Report of the 9th Session of the IOTC Working Party on Neritic Tunas

Mahe, Seychelles, 1 – 5 July 2019

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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 9th Session of the Indian Ocean Tuna Commission's (IOTC) Working Party on Neritic Tunas (WPNT09) was held in Mahé, Seychelles from 1-5 July 2019. A total of 18 participants (18 in 2018, 26 in 2017, 20 in 2016) attended the Session. The list of participants is provided at Appendix I. The meeting was opened by the Chairperson, Dr Farhad Kaymaram from I.R. Iran, who welcomed participants to the meeting including the Invited Expert, Dr Shijie Zhou, from CSIRO, Australia and the workshop facilitator Dr Toshihide Kitakado, from Japan.

The following are a subset of the complete recommendations from the WPNT09 to the Scientific Committee which are provided at Appendix XIII.

Data-limited stock assessment: Improving catch-only methods

WPTmT09.01 (para 32) The WPNT **DISCUSSED** the potential diagnostics for catch-only methods and **RECOMMENDED** that the retrospective or hindcasting analysis be incorporated into the modelling as diagnostics tools. These analyses are helpful in revealing whether the catch series is consistent with respect to the stock productivity and if the model results are driven by more recent data.

Review of the statistical data available for neritic tunas: IOTC database

WPTmT09.02 (para 38) The WPNT **RECOMMENDED** the SC to provide strong management advice for neritic species, **NOTING** that that catches of some species have reached their highest levels in the Indian Ocean in recent years, while catch statistics remain uncertain.

Revision of the WPNT Program of Work (2020–2024)

WPTmT09.03 (para 76) The WPNT **RECOMMENDED** that the SC consider and endorse the WPNT Program of Work (2020–2024), as provided in Appendix VI.

Date and place of the 10th and 11th Working Party on Neritic Tunas

WPTmT09.04 (para 79) The WPNT **NOTED** that Kenya expressed interest in potentially hosting the 10th Session of the WPNT and **RECOMMENDED** the SC consider as preferred dates for the first week of July 2020. The WPNT further **NOTED** that Sri Lanka and Malaysia have expressed an interest in potentially hosting the 11th Session of the WPNT in 2021, with dates yet to be agreed.

Meeting participation fund (MPF)

WPTmT09.05 (para 81) 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 8).
2) The continued success of the WPNT, at least in the short term, appears heavily reliant on the provision of support via the MPF which was established primarily for the purposes of supporting scientists to attend and contribute to the work of the Scientific Committee and its Working Parties.
3) The MPF should be utilised so as to ensure that all developing Contracting Parties of the Commission are able to attend the WPNT meeting, as neritic tunas are an important resource for many of the coastal countries of the Indian Ocean.

Review of the draft, and adoption of the Report of the 9th Working Party on Neritic Tunas

WPTmT09.06 (para 87) The WPNT **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPNT09, 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 2019 (Fig. 1):

- 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: 2019

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 627 851 t landed in 2017. 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**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**Advice to the Commission**
Bullet tuna *Auxis rochei*	Catch 2017: 15,864 t Average catch 2013–2017: 11,844 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 2017: 84,684 t Average catch 2013–2017: 95,568 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 bullet tuna MSY was reached between 2009 and 2011. This catch advice should be maintained until an assessment of frigate tuna is available. Considering that MSY-based reference points for assessed species can change over time, the stock should be closely monitored. Mechanisms need to be developed by the Commission to improve current statistics by encouraging CPCs to comply with their recording and reporting requirements, so as to better inform scientific advice. Click here for a full stock status summary: Appendix VIII

Stock	Indicators	Previous	2014	2015	2016	2017	2018	2019	Advice to the Commission
Kawakawa *Euthynnus affinis*	Catch 2017[2]: 159,121 t Average catch 2013-2017 160,756 t MSY (1,000 t) [*] 152 [125 –188] F_{MSY} [*] 0.56 [0.42–0.69] B_{MSY} (1,000 t) [*] 202 [151–315] F_{2013}/F_{MSY} [*] 0.98 [0.85–1.11] B_{2013}/B_{MSY} [*] 1.15 [0.97–1.38] B_{2013}/B_0 [*] 0.58 [0.33–0.86]								Although the stock status is classified as not overfished and not subject to overfishing, the Kobe strategy II matrix developed in 2015 showed that there is a 96% probability that biomass is below MSY levels and 100% probability that $F>F_{MSY}$ by 2016 and 2023 if catches are maintained at the 2013 levels. There is a 55% probability that biomass is below MSY levels and 91% probability that $F>F_{MSY}$ by 2023 if catches are maintained at around 2016 levels. The modelled probabilities of the stock achieving levels consistent with the MSY reference points (e.g. $SB > SB_{MSY}$ and $F<F_{MSY}$) in 2023 are 100% for a future constant catch at 80% of 2013 catch levels. If catches are reduced by 20% based on 2013 catch levels at the time of the assessment (170,181 t)[1], the stock is expected to recover to levels above MSY reference points with a 50% probability by 2023. Click here for a full stock status summary: Appendix IX
Longtail tuna *Thunnus tonggol*	Catch 2017[2]: 139,209 t Average catch 2013–2017: 142,550 t MSY (1,000 t) (*): 140 (103–184) F_{MSY} (*): 0.43 (0.28–0.69) B_{MSY} (1,000 t) (*): 319 (200–623) F_{2015}/F_{MSY} (*): 1.04 (0.84–1.46) B_{2015}/B_{MSY} (*): 0.94 (0.68–1.16) B_{2015}/B_0 (*): 0.48 (0.34–0.59)								There is a substantial risk of exceeding MSY-based reference points by 2018 if catches are maintained at current (2015) levels (63% risk that $B_{2018}<B_{MSY}$, and 55% risk that $F_{2018}>F_{MSY}$) (Table 2). If catches are reduced by 10% this risk is lowered to 33% probability $B_{2018}<B_{MSY}$ and 28% probability $F_{2018}>F_{MSY}$). If catches are capped at current (2015) levels at the time of the assessment (i.e., 136,849 t), the stock is expected to recover to levels above MSY reference points with at least a 50% probability by 2025. Catches have remained below estimated MSY since 2015. Click here for a full stock status summary: Appendix X
Indo-Pacific king mackerel *Scomberomorus guttatus*	Catch 2017[2]: 53,383 t Average catch 2013-2017: 48,611 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 2017[2]: 158,290 t Average catch 2013-2017: 164,490 t MSY (1,000 t) [*]: 131 [96–180]								There is a continued high risk of exceeding MSY-based reference points by 2025, even if catches are reduced to 80% of the 2015 levels (73% risk that $B_{2025}<B_{MSY}$, and 99% risk that $F_{2025}>F_{MSY}$). The modelled probabilities of the stock achieving levels consistent with

[1] as estimated in 2015

Stock	Indicators	Previous	2014	2015	2016	2017	2018	2019	Advice to the Commission
Scomberomorus commerson	F_{MSY} [*]: 0.35 [0.18–0.7] B_{MSY} (1,000 t) [*]: 371 [187–882] F_{2015}/F_{MSY} [*]: 1.28 [1.03–1.69] B_{2015} B_{MSY} [*]: 0.89 [0.63–1.15] B_{2015}/B_0 [*]: 0.44 [0.31–0.57]								the MSY reference levels (e.g. B > B_{MSY} and F<F_{MSY}) in 2025 are 93% and 70%, respectively, for a future constant catch at 70% of current catch level. If catches are reduced by 30% of the 2015 levels at the time of the assessment, which corresponds to catches below MSY, the stock is expected to recover to levels above the MSY reference points with at least a 50% probability by 2025 (Table 2). 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 9th Session of the Indian Ocean Tuna Commission's (IOTC) Working Party on Neritic Tunas (WPNT09) was held in Mahé, Seychelles from 1 – 5 July 2019. A total of 18 participants (18 in 2018, 26 in 2017, 20 in 2016) attended the Session. The list of participants is provided at Appendix I. The meeting was opened by the Chairperson, Dr Farhad Kaymaram from I.R. Iran, who welcomed participants to the meeting including the Invited Expert, Dr Shijie Zhou, from CSIRO, Australia and the workshop facilitator Dr Toshihide Kitakado, from Japan.

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 WPNT09 are listed in Appendix III.

3. THE IOTC PROCESS: OUTCOMES, UPDATES AND PROGRESS

3.1 Outcomes of the 21th Session of the Scientific Committee

3. The WPNT **NOTED** paper IOTC–2019–WPNT09–03 which outlined the main outcomes of the 21th Session of the Scientific Committee (SC21), 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 **NOTED** the SC recommended that future capacity building actions and specialised workshops are conducted back-to-back with the regular Working Party meetings so that each CPC can send their most appropriate scientists to the meetings and workshops. At the 2019 WPNT meeting, a data limited assessment workshop was scheduled during the first two days of the regular WPNT meeting.

3.2 Outcomes of the 23rd Session of the Commission

5. The WPNT **NOTED** paper IOTC–2019–WPNT09–04 which outlined the main outcomes of the 23rd Session of the Commission, specifically related to the work of the WPNT.

6. The WPNT **NOTED** the 7 Conservation and Management Measures (CMMs) adopted at the 23rd Session of the Commission (consisting of 7 Resolutions and 0 Recommendations) which will come into force on 29th October 2019:
   - *Resolution 19/01 On an interim plan for rebuilding the Indian Ocean yellowfin tuna stock in the IOTC Area of competence.*
   - *Resolution 19/02 Procedures on a fish aggregating devices (FADs) management plan.*
   - *Resolution 19/03 On the conservation of mobulid species caught in association with fisheries in the IOTC Area of Competence.*
   - *Resolution 19/04 Concerning the IOTC Record of Vessels Authorised to operate in the IOTC Area of Competence.*
   - *Resolution 19/05 On a ban on discards of bigeye tuna, skipjack tuna, yellowfin tuna, and non-targeted species caught by purse seine vessels in the IOTC Area of Competence.*
   - *Resolution 19/06 On establishing a programme for transhipment by large-scale fishing vessels.*
   - *Resolution 19/07 On vessel chartering in the IOTC Area of Competence.*

7. The WPNT **NOTED** that the Resolutions adopted at the 2019 Commission meeting are not related to neritic tuna and to date there have been lack of management measures on these the neritic tuna species. However, the Commission expressed concern about the overall lack of information on neritic tunas, and strongly encouraged the Coastal States to improve data collection and reporting, and develop measures to underpin sustainable management of IOTC neritic species.

8. Participants to WPNT09 were **ENCOURAGED** to familiarise themselves with the adopted Resolutions, especially those most relevant to the WPNT.

3.3 Review of Conservation and Management Measures relevant for neritic tunas

9. The WPNT **NOTED** paper IOTC–2019–WPNT09–05 which aimed to encourage participants at the WPNT09 to review some of the existing Conservation and Management Measures (CMM) relating to neritic tunas, noting that these have now been revised as described in document IOTC–2019–WPNT09–04.

3.4 Progress on the Recommendations of WPNT08 and SC21

10. The WPNT **NOTED** paper IOTC–2019–WPNT09–06 which provided an update on the progress made in implementing the recommendations from the 8th Session of the WPNT for the consideration and potential endorsement by participants.

11. The WPNT **NOTED** a request from WPNT08 for the IOTC Secretariat to liaise with the Government of Pakistan to appraise their revised catch series. The WPNT **NOTED** that the IOTC Secretariat conducted a data compliance and support mission to Pakistan in December 2018 which included discussions on the revised historical catches submitted by Pakistan. The IOTC Secretariat has proposed to draft a joint-paper, in collaboration with the Government of Pakistan and WWF-Pakistan, presenting an evaluation of the revised catch series, to be submitted to the WPDCS meeting in 2019.

12. The WPNT **NOTED** that, following a Data Compliance and Support mission to I.R. Iran in November 2017, a revised procedure for the reporting of geo-referenced catch-and-effort data has been implemented with support from the IOTC Secretariat and that data for 2007-2017 has been successfully received and incorporated within the IOTC database.

13. The WPNT further **NOTED** that, in response to a recommendation from the SC that that the Commission allocates funds to support CPCs to develop CPUE standardisation for priority species, a Data Support mission was conducted by the IOTC Secretariat in June 2019. The aim of this mission was to collaborate with the Iranian Fisheries Organisation (SHILAT) in order to assess the suitability of their datasets for use in developing a standardised CPUE series for gillnet fisheries. The mission was funded by the EU-DG Mare Science Grant.

14. The WPNT participants were **ENCOURAGED** to review IOTC-2019-WPNT09-06 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 (WPNT10).

15. 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. DATA-LIMITED STOCK ASSESSMENT

4.1 Past discussion on data-limited stock assessment

16. The WPNT **NOTED** that to date stock assessments of IOTC neritic tuna species have been based on data-limited methods (e.g., catch-only method). There was generally a lack of understanding on the methodologies among many Working Party participants due to their technical nature. The WPNT **AGREED** that capacity building workshops with hands-on training will enable CPC scientists to improve their understanding of these methods and better contribute to the stock assessment process. The WPNT further **NOTED** that there are a number R packages readily available that allow the rapid implementation of a number of data-limited methods.

4.2 Introduction of R Language

17. The WPNT **NOTED** the tutorial provided by the facilitator regarding the basics of R programming language. The tutorial incorporated a step-by-step guide for the participants on how to import the data into R, and write their own functions to produce data summary and visualisation graphics. The tutorial also introduced the participants to R Markdown, an R package that can be used to generate high quality report, presentation, HTML documents within the integrated computing environment. The WPNT **NOTED** that R Markdown allows for analysis to be produced in a transparent and reproducible manner, thus facilitating collaborative work between scientists.

18. The WPNT **THANKED** the facilitator for providing this useful tutorial as well as the associated code for the participants to apply to their own data.

19. The WPNT **REQUESTED** that, prior to future workshops, the IOTC Secretariat issues a data call to encourage CPC participants to bring examples of their own data to facilitate the practical application and enable hands-on experience.

4.3 Tutorial on catch-only methods

20. The WPNT **THANKED** Dr. Zhou for providing the useful and detailed introduction to data poor catch-only methods.

21. The WPNT **NOTED** a detailed introduction of the catch-only methods, which are a type of stock reduction analysis aiming to locate feasible biomass trajectories subject to prior constraints on stock productivity and depletion levels. The WPNT further **NOTED** the optimised catch only method (OCOM), and the catch-MSY methods are two of the most promising catch-only methods and that the management advice for a number of neritic tuna species are currently based on the OCOM method. Both methods employ a similar biomass dynamic model but differ in ways in which the prior assumption of intrinsic growth rate parameter and depletion level are derived. The WPNT further **NOTED** a comparison study using data-rich stocks suggested that the OCOM performs relatively well compared to some other methods. Table 2 provides a summary of key assumptions for the OCOM method.

22. The WPNT **NOTED** the OCOM method estimates the prior of the intrinsic growth rate parameter based on its empirical relationship with other life history parameters (mainly natural mortality) derived from data rich stocks, and estimates the terminal depletion level based on the catch history trend. The WPNT **NOTED** the method also requires the assumption on initial depletion if the model starts earlier than the catch series, but this assumption is less influential than the assumption for the terminal year.

23. The WPNT **AGREED** that given that catch series are the only data input to the OCOM method (and other catch-only methods as well), it is important to evaluate the quality of current estimates in order to assess model precision and bias. The WPNT **NOTED** that while the nominal catches in the IOTC database are considered to be the most accurate estimates of total catches, there are still considerable uncertainties with the IOTC catch estimates due to on-going issues related to data collection and reporting of neritic species. The WNPT further **NOTED** that the quality of the catch series are also likely to vary between the neritic tuna species, with catches for kawakawa, longtail tuna and narrow-barred Spanish mackerel considered to be relatively more reliable than the other neritic species.

24. The WPNT **NOTED** the tutorial on the implementation of the OCOM method through a dedicated R package. The WPNT **THANKED** Dr Zhou for providing this very useful step-by-step tutorial and the associated scripts for the participants to apply to their own data.

25. The WPNT **NOTED** the *OCOM* package provides a simple and elegant interface that encapsulates the technical detail and allows the user to implement the model in a few lines of code. The WPNT made a few suggestions for the future enhancement of the package, e.g., adding the confidence interval for the terminal stock status in the KOBE plot, and including a projection routine that would allow the calculation of K2SM strategy matrix for providing catch advice.

Table 2: A summary of the OCOM method assumptions and potential improvement

Key assumption/input	Sources of uncertainty/error	Solution
Population dynamics follows Schaefer surplus production model	The production function is symmetric (B_{msy}=K/2)	Introducing a shape parameter to allow a more flexible surplus production function
Population dynamics has no process error	There could be a process error	Include the process error with a given process error variance to inflate uncertainty
Catch data series is available since the beginning of fishery	Early catch data may not be reliable	Dropping earlier catch data and conduct sensitivity by assuming various initial depletion levels
Time series of catch is correct	Non-constant proportional bias?	Conduct sensitivity to alternative catch series

a prior distribution for the intrinsic rate of increase "r" is required	Automatically lined with an input for "M"	Check sensitivity of model results to a plausible range of M values; allow more flexibility in the choice of prior for "r".
a prior distribution for the final depletion level "s"	Really tricky (given by BRT)	Allow some flexibility in the choice of final depletion

4.4 Review on other data-limited methods

26. The WPNT **NOTED** that the review of data-limited methods that are commonly used in many data-poor fisheries, including area based risk assessments (e.g., the SAFE method), age or length based methods, and abundance indices based approaches. The WPNT **NOTED** that these methods differ greatly in terms of the model assumptions and data input requirements.

27. The WPNT further **DISCUSSED** the applicability of various data-limited methods to IOTC neritic tuna species in view of the limited data available and issues of quality. It is suggested that the SAFE method which has been widely used for assessing fishing impact on many bycatch species may have a potential application for the neritic tuna and tuna-like species. The WPNT **NOTED** that some CPCs (e.g., Sri Lanka) have been collecting finer scale catch effort data in their fisheries (with detailed location information) and suggested that these data could be explored for deriving species distributions which are also important inputs to some area-based risk assessment methods.

28. The WPNT **NOTED** that there have been considerable progress in the development of length based methods which requires only length data (and some biological information). The WPNT further **NOTED** many CPCs have collected large amounts of length/biological information and have used them to develop indicators for assessing fishing impacts on local stocks. Given the availability and accessibility of length data, the WPNT **AGREED** that length-based methods should be further explored for their suitability in assessing the stocks of IOTC neritic species.

4.5 Improving catch-only methods

29. The WPNT **NOTED** document IOTC-2019-WPNT09-15 presented by Dr Zhou that provides an overview of a study which aims to improve the current catch-only method, funded by a EU-DG Mare Science Grant and CSIRO.

30. The WPNT **NOTED** the study provides a number of revisions to the estimation of priors for the level of stock depletion and the rate of intrinsic growth parameters. In particular, the estimation of the intrinsic growth rate takes into consideration of both life historical traits and resilience of the species (based on the classifications from fish base). The depletion level is estimated by combining the approaches from the catch-MSY and OCOM methods, with flexible weighting given to either method.

31. The WPNT **NOTED** that another important revision to the current OCOM method is to incorporate CPUE time series into the model, allowing the feasible stock trajectories to be 'conditional' on the trend of CPUE indices. The WPNT **AGREED** that it is a very useful addition to the model – especially when reliable CPUE series are available – and enables the model to be less reliant on the assumption of the terminal depletion, which is often subjective and influential to model results.

32. The WPNT **DISCUSSED** the potential diagnostics for catch-only methods and **RECOMMENDED** that the retrospective or hindcasting analysis be incorporated into the modelling as diagnostics tools. These analyses are helpful in revealing whether the catch series is consistent with respect to the stock productivity and if the model results are driven by more recent data.

33. WPNT **NOTED** that catch-only methods have also been used for assessing some other IOTC species including data-moderate stocks. Given the recent progress and development, the WPNT **ENCOURAGED** CPC scientists to further explore the catch-only methods in conjunction with other assessment approaches so that the utility of these methods in assessing data poor stocks can be further evaluated and improved.

5. NEW INFORMATION ON FISHERIES AND ASSOCIATED ENVIRONMENTAL DATA RELATING TO NERITIC TUNAS

5.1 Review of the statistical data available for neritic tunas: IOTC database

34. The WPNT **NOTED** paper IOTC–2019–WPNT09–07 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 *Mandatory statistical reporting requirements for IOTC Members and Cooperating non-Contracting Parties (CPCs)*, for the period 1950–2017. A summary is provided at Appendix IVa–IVf.

35. The WPNT **NOTED** that a review of Pakistan's revised historical catches by the IOTC Secretariat is on-going, and that recommendations on the revised catch series will be presented to the WPDCS and SC for endorsement later in 2019, prior to a decision on incorporating the revised catches in the IOTC database.

36. The WPNT further **NOTED** that Pakistan's revised catches may lead to sharp increase in catches that may affect future stock assessment results for neritic and tropical tunas, and **REQUESTED** that the IOTC Secretariat provide an update at the next WPNT meeting.

37. The WPNT **NOTED** that the catches of most neritic species have reached their highest levels reported in the Indian Ocean (i.e., increasing ≈50% from 408k t in 2005 to 611k t in 2017), indicating the possibility that the 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 that include:

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

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

   iii. Improvements in the reporting of catches of neritic species (e.g., Indonesia, Sri Lanka), and 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.

38. The WPNT **RECOMMENDED** the SC to provide strong management advice for neritic species, **NOTING** that that catches of some species have reached their highest levels in the Indian Ocean in recent years, while catch statistics remain uncertain.

39. The WPNT **NOTED** that despite access to the Meeting Participation Fund (MPF), attendance at the WPNT meeting by developing coastal states important for catches of neritic species could be improved, and **REQUESTED** the attendance from the following CPCs – Indonesia, I.R. Iran, India and Pakistan – which account for around 75% of the catches of neritic species.

40. 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 (e.g., Pakistan).

   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).

   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).

41. The WPNT **NOTED** that compliance with the mandatory data reporting obligations is particularly low for neritic tuna species, despite the importance of scientific data for stock assessment, and **REQUESTED** CPCs do

their best to collect data and comply with data reporting requirements adopted by the IOTC. The WPNT further **NOTED** that these issues have been noted for several years with little progress made intersessionally.

42. The WPNT **ACKNOWLEDGED** however the recent improvements in the data collection and reporting of neritic tunas by I.R. Iran and Pakistan in particular, including the development of a standardized CPUE series for Iranian gillnets, and encouraged other CPCs important for catches of neritic tunas to focus their efforts on improving the data collection and reporting of neritic tunas.

43. 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.

44. 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.

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

- that IOTC Data Support and Compliance missions be conducted to India and Oman to review the current arrangements for the collection and reporting of neritic tunas and tuna-like species to the IOTC;
- that the IOTC Secretariat provide technical assistance and support to Pakistan to assess the potential for development of a standardized CPUE for the Pakistani gillnet fleet;
- that the IOTC Secretariat, in collaboration with CPCs, explores options for the developing a regional standardized CPUE series for the principal gillnet fleets operating in the Northern Indian Ocean.

46. The WPNT further **NOTED** that the IOTC Secretariat is currently undertaking a project that aims to improve the capacity for IOTC and IOTC Member countries to collect, store and utilize data collected from artisanal fisheries to assist the management of tuna and tuna-like species, including vulnerable shark and rays. Specifically:

i.) Provide an evaluation of the current status of data collection for priority CPCs identified as important for catches of artisanal fisheries (i.e., IOTC neritic species and CITES species) – including the current situation in terms of port sampling systems in place (e.g., coverage, potential biases, gaps in the data collection).

ii.) Develop or update the general guidelines for data collection from artisanal fisheries at the landing place, through sampling by enumerators; including development of a set of indicators to be used to assess the quality of data collection and management systems for artisanal fisheries.

iii.) Propose recommendations on strategies for obtaining data and capacity building for monitoring and reporting artisanal fisheries, for the consideration of CPCs and the IOTC Scientific Committee.

