Report of the 10th Session of the IOTC Working Party on Neritic Tunas

Microsoft Teams Online, 6 – 8 July 2020

DISTRIBUTION:

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ACRONYMS

B	Biomass (total)
BLT	Bullet tuna
B_{MSY}	Biomass which produces MSY
CMM	Conservation and Management Measure (of the IOTC; Resolutions and Recommendations)
C-MSY	Catch and Maximum Sustainable Yield data limited stock assessment method
COM	Narrow-barred Spanish mackerel
CPCs	Contracting parties and cooperating non-contracting parties
CPUE	Catch per unit of effort
current	Current period/time, i.e. $F_{current}$ means fishing mortality for the current assessment year.
EEZ	Exclusive Economic Zone
F	Fishing mortality; F_{2017} is the fishing mortality estimated in the year 2017
FAD	Fish aggregating device
F_{MSY}	Fishing mortality at MSY
FRI	Frigate tuna
GLM	Generalised Linear Model
GUT	Indo-Pacific king mackerel
IO	Indian Ocean
IOTC	Indian Ocean Tuna Commission
KAW	Kawakawa
LL	Longline
LOT	Longtail tuna
M	Natural mortality
MPF	Meeting Participation Fund
MSY	Maximum sustainable yield
n.a.	Not applicable
OCOM	Optimised Catch Only Method
PS	Purse-Seine
ROS	Regional Observer Scheme
SB	Spawning Biomass (sometimes expressed as SSB)
SB_{MSY}	Spawning stock Biomass which produces MSY
SC	Scientific Committee of the IOTC
SEAFDEC	Southeast Asian Fisheries Development Center
SRA	Stock Reduction Analysis
SWIOFP	South West Indian Ocean Fisheries Project
VB	Von Bertalanffy (growth)
WPDCS	Working Party on Data Collection and Statistics
WPNT	Working Party on Neritic Tunas of the IOTC
WWF	World Wide Fund for Nature (a.k.a World Wildlife Fund)

STANDARDISATION OF IOTC WORKING PARTY AND SCIENTIFIC COMMITTEE REPORT TERMINOLOGY

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

HOW TO INTERPRET TERMINOLOGY CONTAINED IN THIS REPORT

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

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

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

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

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EXECUTIVE SUMMARY

The 10th Session of the Indian Ocean Tuna Commission's (IOTC) Working Party on Neritic Tunas (WPNT10) was held online using the Microsoft Teams online platform from 6 - 8 July 2020. A total of 43 participants (18 in 2019, 18 in 2018, and 26 in 2017) attended the Session. The list of participants is provided at Appendix I. The meeting was opened by the Chairperson, Ms Ririk Sulistyaningsih from Indonesia, who welcomed participants to the meeting.

The following are the recommendations from the WPNT10 to the Scientific Committee which are provided in Appendix XIII.

Review of the statistical data available for neritic tunas

WPNT10.01 (para 15) **CONSIDERING** point iii above, the WPNT **RECOMMENDED** that the reconstruction and re-estimation of historical catch series for neritic tuna and tuna-like species, at least for the major fleets known to target these species, be considered as a priority activity for future works of the group.

Revision of the WPNT Program of Work (2021–2025)

WPNT10.02 (para 101) The WPNT **RECOMMENDED** that the SC consider and endorse the WPNT Program of Work (2021–2025), as provided in Appendix VI.

Date and place of the 11th and 12th Working Party on Neritic Tunas

WPNT10.03 (para 103) The WPNT **NOTED** that Kenya had expressed interest in potentially hosting the 10th Session of the WPNT while Sri Lanka and Malaysia had expressed an interest in potentially hosting the 11th Session of the WPNT in 2021. However the global Covid-19 pandemic resulted in these plans being abandoned. The Secretariat will continue to liaise with CPCs to determine their interest in hosting these meetings in the future when this once again becomes feasible. The WPNT **RECOMMENDED** the SC consider early July 2021 as a preferred time period to hold the WPNT11 in 2021.

Meeting participation fund (MPF)

WPNT10.04 (para 104) The WPNT **RECOMMENDED** that the SC and Commission note the following:

1) The participation of developing coastal state scientists to the WPNT has been consistently high following the adoption and implementation of the IOTC Meeting Participation Fund adopted by the Commission in 2010 (Resolution 10/05 *On the establishment of a Meeting Participation Fund for developing IOTC Members and Non-Contracting Cooperating Parties*), now incorporated into the IOTC Rules of Procedure (2014), as well as though the hosting of the WPNT in developing coastal State Contracting Parties (Members) of the Commission (Table 11). The WPNT **NOTED** that as the 2020 meeting was a virtual meeting, no MPF funds were required to facilitate the participation of scientists to the meeting.
2) The continued success of the WPNT, at least in the short term, appears heavily reliant on the provision of support via the MPF which was established primarily for the purposes of supporting scientists to attend and contribute to the work of the Scientific Committee and its Working Parties.
3) The MPF should be utilised so as to ensure that all developing Contracting Parties of the Commission are able to attend the WPNT meeting, as neritic tunas are an important resource for many of the coastal countries of the Indian Ocean.

Review of the draft, and adoption of the Report of the 10th Working Party on Neritic Tunas

WPNT10.05 (para 105) The WPNT **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPNT10, provided at Appendix XIII, as well as the management advice provided in the draft resource stock status summary for each of the six neritic tuna (and mackerel) species under the IOTC mandate, and the combined Kobe plot for the species assigned a stock status in 2020 (Fig. 10):

- Bullet tuna (*Auxis rochei*) – Appendix VII
- Frigate tuna (*Auxis thazard*) – Appendix VIII
- Kawakawa (*Euthynnus affinis*) – Appendix IX

- Longtail tuna (*Thunnus tonggol*) – Appendix X
- Indo-Pacific king mackerel (*Scomberomorus guttatus*) – Appendix XI
- Narrow-barred Spanish mackerel (*Scomberomorus commerson*) – Appendix XII

Table 1. Status summary for species of neritic tuna and tuna-like species under the IOTC mandate: 2020

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 with a total estimated catch of 621 445 t landed in 2018. They are caught primarily by coastal fisheries, including small-scale industrial and artisanal fisheries. They 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	Previous	2015	2016	2017	2018	2019	2020	Advice to the Commission
Bullet tuna *Auxis rochei*	Catch 2018: 31,052 t Average catch 2014–2018: 15,913 t MSY (1,000 t) unknown F_{MSY}: unknown B_{MSY} (1,000 t): unknown $F_{current}/F_{MSY}$: unknown $B_{current}/B_{MSY}$: unknown $B_{current}/B_0$: unknown								For assessed species of neritic tunas in Indian Ocean (longtail tuna, kawakawa and narrow barred Spanish mackerel), the MSY was estimated to have been reached between 2009 and 2011 and both F_{MSY} and B_{MSY} were breached thereafter. Therefore, in the absence of a stock assessment of bullet tuna a limit to the catches should be considered by the Commission, by ensuring that future catches do not exceed the average catches estimated between 2009 and 2011 (8,870 t). The reference period (2009-2011) was chosen based on the most recent assessments of those neritic species in the Indian Ocean for which an assessment is available under the assumption that also for bullet tuna MSY was reached between 2009 and 2011. This catch advice should be maintained until an assessment of bullet tuna is available. Considering that MSY-based reference points for assessed species can change over time, the stock should be closely monitored. Mechanisms need to be developed by the Commission to improve current statistics by encouraging CPCs to comply with their recording and reporting requirements, so as to better inform scientific advice. Click here for a full stock status summary: Appendix VII
Frigate tuna *Auxis thazard*	Catch 2018: 92,725 t Average catch 2014–2018: 99,340 t MSY (1,000 t) unknown F_{MSY}: unknown B_{MSY} (1,000 t): unknown $F_{current}/F_{MSY}$: unknown $B_{current}/B_{MSY}$: unknown $B_{current}/B_0$: unknown								For assessed species of neritic tunas in Indian Ocean (longtail tuna, kawakawa and narrow barred Spanish mackerel), the MSY was estimated to have been reached between 2009 and 2011 and both F_{MSY} and B_{MSY} were breached thereafter. Therefore, in the absence of a stock assessment of frigate tuna a limit to the catches should be considered by the Commission, by ensuring that future catches do not exceed the average catches estimated between 2009 and 2011 (94,921 t). The reference period (2009-2011) was chosen based on the most recent assessments of those neritic species in the Indian Ocean for which an assessment is available under the assumption that also for 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. Click here for a full stock status summary: Appendix VIII

Stock	Indicators	Previous	2015	2016	2017	2018	2019	2020	Advice to the Commission
Kawakawa *Euthynnus affinis*	Catch 2018[2]: 164,133 t Average catch 2014-2018 152,919 t MSY (1,000 t) [*] 149 [124 –223] F_{MSY} [*] 0.44 [0.21–0.82] B_{MSY} (1,000 t) [*] 356 [192–765] F_{2018}/F_{MSY} [*] 0.98 [0.47–1.75] B_{2018}/B_{MSY} [*] 1.13 [0.75–1.58] B_{2013}/B_0 [*]								A new stock assessment was carried out in 2020 using data-limited assessment techniques. The OCOM model indicated that F was just FMSY (F/FMSY=0.98) and B above BMSY (B/BMSY=1.13). The estimated probability of the stock currently being in green quadrant of the Kobe plot is about 50%. The available gillnet CPUE showed a somewhat increasing trend. On the weight-of-evidence available in 2020, the stock status is assessed to be not overfished and overfishing is not occurring. However the assessment models rely on catch data, which is considered to be highly uncertain. The catch in 2018 was above the estimated MSY. 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 IX
Longtail tuna *Thunnus tonggol*	Catch 2018[2]: 135,282 t Average catch 2014–2018: 141,996 t MSY (1,000 t) (*): 129 (100–151) F_{MSY} (*): 0.32 (0.15–0.66) B_{MSY} (1,000 t) (*): 395 (129–751) F_{2018}/F_{MSY} (*): 1.52 (0.75–2.87) B_{2018}/B_{MSY} (*): 0.69 (0.45–1.21) B_{2015}/B_0 (*): (–)								A new stock assessment was carried out in 2020 using data-limited assessment techniques. The OCOM model indicated that F was above FMSY (F/FMSY=1.52) and B below BMSY (B/BMSY=0.69), with an estimated probability of 76% for the stock currently being in red quadrant of the Kobe plot. The recent catches are close to historical high levels and available gillnet CPUE showed declining catch rates, which is a cause of concern. On the weight-of-evidence available in 2020, the stock status is assessed to be overfished and overfishing is occurring. However the assessment models rely on catch data, which is considered to be highly uncertain. The catch in 2018 was just 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. Click here for a full stock status summary: Appendix X
Indo-Pacific king mackerel *Scomberomorus guttatus*	Catch 2018[2]: 43,468 t Average catch 2014-2018: 45,943 t MSY (1,000 t) Unknown F_{MSY}: Unknown B_{MSY} (1,000 t): Unknown $F_{current}/F_{MSY}$: Unknown $B_{current}/B_{MSY}$: Unknown $B_{current}/B_0$: Unknown								For assessed species of neritic tunas in Indian Ocean (longtail tuna, kawakawa and narrow barred Spanish mackerel), the MSY was estimated to have been reached between 2009 and 2011 and both F_{MSY} and B_{MSY} were breached thereafter. Therefore, in the absence of a stock assessment of Indo-Pacific king mackerel a limit to the catches should be considered by the Commission, by ensuring that future catches do not exceed the average catches estimated between 2009 and 2011 at the time of the assessment (46,787 t). The reference period (2009-2011) was chosen based on the most recent assessments of those neritic species in the Indian Ocean for which an assessment is available under the assumption that also for Indo-Pacific king mackerel MSY was reached between 2009 and 2011. This catch advice should be maintained until an assessment of Indo-Pacific king mackerel is available. 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 XI
Narrow-barred Spanish mackerel	Catch 2018[2]: 154,785 t Average catch 2014-2018: 175,891 t MSY (1,000 t) [*]: 158 [132–187]								A new stock assessment was carried out in 2020 using data-limited assessment techniques. The OCOM model indicated that F was above FMSY (F/FMSY=1.24) and B

Stock	Indicators		Previous	2015	2016	2017	2018	2019	2020	Advice to the Commission
Scomberomorus commerson	F_{MSY} [*]: B_{MSY} (1,000 t) [*]: F_{2018}/F_{MSY} [*]: B_{2018} B_{MSY} [*]: B_{2018}/B_0 [*]:	0.49 [0.25–0.87] 324 [196–593] 1.24 [0.65–2.13] 0.89 [0.65–2.13]								below BMSY (B/BMSY=0.89). The estimated probability of the stock currently being in red quadrant of the Kobe plot is about 73%. On the weight-of-evidence available in 2020, the stock status is assessed to be overfished and overfishing is occurring. However the assessment models rely on catch data, which is considered to be highly uncertain. The catch in 2018 was just below the estimated MSY and the available Gillnet CPUE show a somewhat increasing trend in recent years. Despite the substantial uncertainties, the stock is probably 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 XII

*Indicates range of plausible values

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		

1. Opening of the Meeting

1. The 10th Session of the Indian Ocean Tuna Commission's (IOTC) Working Party on Neritic Tunas (WPNT10) was held online using the Microsoft Teams online platform from 6 - 8 July 2020. A total of 43 participants (18 in 2019, 18 in 2018, and 26 in 2017) attended the Session. The list of participants is provided at Appendix I. The meeting was opened by the Chairperson, Ms Ririk Sulistyaningsih from Indonesia, who welcomed participants to the meeting.

2. Adoption of the Agenda and Arrangements for the Session

2. The WPNT **ADOPTED** the Agenda provided at Appendix II. The documents presented to the WPNT10 are listed in Appendix III.

3. The IOTC process: Outcomes, updates and progress

3.1 *Outcomes of the 22nd Session of the Scientific Committee*

3. The WPNT **NOTED** paper IOTC–2020–WPNT10–03 which outlined the main outcomes of the 22nd Session of the Scientific Committee (SC22), specifically related to the work of the WPNT and **AGREED** to consider how best to progress these issues at the present meeting.

4. The WPNT were informed that "*the SC **NOTED** that compliance with data reporting obligations remains low for neritic tuna species, and **REQUESTED** CPCs do their best to collect data and comply with data reporting requirements adopted by the IOTC*".

3.2 *Outcomes of the 23rd Session of the Commission*

5. The WPNT **NOTED** paper IOTC–2020–WPNT10–04 which outlined the main outcomes of the 23rd Session of the Commission, specifically related to the work of the WPNT. The WPNT further **NOTED** that the 24th Session of the Commission which was due to be held in June 2020 had been postponed until November and therefore no new outcomes or Resolutions are available since the 23rd session.

6. Participants to WPNT10 were **ENCOURAGED** to familiarise themselves with the previously adopted Resolutions, especially those most relevant to the WPNT.

3.3 *Review of Conservation and Management Measures relevant for neritic tunas*

7. The WPNT **NOTED** paper IOTC–2020–WPNT10–05 which aimed to encourage participants at the WPNT10 to review some of the existing Conservation and Management Measures (CMM) relating to neritic tunas, noting that these were revised in 2019, but not 2020 as described in document IOTC–2020–WPNT10–04.

3.4 *Progress on the Recommendations of WPNT09 and SC22*

8. The WPNT **NOTED** paper IOTC–2020–WPNT10–06 which provided an update on the progress made in implementing the recommendations from the 9th Session of the WPNT for the consideration and potential endorsement by participants.

9. The WPNT **NOTED** that good progress had been made on these Recommendations, and that several of these, would be directly addressed by the assessment scientists when presenting the updated results for 2020.

10. The WPNT participants were **ENCOURAGED** to review IOTC-2020-WPNT10-06 during the meeting and report back on any progress in relation to requests or actions by CPCs that have not been captured by the report, and to note any pending actions for attention before the next meeting (WPNT11).

11. The WPNT **REQUESTED** that the IOTC Secretariat continue to annually prepare a paper on the progress of the recommendations arising from the previous WPNT, incorporating the final recommendations adopted by the Scientific Committee and endorsed by the Commission.

4. New Information on Fisheries and Associated Environmental Data for Neritic Tunas

4.1 *Review of the statistical data available for neritic tunas (IOTC Secretariat)*

12. The WPNT **NOTED** paper IOTC–2020–WPNT10–07 which provided an overview of the standing of a range of information received by the IOTC Secretariat for the six species of neritic tuna and tuna-like species, in

accordance with IOTC Resolution 15/02 *On mandatory statistical reporting requirements for IOTC Members and Cooperating non-Contracting Parties (CPCs)*, for the period 1950–2018. A summary is provided at Appendix IVa–IVf.

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

14. The WPNT **NOTED** that the reported catches of all neritic species combined have reached their highest levels (increasing by around 50% from 414k t in 2005 to 646k t in 2014), indicating the possibility that several species may be overfished. The reasons for the increase in catches in recent years remain unclear, but may be related to a combination of factors including:

    i. Relocation of high-seas fishing effort to coastal waters and a change in targeting from tropical tunas to neritic tunas, as a result of the threat of piracy in the North-Western Indian Ocean in the late-2000s (particularly relevant for Iranian and Pakistani gillnetters);

    ii. Increase in fishing fleets capacity (e.g., longline-trolling fisheries in India, coastal fisheries of Indonesia);

    iii. Improvements in the reporting of catches of neritic species (e.g., Indonesia, Sri Lanka, Pakistan) which may suggest under-reporting of neritic species in earlier years;

    iv. Non-reporting of coastal catches from a number of CPCs (e.g., Yemen, Somalia, Tanzania), whose catches have been repeated in the IOTC database from previous years in the absence of any other information.

15. **CONSIDERING** point iii above, the WPNT **RECOMMENDED** the reconstruction and re-estimation of historical catch series for neritic tuna and tuna-like species, at least for the major fleets known to target these species, be considered as a priority activity for future works of the group.

16. The WPNT **NOTED** that, due to the high uncertainty in the information provided for several gears by some key fleets in 2018 (data for reference year 2017) the Secretariat had to re-estimate a consistent fraction of nominal catches reported for all neritic tuna and tuna-like species, and **SUGGESTED** that involved CPCs liaise with the Secretariat to determine whether updates to nominal catch data for their concerned fisheries can be provided for 2017.

17. **NOTING** the marked increase in Bullet tuna catches reported for 2018 (32k t, i.e. +100% compared to the 16k t reported in 2017) the WPNT **ACKNOWLEDGED** that the detected increase originates from data reported by a newly developed industrial purse-seine fleet from Indonesia, that appears to be targeting skipjack tuna as well as neritic tuna species.

18. **CONSIDERING** that the currently available information on fishing crafts as well as the list of authorized and active vessels provided by Indonesia for the concerned year does not reflect the presence of such new component in their fleets, the WPNT **REQUESTED** Indonesia to provide further updates on the matter to exclude any potential issues in data reporting.

19. Also, the WPNT **NOTED** that preliminary catch data provided by Indonesia in 2020 (for reference year 2019) still show the presence of the above mentioned industrial purse-seine fleet component, although reported nominal catch data for the fishery show sensible differences in targeted species compared to the previous year, with the majority of catches now reported for Skipjack tuna, and neritic tuna catches not exceeding 5k t for each species in 2019.

20. The WPNT **ACKNOWLEDGED** that the Secretariat will continue to provide support to Pakistan to assess the relevance of their national crew-based data collection programme as a potential source of information for the provision of catch-and-effort as well as size-frequency data according to IOTC Resolution 15/02.

21. Also, the WPNT **ACKNOWLEDGED** that Pakistan is collecting separate information for the two distinct gear configurations used by their gillnet fleet, namely surface and sub-surface setting, and that if other countries have the same requirements then the possibility of introducing separate gear codes to report data specific for the two gear configurations could be considered in the future.

22. The WPNT further **NOTED** that Pakistan's revised catches (1987-2018) have been endorsed by the IOTC Scientific Committee at its 22nd session in December 2019, and are now an integral part of the IOTC databases and are regularly disseminated to the public.

23. The WPNT **ACKNOWLEDGED** that the revised time series from Pakistan introduces species-specific changes resulting in a marked increase in catches of Frigate tuna (in the years between 1995 and 2018), a decrease in catches of Kawakawa for the same years, and stable catches of all remaining neritic tuna species. Seerfish are also affected by these revisions, albeit to a lesser extent.

24. The WPNT **RECALLED** a number of reasons for the low levels of compliance in terms of data reporting of neritic species, including:

   i. Technical or financial constraints in implementing data collection, processing and reporting systems for fisheries datasets, particularly in the context of small-scale coastal fisheries, which account for the majority of catches of neritic species.

   ii. Limitations on current data collection mechanisms to fully report catches by species or gear according to the IOTC data requirements, or difficulties sampling IOTC species in sufficient numbers (e.g., Kenya, prior to implementation of the recent Catch Assessment Survey; also Thailand and Malaysia coastal fisheries, which catch relatively low quantities of neritic species; I.R. Iran catch-and-effort according to the IOTC data reporting requirements).

   iii. Difficulties understanding IOTC data reporting obligations, or issues processing data in the format required by IOTC (e.g., Thailand size frequency data in recent years, Oman catch-and-effort data).

   iv. Limited coordination between national institutions responsible for collecting IOTC datasets which often combine data collection activities across more than one fisheries agency, such as the Ministry of Fisheries and fisheries research organisations (e.g., India and Tanzania).

25. The WPNT **NOTED** that compliance with the mandatory data reporting obligations (in particular concerning catch-and-effort and size-frequency data) is particularly low for the majority of coastal fisheries catching neritic tuna species, despite the importance of this information for stock assessment purposes, and **REQUESTED** CPCs do their best to collect data and comply with IOTC data reporting requirements.

26. The WPNT further **ACKNOWLEDGED** that these issues have been noted for several years now, with very little progress made intersessionally.

27. However, the WPNT also **ACKNOWLEDGED** the recent improvements in the data collection and reporting of neritic tunas by I.R. Iran, Pakistan and Indonesia in particular, including the development of a standardized CPUE series for Iranian gillnets and the reporting of catch-and-effort, as well as size-frequency data according to Resolution 15/02, by several Indonesian fisheries in recent years, and encouraged other CPCs important for catches of neritic tunas to focus their efforts on improving the data collection and reporting of neritic tunas with support from the IOTC Secretariat.

28. The WPNT **RECALLED** that the distribution of catches of neritic species are concentrated particularly in Indonesia, I.R. Iran, India, Pakistan and Oman (which together account for over 80% of the total catches of neritic species in recent years), and **REQUESTED** that support for these CPCs is prioritised by the IOTC Secretariat to improve the reporting of mandatory datasets.

29. **NOTING** the uncertainty in the information contained in several key datasets, including nominal catches which are the main source of data for catch-only assessments, the WPNT **SUGGESTED** that an approach to include such uncertainty in the assessment models is considered, **NOTING** that metadata exists in the IOTC datasets (i.e., degrees of re-estimation applied to the original data by the Secretariat) that could already serve this purpose.

30. The WPNT **ACKNOWLEDGED** that any attempt at systematically re-estimating the historical catch series for assessment purposes should focus on a fraction of the overall time-series, whose extent should be determined on a species-by-species basis depending on the status of the corresponding assessments.

31. The WPNT **AGREED** the following capacity building priorities to improve the quality and availability of neritic species datasets:

   - IOTC Data Support and Compliance missions will be conducted to India to review the current arrangements for the collection and reporting of neritic tunas and tuna-like species to the IOTC;

- the IOTC Secretariat will provide technical assistance and further support to Pakistan to assess the potential for development of a standardized CPUE for the Pakistani gillnet fleet;
- the IOTC Secretariat, in collaboration with concerned CPCs, will explore options for developing a regional standardized CPUE series for the principal gillnet fleets operating in the Northern Indian Ocean, building on the outcomes of a preliminary mission to I.R. Iran conducted in 2019.

32. The WPNT further **NOTED** that the IOTC Secretariat, with support from global stakeholders, is contributing to several projects aiming to improve the capacity for IOTC coastal countries to collect, store and utilize data from artisanal fisheries to assist the management of tuna and tuna-like species, including vulnerable shark and rays, and that the outcome of such projects (FAO – CITES review of artisanal fisheries in the Indian Ocean, IFAD agriculture and fisheries development programme for the Republic of Tanzania) are expected to have a positive impact in the future on the quality and timeliness of provision of information for several important fisheries that target or interact with neritic tuna species.

