1$)		
Stock not subject to overfishing ($F_{year}/F_{MSY}\leq 1$)		
Not assessed/Uncertain		

Table 2. IUCN threat status of 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*	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 Red List 2020, Rigby et al. 2020

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 (Murua *et al.* 2018). 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 'Endangered' 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*[7].

The following key points should also be noted:

- **Maximum Sustainable Yield (MSY)**: Not applicable. Retention prohibited.
- **Reference points**: Not applicable.
- **Main fisheries** (2016-2020): Gillnet (reported as discard/ released from gillnet and longline).
- **Main fleets** (2016-2020): Pakistan; (reported as discarded/released alive by Japan, Korea, Sri Lanka, South Africa, Indonesia).

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[7]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

Table 1. 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[8]
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 2020, The IUCN Red List of Threatened species. <www.iucnredlist.org>. Downloaded on 16 September 2020

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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) presented in 2018 (Williams et al., 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 (Wallace et al., 2011). Bycatch and mortality from gillnet fisheries have greater population-level impacts on marine turtles relative to other gear types, such as longline, purse seine and trawl fisheries in the Indian Ocean (Wallace et al., 2013). Population levels of impacts of leatherback turtles caught in longline gear in the Southwest Indian Ocean were also identified as a conservation priority.

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

[8] IUCN, 2020. The process of the threat assessment from IUCN is independent from the IOTC and is presented for information purpose only

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:

1. The available evidence indicates considerable risk to marine turtles in the Indian Ocean.
2. Given the high mortality rates associated with marine turtle interactions with gillnet fisheries and the increasing use of gillnets in the Indian Ocean (Aranda, 2017) there is a need to both assess and mitigate impacts on threatened and endangered marine turtle populations.
3. 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.
4. Current reported interactions are known to be a severe underestimate.
5. The Ecological Risk Assessment (Nel et al., 2013) 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.
6. 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.
7. Efforts should be undertaken to encourage CPCs to investigate means to reduce marine turtle bycatch and mortality in IOTC fisheries.
8. That appropriate mechanisms are developed by the Compliance Committee to ensure CPCs comply with their data collection and reporting requirements for marine turtles.

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APPENDIX 31
EXECUTIVE SUMMARY: SEABIRDS

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[9]
Albatross		
Atlantic Yellow-nosed Albatross	*Thalassarche chlororhynchos*	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	*Diomedea 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

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

considered to be the primary threat. The level of mortality of seabirds due to fishing gear in the Indian Ocean is poorly known, although where there has been rigorous assessment of impacts in areas south of 25 degrees (e.g., in South Africa), very high seabird incidental catches rates have been recorded in the absence of a suite of proven incidental catches mitigation measures.

Outlook. Resolution 12/06 *On Reducing the Incidental Bycatch of Seabirds in Longline Fisheries* includes an evaluation requirement (para. 8) by the Scientific Committee in time for the 2016 meeting of the Commission. The level of compliance with 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

Table 1. 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*	LC	-
Balaenopteridae	Common minke whale	*Balaenoptera acutorostrata*	LC	-
	Antarctic minke whale	*Balaenoptera bonaerensis*	NT	-
	Sei whale	*Balaenoptera borealis*	EN	PS
	Bryde's whale	*Balaenoptera edeni/brydei*	LC	-
	Blue whale	*Balaenoptera musculus*	EN	-
	Fin whale	*Balaenoptera physalus*	VU	-
	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*	LC	GN
	Dwarf sperm whale	*Kogia sima*	LC	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 bowdoini*	DD	-
	Blainville's beaked whale	*Mesoplodon densirostris*	DD	-
	Gray's beaked whale	*Mesoplodon grayi*	DD	-
	Hector's beaked whale	*Mesoplodon hectori*	DD	-
	Deraniyagala's beaked whale	*Mesoplodon hotaula*	DD	-
	Strap-toothed whale	*Mesoplodon layardii*	DD	-
	True's beaked whale	*Mesoplodon mirus*	DD	-
	Spade-toothed whale	*Mesoplodon traversii*	DD	-
	Shepherd's beaked Whale	*Tasmacetus 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*	LC	GN
	Short-finned pilot whale	*Globicephala macrorhynchus*	LC	LL, GN

	Long-finned pilot whale	*Globicephala melas*	LC	-
	Risso's dolphin	*Grampus griseus*	LC	LL, GN
	Fraser's dolphin	*Lagenodelphis hosei*	LC	-
	Irrawaddy dolphin	*Orcaella brevirostris*	EN	GN
	Australian snubfin dolphin	*Orcaella heinsohni*	VU	GN
	Killer whale	*Orcinus orca*	DD	LL, GN
	Melon-headed whale	*Peponocephala electra*	LC	LL, GN
	False killer whale	*Pseudorca crassidens*	NT	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*	LC	-
	Spinner dolphin	*Stenella longirostris*	LC	GN
	Rough-toothed dolphin	*Steno bredanensis*	LC	GN
	Indo-Pacific bottlenose dolphin	*Tursiops aduncus*	NT	GN
	Bottlenose dolphin	*Tursiops truncatus*	LC	LL, GN
Phocoenidae	Indo-Pacific finless porpoise	*Neophocaena phocaenoides*	VU	GN

* The assessment of the status level in IUCN is independent of IOTC processes
** Published bycatch records only (reference at the end of the document)
*** Arabian Sea population: EN
The IUCN Red List of Threatened species. <www.iucnredlist.org>.
Downloaded on 16 September 2020.

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Stock status. The current[10] 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 (Anderson, 2014). Many reports (e.g., Sabarros et al., 2013) 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 (e.g., Escalle et al., 2015), but should be further monitored.

Outlook. Resolution 13/04 *On the conservation of cetaceans* highlights the concerns of the IOTC regarding the lack of accurate and complete data collection and reporting to the IOTC Secretariat of interactions and mortalities of

[10] September 2020

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 drift gillnets (Anderson, 2014).
- Current reported interactions and mortalities are scattered but are most likely severely underestimated.
- Maintaining or increasing fishing effort in the Indian Ocean without appropriate mitigation measures in place will likely result in further declines in a number of cetacean species. An increasing effort by tuna drift gillnet fisheries has been reported to the IOTC, which is a major cause of concern for a number of species, particularly in the northern Indian Ocean.
- Appropriate mechanisms should be developed by the Compliance Committee to ensure CPCs comply with their data collection and reporting requirements for cetaceans.

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APPENDIX 33
STATUS OF YELLOWFIN TUNA CATCHES PURSUANT TO RESOLUTIONS 19/01 AND 21/01

Table 1: estimated over catches for 2021 and catch limits for 2022 for all for industrial fisheries subject to Resolution 19/01

IOTC Res. 19/01 catch limits (2022)

Based on CORRECTION NOTICE REGARDING RESOLUTION 19/01 YELLOWFIN TUNA ALLOCATED CATCH LIMITS FOR 2021

https://www.iotc.org/documents/correction-notice-regarding-resolution-1901-yellowfin-tuna-allocated-catch-limits-2021

1. Purse seine

Fleet	Baseline		Catch (tonnes)								c. Annual limit	Res. 19/01 para 13a (2017, 2018, 2019)*		Overcatch 2017+2018+2019*	Catch limit 2020	Overcatch 2020	Catch limit 2021	*Overcatch 2021++*	*Catch limit 2022*
	Year	Reduction	2014	2015	2016	2017	2018	2019	a. 2020	*b. 2021++*		d. Sum of annual limits = c x 3*	e. accumulated catch	f = e- d	g = c	h = a - g	i = c - f - h	*j = i - a*	*k = c - j*
EU	2014	15.0%	91,405	86,149	87,075	86,893	78,148	71,791	71,058	*71,058*	77,694	233,083	236,832	3,749	77,694	-	73,945	-	*77,694*
IDN **	2014	15.0%	14,582	8,363	10,786	11,598	12,342	16,388	15,866	*15,866*	12,395	37,184	40,328	3,144	12,395	3,471	5,780	*10,087*	*2,308*
KOR	2014	15.0%	8,852	7,509	10,347	6,362	5,415	8,730	2,393	*2,393*	7,524	22,573	20,507	-	7,524	-	7,524	-	*7,524*
MUS	2018	7.5%	4,844	5,448	7,404	7,681	11,322	12,290	9,681	*9,681*	10,473	31,419	31,293	-	10,473	-	10,473	-	*10,473*
SYC	2015	15.0%	23,463	39,072	40,014	41,694	35,023	33,006	30,502	*30,502*	33,211	66,422	68,029	1,607	33,211	-	31,605	-	*33,211*