The WPNT **REQUESTED** that the results of this project be presented at the next WPNT meeting.

5.2 Review new information on fisheries and associated environmental data (general CPC papers)

47. The WPNT **NOTED** paper IOTC–2019–WPNT09–09 which summarised neritic tuna data from Comorian fisheries, including the following abstract provided by the authors:

"Neritic tuna data from Comorian fisheries represents a weak part of the annual total catch but really helps to local consumption in term of product variability and market. Its production represents almost 3% of annual total production of these six last years. Neritic tuna catches constitute the fourth important component of fishery harvest behind small pelagic, tuna like and tropical tuna. The main specie caught is Kawakawa (Euthynnus affinis), followed by Bullet tuna (Auxis rochei). The Frigate tuna (Auxis thazard) and the Longtail tuna (Thunnus tonggol) are not often caught. The Indo-Pacific king mackerel (Scomberomorus guttatus) and Narrow-barred Spanish mackerel (Scomberomorus commerson) are extremely rare. All these neritic tunas are mainly caught by trolling line or hook and line using fibber glass small boat or wooden pirogue. The main fishing gear is depending on the habitat of the Comorian Island you are. A comparison of low and high seasonally production shows that these last 3 years are low productive than the first four years of this interval from 2011 to 2017".

48. The WPNT **NOTED** the sharp decrease in Comoros catches of neritic tunas from 2014/2015 onwards – that may be the result of improvements to the port sampling methodology, rather than an actual decrease in landings – and **REQUESTED** that Comoros examine this issue in more detail and advise the IOTC Secretariat as to whether catches for earlier years should be revised in line with the most recent catch trends.

49. The WPNT **NOTED** paper IOTC–2019–WPNT09–10 which examined the length frequency ratios of *S. plurilineatus* and *S. commerson*, and included the following abstract below, was not discussed as the author was unable to attend the WPNT meeting:

"A study was conducted in Kenyan marine catches of kingfish noted that there are two distinct species caught by artisanal fishers in the Kenyan Marine Ecosystem. The study also compared the length frequency ratio for the two species Scomberomorous plurilineatus and Scomberomorous commerson. Scomberomorous are caught predominantly by hand lines, thus this fishing method was used during the survey. The main objective of this study was to identify the lengths at which the two species are caught and monitor the impact of the gear on stock recruitment of the two species. This study will inform on the need to treat the species as separate and not one as far as the Management of kingfish populations is concerned. The survey was undertaken in two landing sites, Viz Mkunguni and Old port in Mombasa from June to December 2017 on diverse dates. The lengths frequency of S. plurilineatus and S. commerson were obtained from 70 individuals for both the species. Lengths frequency for S. plurilineatus varied from 82cm for the smallest to approximately 120 cm for the largest, while S. commerson length frequency varied from 68 cm for the smallest to 130 cm for the largest. Length at first maturity (LM) for S. commerson in the region ranges between 55- 82cm. Ref; Fish base). Results; This study shows that the two Scomberomorus species are captured having attained maturity. The presence of the two species in Kenyan waters means that there is a possibility of the same in the neighboring countries. A further assessment of the species through genetic study would enrich the IOTC management of the species in this area of competence."

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

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

50. The WPNT **NOTED** paper IOTC–2019–WPNT09–11 which summarised the CPUE standardisation of frigate tuna in West Sumatra, including the following abstract provided by the authors:

"*Frigate tuna (Auxis thazard) is one of the major commercial tuna species, both by the industrial and small scale fisheries, particularly in West Sumatra. In Indonesia, A. thazard is a group of "tongkol" together with A. rochei, Thunnus tonggol and Euthynnus affinis. This study describes a preliminary examination of frigate tuna catch from purse seine in the Indian Ocean West Sumatera (FMA 572). The data were collected daily by enumerators on fish landing site from 2013 to 2017. General Linear Model (GLM) with gamma were applied in this study to standardize the CPUE. The results showed that the variation of CPUE influenced by year and quarter but not the fleet size (GT). In general, the population of frigate in the Indian Ocean West Sumatera (FMA 572) waters were suggested sustainable*".

51. The WPNT **NOTED** that the effect of *fleet size* is statistically significant although the p value is much larger than the other explanatory variables. The WPNT suggested plots showing relationship between CPUE and explanatory variables could be useful diagnostics. The WPNT **NOTED** there is no detailed spatial information in the data and the standardisation may have little effect on the nominal CPUE given that very few variables were included in the *GLM* model.

52. The WPNT **NOTED** paper IOTC–2019–WPNT09–17 which summarised the CPUE standardisation of four neritic tuna species from Iranian drift gillnet fishery, including the following abstract provided by the authors:

"*We analysed the catch effort data from the Iranian gillnet fishery in the coastal waters of Persian Gulf and Oman sea, and applied statistical models to obtain abundance indices from nominal catch per unit effort (CPUE) for the main neritic tuna species captured in the fishery. The spatial and temporal trend of catch and effort was characterised, and standardisation analysis using GLM models was conducted for longtail tuna (Thunnus tonggol), narrow-barred Spanish mackerel (Scomberomorus commerson), kawakawa (Euthynnis affinis), and frigate tuna (Auxis thazard), using trip-level catch effort data collected from the port-sampling program from 2008 to 2017. Additional analyses using Bayesian MCMC and mixed effects models were also investigated. The analyses showed that the standardised catch rates have declined for the longtail tuna and has been increasing for the narrow-barred Spanish mackerel in recent years, and standardised catch rates for kawakawa and frigate tuna showed a slight increasing, but overall stable trend. The caveats of the data used for CPUE standardisations were discussed. This analysis represents the first attempt to estimate a relative abundance index from the Iranian gillnet fishery for potential use in stock assessments of IOTC neritic tuna stocks*".

53. The WPNT **NOTED** that the analysis was conducted as part of a Data Support mission to I.R. Iran in 2019 in response to the SC recommendation to provide support CPCs to develop standardized CPUE series for priority species. The WPNT **CONGRATULATED** the IOTC Secretariat for the successful mission and also the Iranian Fisheries Organization (SHILAT) for its full support of the mission. The WPNT **AGREED** that the work represents a significant progress towards improving the utilisation of CPCs fishery dataset for assessing IOTC neritic tuna stocks

54. The WPNT **NOTED** that the analysis concluded the Iranian port-sampling program provides ample information on vessel characteristics, spatial and temporal distribution of catch and effort, allowing abundance indices to be examined in a standardisation framework. The WPNT further **NOTED** that some caveats in the data would need to be considered when interpreting of the results.

55. The WPNT **NOTED** that the standardised CPUE indices show somewhat different trends among the four species considered in the analysis, which appeared to be counterintuitive considering that they are residing in the same pelagic environment and caught by a multi-species fishery. It is possible that a shift in targeting might have occurred over time which was not captured in the model. The WPNT suggested future analyses could consider including species composition in the standardisation to account for potential targeting effect.

56. The WPNT **NOTED** paper IOTC–2019–WPNT09–12 which summarised biometric parameters of frigate tuna from fishery dependent and fishery independent surveys conducted in Sri Lankan waters, including the following abstract provided by the authors:

"*The neritic tuna catch in Sri Lankan waters is mainly composed of Auxis thazard (frigate tuna), Auxis rochei (bullet tuna), Euthynnus affinis (kawakawa) and Scomberomorus commerson (narrow- barred Spanish mackerel). Among them, frigate tuna is the dominant species presently contributing over 40% to the total neritic tuna production. Though several studies have been conducted to estimate some biometric parameters of the frigate tuna in Sri Lankan waters, all of the studies have focused on fishery dependent data. This paper attempts to estimate the biometric parameters of frigate tuna using both fishery independent data and fishery dependent data. Length–weight relationship (LWR) was calculated using the equation W = aLb and the Fulton's condition factor (K) was estimated from the relationship K=100W/L3 (W = total weight; L = total length) to assess the condition of the selected fish. Fishery dependent data from 373 specimens was obtained from the samples collected from the coastal fisheries catches from October 2015 to September 2017. Fishery independent data of 254 specimens was obtained from the samples collected from R/V Dr. Fridtjof Nansen Ecosystem survey conducted in Sri Lankan waters from 24 June 2018 to 16 July 2018. The total length and the weight of the fishery dependent samples ranged from 21.50 cm – 44.20 cm and 118.89 g – 1430.90 g respectively while those parameters of fishery independent samples ranged from 14.00 cm – 19.00 cm and 20.00 g – 80.00 g respectively. The LWR for the commercial catch and the fishery independent catch were W = 0.003L3.428 and W = 0.037L2.540 respectively. The estimated K value for the commercial catch and fishery independent catch were 1.48 ± 0.15 and 1.03 ± 0.16 respectively. Considering the growth pattern of the two studies, commercial catch showed a positive allometric growth while fishery independent survey showed a negative allometric growth. Based on the results of the K, it can be concluded that the population consisting of larger fish from the commercial catches was at a better condition than the juvenile population studied during the fishery independent survey. According to the results of the fishery independent survey, two possible nursery grounds for Auxis thazard in the Sri Lankan waters were identified*".

57. The WPNT **NOTED** that the fishery independent survey and commercial fishery samples used in the analysis cover different periods and duration, thus it may be difficult to compare them. However, the WPNT **ACKNOWLEGED** that fishery independent data can provide very valuable information for validating fishery dependent data.

58. The WPNT **NOTED** paper IOTC–2019–WPNT09–13 which summarised some biological aspects of Kawakawa in the northern part of Peninsular Malaysia, including the following abstract provided by the authors:

"*Neritic tuna species are among the important pelagic fish caught by commercial and traditional fishing gears. The main neritic tuna found in Malaysian waters are longtail (Thunnus tonggol), kawakawa (Euthynnus affinis) and frigate tuna (Auxis thazard). In 2018, neritic tunas contribute about 5% of the total marine catches in Malaysia. Annual catch of neritic tuna in the Malacca Straits is about 32% and had showed a decreasing trend but the opposite was observed in the South China Sea. Purse seiners contributed about 85% of the annual catches of neritic tuna and it is the most important fishing gear for this fishery, especially the 40-69.6 GRT and >70 GRT vessel size. Two types of purse seines operate in Malaysia; using FADs and light luring. This present study will also include information on biological aspects of E. affinis such as growth parameters and length distribution*".

59. The WPNT **NOTED** that purse seine and trawls are the main gears. The WPNT further **NOTED** Kawakawa is the main neritic tuna species caught by these gears and the catches of longtail and frigate tuna are low.

60. The WPNT **NOTED** paper IOTC–2019–WPNT09–14 which summarised the population parameters of longtail tuna in the Northern of the Persian Gulf and Oman Sea, including the following abstract provided by the authors:

"*Length frequency data of longtail tuna was collected from April 2015 to March 2016. This study provides population parameters of this species in the Persian Gulf and Oman Sea. A total monthly data of 4383 individuals ranging from 25 to 124 cm fork length were analyzed with FiSAT II software using the ELEFAN1 package to estimate the population parameters. The length-weight relationship was TW= 0.00002FL2.87 (R2=0.97) showing an Isometric growth for T. tonggol. Growth parameters were computed L∞ =129.6 cm, K=0.39 year-1 and t0 = −0.28 with the growth performance index, φ' of 8.7. The total mortality (Z) was estimated 1.58 year-1 using catch curve method. The natural (M) and fishing mortality (F) were obtained 0.49 year-1 and 1.09 respectively. The exploitation ratio was 0.69. Length at first capture (Lc) was estimated as 60.2 cm fork length. The yield per recruit (Y/R) maximized in maximum fishing mortality rate 0.85 year-1. The biomass per recruit decreased to 17.2% of unexploited biomass (Virgin biomass) at F. The current fishing mortality exceeds optimum fishing mortality (Fopt) and limit fishing mortality (Flimit). The results indicated that fishing effort should be reduced to prevent stock overexploitation in the Persian Gulf and Oman Sea*".

61. The WPNT **NOTED** that the knife edge selectivity assumed in the catch-curve analysis may not conform to the true selectivity of the gillnet fishery, which is likely to be dome shaped, therefore the fishing mortality is likely to be overestimated if large fish have been missing from the samples. The WPNT **SUGGESTED** further analyses should consider a more realistic selectivity.

62. The WPNT **NOTED** paper IOTC–2019–WPNT09–16 which summarised the distribution, abundance and some aspects of biology of kawakawa from the Northern Arabian Sea and the status of neritic tuna fisheries in Pakistan, including the following abstract provided by the authors:

"*Neritic tuna contributes substantially to the total fish landings of Pakistan. It is estimated that about neritic tuna alone have a share of 45 % in the total landings of tuna landed in 2018. Kawakawa contribution is although about 6 % but it is important because it is the main species which is consumed locally in Pakistan. Of the five species of neritic tuna, longtail tuna (Thunnus tonggol) contributes 11,985 m. tons during 2018. Landings of frigate tuna (Auxis thazard thazard) during 2018 was recorded to be 10,986 m. tons which is followed by kawakawa (Euthynnus affinis) as 4,123 m. tons. Other two species i.e. bullet tuna (Auxis rochei) and striped bonito (Sarda orientalis) contributed insignificantly in the total tuna landings of Pakistan. During 2019, a major part of the fleet mainly operated in the offshore deeper waters; therefore, landings of neritic tunas were comparatively lesser than previous year. The paper also describes some aspects of the biology of kawakawa from Northern Arabian Sea*".

63. The WPNT **NOTED** paper IOTC–2019–WPNT09–INFO01 which investigates capture rates of neritic tuna species in the tuna gillnet fisheries of Pakistan, including the following abstract provided by the authors:

"*The results from the study suggest no significant impact on target catch, however, holds promising results as the different gear settings result in positive impact on incidentally caught species. We are encouraged by the results of the study and recommend coupling of technologies such as the use of electronic monitoring systems for triangulating observer data and expanding studies elsewhere, in addition to also studying the gear behavior. Sub-surface gear settings in tuna directed gillnet fisheries provide trade-off among target and non-target catch and may be considered as a potential conservation and management measure in gillnet fisheries*"

64. The WPNT **NOTED** that the comparison of the catch efficiency between the surface and sub-surface gear is based on nominal CPUE, and differences were noted in catches by each gear type by vessels operating in similar waters. The WPNT **SUGGESTED** that standardised catch rates may be more appropriate if there are other variables that may affect differences in catchability.

65. The WPNT **RECALLED** that Resolution 19/01 mandates that "CPCs shall set their gillnets at 2m depth from the surface in gillnet fisheries by 2023 in order to mitigate ecological impacts of gillnets".

66. The WPNT **NOTED** paper IOTC–2019–WPNT09–18 which summarises the Purse Seine fisheries and CPUE of Neritic Tuna in the Andaman Sea, Thailand, including the following abstract provided by the authors:

"Purse Seine fishery in the Andaman Sea operation was 1 2 days per trip or 21 days per month. Fishing grounds located along the Andaman Sea where distances from shores are 10 to 30 nautical miles and depth of water range from 20-80 m. The operate net made from black nylon with mesh size as 2.5 cm. Average annual catch rate from January to December 2018 was 2,306.5 kg/day. The peak of CPUE occurred in March to May. Catch composed of Decapterus macrosoma 15.1%, followed by Rastrelliger kanagurta 13.2%, Decapterus maruadsi 10.9%, Neritic tuna 10.1%, Selar crumenophthalmus 8.7%, Sardinella gibbosa 3.9%, Megalaspis cordyla 3.5%,

Siganus canaliculatus 3.1% and other species 31.5%. The average annual catch rate of Neritic tuna was 188.6 kg/day. Neritic tuna in the Andaman Sea was caught mainly from purse seine fishery, by Thai purse seine (TPS) 825.0 kg/day (38.5%), followed by light luring purse seine (LPS) 161.0 kg/day (9.5%), and purse seine with fish aggregating devices (FADs) 148.8 kg/day (7.9%). The highest CPUE was Euthynnus affinis, Thunnus tonggol, Auxis thazard, and Auxis rochei was 66.6, 64.9, 33.0 and 24.1 kg/day, respectively."

67. The WPNT **NOTED** that Thailand has been reporting neritic tuna catch to IOTC by aggregated species. The WPNT suggested that the information collected from the research (such as those presented in the study) can be used to disaggregate the catches, so that they can be reported by species.

6.2 General Data for input into stock assessments

6.3 Stock assessment updates

68. The WPNT **NOTED** that there was no stock assessment scheduled for neritic tuna species this year.

69. The WPNT **NOTED** that Dr Zhou presented a preliminary exploration of applying the revised OCOM method to six neritic tuna species (document IOTC–2019–WPNT09–15). The WPNT further **NOTED** that the author has also conducted regional analysis assuming a hypothetic four-region stock structure (NW, NE, SW, and SE Indian Ocean). The WPNT **AGREED** that the regional analysis is useful in exploring regional differences in fishing impact but the assumed regions are unlikely to represent the spatial structure of the stocks as the stock structure of neritic tuna is currently unknown,. The WPNT **NOTED** the method will be examined in more details in the scheduled neritic tuna assessments next year.

70. The WPNT **NOTED** that life history parameters used in the analysis are from two sources, one is based on independent local area studies, and the other is derived from a hierarchical Bayesian meta-analysis that collates available data. The WPNT **NOTED** that local area studies have taken place in particular regions for particular time periods and estimates are highly variable. The WPNT **AGREED** that robust estimates of biological parameter are necessary to most data-poor assessments and encouraged CPC scientists to continue to collect and analyse quantitative biological information.

7. PROGRAM OF WORK (RESEARCH AND PRIORITIES)

71. The WPNT **RECALLED** that the SC, at its 17th Session, **REQUESTED** that during the Working Party meetings, each group not only develop a Draft Program of Work for the next five years containing low, medium and high priority projects, but that all High Priority projects are ranked. The intention is that the SC would then be able to review the rankings and develop a consolidated list of the highest priority projects to meet the needs of the Commission. Where possible, budget estimates should be determined, as well as the identification of potential funding sources (SC17 Para.178).

7.1 Revision of the WPNT Program of Work (2020–2024)

72. The WPNT **NOTED** paper IOTC-2019-WPNT09-08 providing an outline of the programme of work for 2020 – 2024.

73. The WPNT **NOTED** the importance of neritic tuna resources in terms of its contribution to the health and nutrition, livelihoods, employment and wealth creation of fisheries communities and related local economies, and **REQUESTED** the program of work to include a component that address the socio-economic aspect of the fisheries.

74. The WPNT **REQUESTED** a one-day workshop focusing on length based or area based methods to be held back-to-back with the 11th session of the WPNT in 2021.

75. The WPNT **UPDATED** Table 7 providing an overview of the datasets available for key CPCs catching neritic tuna species and **ENCOURAGED** CPCs to make these data available for stock assessment purposes.

Table 3. Neritic tuna datasets by CPC

CPC	Fishery	Logbook data	Port sampling data	Contact Organisation
Thailand	Coastal Seine	2015 - present	>10 years	Department of Fisheries, Thailand
Malaysia	Seine/trawl/gillnet/line	-	1980 - present	nor_azlin@dof.gov.my
Indonesia	Line/seine	2013-2016	2014-2016, 2018	Directorate General Capture Fisheries (DGCF) Ministry of Marine Affairs and Fisheries of Indonesia.

Oman	Artisanal fleet (unspecified gear types)	-	1984 - present	
I.R. Iran	Gillnet	GN >10 years	2013 - present	IFO
Sri Lanka	Gillnet/ Longline/ring net/other	2015-present (2016 data more precise)	>10 years	NARA/ DFAR
Maldives		Very recent (2004-2015 exist but quality uncertain)		MRC
India	Gillnet/seine/trawls/ Artisanal gears		>10 years	CMFRI
Tanzania	Artisanal	1980s		
Mozambique	Artisanal			Fisheries Research Institute (IIP)
Kenya	Sport fisheries data	> 10 years		Kenya Fisheries Services
Pakistan	Gillnet fleet	[2]	1985-1995; 2012-2018	Fisheries Commission of Maritime affairs, Pakistan; WWF-Pakistan

76. The WPNT **RECOMMENDED** that the SC consider and endorse the WPNT Program of Work (2020–2024), as provided in Appendix VI.

8. OTHER BUSINESS

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

77. 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 2020, by an Invited Expert:

1) data poor assessment approaches (e.g. catch only methods, length-based approaches);
2) CPUE standardisations.

78. The WPNT **NOTED** with thanks the excellent contributions of both the invited expert for the meeting, Dr Shijie Zhou (CSIRO, Australia) and the course facilitator, Dr Toshihide Kitakado (Japan), in support of the data limited workshop.

8.2 Date and place of the 10th and 11th Working Party on Neritic Tunas

79. The WPNT **NOTED** that Kenya expressed interest in potentially hosting the 10th Session of the WPNT and **RECOMMENDED** the SC consider as preferred dates for the first week of July 2020. The WPNT further **NOTED** that Sri Lanka and Malaysia have expressed an interest in potentially hosting the 11th Session of the WPNT in 2021, with dates yet to be agreed.

Meeting participation fund (MPF)

80. The WPNT **ENCOURAGED** the participation from young scientists at the meeting and **SUGGESTED** an award to be given to one of the presenting papers to continue to encourage young scientists to participate in IOTC meetings.

81. The WPNT **RECOMMENDED** that the SC and Commission note the following:

4) 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 8).
5) 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.

[2] Crew based observer data available from 2013 onwards available on request from the Government of Pakistan, collected by WWF-Pakistan.

6) 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 4. 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 Election of a Chairperson and Vice-Chairperson for the next biennium

Chairperson

82. The WPNT **NOTED** that the second term of the current Chairperson, Dr Farhad Kaymaram, is due to expire at the end of the current WPNT meeting and, as per the IOTC Rules of Procedure (2014), participants are required to elect a new Chairperson for the next biennium.

83. The WPNT **THANKED** Dr Kaymaram for his Chairmanship over the past four years and looked forward to his continued engagement in the activities of the WPNT in the future.

84. **NOTING** the Rules of Procedure (2014), the WPNT **CALLED** for nominations for the newly vacated position of Chairperson of the IOTC WPNT for the next biennium. Ms Ririk Sulistyaningsih was nominated, seconded and elected as Chairperson of the WPNT for the next biennium.

Vice-Chairperson

85. The WPNT **NOTED** that the second term of the current Vice-Chairperson, Dr Mathias Igulu, is due to expire at the closing of the current WPNT meeting and, as per the IOTC Rules of Procedure (2014), participants are required to elect a new Vice-Chairperson for the next biennium.

86. **NOTING** the Rules of Procedure (2014), the WPNT **CALLED** for nominations for the position of the Vice Chairperson of the IOTC WPNT for the next biennium. Dr Farhad Kaymaram was nominated, seconded and elected as Vice-Chairperson of the WPNT for the next biennium.