33. The WPNT **REQUESTED** that the results of these projects be presented in due course during the next WPNT meetings, and used to further drive the identification of priority areas for the activities of the group.

4.2 Review of new information on fisheries and associated environmental data

34. The WPNT **NOTED** paper IOTC-2020-WPNT10-09 which provided main outcomes from the 2019 IOTC Ecoregions Workshop, including the following abstract provided by the authors:

> "*WPEB14 recommended to convene a workshop in 2019 to provide advice on the identification of draft ecoregions to foster discussions on the operationalization of the ecosystem approach to fisheries management (EAFM) in the Indian Ocean Tuna Commission (IOTC) convention area. This workshop took place the 30th, 31st of August and 1st of September in La Reunion Island and gather 17 participants with a wide range of expertise in IOTC species, fisheries and oceanography in the Indian Ocean. Prior to the workshop, a consultant was hired to prepare a baseline draft proposal of ecoregions to be presented and discussed at the workshop by all the participants. During the workshop, the group discussed the potential benefits and uses of ecoregions in the context of IOTC species and fisheries. The group also provided feedback on the technical aspects, data and methods used in the derivation of draft ecoregions. Three baseline ecoregion classifications were reviewed by the group, which in combination with expert knowledge, were used to derive draft ecoregions within the IOTC convention area. The draft ecoregions are not intended to be used for management purposes. At this stage, the benefits and potential uses (e.g. development of ecosystem report card, ecosystem status overview, etc.) of the draft ecoregions should be tested as a tool to facilitate the operationalization of the EAFM in IOTC.*"

35. The WPNT **CONGRATULATED** the authors for the important work done towards a definition of draft ecoregions within the Indian Ocean, and that these provide a structured way to organise the ecosystems data and investigate ecosystem functioning.

36. The WPNT **NOTED** that the delineation of the eco-regions was mainly based on the fisheries targeting IOTC tuna and tuna-like species but that data for non-target (bycatch) species could be used in a second step to assess the relevance and appropriateness of the eco-regions to larger fish pelagic communities.

37. For this reason, the WPNT **NOTED** that a second workshop, when planned, should further focus on ecoregions identification methods and include all new knowledge on the differences in fisheries operations that might become available in the meantime, as well as any revision in the existing datasets. Eventually, a revised analysis using new datasets and incorporating expert knowledge as well as feedback from the workshop participants might contribute to further refinements of the draft ecoregions, although no major changes are expected.

38. The WPNT **ACKNOWLEDGED** that most of the data used to identify the ecoregions comes from commercial species and their fisheries, **NOTING** that it might be possible that the ecoregions defined for these could also be useful to provide advice, at the appropriate scale, to bycatch species as well (including neritic tuna species).

39. The WPNT **NOTED** that the draft eco-regions within the IOTC convention area should be compared against the population units inferred from the genomic and analyses conducted throughout the results of the PSTBS-IO project described in the paper IOTC-2020-WPNT10-10.

5. NERITIC TUNA SPECIES – REVIEW OF NEW INFORMATION ON STOCK STATUS

5.1 Review new information on the biology, stock structure, fisheries and associated environmental data

40. The WPNT **NOTED** paper IOTC–2020–WPNT10–10 on the Population Structure of neritic tuna in the Indian Ocean, including the following abstract provided by the authors:

"*Longtail tuna (*Thunnus tonggol*), kawakawa (*Euthynnus affinis*) and narrow-barred Spanish mackerel (*Scomberomorus commerson*) are important fish resources in the Indian Ocean. These species are currently managed as single stocks. Studies to date have not demonstrated strong evidence of population structure. In this study we report results from the multi-agency, collaborative PSTBS-IO project, which involved large-scale sampling and cutting-edge sequencing technology to investigate the genetic population structure of these three neritic species, along with priority tropical and temperate tuna, billfish and sharks. These analyses provide strong evidence of at least three, two and four different populations in the Indian Ocean for longtail tuna, kawakawa and the narrow-barred Spanish mackerel respectively. These results warrant reconsideration of how these species are monitored and managed in the Indian Ocean and highlight the need for further targeted research to confirm the temporal stability of these results and provide a comprehensive understanding of population boundaries for these species within the Indian Ocean*.".

41. The WPNT **THANKED** the authors for the presentation and **NOTED** the importance of this study that was originally requested by the WPNT in 2014.

42. The WPNT **NOTED** that the genetic methodology used in the study integrates information over many generations thus showing connectivity in populations over an evolutionary time-scale. The WPNT **NOTED** that for management purposes a more demographic timescale may be required which is possible to ascertain from microchemistry studies, but that the lack of representative samples and cost of this technique made it difficult to undertake comprehensively in the current project (see below).

43. The WPNT **NOTED** that the sample coverage was not as comprehensive as the authors would have liked, in particular around the North Western Indian Ocean including the Arabian Gulf and of the three neritic species included in the study, only kawakawa had reasonable coverage. The WPNT **NOTED** this lack of samples from around the Arabian Gulf was due to logistical issues with getting samples to the CSIRO laboratory for analysis. The WPNT **NOTED** that the full spatial range of the species needs to be sampled in order to obtain a more comprehensive analysis of the population structure within the entire Indian Ocean

44. The WPNT **NOTED** methods used during the study including a discussion of validation of results by removing one group at a time to determine whether the results remain the same to which the authors responded that they had not yet explored the results in this way but have conducted a hierarchical analysis to distinguish between genetic groups.

45. The WPNT **NOTED** that there is need to extend this work as there are still many questions unanswered which are needed to fully inform stock assessments conducted by the WPNT. The WPNT **ENCOURAGED** collaboration by members of the WPNT with the study team in providing samples and expertise both for spatial areas which have not yet been sampled and to help to further extend the density of sample coverage in areas that have already been covered. The WPNT **NOTED** that there are no active proposals for furthering this study but there is interest in continuing this work.

46. The WPNT **NOTED** concerns that were raised about potential biases being introduced during analyses. The authors responded that there is little concern for the methodology assigning genetic groups incorrectly in the results as the genetic signals found for the neritic species studied were all very clear and testing was conducted to avoid any potential sources of bias.

47. The WPNT **NOTED** that a very low level of human error in species identification at sampling was found when studying the genetic materials obtained from these samples. Additionally, the WPNT **NOTED** that part of the quality control for the sampling included screening samples thoroughly to verify the sampled species before further analyses were conducted.

48. The WPNT **NOTED** that currently stock assessments are conducted assuming the presence of just one stock of each neritic species in the Indian Ocean, but the results of this study and further verification studies may lead to stocks being assessed including stock structure information relating to the differing genetic groups identified.

49. The WPNT **NOTED** that the presentation focused on the genetic results rather than on the microchemistry analyses which were also conducted as part of this study. The WPNT **NOTED** that this was due to the fact that the results from the genetic analyses were much clearer than those of the microchemistry as the microchemistry analyses (unlike the genetic analyses) were confounded by cohort and year effects due to difficulties with sampling fish of the same age, at the same time in different sample areas.

50. The WPNT **NOTED** that only the three highest priority neritic species were included in this study but there is a desire to include further neritic species in future analyses when additional funding becomes available. The WPNT also **NOTED** the relatively low cost of the methodology of genetic analysis, in particular in relation to microchemistry analyses.

5.2 Data for input into stock assessments

51. The WPNT **NOTED** paper IOTC-2020-WPNT10-11 on the Nominal CPUE, length distribution and condition factor of kawakawa in the Indian Ocean, including the following abstract provided by the authors:

> *"Kawakawa (*Euthynnus affinis*) one of the important catch for small-scale fisheries in Indonesia. This species is included in neritic tuna group that mostly utilized by using purse seine and gillnet. The objectives of this research are to investigate the Nominal CPUE, length distribution and condition factor of kawakawa. Data collection was conducted for 11 months from February to December 2019 in Aceh, West Sumatera, and Bengkulu (Indian Ocean). Total of 1,622 specimens were collected, measured (cmFL) and weighted (kg). CPUE analysis shows the fluctuations in each month with the highest CPUE value in August and the lowest in May. Length distribution ranged from 20 – 55 cmFL and weight ranged from 0.13 – 3.06 kg. Analysis of length-weight relationships showed the equation $W = 0.0124L^{3.1079}$ with determination coefficient (R2) 0.9665. Growth pattern of kawakawa was positive allometric. The highest relative condition factor (Kn) occurred at upper limit of length class 21 cmFL with 1.25 and the lowest at 57 cmFL with 1.06. The condition factor was relatively stable with the highest value occurred on December with 1.265 and the lowest on April with 1.081. This fluctuated for small size group and decrease along with the length increase for the adult fish".*

52. The WPNT **THANKED** the authors for the presentation.

53. The WPNT **ACKNOWLEDGED** that Indonesia has provided neritic tuna size-frequency data for 2019 for some of its fisheries (using the recommended form 4-SF) and that the Kawakawa size-frequency data discussed in the paper might not be included in these submissions.

54. Therefore, and considering the paucity of biometric data generally available for neritic tuna species, the WPNT **ENCOURAGED** Indonesia to liaise with the IOTC Secretariat and ensure that all missing information (if any) is provided in agreement with the requirements expressed by Resolution 15/02 at their earliest availability.

55. The WPNT **NOTED** outliers on the graph showing the relationship between the length and weight of sampled fish and that these outliers did not appear to be affecting the relationship curve. The WPNT **SUGGESTED** that these outliers could be considered in more detail during the next assessment.

56. The WPNT **NOTED** that the authors presented data only from 2019 and **NOTED** that it would be useful to determine CPUE for previous years in addition to 2019 as detailed historical CPUE series are valuable for stock assessments. The WPNT **NOTED** this is the case for all CPCs, not only Indonesia. The WPNT **NOTED** that for Indonesia in past years tropical tuna species were prioritised and neritic tuna were not a high priority group for research but they are trying to be more consistent with the collection and reporting of biological data going forwards.

6. STOCK ASSESSMENT UPDATES

6.1 Stock Assessments (Longtail tuna, Narrow-barred Spanish Mackerel, Kawakawa)

57. The WPNT **NOTED** that three assessment methods (CMSY, OCOM, and BSM) have been applied to each of longtail, Spanish mackerel, and kawakawa in 2020.

58. The WPNT **NOTED** paper IOTC-2020-WPNT10-12 that examined and compared two stock assessment approaches (CMSYZ and BSM) for three neritic tuna species, including the following abstract provided by the authors:

"Stock assessment has been conducted for three neritic species, Kawakawa, longtail tuna and narrow-barred Spanish mackerel, in the Indian Ocean based on the biomass dynamic models. Two different approaches were applied; 1) state-space biomass dynamics models using both of catch series and standardized abundance index (here, the Iranian coastal gillnet CPUE, annually averaged) and 2) Catch only analyses using the Cmsy method. In the second analyses, we focused on the sensitivity/robustness of the results to i) the assumption of prior distributions for r, K, initial and final depletions and ii) the assumption of production functions. For all the analyses, we employed Bayesian methods to estimate parameters and evaluate associated estimation uncertainty. Non-informative priors were used, and posterior samples were generated using a Markov chain Monte Carlo (MCMC) method or acceptance/rejection sampling. Our overall conclusions were a) analyses with CPUE series looked too optimistic for all the species, which was driven by a recent increasing trend of CPUE; b) Cmsy method provided with robust results to some extent even when the prior assumptions were moderately changed; c) however the result of the Cmsy method seemed sensitive to the production functions, and therefore there should be careful diagnostic examinations using retrospective analyses and hindcasting approaches".

59. The WPNT thanked the authors for performing the comprehensive analysis to address some general issues related to two assessment approaches (CMSY and BSM). The WPNT **NOTED** that the study emphasised a number of modelling aspects that are important for the assessment, in particular, (1) assessing the sensitivity the model to the key prior assumptions; (2) evaluating the robustness of the model to alternative production functions; (4) developing appropriate diagnostic tools to assess the predictive skills of models (e.g. retrospective and hindcasting analysis); and (4) improving the abundance indices.

60. The WPNT agreed that the performance of the CMSY and OCOM data-limited models should be assessed. However, The WPNT **NOTED** that diagnostics based on retrospective analysis or model residuals may not be applied in the same way as in data-rich situations due to the lack of data and some additional constraints placed on these types of models.

61. The WPNT **RECALLED** that the overall performance and robustness of data-limited models have been assessed with simulations and against data-rich stocks available from the RAM legacy database and published in some peer-review articles (e.g. Zhou et al 20181)

Assessment using CMSY method for Indian Ocean longtail tuna, Spanish Mackerel, and Kawakawa

62. The WPNT **NOTED** paper IOTC-2020-WPNT10-13 that details the CMSY assessment for longtail tuna, including the following abstract provided by the authors:

"Assessing the status of the stocks of neritic tuna species in the Indian Ocean is challenging due to the paucity of data. There is lack of reliable information on stock structure, abundance and biological parameters. Stock assessments have been conducted annually for Longtail tuna (Thunnus tonggol) from 2013 to 2017 using data-limited methods. This paper provides an update to the CMSY assessment based on the most recent catch information. In addition, a Bayesian biomass dynamic model was also implemented to include the recently available CPUE indices of the longtail tuna developed from the Iranian gillnet fishery".

Management Quantity	**Aggregate Indian Ocean**
Most recent catch estimate (year)	135282 t (2018)
Mean catch – most recent 5 years	141 996 t (2014 – 2018)
MSY (95% CI)	146 000 (118 100 – 181 000)

[1] Zhou, S., Punt, A.E., Smith, A.D.M., Ye, Y., Haddon, M., Dichmont, C.M., Smith, D.C. 2018. An optimized catch-only assessment method for data poor fisheries. *ICES Journal of Marine Science*.

Data period used in assessment	1950 – 2018
F_{MSY} (95% CI)	0.60 (0.48 - 0.74)
B_{MSY} (95% CI)	245 000 (177 000 – 341 000)
$F_{current}/F_{MSY}$ (95% CI)	0.97 (0.78 – 2.12)
$B_{current}/B_{MSY}$ (95% CI)	0.96 (0.44 – 1.19)
$B_{current}/B_0$ (95% CI)	0.48 (0.22 – 0.60)

63. The WPNT **NOTED** the results from the CMSY assessment reference model (Table 2, Fig. 1).

Table 2. **Longtail tuna: Key management quantities from the CMSY used in 2020.**

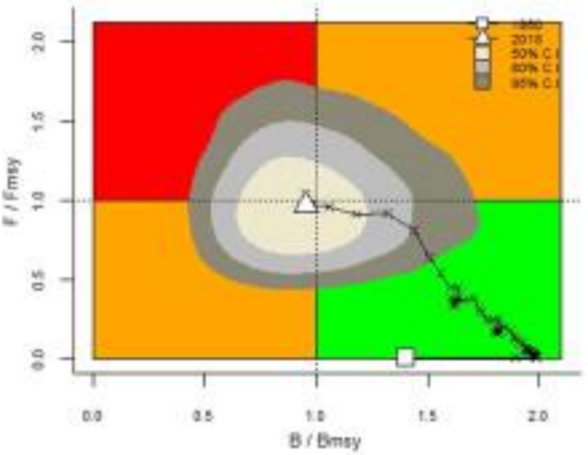

Fig. 1. Longtail tuna. CMSY Indian Ocean assessment Kobe plot for longtail tuna. The Kobe plot presents the trajectories for the range of plausible model options included in the formulation of the final management advice. The trajectory of the geometric mean of the plausible model options is also presented.

64. The WPNT **NOTED** paper IOTC-2020-WPNT10-14 that details the CMSY assessment for Narrow-barred Spanish Mackerel, including the following abstract provided by the authors:

"Assessing the status of the stocks of neritic tuna species in the Indian Ocean is challenging due to the paucity of data. There is lack of reliable information on stock structure, abundance and biological parameters. Stock assessments have been conducted annually for narrow-barred Spanish mackerel (Scomberomorus commerson) from 2013 to 2017 using data-limited methods (Zhou and Sharma, 2013; Zhou and Sharma, 2014; Martin and Sharma, 2015; Martin and Robinson, 2016, Martin & Fu, 2017). This paper provides an update to the CMSY assessment based on the most recent catch information. A Bayesian biomass dynamic model was also implemented to include the recently available CPUE indices of Spanish mackerel developed from the Iranian gillnet fishery".

65. The WPNT **NOTED** the results from the CMSY assessment reference model (Table 3, Fig. 2).

Table 3. Narrow-barred Spanish Mackerel: Key management quantities from the CMSY used in 2020.

Management Quantity	Aggregate Indian Ocean
Most recent catch estimate (year)	154 785 t (2018)
Mean catch – most recent 5 years	175 891 t (2014 – 2018)
MSY (95% CI)	166 000 (126 100 – 218 000)
Data period used in assessment	1950 – 2018
F_{MSY} (95% CI)	0.60 (0.48 - 0.74)
B_{MSY} (95% CI)	277 000 (194 000 – 396 000)
$F_{current}/F_{MSY}$ (95% CI)	0.97 (0.78 – 2.14)
$B_{current}/B_{MSY}$ (95% CI)	0.96 (0.44 – 1.19)
$B_{current}/B_0$ (95% CI)	0.48 (0.22 – 0.60)

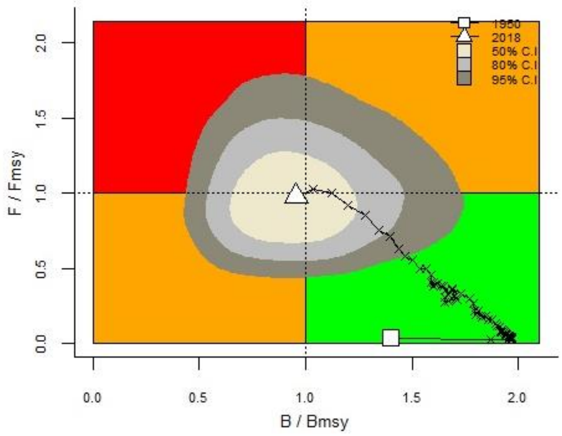

Fig. 2. Narrow-barred Spanish Mackerel. CMSY Indian Ocean assessment Kobe plot for barrow-barred Spanish Mackerel. The Kobe plot presents the trajectories for the range of plausible model options included in the formulation of the final management advice. The trajectory of the geometric mean of the plausible model options is also presented.

66. The WPNT **NOTED** paper IOTC-2020-WPNT10-15 that details the CMSY assessment for kawakawa, including the following abstract provided by the authors:

"Assessing the status of the stocks of neritic tuna species in the Indian Ocean is challenging due to the paucity of data. There is lack of reliable information on stock structure, abundance and biological parameters. Stock assessments have been conducted for Kawakawa (Euthynnus affinis) from 2013 to 2015 using data-limited methods (Zhou and Sharma, 2013; Zhou and Sharma, 2014; Martin and Sharma, 2015). This paper provides an update to these assessments based on the most recent catch information report to the IOTC, using two methods to assess the status of E. affinis: (i) an updated Catch-MSY method (Kimura and Tagart 1982; Walters et. al. 2006; Martell and Froese 2012; Froese et al. 2016) and (ii) a Bayesian biomass dynamic model, BSM (Froese et al. 2016), which utilised the recently available CPUE indices of the kawakawa developed from the Iranian gillnet fishery".

67. The WPNT **NOTED** the results from the CMSY assessment method (Table 4, Fig. 3)

Table 4. Kawakawa: Key management quantities from the CMSY used in 2020.

Management Quantity	**Aggregate Indian Ocean**
Most recent catch estimate (year)	164,133 t (2018)
Mean catch – most recent 5 years	152 919 t (2014 – 2018)
MSY (95% CI)	145 000 (114 000 – 185 000)
Data period used in assessment	1950 – 2018
F_{MSY} (95% CI)	0.60 (0.48 - 0.74)
B_{MSY} (95% CI)	244 000 (173 000 – 343 000)
$F_{current}/F_{MSY}$ (95% CI)	1.16 (0.95 – 2.59)
$B_{current}/B_{MSY}$ (95% CI)	0.97 (0.44 – 1.19)
$B_{current}/B_0$ (95% CI)	0.49 (0.22 – 0.60)

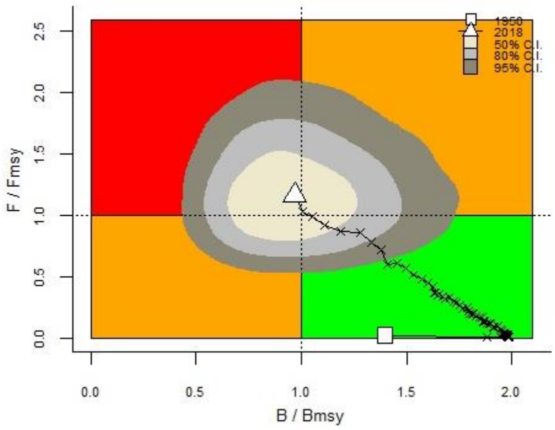

Fig. 3. Kawakawa. CMSY Indian Ocean assessment Kobe plot for kawakawa. The Kobe plot presents the trajectories for the range of plausible model options included in the formulation of the final management advice. The trajectory of the geometric mean of the plausible model options is also presented.

68. The WPNT **NOTED** the implementation of the CMSY model remained the same as in the 2017 assessment, with updates restricted mainly to the catch series.

69. The WPNT **NOTED** that the range of values used for the prior distribution for the population intrinsic growth parameter r was the same for the three neritic species while these species have different life history traits which would be expected to result in different r values.

70. The WPNT **NOTED** that the range of r values of 0.6-1.5 used for longtail tuna was the same as that for 2017 but that these values are expected to be much lower according to FishBase, i.e. in the range of 0.2-0.5 (https://www.fishbase.in/summary/Thunnus-tonggol.html).

71. The WPNT **NOTED** that a range of medium values for the population growth parameter r would result in lower resilience of the stock to fishing pressure and would affect the estimate of the fishing mortality at MSY which is directly proportional to r. However, this is not expected to have a major impact on estimates of benchmark reference points (e.g. F/Fmsy) which are in relative terms.

72. The WPNT **NOTED** that the truncation of biomass from the CMSY models is due to the rejection of model estimates falling outside of the depletion range. The WPNT further **NOTED** that relaxing the depletion range constraint will not necessarily eliminate the truncation but is likely to increase the model uncertainty.

73. The WPNT **NOTED** that the final (year) depletion range 0.2 – 0.6 assumed in the reference model for all three species was chosen to maintain some level of consistency with the previous assessment and to account for the reduced fishing pressure in recent years. The WPNT **AGREED** that the final depletion assumption is very important, and the derivation of which should be based on a defensible and robust approach.

Assessment using OCOM method for Indian Ocean longtail tuna, Narrow-barred Spanish Mackerel, and Kawakawa

74. The WPNT **NOTED** paper IOTC-2020-WPNT10-16 that provides the stock assessment for longtail tuna, Spanish Mackerel, and Kawakawa using the OCOM method.

75. The WPNT **NOTED** the results from the OCOM assessment method pertaining to longtail tuna (Table 5,Fig. 4).

Table 5. Longtail tuna: Key management quantities from the OCOM used in 2020.

Management Quantity	Indian Ocean
Most recent catch estimate	135282 t (2018)
Mean catch over last 5 years	141 996 t (2014 – 2018)
MSY (plausible range)	128 750 (99 902 – 151 357)
Data period used in assessment	1950 – 2018
F_{MSY} (plausible range)	0.32 (0.15 – 0.66)
B_{MSY} (plausible range)	395 460 (129 240 – 751 316)
$F_{current}/F_{MSY}$ (plausible range)	1.52 (0.751 – 2.87)
$B_{current}/B_{MSY}$ (plausible range)	0.69 (0.45 – 1.21)

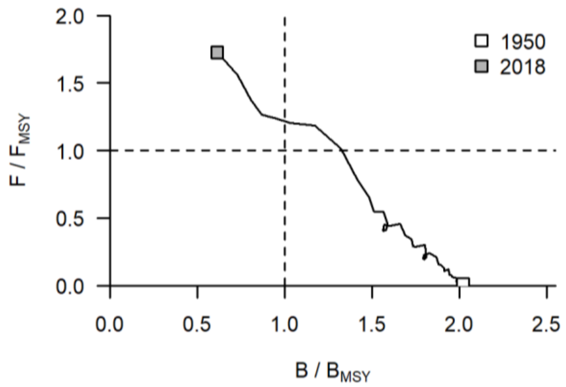

Fig. 4. Longtail tuna OCOM Indian Ocean assessment Kobe plot. The Kobe plot presents the trajectories for the range of plausible model options included in the formulation of the final management advice. The trajectory of the geometric mean of the plausible model options is also presented.