2. Longline

Fleet	Baseline		Catch (tonnes)								c. Annual limit	Res. 19/01 para 13a (2017, 2018, 2019)*		Overcatch 2017+2018+2019*	Catch limit 2020	Overcatch 2020	Catch limit 2021	*Overcatch 2021++*	*Catch limit 2022*
	Year	Reduction	2014	2015	2016	2017	2018	2019	a. 2020	*b. 2021++*		d. Sum of annual limits = c x 3*	e. accumulated catch	f = e- d	g = c	h = a - g	i = c - f - h	*j = i - a*	*k = c - j*
TWN	2014	10.0%	12,285	13,921	16,958	9,115	10,845	9,427	9,075	*9,075*	11,057	33,170	29,387	-	11,057	-	11,057	-	*11,057*
IDN **	2014	10.0%	12,645	10,549	10,404	10,527	9,610	4,261	5,656	*5,656*	11,381	34,142	24,398	-	11,381	-	11,381	-	*11,381*
SYC	2018	10.0%	1,616	2,395	3,247	4,305	6,985	8,482	6,821	*6,821*	6,286	12,572	15,466	2,894	6,286	535	2,857	*3,964*	*2,323*
LKA	2014	10.0%	8,625	5,933	3,939	6,448	8,554	10,746	7,481	*7,481*	7,763	23,288	25,748	2,461	7,763	-	5,302	*2,179*	*5,583*

3. Gillnet

Fleet	Baseline		Catch (tonnes)								c. Annual limit	Res. 19/01 para 13a (2017, 2018, 2019)*		Overcatch 2017+2018+2019*	Catch limit 2020	Overcatch 2020	Catch limit 2021	*Overcatch 2021++*	*Catch limit 2022*
	Year	Reduction	2014	2015	2016	2017	2018	2019	a. 2020	*b. 2021++*		d. Sum of annual limits = c x 3	e. accumulated catch	f = e- d	g = c	h = a - g	i = c - f - h	*j = i - a*	*k = c - j*
IRN	2014	10.0%	24,401	26,780	31,079	37,193	35,534	44,024	20,607	20,607	21,961	65,883	116,751	50,868	21,961	-	- 28,907	49,513.98	- 27,553

4. Other gears

Fleet	Baseline		Catch (tonnes)								c. Annual limit	Res. 19/01 para 13a (2018, 2019)		Overcatch 2017+2018+2019*	Catch limit 2020	Overcatch 2020	Catch limit 2021	*Overcatch 2021++*	*Catch limit 2022*
	Year	Reduction	2014	2015	2016	2017	2018	2019	a. 2020	*b. 2021++*		d. Sum of annual limits = c x 2	e. accumulated catch	f = e- d	g = c	h = a - g	i = c - f - h	*j = i - a*	*k = c - j*
MDV BB	2014	5.0%	11,416	9,270	4,978	10,543	10,749	10,165	10,697	*10,697*	10,845	21,690	20,914	-	10,845	-	10,845	-	*10,845*
MDV HL	2014	5.0%	17,831	19,247	24,648	16,713	16,704	15,918	15,181	*15,181*	16,939	33,879	32,622	-	16,939	-	16,939	-	*16,939*

+ Catches are taken from current IOTC best scientific estimates (https://www.iotc.org/data/datasets/latest/NC-SCI)

++ Catches for 2021 are not yet available, and therefore assumed to be at the same exact levels of 2020

* 2018, 2019 for Seychelles

** Catches are taken from National Reports

Fleets to whom Res.19/01 still applies

Table 2: theoretical (a, d) [Resolution 21/01] and estimated (c) [Resolution 19/01 + 21/01] catch limits for 2022; estimated over-catch (b) [Resolution 19/01] for all CPCs bound to Resolution 21/01; catch limits for 2022 (g) [Resolution 19/01] for all for industrial fisheries of the six CPCs objecting to Resolution 21/01

a. IOTC Res. 21/01

CPC		Catches (best scientific estimates)						Reference		Catch limit (2022)		
Code	Status	2014	2015	Average (2017-2019)	Max (2017-2019)	2018	Last year (2020)	Year	h. Catches	i. Reduction	Criteria	j. Limit (h * (1 - i))
CHN	DG, DW	13,363	15,714	13,401	15,486	15,486	12,781	2014	13,363	21%	Para. 5	10,557
EU	DD, DW	92,590	87,242	79,703	87,707	78,886	71,884	2014	92,590	21%	Para. 5	73,146
KOR	DG, DW	10,409	9,183	8,648	10,790	6,990	3,687	2014	10,409	13%	Para. 5 + 11	9,056
LKA	DG, C	37,778	32,673	40,850	44,756	39,817	37,013	2014	37,778	12%	Para. 5.a + 10	33,245
PAK	DG, C	16,441	18,817	18,509	27,784	18,384	7,919	2014	16,441	12%	Para. 5.a + 10	14,468
YEM	LD, C	29,180	24,518	18,083	18,110	18,077	18,134	2014	29,180	10%	Para. 5.b + 10	26,262
MDV	DG, S, C	49,212	52,439	47,093	49,361	47,217	42,705	2015	52,439	10%	Para. 5.b + 10	47,195
SYC	DG, S, C	25,079	41,468	43,201	46,056	42,051	38,250	2017-2019 (avg.)	43,201	10%	Para. 5.b + 10	38,881
MUS	DG, S, C	4,908	5,530	10,786	12,684	11,656	9,779	2018	11,656	10%	Para. 6.b	10,490
COM	LD, S, C	1,399	1,748	4,426	5,279	3,194	6,745	2014	5,279	-	Para. 7	5,279
JPN	DD, DW	4,072	3,478	3,327	4,003	3,382	2,085	2014	4,003	-	Para. 7	4,003
KEN	DG,C	71	108	2,550	3,654	3,592	3,654	2014	3,654	-	Para. 7	3,654
TZA	LD, C	3,441	4,011	3,904	3,905	3,904	3,905	2014	3,905	-	Para. 7	3,905
AUS	DD, C	20	73	50	66	39	18	2014	73	-	Para. 8	2,000
BGD	LD, C	-	-	-	-	-	2	2014	-	-	Para. 8	2,000
ERI	LD, C	-	-	-	-	-	-	2014	-	-	Para. 8	2,000
MOZ	LD, C	5	69	162	168	155	301	2014	69	-	Para. 8	2,000
MYS	DG, C	77	144	419	446	446	374	2014	144	-	Para. 8	2,000
SDN	LD, C	-	-	-	-	-	-	2014	-	-	Para. 8	2,000
THA	DG, C	187	109	-	-	-	-	2014	109	-	Para. 8	2,000
ZAF	DG, C	83	182	323	389	331	217	2014	182	-	Para. 8	2,000
FRA	DD,C	-	-	-	-	-	-	2014	-	-	Para. 8 + 9	500
GBR	DD, DW	2	2	3	4	4	2	2014	2	-	Para. 8 + 9	500
PHL	DG, DW	69	69	24	73	-	-	2014	69	-	Para. 8 + 9	700

Fixed catch limit

b. Overcatches according to Res. 19/01

PS	LL	GN	OT	k. Total
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	2,179	-	-	2,179
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	3,964	-	-	3,964
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-

c. Catch limits for 2022 (Res. 21/01, para 14.a)