8.4 Review of the draft, and adoption of the Report of the 9th Working Party on Neritic Tunas

87. The WPNT **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPNT09, 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 2019 (Fig. 1):
    - 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

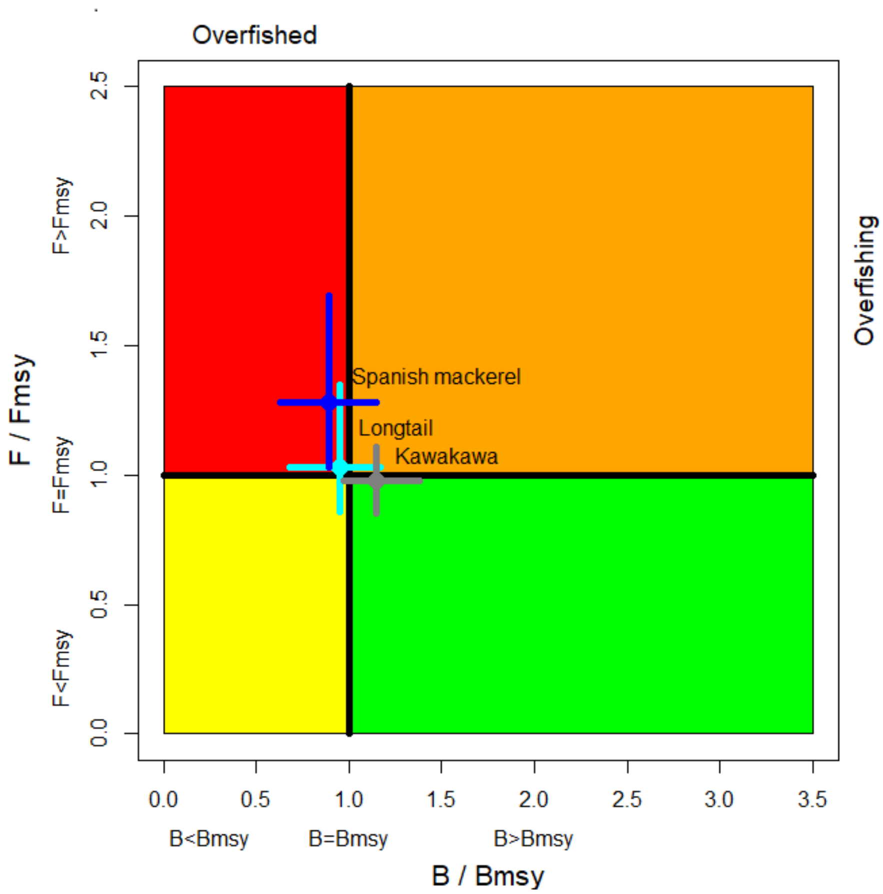

Fig. 1. Combined Kobe plot for longtail tuna, narrow-barred Spanish mackerel and kawakawa, showing the estimates of stock size (B) and current fishing mortality (F) in 2015 in relation to optimal spawning stock size and optimal fishing mortality. Cross bars illustrate the range of uncertainty from the model runs.

88. The report of the 9th Session of the Working Party on Neritic Tunas (IOTC–2019–WPNT09–R) was **ADOPTED** on 5 July 2019.

APPENDIX I
LIST OF PARTICIPANTS

CHAIRPERSON
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APPENDIX II

AGENDA FOR THE 9TH WORKING PARTY ON NERITIC TUNAS

Date: 1–5 July 2019
Location: Mahé, Seychelles
Venue: H Hotel
Time: 09:00 – 17:00 daily
Chair: Dr Farhad Kaymaram; **Vice-Chair**: Dr Mathias Igulu

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

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

3. **DATA LIMITED WORKSHOP (see Annex 1)**

4. **THE IOTC PROCESS: OUTCOMES, UPDATES AND PROGRESS**
   - 3.1 Outcomes of the 21st 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 WPNT08 (IOTC Secretariat)

5. **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)

6. **NERITIC TUNA SPECIES – REVIEW OF NEW INFORMATION ON STOCK STATUS**
   - 7.1 Review new information on the biology, stock structure, fisheries and associated environmental data (all)
   - 7.2 Data for input into stock assessments (all)
   - 7.3 Stock assessment updates (all)
   - 7.4 Stock status indicators for other neritic tuna species (all)
   - 7.5 Development of management advice for neritic tuna species (all)

7. **PROGRAM OF WORK (RESEARCH AND PRIORITES)**
   - 8.1 Revision of the WPNT Program of Work 2020–2024 (Chair)
   - 8.2 Development of priorities for an Invited Expert at the next WPNT meeting

8. **OTHER BUSINESS**
   - 9.1 Election of a Chairperson and a Vice-Chairperson of the WPNT for the next biennium
   - 9.2 Date and place of the 10th and 11th Working Party on Neritic Tunas (Chair)
   - 9.3 Review of the draft, and adoption of the Report of the 9th Working Party on Neritic Tunas (Chair)

APPENDIX III
LIST OF DOCUMENTS

Document	Title	Availability
IOTC–2019–WPNT09–01a	Draft: Agenda of the 9th Working Party on Neritic Tunas	✓ 17 June 2019
IOTC–2019–WPNT09–01b	Annotated agenda of the 9th Working Party on Neritic Tunas	✓ 17 June 2019
IOTC–2019– WPNT09–02	List of documents of the 9th Working Party on Neritic Tunas	✓ 17 June 2019
IOTC–2019– WPNT09–03	Outcomes of the 21th Session of the Scientific Committee (IOTC Secretariat)	✓ 17 June 2019
IOTC–2019– WPNT09–04	Outcomes of the 23nd Session of the Commission (IOTC Secretariat)	✓ 17 June 2019
IOTC–2019– WPNT09–05	Review of current Conservation and Management Measures relating to neritic tuna species (IOTC Secretariat)	✓ 17 June 2019
IOTC–2019– WPNT09–06	Progress made on the recommendations and requests of WPNT08 and SC21 (IOTC Secretariat)	✓ 17 June 2019
IOTC–2019– WPNT09-07	Review of the statistical data available for the neritic tuna species (IOTC Secretariat)	✓ 17 June 2019
IOTC–2019– WPNT09–08	Revision of the WPNT Program of Work (2019–2023) (IOTC Secretariat)	✓ 17 June 2019
IOTC–2019– WPNT09–09	Comparison of low and high production years of neritic tuna in Comoros from 2011 to 2017	17 June 2019
IOTC–2019– WPNT09–10	Presence of two kingfish species *scomberomorous plurilineatus* and *scomberomorous commerson* caught by hand lines in the Kenyan marine ecosystem	✓ 17 June 2019
IOTC–2019– WPNT09–11	Preliminary study of frigate tuna (Auxis thazard) CPUE standardization in the Indian Ocean West Sumatera (FMA 572)	✓ 17 June 2019
IOTC–2019– WPNT09–12	Some biometric parameters of Auxis thazard (Lacepède, 1800) (frigate tuna) – data from fishery dependent and fishery independent surveys conducted in Sri Lankan waters	✓ 17 June 2019
IOTC–2019– WPNT09–13	Status of neritic tuna fishery and some biological aspects of Kawakawa (Euthynnus affinis) in the northern part of Peninsular Malaysia	✓ 17 June 2019
IOTC–2019– WPNT09–14	Population dynamic parameters of Longtail tuna (Thunnus tonggol) in the Northern of the Persian Gulf and Oman Sea	✓ 17 June 2019
IOTC–2019– WPNT09–15	Improving data limited methods for assessing Indian Ocean neritic tuna species	✓ 17 June 2019
IOTC–2019– WPNT09–16	Distribution, abundance and some aspects of biology of kawakawa (Euthynnus affinis) from Northern Arabian Sea with an update on neritic tuna fisheries of Pakistan	17 June 2019
IOTC–2019– WPNT09–17	Standardisations of neritic tuna catch effort data from the Iranian gillnet fleet 2008–2017	✓ 17 June 2019
Data sets		
IOTC-2019-WPNT09-DATA01	IOTC Neritic tuna datasets available	✓ 17 June 2019
IOTC-2019- WPNT09-DATA02	IOTC Species data catalogues – availability of data	✓ 17 June 2019
IOTC-2019- WPNT09-DATA03	Nominal catches per Fleet, Year, Gear, IOTC Area and species	✓ 17 June 2019
IOTC-2019- WPNT09-DATA04	Catch and effort data - vessels using drifting longline	✓ 17 June 2019
IOTC-2019- WPNT09-DATA05	Catch and effort data - vessels using pole and lines or purse seines	✓ 17 June 2019
IOTC-2019- WPNT09-DATA06	Catch and effort data - vessels using other gears (e.g., gillnets, lines and unclassified gears)	✓ 17 June 2019
IOTC-2019- WPNT09-DATA07	Catch and effort data - all gears	✓ 17 June 2019

Document	Title	Availability
IOTC-2019- WPNT09-DATA08	Catch and effort – reference file	✓ 17 June 2019
IOTC-2019- WPNT09-DATA09_Rev1	Size frequency data - neritic tunas	✓ 17 June 2019
IOTC-2019- WPNT09-DATA10_Rev1	Size frequency – reference file	✓ 17 June 2019
IOTC-2019- WPNT09-DATA11	Equations used to convert from fork length to round weight for neritic tuna species	✓ 17 June 2019

APPENDIX IVA
MAIN STATISTICS FOR BULLET TUNA (*AUXIS ROCHEI*)

Extract from IOTC–2019–WPNT09–07

Fisheries and main catch trends

- Main fisheries: bullet tuna is mainly caught using gillnets, handlines and trolling, across the broader Indian Ocean area. This species is also an important catch for coastal purse seiners (**Table 4; Fig.19**).
- Main fleets (i.e., in terms of highest catches in recent years):
  Catches are highly concentrated: in recent years nearly 90% of catches in the Indian Ocean have been accounted for by fisheries in India, Sri Lanka, Indonesia (**Fig.20**).
- Retained catch trends:
  Estimated catches of bullet tuna reached around 2,000 t in the early 1990's, increasing markedly in the following years to reach a peak in 1997, at around 4,900 t. The catches decreased slightly in the following years and remained at values of between 3,700 t and 4,000 t until the late-2000's, increasing sharply again up to the 10,000 t recorded in 2010. Since 2014 catches have increased from 10,000 t to almost 16,000 t – mostly due to an increased in catches reported by India (handline, gillnet and trolling fisheries).
- Discard levels: are moderate for industrial purse seine fisheries. The EU recently reported discard levels of bullet tuna for its purse seine fleet, for 2003–07, estimated using observer data.

***Changes to the catch series*:** there have been relatively large revisions (i.e., >20%) to the catches since 2014 compared with those presented to the WPNT meeting in 2018; mostly the result of revisions to the catches for Indonesia from 2010 onwards, as well as updates to the catches for India which were submitted in late-2018.

Bullet tuna – estimation of catches: data related issues

Retained catches for bullet tuna were derived from incomplete information, and are therefore uncertain[3] (**Fig.21**), due to:

- Aggregation: Bullet tunas are usually not reported by species, but are instead aggregated with frigate tunas or, less frequently, other small tuna species.
- Mislabeling: Bullet tunas are usually mislabeled as frigate tuna, with their catches reported under the latter species.
- Underreporting: the catches of bullet tuna by industrial purse seiners are rarely, if ever, reported.

For the reasons listed above the catches of bullet tunas in the IOTC database are thought to be highly uncertain and represent only a small fraction of the total catches of this species in the Indian Ocean.

[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.

TABLE 4. Bullet tuna: scientific estimates of catches of bullet tuna by type of fishery for the period 1950–2017 (in metric tonnes).

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Purse seine	-	-	28	278	552	655	908	1,055	1,372	635	549	518	2,539	3,023	2,117	2,982
Gillnet	41	153	296	531	1,222	1,741	2,236	2,587	3,347	2,702	2,846	2,735	3,202	3,022	2,827	4,209
Line	113	193	325	393	780	1,190	1,858	2,182	2,903	1,471	1,512	1,228	2,895	5,191	4,681	6,674
Other	5	13	44	242	755	1,322	1,638	2,022	2,748	3,905	4,510	4,623	1,387	1,402	1,965	1,999
Total	**159**	**360**	**693**	**1,444**	**3,309**	**4,907**	**6,640**	**7,847**	**10,370**	**8,712**	**9,418**	**9,104**	**10,023**	**12,638**	**11,590**	**15,864**

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.

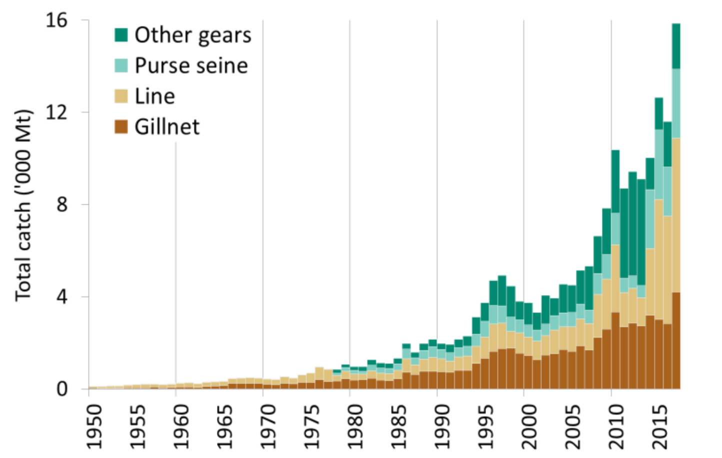


Fig.19. Bullet tuna: Annual catches by gear recorded in the IOTC Database (1950–2017).

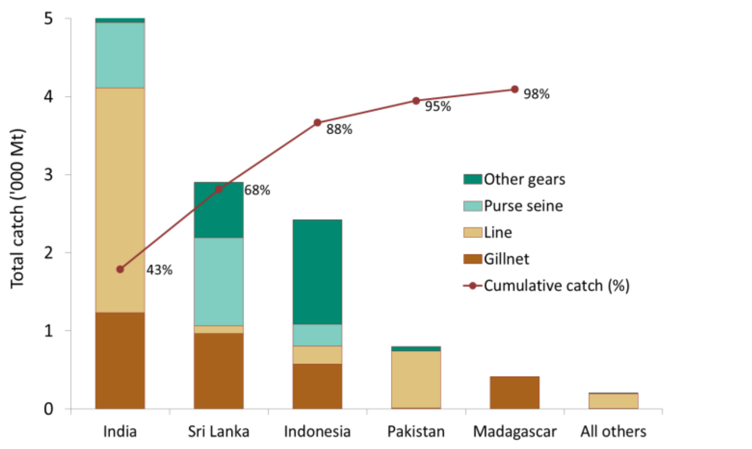


Fig.20. Bullet tuna: Average catches in the Indian Ocean over the period 2013–17 by country[4].

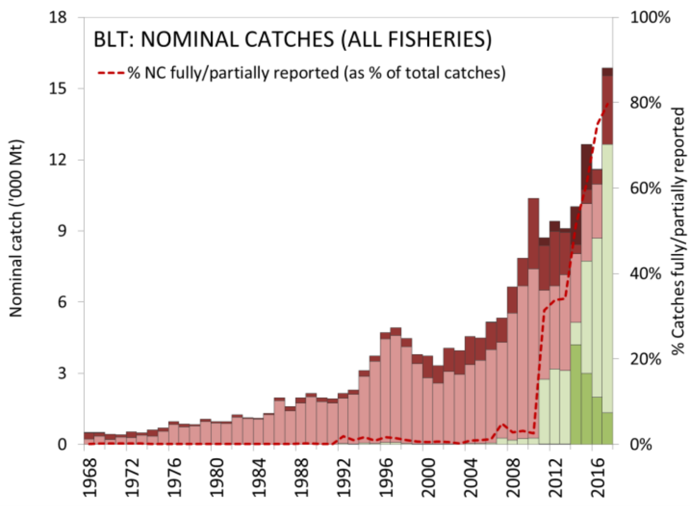


Fig.21. Bullet tuna: nominal catch; uncertainty of annual catch estimates for all fisheries (1978–2017).

Catches are assessed against IOTC reporting standards, where a 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 (estimated by the IOTC Secretariat).

Bullet tuna – Effort trends

[4] Countries are ordered from left to right, according to the importance of catches of longtail reported for 2013-2017. The red line indicates the (cumulative) proportion of catches of longtail tuna for the countries concerned, over the total combined catches of this species reported from all countries and fisheries for 2013-2017.

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

Bullet tuna – Catch-per-unit-effort (CPUE) trends

- Availability: highly incomplete, and, when available, are considered to be of poor quality for the fisheries having reasonably long catch-and-effort data series – as is the case with the gillnet fisheries of Sri Lanka (**Fig.22**).
- Main CPUE series available: Sri Lanka (gillnets) (**Fig.23**).

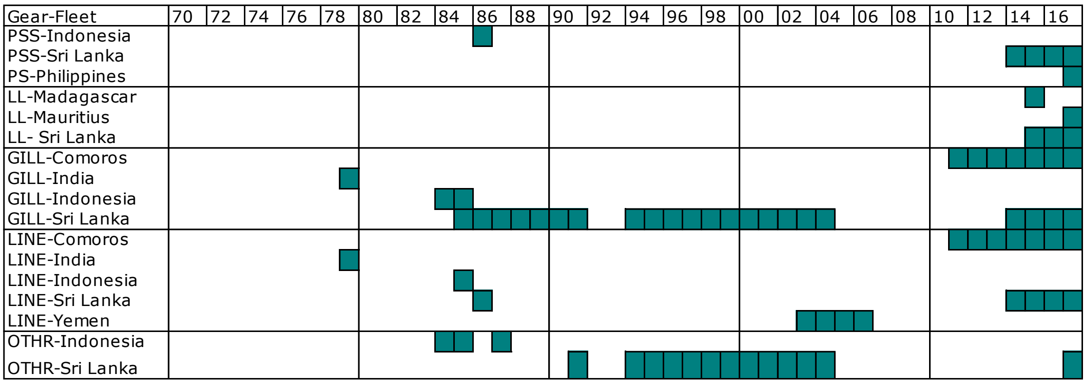


Fig.22. Bullet tuna: Availability of catches and effort series, by fishery and year (1970–2017)[5]. Note that no catches and effort are available at all for 1950–78.

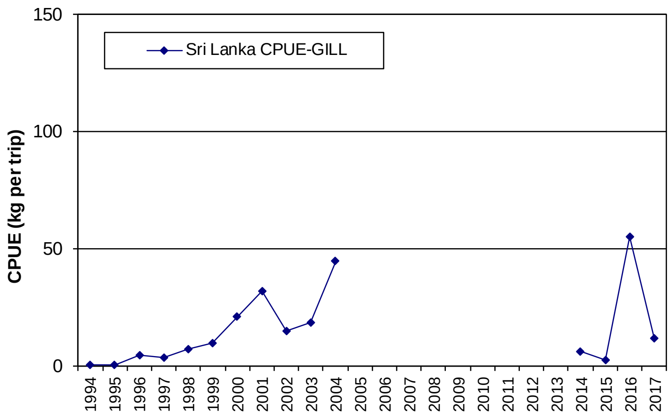


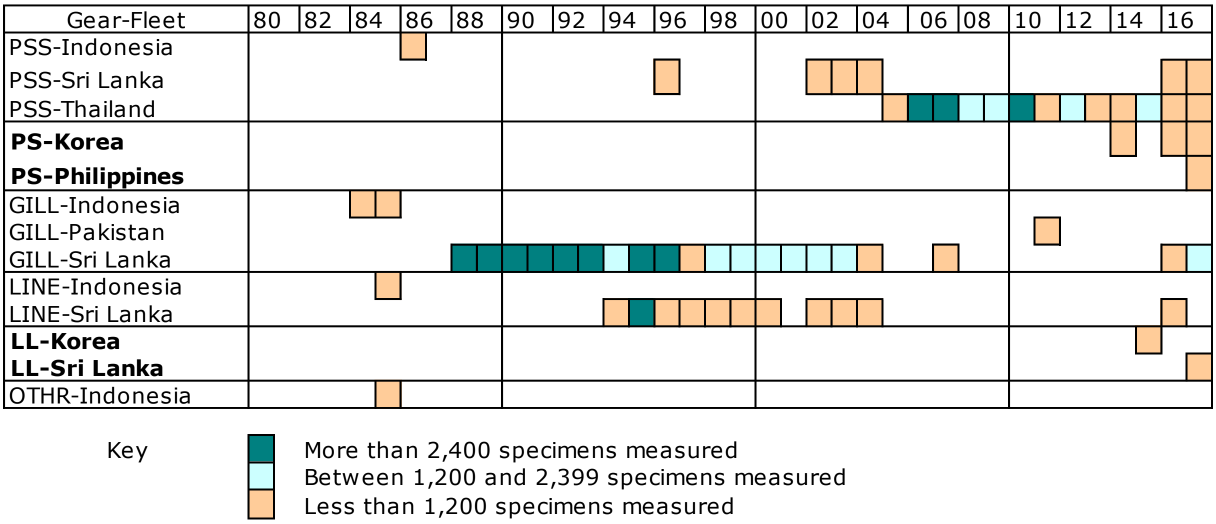
Fig.23. Bullet tuna: Nominal CPUE series for the gillnet fishery of Sri Lanka derived from the available catches and effort data (1994–2004 and 2014-2017).

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

- Sizes: Fisheries catching bullet tuna in the Indian Ocean tend to catch specimens ranging between 15 and 35 cm.
- Size frequency data: highly incomplete, with data only available for selected years and/or fisheries (**Fig.24**).

  Main sources for size samples: Sri Lanka (gillnet and trolling).
  Total numbers of samples, across all years, are also well below the minimum sampling standard of 1 fish per tonne of catch recommended by the IOTC Secretariat to reliably assess changes in average weight.
- 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] Note that the above list is not exhaustive, showing only the fisheries for which catches and effort are available in the IOTC database. Furthermore, when available catches and effort may not be available throughout the year existing only for short periods



- **Fig. 24.** Bullet tuna: Availability of length frequency data, by fishery and year (1980–2017)[6]. Note that no length frequency data are available at all for 1950–83.

- **Other biological data**: Equations available for bullet tuna are shown below:

Species	From type measurement – To type measurement	Equation	Parameters	Sample size	Length
Bullet tuna	Fork length – Round Weight	RND=a*L^b	a= 0.00001700 b= 3.0		Min:10 Max:40

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

[6] Note that the above list is not exhaustive, showing only the fisheries for which size data are available in the IOTC database. Furthermore, when available size data may not be available throughout the year existing only for short periods

APPENDIX IVB
MAIN STATISTICS FOR FRIGATE TUNA (*AUXIS THAZARD*)

Extract from IOTC–2019–WPNT09–07

Fisheries and main catch trends

- Main fisheries: frigate tuna is mainly caught using gillnets, coastal longline and trolling, handlines and trolling, and to a lesser extent coastal purse seine nets (**Table 3; Fig.12**). The species is also an important bycatch for industrial purse seine vessels and is the target of some ring net fisheries (recorded as purse seine in Table 3).
- Main fleets (i.e., highest catches in recent years):
  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, I.R. Iran, India, Sri Lanka) (**Fig.13**).
- Retained catch trends:
  Estimated catches have increased steadily since the late-1970's, reaching around 30,000 t in the late-1980's, to between 55,000 and 60,000 t by the mid-1990's, and remaining at the same level in the following ten years. Between 2010 and 2014 catches have increased to over 95,000 t, rising to the highest levels recorded; although catches have since decline marginally to between 85,000 – 90,000 t since 2014.
- Discard levels**:** are moderate for industrial purse seine fisheries. In previous years the EU has reported discard levels of frigate tuna for its purse seine fleet, for 2003–07, estimated using observer data.

Changes to the catch series**:** there were relatively small revisions (i.e., up to ≈15%) to the catches for 2016 and 2017; mostly the result of revisions to the catches for Indonesia from 2010 onwards, and also the revision of catches allocated to coastal and offshore gillnet fisheries of I.R. Iran.