76. The WPNT **NOTED** the results from the OCOM assessment method pertaining to Spanish Mackerel (

77. Table 6,Fig. 5).

Table 6. Narrow-barred Spanish Mackerel: Key management quantities from the OCOM 2020.

Management Quantity	Aggregate Indian Ocean
Most recent catch estimate (year)	154 785 t (2018)
Mean catch – most recent 5 years	175 891 t (2014 – 2018)
MSY (95% CI)	157 762 (132 144– 187 192)
Data period used in assessment	1950 – 2018
F_{MSY} (95% CI)	0.49 (0.25 – 0.87)
B_{MSY} (95% CI)	323 500(196 260–592 530)
$F_{current}/F_{MSY}$ (95% CI)	1.24 (0.65–2.13)
$B_{current}/B_{MSY}$ (95% CI)	0.80 (0.54–1.27)

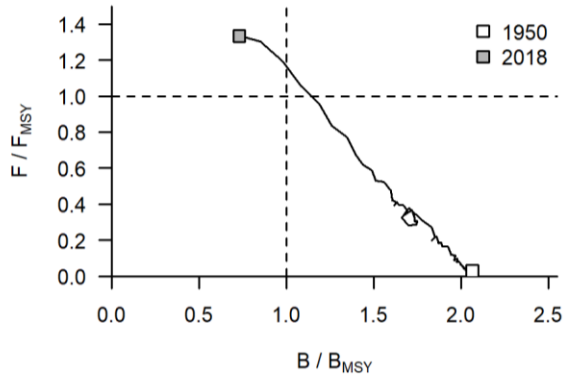

Fig. 5. Narrow-barred Spanish Mackerel OCOM Indian Ocean assessment Kobe plot. The Kobe plot presents the trajectories for the range of plausible model options included in the formulation of the final management advice. The trajectory of the geometric mean of the plausible model options is also presented.

78. The WPNT **NOTED** the results from the OCOM assessment method pertaining to kawakawa (Table 7, Fig. 6).

Table 7. Kawakawa: Key management quantities from the OCOM used in 2020.

Management Quantity	**Aggregate Indian Ocean**
Most recent catch estimate (year)	164,133 t (2018)
Mean catch – most recent 5 years	152 919 t (2014 – 2018)
MSY (95% CI)	148 825 (124 114 – 222 505)
Data period used in assessment	1950 – 2018
F_{MSY} (95% CI)	0.44 (0.21–0.82)
B_{MSY} (95% CI)	355 670 (192 080 –764 530)
$F_{current}/F_{MSY}$ (95% CI)	0.98 (0.47–1.75)
$B_{current}/B_{MSY}$ (95% CI)	1.13 (0.75–1.58)

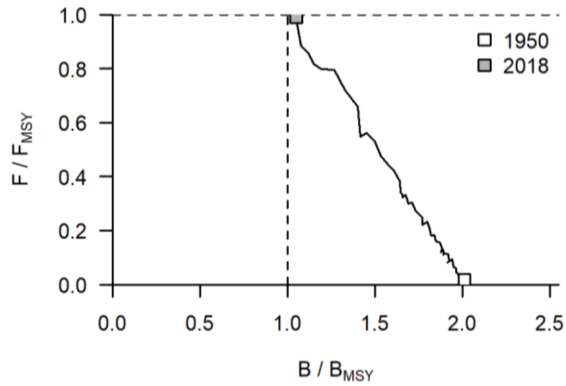

Fig. 6. Kawakawa. OCOM Indian Ocean assessment Kobe plot for kawakawa. The Kobe plot presents the trajectories for the range of plausible model options included in the formulation of the final management advice. The trajectory of the geometric mean of the plausible model options is also presented.

79. The WPNT **NOTED** that the OCOM assessments for the three neritic tuna species are based on an updated and improved version of the package that was used for the 2017 assessment.

80. The WPNT **NOTED** that the OCOM method derived the prior range for r based on life-history traits (i.e. natural mortality and maximum life span), and estimated the depletion from the catch trend using a modelling approach (i.e. bootstrapped regression tree) with the uncertainty range quantified from an empirical study involving a large number of fish stocks.

81. The WPNT **NOTED** that the r values used in the OCOM model are lower than those assumed in the CMSY analysis, which explains that the results from the OCOM model are more pessimistic than the CMSY analysis. The WPNT further **NOTED** that the OCOM method assumes no prior range for K, therefore the uncertainty in model estimates appears larger.

82. The WPNT **NOTED** that both the OCOM and CMSY models are based on the Schaefer formulation of surplus production while alternative formulations (i.e. Fox or Pella and Tomlinson) may provide different results and outcomes (see IOTC-2020-WPNT10-12). The WPNT **NOTED** however that the use of such alternative formulations would require some adaption of the methods used for eliciting a prior distribution for the population parameter r since they were developed for a Schaefer-type model and the interpretation of r changes with model formulation.

83. The WPNT **NOTED** that a prior distribution for r could be developed with a simulation framework in which a production curve could be informed from an age-structured model parameterized with detailed life-history traits and **ENCOURAGED** such an approach to be explored in future assessments.

Assessment using Bayesian Surplus production model (BSM) for Indian Ocean longtail tuna, Spanish Mackerel, and Kawakawa

84. The WPNT **NOTED** the BSM assessment for Ocean longtail tuna, Spanish Mackerel, and Kawakawa are also detailed in paper IOTC-2020-WPNT10-13, paper IOTC-2020-WPNT10-14, and paper IOTC-2020-WPNT10-15.

85. The WPNT **NOTED** the results from the BSM assessment reference model pertaining to longtail tuna (Table 8, Fig. 7).

Table 8. Longtail tuna: Key management quantities from the *BDM* used in 2017.

Management Quantity	Indian Ocean
MSY (95% CI)	141 000 t (127 010 – 156 000)
Data period used in assessment	1950 – 2018
F_{MSY} (95% CI)	0.62 (0.48 – 0.82)
B_{MSY} (95% CI)	226 000 t (185 000– 275 000)
$F_{current}/F_{MSY}$ (95% CI)	1.08 (0.78 – 1.51)
$B_{current}/B_{MSY}$ (95% CI)	0.90 (0.64 – 1.23)
$B_{current}/B_0$ (95% CI)	0.45 (0.32 – 0.62)
MSY (95% CI)	141 000 t (127 010 – 156 000)

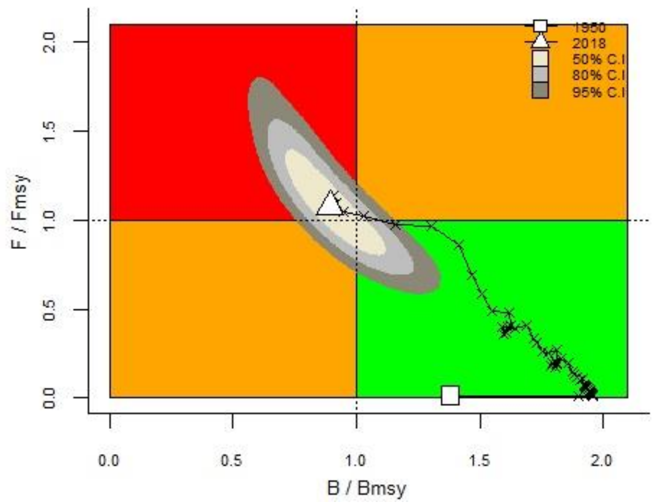

Fig. 7. Longtail tuna. BSM Indian Ocean assessment Kobe plot for longtail tuna. The Kobe plot presents the trajectories for the range of plausible model options included in the formulation of the final management advice. The trajectory of the geometric mean of the plausible model options is also presented.

86. The WPNT **NOTED** the results from the BSM assessment reference model pertaining to Spanish Mackerel (Table 9,Fig. 8).

Table 9. Spanish Mackerel: Key management quantities from the BDM used in 2020.

Management Quantity	Indian Ocean
MSY (95% CI)	149 000 t (119 010 – 188 000)
Data period	1950 – 2018
F_{MSY} (95% CI)	0.38 (0.26 – 0.57)
B_{MSY} (95% CI)	392 000 t (303 000– 508 000)
$F_{current}/F_{MSY}$ (95% CI)	0.80 (0.66 – 1.11)
$B_{current}/B_{MSY}$ (95% CI)	1.29 (0.93 – 1.58)
$B_{current}/B_0$ (95% CI)	0.65 (0.47 – 0.79)
MSY (95% CI)	149 000 t (119 010 – 188 000)

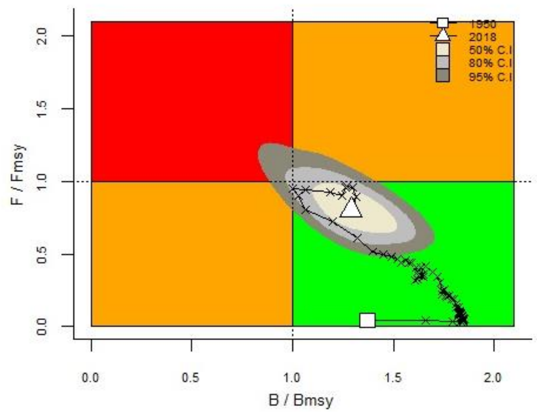

Fig. 8. Narrow-barred Spanish Mackerel. BSM Indian Ocean assessment Kobe plot for narrow-barred Spanish Mackerel. The Kobe plot presents the trajectories for the range of plausible model options included in the formulation of the final management advice. The trajectory of the geometric mean of the plausible model options is also presented.

87. The WPNT **NOTED** the results from the BSM assessment method pertaining to kawakawa (Table 10, Fig. 9).

Table 10. kawakawa: Key management quantities from the BDM used in 2020.

Management Quantity	Indian Ocean
MSY (95% CI)	148 000 t (125 000–175 000)
Data period	1950 – 2018
F_{MSY} (95% CI)	0.43 (0.31–0.59)
B_{MSY} (95% CI)	346 000 t (277 000–432 000)
$F_{current}/F_{MSY}$ (95% CI)	0.89 (0.75–1.17)
$B_{current}/B_{MSY}$ (95% CI)	1.25 (0.95–1.48)
$B_{current}/B_0$ (95% CI)	0.62 (0.47–0.74)

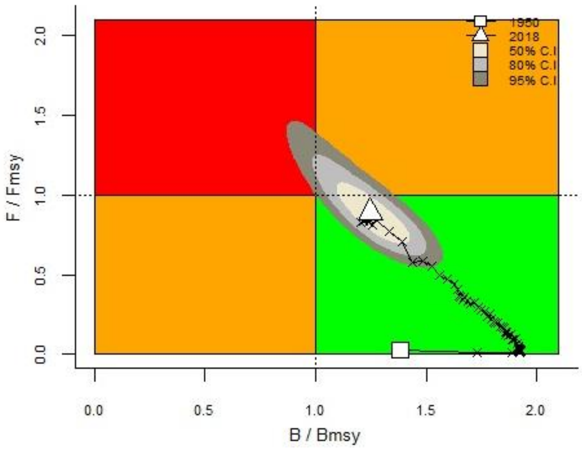

Fig. 9. Kawakawa. BSM Indian Ocean assessment Kobe plot for longtail tuna. The Kobe plot presents the trajectories for the range of plausible model options included in the formulation of the final management advice. The trajectory of the geometric mean of the plausible model options is also presented.

88. The WPNT **NOTED** that the BSM assessment results are very similar to the CMSY analysis when the same priors are used (i.e. depletion and process errors) and queried whether this is because the models were dominated by the prior assumptions. The WPNT **SUGGESTED** it would be useful to conduct analysis to explore the influence on the model from the CPUE data alone.

89. The WPNT **NOTED** that the available CPUE index (2008 – 2017) is much shorter than the catch series (1950 – 2019) and suggested that the model may consider using a shortened timespan to reduce uncertainty. The WPNT **NOTED** however the initial equilibrium state (under fishing) would be highly uncertain for such configurations due to the lack of data.

90. The WPNT **NOTED** the BSM explored two alterative options to explain the increasing CPUE trend for Spanish mackerel and kawakawa, by assuming a high depletion level (0.4 – 0.8) or a larger process error. The WPNT queried the increasing trend in biomass when the catch was increasing. The WPNT **NOTED** this would happen if the surplus production (depending on r, K, and stock status) is higher than the catch removal, or could be explained by the process error terms estimated within the model.

91. The WPNT **NOTED** the incorporation of Iranian Gillnet CPUE index into the BSM improves the model's power to estimate abundance but the validity of the Iranian Gillnet CPUE remained to be verified. The WPNT **NOTED** that some other CPUE time series for neritic tuna species from gillnet fisheries of Sri Lanka and Pakistan might become available soon and **ENCOURAGED** all CPCs to collect accurate catch and effort data in order to develop new complementary time series and augment the information provided to the assessment models.

92. The WPNT **NOTED** that it would be useful to have a standard framework of data curation (e.g. identification of outliers) and analysis to build on the experience of the analysis of the Iranian CPUE time series. The WPNT **SUGGESTED** that a short workshop (1 or 2 days) could be held prior to the next meeting of the WPNT to review data available from the various CPCs fishing for neritic tunas to produce revised CPUE series and provide technical expertise for their analysis.

6.2 Selection of Stock Status indicators

93. The WPNT discussed extensively the assessment models presented and **NOTED** that these models are generally consistent in the underlying population dynamics. The WPNT further **NOTED** that the OCOM model has provided a more defensible approach in addressing the uncertainty of key parameters (e.g. the utilisation of species-specific life history parameters). Therefore, the WPNT agreed that the results of the OCOM models should be used for providing management advice.

94. The WPNT **AGREED** that the availability of the CPUE represents an important step in the development of better assessment methods of neritic tuna species. However, the validity of these indices as an index of abundance remains to be verified. The WPNT **ENCOURAGED** CPCs to continue to devote effort to developing CPUE indices for fisheries where suitable data are available.

95. The WPNT **ADOPTED** the OCOM management advice developed for longtail tuna (*Thunnus tonggol*), Narrow-barred Spanish Mackerel (*Scomberomorus commerson*), and kawakawa (*Euthynnus affinis*) as provided in the draft resource stock status summary – Appendix X, XII and IX, respectively and **REQUESTED** that the IOTC

Secretariat update the draft stock status summary for the three species with the latest 2016 catch data, and for the summary to be provided to the SC as part of the draft Executive Summary, for its consideration.

7. PROGRAM OF WORK (RESEARCH AND PRIORITIES)

7.1 Revision of the WPNT Program of Work 2021–2025

96. The WPNT **NOTED** paper IOTC-2020-WPNT10-08 on Revision of the WPNT Program of Work (2021-2025).

97. The WPNT **NOTED** that the Workplan has become overly long and difficult to implement and therefore the Secretariat will work with Chairs of the WPNT and SC to provide a more streamlined Workplan for further discussions.

98. The WPNT **NOTED** that it is important to assign high priority to the most important work that is required from the WPNT in order to secure funding for this work when the Program of Work is presented by the SC to the Commission. The WPNT **AGREED** that the following work streams will be presented as high priority in the Program of Work:
    - CPUE standardisation;
    - Improvement of stock assessment methodology, in particular further investigations of the effect of input priors and parameters on model outputs and further model validation analyses;
    - Data mining and collation to improve stock assessments.

99. The WPNT **NOTED** the need to remove from the Program of Work projects that have been completed including the stock structure project presented during this meeting. The WPNT **NOTED** that they hope that this work will continue further and contribute to stock assessments in the future and that there is a potential to combine further investigation of regional differences in genetics with the development of further stock assessment models.

100. The WPNT **NOTED** that there is further interest in capacity building workshops to provide support and training on CPUE standardisation and other topics relevant to data limited stock assessments at future WPNT meetings. The WPNT **SUGGESTED** that this could be done alongside capacity building missions by the Secretariat to CPCs to help build local capacity to conduct CPUE analyses and to explore the availability of further data held by CPCs. The WPNT **NOTED** that if workshops are held during WPNT meetings it would be beneficial for CPCs to bring along data (the secretariat will provide guidance on the data format) and scientists with statistical analysis expertise.

101. The WPNT **NOTED** planned field missions of the Secretariat to India, Pakistan and Oman to aid with data mining work and that WWF Pakistan hold data that could be valuable for stock assessment purposes. The WPNT **NOTED** that the Secretariat and SC chair intend to coordinate with WWF to explore these data and their utility.

102. The WPNT **RECOMMENDED** that the SC consider and endorse the WPNT Program of Work (2021–2025), as provided in Appendix VI.

8. OTHER BUSINESS

8.1 Development of priorities for an Invited Expert at the next WPNT meeting

103. The WPNT **NOTED** that due to the postponement of stock assessments for the remaining three neritic tuna species, these would be addressed in 2021. Therefore, the WPNT **AGREED** to the following core areas of expertise and priority areas for contribution that need to be enhanced for the next meeting of the WPNT in 2021, by an Invited Expert:
    1) data poor assessment approaches (e.g. catch only methods, length-based approaches);
    2) CPUE standardisations.

8.2 Date and place of the 11th and 12th Working Party on Neritic Tunas

104. The WPNT **NOTED** that Kenya had expressed interest in potentially hosting the 10th Session of the WPNT while Sri Lanka and Malaysia had expressed an interest in potentially hosting the 11th Session of the WPNT in 2021. However the global Covid-19 pandemic resulted in these plans being abandoned. The Secretariat will continue

to liaise with CPCs to determine their interest in hosting these meetings in the future when this once again becomes feasible. The WPNT **RECOMMENDED** the SC consider early July 2021 as a preferred time period to hold the WPNT11 in 2021.

Meeting participation fund (MPF)

105. The WPNT **RECOMMENDED** that the SC and Commission note the following:
   1) The participation of developing coastal state scientists in the WPNT has been consistently high following the adoption and implementation of the IOTC Meeting Participation Fund adopted by the Commission in 2010 (Resolution 10/05 *On the establishment of a Meeting Participation Fund for developing IOTC Members and Non-Contracting Cooperating Parties*), now incorporated into the IOTC Rules of Procedure (2014), as well as though the hosting of the WPNT in developing coastal State Contracting Parties (Members) of the Commission (Table 11). The WPNT **NOTED** that as the 2020 meeting was a virtual meeting, no MPF funds were required to facilitate the participation of scientists to the meeting.
   2) The continued success of the WPNT, at least in the short term, appears heavily reliant on the provision of support via the MPF which was established primarily for the purposes of supporting scientists to attend and contribute to the work of the Scientific Committee and its Working Parties.
   3) The MPF should be utilised so as to ensure that all developing Contracting Parties of the Commission are able to attend the WPNT meeting, as neritic tunas are an important resource for many of the coastal countries of the Indian Ocean.

Table 11. Working Party on Neritic Tunas participation summary.

Meeting	Host Country	Total participants	Developing CPC participants	Host country participants	MPF recipients
WPNT01	India	28	23	11	9
WPNT02	Malaysia	35	26	13	10
WPNT03	Indonesia	42	34	16	11
WPNT04	Thailand	37	28	12	13
WPNT05	Tanzania	26	26	16	9
WPNT06	Seychelles	20	12	0	8
WPNT07	Maldives	26	18	5	13
WPNT08	Seychelles	18	8	0	7
WPNT09	Seychelles	18	10	0	6
Total		222	162	62	77

8.3 Review of the draft, and adoption of the Report of the 10th Working Party on Neritic Tunas

106. The WPNT **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPNT10, provided in Appendix XIII, as well as the management advice provided in the draft resource stock status summary for each of the six neritic tuna (and mackerel) species under the IOTC mandate, and the combined Kobe plot for the species assigned a stock status in 2020 (10):
   - Bullet tuna (*Auxis rochei*) – Appendix VII
   - Frigate tuna (*Auxis thazard*) – Appendix VIII
   - Kawakawa (*Euthynnus affinis*) – Appendix IX
   - Longtail tuna (*Thunnus tonggol*) – Appendix X
   - Indo-Pacific king mackerel (*Scomberomorus guttatus*) – Appendix XI
   - Narrow-barred Spanish mackerel (*Scomberomorus commerson*) – Appendix XII

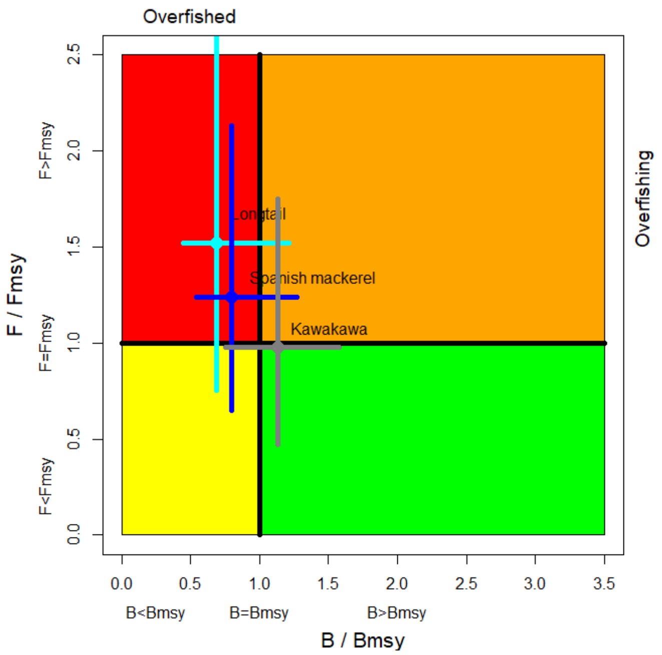

Fig. 10. Combined Kobe plot for longtail tuna, narrow-barred Spanish mackerel and kawakawa, showing the estimates of stock size (B) and current fishing mortality (F) in 2018 in relation to optimal spawning stock size and optimal fishing mortality. Cross bars illustrate the range of uncertainty from the model runs.

107. The report of the 10th Session of the Working Party on Neritic Tunas (IOTC–2020–WPNT10–R) was **ADOPTED** by correspondence.