CPC code	m. Base limit (j)	n. Limit (m - k)
CHN	10,557	**10,557**
EU	73,146	**73,146**
KOR	9,056	**9,056**
LKA	33,245	**31,066**
PAK	14,468	**14,468**
YEM	26,262	**26,262**
MDV	47,195	**47,195**
SYC	38,881	**34,917**
MUS	10,490	**10,490**
COM	5,279	**5,279**
JPN	4,003	**4,003**
KEN	3,654	**3,654**
TZA	3,905	**3,905**
AUS	2,000	**2,000**
BGD	2,000	**2,000**
ERI	2,000	**2,000**
MOZ	2,000	**2,000**
MYS	2,000	**2,000**
SDN	2,000	**2,000**
THA	2,000	**2,000**
ZAF	2,000	**2,000**
FRA	500	**500**
GBR	500	**500**
PHL	700	**700**

d. CPC objecting to 21/01 (or previous resolutions)

CPC		Catches (best scientific estimates)						Reference		Catch limit (2022)		
Code	Status	2014	2015	Average (2017-2019)	Max (2017-2019)	2018	Last year (2020)	Year	Catches	Reduction	Criteria	Limit
IDN	DG, C	25,275	25,945	26,788	35,567	22,635	36,517	2014	25,275	12%	Para. 5.a	22,242
IND	DG, C	33,427	17,159	28,320	37,488	37,488	20,795	2014	33,427	12%	Para. 5.a	29,416
IRN	DG, C	46,216	42,599	57,605	58,650	58,650	48,314	2014	46,216	12%	Para. 5.a	40,670
OMN	DG, C	7,208	15,183	28,456	37,033	28,837	68,785	2014	7,208	12%	Para. 5.a	6,343
MDG	LD, C	735	747	707	715	704	709	2014	735	-	Para. 8	2,000
SOM	LD, C	-	-	-	-	-	-	2014	-	-	Para. 8	2,000

e.Resolution applying

19/01
18/01
19/01
19/01
19/01
19/01

f. Catch limits for 2022 by type of industrial gear

PS	LL	GN	OT
2,308	11,381	-	-
-	-	-	-
		- 27,553	
-	-	-	-
-	-	-	-
-	-	-	-

g. Catch limits for 2022 for all industrial fisheries combined (Res. 19/01)

CPC code	Limit
IDN	13,689
IND	-
IRN	- 27,553
OMN	-
MDG	-
SOM	-

Catches: 0 ≤ catches < 2000 t; 2000 t ≤ catches < 5000 t; catches ≥ 5000 t

Status: **LD** = least developed country, **DG** = developing country, **DD** = developed country, **S** = small islands developing state, **C** = coastal state, **DW** = distant water fishing nation

Table 3: estimated total catch limits for 2022 for all CPCs bound to Resolution 21/01 (left) and estimated catch limits for industrial fisheries for all CPCs bound to Resolution 19/01 (right)

Estimated YFT catch limits (t) for 2022 as per Res. 21/01	
CPC	Limit
CHN – China	10,557
EU – European Union	73,146
KOR – Republic of Korea	9,056
LKA – Sri Lanka	31,066
PAK – Pakistan	14,468
YEM – Yemen	26,262
MDV – Maldives	47,195
SYC – Seychelles	34,917
MUS – Mauritius	10,490
COM – Comoros	5,279
JPN – Japan	4,003
KEN – Kenya	3,654
TZA – Tanzania	3,905
AUS – Australia	2,000
BGD – Bangladesh	2,000
ERI – Eritrea	2,000
MOZ – Mozambique	2,000
MYS – Malaysia	2,000
SDN – Sudan	2,000
THA – Thailand	2,000
ZAF – South Africa	2,000
FRA – France (territories)	500
GBR – United Kingdom	500
PHL – Philippines	700

Estimated YFT catch limits (t) for 2022 as per Res. 19/01					
CPC	Limit for purse seine	Limit for longline	Limit for gillnet	Limit for all other gears	Limit
IDN – Indonesia	2,308	11,381	-	-	13,689
IND – India	-	-	-	-	-
IRN – I.R. Iran	-	-	-27,553	-	-27,553
OMN – Oman	-	-	-	-	-
MDG – Madagascar	-	-	-	-	-
SOM – Somalia	-	-	-	-	-

APPENDIX 34
PROGRESS MADE ON THE RECOMMENDATIONS OF SC23

SC23 Report	SC recommendations	Update/Progress
	National Reports from CPCs	
SC23.08 Para. 31	**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 2020, 25 reports were provided by CPCs (23 in 2019, 26 in 2018, 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 and that the provision of national reports is a mandatory requirement for all CPCs
SC23.09 Para. 32	The SC **RECOMMENDED** that the Compliance Committee and Commission note the lack of compliance by 6 Contracting Parties (Members) and 2 Cooperating Non-Contracting Party (CNCPs) that did not submit a National Report to the Scientific Committee in 2020, noting that the Commission agreed that the submission of the annual reports to the Scientific Committee is mandatory	**Update:** The SC chair presented the report of the S23 to the Commission in June 2021. The Commission noted this issue with concern.
	Report of the 15th Session of the Working Party on Ecosystems and Bycatch (WPEB15)	
SC23.10 Para. 59	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
SC23.11 Para. 78	***Report of the 22nd Session of the Working Party on Tropical Tunas (WPTT22)***	
	The SC **NOTED** that the reference points for skipjack tuna are defined with respect to unfished spawning biomass only in resolution 16/02; nonetheless the notation is in terms of B (total exploitable biomass) instead of SB (spawning biomass). Although the resolution also specified Etarg (annual equilibrium exploitation rate associated with the unfished target spawning biomass), it was intended as a control parameter for the harvest control rule, rather than as an explicit target. Meanwhile Resolution 16/02 did not define a limit exploitation rate (Elim). The SC further **NOTED** that resolution 15/10 had specified a default depletion-based target and limit fishing mortality rate but it was discussed whether these are appropriate for skipjack tuna (the default values are defined only when MSY-based reference points cannot be estimated robustly according to 15/10). As such the SC **RECOMMENDED** that the skipjack MSE project to revisit these reference points, including to investigate the plausibility of establishing a limit reference	**Update:** The updated work on the skipjack harvest control has been presented to the TCMP and WPTT in 2021. The Recommendations from the SC have been taken into account in the updated work.

	point for fishing mortality (or exploitation rate)) and to evaluate the differences on the catch forecasts by using total biomass instead of spawning biomass in the HCR.	
SC23.12 Para. 107	***Report of the 16th session of the working party on Data Collection and Statistics (WPDCS16)*** Furthermore, the SC **RECOMMENDED** the Commission to consider how to best take into account the confidentiality aspects inherent to such a dataset (e.g. through updates to Res. 12/02) while at the same time ensuring proper attribution of its ownership. (Refer to paras. 104 and 106 for qualifying details on this Recommendation)	**Update**: Ongoing
SC23.13 Para. 109	**ACKNOWLEDGING** a potential lack of clarity in the current definition of "For reporting (Optional)" data elements in the context of the ROS minimum standard data fields, the SC **RECOMMENDED** that the Commission require CPCs to report such fields to the IOTC Secretariat (as part of their regular ROS data submissions) when these are available to the national observer programmes.	**Update**: Ongoing
SC23.14 Para. 111	For this reason, the SC **RECOMMENDED** that an ad-hoc, intersessional Working Group on the development of EM Programme Standard be constituted and physical or virtual workshops (depending on the circumstances) be held to further progress with the definition of EMS minimum standards.	**Update**: Completed. The First ad hoc Working Group on Electronic Monitoring Standards was held in November 2021.
SC23.15 Para. 114	***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 2021 and 2022.
SC23.16 Para. 116	***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 as due to all meetings being online, the MPF has not been utilized since 2019.
SC23.17	***IOTC species identification guides: Tuna and tuna-like species***	**Update**: Ongoing. Budget has been made available through the IOTC main budget and an EU grant to continue the printing of ID cards and this has continued in 2021.