Frigate tuna: estimation of catches – data related issues

Retained catches for frigate tuna were derived from incomplete information, and are therefore uncertain[7] (**Fig.14**), notably for the following fisheries:

- Artisanal fisheries of Indonesia: Indonesia did not report catches of frigate tuna by species or by gear for 1950–2004; catches of frigate tuna, bullet tuna and other species were reported 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, in a recent review by the IOTC Secretariat conducted by an independent consultant in 2012 he indicated that the catches of frigate tuna had been underestimated by Indonesia. While the new catches estimated for the frigate tuna in Indonesia remain uncertain, the new figures are considered more reliable than those existing in the past.
- Artisanal fisheries of India and Sri Lanka: Although these countries report catches of frigate tuna, until recently the catches have not been reported by gear. The catches of both countries were also reviewed by an independent consultant in 2012 and assigned by gear on the basis of official reports and information from various other alternative sources. The new catch series was previously presented to the WPNT in 2013, in which the new catches estimated for Sri Lanka are as much as three times higher than compared to previous estimates.
- Artisanal fisheries of Myanmar and Somalia: None of these countries have ever reported catches of frigate tuna to the IOTC Secretariat, and catch levels are highly uncertain. In the case of Myanmar, catches are taken from FAO and SEAFDEC (various years).
- Other artisanal fisheries: The catches of frigate tuna and bullet tuna are seldom reported by species and, when they are reported by species, usually refer to both species (due to species misidentification or commercial categories used within countries, with all catches often assigned as frigate tuna).

[7] 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.

- Industrial fisheries: The catches of frigate tuna recorded for industrial purse seiners are thought to be a fraction of those retained on board. Due to this species being a bycatch, catches of frigate tuna are seldom recorded in the logbooks, nor can they be monitored in port. Currently the only discards data for frigate tuna reported to the IOTC Secretariat refer to the EU purse seine fleet, for 2003–07, estimated using observer data.

TABLE 3. Frigate tuna: Best scientific estimates of the catches of frigate tuna by type of fishery for the period 1950–2017 (in metric tonnes). Data as of June 2019.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Purse seine	-	15	824	4,664	7,550	10,021	9,501	9,663	12,044	11,636	10,369	10,371	13,153	9,639	11,199	9,158
Gillnet	485	1,239	2,837	6,948	14,519	20,190	24,082	23,750	30,908	30,145	31,040	29,978	37,002	28,354	30,086	28,791
Line	1,265	2,409	4,419	7,432	13,753	27,150	30,806	34,923	38,209	37,568	36,283	39,945	37,423	35,224	34,568	32,866
Other	1,441	2,007	2,349	3,683	9,276	13,670	15,193	18,112	18,550	18,934	17,665	19,024	14,630	13,837	13,725	13,870
Total	**3,191**	**5,670**	**10,428**	**22,728**	**45,099**	**71,031**	**79,582**	**86,448**	**99,710**	**98,282**	**95,356**	**99,318**	**102,207**	**87,054**	**89,578**	**84,684**

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.

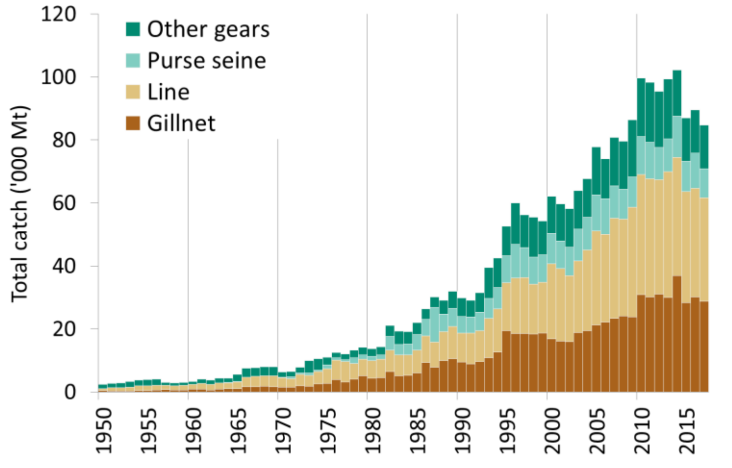


Fig.12. Frigate tuna: Annual catches by gear recorded in the IOTC Database (1950–2017).

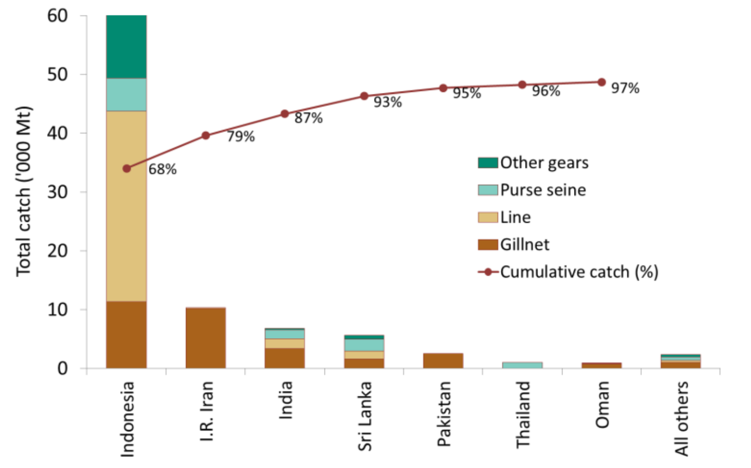
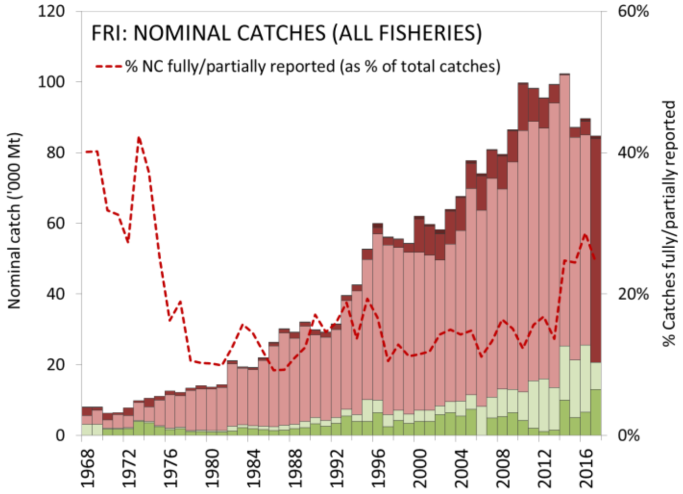


Fig.13. Frigate tuna: Average catches in the Indian Ocean over the period 2013–17, by country[8].



[8] Countries are ordered from left to right, according to the importance of catches of longtail reported for 2013-2017. The red line indicates the (cumulative) proportion of catches of longtail tuna for the countries concerned, over the total combined catches of this species reported from all countries and fisheries for 2013-2017.

Fig.14. Frigate tuna: nominal catch; uncertainty of annual catch estimates for all fisheries (1978–2017).

Catches are assessed against IOTC reporting standards, where a 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 (estimated by the IOTC Secretariat).

Frigate tuna – Effort trends

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

Frigate tuna – Catch-per-unit-effort (CPUE) trends

- Availability: highly incomplete, although data are available for short periods of time (e.g., more than 10 years) for selected fisheries (**Fig.15**).
- Main CPUE series available: Sri Lanka (gillnets), Iran (gillnets) and Maldives (pole and line, hand and troll lines) (**Fig.16**). However the quality of catch-and-effort recorded for Sri Lankan and Iran gillnets are thought to be low due to large changes in the CPUE between consecutive years.

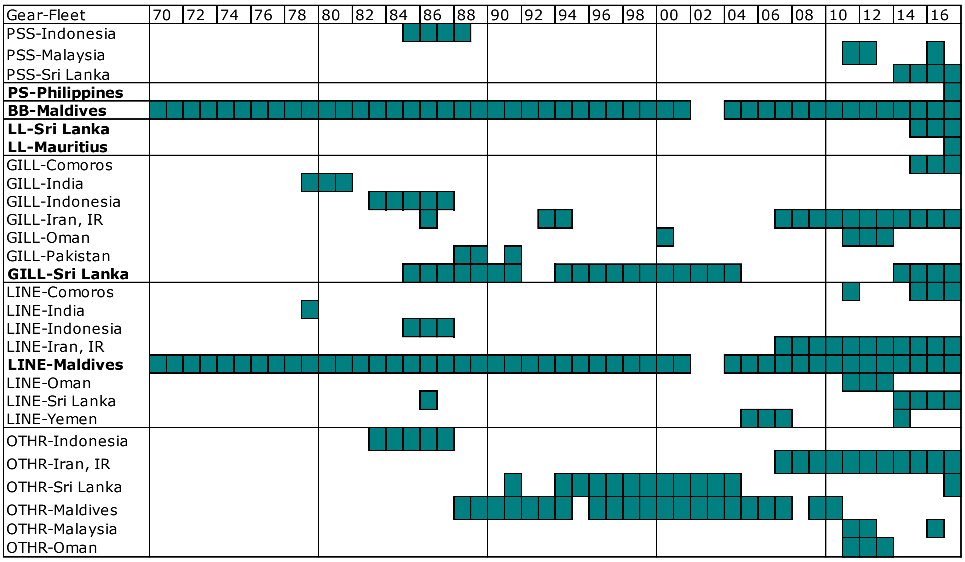


Fig.15: Frigate tuna: Availability of catches and effort series, by selected fishery and year (1970–2017)[9]. Note that no catch-and-effort data are available for 1950–69.

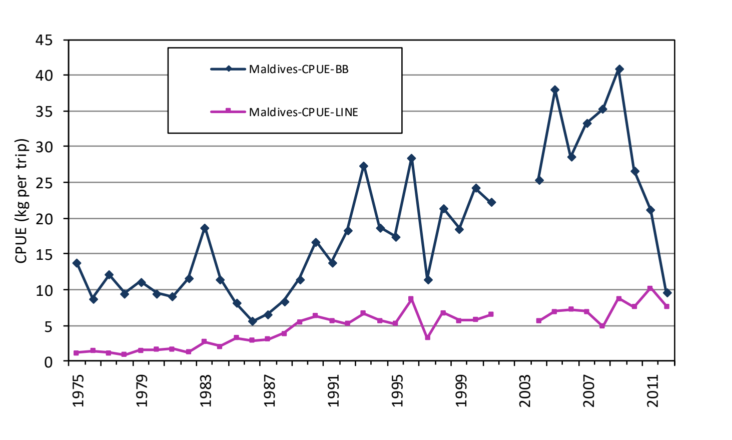


Fig.16(a). Frigate tuna: Nominal CPUE series for the baitboat (BB using mechanized boats) and line (LINE, including handlines and trolling using mechanized boats) fisheries of Maldives derived from the available catches and effort data (1975–2016). Data since 2013 has been reported as fishing days (rather than as fishing trips for data up to 2013).

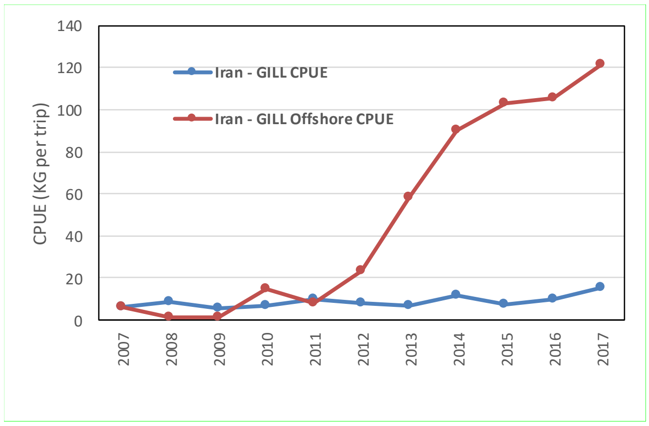


Fig 16(b). Frigate tuna Nominal CUE series for Gillnet coastal and offshore fisheries of Iran from available catch and effort data (2007-2017).

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

- Sizes: the sizes of frigate tunas taken by Indian Ocean fisheries typically range between 20 – 50 cm depending on the type of gear used, season and location. Fisheries operating in the Andaman Sea (coastal purse seines and troll lines) tend to catch frigate tuna of small to medium size (15–40 cm) while the gillnet, baitboat and other fisheries operating in the Indian Ocean catch usually larger specimens (25–50 cm).
- Size frequency data: highly incomplete, with data only available for selected years and/or fisheries (**Fig.17**).

  Main sources for size samples: Sri Lanka (gillnet) and Thailand (coastal purse seiners).
  Length distributions derived from data available for gillnet fisheries are shown in **Fig.18**. Generally speaking total numbers of samples are below the minimum sampling standard of 1 fish per tonne of catch recommended by the IOTC Secretariat to reliably assess changes in average weight – with the exception of samples recorded for Sri Lanka gillnets during the mid-1980s to early-1990, which were obtained with the support of IPTP funding.
- 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.

[9] Note that the above list is not exhaustive, showing only the fisheries for which catches and effort are available in the IOTC database. Furthermore, when available catches and effort may not be available throughout the year existing only for short periods

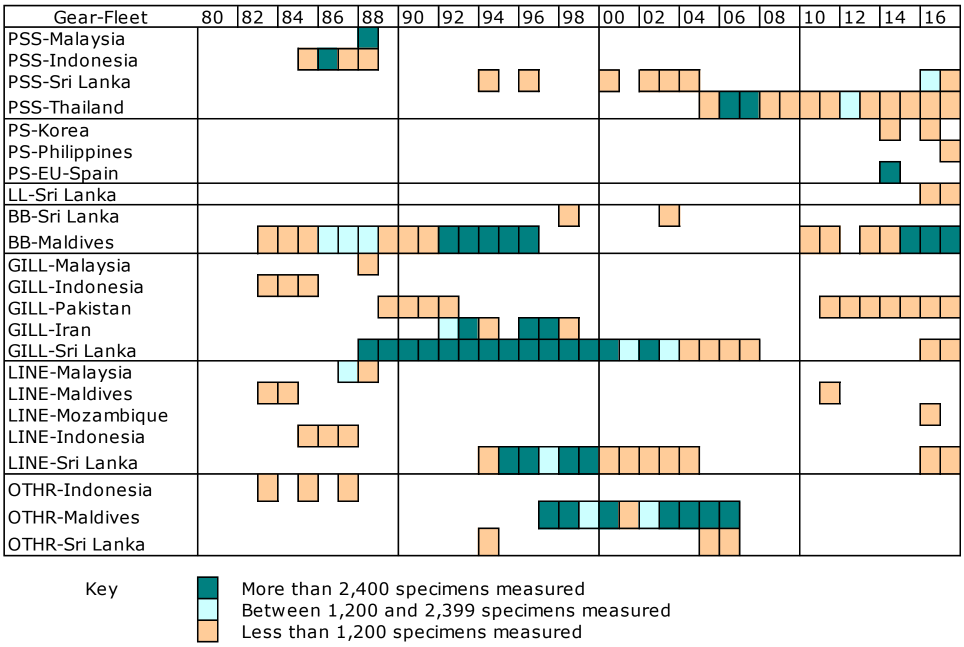


Fig.17. Frigate tuna: Availability of length frequency data, by fishery and year (1980–2017)[10]. Note that no length frequency data are available at all for 1950–82.

Other biological data: Equations available for frigate tuna are shown below:

Species	From type measurement – To type measurement	Equation	Parameters	Sample size	Length
Frigate tuna	Fork length – Round Weight	RND=a*L^b	a= 0.00001700 b= 3.0		Min:20 Max:45

Source: Data from Indian Ocean: IOTC-2011-WPNT01-10 Tuna Fishery of India with Special Reference to Biology and Population Characteristics of Neritic Tunas Exploited from Indian EEZ.

[10] Note that the above list is not exhaustive, showing only the fisheries for which size data are available in the IOTC database. Furthermore, when available size data may not be available throughout the year existing only for short periods

APPENDIX IVC
MAIN STATISTICS FOR KAWAKAWA (*EUTHYNNUS AFFINIS*)

Extract from IOTC–2019–WPNT09–07

Fisheries and main catch trends

- Main fisheries: Kawakawa are caught mainly by, gillnets, handlines and trolling, and coastal purse seiners, and may be also an important bycatch of the industrial purse seiners (**Table 5; Fig.25**).
- Main fleets (i.e., highest catches in recent years): Indonesia, India, I.R. Iran, and Pakistan (**Fig.26**).
- Retained catch trends:
  Annual estimates of catches for the kawakawa increased markedly from around 20,000 t in the mid-1970's to reach the 45,000 t mark in the mid-1980's to over 155,000 t in recent years (since 2011). Since 2011 catches have fluctuated between 160,000 t and 168,000 t – the highest catches ever recorded for this species in the Indian Ocean.
- Discard levels: are moderate for industrial purse seine fisheries. In recent years the EU has reported discard levels of kawakawa for its purse seine fleet, for 2003–07, estimated using observer data.

Changes to the catch series**:** there were no major revisions to the catch series for kawakawa since the WPNT meeting in 2018.

Kawakawa tuna – estimation of catches: data related issues

Retained catches for kawakawa were derived from incomplete information, and are therefore considered to be highly uncertain[11] (**Fig.27**), notably for the following fisheries:

- 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 – while 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 they are not always reported 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 have 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 catches of kawakawa recorded for industrial purse seiners are thought to be a fraction of those retained on board. Due to this species being a bycatch, its catches are seldom recorded in the logbooks, nor are they monitored in port. The EU recently reported catch levels of frigate tuna for its purse seine fleet, for 2003–07, estimated using observer data.

[11] 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.

TABLE 5. Kawakawa: Best scientific estimates of the catches of kawakawa by type of fishery for the period 1950–2017 (in metric tonnes). Data as of June 2019.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Purse seine	110	385	2,616	12,070	21,396	28,613	32,441	37,051	35,064	44,892	42,722	42,479	40,438	42,351	39,126	42,540
Gillnet	2,552	4,473	9,691	17,959	30,709	53,510	70,785	69,593	64,507	74,761	75,552	86,043	79,988	76,200	81,711	83,254
Line	1,725	3,274	6,642	9,865	15,673	19,911	22,710	23,983	23,562	25,801	32,694	29,323	31,091	31,455	29,925	26,680
Other	295	719	1,357	2,690	5,127	7,819	9,015	10,129	9,994	10,007	9,986	10,329	8,436	7,428	8,337	6,647
Total	**4,683**	**8,851**	**20,306**	**42,583**	**72,905**	**109,853**	**134,952**	**140,756**	**133,127**	**155,460**	**160,954**	**168,174**	**159,952**	**157,435**	**159,099**	**159,121**

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.

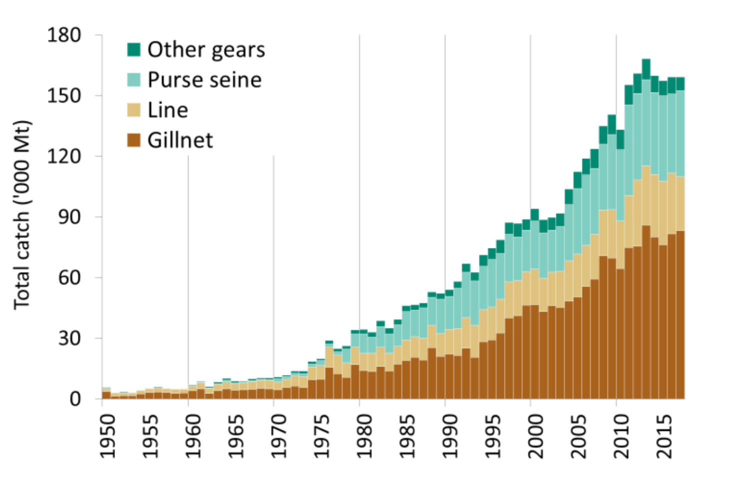


Fig.25. Kawakawa: Annual catches by gear recorded in the IOTC Database (1950–2017).

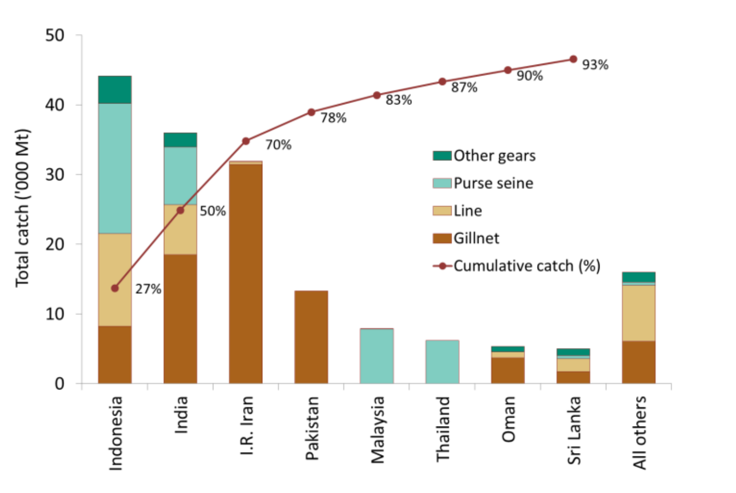


Fig.26. Kawakawa: Average catches in the Indian Ocean over the period 2013–17, by country[12].

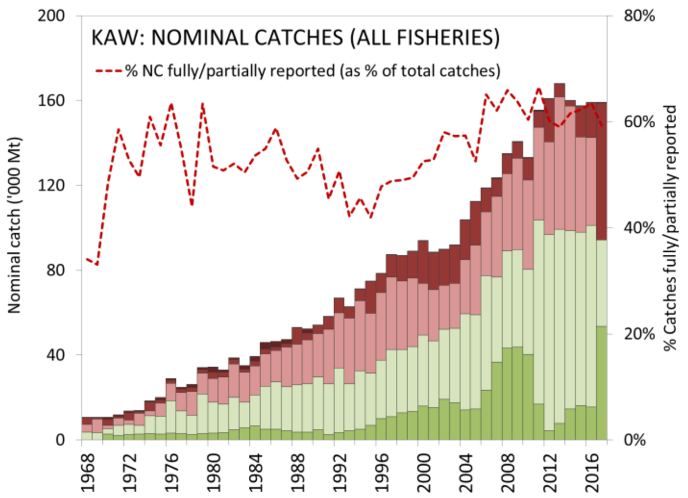


Fig.27. Kawakawa: nominal catch; uncertainty of annual catch estimates for all fisheries (1977–2017).

Catches are assessed against IOTC reporting standards, where a 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 (estimated by the IOTC Secretariat).

[12] Countries are ordered from left to right, according to the importance of catches of longtail reported for 2013-2017. The red line indicates the (cumulative) proportion of catches of longtail tuna for the countries concerned, over the total combined catches of this species reported from all countries and fisheries for 2013-2017.

Kawakawa tuna – Effort trends

- Availability: Effort trends are unknown for longtail tuna in the Indian Ocean.

Kawakawa tuna – Catch-per-unit-effort (CPUE) trends

- Availability: highly incomplete, with data available for only short periods of time and selected fisheries (**Fig.28**).
- Main CPUE series available: Maldives (baitboats and troll lines) (**Fig.29**), 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.