Appendix I
List of participants

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APPENDIX II
AGENDA FOR THE 10TH WORKING PARTY ON NERITIC TUNAS

Date: 6–8 July 2020
Location: Online
Venue: NA
Time: 12:00 – 16:00 daily
Chair: Ms Ririk Sulistyaningsih; **Vice-Chair**: Dr Farhad Kaymaram

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

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

3. **THE IOTC PROCESS: OUTCOMES, UPDATES AND PROGRESS**
   - 3.1 Outcomes of the 22nd Session of the Scientific Committee (IOTC Secretariat)
   - 3.2 Outcomes of the 23rd Session of the Commission (IOTC Secretariat)
   - 3.3 Review of Conservation and Management Measures relevant to neritic tunas (IOTC Secretariat)
   - 3.4 Progress on the recommendations of WPNT09 (IOTC Secretariat)

4. **NEW INFORMATION ON FISHERIES AND ASSOCIATED ENVIRONMENTAL DATA FOR NERITIC TUNAS**
   - 4.1 Review of the statistical data available for neritic tunas (IOTC Secretariat)
   - 4.2 Review new information on fisheries and associated environmental data (general CPC papers)

5. **NERITIC TUNA SPECIES – REVIEW OF NEW INFORMATION ON STOCK STATUS**
   - 5.1 Review new information on the biology, stock structure, fisheries and associated environmental data (all)
   - 5.2 Data for input into stock assessments (all)

6. **STOCK ASSESSMENT UPDATES**
   - 6.1 Stock Assessments
     - Longtail tuna
     - Narrow-barred Spanish Mackerel
     - Kawakawa
   - 6.2 Stock status indicators for other neritic tuna species (all)
   - 6.3 Development of management advice for neritic tuna species (all)

7. **PROGRAM OF WORK (RESEARCH AND PRIORITES)**
   - 7.1 Revision of the WPNT Program of Work 2021–2025 (Chair)
   - 7.2 Development of priorities for an Invited Expert at the next WPNT meeting

8. **OTHER BUSINESS**
   - 8.1 Review of the draft, and adoption of the Report of the 10th Working Party on Neritic Tunas (Chair)

APPENDIX III
LIST OF DOCUMENTS

Document	Title
IOTC–2020–WPNT10–01a	Draft: Agenda of the 10th Working Party on Neritic Tunas
IOTC–2020–WPNT10–01b	Annotated agenda of the 10th Working Party on Neritic Tunas
IOTC–2020–WPNT10–02	List of documents of the 10th Working Party on Neritic Tunas
IOTC–2020–WPNT10–03	Outcomes of the 22nd Session of the Scientific Committee (IOTC Secretariat)
IOTC–2020–WPNT10–04	Outcomes of the 23nd Session of the Commission (IOTC Secretariat)
IOTC–2020–WPNT10–05	Review of current Conservation and Management Measures relating to neritic tuna species (IOTC Secretariat)
IOTC–2020–WPNT10–06	Progress made on the recommendations and requests of WPNT09 and SC22 (IOTC Secretariat)
IOTC–2020–WPNT10-07	Review of the statistical data available for the neritic tuna species (IOTC Secretariat)
IOTC–2020–WPNT10–08	Revision of the WPNT Program of Work (2021–2025) (IOTC Secretariat)
IOTC–2020–WPNT10–09	Main Outcomes of the IOTC Workshop -Identification of Regions in the IOTC Convention Area to Inform the Implementation of the Ecosystem Approach to Fisheries Management (Juan-Jorda M-J)
IOTC–2020–WPNT10–10	Population structure of neritic tuna in the Indian Ocean from the PSTBS-IO project (Davies C et al)
IOTC–2020–WPNT10–11	Nominal CPUE, Length Distribution and Condition Factor of Kawakawa *Euthynnus Affinis* in Indian Ocean (Agustina M)
IOTC–2020–WPNT10–12	Application of Bayesian biomass dynamic models to neritic tuna species in the Indian Ocean (Kitikado T et al.)
IOTC–2020–WPNT10–13	Assessment of Indian Ocean longtail tuna using data-limited methods (IOTC secretariat)
IOTC–2020–WPNT10–14	Assessment of Indian Ocean narrow-barred Spanish mackerel using data-limited methods (IOTC secretariat)
IOTC–2020–WPNT10–15	Assessment of Indian Ocean kawaka using data-limited methods (IOTC secretariat)
IOTC–2020–WPNT10–16	Assessment of Longtail tuna, Kawakawa, and Narrow-barred Spanish mackerel using optimised catch-only method (Zhou S)
Information papers	
IOTC–2020–WPNT10–INF01	Size structure and growth parameters of the frigate tuna (*Auxis thazard*) landed in the port of Antsiranana (2012 – 2019). (Jaona G)
IOTC–2020–WPNT10–INF02	Neritic tuna fishery in Sri Lankan waters: An update (Dalpathadu, KR and Haputhantri SSK)
IOTC–2020–WPNT10–INF03	Status of Neritic Tuna in Pakistan with special reference to longtail tuna (Moazzam M)

APPENDIX IV
STATISTICS FOR NERITIC TUNAS

Extract from IOTC–2020–WPNT10–07

Fisheries and catch trends for neritic species

- Main species: Kawakawa, longtail tuna and narrow-barred Spanish mackerel are the main neritic species, accounting for over 74% of the total catches of neritic species in recent years (**Fig. A1c-d**).
- Main fisheries: Neritic tunas are caught mainly using drifting gillnets and purse seine nets in coastal waters – although some species are also caught using industrial purse seines, hand lines, troll lines or other gears both in coastal waters and on the high seas (**Fig. A2**). The catches of neritic tunas recorded for industrial purse seiners are thought to be a fraction of those retained on board: due to those species being taken as bycatch, their catches are seldom recorded in the logbooks, nor are they monitored in port.
- Main fleets (i.e., highest catches in recent years): Although neritic species are caught in the EEZ of most coastal states in the Indian Ocean, total catches are highly concentrated to the point that over 77% of total catches of neritic species are accounted for by four countries: Indonesia, I.R. Iran, India and Pakistan (**Fig. A3**).
- Retained catch trends: The contribution of catches of neritic tunas to total catches of IOTC species in the Indian Ocean has changed substantially over the last 30 years, in particular with the arrival of industrial purse seine fleets to the Indian Ocean in the early-1980s, which saw an increase in targeting of tropical tunas. With the onset of piracy in the late-2000s, fishing efforts of fleets operating in the north-west Indian Ocean have been displaced or reduced – in particular, those exerted by the Asian longline fleets targeting tropical tunas – leading to an increase in the proportion of catches from neritic species (**Fig. A1a-b**). While the threat of piracy has declined in recent years, and some fleets have resumed fishing in areas closer to Somali waters, overall catches of neritic tunas have not declined to pre-piracy levels (neither in absolute nor in relative terms) suggesting a longer-term change in the targeting of species by some fleets.
- Economic markets: The majority of the catches of neritic tuna species are sold locally, in raw or processed form (e.g. local canneries), or exported to markets in neighboring countries. In addition, a small component of the catches of neritic tunas, in particular longtail tuna, is also exported to the European Union (EU) or other markets in the region (e.g. Saudi Arabia, Sri Lanka, etc.).

TABLE A1. Best scientific estimates of the annual nominal catches (MT) of the six neritic tuna species by type of fishery for the period 1950–2018. Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, Danish seine, liftnet, longline (drifting), longline (fresh), trawling. Color codes (yellow = lower, green = higher) describe the intensity of captures by gears across decades (left) and years (right). Data as of May 2020.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Purse seine	176	605	4,800	24,816	45,353	63,557	78,482	74,904	93,605	88,861	81,250	78,701	74,832	73,672	72,867	118,946
Gillnet	3,320	6,115	11,493	20,503	28,163	38,665	284,705	311,252	340,955	359,220	363,839	379,578	360,936	376,413	371,770	348,225
Line	5,640	9,508	18,348	34,402	48,653	77,420	99,569	104,017	110,352	116,575	121,462	122,675	122,876	117,056	115,437	96,964
Other	1,811	2,857	4,390	17,187	32,002	57,250	79,466	73,214	78,383	80,565	78,002	65,536	65,382	69,719	71,116	57,310
Total	**27,546**	**49,658**	**96,499**	**199,421**	**294,983**	**430,218**	**542,223**	**563,388**	**623,295**	**645,221**	**644,553**	**646,490**	**624,026**	**636,860**	**631,191**	**621,445**

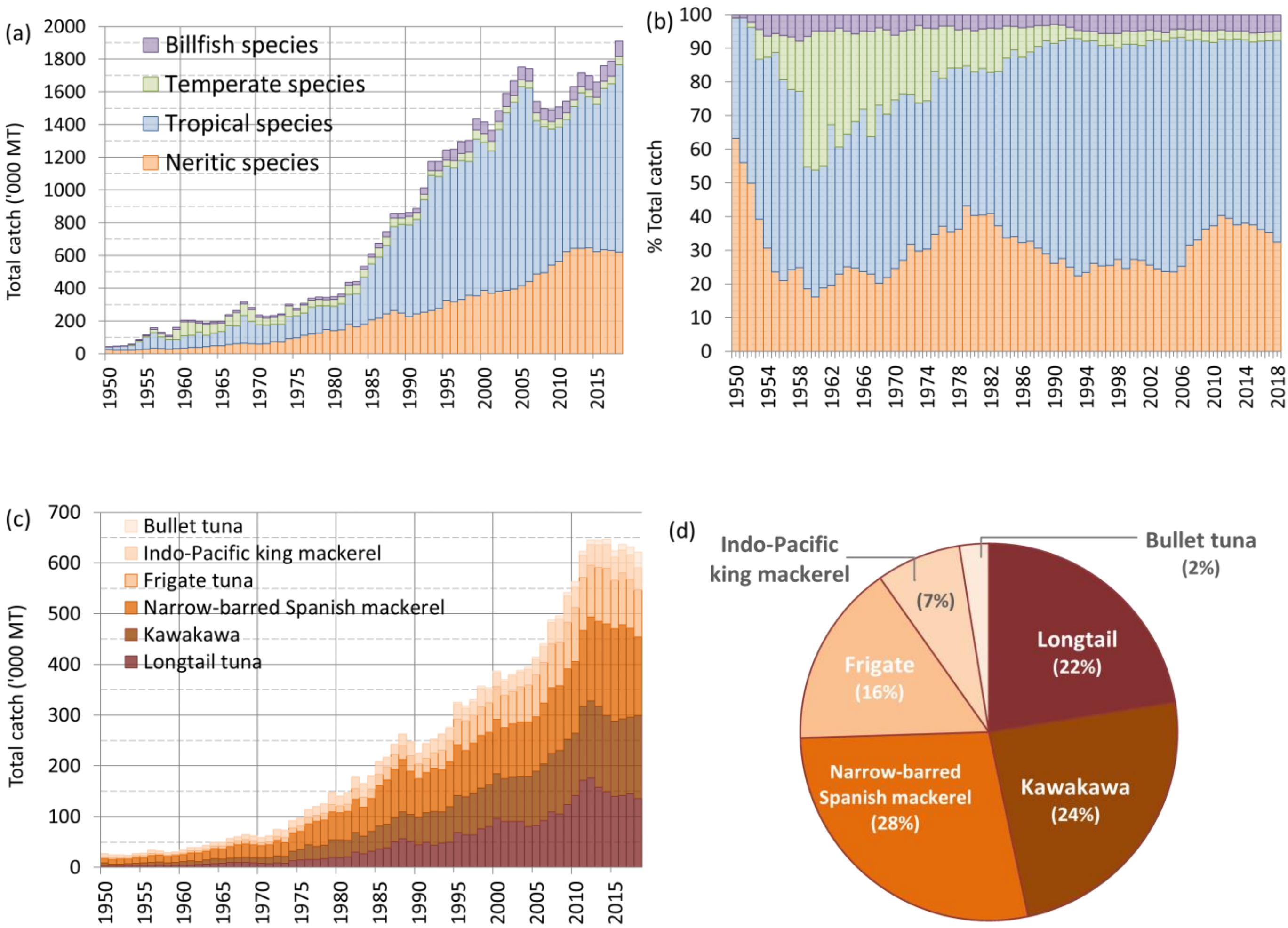


Fig. A1. Top: Contribution of the neritic tuna species to the total catches of IOTC species in the Indian Ocean, over the period 1950-2018. (a) Annual nominal catches (MT) by group of species; (b) Percentage of the annual nominal catches by group of species. Bottom: Contribution of each neritic tuna species to the total combined catches of neritic tunas. (c) Annual nominal catches (MT) by species, 1950-2018; (d) Percentage of the average annual catch by species, 2014-2018

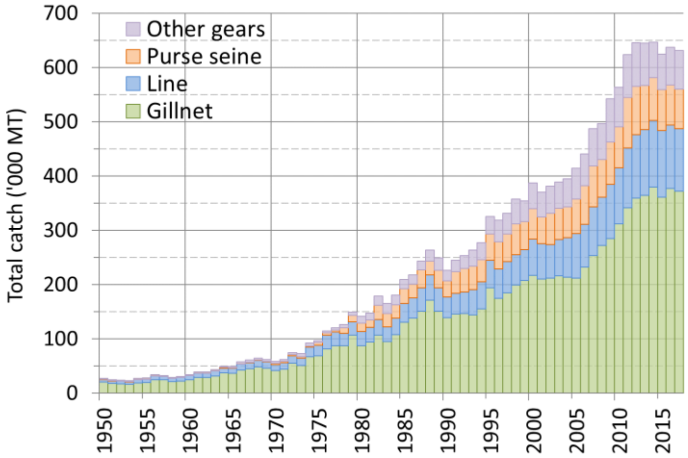


Fig. A2. Annual time series of nominal catches (MT) of neritic tuna species by type of fishery recorded in the IOTC database (1950–2018). Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, Danish seine, liftnet, longline (drifting), longline (fresh), trawling

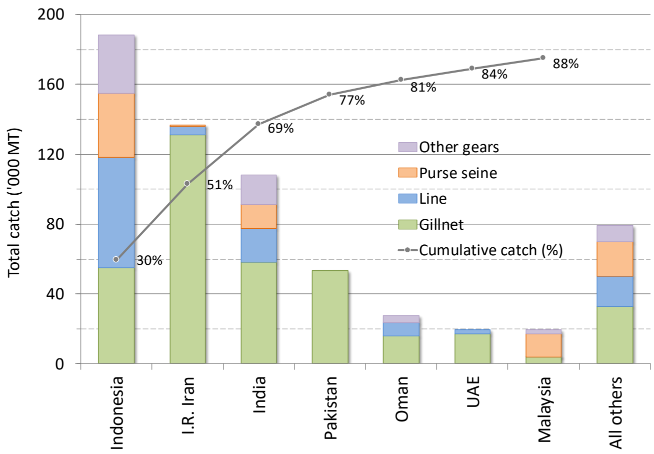


Fig. A3. Average nominal catches of neritic tuna species over the period 2014–2018, by type of fishery and CPC ordered according to the importance of catches. The solid line indicates the cumulative percentage of the total combined catches of the species for the CPCs concerned

APPENDIX IVA
MAIN STATISTICS FOR KAWAKAWA (EUTHYNNUS AFFINIS)

Extract from IOTC–2020–WPNT10–07

Fisheries and main catch trends for Kawakawa

- Main fisheries: Kawakawa are caught mainly by gillnets, handlines and trolling, and coastal purse seiners (**Table A2; Fig. A5**).
- Main fleets (i.e., highest catches in recent years): Indonesia, India, I.R. Iran, and Malaysia (**Fig. A6**).
- Retained catch trends: Annual estimates of catches for kawakawa increased markedly from around 20,000 MT in the mid-1970's, to 45,000 MT in the mid-1980's and over 145,000 MT in recent years (since 2011). Since 2011 catches have fluctuated between 145,000 MT and 165,000 MT – the highest catches ever recorded for this species in the Indian Ocean.
- Discard levels: Low for industrial purse seine fisheries: in recent years, the EU and Seychelles have reported discard levels of kawakawa for their purse seine fleet estimated from 2008 to 2017 through observer data.

Changes to the catch series

There were relatively small revisions (i.e., between -1% and -7%, depending on the year) to the catches reported in years between 1987 and 2018 and almost exclusively due to the revision in the catch series of Pakistan gillnetters introduced during late 2019. Overall, the revised catches of kawakawa until 2017 are now 163,988 MT lower than what reported at the previous WPNT in 2019 (**Fig. A4**).

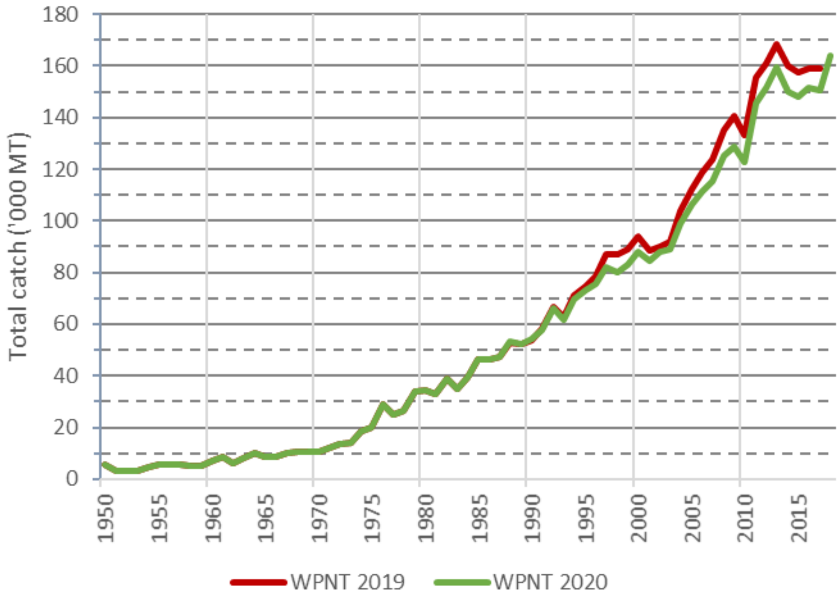


Fig. A4. Annual time series of nominal catches (MT) of kawakawa available for the period 1950-2017 at the ninth session of the IOTC Working Party on Neritic Tunas (WPNT09) and at the tenth session (WPNT10) for the period 1950-2018

Estimation of catches: data related issues

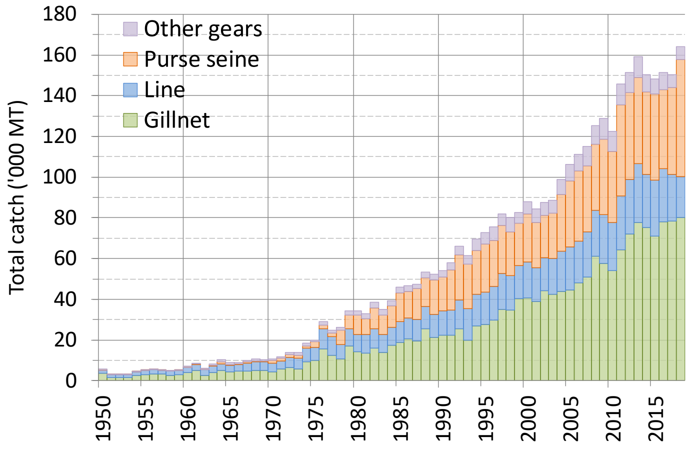
Retained catches for kawakawa were derived from incomplete information, and are therefore considered to be highly uncertain[2] (**Fig. A6**), notably for the following fisheries:

[2] The uncertainty in the catch estimates has been assessed by the Secretariat and is based on the amount of processing required to account for the presence of conflicting catch reports, the level of aggregation of the catches by species and or gear, and the occurrence of non-reporting fisheries for which catches had to be estimated.

- Artisanal fisheries of Indonesia: Indonesia did not report catches of kawakawa by species or by gear for 1950–2004; catches of kawakawa, longtail tuna and, to a lesser extent, other species were reported as species aggregates for this period. In the past, the IOTC Secretariat used the catches reported since 2005 to break the aggregates for 1950–2004 by gear and species. A review by the IOTC Secretariat, conducted by an independent consultant in 2012, indicated that the catches of kawakawa had been overestimated by Indonesia. While the new catches estimated for kawakawa in Indonesia remain uncertain, the new figures are considered more reliable than those previously recorded in the IOTC database, although fundamental issues remain with the quality of official catches reported by Indonesia to the IOTC Secretariat (e.g., unexplained fluctuations in catches by species between years, as well as large revisions in catches).
- Artisanal fisheries of India: Although India reports catches of kawakawa, these are not always available by gear. The catches of kawakawa in India were also reviewed by the IOTC Secretariat in 2012 and assigned by gear on the basis of official reports and information from various other alternative sources.
- Artisanal fisheries of Myanmar and Somalia: None of these countries has ever reported catches to the IOTC Secretariat. Catch levels are unknown.
- Other artisanal fisheries: The catches of kawakawa are usually not reported by species, being combined with catches of other small tuna species like skipjack tuna and frigate tuna (e.g., coastal purse seiners of Thailand and, until recently, Malaysia).
- Industrial fisheries: The highest captures for the species from any industrial fishery were reported in 2018 by Indonesian purse seiners with around 17,000 MT in total (corroborating the idea that the fishery is actually targeting neritic species). The EU and Seychelles recently reported catch levels of kawakawa for their purse seine fleet, estimated from 2008 to 2017 through observer data.

TABLE A2. Best scientific estimates of the annual nominal catches (MT) of kawakawa by type of fishery for the period 1950–2018. Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, Danish seine, liftnet, longline (drifting), longline (fresh), trawling. Color codes (yellow = lower, green = higher) describe the intensity of captures by gears across decades (left) and years (right). Data as of May 2020.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Purse seine	111	385	2,616	12,070	21,398	28,613	37,051	35,064	44,892	42,722	42,479	40,438	42,351	39,124	42,590	57,370
Gillnet	2,552	4,473	9,691	18,002	28,450	47,186	57,591	54,034	64,159	71,880	77,684	75,302	70,899	77,939	78,431	80,334
Line	1,721	3,270	6,642	9,854	15,270	19,848	24,003	23,583	26,641	26,860	28,772	26,073	27,572	26,043	22,853	19,981
Other	295	719	1,357	2,690	5,127	7,819	10,129	9,994	10,007	9,986	10,329	8,436	7,428	8,337	6,648	6,448
Total	**4,679**	**8,847**	**20,306**	**42,615**	**70,245**	**103,466**	**128,774**	**122,675**	**145,699**	**151,449**	**159,264**	**150,248**	**148,251**	**151,443**	**150,522**	**164,133**



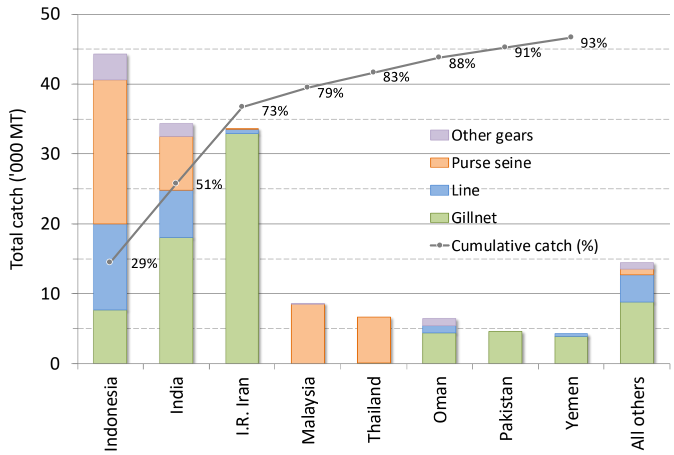


Fig. A5. Annual nominal catches of kawakawa by type of fishery recorded in the IOTC database (1950–2018). Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, Danish seine, liftnet, longline (drifting), longline (fresh), trawling

Fig. A6. Average nominal catches of kawakawa over the period 2014–2018, by type of fishery and CPC ordered according to the importance of catches. The solid line indicates the cumulative percentage of the total combined catches of the species for the CPCs concerned

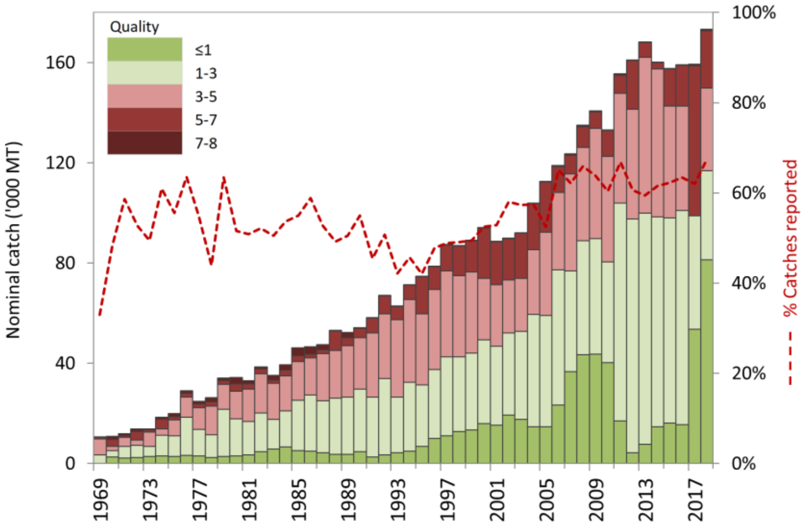


Fig. A7. Annual nominal catches (MT) of kawakawa estimated by quality score (barplot) and percentage of nominal catch fully/partially reported to the IOTC Secretariat (red dashed line) for all fisheries (1969–2018). Catches are assessed against IOTC reporting standards, where a quality score of 0 indicates catches that are fully reported according to IOTC standards; catches assigned a score of between 2–6 do not report catch data fully by gear and/or species (i.e., partially adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document; catches with a score of 8 refer to fleets that do not report catch data to the IOTC (i.e. estimated by the IOTC Secretariat)

Effort trends

- Availability: Effort trends are unknown for kawakawa in the Indian Ocean, due to a general lack of catch-and-effort data.

Catch-per-unit-effort (CPUE) trends

- Availability: Highly incomplete, with data available for only short periods of time and selected fisheries (**Fig. A8**).
- Main CPUE series available: Maldives (baitboats and troll lines) and Sri Lanka (gillnets). However the catch-and-effort data recorded for Sri Lankan gillnets are thought to be unreliable, due to the dramatic changes in CPUE recorded between consecutive years. Also the fishing effort units reported by Maldives changed from trips to fishing days from 2013 onwards.