Para. 117	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.	
SC23.18 Para. 118	***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
SC23.19 Para. 163	***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 2021.

APPENDIX 35A
WORKING PARTY ON NERITIC TUNAS PROGRAM OF WORK (2022 – 2026)

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

Topic in order of priority	Sub-topic and project	Timing				
		2022	2023	2024	2025	2026
1. 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.					
	➢ Sri Lanka (priority species: Frigate tuna, Kawakawa, bullet tuna)					
	➢ Indonesia (priority species: Kawakawa, Bullet tuna, Frigate tuna)					
	➢ Pakistan (priority species: Longtail tuna, Kawakawa, narrow-barred Spanish mackerel)					
	➢ Iran gillnet CPUEs for all species					
	➢ India available CPUEs to be provided to next assessment session					
	Capacity building support for CPCs to develop standardised CPUEs for their fisheries					

2. 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 (eg. CMSY, OCOM, LB-SPR, Risk based methods). • Exploration of priors and how these can be quantifiably and transparently developed • Take into consideration the outputs of genetic studies to investigate stock structure and regional differences in populations 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.					
3. 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)). 4) Reconstruction of historical catch by CPCs using recovered or captured information. 5) Re-estimation of historic catches (with consultation and consent of concerned CPCs) for assessment purposes (taking into account updated identification of uncertainties and knowledge of the history of the fisheries) • (Data support missions to priority countries: India, Oman, Pakistan)					

Other Future Research Requirements						
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. Priorities for Bullet and Frigate tunas as well as Indo-Pacific King Mackerel.					
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) ➢ 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 TUNAS 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). As there was no meeting in 2021, this table is unchanged from 2019.

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 and overall reproductive potential, to inform future stock assessments.		TBD					
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 (2022 – 2026)

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

Topic in order of priority	Sub-topic and project	Timing				
		2022	2023	2024	2025	2026
1. Data mining and processing – (Development of subsequent CPUE indices)	Data on gillnet fisheries are available in Pakistan (and potentially other CPCs) and the recovery of this information and the development of gillnet CPUE indices would improve species assessments, particularly for: • Black marlin • Sailfish					
2. Biological and ecological information (incl. parameters for stock assessment and provide answers to the Commission)	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 inter-sessionally 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).					
3. Stock structure (connectivity and diversity)	Continue work on determining stock structure of Swordfish, using complimentary data sources, including genetic and microchemistry information as well as other relevant sources/studies.					
Other Future Research Requirements (not in order of priority)						
	1.1 Age and growth research					

1. Biological and ecological information (incl. parameters for stock assessment and provide answers to the Commission)	1.1.1 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)					
	1.2 Spawning time and locations					
	1.2.1 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.					
2. Historical data review	2.1 Changes in fleet dynamics					
	2.1.1 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.					
	2.2 Species identification					
	2.2.1 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.					

	2.3 Tagging data recovery from alternate sources (e.g. Billfish foundation) to supplement IOTC tagging database information.						
3. Observer Training to improve data collection for billfish (and other) species	3.1 Training for observers with respect to billfish species identification, various length measurements and biological sampling (gonads, spines and otoliths).						
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						
	4.1.2 Striped marlin: Priority fleets: Japan, Taiwan,China						
	4.1.3 Black marlin: Priority fleets: Longline: Taiwan,China; Gillnet: I.R. Iran, Sri Lanka, Indonesia						
	4.1.4 Blue marlin: Priority fleets: Japan, Taiwan,China, Indonesia						
	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;						
	4.1.6 Joint analysis of operational catch and effort data from Indian Ocean longline fleets as recommended by WPM						
5. Stock assessment / Stock indicators	5.1 Workshops on techniques for assessment including CPUE estimations for billfish species in 2021 and 2022. Priority fleets: Gillnet fisheries						
6. Target and Limit reference points	6.1 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.						
7. Management measure options	7.1 To advise the Commission, on potential management measures having been examined through the Management Strategy Evaluation (MSE) process.						
	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.					
8. Close-Kin Mark-Recapture studies	Review of CKMR applicability for Billfish species and potential feasibility study					
9. Stock structure (connectivity and diversity)	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.					

APPENDIX 35D
WORKING PARTY ON ECOSYSTEMS AND BYCATCH PROGRAM OF WORK (2022 – 2026)

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

Topic in order of priority	**Sub-topic and project**	Timing				
		2022	2023	2024	2025	2026
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. This may include Next Generation Sequencing (NGS), Nuclear markers (i.e., microsatellite) as well as other components of close-kin mark recapture studies (CKMR).					
2. Biological and ecological information (incl. parameters for stock assessment)	2.1 Age and growth research (Priority species: blue shark (BSH), shortfin mako shark (SMA) and oceanic whitetip shark (OCS); silky shark (FAL))					
	2.1.1 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					
	2.3 Reproduction research Priority species: blue shark (BSH), shortfin mako shark (SMA) and oceanic whitetip shark (OCS), and silky shark (FAL)					

	2.4 Ecological Risk Assessment (cetaceans)					
3. Connectivity, movements, habitat use and post release mortality	Electronic tags (PSATs, SPOT, Splash MiniPAT) to assess the efficiency of management resolutions on non-retention species (BSH in LL, marine turtles and rays in GIL and PS, whale sharks) and to determine connectivity, movement rates and mortality estimates.					

Other Future Research Requirements (not in order of priority)

Topic	Sub-topic and project	2022	2023	2024	2025	2026
1. Fisheries data collection	1.1 Historical data mining for the key species and IOTC fleets (e.g., as artisanal gillnet and longline coastal fisheries) including (Workshops – leader?):					
	1.1.1 Capacity building of fisheries observers (including the provision of ID guides, training, etc. Fishing gear guides from SPC)					
	1.1.2 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					
	1.2 Implementation of the Pilot Project (Resolution 16/04) for the Regional Observer Scheme					
	1.2.1 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)					

	1.2.2 Development of a Regional Observer database and population with historic observer data					
	1.2.3 Development, piloting and implementation of an electronic reporting tool to facilitate data reporting					
	1.2.4 Development and trial of Electronic Monitoring Systems for gillnet fleets					
	1.2.5 Port sampling protocols for artisanal fisheries					
	1.3 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					
2. Bycatch mitigation measures	Undertake a series of gear specific workshops focusing on multi-taxa bycatch issues					
	Develop studies on bycatch mitigation measures (operational, technological aspects and best practices)					
	2.1 Sharks a) Harmonise and finalise guidelines and protocols for safe handling and release of sharks and rays caught in IOTC fisheries					
	2.2 Sea turtles 2.2.1 Res. 12/04 (para. 11) Part I. The IOTC Scientific Committee shall request the IOTC Working Party on Ecosystems and Bycatch to:					
	a) Develop recommendations on appropriate mitigation measures for gillnet, longline and purse seine fisheries in the IOTC area; [mostly completed for LL and PS]					
	b) Develop regional standards covering data collection, data exchange and training					

2.2.2 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.					
2.2.3 Regional workshop to review the effectiveness of marine turtle mitigation measures					
2.2.4 Harmonise and finalise guidelines and protocols for safe handling and release of sea turtles caught in IOTC fisheries					
2.3 Seabirds 2.3.1 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.					
2.3.2 Bycatch assessment for seabirds taking into account the information from the various ongoing initiatives in the IO and adjacent oceans					

2.3.3 Study on cryptic mortality of seabirds in tuna LL fisheries.					
2.3.4 Study post release survival rates for seabirds and harmonise and finalise guidelines and protocols for safe handling and release of seabirds caught in IOTC fisheries					
2.4 Cetaceans 2.4.1 Collate all data available on bycatch of key species interacting with all tuna fisheries in the IOTC area (tuna drift gillnets, longlines, purse seines)					
2.4.2 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					
2.4.3 Testing mitigation methods for cetacean bycatch in tuna drift gillnet fisheries					
2.4.4 Harmonise and finalise guidelines and protocols for safe handling and release of cetaceans caught in IOTC fisheries					
2.4.5. Intersessional meeting to discuss cetacean guidelines, ERA, Data gaps.					