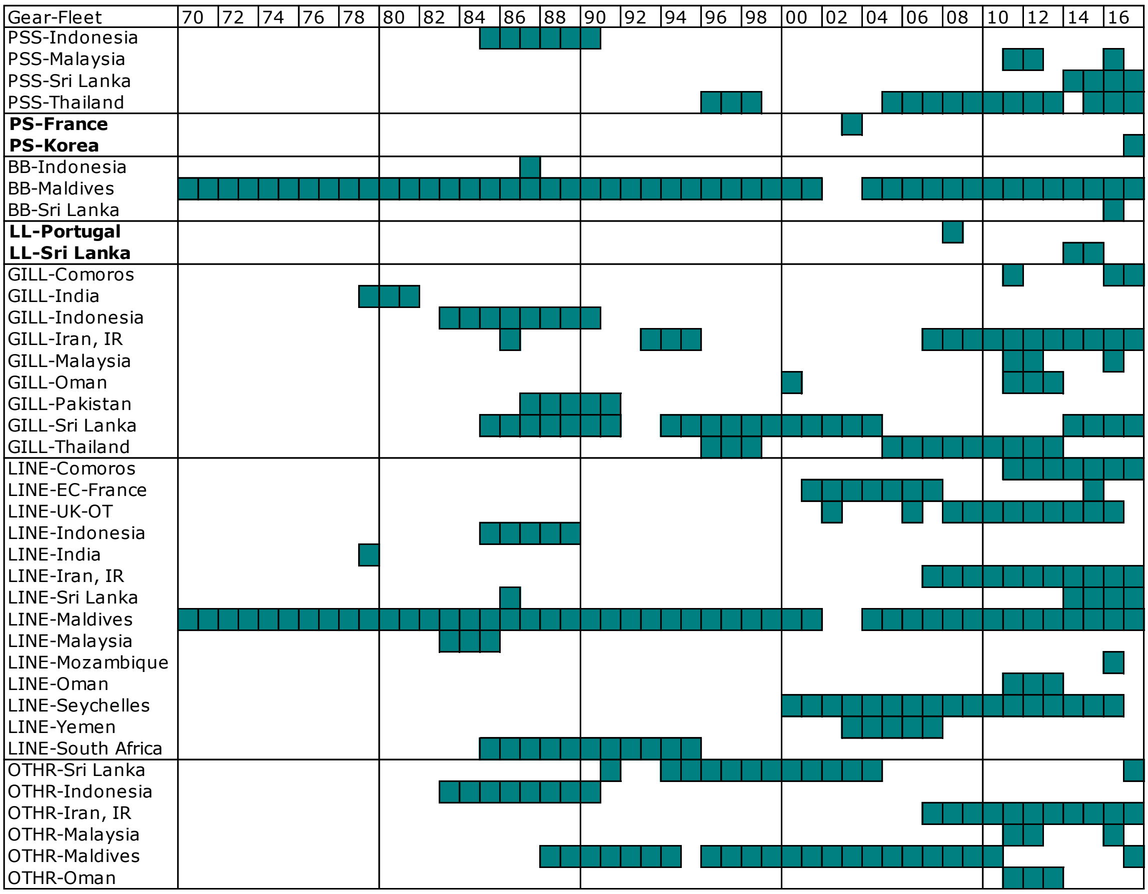


Fig. 28. Kawakawa: Availability of catches and effort series, by fishery and year (1970-2017)[13]. Note that no catches and effort are available at all for 1950–69.

[13] Note that the above list is not exhaustive, showing only the fisheries for which catches and effort are available in the IOTC database. Furthermore, when available catches and effort may not be available throughout the year existing only for short periods

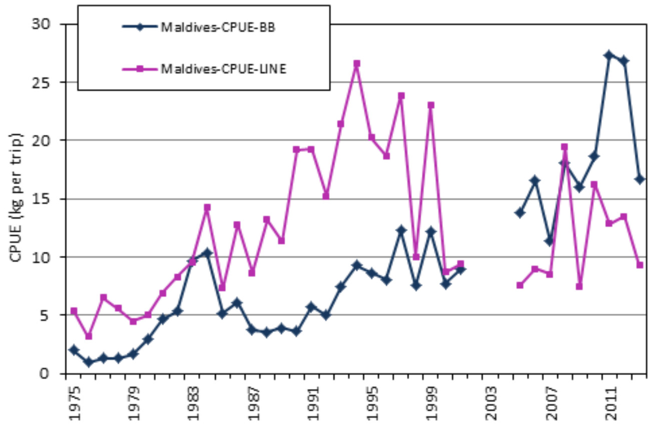


Fig. 29a. Kawakawa: Nominal CPUE series for baitboat (BB) and troll line (TROL) fisheries of Maldives (1975–2017) derived from the available catch-and-effort data.

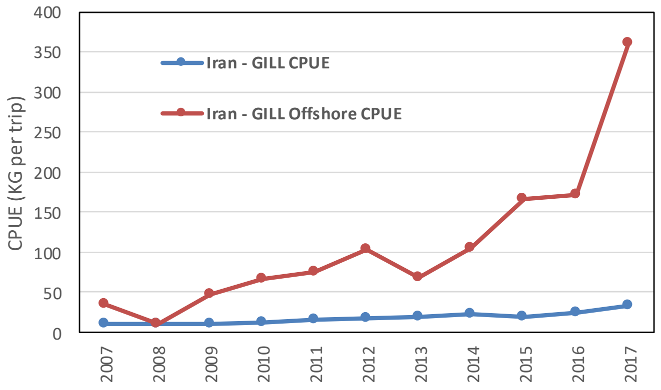


Fig. 29b. Kawakawa: Nominal CPUE series for the gillnet fishery (coastal and offshore) of I.R. Iran derived from the available catches and effort data (2007-2017).

Kawakawa tuna – 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 (**Fig.31a**). 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 catch usually larger specimens (25–55 cm).
- Size frequency data: overall highly incomplete, with data only available for selected years and/or fisheries (**Fig.30**).

  Main sources for size samples: Sri Lanka (gillnet), and I.R. Iran (gillnets).
  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 (**Fig. 31b**). 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.
  Length distributions derived from the data available for gillnet fisheries are shown in **Fig.31a**. Data are not available in sufficient numbers for all other fisheries.
- 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.

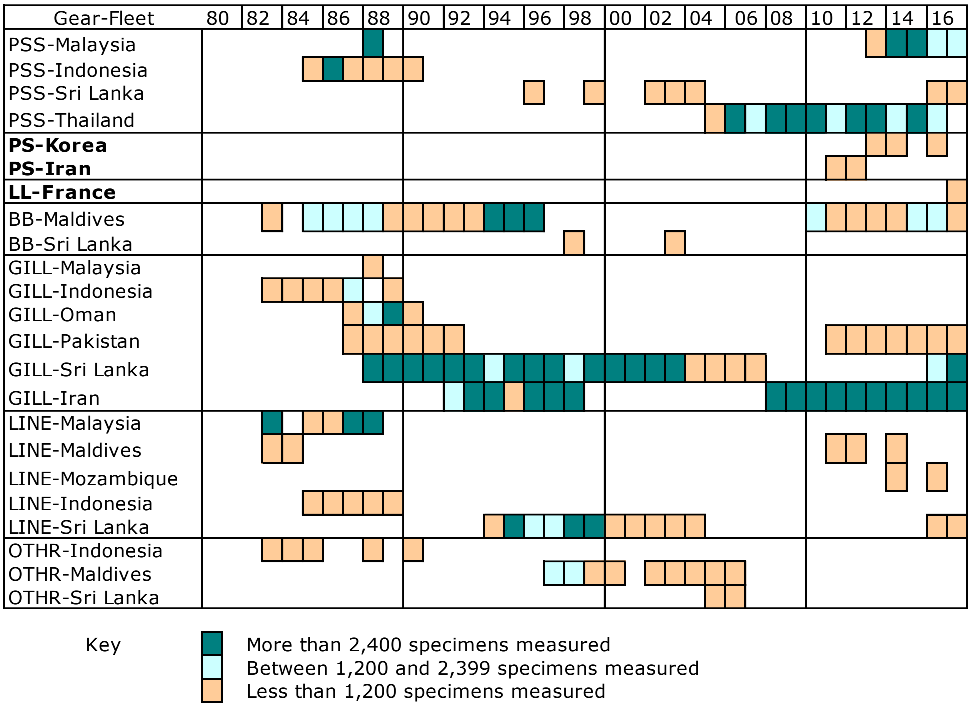


Fig.30. Kawakawa: Availability of length frequency data, by fishery and year (1980-2017)[14]. Note that no length frequency data are available for 1950–82.

Other biological data: Equations available for kawakawa are shown below

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

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

[14] Note that the above list is not exhaustive, showing only the fisheries for which size data are available in the IOTC database. Furthermore, when available size data may not be available throughout the year existing only for short periods

APPENDIX IVD
MAIN STATISTICS FOR LONGTAIL TUNA (*THUNNUS TONGGOL*)

Extract from IOTC–2019–WPNT09–07

Fisheries and main catch trends

- Main fisheries: longtail tuna are caught mainly using gillnets and, to a lesser extent, coastal purse seine nets and trolling (**Table 2; Fig. 5**).
- Main fleets (i.e., highest catches in recent years):
  Over 40% of the catches of longtail in the Indian Ocean are accounted for by I.R. Iran (gillnetters), followed by Indonesia (gillnet and trolling), Pakistan (gillnetters) (**Fig.6**).
- Retained catch trends:
  Estimates catches of longtail tuna have increased steadily from the mid-1950s, reaching around 15,000t in the mid-1970's, over 35,000t by the mid-1980's, and more than 96,000 t 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 t in 2011. Since 2011 catches levels have generally fluctuated between 130,000 – 160,000 t.

  Around the late-2000s I.R. Iran has reported large increases catches of longtail tuna in coastal waters in the Arabian Sea, as a result of the threat of piracy and displacement of fishing effort (and change of targeting) by gillnet vessels formerly operating in the North-West Indian Ocean. Since 2013 lower catches have been reported – albeit not to pre-piracy levels – in response to the reduced threat of piracy, and resumption of fishing activity on 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 no major revisions to the catches of longtail tuna since the WPNT meeting in 2018.

Longtail tuna: 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[15] (**Fig.7**); 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 2014-2016 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 is 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 the estimates of longtail tuna.
- 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. The catches of India were also reviewed by the 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 have 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).

[15] 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.

TABLE 2. Longtail tuna: latest scientific estimates of the catches of longtail tuna by type of fishery for the period 1950–2017 (in metric tonnes). Data as of June 2019.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Purse seine	63	204	1,012	4,863	10,933	17,719	18,885	20,649	16,531	26,062	25,218	17,227	12,772	10,497	11,566	8,814
Gillnet	2,943	6,209	10,026	25,839	41,648	63,485	69,708	87,159	105,094	120,746	114,623	113,084	103,100	99,116	94,104	98,152
Line	560	819	1,519	4,056	5,016	9,502	11,206	12,494	12,977	15,964	25,916	20,847	26,592	20,927	19,246	22,254
Other	0	0	125	1,090	1,992	3,731	5,460	5,300	6,513	8,467	9,079	5,880	5,040	6,256	7,284	9,989
Total	**3,566**	**7,232**	**12,681**	**35,848**	**59,589**	**94,437**	**105,260**	**125,601**	**141,115**	**171,238**	**174,835**	**157,038**	**147,504**	**136,796**	**132,200**	**139,209**

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.

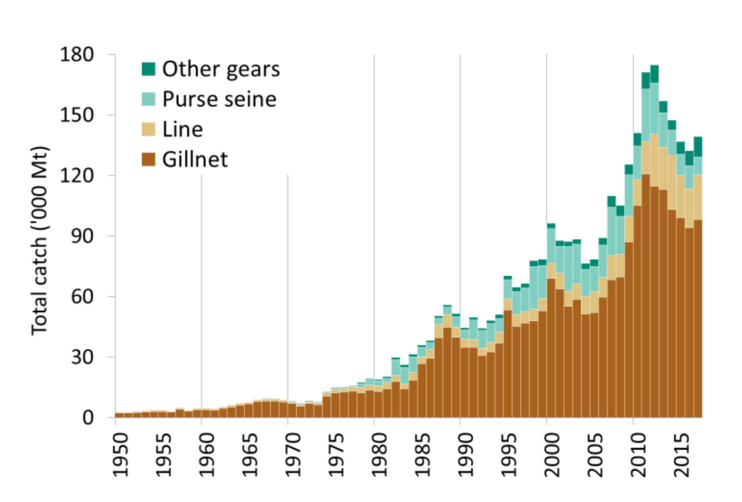


Fig.5. Longtail tuna: Annual catches by gear recorded in the IOTC Database (1950–2017).

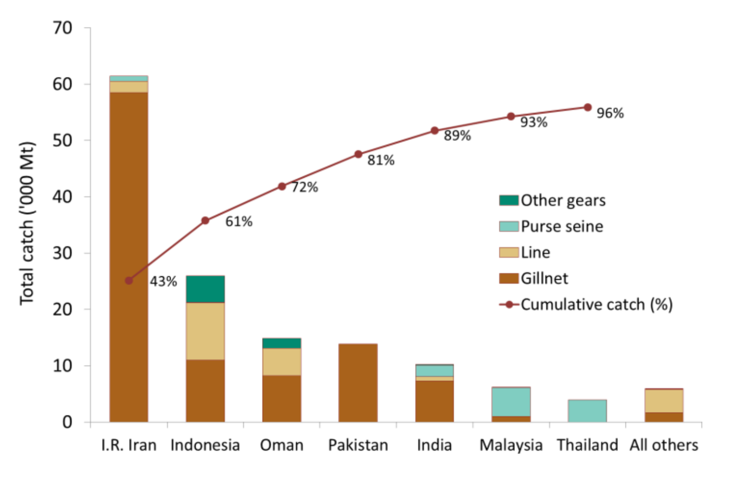


Fig.6. Longtail tuna: Average catches in the Indian Ocean over the period 2013–17, by country[16].

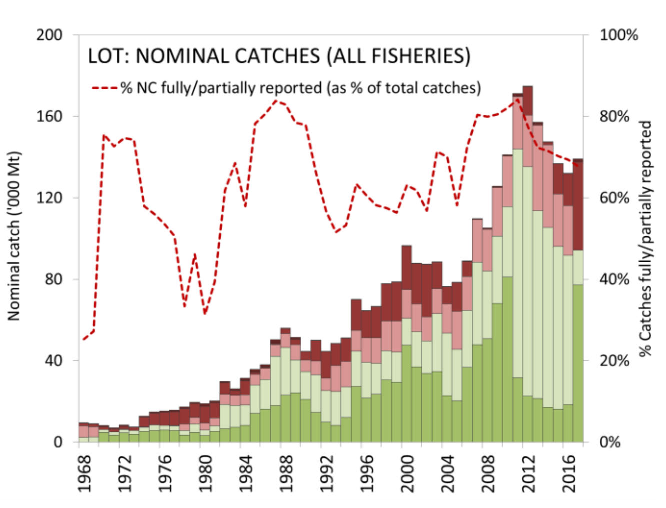


Fig.7. Longtail tuna: nominal catch; uncertainty of annual catch estimates for all fisheries (1978–2017).

Catches are assessed against IOTC reporting standards, where a 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 (estimated by the IOTC Secretariat).

[16] Countries are ordered from left to right, according to the importance of catches of longtail reported for 2013-2017. The red line indicates the (cumulative) proportion of catches of longtail tuna for the countries concerned, over the total combined catches of this species reported from all countries and fisheries for 2013-2017.

Longtail tuna – Effort trends

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

Longtail tuna – Catch-per-unit-effort (CPUE) trends

- <u>Availability</u>: highly incomplete, with data available for only short periods of time and selected fisheries (**Fig.8**).
- <u>Main CPUE series available</u>: Thailand coastal purse seine and gillnet vessels (i.e., available over 10 years). I.R. Iran has also recently reported catch and effort for their coastal fisheries from 2007 to 2017. (**Fig.9**).

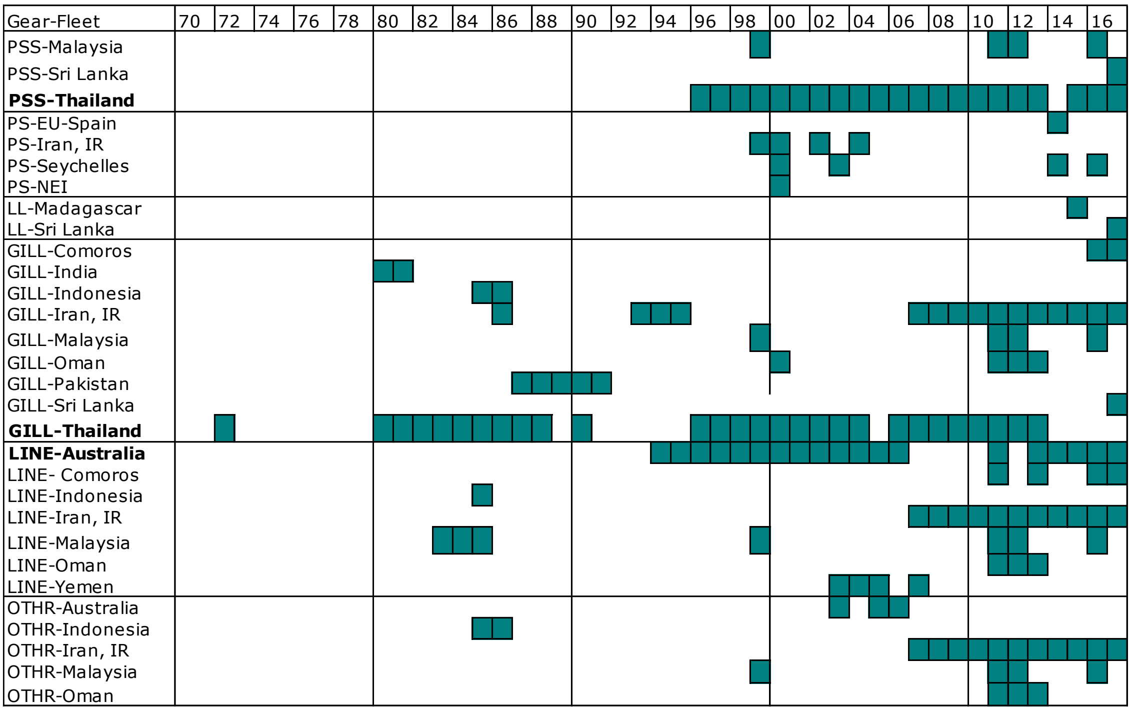


Fig.8. Longtail tuna: Availability of catches and effort series, by fishery and year (1970–2017)[17]. No catch-and-effort is available for 1950–1971.

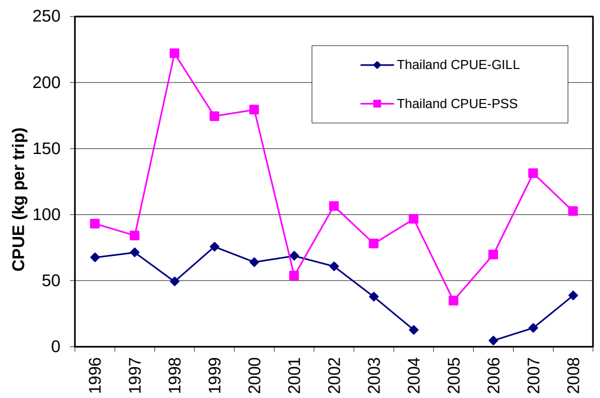


Fig.9a. Longtail tuna: Nominal CPUE series for gillnet (GILL) and coastal purse seine (PSS) fisheries of Thailand derived from available catch-and-effort data (1996–2008);

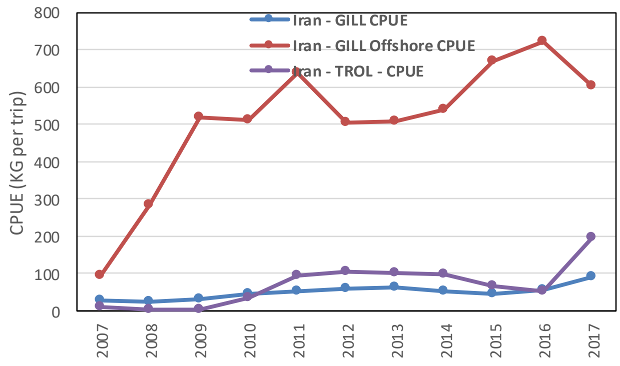


Fig.9b. Longtail tuna: Nominal CPUE series: for gillnet (GILL & Offshore) and trolling (TROL) fisheries of Iran derived from available catch-and-effort data (2007-2017);

[17] Note that the above list is not exhaustive, showing only the fisheries for which catches and effort are available in the IOTC database. Furthermore, catch-and-effort data are sometimes incomplete for a given year, existing only for short periods.

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

- <u>Sizes</u>: longtail tunas taken by Indian Ocean fisheries typically range between 20 – 100 cm depending on the type of gear used, season and location (**Fig.10**). Fisheries operating in the Andaman Sea (coastal purse seines and trolling) tend to catch smaller sized longtail tuna (e.g., 20–45cm), while gillnet fisheries of I.R. Iran and Pakistan (Arabian Sea) catch larger specimens (e.g., 50–100cm).
- <u>Size frequency data</u>**:** highly incomplete, with data available only for selected fisheries.

  <u>Main sources for size samples</u>: I.R. Iran (gillnet), Oman (gillnet), Pakistan (gillnet), and Thailand (coastal purse seiners).
  Length distributions derived from data available for gillnet fisheries are shown in **Fig.11**. Total numbers of samples, across all years, are also well below the minimum sampling standard of 1 fish per tonne of catch recommended by the IOTC Secretariat to reliably assess changes in average weight.
- <u>Catch-at-Size (Age) table</u>: Not available, due to lack of size samples and uncertainty over the reliability of retained catch estimates.
- <u>Sex ratio data</u>: have not been provided to the Secretariat by CPCs.

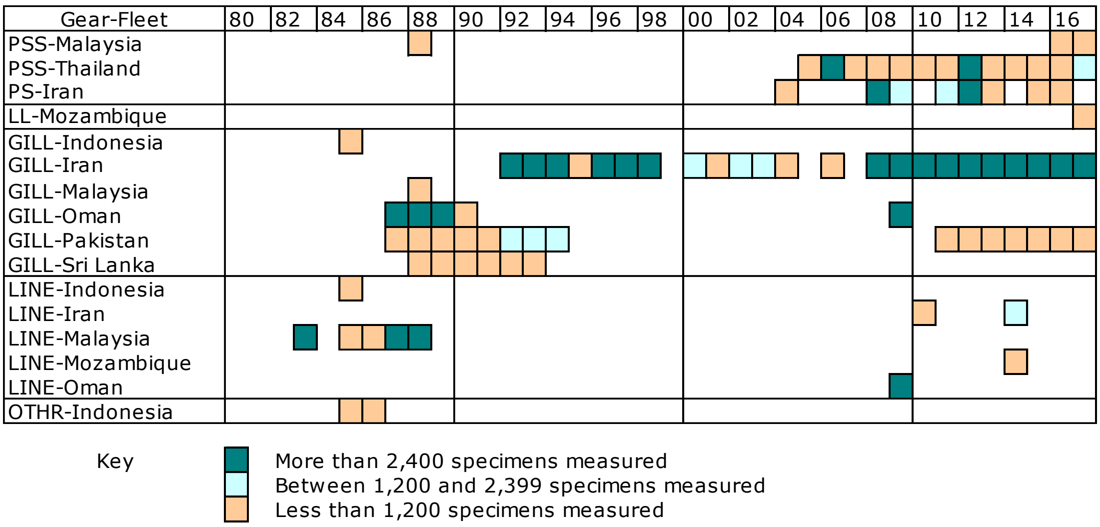


Fig.10. Longtail tuna: Availability of length frequency data, by fishery and year (1980–2017)[18]. Note that no length frequency data are available at all for 1950–1982.