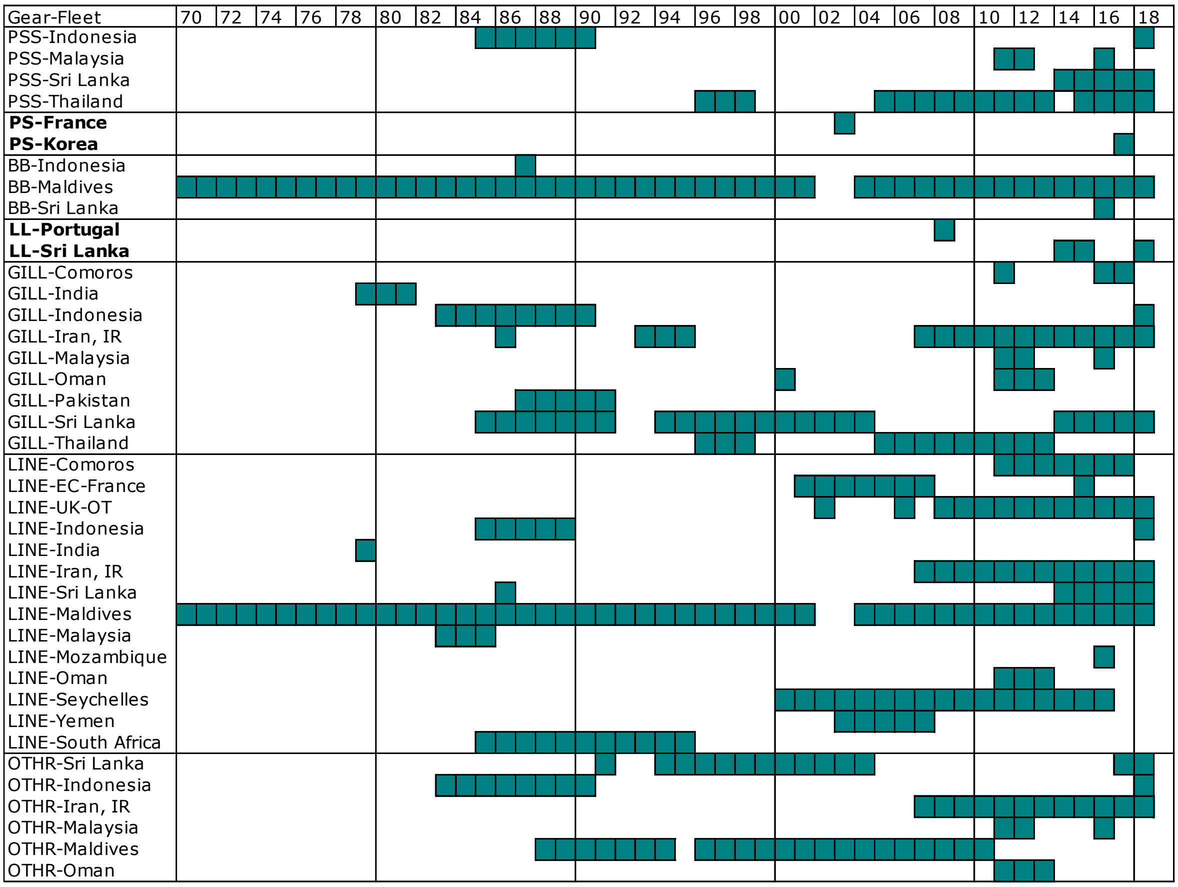


Fig. A8. Availability of catch-and-effort series for kawakawa, by fishery and year (1970-2018). No catches and effort are available for the years 1950–69. Note that the above list is not exhaustive, showing only the fisheries for which catches and effort are available in the IOTC database. Furthermore, catches and effort - even when available - may not cover the entire year and be limited to just a few month

Fish size or age trends (e.g., by length, weight, sex and/or maturity)

- Sizes: The size of kawakawa taken by the Indian Ocean fisheries typically ranges between 20 and 60 cm depending on the type of gear used, season and location. The coastal purse seine fisheries operating in the Andaman Sea tend to catch kawakawa of a relatively small size (15–30 cm) while gillnet, baitboat and other fisheries operating in the Indian Ocean usually catch larger specimens (25–55 cm).
- Size frequency data: Overall highly incomplete, with data only available for selected years and/or fisheries (**Fig. A9**).

  Main sources for size samples: I.R. Iran (gillnets), Thailand (coastal purse seiners), Sri Lanka (gillnets), Malaysia (troll lines and coastal purse seiners).

Trends in average weight can be assessed for Sri Lankan gillnets from the mid-1980s to early-1990s, but the amount of specimens measured has been very low in recent years. Since 1998 there has also been some sampling of lengths from Iranian gillnets – although average lengths are significantly larger than specimens reported by other fleets which reflect differences in the selectivity of offshore gillnets operating in the Arabian Sea, rather than an actual change in average sizes in the underlying population.

- Catch-at-Size (Age) table: Not available, due to lack of size samples and uncertainty over the reliability of retained catch estimates.
- Sex ratio data: Have not been provided to the Secretariat by CPCs.

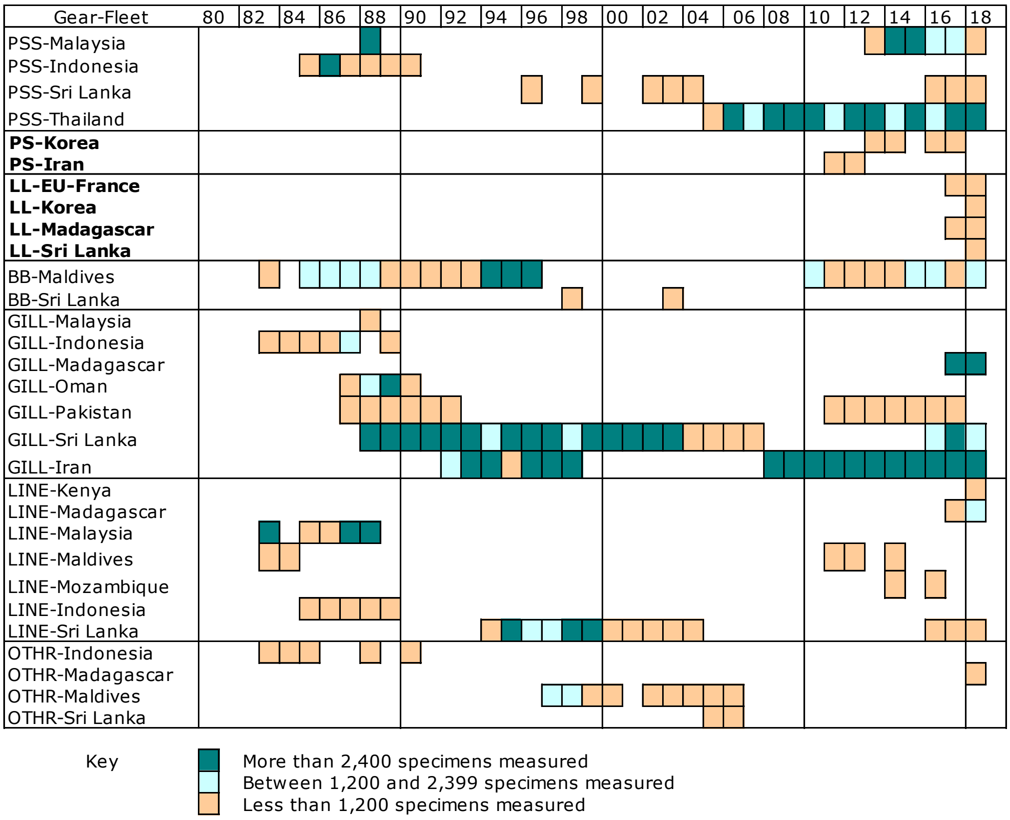


Fig. A9. Availability of kawakawa size frequency data, by fishery and year (1980-2018). No size frequency data are available for 1950–82. Note that the above list is not exhaustive, showing only the fisheries for which size data are available in the IOTC database. Furthermore, size data - even when available - may not cover the entire year and be existing only for short periods

Other biological data: The length-weight equation available for kawakawa is shown below:

Species	*From type measurement – To type measurement*	*Equation*	*Parameters*	*Length*
Kawakawa	*Fork length (cm) – Round Weight (kg)*	*RND=a*L^b*	*a= 0.0000260 b= 2.9*	*Min: 20 cm Max: 65 cm*

Source: Data from North Indian Ocean: IPTP Sampling Programme in Sri Lanka (1989)

APPENDIX IVB

MAIN STATISTICS FOR LONGTAIL TUNA (THUNNUS TONGGOL)

Extract from IOTC–2020–WPNT10–07

Fisheries and main catch trends for longtail tuna

- Main fisheries: Longtail tunas are caught mainly using gillnets and, to a lesser extent, coastal purse seine nets and trolling (**Table A3; Fig. A11**).
- Main fleets (i.e., highest catches in recent years): Over 40% of the catches of longtail tuna in the Indian Ocean are accounted for by I.R. Iran (gillnetters), followed by Indonesia (gillnet and trolling) and Pakistan (gillnetters) (**Fig. A12**).
- Retained catch trends: Estimated catches of longtail tuna have increased steadily from the mid-1950s, reaching around 15,000 MT in the mid-1970's, over 35,000 MT by the mid-1980's, and more than 96,000 MT in 2000. Between 2000 and 2005, catches declined, but have since recovered and reached the highest levels recorded in recent years at over 170,000 MT in 2011. Since then, catch levels have generally fluctuated between 130,000 – 160,000 MT.

  Around the late-2000s I.R. Iran has reported large increases in their catches of longtail tuna from coastal waters in the Arabian Sea, as a result of the threat of piracy and displacement of fishing effort (as well as an explicit change of targeting) by gillnet vessels formerly operating in the North-West Indian Ocean. Since 2013 lower catches have been reported – albeit not to yet down to pre-piracy levels – in response to the reduced threat of piracy and resumption of fishing activity in offshore waters and (potentially) the high seas.
- Discard levels: Are thought to be very low, although estimates of discards are unknown for most fisheries.

Changes to the catch series

There were relatively small revisions (i.e., between -4% and +7%, depending on the year) to the catches recorded in years between 1987 and 2018, almost exclusively due to the revision in the catch series of Pakistan gillnetters introduced during late 2019. Overall, the revised catches of longtail tuna until 2017 are now 31,408 MT higher than what reported at the previous WPNT in 2019 (**Fig. A10**).

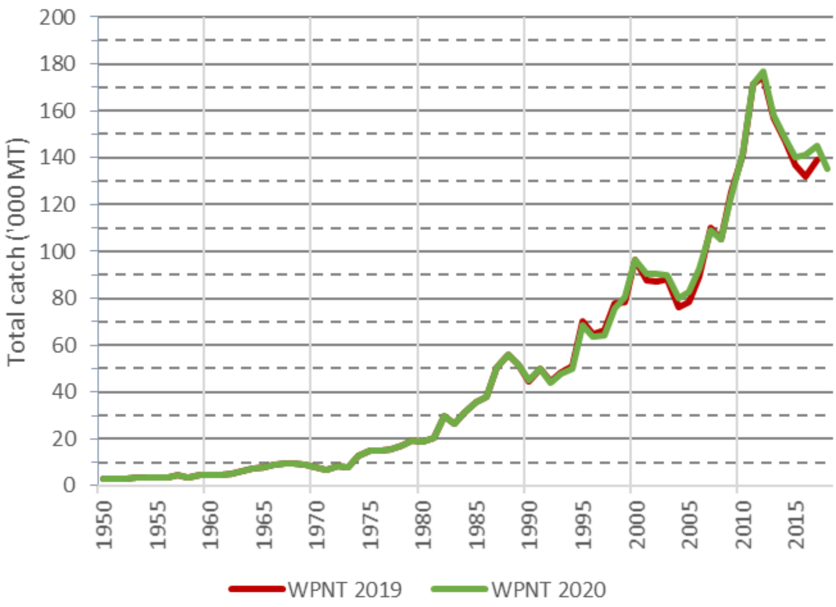


Fig. A10. Annual time series of nominal catches (MT) of longtail tuna available for the period 1950-2017 at the ninth session of the IOTC Working Party on Neritic Tunas (WPNT09) and at the tenth session (WPNT10) for the period 1950-2018

Estimation of catches – data related issues

Retained catches for longtail tuna were derived from incomplete information – due to deficiencies in port sampling for many of the main fleets – and are therefore uncertain[3] (**Fig. A13**); notably for the following fisheries:

- Artisanal fisheries of Indonesia: Indonesia did not report catches of longtail tuna by species or by gear for 1950–2004; instead catches of longtail tuna, kawakawa and other species were reported as aggregated for this period. In the past, the IOTC Secretariat used the catches reported since 2005 to break the aggregates for 1950–2004, by gear and species. However, a recent review by the IOTC Secretariat, conducted by an independent consultant in 2012, indicated that catches of longtail tuna had been severely overestimated by Indonesia. While the new catches estimated for the longtail tuna in Indonesia remain uncertain, the new figures are considered more reliable than those existing in the past.

  Between 2014 and 2016 the IOTC Secretariat conducted a pilot sampling project of artisanal fisheries in North and West Sumatra to improve estimates of catch by species for coastal fisheries. One of the key issues was the misclassification of juvenile tunas (tongkol) as longtail tuna (*Thunnus tonggol*) by district authorities in Indonesia, which is believed to have led to over-estimates of catches of longtail for a number of years. Based on the results of the pilot sampling, the IOTC Secretariat is working with Indonesia to further improve their estimates of longtail tuna landings.
- Artisanal fisheries of India and Oman: Although these countries report catches of longtail tuna, until recently the catches have not been reported by gear. The IOTC Secretariat used alternative information to assign the catches reported by Oman by gear, while the catches of India were reviewed by an independent consultant in 2012 and assigned by gear on the basis of official reports and information from various alternative sources.
- Artisanal fisheries of Myanmar and Somalia: None of these countries has ever reported catches of longtail tuna to the IOTC Secretariat. While catch levels are unknown, they are unlikely to be substantial. In the case of Myanmar, catches are taken from FAO and SEAFDEC (various years).
- Industrial fisheries: longtail tuna is generally not targeted by industrial fleets, and only in recent years (from 2011 onward) evidences of yearly captures exceeding 20,000 MT were recorded, mostly from the offshore gillnet fisheries of I.R. Iran and the Indonesian industrial purse seine fleet, that reported around 5,000 MT of captures for the species in 2018 (suggesting that the fleet is actually targeting neritic tuna species).

TABLE A3. Best scientific estimates of the annual nominal catches (MT) of longtail tuna by type of fishery for the period 1950–2018. Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, Danish seine, liftnet, longline (drifting), longline (fresh), trawling. Color codes (yellow = lower, green = higher) describe the intensity of captures by gears across decades (left) and years (right). Data as of May 2020.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Purse seine	65	204	1,012	4,863	10,933	17,719	85,253	105,597	120,878	120,381	114,993	108,186	104,891	105,879	106,619	98,194
Gillnet	2,941	6,209	10,026	25,892	40,923	65,081	12,494	12,977	15,989	21,874	19,959	22,578	18,254	16,527	19,546	15,569
Line	557	816	1,519	4,056	5,003	9,497	5,300	6,513	8,467	9,079	5,880	5,040	6,256	7,284	9,989	7,596
Other	0	0	125	1,090	1,992	3,731	20,649	16,531	26,062	25,218	17,227	12,772	10,497	11,566	8,814	13,922
Total	**3,564**	**7,230**	**12,681**	**35,901**	**58,852**	**96,028**	**123,696**	**141,618**	**171,396**	**176,551**	**158,058**	**148,577**	**139,899**	**141,256**	**144,968**	**135,282**

[3] The uncertainty in the catch estimates has been assessed by the Secretariat and is based on the amount of processing required to account for the presence of conflicting catch reports, the level of aggregation of the catches by species and or gear, and the occurrence of non-reporting fisheries for which catches had to be estimated.

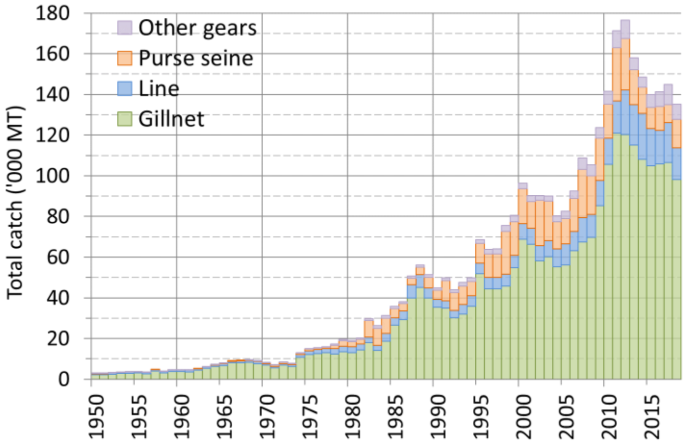


Fig. A11. Annual nominal catches (MT) of longtail tuna by type of fishery recorded in the IOTC database (1950–2018). Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, Danish seine, liftnet, longline (drifting), longline (fresh), trawling

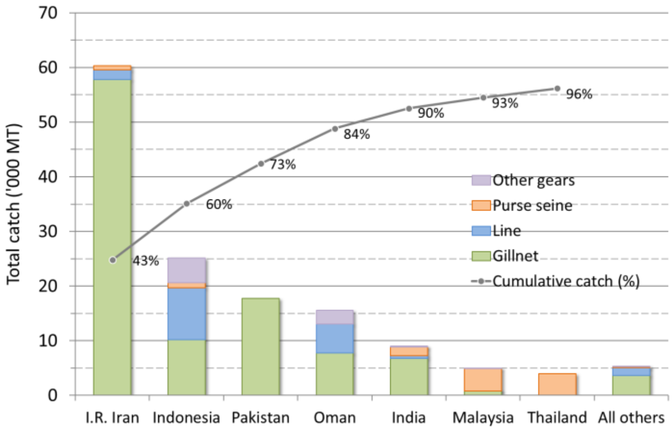


Fig. A12. Average nominal catches (MT) of longtail tuna over the period 2014–2018, by type of fishery and CPC ordered according to the importance of catches. The solid line indicates the cumulative percentage of the total combined catches of the species for the CPCs concerned

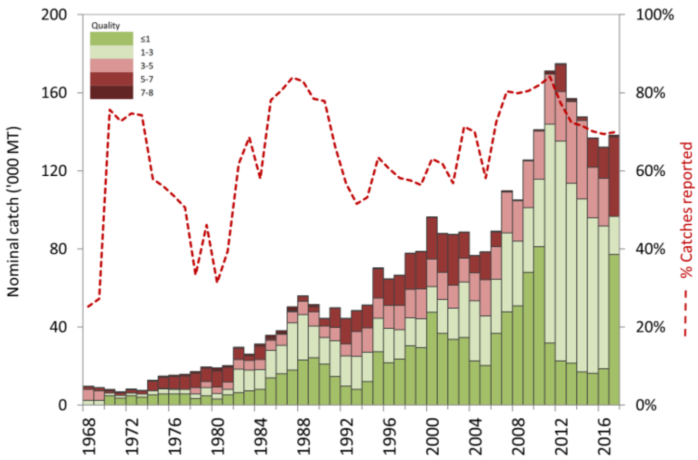


Fig. A13. Annual nominal catches (MT) of longtail tuna estimated by quality score (barplot) and percentage of nominal catch fully/partially reported to the IOTC Secretariat (red dashed line) for all fisheries (1969–2018). Catches are assessed against IOTC reporting standards, where a quality score of 0 indicates catches that are fully reported according to IOTC standards; catches assigned a score of between 2–6 do not report catch data fully by gear and/or species (i.e., partially adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document; catches with a score of 8 refer to fleets that do not report catch data to the IOTC (i.e. estimated by the IOTC Secretariat)

Effort trends

- Availability: Effort trends are generally unknown for longtail tuna in the Indian Ocean due to the lack of catch-and-effort data.

Catch-per-unit-effort (CPUE) trends

- Availability: Highly incomplete, with data available for only short periods of time and selected fisheries (**Fig. A14**).
- Main CPUE series available: Thailand coastal purse seine and gillnet vessels (available for over 10 years, although the effort unit switched from trips to fishing hours then recently to fishing days). I.R. Iran has also recently reported catch and effort for their coastal fisheries from 2007 to 2018.

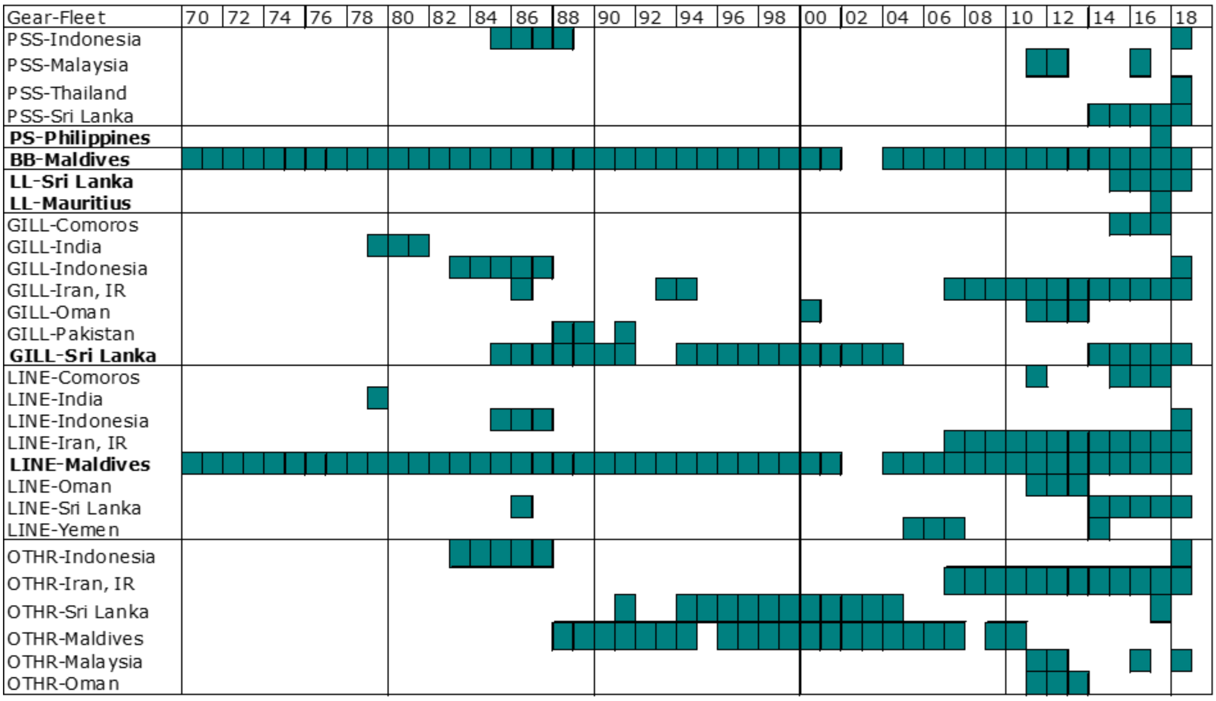


Fig. A14. Availability of longtail tuna catch-and-effort series, by fishery and year (1970-2018). No catches and effort are available at all for 1950–69. Note that the above list is not exhaustive, showing only the fisheries for which catches and effort are available in the IOTC database. Furthermore, catches and effort - even when available - may not cover the entire year and be limited to just a few months

Fish size or age trends (e.g., by length, weight, sex and/or maturity)

- Sizes: Longtail tunas taken by Indian Ocean fisheries typically range between 20 – 100 cm depending on the type of gear used, season and location (**Fig. A15**). Fisheries operating in the Andaman Sea (coastal purse seines and trolling) tend to catch smaller-sized longtail tunas (e.g., 20–45cm), while gillnet fisheries of I.R. Iran and Pakistan (Arabian Sea) catch larger specimens (e.g., 50–100cm).
- Size frequency data**:** Highly incomplete, with data available only for selected fisheries.
- Main sources for size samples: I.R. Iran (gillnet), Oman (gillnet), Pakistan (gillnet), and Thailand (coastal purse seiners).
- Catch-at-Size (Age) table: Not available, due to lack of size samples and uncertainty over the reliability of retained catch estimates.
- Sex ratio data: Have not been provided to the Secretariat by CPCs.