3. CPUE standardisation / Stock Assessment / Other indicators	3.1 Develop standardised CPUE series for each key shark species and fishery in the Indian Ocean					
	3.1.1 Development of CPUE guidelines for standardisation of CPC data.					
	3.1.2 Blue shark: Priority fleets: TWN,CHN LL, EU,Spain LL, Japan LL; Indonesia LL; EU,Portugal LL					
	3.1.3 Shortfin mako shark: Priority fleets: Longline and Gillnet fleets					
	3.1.4 Oceanic whitetip shark: Priority fleets: Longline fleets; purse seine fleets					
	3.1.5 Silky shark: Priority fleets: Purse seine fleets					
	3.2 Joint CPUE standardization across the main LL fleets for silky shark, using detailed operational data					
	3.3 Stock assessment and other indicators					
4. Bycatch and discards	4.1 Review proposal on retention of non-targeted species					
	4.1.1 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.					
5. Ecosystems	5.1 Develop a plan for Ecosystem Approach to Fisheries (EAF) approaches in the IOTC, in conjunction with the Common Oceans Tuna Project.					
	5.1.2 Workshop for CPCs on continuing efforts to the development of an EAF including delineation of candidate eco regions within IOTC.					
	5.1.3 Practical Implementation of EBFM with the development and testing of ecosystem report cards.					
	5.1.4 Evaluation of EBFM plan in IOTC area of competence by the WPEB to review its elements components and make any corrective measures.					
	5.2 Assessing the impacts of climate change and socio-economic factors on IOTC fisheries					
	5.3 Evaluate alternative approaches to ERAs to assess ecological risk					

5.4 Progress on Climate webpage on IOTC website and liaise with WPDCS for technical implementation					

APPENDIX 35E
WORKING PARTY ON TROPICAL TUNAS PROGRAM OF WORK (2022 – 2026)

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

Topic in order of priority	Sub-topic and project	TIMING				
		2022	2023	2024	2025	2026
Stock assessment priorities	Stock assessment priorities – detailed review of the assessment and its existing data sources, including *:* i. Peer review of YFT stock assessment as per the SC endorsed ToRs ii. Size frequency data: Evaluation of the reliability of length composition from the longline fisheries (including recent and historical data), iii. Tagging data: Further analysis of the tag release/recovery data set. iv. Organisation of expert group to investigate tagging mortality v. Re-estimation of M using updated tagging data. vi. Additional growth and other biological studies for Tropical tunas.					
CPUE standardisation	Develop standardised CPUE series for each tropical tuna fleet/fishery for the Indian Ocean • Review period where stock was assessed as being overfished without experiencing overfishing. • Regional scaling parameters • Effect of piracy on CPUE after piracy period					
Fisheries impact analysis	Impact of individual fisheries on stock parameters					

Other Future Research Requirements (not in order of priority)						
	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.					

1. Stock structure (connectivity and diversity)	1.1.1 Population genetic analyses to decipher intraspecific connectivity, levels of gene flow, genetic divergence and effective population sizes based on genome-wide distributed Single Nucleotide Polymorphisms (SNPs).					
	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). 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.					
2. Biological and ecological information (incl. parameters for stock assessment)	2.1 Biological sampling					
	2.1.1 Design and develop a plan for a biological sampling program to support research on tropical tuna biology. The plan would consider the need for the sampling program to provide representative coverage of the distribution of the different tropical tuna species within the Indian Ocean and make use of samples and data collected through observer programs, port sampling and/or other research programs. The plan would also consider the types of biological samples that could be collected (e.g. otoliths, spines, gonads, stomachs, muscle and liver tissue, fin clips, etc.), the sample sizes required for estimating biological parameters, and the logistics involved in collecting, transporting and processing biological samples. The specific biological parameters that could be estimated include, but are not limited to, estimates of growth, age at maturity, fecundity, sex ratio, spawning season, spawning fraction and stock structure.					
	2.1.2 Collect gonad samples from tropical tunas to confirm the spawning periods and location of the spawning area that are presently hypothesized for each tropical tuna species.					
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.					
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 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.					
		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.					
		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.					
		Bigeye tuna: High priority fleets					
		Skipjack tuna: High priority fleets					
		Yellowfin tuna: High priority fleets					
		4.1.5 Gillnet CPUE standardization including further investigate and use of gillnet CPUE series from Sri Lankan gillnet fishery					
		4.1.6 Workshops to assist in standardising CPUEs for tropical tuna fleets					

		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).					
		4.3 Investigate the potential to use the Indian longline survey as a fishery-independent index of abundance for tropical tunas.					
5	Stock assessment / stock indicators	5.1 Develop and compare multiple assessment approaches to determine stock status for tropical tunas 5.2 Scoping of ongoing age composition data collection for stock assessment 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).					
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, 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: i. Acoustic FAD monitoring, with the objective of deriving abundance indices based on the biomass estimates provided by echo-sounder buoys attached to FADs 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 iii. Aerial surveys, potentially using remotely operated or autonomous drones					

		iv. Studies (research) on flux of tuna around anchored FAD arrays to understand standing stock and independent estimates of the stock abundance. 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 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). Used when assessing tropical tuna stock status and when establishing the Kobe plot and Kobe matrices					
8	Fisheries Independent Monitoring	8.1 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). It would be valuable to conduct a scoping exercise to evaluate the applicability to the tropical tuna species 8.2 Future work to be conducted on implementation					
9	Fisheries Indicators	9.1 Examination of additional fisheries indicators and their discussion at WP meetings. Perhaps a section in report to accommodate these. See how this is being addressed in other RFMOs.					
10	Peer review	10.1 Plan and ToRs for a peer review to be presented to the SC					

APPENDIX 35F
WORKING PARTY ON DATA COLLECTION AND STATISTICS PROGRAM OF WORK (2022 – 2026)

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				
			2022	2023	2024	2025	2026
1. Artisanal fisheries data collection	**1.1.** Implement a region-wide study focusing on the application of FAO methodology for the characterization of artisanal fisheries (Secretariat, CPCs)						
	1.2. Assist the implementation of data collection and sampling activities for artisanal fisheries in countries/fisheries insufficiently sampled in the past; priority to be given to the following fisheries:	**1**					
	· Coastal fisheries of Indonesia						
	· Coastal fisheries of India						

· Coastal fisheries of Bangladesh						
· Coastal fisheries of Pakistan						
· Coastal fisheries of I.R. Iran						
· Coastal fisheries of Kenya						
· Coastal fisheries of Somalia						
· Coastal fisheries of Sri Lanka						
1.3 Enhance the use of electronic tools to support data collection in artisanal fisheries	**2**					
1.3.1. Define minimum standards for artisanal fisheries data collection						

	1.3.2. Encourage and support sharing of experience and initiatives already implemented by IOTC CPCs in this regard						
2. Evaluation of catch data uncertainties	**2.1** Review of historical catch data for all stocks being assessed in the following year to determine the level of uncertainty to be used for stock assessment and management procedures[11]	**2**					
3. Compliance with IOTC data reporting requirements	**3.1.** Data support missions						
	3.1.1. Drafting 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 CPCs / fisheries:						
	· Indonesia						

[11] Secretariat / WPTT / WPM / national scientists / external experts

· India						
· Pakistan						
· Oman						
· Sri Lanka						
· Somalia						
3.2. Workshops to clarify data reporting requirements[12]						
3.3. Support the documentation of sampling protocols and processing[13]						
3.4. Strengthen collaboration with the WGFAD to propose new terminology for FAD activities and types						

[12] Recommended by the CoC

[13] Secretariat to finalize the template, CPC to provide information

4. Data access	**4.1.** Improve discoverability of IOTC scientific assets through standard metadata and DOIs[14]						
5. ROS – Support for the implementation of the IOTC Regional Observer Scheme	**5.1.** ROS e-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, ICCAT ST09 and other custom observer forms)						
	5.2.2. Implement dissemination best-practices for all data collected by the ROS Regional Database						