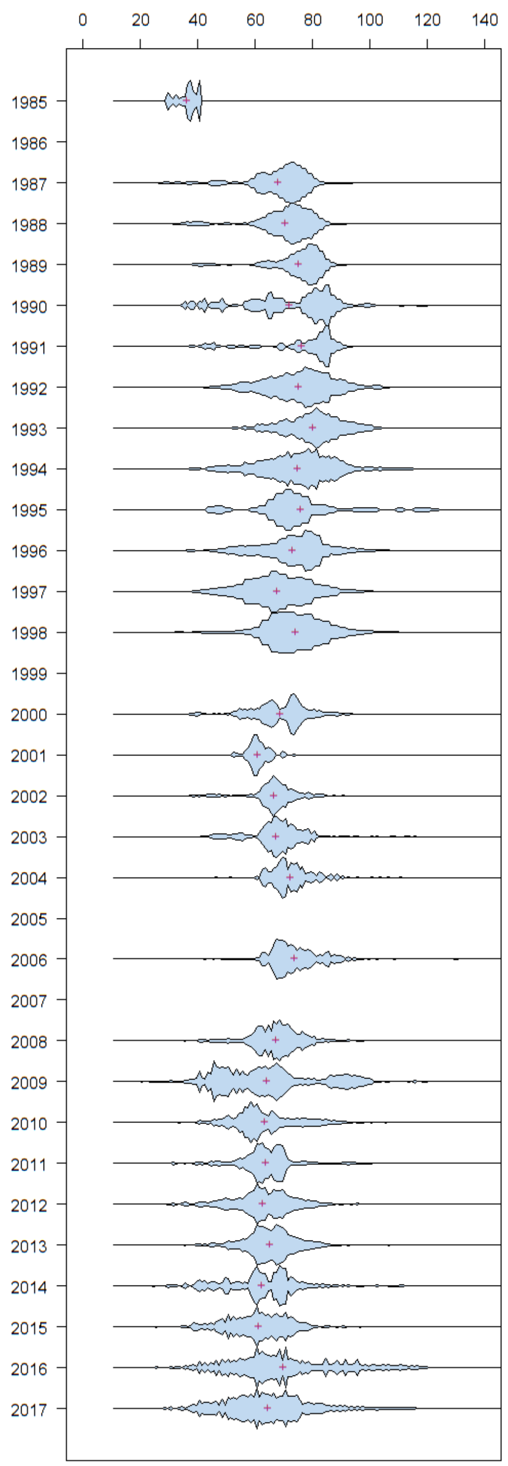
Other biological data: Equations available for longtail tuna are shown below:

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

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, Sh. Ghasemi & S.A. Talebzadeh.

[18] Note that the above list is not exhaustive, showing only the fisheries for which size data are available in the IOTC database. Furthermore, when available size data may not be available throughout the year existing only for short periods

LOT (Gillnet samples): size (in cm)



LOT (Gillnet): no. of samples ('000)

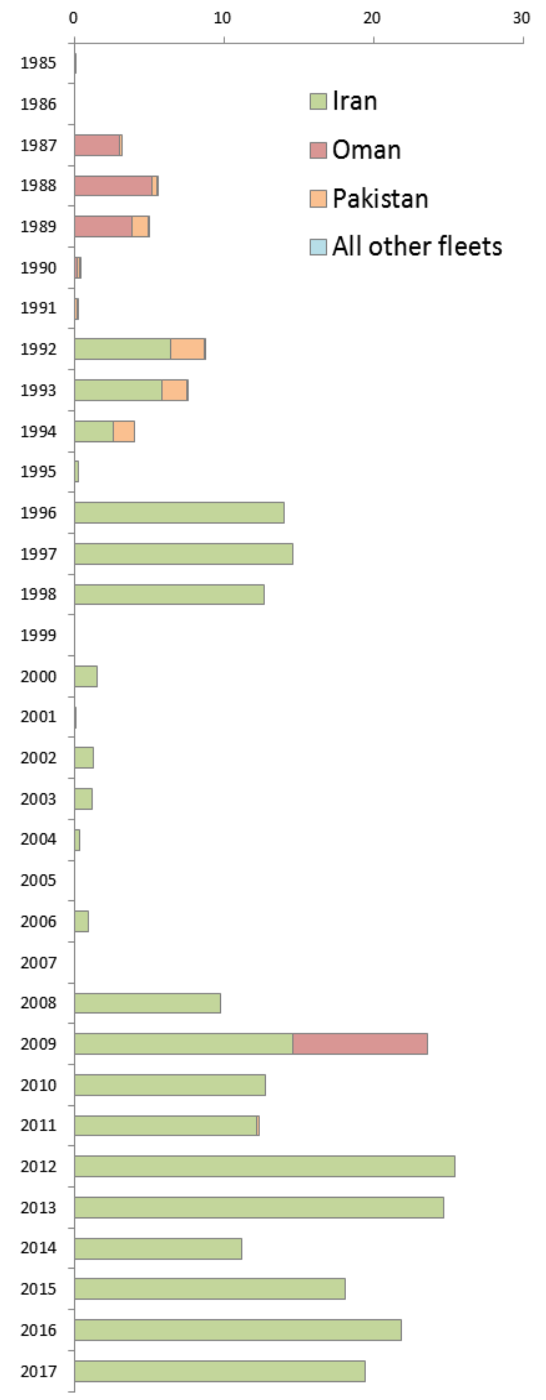


Fig.11a-b. Left: Longtail tuna (gillnet fisheries): Length frequency distributions (by 1cm length class) derived from data available at the IOTC Secretariat, 1985-2017.

Right: Number of longtail tuna specimens (gillnet fisheries) sampled for lengths, by fleet and year.

APPENDIX IVE
MAIN STATISTICS FOR INDO-PACIFIC KING MACKEREL (*SCOMBEROMORUS GUTTATUS*)

Extract from IOTC–2019–WPNT09–07

Fisheries and main catch trends

- Main fisheries: Indo-Pacific king mackerel[19] are caught mainly by gillnet fisheries in the Indian Ocean, however significant numbers are also caught trolling (**Table7; Fig.39**).
- Main fleets (i.e., in terms of highest catches in recent years):
  Almost two-thirds of catches are accounted for by fisheries in India and Indonesia; with important catches also reported by I.R. Iran (**Fig.40**).
- Retained catch trends:
  Estimated catches have increased steadily since the mid 1960's, reaching around 24,000 t in the late 1970's and over 30,000 t by the mid-1990's, when catches remained stable until around 2006. Since the late-2000s catches have increased sharply to over 40,000 t, with the highest catches recorded in 2009 and 2017 at around 53,000 t.
- Discard levels**:** are thought to be very low, although estimates of discards are unknown for most fisheries.

***Changes to the catch series*:** there were no major revisions to the catch series for Indo-Pacific king mackerel since the WPNT meeting in 2018.

Indo-Pacific King mackerel: estimation of catches – data related issues

Retained catches for King mackerel were derived from incomplete information, and are therefore uncertain[20] (**Fig.41**), notably for the following fisheries:

- Species aggregation: King mackerels are often not reported by species but are aggregated with narrow-barred Spanish mackerel or, less frequently, other small tuna species.
- Mislabelling: King mackerels are often mislabelled as narrow-barred Spanish mackerel, their catches reported under the latter species.
- Underreporting: the catches of King mackerel may be not reported for some fisheries catching them as a bycatch.

It is for the above reasons that the catches of King mackerel in the IOTC database are thought to represent only a small fraction of the total catches of this species in the Indian Ocean.

[19] Hereinafter referred to as King mackerel.

[20] 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.

TABLE 7. Indo-Pacific king mackerel: Best scientific estimates of the catches of Indo-Pacific king mackerel by type of fishery for the period 1950–2017 (in metric tonnes). Data as of June 2019.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Purse seine	-	-	34	584	772	938	1,239	1,605	1,104	1,268	1,103	1,237	1,265	1,153	1,152	1,171
Gillnet	4,365	6,896	13,942	17,095	21,709	23,634	31,192	32,069	26,800	28,432	27,733	29,939	33,322	31,655	30,697	35,268
Line	252	351	774	1,335	1,834	2,504	3,520	4,041	3,497	3,677	3,670	3,781	3,838	4,209	4,378	4,862
Other	13	21	48	3,879	5,100	9,353	11,929	15,733	10,859	11,268	9,967	11,303	10,978	10,463	10,302	12,082
Total	**4,630**	**7,269**	**14,798**	**22,893**	**29,415**	**36,428**	**47,880**	**53,448**	**42,260**	**44,646**	**42,473**	**46,259**	**49,403**	**47,480**	**46,529**	**53,383**

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.

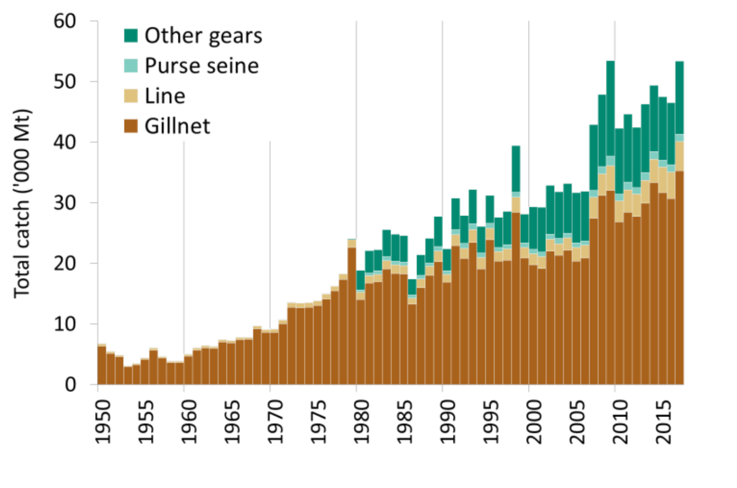


Fig. 39. Indo-Pacific king mackerel: Annual catches by gear recorded in the IOTC Database (1950–2017).

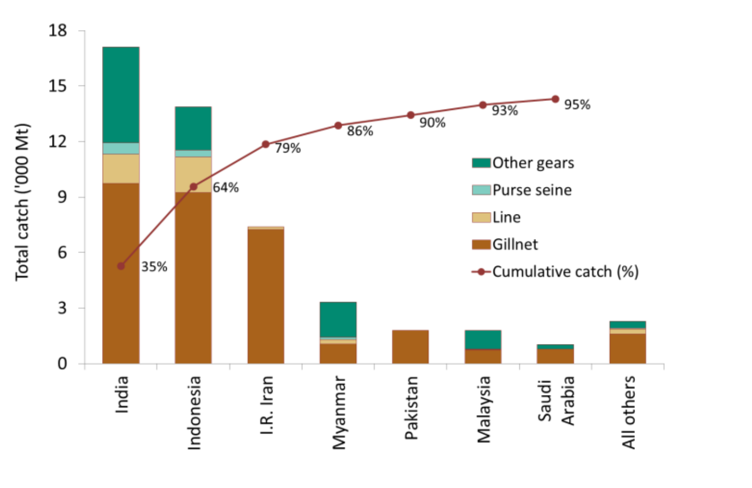


Fig. 40. Indo-Pacific king mackerel: Average catches in the Indian Ocean over the period 2013–17, by country[21].

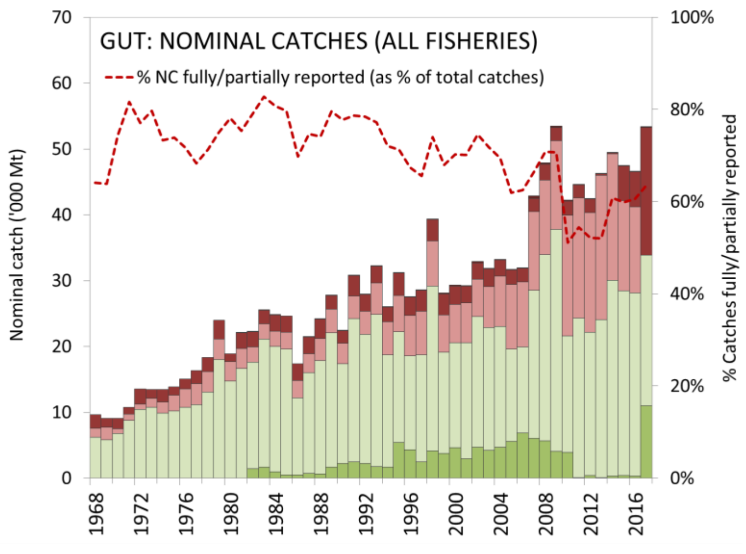


Fig. 41. Indo-Pacific king mackerel: nominal catch; uncertainty of annual catch estimates (1978–2017).

Catches are assessed against IOTC reporting standards, where a 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 (estimated by the IOTC Secretariat).

[21] Countries are ordered from left to right, according to the importance of catches of longtail tuna 2013-2017. The red line indicates the (cumulative) proportion of catches of longtail tuna for the countries concerned, over the total combined catches of this species reported from all countries and fisheries for 2013-2017.

Indo-Pacific King Mackerel – Effort trends

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

Indo-Pacific King Mackerel – Catch-per-unit-effort (CPUE) trends

- Availability: no data available for most fisheries, and where available, data refer to very short periods (**Fig.42**). This makes it impossible to derive any meaningful CPUE from the existing data.

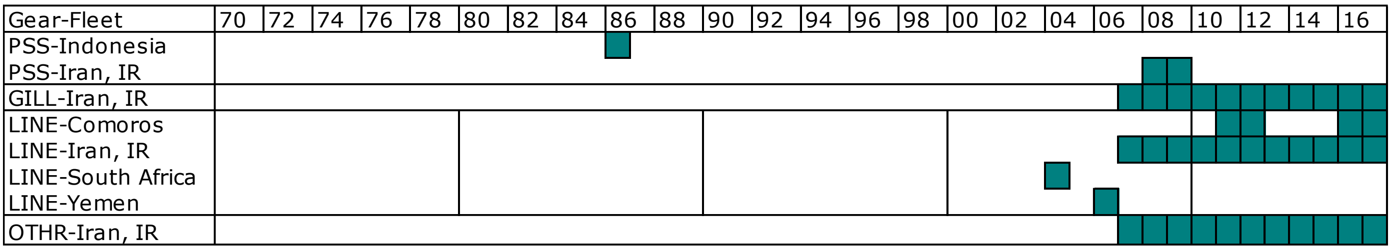


Fig. 42. Indo-Pacific king mackerel: Availability of catches and effort series, by fishery and year (1970–2017)[22]. Note that no catches and effort are available at all for 1950–85.

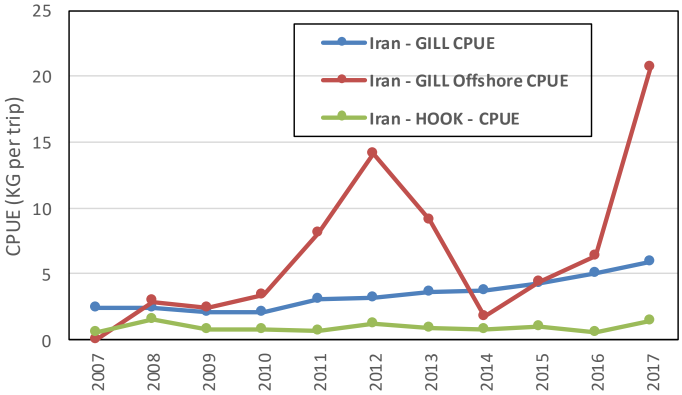
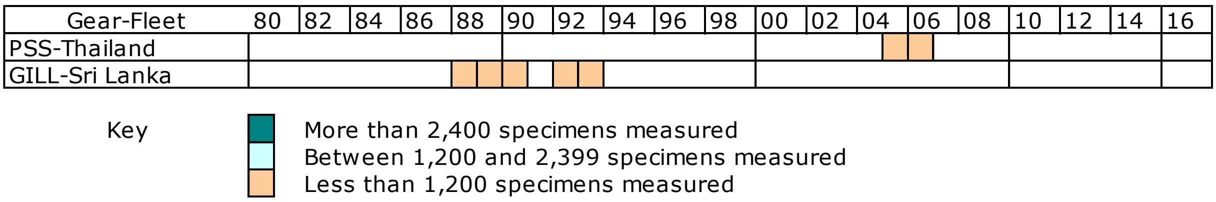


Fig. 43. Indo-Pacific king mackerel: Nominal CPUE series for the gillnet fishery (coastal and offshore) of I.R. Iran derived from the available catches and effort data (2007-2017).

Indo-Pacific king mackerel – Fish size or age trends (e.g., by length, weight, sex and/or maturity)

- Size frequency data: trends in average weight cannot be assessed for most fisheries due to lack of data.

  Main sources of size samples: Thailand (coastal purse seiner) and Sri Lankan (gillnet) – however the number of samples is very small and the data refer to very short periods (**Fig.43**).
- 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.



[22] Note that the above list is not exhaustive, showing only the fisheries for which catches and effort are available in the IOTC database. Furthermore, when available catches and effort may not be available throughout the year existing only for short periods.

- **Fig. 44.** Indo-Pacific king mackerel: Availability of length frequency data, by fishery and year (1980–2017)[23]. Note that no length frequency data are available for 1950–82.
-
- **Other biological data**: The equations available for King mackerel are shown below

Species	*From type measurement – To type measurement*	*Equation*	*Parameters*	*Sample size*	*Length*
Indo-pacific king mackerel	*Fork length – Round Weight*	*RND=a*L^b*	*a= 0.0000100000* *b= 2.89400*		*Min:20* *Max:80*

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

[23] Note that the above list is not exhaustive, showing only the fisheries for which size data are available in the IOTC database. Furthermore, when available size data may not be available throughout the year existing only for short periods.

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

Extract from IOTC–2019–WPNT09–07

Fisheries and main catch trends

- Main fisheries: Narrow-barred Spanish mackerel are caught mainly using gillnet, however significant numbers are also caught using troll lines (**Table 6; Fig.32**).
- Main fleets (i.e., highest catches in recent years):
  Fisheries in Indonesia, India, and I.R. Iran account for around 60% of catches in recent years (**Fig.33**). 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 t in the late-1970's to over 100,000 t by the late-1990's. Since 2011, some of the highest catches for this species have been recorded, with catches fluctuating beween 145,000 and 171,000 t
- Discard levels**:** are thought to be very low, although estimates of discards are unknown for most fisheries.

***Changes to the catch series*:** there were no major revisions to the catch series since the WPNT meeting in 2018.

Narrow-barred Spanish mackerel: estimation of catches – data related issues

Retained catches for Spanish mackerel were derived from incomplete information, and are therefore uncertain[24] (**Fig.34**), notably for the following fisheries:

- Artisanal fisheries of Indonesia and India: Indonesia and India have only recently reported catches of 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 Indonesia and India component represent around 50% of the total catches of this species in the Indian Ocean.
- Artisanal fisheries of Madagascar: To date, Madagascar has not reported catches of narrow-barred Spanish mackerel to the IOTC. 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, Thailand report catches of narrow-barred Spanish mackerel and Indo-Pacific king mackerel aggregated.
- All fisheries: In some cases the catches of seerfish species are misreported, with catches of Indo-Pacific king mackerel and, to a lesser extent, other seerfish species reported as narrow-barred Spanish mackerel. Similarly, the

[24] 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.

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 6. Narrow-barred Spanish mackerel: Best scientific estimates of the catches of narrow-barred Spanish mackerel by type of fishery for the period 1950–2017 (in metric tonnes). Data as of June 2019.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Purse seine	-	0	285	2,355	4,145	5,611	6,133	8,459	8,789	9,113	8,900	9,419	8,534	8,169	8,440	7,958
Gillnet	9,498	17,679	32,168	54,918	62,712	67,069	74,597	76,030	80,532	80,449	87,416	90,349	99,457	98,128	99,987	91,782
Line	1,763	2,501	4,672	11,334	12,071	17,350	19,825	22,369	23,276	29,113	32,032	29,272	34,981	36,696	34,466	32,427
Other	57	96	468	5,603	9,741	21,351	22,741	28,170	24,551	25,802	29,358	26,842	25,065	25,996	27,729	26,752
Total	**11,318**	**20,277**	**37,593**	**74,210**	**88,670**	**111,382**	**123,297**	**135,028**	**137,148**	**144,477**	**157,707**	**155,882**	**168,037**	**168,989**	**170,622**	**158,920**

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.

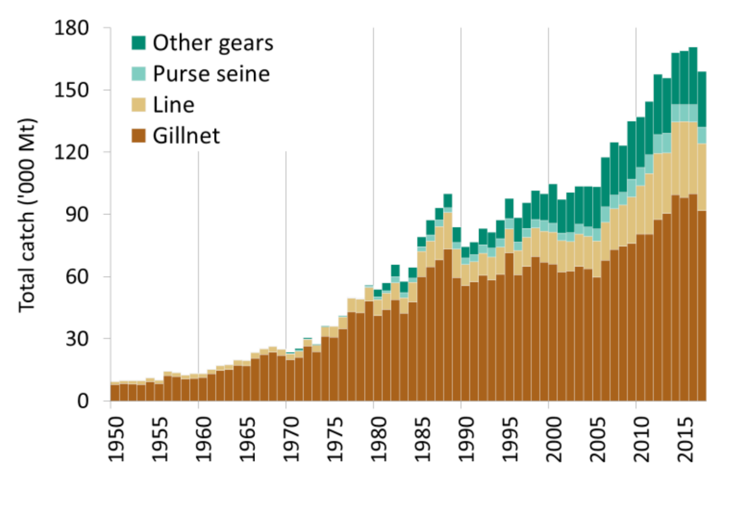


Fig.32. Narrow-barred spanish mackerel: Annual catches by gear recorded in the IOTC Database (1950–2017).

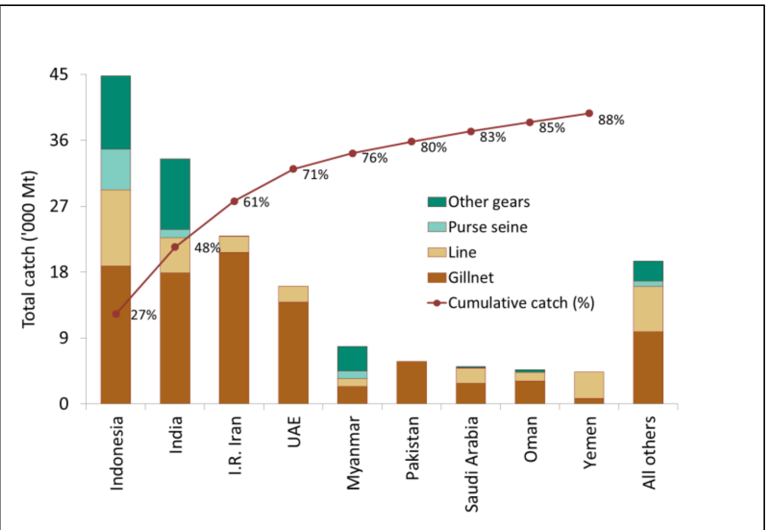
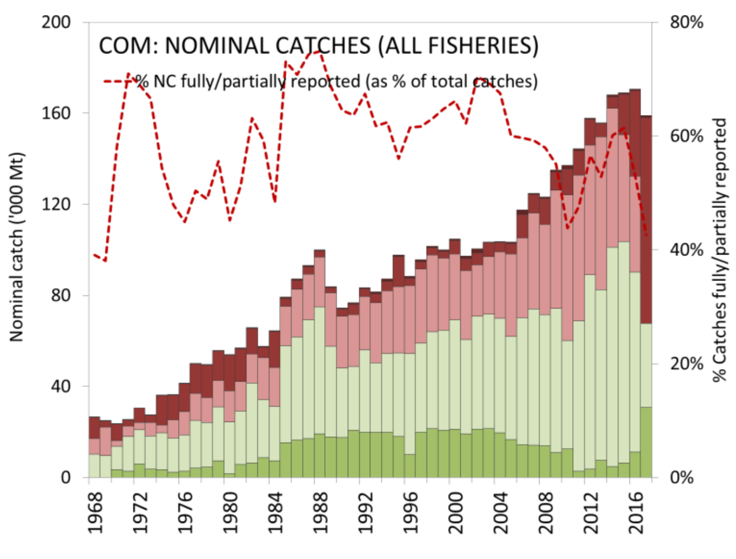


Fig.33. Narrow-barred spanish mackerel: Average catches in the Indian Ocean over the period 2013–17, by country[25].



[25] Countries are ordered from left to right, according to the importance of catches of longtail reported for 2013-2017. The red line indicates the (cumulative) proportion of catches of longtail tuna for the countries concerned, over the total combined catches of this species reported from all countries and fisheries for 2013-2017.

Fig.34. Narrow-barred spanish mackerel: nominal catch; uncertainty of annual catch estimates for all fisheries (1978–2017).

Catches are assessed against IOTC reporting standards, where a 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 (estimated by the IOTC Secretariat).