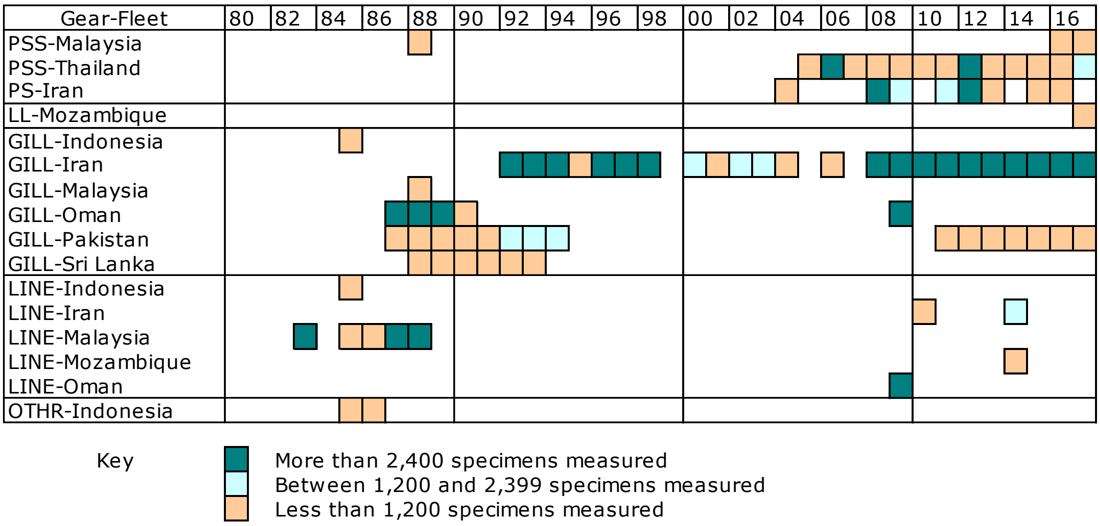


Fig. A15. Availability of longtail tuna size frequency data, by fishery and year (1980-2018). No size frequency data are available for 1950–82. Note that the above list is not exhaustive, showing only the fisheries for which size data are available in the IOTC database. Furthermore, size data - even when available - may not cover the entire year and be existing only for short periods

Other biological data: The length-weight equation available for longtail tuna is shown below:

Species	*From type measurement – To type measurement*	*Equation*	*Parameters*	*Length*
Longtail tuna	Fork length (cm) – Round Weight (kg)	RND=a*L^b	a= 0.00002 b= 2.83	Min: 29 cm Max: 128 cm

Source: Data from Indian Ocean: IOTC-2011-WPNT01-18 Population dynamic parameters of Thunnus tonggol in the north of the Persian Gulf and Oman Sea; F. Kaymaram, M. Darvishi, F. Parafkandeh, S. Ghasemi & S.A. Talebzadeh

APPENDIX IVC

MAIN STATISTICS FOR NARROW-BARRED SPANISH MACKEREL (SCOMBEROMORUS COMMERSON)

Extract from IOTC–2020–WPNT10–07

Fisheries and main catch trends for narrow-barred Spanish mackerel

- Main fisheries: Narrow-barred Spanish mackerel are caught mainly using gillnet, however significant numbers are also caught using troll lines (**Table A4; Fig. A17**).
- Main fleets (i.e., highest catches in recent years: Fisheries in Indonesia, India, I.R. Iran and Pakistan account for around 70% of catches in recent years (**Fig. A18**). Narrow-barred Spanish mackerel is also targeted throughout the Indian Ocean by artisanal and sports/recreational fisheries.
- Retained catch trends: Catches of narrow-barred Spanish mackerel increased from around 50,000 MT in the late-1970’s to over 100,000 MT by the late-1990’s. Since 2011, some of the highest catches for this species have been recorded, with annual catches fluctuating between 145,000 and 185,000 MT.
- Discard levels**:** Thought to be very low, although estimates of discards are unknown for most fisheries.

Changes to the catch series

There were relatively small revisions (i.e., between 2% and 11%, depending on the year) to the catches recorded in years between 1987 and 2018, almost exclusively due to the revision in the catch series of Pakistan gillnetters introduced during late 2019. Overall, the revised catches of narrow-barred Spanish mackerel until 2017 are now 152,169 MT higher than what reported at the previous WPNT in 2019 (**Fig. A16**).

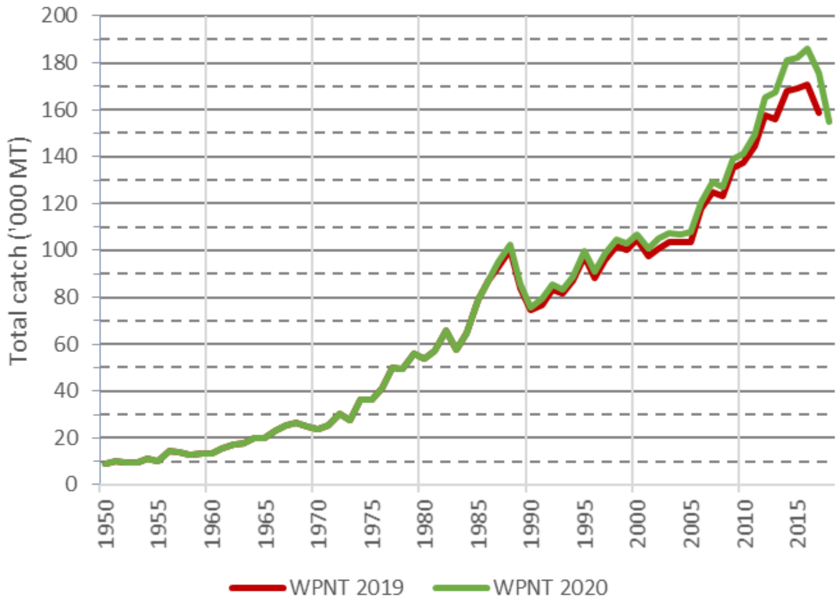


Fig. A16. Annual time series of nominal catches (MT) of narrow-barred Spanish mackerel available for the period 1950-2017 at the ninth session of the IOTC Working Party on Neritic Tunas (WPNT09) and at the tenth session (WPNT10) for the period 1950-2018

Estimation of catches – data related issues

Retained catches for narrow-barred Spanish mackerel were derived from incomplete information, and are therefore uncertain[4] (**Fig. A19**), notably for the following fisheries:

- Artisanal fisheries of Indonesia and India: Indonesia and India have only recently reported catches of narrow-barred Spanish mackerel by gear, including catches by gear for the years 2005–08 and 2007–08, respectively. In the past, the IOTC Secretariat used the catches reported in recent years to break the aggregates for previous years, by gear and species. However, in a review conducted by the IOTC Secretariat by an independent consultant in 2012 the catches of narrow-barred Spanish mackerel were reassigned by gear for both India and Indonesia. In recent years, the catches of narrow-barred Spanish mackerel estimated for their Indonesia and India component represent around 45% of the total catches of this species in the Indian Ocean.
- Artisanal fisheries of Madagascar: Madagascar started reporting catches from 2018. However, the data is still under reviewed as its coverage is very low: for this reason, the catches currently available through the IOTC database are still those estimated following the 2012 review. In fact, during 2012 the IOTC Secretariat conducted a review aiming to break the catches recorded in the FAO database as narrow-barred Spanish mackerel by species, on the assumption that all catches of tunas and tuna-like species had been combined under this name (the review used data from various sources including a reconstruction of the total marine fisheries catches of Madagascar (1950–2008), undertaken by the *Sea Around Us* project). However, the new catches estimated are still considered to be highly uncertain.
- Artisanal fisheries of Somalia: Catch levels are unknown.
- Other artisanal fisheries: UAE do not report catches of narrow-barred Spanish mackerel by gear. Although most of the catches are believed to be taken by gillnets, some narrow-barred Spanish mackerel may be also caught by using small surrounding nets, lines or other artisanal gears. In addition, until 2017, Thailand reported catches of narrow-barred Spanish mackerel and Indo-Pacific king mackerel aggregated.
- All fisheries: Catches of seerfish species are misreported in some cases, with catches of Indo-Pacific king mackerel and, to a lesser extent, other seerfish species reported as narrow-barred Spanish mackerel. Similarly, the catches of wahoo in some longline fisheries are thought to be misreported as narrow-barred Spanish mackerel – although this is thought to have little impact in the case of the narrow-barred Spanish mackerel but may be important for other seerfish species.

TABLE A4. Best scientific estimates of the annual nominal catches (MT) of narrow-barred Spanish mackerel by type of fishery for the period 1950–2018. Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, Danish seine, liftnet, longline (drifting), longline (fresh), trawling. Color codes (yellow = lower, green = higher) describe the intensity of captures by gears across decades (left) and years (right). Data as of May 2020.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Purse seine	-	0	285	2,354	4,141	5,440	8,459	8,100	8,829	8,900	9,419	8,534	8,169	8,505	8,133	7,202
Gillnet	9,526	17,709	32,168	55,524	65,049	70,952	80,062	85,345	89,981	100,331	103,500	117,455	115,626	118,432	111,078	98,842
Line	1,735	2,471	4,672	11,334	12,032	17,318	22,279	23,250	25,029	26,420	27,788	29,898	32,457	30,879	29,222	26,870
Other	57	96	468	5,603	9,746	21,353	28,170	24,551	25,802	29,358	26,842	25,065	25,996	27,971	27,253	21,871
Total	**11,318**	**20,276**	**37,593**	**74,815**	**90,968**	**115,064**	**138,970**	**141,245**	**149,641**	**165,010**	**167,549**	**180,952**	**182,247**	**185,786**	**175,686**	**154,785**

[4] The uncertainty in the catch estimates has been assessed by the Secretariat and is based on the amount of processing required to account for the presence of conflicting catch reports, the level of aggregation of the catches by species and or gear, and the occurrence of non-reporting fisheries for which catches had to be estimated.

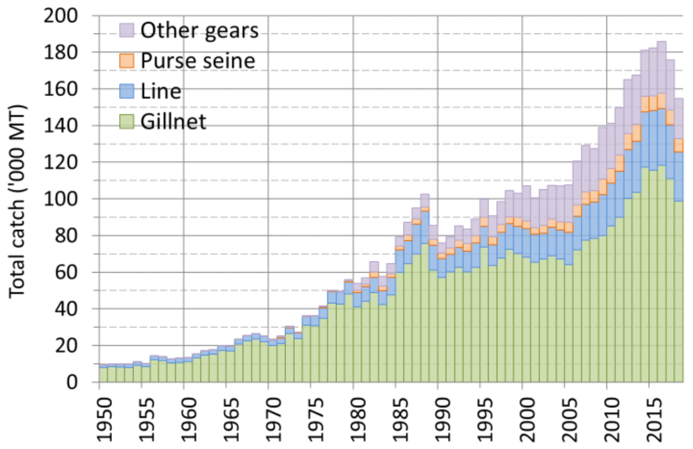


Fig. A17. Annual nominal catches (MT) of narrow-barred Spanish mackerel by type of fishery recorded in the IOTC database (1950–2018). Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, Danish seine, liftnet, longline (drifting), longline (fresh), trawling

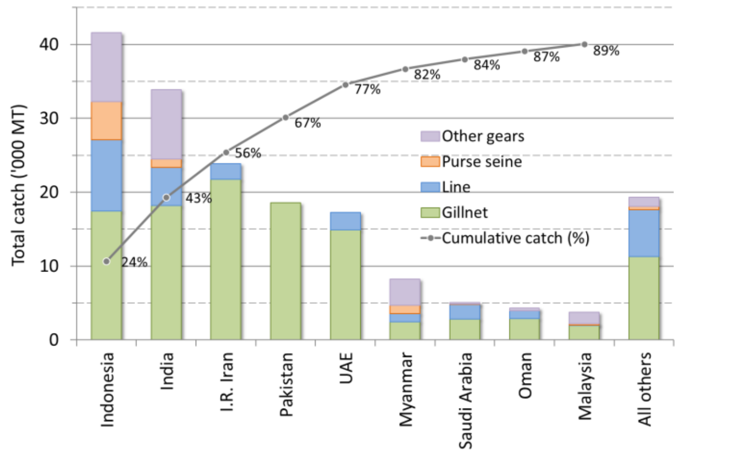


Fig. A18. Average nominal catches (MT) of narrow-barred Spanish mackerel over the period 2014–2018, by type of fishery and CPC ordered according to the importance of catches. The solid line indicates the cumulative percentage of the total combined catches of the species for the CPCs concerned

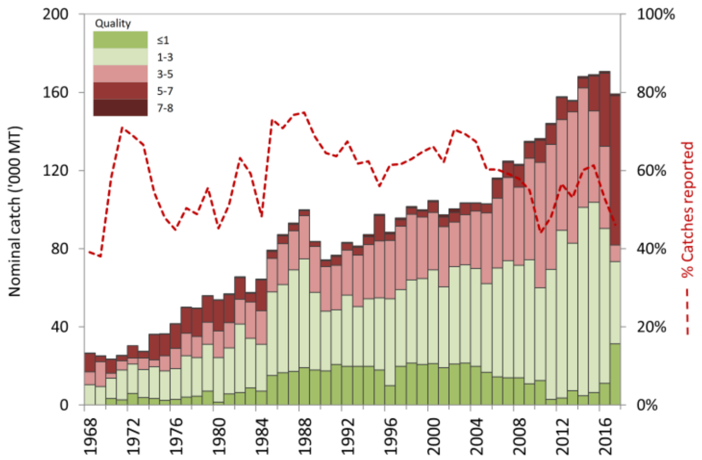


Fig. A19. Annual nominal catches (MT) of narrow-barred Spanish mackerel estimated by quality score (barplot) and percentage of nominal catch fully/partially reported to the IOTC Secretariat (red dashed line) for all fisheries (1969–2018). Catches are assessed against IOTC reporting standards, where a quality score of 0 indicates catches that are fully reported according to IOTC standards; catches assigned a score of between 2–6 do not report catch data fully by gear and/or species (i.e., partially adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document; catches with a score of 8 refer to fleets that do not report catch data to the IOTC (i.e. estimated by the IOTC Secretariat)

Effort trends

- Availability: Effort trends are unknown for narrow-barred Spanish mackerel in the Indian Ocean, due to a lack of catch-and-effort data.

Catch-per-unit-effort (CPUE) trends

- Availability: Highly incomplete data, available only for selected years and/or fisheries (**Fig. A20**).
- Main CPUE series available (i.e., over 10 years or more): Sri Lanka (gillnets) – however the catches and effort are not available for years between 2005 and 2013 and in recent years are thought to be unreliable due to the dramatic changes in CPUE recorded in 2015 and 2016.

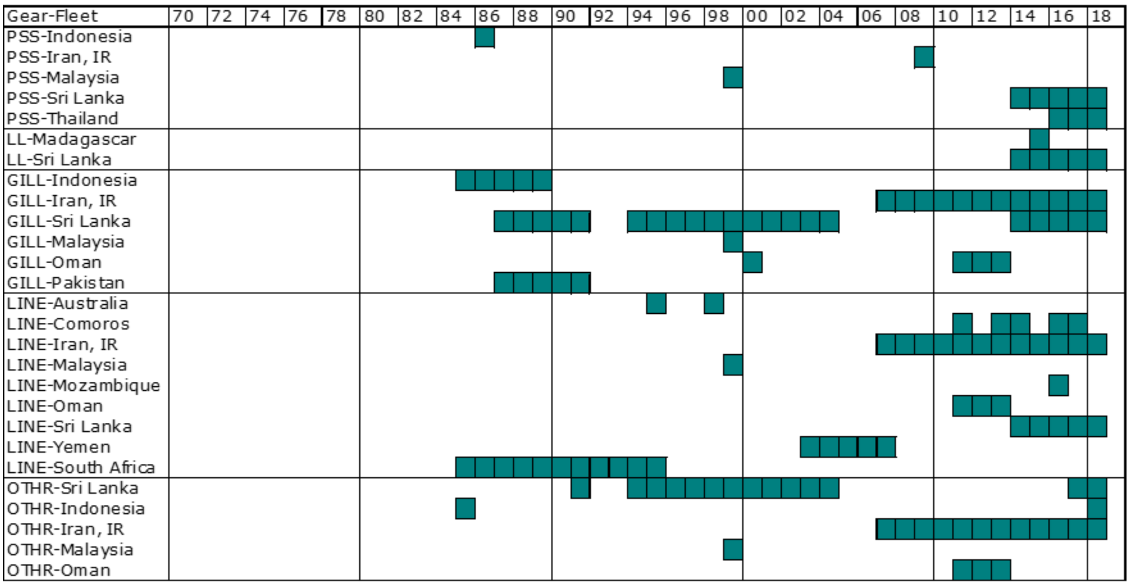


Fig. A20. Availability of narrow-barred Spanish mackerel catch-and-effort series, by fishery and year (1970-2018). No catches and effort are available at all for 1950–69. Note that the above list is not exhaustive, showing only the fisheries for which catches and effort are available in the IOTC database. Furthermore, catches and effort - even when available - may not cover the entire year and be limited to just a few months

Fish size or age trends (e.g., by length, weight, sex and/or maturity)

- Sizes: The sizes of narrow-barred Spanish mackerel taken by the Indian Ocean fisheries typically range between 30 and 140 cm depending on the type of gear used, season and location – with 32–119 cm fish taken in the Eastern Peninsular Malaysia area, 17–139 cm fish taken in the East Malaysia area and 50–90 cm fish taken in the Gulf of Thailand. Similarly, narrow-barred Spanish mackerel caught in the Oman Sea are typically larger than those caught in the Persian Gulf.[5]
- Size frequency data: Highly incomplete data, available only for selected years and/or fisheries (**Fig. A21**).

  Total numbers of samples, across all years, are also well below the minimum sampling standard of 1 fish per MT of catch recommended by the IOTC Secretariat to reliably assess changes in average weight.

  Main sources for size samples: Sri Lanka (gillnet) (from late-1980s until early-1990s), and I.R. Iran (gillnet) (from the late-2000s).
- Catch-at-Size (Age) table: Not available, due to lack of size samples and uncertainty over the reliability of retained catch estimates.
- Sex ratio data: Have not been provided to the Secretariat by CPCs.

[5] The IOTC Secretariat did not find any data in support of this statement.

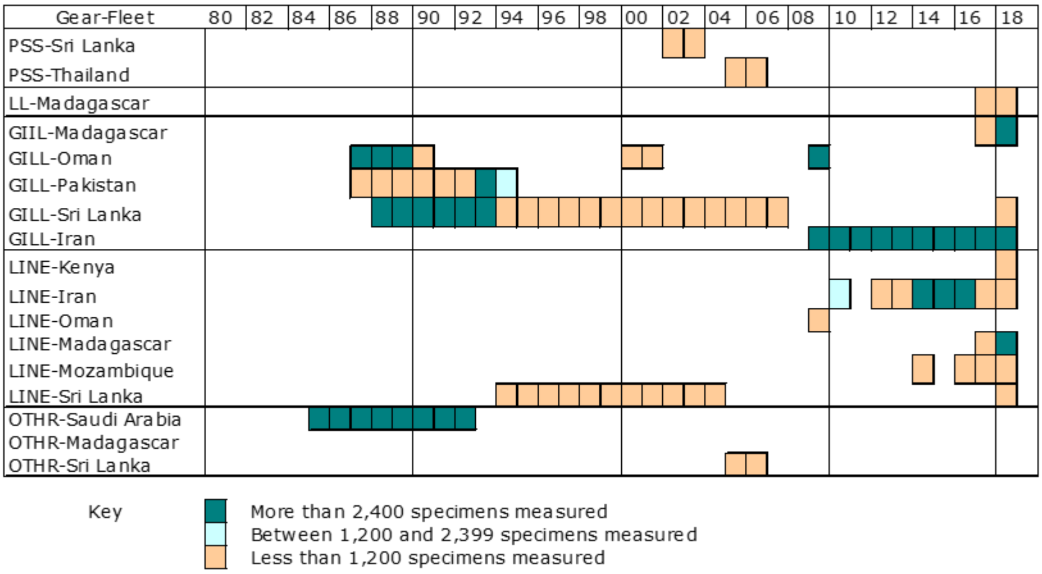


Fig. A21. Availability of narrow-barred Spanish mackerel size frequency data, by fishery and year (1980–2018). No size frequency data are available for 1950–83. Note that the above list is not exhaustive, showing only the fisheries for which size data are available in the IOTC database. Furthermore, size data - even when available - may not cover the entire year and be existing only for short periods

Other biological data: The length-weight equation available for narrow-barred Spanish mackerel is shown below:

Species	From type measurement – To type measurement	Equation	Parameters	Length
Narrow-barred Spanish mackerel	Fork length (cm) – Round Weight (kg)	RND=a*L^b	a= 0.00001176 b= 2.9002	Min: 20 cm Max: 200 cm

Source: Data from North Indian Ocean: IPTP Sampling Programme in Sri Lanka (1989).

APPENDIX V

MAIN ISSUES IDENTIFIED RELATING TO THE STATISTICS OF NERITIC TUNAS

Extract from IOTC–2020–WPNT10–07

Data type(s)	Fisheries	Issue	Progress
Nominal catch, catch-and-effort, size data	Coastal fisheries of Madagascar, Myanmar, and Yemen	Non-reporting countries Catches of neritic tunas for these fisheries have been entirely estimated by the IOTC Secretariat in recent years – however the quality of estimates is thought to be poor due to a lack of reliable information on the fisheries operating in these countries.	• Madagascar: A new sampling programme is in place in Madagascar since 2017. The country submitted nominal catch, catch and effort and size data for the years 2017 and 2018. However, the sampling level is very low and the data does not cover all fishing regions: for this reason, the information is still pending incorporation in the IOTC database as it cannot be adequately raised by the Secretariat. • Myanmar (non-reporting, non-IOTC member): no update. Catches in the IOTC database are based on estimates published by SEAFDEC and FAO FishStat (various years). • Yemen: Catches are estimated based on information provided by FAO FishStat. In 2018 there were revisions to the catch series for Yemen, which affects some species more than others (e.g., narrow-barred Spanish mackerel). Before incorporating revisions to the data for all species, the IOTC Secretariat is currently seeking clarification on the rationale for the scale of the revisions.
Nominal catch, catch-and-effort, size data	Coastal fisheries of India, Indonesia, Kenya, Malaysia, Mozambique; Oman, Tanzania, and Thailand	Partially-reported data These fisheries do not fully report catches of neritic tunas by species and/or gear, as per the reporting standards of IOTC Res.15/02. For example: • Nominal catches may have been partially allocated by gear and species by the IOTC Secretariat, where necessary. • Catch and-effort and size data may also be missing, or not fully reported to Res.15/02 standards.	• India: Catch-and-effort and size data for coastal fisheries have not been reported at all or are not reported according to standards. • Indonesia: Catch-and-effort, and size data, reported for coastal fisheries – albeit for a very small number of landing sites (i.e., less than 10) covered by the IOTC-OFCF pilot sampling project. In 2019 (2018 as reference data) catch-and-effort from logbooks was reported for the first time by Indonesia for several semi-industrial and coastal fisheries (coastal purse seiners, gillnetters, handline, troll-line and liftnet vessels) although with a coverage of 5% or less. • Kenya: Kenya has recently undertaken a Catch Assessment Survey to improve catch estimates for artisanal fisheries and is currently in the process of finalizing the estimates, with support from the IOTC Secretariat, prior to submission of the revised data to IOTC. • Mozambique: An IOTC Data Compliance mission was conducted by the IOTC Secretariat in June 2014 to assess current levels of reporting and the status of fisheries data collection. Following the mission, Mozambique reported catch and effort data; however, there are still issues on the classification of the different fleets. Size frequency data was also reported by species, for sport and recreational fisheries. Request for clarifications on several issues related to recent data submissions was sent to Mozambique and the IOTC Secretariat is still awaiting feedback • Oman: no update. No size data submitted, although it is understood that data has been collected. Biological information for some neritic species is known to have been collected in the past by national research institutions and could potentially be shared with the IOTC Secretariat.