[14] Secretariat in collaboration with INTERREG project

5.3. ROS Electronic Monitoring Systems						
5.3.1. Implement pilot EMS system on gillnet / coastal longline vessels for fleets insufficiently covered by on-board observers possibly by providing support through remote meetings until travel bans are lifted[15]						
5.3.2. Ad hoc Working Group on EMS programme standards, including workshops (in person / virtual, depending on the case)	**3**					
5.4. Evaluate the combination of alternative data collection systems and protocols for the collection of scientific observer data for artisanal and coastal fisheries, with an initial expert to develop protocols and guidelines for minimum data collection requirements in small-scale, artisanal, and coastal fisheries, including through EMS systems.						
5.5. Supporting intersessional work to finalize the outputs from the ROS Pilot Project training programme[16]						

[15] Sri Lanka EMS, training + data exchange

[16] Secretariat / service provider / international experts / peer-reviewers

APPENDIX 35G
WORKING PARTY ON METHODS PROGRAM OF WORK (2022 – 2026)

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	Timing				
		2022	2023	2024	2025	2026
1. Management Strategy Evaluation	Continuation of Management Strategy Evaluation for Albacore, Skipjack, Yellowfin, Bigeye tunas as well as Swordfish					
	Peer review of BET MSE as per the ToRs endorsed by the SC					
Future Research Requirements (not in order of priority)						
Management Strategy Evaluation	1.1 Albacore					
	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					
1.2.1 Revision and adaptation of framework for simulation evaluations of MPs. Moving from HCR to fully specified MP.					
1.2.2 Develop revised production model for inclusion in simulation framework					
1.2.3 Condition OM on updated assessment model from 2020.					
1.2.4 Present revised MP results to TCMP with target adoption date of 2023					
1.2.5 Additional iterations if required					
1.3 Bigeye tuna					
1.3.1 Update OM & present preliminary MP results to TCMP, WPTT/WPM review of new OM					
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					

	1.4.1 Update OM & present preliminary MP results to TCMP, WPTT/WPM review of new OM					
	1.4.2 Present revised MP results to TCMP with target adoption date of 2024; iteratively update development if required)					
	1.4.3 additional iterations if required					
	1.5 Swordfish					
	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					
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*)					
Presentation of stock status advice for data limited stocks	2.1 Explore potential methods of presenting stock status advice to managers from a range of data limited scenarios, e.g. through the development of a 'Tier' approach for providing stock status advice, based on the type of indictors used to determine stock status (e.g. CPUE series, stock assessment					

	model)					
Peer Review	External peer review based on Terms of Reference agreed to by the WPM and following the schedule recommended in Appendix V of the WPM12 report.					
Capacity Building	Ongoing development of tools, materials and courses to continue Capacity Building for increasing participation in the MSE process					

APPENDIX 36
SCHEDULE OF STOCK ASSESSMENTS FOR IOTC SPECIES AND SPECIES OF INTEREST FROM 2022–2026, AND FOR OTHER WORKING PARTY PRIORITIES

Working Party on Neritic Tunas					
Species	**2022****	**2023***	**2024***	**2025****	**2026***
Bullet tuna	Data preparation	Data preparation	**Assessment**	Data preparation	Data preparation
Frigate tuna	Data preparation	Data preparation	**Assessment**	Data preparation	Data preparation
Indo-Pacific king mackerel	Data preparation	Data preparation	**Assessment**	Data preparation	Data preparation
Kawakawa	Data preparation	**Assessment**	Data preparation	Data preparation	**Assessment**
Longtail tuna	Data preparation	**Assessment**	Data preparation	Data preparation	**Assessment**
Narrow-barred Spanish mackerel	Data preparation	**Assessment**	Data preparation	Data preparation	**Assessment**

* Including data-limited stock assessment methods;
** Including species-specific catches, CPUE, biological information and size distribution as well as identification of data gaps and discussion of improvements to the assessments (stock structure); one day may be reserved for capacity building activities.
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	**2022**	**2023**	**2024**	**2025**	**2026**
Black marlin			**Full assessment**		
Blue marlin	**Full assessment**			**Full assessment**	
Striped marlin			**Full assessment**		
Swordfish	**Indicators****	**Full assessment**		**Indicators****	**Full assessment**
Indo-Pacific sailfish	**Full assessment***			**Full assessment***	

* Including data poor stock assessment methods; Note: the assessment schedule may be changed depending on the annual review of fishery indicators, or SC and Commission requests.
** Including biological parameters, standardized CPUE, and other fishery trend.

Working Party on Tropical Tunas					
Species	**2022**	**2023**	**2024**	**2025**	**2026**
Bigeye tuna	**Data preparatory meeting** **Full assessment**	Indicators	Indicators	**Data preparatory meeting** **Full assessment**	Indicators
Skipjack tuna	Indicators	**Data preparatory meeting** **Full assessment**	Indicators	Indicators	**Data preparatory meeting** **Full assessment**
Yellowfin tuna	Indicators	Indicators	**Data preparatory meeting** **Full assessment**	Indicators	Indicators
Working Party on Ecosystems and Bycatch					
Species	**2022**	**2023**	**2024**	**2025**	**2026**
Blue shark	-	–	–	Data preparatory meeting Full assessment	-
Oceanic whitetip shark	Indicator analysis	–	Data preparation	Indicator analysis	-
Scalloped hammerhead shark	Assessment*	–	–	–	-
Shortfin mako shark	–		Data preparatory meeting Full assessment	–	-
Silky shark	-	Assessment*	-	–	Assessment*
Bigeye thresher shark	Assessment*	-	–	–	Assessment*
Pelagic thresher shark	Assessment*	-	–	–	Assessment*
Porbeagle shark	–	Assessment*	–	–	-
Mobulid Rays	-	-	Interactions/ Indicators	–	-

Marine turtles	–	Indicators	–	–	-
Seabirds	Review of mitigation measures in Res. 12/06	–	–	–	Review of mitigation measures in Res. 12/06
Marine Mammals	–	–	–	Review of mitigation measures	-
Ecosystem Based Fisheries Management (EBFM) approaches	ongoing	ongoing	ongoing	ongoing	-

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

Working Party on Temperate Tunas					
Species	**2022**	**2023**	**2024**	**2025**	**2026**
Albacore	Data preparatory Meeting Stock assessment meeting	–	–	Data preparatory Meeting Stock assessment meeting	

APPENDIX 37
SCHEDULE OF IOTC WORKING PARTY AND SCIENTIFIC COMMITTEE MEETINGS
(2022 and 2023)

	2022			2023		
Meeting	**No.**	**Date**	***Location**	**No.**	**Date**	***Location**
Management Strategy Evaluation Task Force of the **Working Party On Methods** Meeting	13th	7 – 10 March (4d)	TBC	14th	TBC	TBC
Working Party on **Temperate Tunas** (WPTmT) Data preparatory meeting	08th	13 – 15 April (3d)	TBC	-	-	-
Working Party on **Tropical Tunas (**WPTT) Data Preparatory meeting	24th	30 May – 3 June (5d)	TBC	25th	TBC	TBC
Working Group on Electronic Monitoring Standards (WGEMS)	2nd	13 – 15 June (3d)	TBC			
Working Party on **Neritic Tunas** (WPNT)	12th	4-8 July (5d)	TBC	13th	July	TBC
Working Party on **Temperate Tunas** (WPTmT) Assessment meeting	08th	25 – 29 July (5d)	TBC	-	-	-
Working Party on **Ecosystems and Bycatch** (WPEB)	18th	5-9 September (5d)	TBC	19th	September (with WPB)	TBC
Working Party on **Billfish** (WPB)	20th	12-15 September (4d)	TBC	21st	September (with WPEB)	TBC
Ad hoc Working Group on FADs (WGFAD)	3rd	3-5 October (3d)	TBC	4th	TBC	TBC
Working Party on **Methods** (WPM)	13th	19-21 October (3d) (with WPTT)	TBC	14th	October (with WPTT)	TBC
Working Party on **Tropical Tunas** (WPTT) Assessment meeting	24th	24-29 October (6d) (with WPM)	TBC	25th	October (with WPM)	TBC
Working Party on **Data Collection and Statistics** (WPDCS)	18th	29 November - 3 December (5d)	TBC	19th	November	TBC
Scientific Committee	25th	5-9 December (5d)	TBC	26th	December	TBC

*Due to the Covid-19 crisis and the cancellation of physical meetings for the foreseeable future, offers to host meetings in 2022 were not requested. Should the situation change, the Secretariat will work with Member countries to determine hosting of these meetings.