Narrow-barred Spanish mackerel – Effort trends

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

Narrow-barred Spanish mackerel – Catch-per-unit-effort (CPUE) trends:

- Availability: highly incomplete data, available only for selected years and/or fisheries (**Fig.35**).
- Main CPUE series available (i.e., over 10 years or more):
  Sri Lanka (gillnets) – however the catches and effort recorded are thought to be unreliable due to the dramatic changes in CPUE recorded in 2003 and 2004 (**Fig.36**).

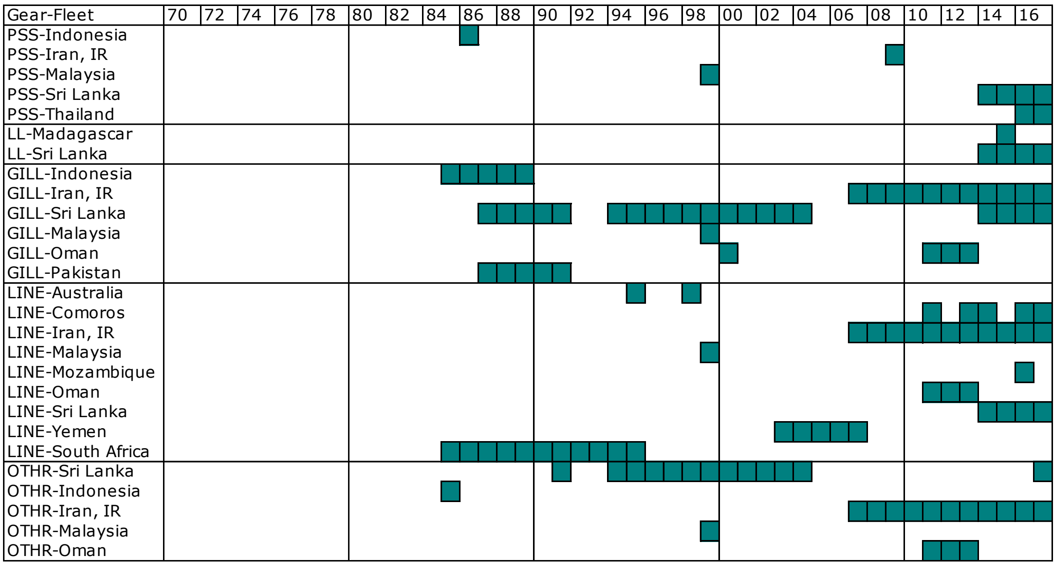


Fig.35. Narrow-barred Spanish mackerel: Availability of catches and effort series, by fishery and year (1970–2017)[26]. No catches and effort are available at for 1950–84, and 2008–10.

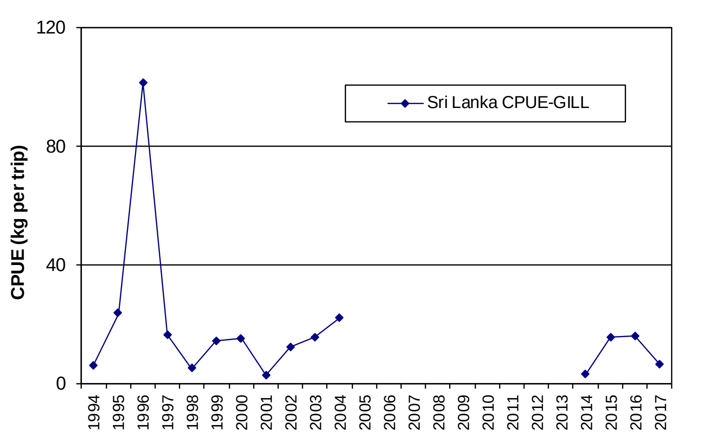


Fig.36a. Narrow-barred Spanish mackerel: Nominal CPUE series for the gillnet fishery of Sri Lanka derived from the available catches and effort data (1994–2004 and 2014-2016). No data available since 2004.

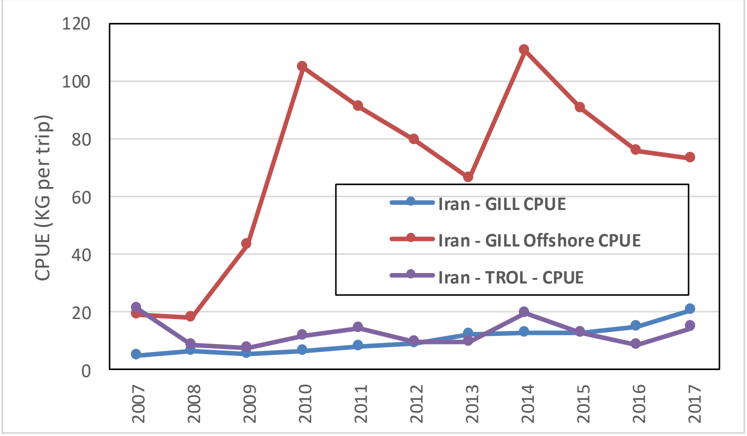


Fig.36b. Narrow-barred Spanish mackerel: Nominal CPUE series for the gillnet fishery (coastal and offshore) of Iran derived from the available catches and effort data (2007-2017).

Narrow-barred Spanish mackerel – 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 ranges 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.[27]
- Size frequency data: highly incomplete data, available only for selected years and/or fisheries (**Fig.37**).

  Total numbers of samples, across all years, are also well below the minimum sampling standard of 1 fish per tonne of catch recommended by the IOTC Secretariat to reliably assess changes in average weight.
  Main sources for size samples: Sri Lankan (gillnet) (from late-1980s until early-1990s), and I.R. Iran (gillnet) (from the late-2000s) (**Fig.38b**). Length distributions derived from the data available for gillnet fisheries are shown in (**Fig.38a)**. No data are available in sufficient numbers for other fisheries.
- 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.

[26] Note that the above list is not exhaustive, showing only the fisheries for which catches and effort are available in the IOTC database. Furthermore, when available catches and effort may not be available throughout the year existing only for short periods

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

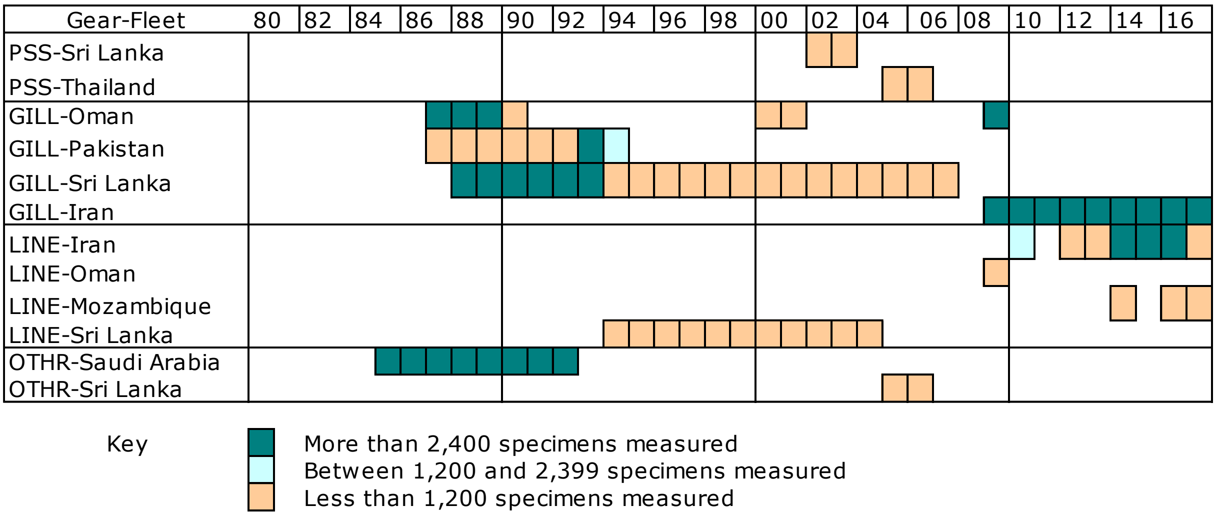


Fig.37. Narrow-barred Spanish mackerel: Availability of length frequency data, by fishery and year (1980–2017)[28]. Note that no length frequency data are available prior to 1984.

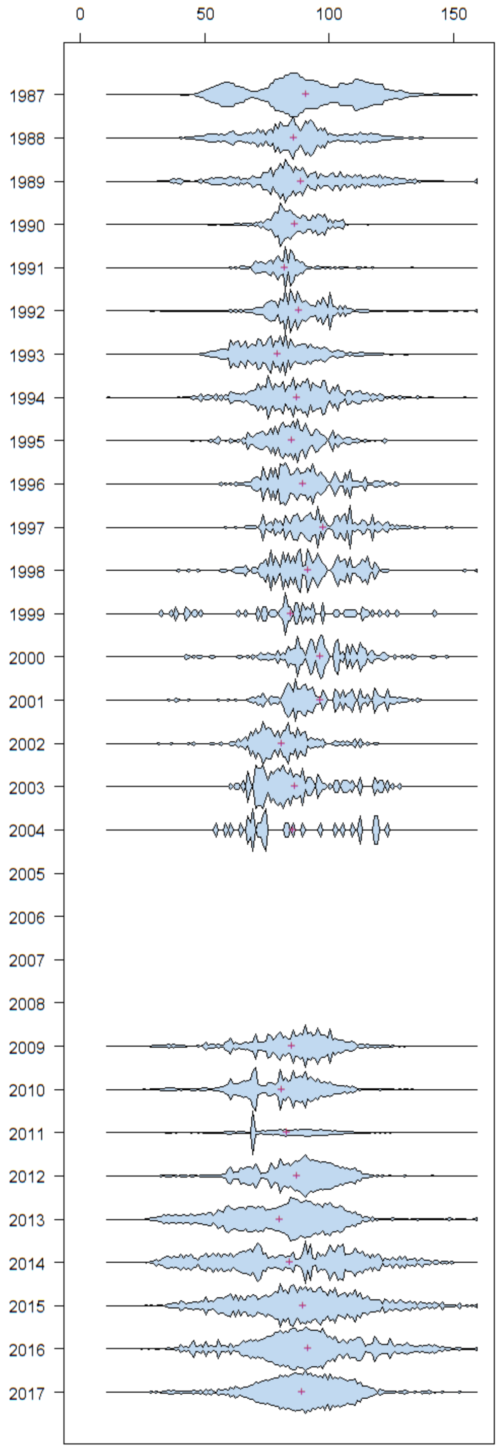
Other biological data: Equations available for Spanish mackerel are shown below:

Species	From type measurement – To type measurement	Equation	Parameters	Sample size	Length
Spanish mackerel	Fork length – Round Weight	RND=a*L^b	a= 0.00001176 b= 2.9002		Min:20 Max:200

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

[28] Note that the above list is not exhaustive, showing only the fisheries for which size data are available in the IOTC database. Furthermore, when available size data may not be available throughout the year existing only for short periods.

COM (Gillnet samples): size (in cm)



COM (Gillnet): no. of samples (‘000)

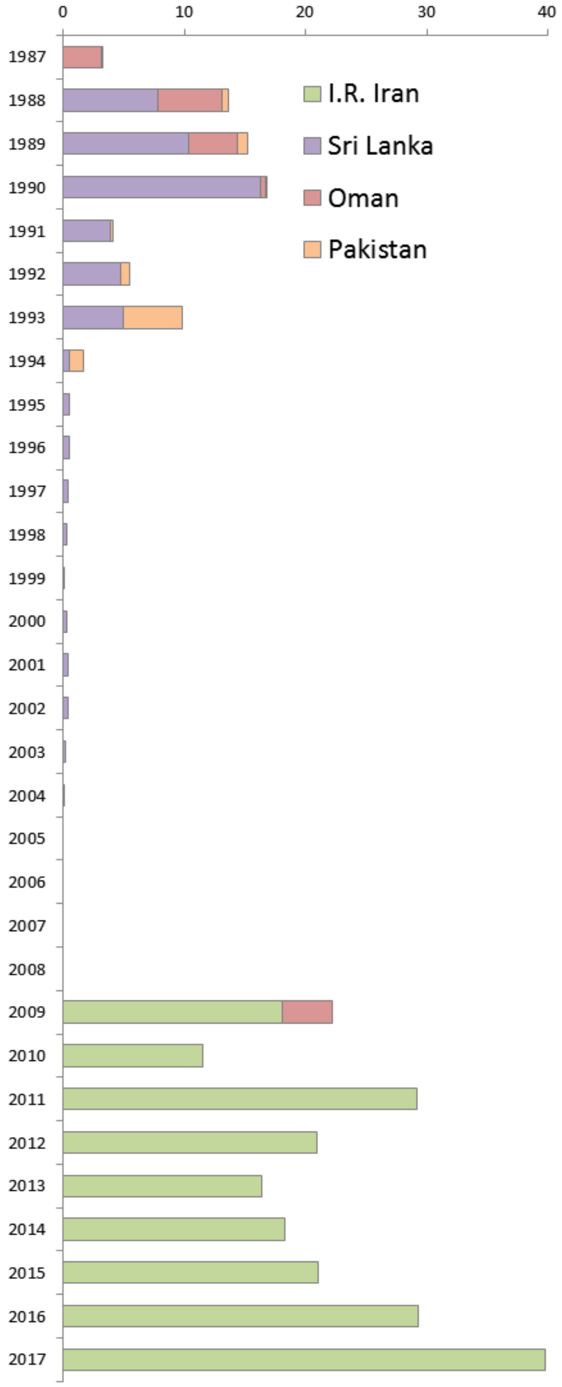


Fig.38a-b. Left: Narrow-barred Spanish Mackerel (gillnet fisheries): Length frequency distributions (by 1cm length class) derived from data available at the IOTC Secretariat, 1987-2017.

Right: Number of narrow-barred Spanish mackerel specimens (gillnet fisheries) sampled for lengths, by fleet and year.

APPENDIX V
MAIN ISSUES IDENTIFIED RELATING TO THE STATISTICS OF NERITIC TUNAS

Extract from IOTC–2019–WPNT09–07

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: no regular data collection system exists for recording catches from coastal fisheries. Pilot sampling, funded by COI-SmartFish and assistance from the IOTC Secretariat, was conducted in selected provinces in 2013. Since then Smartfish have agreed to provide Madagascar with additional support for data collection and management. • 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: no update. No catch-and-effort or size data has been reported for coastal fisheries. • 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. • 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. • Oman: no update. No size data submitted, although it is understood that data has been collected. • 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. Catch-and-effort for coastal (artisanal) fisheries also does not appear to have been reported. • Tanzania: a data compliance mission was conducted in February 2016, including a list of outstanding issues and recommendations to improve levels of compliance. Catch data (aggregated by species) are based on data from the National Report submitted to SC. Catches also appear to be underreported for some years (i.e., excluding catches from Zanzibar).

	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 upload of catch-and-effort data to the IOTC database remains pending until inconsistencies in the data are satisfactorily resolved. • 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 as yet. The upload of catch-and-effort data to the IOTC database remains pending until inconsistencies in the data are satisfactorily 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 operates 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: Update: Following an IOTC Data Compliance mission in November 2017, I.R. Iran has submitted catch-and-effort data in a new data reporting format in accordance to the reporting requirements of Resolution 15/02. This has recently led to substantial improvements in the data available for the Iranian fisheries in the IOTC database. • Pakistan – drifting gillnets: Update: In 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. Update: WWF-Pakistan has been a coordinating a skipper-based observer programme for over three 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. The IOTC Secretariat is currently liaising with WWF-Pakistan to evaluate the quality of the observer data collected.
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 and 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: 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).
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	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.

		little information is available on the level of discards.	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 is currently coordinating a Stock Structure Project, which commenced in 2016, that aims 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.

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

The following is the Draft WPNT Program of Work (2020 to 2024) and is based on the specific requests of the Commission and Scientific Committee as well as topics identified during the WPNT09. 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	Sub-topic and project	Priority	Est. budget and/or potential source	Timing				
				2020	2021	2022	2023	2024
1. Data mining and collation	Collate and characterize operational level data for the main neritic tuna fisheries in the Indian Ocean to investigate their suitability to be used for developing standardised CPUE indices. The following data should be collated and made available for collaborative analysis: 1) catch and effort by species and gear by landing site; 2) operational data: stratify this by vessel, month, and year for the development as an indicator of CPUE over time; and 3) operational data: collate other information on fishing techniques (i.e. area fished, gear specifics, depth, environmental condition (near shore, open ocean, etc.) and vessel size (length/horsepower)). (Data support missions to priority countries: India, Oman, Pakistan)	High (3)	Commission					
2. CPUE standardisation	Develop standardised CPUE series for the main fisheries for longtail, kawakawa, Indo-Pacific King mackerel and Spanish mackerel in the Indian Ocean, with the aim of developing CPUE series for stock assessment purposes.	High (1)						

	➢ Sri Lanka (priority species: Frigate tuna, Kawakawa, bullet tuna)		Consultant with CPCs
	Indonesia (priority species: Kawakawa, Bullet tuna, Frigate tuna)		Consultant with CPCs
	Pakistan (priority species: Longtail tuna, Kawakawa, narrow-barred Spanish mackerel)		Consultant with CPCs
3. Stock assessment / Stock indicators	Explore alternative assessment approaches and develop improvements where necessary based on the data available to determine stock status for longtail tuna, kawakawa and Spanish mackerel The Weight-of-Evidence approach should be used to determine stock status, by building layers of partial evidence, such as CPUE indices combined with catch data, life-history parameters and yield-per recruit metrics, as well as the use of data poor assessment approaches. Improve the presentation of management advice from different assessment approaches to better represent the uncertainty and improve communication between scientists and managers in the IOTC.	High (2)	IOTC Regular Budget/ EU grant 305
4. Biological information (parameters for stock assessment)	Quantitative biological studies are necessary for all neritic tunas throughout their range to determine key biological parameters including age-at-maturity, and fecundity-at-age/length relationships, age-length keys, age and growth, longevity which will be fed into future stock assessments.	High	CPCs directly
5. Stock structure (connectivity)	Genetic research to determine the connectivity of neritic tunas throughout their distributions (LOT, KAW, COM)	High (4)	1.3 m Euro: European Union
	➢ Determine the degree of shared stocks for all neritic tunas under the IOTC mandate in the Indian Ocean, so as to better equip the SC in providing management advice based on unit stocks delineated by geographic distribution and connectivity. ➢ Genetic research to determine the connectivity of neritic tunas throughout their distributions		TBD

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.	High (5)						

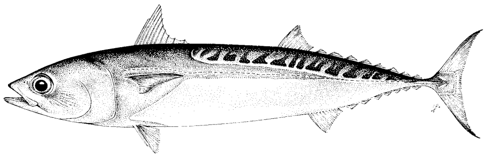
Table 2. Assessment schedule for the IOTC Working Party on Neritic Tunas 2020–2024

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

* Including data-limited stock assessment methods.
** Including species-specific catches, CPUE, biological information and size distribution.
*** Identification of data gaps and discussion of improvements to the assessments (stock structure).
Note: the assessment schedule may be changed dependent on the annual review of fishery indicators, or SC and Commission requests.

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		2019 stock status determination
Indian Ocean	Catch 2017[2]: Average catch 2013–2017:	15,864 t 11,844 t	
	MSY (1,000 t) (80% CI): F_{MSY} (80% CI): B_{MSY} (1,000 t) (80% CI): $F_{current}/F_{MSY}$ (80% CI): $B_{current}/B_{MSY}$ (80% CI): $B_{current}/B_0$ (80% CI):	unknown unknown unknown unknown unknown unknown	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2] Proportion of catch estimated or partially estimated by IOTC Secretariat in 2017: 20%
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 10,000 t. However since 2014 catches have increased from 10,000 t to almost 16,000 t – mostly due to an increase in catches reported by India (handline, gillnet and trolling fisheries) (Fig.1). There is insufficient information to evaluate the effect that these levels of catches, or an increase in catches, may have on the resource. Research emphasis should be focused on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.).

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

The following should be also noted:

- The Maximum Sustainable Yield estimate for the Indian Ocean stock is unknown.
- Limit reference points: The Commission has not adopted limit reference points for any of the neritic tunas under its mandate.
- Further work is needed to improve the reliability of the catch series. Reported catches should be verified or estimated, based on expert knowledge of the history of the various fisheries or through statistical extrapolation methods.
- Research emphasis should be focused on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.).
- Species identification, data collection and reporting urgently need to be improved.
- There is limited information submitted by CPCs on total catches, catch and effort and size data for neritic tunas, despite their mandatory reporting status. In the case of 2017 catches, 20% of the total catches were either fully or partially estimated by the IOTC Secretariat, which increases the uncertainty of the stock assessments using these data. Therefore the management advice to the Commission includes the need for CPCs to comply with IOTC data requirements per Resolution 15/01 and 15/02.
- **Main fishing gear (average catches 2013-17)**: bullet tuna is mainly caught using gillnets (≈27%, handlines and trolling (≈35%). This species is also an important catch for coastal purse seiners (Fig. 1).
- **Main fleets (average catches 2013-17)**: Catches are highly concentrated: in recent years over 90% of catches in the Indian Ocean have been accounted for by fisheries in India, Sri Lanka, and Indonesia.

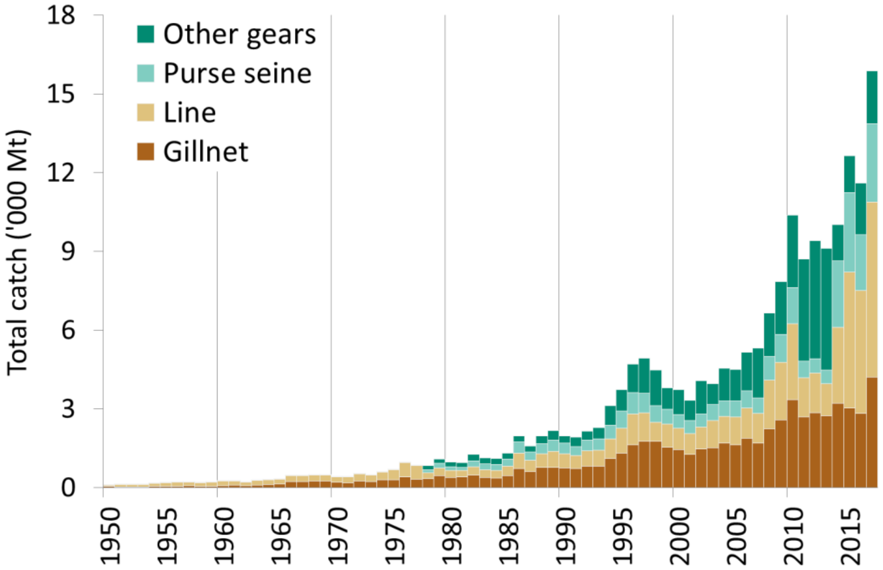
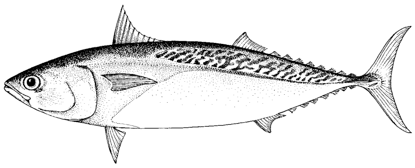


Fig. 1. Bullet tuna: Annual catches of bullet tuna by gear recorded in the IOTC Database (1950–2017)[29].

[29] **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		2019 stock status determination
Indian Ocean	Catch 2017[2]: Average catch 2013–2017:	84,684 t 92,568 t	
	MSY (1,000 t) (80% CI): F_{MSY} (80% CI): B_{MSY} (1,000 t) (80% CI): $F_{current}/F_{MSY}$ (80% CI): $B_{current}/B_{MSY}$ (80% CI): $B_{current}/B_0$ (80% CI):	unknown unknown unknown unknown unknown unknown	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2] Proportion of catch estimated or partially estimated by IOTC Secretariat in 2018: 76%
Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.