			• Sri Lanka: while catch-and-effort are submitted as offshore and within the EEZ, it is unclear whether catches within the EEZ refer to the semi-industrial/industrial fisheries • Tanzania: a data compliance mission was conducted in February 2016, to try and address several outstanding issues and issue recommendations to improve levels of compliance. Catch data (aggregated by species) are based on data from the National Report submitted to SC and also appear to be underreported for some years (i.e., excluding catches from Zanzibar). Another follow-up data compliance mission was conducted in 2019 with the following findings: Tanzania is in the process of implementing a new data collection system using mobile phones, that needs to be extended to incorporate all species under IOTC mandate as well as all the requirements from IOTC Resolution 15/02. Harmonization of data between mainland Tanzania and Zanzibar is still an internal issue as of today.
	Coastal fisheries of Indonesia, Malaysia, and Thailand	Reliability of catch estimates A number of issues have been identified for the following fisheries, which compromise the quality of the data in the IOTC database.	• Indonesia (nominal catch): catch estimates for neritic tunas are considered highly uncertain due to issues of species misidentification and aggregation of juvenile neritic and tropical tunas species reported as commercial category *tongkol*. Between 2014-2017 the IOTC Secretariat supported a pilot sampling project of artisanal fisheries in North and West Sumatra to improve estimates of neritic tunas and juvenile tuna species in particular. • Malaysia (catch-and-effort): no update. Issues regarding the reliability of catch-and-effort reported in recent years have been raised by the IOTC Secretariat and, to date, remain unresolved (e.g., large fluctuations in the nominal CPUE, and inconsistencies between different units of effort recorded in recent years). The catch-and-effort data is still pending upload to the IOTC database until inconsistencies in the data have been resolved: among other things, Malaysia reported difficulties in assigning efforts to specify fishing regions / grids according to the requirements of Resolution 15/02, to the point that data is often georeferenced generically as belonging to the Eastern Indian Ocean region. • Thailand (catch-and-effort): no update. Catch-and-effort shows large increases for longtail in recent years despite a decrease in effort: clarification has been requested from Thailand by the IOTC Secretariat, but no response has been received yet. The catch-and-effort data remain pending upload to the IOTC database until the inconsistencies with the level of fishing effort have been resolved.
Catch and effort, size data	(Offshore) Surface and longline fisheries: I.R. Iran and Pakistan	Non-reporting or partially-reported data A substantial component of these fisheries is thought to operate in offshore waters, including waters beyond the EEZs of the flag countries concerned: although the fleets have reported total catches of neritic tunas, they have not reported catch-and-effort data as per the reporting standards of IOTC Res.15/02.	• I.R. Iran – drifting gillnets (coastal / offshore): Following an IOTC Data Compliance mission in November 2017, I.R. Iran started submitting catch-and-effort data in accordance with the reporting requirements of Resolution 15/02 leading to substantial improvements in the data available for the Iranian fisheries in the IOTC database also for what concerns the newly developed coastal-longliners fleet. • Pakistan – drifting gillnets: Update: Since 2018 Pakistan began reporting size data for some neritic tuna species (e.g., frigate tuna and kawakawa). However, no catch-and-effort has been reported to date, due to deficiencies in port sampling and absence of logbooks on-board vessels. WWF-Pakistan has been a coordinating a crew-based data collection programme for over four years, which includes information on total enumeration of catches and fishing location (for sampled vessels) that could potentially be used to estimate catch-and-effort for Pakistan gillnet

			vessels in the absence of a national logbook program for its gillnet fleet. The information collected through this programme has been used to re-estimate the total catches of several species from 1987 onwards, and the IOTC Secretariat is currently liaising with WWF-Pakistan to evaluate the quality of the fine-grained data collected by the programme to determine whether it could be effectively used to officially provide C-E data according to Resolution 15/02.
Nominal catch, catch-and-effort, size data	All industrial purse seine fisheries	The total catches of frigate tuna, bullet tuna and kawakawa reported for industrial purse seine fleets are considered to be very incomplete, as they do not account for all catches retained onboard or include amounts of neritic tunas discarded. The same applies to catch-and-effort data.	There is a general lack of information on retained catches, catch-and-effort, and size data for neritic tunas retained by all purse seine fleets – in particular frigate tuna, bullet tuna, and kawakawa. Discard levels of neritic tunas by purse seiners are also only available for the EU purse seine fisheries during 2003-07. Update: reporting coverage of the Regional Observer Scheme is increasing and this might trigger an improvement in the estimates of catches for neritic species (both retained and discarded). In 2019 (with 2018 as reference year) Indonesia started reporting nominal catches as well as catch-and-effort data for a new industrial purse seine component of their fleet that seems to explicitly target neritic tunas (leading to remarkable increases in catches of bullet tuna reported for the year). Considering the relatively small dimensions (on average) of the Indonesian purse seine vessels listed in the IOTC Record of Authorised Vessels, it is still questionable whether this component of the fleet (as well as its associated catches) shall be properly considered as 'industrial' purse seiners rather than small, coastal ones; in any case, further clarification is required to properly attribute these catches to the originating fishery and determine the correctness of the reported estimates.
Discards	All fisheries	Although discard levels of neritic species are believed to be low for most fisheries, with the exception of industrial purse seiners, very little information is available on the level of discards.	The total amount of neritic tunas discarded at sea remains unknown for most fisheries and time periods, other than EU purse seine fisheries during 2003–07. Update: No update, although as reporting coverage of the Regional Observer Scheme improves, there is the potential for an improvement in the estimates of catches of neritic species (retained and discarded).
Biological data	All fisheries	There is a general lack of biological data for neritic tuna species in the Indian Ocean, in particular basic data that can be used to establish length-weight-age keys, non-standard measurements-fork length keys and processed weight-live weight keys.	Collection of biological information, including size data, remains very low for most neritic species. Update: The IOTC has been coordinating a Stock Structure Project, which commenced in 2016 and was completed in 2020. The project aimed to supplement gaps in the existing knowledge on biological data and provide an insight on whether neritic tuna and tuna like species should be considered as a single Indian Ocean stock. The draft report has been submitted to the IOTC Secretariat and is currently pending review: it will be shared with the scientific community before the end of the year.

APPENDIX VI

WORKING PARTY ON NERITIC TUNAS PROGRAM OF WORK (2021–2025)

The following is the Draft WPNT Program of Work (2021 to 2025) and is based on the specific requests of the Commission and Scientific Committee as well as topics identified during the WPNT10. The Program of Work consists of the following, noting that a timeline for implementation would be developed by the SC once it has agreed to the priority projects across all of its Working Parties:

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

In selecting the priority projects, the SC is **REQUESTED** to take into consideration the data poor nature of the neritic tuna species and the potentially already fully exploited status of the species. Improved length frequency as well as improved abundance time series would improve stock assessments for these stocks so is a high priority.

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**				
		2021	**2022**	**2023**	**2024**	**2025**
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					
	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. • 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) 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)					

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.					
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.					

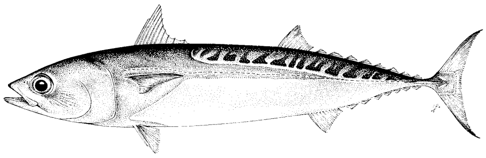
Table 2. Assessment schedule for the IOTC Working Party on Neritic Tunas 2021–2025

Working Party on Neritic Tunas					
Species	**2021***	**2022****	**2023***	**2024****	**2025***
Bullet tuna	**Assessment**	Data preparation	Data preparation	**Assessment**	Data preparation
Frigate tuna	**Assessment**	Data preparation	Data preparation	**Assessment**	Data preparation
Indo-Pacific king mackerel	**Assessment**	Data preparation	Data preparation	**Assessment**	Data preparation
Kawakawa	Data preparation	Data preparation	**Assessment**	Data preparation	Data preparation
Longtail tuna	Data preparation	Data preparation	**Assessment**	Data preparation	Data preparation
Narrow-barred Spanish mackerel	Data preparation	Data preparation	**Assessment**	Data preparation	Data preparation

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

APPENDIX VII
EXECUTIVE SUMMARY: BULLET TUNA

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



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

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

Area[1]	**Indicators**		**2020 stock status determination**
Indian Ocean	Catch 2018[2]:	31,052 t	
	Average catch 2014–2018:	15,913 t	
	MSY (1,000 t) (80% CI):	unknown	
	F_{MSY} (80% CI):	unknown	
	B_{MSY} (1,000 t) (80% CI):	unknown	
	$F_{current}/F_{MSY}$ (80% CI):	unknown	
	$B_{current}/B_{MSY}$ (80% CI):	unknown	
	$B_{current}/B_0$ (80% CI):	unknown	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2] Proportion of catch estimated or partially estimated by IOTC Secretariat in 2019: 10%
Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.

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

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

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

Outlook. Until recently annual catches for bullet tuna have fluctuated but remained around 9,000 t. However, catches in 2018 increased from around 16,000 t to 31,000 t – mostly due to an increase in catches reported by Indonesia purse seine fisheries) (Fig.1). There is insufficient information to evaluate the effect that these levels of catches, or an increase in catches, may have on the resource. Research emphasis should be focused on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.).

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

The following should be also noted:

- The Maximum Sustainable Yield estimate for the Indian Ocean stock is unknown.
- Limit reference points: The Commission has not adopted limit reference points for any of the neritic tunas under its mandate.
- Further work is needed to improve the reliability of the catch series. Reported catches should be verified or estimated, based on expert knowledge of the history of the various fisheries or through statistical extrapolation methods.
- Research emphasis should be focused on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.).
- Species identification, data collection and reporting urgently need to be improved.
- There is limited information submitted by CPCs on total catches, catch and effort and size data for neritic tunas, despite their mandatory reporting status. In the case of 2019 catches (reference year 2018), 10% of the total catches were either fully or partially estimated by the IOTC Secretariat, which increases the uncertainty of the stock assessments using these data. Therefore the management advice to the Commission includes the need for CPCs to comply with IOTC data requirements per Resolution 15/01 and 15/02.
- **Main fishing gear (average catches 2014-18)**: bullet tuna is mainly caught using coastal purse seine (41%), handlines and trolling (≈30%), and gillnets (≈19%) (Fig. 1).
- **Main fleets (average catches 2014-18)**: Catches are highly concentrated: in recent years over 90% of catches in the Indian Ocean have been accounted for by fisheries in India, Indonesia and Sri Lanka,

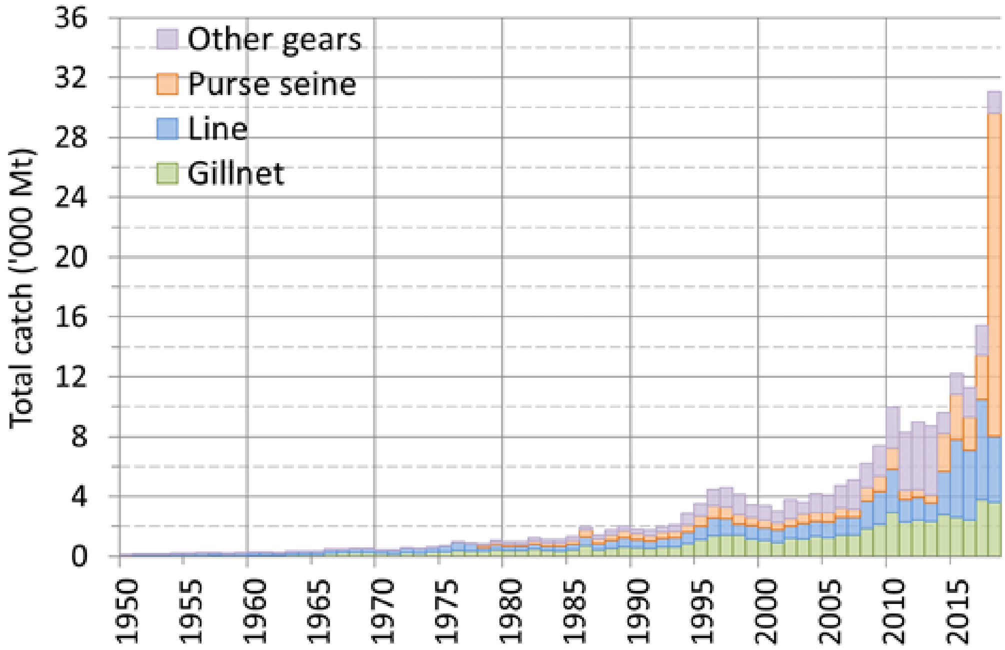
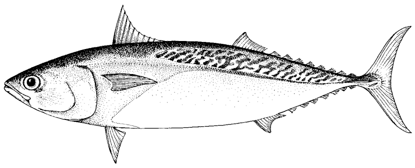


Fig. 1. Annual catches of Bullet tuna by gear as recorded in the IOTC Database (1950–2018)[6].

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

APPENDIX VIII
EXECUTIVE SUMMARY: FRIGATE TUNA

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



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

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

Area[1]	Indicators		2020 stock status determination
Indian Ocean	Catch 2018[2]:	92,725 t	
	Average catch 2014–2018:	99,340 t	
	MSY (1,000 t) (80% CI):	unknown	
	F_{MSY} (80% CI):	unknown	
	B_{MSY} (1,000 t) (80% CI):	unknown	
	$F_{current}/F_{MSY}$ (80% CI):	unknown	
	$B_{current}/B_{MSY}$ (80% CI):	unknown	
	$B_{current}/B_0$ (80% CI):	unknown	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2] Proportion of catch estimated or partially estimated by IOTC Secretariat in 2019: 65%
Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.

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

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

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

Outlook. Estimated catches have increased steadily since the late-1970's, reaching around 30,000 t in the late-1980's, to between 51,000 and 58,000 t by the mid-1990's, 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 92,000 – 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 (94,921 t). The reference period (2009-2011) was chosen based on the most recent assessments of those neritic species in the Indian Ocean for which an assessment is available under the assumption that also for bullet tuna MSY was reached between 2009 and 2011. This catch advice should be maintained until an assessment of frigate tuna is available. Considering that MSY-based reference points for assessed species can change over time, the stock should be closely monitored. Mechanisms need to be developed by the Commission to improve current statistics by encouraging CPCs to comply with their recording and reporting requirements, so as to better inform scientific advice.

The following should be also noted:

- The Maximum Sustainable Yield estimate for the Indian Ocean stock is unknown.
- Limit reference points: The Commission has not adopted limit reference points for any of the neritic tunas under its mandate.
- Further work is needed to improve the reliability of the catch series, such as verification or estimation based on expert knowledge of the history of the various fisheries or through statistical extrapolation methods.
- Research emphasis should be focused on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.).
- Species identification, data collection and reporting urgently need to be improved.
- There is limited information submitted by CPCs on total catches, catch and effort and size data for neritic tunas, despite their mandatory reporting status. In the case of 2019 catches (reference year 2018), 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 fishing gear (average catches 2014-18)**: frigate tuna is mainly caught using gillnets (≈41%), coastal longline and trolling, handlines and trolling (≈33%), and to a lesser extent coastal purse seine nets (Table 3). The species is also a bycatch for industrial purse seine vessels and the target of some ring net fisheries.
- **Main fleets (average catches 2014–18)**: Catches of frigate tuna are highly concentrated: Indonesia accounts for around two-thirds of catches, while over 90% of catches are accounted for by four countries (Indonesia, Pakistan, I.R. Iran and India).

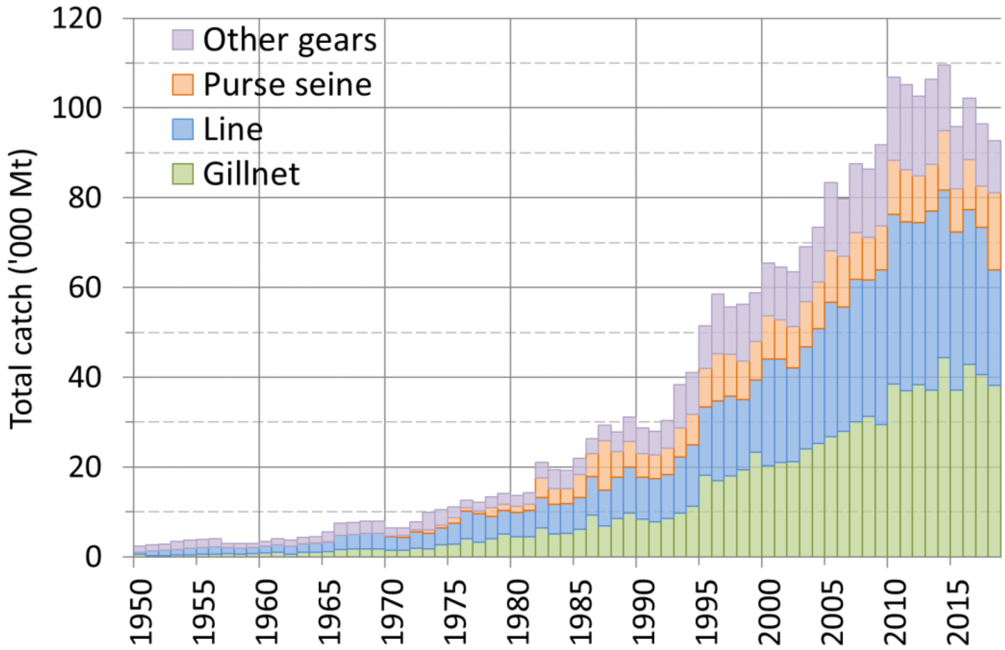
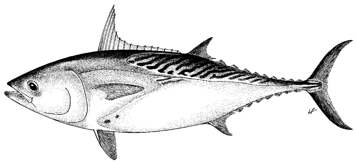


Fig.1. Annual catches of frigate tuna by gear as recorded in the IOTC Database (1950–2018)[7].

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

APPENDIX IX
EXECUTIVE SUMMARY: KAWAKAWA

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



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

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

Area[1]	Indicators		2020 stock status determination
Indian Ocean	Catch 2018[2]: Average catch 2014-2018:	164,133 t 152,919 t	50%
	MSY (95% C.I.) [*] F_{MSY} (95% C.I.) [*] B_{MSY} (95% C.I.) [*] $F_{current}/F_{MSY}$ (95% C.I.) [*] $B_{current}/B_{MSY}$ (95% C.I.) [*]	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 catch estimated or partially estimated by IOTC Secretariat in 2019: 33%
Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.
*Range of plausible values of biologically realistic OCOM model realizations (see IOTC-2020-WPNT10-R)

Colour key	Stock overfished(SB_{year}/SB_{MSY}< 1)	Stock not overfished (SB_{year}/SB_{MSY}≥ 1)
Stock subject to overfishing(F_{year}/F_{MSY}> 1)	35%	15%
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)	0%	50%
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. A new stock assessment was carried out in 2020 using data-limited assessment techniques. The OCOM model indicated that F was just FMSY (F/FMSY=0.98) and B above BMSY (B/BMSY=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 – despite the decrease in catches from their peak in 2013. Based on the weight-of-evidence available, the kawakawa stock for the Indian Ocean is classified as **not overfished** and **not subject to overfishing** (Table 1, Fig. 2).

Outlook. There is considerable uncertainty about stock structure and the estimate of total catches. Due to the uncertainty associated with catch data (e.g., 33% of catches partially or fully estimated by the IOTC Secretariat in 2018) and the limited number of CPUE series available for fleets representing a small proportion of total catches, only data poor assessment approaches can currently be used. Aspects of the fisheries for this species, combined with the lack of data on which to base a more complex assessment (e.g. integrated models) are a cause for considerable concern. In the interim, until more traditional approaches are developed, data-poor approaches will be used to assess stock status. Continued increase in the annual catches for kawakawa is also likely to further increase the pressure on the Indian Ocean stock. Research emphasis should be focused on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.). However, it should be noted that catches have since declined from 168,174 t (2013) to 159,121 t (2017)

Management Advice. However, the assessment models rely on catch data, which is considered to be highly uncertain. The catch in 2018 was above 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 33% of the catches (in 2019, with reference year 2018), which increases the uncertainty of the stock assessments using these data. Therefore the management advice to the Commission includes the need for CPCs to comply with IOTC data requirements per Resolution 15/01 and 15/02.
- **Main fishing gear (average catches 2014–18)**: Kawakawa are caught mainly by gillnets (≈50%), purse seiners (including coastal ones, ≈29%) and handlines and trolling (≈16%). The species represents an important bycatch of the industrial purse seine fishery (Fig. 1).
- **Main fleets (average catches 2014–18)**: Catches are highly concentrated: Indonesia, India, and I.R. Iran account for ≈75% of catches in recent years.

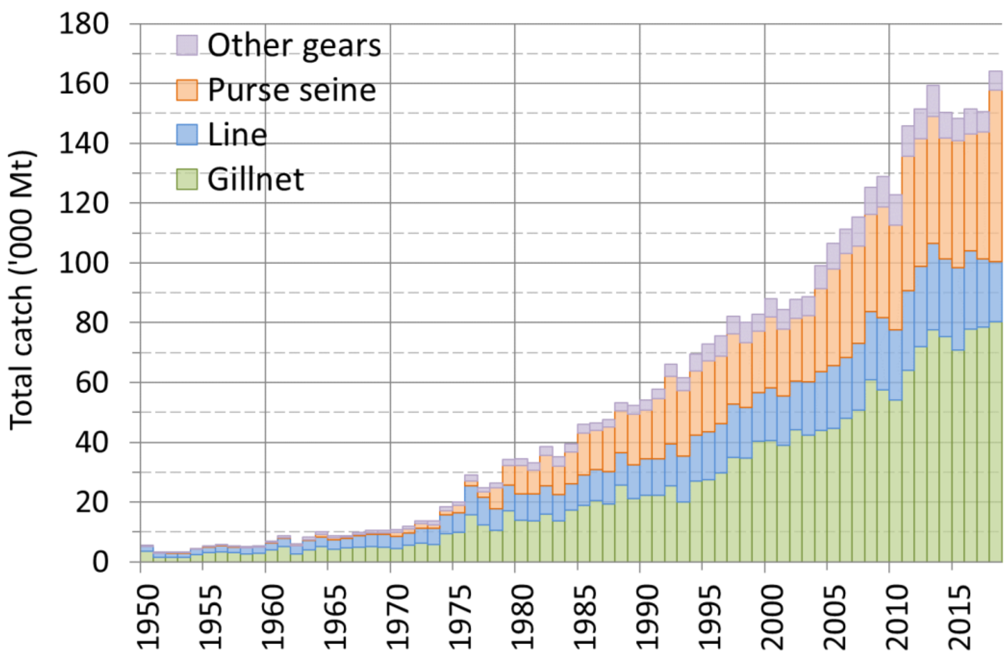


Fig.1. Annual catches of Kawakawa by gear as recorded in the IOTC database (1950–2018)[8].

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

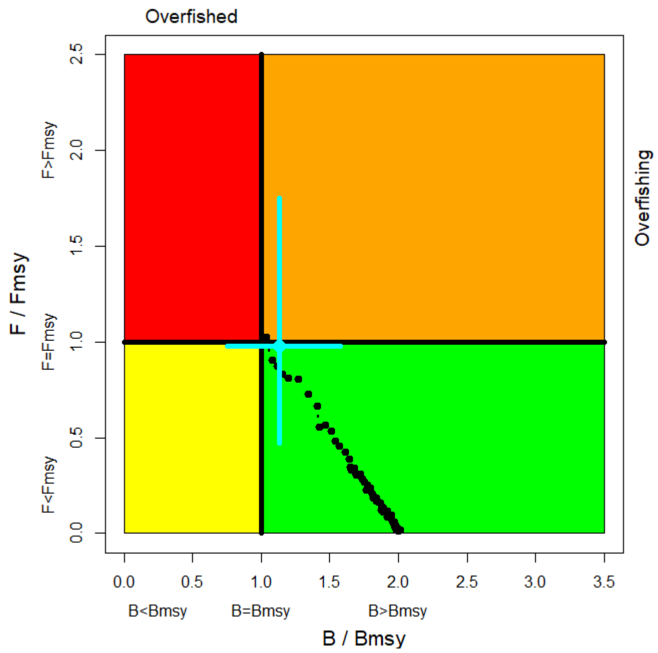
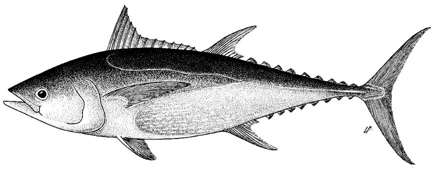


Fig.2. OCOM Indian Ocean assessment Kobe plot for kawakawa. The Kobe plot presents the trajectories for the range of plausible model options included in the formulation of the final management advice. The trajectory of the geometric mean of the plausible model options is also presented.