APPENDIX 38
CONSOLIDATED SET OF RECOMMENDATIONS OF THE 24TH SESSION OF THE SCIENTIFIC COMMITTEE (6 – 10 DECEMBER 2021) TO THE COMMISSION

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

Tuna – Highly migratory species

SC24.01 (para. 154) 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 2021 (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

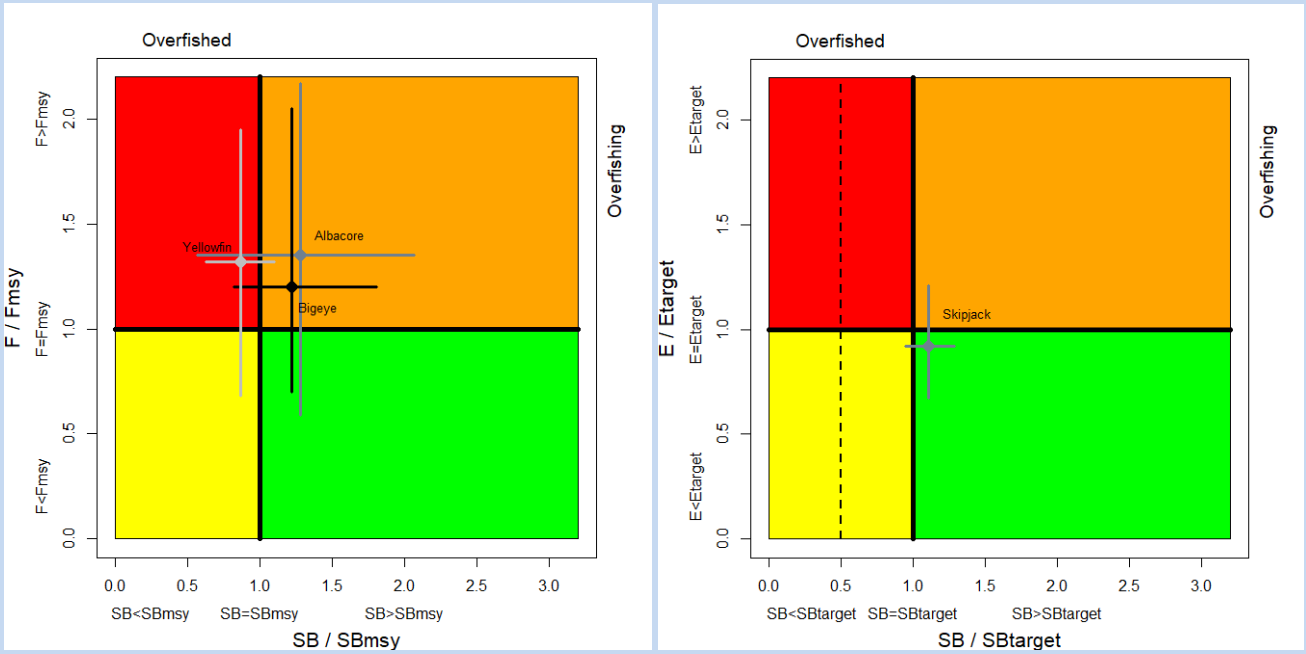

Fig. 1. (Left) Combined Kobe plot for bigeye tuna (black: status in 2018, based on the assessment conducted in 2019), and yellowfin tuna (light grey: 2020, with assessment conducted in 2021) and albacore (dark grey: 2017 with assessment conducted in 2019) showing the estimates of current spawning biomass (SB) and current fishing mortality (F) in relation to optimal spawning stock size and optimal fishing mortality. (Right) Kobe plot for skipjack tuna (2019 with assessment conducted in 2020) showing the estimates of the current stock status (The dashed line indicates the limit reference point at 20%SB0 while SBtarget=0.4 SB0). Cross bars illustrate the range of uncertainty from the model runs with an 80% CI (95% CI for albacore).

Billfish

SC24.02 (para. 157) 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 2021 (Fig. 3):

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

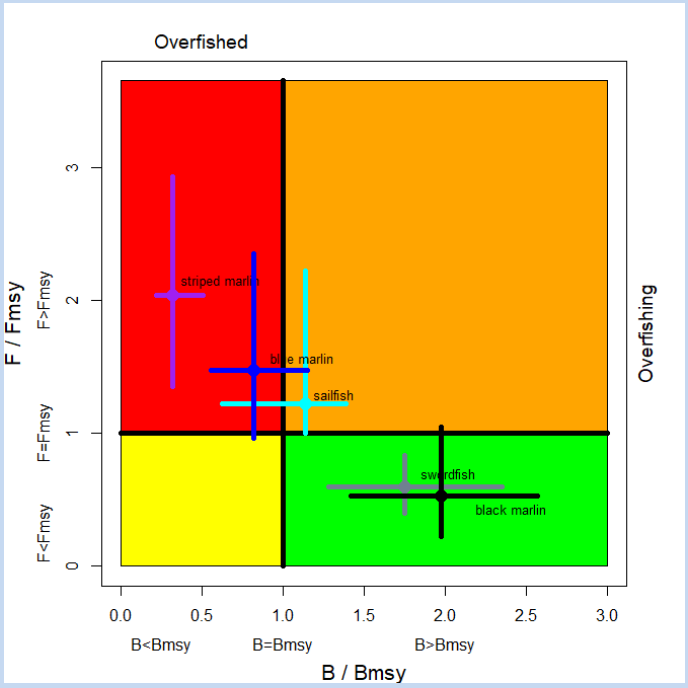

Fig. 3. Combined Kobe plot for swordfish (2018 with assessment conducted in 2020, grey), Indo-Pacific sailfish (2017 with assessment conducted in 2019, cyan), black marlin (2019 with assessment conducted in 2021, black), blue marlin (2017 with assessment conducted in 2019, blue) and striped marlin (2019 with assessment conducted in 2021, purple) showing the estimates of current stock size (SB or B, species assessment dependent) and current fishing mortality (F) in relation to optimal stock size and optimal fishing mortality. Cross bars illustrate the range of uncertainty from the model runs. Given unresolved uncertainty in the assessment, status for black marlin and sailfish should be interpreted with caution.

Tuna and seerfish – Neritic species

SC24.03 (para. 156) 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 2021 (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

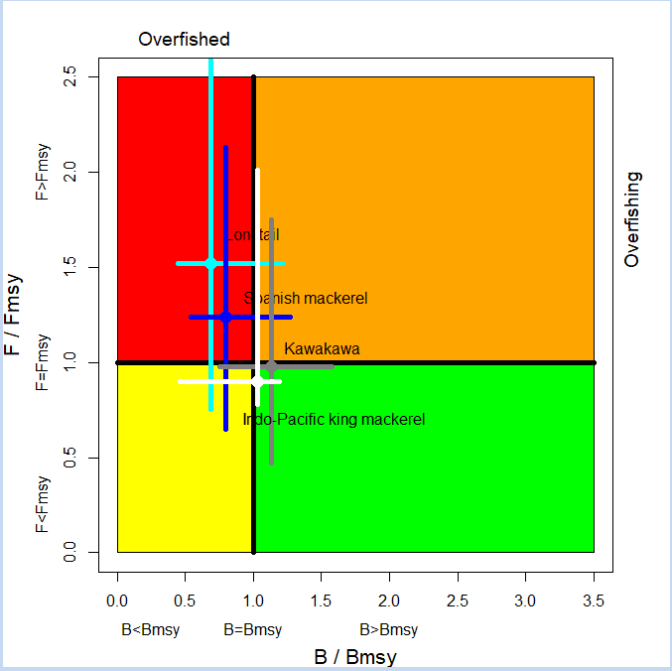

Fig. 2. Combined Kobe plot for longtail tuna (cyan), narrow-barred Spanish mackerel (blue), kawakawa (grey)(all for 2018 with assessment carried out in 2020) and Indo-Pacific king mackerel (2019 with assessment carried out in 2021, white), showing the estimates of stock size (B) and current fishing mortality (F) in relation to optimal biomass and optimal fishing mortality. Cross bars illustrate the range of uncertainty from the model runs. Given unresolved uncertainty in the assessment, status for bullet tuna, frigate tuna and Narrow-barred Spanish mackerel should be interpreted with caution.