APPENDIX X
EXECUTIVE SUMMARY: LONGTAIL TUNA

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



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

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

Area[1]	Indicators		2020 stock status determination
Indian Ocean	Catch 2018[2]: Average catch 2014–2018:	135,282 t 141,996 t	**76%**
	MSY (95% C.I.) (*): F_{MSY} (95% C.I.) (*): B_{MSY} (95% C.I.) (*): $F_{current}/F_{MSY}$ (95% C.I.) (*): $B_{current}/B_{MSY}$ (95% C.I.) (*):	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 catches estimated or partially estimated by IOTC Secretariat in 2019: 28%
Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.
* Range of plausible values of biologically realistic OCOM model realizations (IOTC-2020-WPNT10-R)

Colour key	Stock overfished(SB_{year}/SB_{MSY}< 1)	Stock not overfished (SB_{year}/SB_{MSY}≥ 1)
Stock subject to overfishing(F_{year}/F_{MSY}> 1)	76%	2%
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)	2%	20%
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. Analysis using the Optimised Catch-Only Method (OCOM) indicates that the stock is being exploited at a rate that exceeded F_{MSY} in recent years and that the stock appears to be below B_{MSY} and above F_{MSY} (76% of plausible models runs) (Fig. 2). Catches were above MSY between 2010 and 2014, however since 2015 catches have marginally decreased (Fig. 1) and were below estimated MSY in 2018. The F_{2018}/F_{MSY} ratio is slightly higher than previous estimates. The estimate of the B_{2018}/B_{MSY} ratio (0.94) was slightly 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 stock structure and the total catches of longtail tuna in the Indian Ocean. The increase in annual catches to a peak in 2012 increased the pressure on the longtail tuna Indian Ocean stock, although the catch trend has reversed since then. As noted in 2015, the apparent fidelity of longtail tuna to particular areas/regions is a matter for concern as overfishing in these areas can lead to localised depletion. Research emphasis should be focused on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.).

Management advice. The catch in 2018 was just 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 146,000 t was exceeded between 2011 and 2014. Limits to catches are warranted to recover the stock to the B_{MSY} level.
- Limit reference points: The Commission has not adopted limit reference points for any of the neritic tunas under its mandate.
- Further work is needed to improve the reliability of the catch series. Reported catches should be verified or estimated, based on expert knowledge of the history of the various fisheries or through statistical extrapolation methods.
- Improvements in data collection and reporting are required if the stock is to be assessed using integrated stock assessment models.
- Research emphasis should be focused on collating catch per unit effort (CPUE) time series for the main fleets (I.R. Iran, Indonesia, Pakistan, 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 2019 catches (reference year 2018) 28% of the total catches were either fully or partially estimated by the IOTC Secretariat, which increases the uncertainty of the stock assessments using these data. Therefore the management advice to the Commission includes the need for CPCs to comply with IOTC data requirements per Resolution 15/01 and 15/02.
- **Main fishing gear (average catches 2014–18)**: Longtail tuna are caught mainly using gillnets (≈74% of catches) and, to a lesser extent, coastal purse seine nets and trolling (Fig. 1).
- **Main fleets (average catches 2014–18)**: 43% of the catches of longtail in the Indian Ocean are accounted for by I.R. Iran, followed by Indonesia (≈17%), Pakistan (≈13%) and Oman (≈11%).

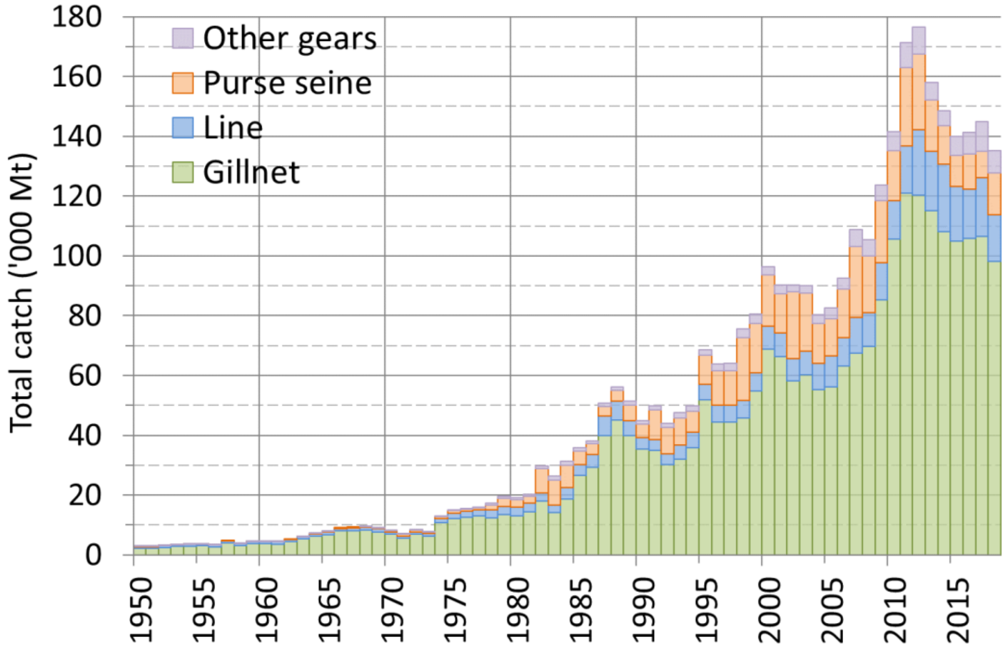


Fig. 1. Annual catches of Longtail tuna by gear as recorded in the IOTC Database (1950–2018)[9].

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

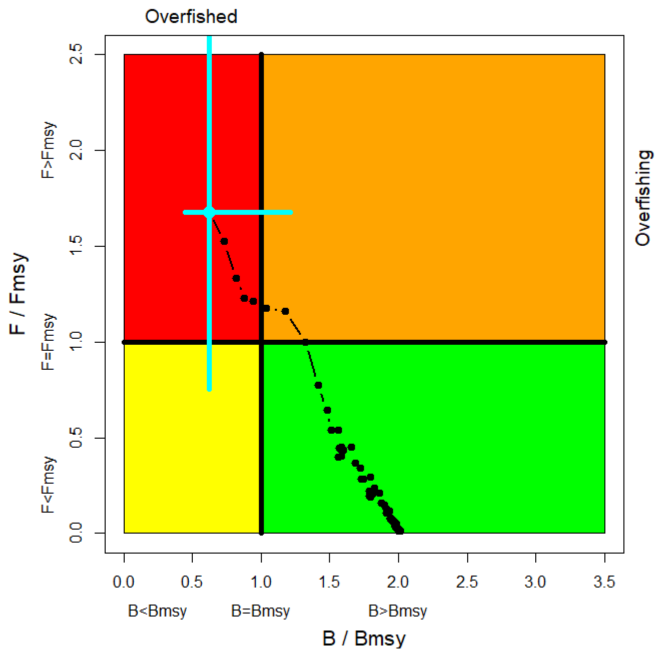
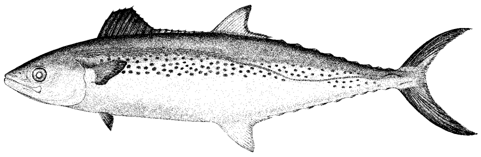


Fig. 2. Longtail tuna OCOM Indian Ocean assessment Kobe plot. The Kobe plot presents the trajectories for the range of plausible model options included in the formulation of the final management advice. The trajectory of the geometric mean of the plausible model options is also presented.

APPENDIX XI
EXECUTIVE SUMMARY: INDO-PACIFIC KING MACKEREL

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



Status of the Indian Ocean Indo-Pacific king mackerel (GUT: *Scomberomorus guttatus*) resource

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

Area[1]	**Indicators**		**2020 stock status determination**
Indian Ocean	Catch 2018[2]: Average catch 2014-2018:	43,468 t 45,943 t	
	MSY (1,000 t): F_{MSY}: B_{MSY} (1,000 t) : $F_{current}/F_{MSY}$: $B_{current}/B_{MSY}$: $B_{current}/B_0$:	Unknown Unknown Unknown Unknown Unknown Unknown	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2] Proportion of catch estimated or partially estimated by IOTC Secretariat in 2019: 34%
Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.

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

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. A preliminary assessment was undertaken in 2016 for Indo-Pacific king mackerel using catch-only methods techniques (Catch-MSY and OCOM). The OCOM model, which was considered the more robust of the two catch-only models in terms of assumptions and treatment of priors, indicated that overfishing was not occurring and the stock was not overfished. The continuing uncertainty in catches (37% estimated) for this species, combined with the highly variable and uncertain estimates of growth parameters used to estimate model priors, warrant caution in interpreting the model results for Indo-Pacific king mackerel. Given that no new assessment was undertaken in 2020, the WPNT considered that stock status in relation to the Commission's B_{MSY} and F_{MSY} target reference points remains **unknown** (Table 1).

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 yet to be used to provide stock status advice, further refinements to the catch-only methods and application of additional data-poor approaches may improve confidence in the results. Research emphasis should be focused on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.).

Management advice. For assessed species of neritic tunas in Indian Ocean (longtail tuna, kawakawa and narrow barred Spanish mackerel), the MSY was estimated to have been reached between 2009 and 2011 and both F_{MSY} and B_{MSY} were breached thereafter. Therefore, in the absence of a stock assessment of Indo-Pacific king mackerel a limit to the catches should be considered by the Commission, by ensuring that future catches do not exceed the average catches between 2009 and 2011 estimated at the time of the assessment (46,787 t). The reference period (2009-2011) was chosen based on the most recent assessments of those neritic species in the Indian Ocean for which an assessment is available under the assumption that also for Indo-Pacific king mackerel MSY was reached between 2009 and 2011. This catch advice should be maintained until an assessment of Indo-Pacific king mackerel is available. This catch advice should be maintained until an assessment of Indo-Pacific king mackerel is available. Considering that MSY-based reference points for assessed species can change over time, the stock should be closely monitored. Mechanisms need to be developed by the Commission to improve current statistics by encouraging CPCs to comply with their recording and reporting requirements, so as to better inform scientific advice.

The following should be also noted:

- Limit reference points: The Commission has not adopted limit reference points for any of the neritic tunas under its mandate.
- Research emphasis should be focused on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.).
- Further work is needed to improve the reliability of the catch series. Reported catches should be verified or estimated, based on expert knowledge of the history of the various fisheries or through statistical extrapolation methods.
- Data collection and reporting urgently needed to be improved, given the limited information submitted by CPCs on total catches, catch and effort and size data for neritic tunas, despite their mandatory reporting status. In the case of 2019 catches (reference year 2018) 34% of the total catches were either fully or partially estimated by the IOTC Secretariat, which increases the uncertainty of the stock assessments using these data. Therefore the management advice to the Commission includes the need for CPCs to comply with IOTC data requirements per Resolution 15/01 and 15/02.
- **Main fishing gear (average catches 2014-18)**: Indo-Pacific King mackerel are caught mainly by gillnets (≈66%), however significant numbers are also caught trolling (Fig. 1).
- **Main fleets (average catches 2014–18)**: Almost two-thirds of catches are accounted for by fisheries in India and Indonesia; with important catches also reported by I.R. Iran.

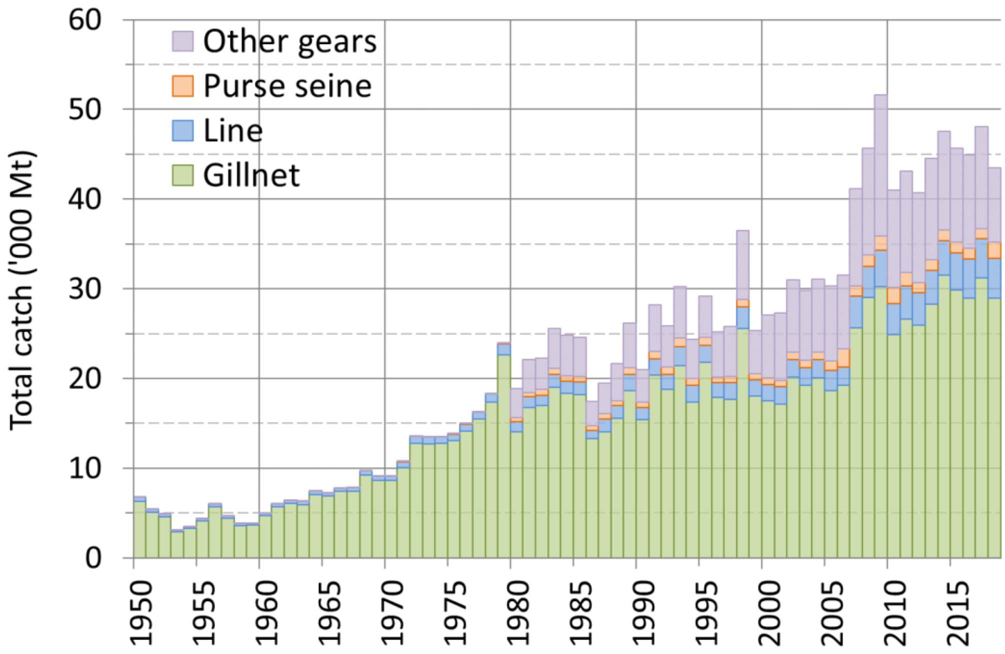
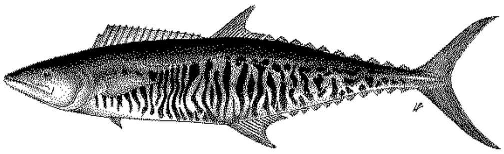


Fig. 1. Annual catches of Indo-Pacific king mackerel by gear as recorded in the IOTC database (1950–2018)[10].

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

APPENDIX XII
EXECUTIVE SUMMARY: NARROW-BARRED SPANISH MACKEREL

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



Status of the Indian Ocean narrow-barred Spanish mackerel (COM: *Scomberomorus commerson*) resource

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

Area[1]	**Indicators**		**2020 stock status determination**
Indian Ocean	Catch 2018[2]: Average catch 2014-2018:	154,785 t 175,891 t	**73%**
	MSY (95% C.I.) [*]: F_{MSY} (95% C.I.) [*]: B_{MSY} (95% C.I.) [*]: $F_{current}/F_{MSY}$ (95% C.I.) [*]: $B_{current}/B_{MSY}$ (95% C.I.) [*]:	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 catch estimated or partially estimated by IOTC Secretariat in 2019: 55%
Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.
* Range of plausible values of biologically realistic OCOM model realizations (IOTC-2020-WPNT10-R)

Colour key	Stock overfished(SB_{year}/SB_{MSY}< 1)	Stock not overfished (SB_{year}/SB_{MSY}≥ 1)
Stock subject to overfishing(F_{year}/F_{MSY}> 1)	73%	3%
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)	3%	22%
Not assessed/Uncertain		

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Stock status. Analysis using the Optimised Catch-Only Method (OCOM) indicates that the stock is being exploited at a rate exceeding F_{MSY} in recent years, and the stock appears to be below B_{MSY}. An analysis undertaken in 2013 in the Northwest Indian Ocean (Gulf of Oman) indicated that overfishing is occurring in this area and that localised depletion may also be occurring[11], though the degree of connectivity of the stock remains unknown. Stock structure remains to be clarified for this stock. Based on the weight-of-evidence available, the stock appears to be **overfished** and **subject to overfishing** (Table 1, Fig. 2). Catches since 2009 and also recent average catches for 2014-2018 are well above the current MSY estimate of 131,000 t (Fig. 1).

Outlook. There is considerable uncertainty about stock structure and the estimate of total catches. The continued increase in annual catches in recent years has further increased the pressure on the Indian Ocean narrow-barred Spanish mackerel stock. The apparent fidelity of narrow-barred Spanish mackerel to particular areas/regions is a matter for concern as overfishing in these areas can lead to localised depletion. Research emphasis should be focused

[11] IOTC-2013-WPNT03-27

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 2018 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.

The following should also be noted:

- Maximum Sustainable Yield for the Indian Ocean stock was estimated at 157,760 t, with catches for 2018 (154,785 t) not exceeding this level.
- Limit reference points: The Commission has not adopted limit reference points for any of the neritic tunas under its mandate.
- Further work is needed to improve the reliability of the catch series. Reported catches should be verified or estimated, based on expert knowledge of the history of the various fisheries or through statistical extrapolation methods.
- Improvement in data collection and reporting is required if the stock is to be assessed using integrated stock assessment models.
- Given the increase in narrow-barred Spanish mackerel catch in the last decade, measures need to be taken to reduce catches in the Indian Ocean (Table 2).
- Research emphasis should be focused on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.).
- There is a lack of information submitted by CPCs on total catches, catch and effort and size data for neritic tunas, despite their mandatory reporting status. In the case of 2019 catches (reference year 2018) 55% of the total catches were either fully or partially estimated by the IOTC Secretariat, which increases the uncertainty of the stock assessments using these data. Therefore the management advice to the Commission includes the need for CPCs to comply with IOTC data requirements per Resolution 15/01 and 15/02.
- **Main fishing gear (average catches 2014-18)**: Narrow-barred Spanish mackerel are caught mainly using gillnet (≈64%), however significant numbers are also caught using troll lines (Fig. 1).
- **Main fleets (average catches 2014-18)**: Fisheries in Indonesia, India, I.R. Iran and Pakistan account for around two-thirds of catches of Spanish mackerel, while the species is also targeted throughout the Indian Ocean by artisanal and sports / recreational fisheries.

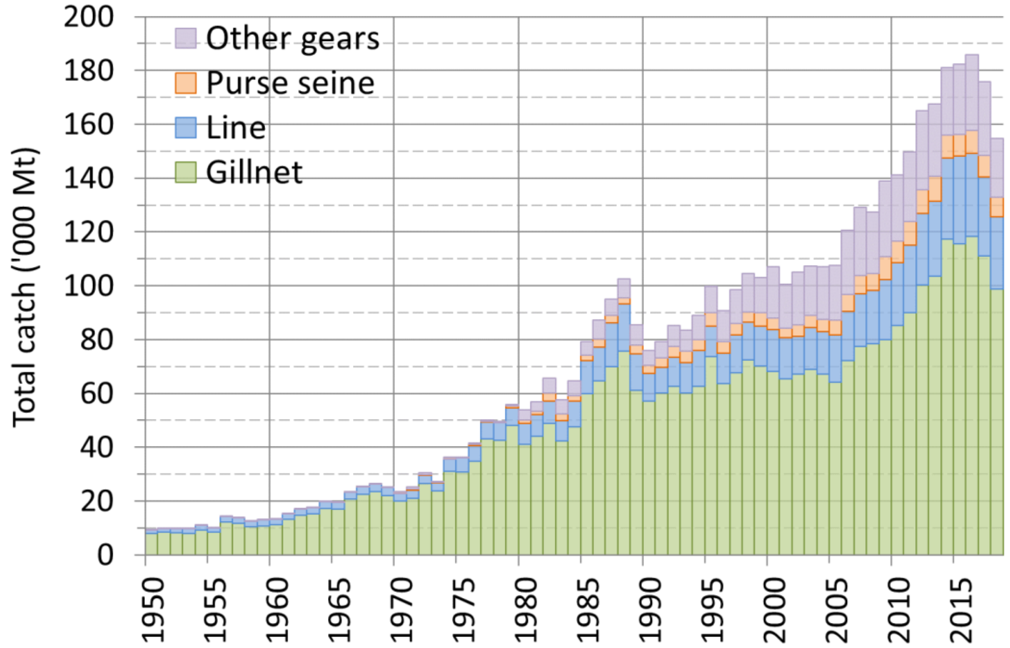

Fig. 1. Annual catches of Narrow-barred Spanish mackerel by gear as recorded in the IOTC database (1950–2018)[12].

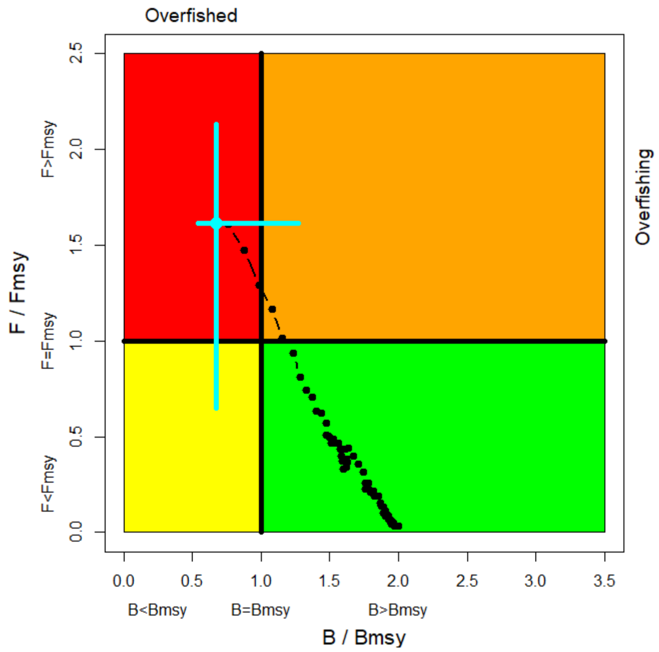

Fig. 2. Narrow-barred Spanish Mackerel OCOM Indian Ocean assessment Kobe plot. The Kobe plot presents the trajectories for the range of plausible model options included in the formulation of the final management advice. The trajectory of the geometric mean of the plausible model options is also presented.

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

APPENDIX XIII

CONSOLIDATED RECOMMENDATIONS OF THE 10TH SESSION OF THE WORKING PARTY ON NERITIC TUNAS

Note: Appendix references refer to the Report of the 10th Session of the Working Party on Neritic Tunas (IOTC–2020–WPNT10–R)

Review of the statistical data available for neritic tunas

WPNT10.01 (para 15) **CONSIDERING** point iii above, the WPNT **RECOMMENDED** that the reconstruction and re-estimation of historical catch series for neritic tuna and tuna-like species, at least for the major fleets known to target these species, be considered as a priority activity for future works of the group..

Revision of the WPNT Program of Work (2021–2025)

WPNT10.02 (para 101) The WPNT **RECOMMENDED** that the SC consider and endorse the WPNT Program of Work (2021–2025), as provided in Appendix VI.

Date and place of the 11th and 12th Working Party on Neritic Tunas

WPNT10.03 (para 103) The WPNT **NOTED** that Kenya had expressed interest in potentially hosting the 10th Session of the WPNT while Sri Lanka and Malaysia had expressed an interest in potentially hosting the 11th Session of the WPNT in 2021. However the global Covid-19 pandemic resulted in these plans being abandoned. The Secretariat will continue to liaise with CPCs to determine their interest in hosting these meetings in the future when this once again becomes feasible. The WPNT **RECOMMENDED** the SC consider early July 2021 as a preferred time period to hold the WPNT11 in 2021.

Meeting participation fund (MPF)

WPNT10.04 (para 104) The WPNT **RECOMMENDED** that the SC and Commission note the following:

1) The participation of developing coastal state scientists to the WPNT has been consistently high following the adoption and implementation of the IOTC Meeting Participation Fund adopted by the Commission in 2010 (Resolution 10/05 *On the establishment of a Meeting Participation Fund for developing IOTC Members and Non-Contracting Cooperating Parties*), now incorporated into the IOTC Rules of Procedure (2014), as well as though the hosting of the WPNT in developing coastal State Contracting Parties (Members) of the Commission (Table 11). The WPNT **NOTED** that as the 2020 meeting was a virtual meeting, no MPF funds were required to facilitate the participation of scientists to the meeting.
2) The continued success of the WPNT, at least in the short term, appears heavily reliant on the provision of support via the MPF which was established primarily for the purposes of supporting scientists to attend and contribute to the work of the Scientific Committee and its Working Parties.
3) The MPF should be utilised so as to ensure that all developing Contracting Parties of the Commission are able to attend the WPNT meeting, as neritic tunas are an important resource for many of the coastal countries of the Indian Ocean.

Review of the draft, and adoption of the Report of the 10th Working Party on Neritic Tunas

WPNT10.05 (para 105) The WPNT **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPNT10, provided at Appendix XIII, as well as the management advice provided in the draft resource stock status summary for each of the six neritic tuna (and mackerel) species under the IOTC mandate, and the combined Kobe plot for the species assigned a stock status in 2020 (Fig. 10):

- Bullet tuna (*Auxis rochei*) – Appendix VII
- Frigate tuna (*Auxis thazard*) – Appendix VIII
- Kawakawa (*Euthynnus affinis*) – Appendix IX
- Longtail tuna (*Thunnus tonggol*) – Appendix X
- Indo-Pacific king mackerel (*Scomberomorus guttatus*) – Appendix XI
- Narrow-barred Spanish mackerel (*Scomberomorus commerson*) – Appendix XII