Sharks

SC24.04 (para. 158) 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

SC24.05 (para. 159) 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

SC24.06 (para. 160) 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

SC24.07 (para. 161) The SC **RECOMMENDED** that the Commission note the management advice developed for cetaceans, as provided in the newly developed Executive Summary encompassing all species commonly interacting with IOTC fisheries for tuna and tuna-like species:

Cetaceans – Appendix 32

GENERAL RECOMMENDATIONS TO THE COMMISSION

NATIONAL REPORTS FROM CPCS

SC24.08 (para. 26) **NOTING** that the Commission, at its 25th Session (in 2021), noted that there was an improvement in submission of National reports in 2020 over the previous year, it also 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 and 15/02. The SC **RECOMMENDED** that the Commission note that there was a decrease in the Submission of National reports in 2021, as only 21 reports were provided by CPCs (25 in 2020, 23 in 2019, 26 in 2018, 23 in 2017 and 23 in 2016 (Table 2).

SC24.09 (para. 27) The SC **RECOMMENDED** that the Compliance Committee and Commission note the lack of compliance by 9 Contracting Parties (Members) and 1 Cooperating Non-Contracting Party (CNCPs) that did not submit a National Report to the Scientific Committee in 2021, noting that the Commission agreed that the submission of the annual reports to the Scientific Committee is mandatory.

REPORT OF THE 19TH SESSION OF THE WORKING PARTY ON BILLFISH (WPB19)

SC24.10 (para. 42) **RECALLING** that one of the Indian Ocean billfish species (shortbill spearfish, *Tetrapturus angustirostris*) is currently not listed among the species managed by IOTC, and considering the ocean-wide distribution of this species, its highly-migratory nature, and that it is a common bycatch in IOTC managed fisheries, the SC reiterated its previous **RECOMMENDATION** that shortbill spearfish be included as an IOTC species

Revision of catch levels of Marlins under Resolution 18/05

SC24.11 (para. 56) The SC **NOTED** that catches in recent years for black marlin and Indo-Pacific sailfish have exceeded all recent MSY estimates and catch limits set by Resolution 18/05 (para 3), and that the current catch trends for the two species show no signs of decline - these catch limits will likely be exceeded again in 2021. Furthermore, results from the 2021 assessment of striped marlin provided certainty that the stock is overfished and subject to overfishing (100% probability) and that biomass has been below that which would produce MSY for over a decade. The biomass of striped marlin is considered severely depleted. As such, the SC **NOTED** the inadequacy of Resolution 18/05 in limiting the catches of billfishes and **RECOMMENDED** the Commission to review the Resolution to update catch limits and provide mechanisms to ensure these limits are adhered to

REPORT OF THE 17TH SESSION OF THE WORKING PARTY ON ECOSYSTEMS AND BYCATCH (WPEB17)

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

SC24.12 (para. 60) 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.

Other matters

SC24.13 (para. 74) The SC **ACKNOWLEDGED** the proposed Letter of Intent between the IWC and IOTC and **NOTED** that this letter is based on the language used in the Letter of Intent between IOTC and ACAP which has been accepted by the Commission. The SC **RECOMMENDED** that the letter is presented at the Commission for further consideration.

SC24.14 (para. 77) The SC **NOTED** the use of subsurface gillnetting in the Indian Ocean may be an effective mitigation measure to reduce bycatch of cetaceans, sharks and sea turtles and that Resolution 19/01 already requests the utilization of subsurface gillnets by 2023 to mitigate ecological impacts of this gear. The SC **RECOMMENDED** that it be kept informed by the Commission on the current status of implementation of the relevant clause of Resolution 19/01.

REPORT OF THE 23RD SESSION OF THE WORKING PARTY ON TROPICAL TUNAS (WPTT23)

Yellowfin tuna Stock Assessment

SC24.15 (para. 103) The SC **NOTED** the importance of the peer review process and its role in providing improved scientific advice for management. The SC therefore **RECOMMENDED** that the Commission endorse the process for a YFT stock assessment review as well as the BET MSE review and provide the financial resources to conduct the work planned.

Update on the WGFAD02

SC24.16 (para. 107) The SC **RECOMMENDED** the Committee endorse the process to improve current definitions of FAD and FAD activities used by the IOTC, to be conducted by the WPTT and WGFAD

REPORT OF THE 12TH SESSION OF THE WORKING PARTY ON METHODS (WPM12)

Management Strategy Evaluation Progress

SC24.17 (para. 114) The SC **NOTED** the guidelines included as Appendix 6a to this report to deal with exceptional circumstances in the MSE process. The SC further **NOTED** that these guidelines are a living document and revisions may still be required in the future. The SC **RECOMMENDED** that the Commission consider and endorse the guidelines.

SC24.18 (para. 115) The SC **NOTED** the revised schedule of MSE work included as Appendix 6b to this report to provide the timeframe for the development of management procedures for key IOTC species. The SC **NOTED** that the revised MSE schedule is still ambitious but that the technical work could, in principle, be completed within the proposed timeframes with minor adjustments. The SC **RECOMMENDED** that the Commission consider and endorse the revised timetable.

REPORT OF THE 17TH SESSION OF THE WORKING PARTY ON DATA COLLECTION AND STATISTICS (WPDCS17)

SC24.19 (para. 136) **NOTING** that the WPDCS identified aspects of several data-related resolutions that are either unclear or inconsistent (15/01, 15/02 and 19/02) the SC **RECOMMENDED** that the Commission consider how to best address these issues at the next revision of each resolution.

SC24.20 (para. 139) **ACKNOWLEDGING** that the workload of the Secretariat data team has increased markedly in recent years to manage an increasing number of datasets, provide more data outputs, and improve data access, the SC **RECOMMENDED** that the Commission consider strengthening the capacity of the Secretariat's Data Group with the addition of an extra staff member**.**

SC24.21 (para. 140) The SC **ACKNOWLEDGED** the long-term relationship between the OFCF and the IOTC to improve the collection, management and reporting of fisheries statistics and **RECOMMENDED** the Commission consider the continuation of this collaboration through an appropriate arrangement.

Update on WGEMS01

SC24.22 (para. 143) The SC **NOTED** the outcomes of the 1st ad-hoc IOTC WGEMS and **RECOMMENDED** the Commission endorse its continuation in the future and for the Commission to discuss if the WGEMS should remain under the WPDCS or report directly to the SC or CoC. The SC **ENDORSED** the Terms of Reference and Plan of Work for the WGEMS.

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

SC24.23 (para. 145) 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

SC24.24 (para. 147) 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

SC24.25 (para. 148) 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 CPC scientific observers, both on board and at port, need to have hard copies.

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

SC24.26 (para. 150) 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.

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

Consultants

SC24.27 (para. 181) 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 24TH SESSION OF THE SCIENTIFIC COMMITTEE

SC24.28 (para. 190) The SC **RECOMMENDED** that the Commission consider the consolidated set of recommendations arising from SC24, provided at Appendix 38.