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

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

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

Outlook. Estimated catches have increased steadily since the late-1970's, reaching around 30,000 t in the late-1980's, to between 55,000 and 60,000 t by the mid-1990's, and remaining at the same level in the following ten years. Between 2010 and 2014 catches have increased to over 95,000 t, rising to the highest levels recorded; although catches have since decline marginally to between 85,000 – 90,000 t since 2014. There is insufficient information to evaluate the effect that this level of catch or a further increase in catches may have on the resource. Research emphasis should be focused on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.).

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

The following should be also noted:

- The Maximum Sustainable Yield estimate for the Indian Ocean stock is unknown.
- Limit reference points: The Commission has not adopted limit reference points for any of the neritic tunas under its mandate.
- Further work is needed to improve the reliability of the catch series, such as verification or estimation based on expert knowledge of the history of the various fisheries or through statistical extrapolation methods.
- Research emphasis should be focused on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.).
- Species identification, data collection and reporting urgently need to be improved.
- There is limited information submitted by CPCs on total catches, catch and effort and size data for neritic tunas, despite their mandatory reporting status. In the case of 2017 catches, 76% of the total catches were either fully or partially estimated by the IOTC Secretariat, which increases the uncertainty of the stock assessments using these data. Therefore the management advice to the Commission includes the need for CPCs to comply with IOTC data requirements per Resolution 15/01 and 15/02.
- **Main fishing gear (average catches 2013-17)**: frigate tuna is mainly caught using gillnets (≈33%), coastal longline and trolling, handlines and trolling (≈39%), and to a lesser extent coastal purse seine nets (Table 3; Fig.12). The species is also a bycatch for industrial purse seine vessels and the target of some ring net fisheries.
- **Main fleets (average catches 2013–17)**: Catches of frigate tuna are highly concentrated: Indonesia accounts for around two-thirds of catches, while over 85% of catches are accounted for by four countries (Indonesia, India, Sri Lanka and I.R. Iran).

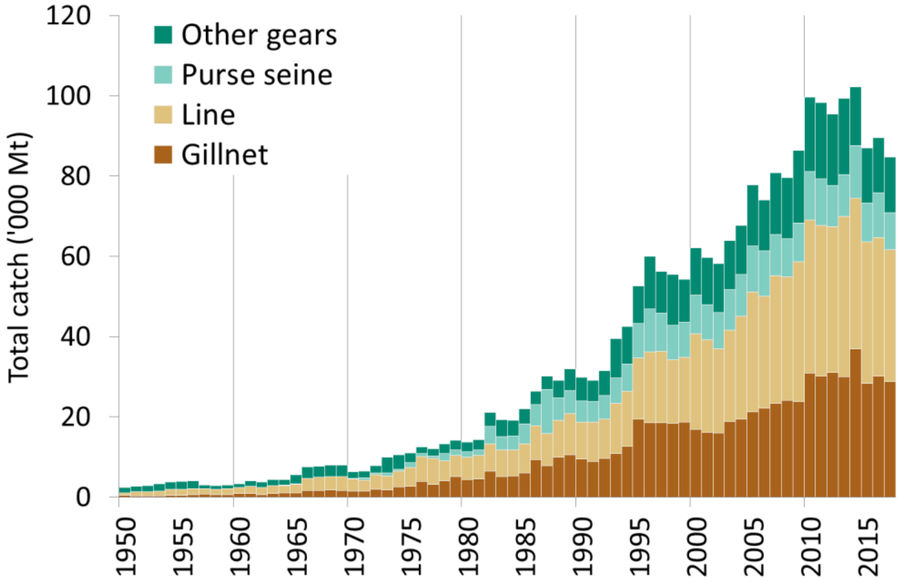
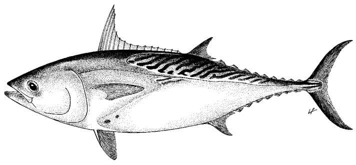


Fig.1. Frigate tuna: Annual catches of frigate tuna by gear recorded in the IOTC Database (1950–2017)[30].

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

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		2019 stock status determination
Indian Ocean	Catch 2017[2]: Average catch 2013-2017:	159,121 t 160,756 t	
	MSY (1,000 t) [*] F_{MSY} [*] B_{MSY} (1,000 t) [*] F_{2013}/F_{MSY} [*] B_{2013}/B_{MSY} [*] B_{2013}/B_0 [*]	152 [125 –188] 0.56 [0.42–0.69] 202 [151–315] 0.98 [0.85–1.11] 1.15 [0.97–1.38] 0.58 [0.33–0.86]	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2] Proportion of catch estimated or partially estimated by IOTC Secretariat in 2017: 41%
Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.
*Range of plausible values of biologically realistic OCOM model realizations (see IOTC-2015-WPNT05-R)

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

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. A stock assessment was not undertaken for kawakawa in 2019 and the status is determined on the basis of the last assessment conducted in 2015, which used catch data from 1950 to 2013. Analysis using an Optimised Catch Only Method (OCOM) approach in 2015 indicates that the stock is near optimal levels of F_{MSY}, and stock biomass is near the level that would produce MSY (B_{MSY}). Due to the quality of the data being used, the simple modelling approach employed in 2015, and the large increase in kawakawa catches over the last decade (Fig. 1), measures need to be taken in order to reduce the level of catches which have surpassed the estimated MSY levels for all years since 2011 – despite the decrease in catches from their peak in 2013. Based on the weight-of-evidence available, the kawakawa stock for the Indian Ocean is classified as **not overfished** and **not subject to overfishing** (Table 1, Fig. 2).

Outlook. There is considerable uncertainty about stock structure and the estimate of total catches. Due to the uncertainty associated with catch data (e.g., 41% of catches partially or fully estimated by the IOTC Secretariat in 2017) and the limited number of CPUE series available for fleets representing a small proportion of total catches, only data poor assessment approaches can currently be used. Aspects of the fisheries for this species, combined with the lack of data on which to base a more complex assessment (e.g. integrated models) are a cause for considerable concern. In the interim, until more traditional approaches are developed, data-poor approaches will be used to assess stock status. Continued increase in the annual catches for kawakawa is also likely to further increase the pressure on the Indian Ocean stock. Research emphasis should be focused on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.). The assessment projections conducted in 2015 concluded that there would be a high risk of exceeding MSY-based reference points if catches were maintained at 2013 levels (96% risk that $B_{2016}<B_{MSY}$, and 100% risk that $F_{2016}>F_{MSY}$) (Table 2). However, it should be noted that catches have since declined from 168,174 t (2013) to 159,121 t (2017).

Management Advice. Although the stock status is classified as not overfished and not subject to overfishing, the Kobe strategy II matrix developed in 2015 showed that there is a 96% probability that biomass is below MSY levels and 100% probability that $F>F_{MSY}$ by 2016 and 2023 if catches are maintained at the 2013 levels. There is a 55% probability that biomass is below MSY levels and 91% probability that $F>F_{MSY}$ by 2023 if catches are maintained at around 2016 levels. The modelled probabilities of the stock achieving levels consistent with the MSY reference points (e.g. $SB > SB_{MSY}$ and $F<F_{MSY}$) in 2023 are 100% for a future constant catch at 80% of 2013 catch levels. If catches are reduced by 20% based on 2013 levels at the time of the assessment (170,181 t)[31], the stock is expected to recover to levels above MSY reference points with a 50% probability by 2023.

The following should be also noted:

- The Maximum Sustainable Yield estimate for the Indian Ocean is estimated to be 152,000 with a range between 125,000 and 188,000 t and so catch levels should be reduced in future to prevent the stock becoming overfished.
- Further work is needed to improve the reliability of the catch series. Reported catches should be verified or estimated, based on expert knowledge of the history of the various fisheries or through statistical extrapolation methods.
- Improvement in data collection and reporting is required if the stock is to be assessed using integrated stock assessment models.
- Limit reference points: The Commission has not adopted limit reference points for any of the neritic tunas under its mandate.
- Research emphasis should be focused on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.).
- Given the limited information submitted by CPCs on total catches, catch and effort and size data for neritic tunas, despite their mandatory reporting status, the IOTC Secretariat was required to estimate 41% of the catches (in 2019), which increases the uncertainty of the stock assessments using these data. Therefore the management advice to the Commission includes the need for CPCs to comply with IOTC data requirements per Resolution 15/01 and 15/02.
- **Main fishing gear (average catches 2013–17)**: Kawakawa are caught mainly by gillnets (≈51%), handlines and trolling (≈18%), and coastal purse seiners, and may also be an important bycatch of the industrial purse seiners (Fig. 1).
- **Main fleets (average catches 2013–17)**: Catches are highly concentrated: Indonesia, India, and I.R. Iran account for over two thirds of catches in recent years.

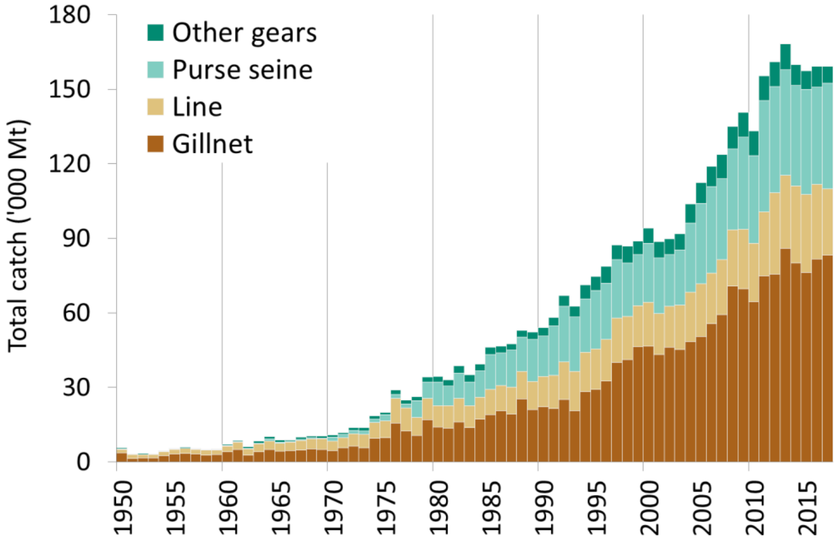


Fig.1. Kawakawa: Annual catches of kawakawa by gear recorded in the IOTC database (1950–2017)[32].

[31] as estimated in 2015

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

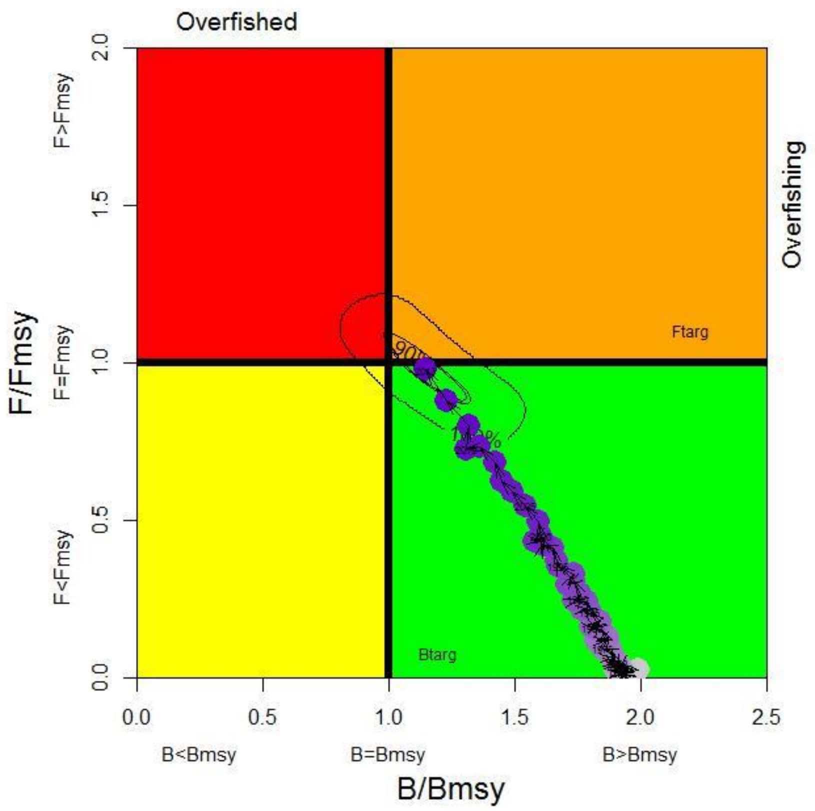


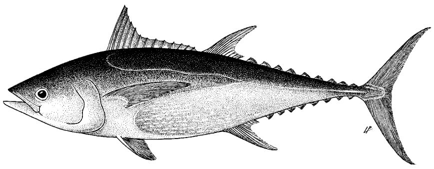
Fig.2. Kawakawa. OCOM aggregated Indian Ocean assessment. Blue circles indicate the trajectory of the point estimates for the B ratio and F ratio for each year between 1950 and 2013 (the black lines represent all plausible model runs shown around 2015 estimate).

Table 2. Kawakawa: OCOM Aggregated Indian Ocean assessment Kobe II Management Strategy Matrix. Probability (percentage) of plausible models violating the MSY-based reference points for five constant catch projections (2013 catch level, -10%, -20%, -30%, +10% and +20%) projected for 3 and 10 years. Data taken from the 2015 stock assessment using catch estimates (i.e. 1950-2013) available at that time.

Reference point and projection timeframe	**Alternative catch projections (relative to 2013) and weighted probability (%) scenarios that violate MSY-based reference point**					
	70% (119,126 t)	**80%** (136,144 t)	**90%** (153,162 t)	**100%** (170,181 t)	**110%** (187,199 t)	**120%** (204,216 t)
$B_{2016} < B_{MSY}$	0	1	37	96	n.a.	100
$F_{2016} > F_{MSY}$	0	18	87	100	100	100
$B_{2023} < B_{MSY}$	0	0	55	100	100	100
$F_{2023} > F_{MSY}$	0	0	91	100	100	100

APPENDIX 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**		**2019 stock status determination**
Indian Ocean	Catch 2017[2]: Average catch 2013–2017:	139,209 t 142,550 t	**67%**
	MSY (1,000 t) (*): F_{MSY} (*): B_{MSY} (1,000 t) (*): F_{2015}/F_{MSY} (*): B_{2015}/B_{MSY} (*): B_{2015}/B_0 (*):	140 (103–184) 0.43 (0.28–0.69) 319 (200–623) 1.04 (0.84–1.46) 0.94 (0.68–1.16) 0.48 (0.34–0.59)	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2] Proportion of catches estimated or partially estimated by IOTC Secretariat in 2017: 37%
Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.
* Range of plausible values of biologically realistic OCOM model realizations (IOTC-2017-WPNT07-R)

Colour key	Stock overfished(SB_{year}/SB_{MSY}< 1)	Stock not overfished (SB_{year}/SB_{MSY}≥ 1)
Stock subject to overfishing(F_{year}/F_{MSY}> 1)	67%	0%
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)	6%	27%
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. Analysis using the Optimised Catch-Only Method (OCOM) indicates that the stock is being exploited at a rate that exceeded F_{MSY} in recent years and that the stock appears to be below B_{MSY} and above F_{MSY} (67% of plausible models runs) (Fig. 2). Catches were above MSY between 2010 and 2014, however since 2015 catches have marginally decreased (Fig. 1) and were below estimated MSY in 2017. The F_{2015}/F_{MSY} ratio is slightly lower than previous estimates, reflecting the decrease in catches reported in the last few years. Nevertheless, the estimate of the B_{2015}/B_{MSY} ratio (0.94) was also slightly lower than in previous years. An assessment using the revised Catch-MSY method was also undertaken in 2017 and results were consistent with OCOM in terms of status. Therefore, based on the weight-of-evidence currently available, the stock is considered to be both **overfished** and **subject to overfishing** (Table 1; Fig. 2).

Outlook. There remains considerable uncertainty about stock structure and the total catches of longtail tuna in the Indian Ocean. The increase in annual catches to a peak in 2012 increased the pressure on the longtail tuna Indian Ocean stock, although the catch trend has reversed since then. As noted in 2015, the apparent fidelity of longtail tuna to particular areas/regions is a matter for concern as overfishing in these areas can lead to localised depletion. Research emphasis should be focused on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.).

Management advice. There is a substantial risk of exceeding MSY-based reference points by 2018 if catches are maintained at current (2015) levels (63% risk that $B_{2018}<B_{MSY}$, and 55% risk that $F_{2018}>F_{MSY}$) (Table 2). If catches are reduced by 10% this risk is lowered to 33% probability $B_{2018}<B_{MSY}$ and 28% probability $F_{2018}>F_{MSY}$). If catches are capped at current (2015) levels at the time of the assessment (i.e., 136,849 t), the stock is expected to recover to levels above MSY reference points with at least a 50% probability by 2025. Catches have remained below estimated MSY since 2015.

The following should be also noted:

- The Maximum Sustainable Yield estimate of around 140,000 t was exceeded between 2010 and 2014. Limits to catches are warranted to recover the stock to the B_{MSY} level.
- Limit reference points: The Commission has not adopted limit reference points for any of the neritic tunas under its mandate.
- Further work is needed to improve the reliability of the catch series. Reported catches should be verified or estimated, based on expert knowledge of the history of the various fisheries or through statistical extrapolation methods.
- Improvements in data collection and reporting are required if the stock is to be assessed using integrated stock assessment models.
- Research emphasis should be focused on collating catch per unit effort (CPUE) time series for the main fleets (I.R. Iran, Indonesia, Pakistan, India and Oman), size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.).
- There is limited information submitted by CPCs on total catches, catch and effort and size data for neritic tunas, despite their mandatory reporting status. In the case of 2017 catches, 37% of the total catches were either fully or partially estimated by the IOTC Secretariat, which increases the uncertainty of the stock assessments using these data. Therefore the management advice to the Commission includes the need for CPCs to comply with IOTC data requirements per Resolution 15/01 and 15/02.
- **Main fishing gear (average catches 2013–17)**: Longtail tuna are caught mainly using gillnets (≈71% of catches) and, to a lesser extent, coastal purse seine nets and trolling (Fig. 1).
- **Main fleets (average catches 2013–17)**: 43% of the catches of longtail in the Indian Ocean are accounted for by I.R. Iran, followed by Indonesia (≈18%), and Oman (≈10%).

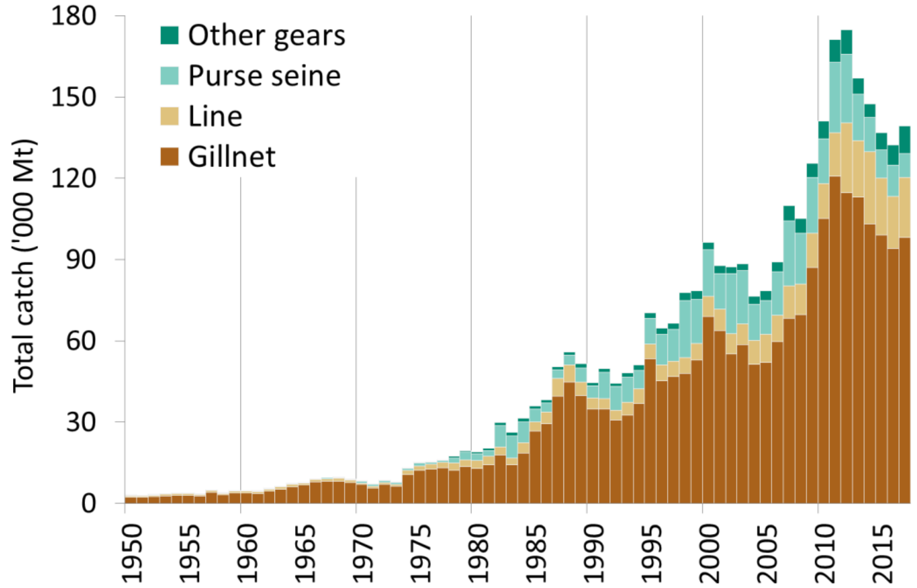


Fig. 1. Longtail tuna: Annual catches by gear recorded in the IOTC Database (1950–2017)[33].

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

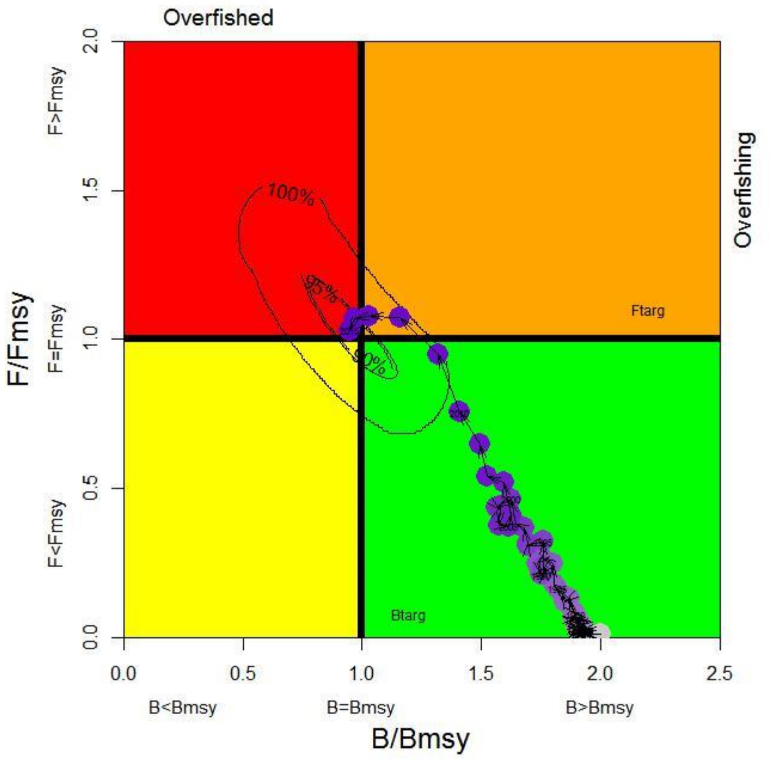


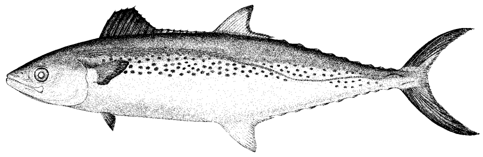
Fig. 2. Longtail tuna. OCOM Indian Ocean assessment Kobe plot. Blue circles indicate the trajectory of the point estimates for the B ratio and F ratio for each year between 1950 and 2015 (the black lines represent all plausible model runs shown around 2015 estimate).

Table 2. Longtail tuna: OCOM aggregated Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of violating the MSY-based reference points for constant catch projections (2015 +20%,+10%, -10%, - 20%, -30% projected for 3 and 10 years). Data taken from the 2017 stock assessment using catch estimates (i.e., 1950-2015) available at that time.

Reference point and projection timeframe	**Alternative catch projections (relative to 2015) and weighted probability (%) scenarios that violate MSY-based reference points**					
	70 % (95,794 t)	80% (109,479 t)	90% (123,164 t)	100% (136,849 t)	110% (150,534 t)	120% (164,219 t)
$B_{2018} < B_{MSY}$	4	9	33	63	92	99
$F_{2018} > F_{MSY}$	2	7	28	55	86	98
$B_{2025} < B_{MSY}$	0	0	1	48	100	100
$F_{2025} > F_{MSY}$	0	0	1	41	100	100

APPENDIX 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**		**2019 stock status determination**
Indian Ocean	Catch 2017[2]: Average catch 2013-2017:	53,383 t 48,611 t	
	MSY (1,000 t): F_{MSY}: B_{MSY} (1,000 t) : $F_{current}/F_{MSY}$: $B_{current}/B_{MSY}$: $B_{current}/B_0$:	Unknown Unknown Unknown Unknown Unknown Unknown	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2] Proportion of catch estimated or partially estimated by IOTC Secretariat in 2017: 37%
Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.

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

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. A preliminary assessment was undertaken in 2016 for Indo-Pacific king mackerel using catch-only methods techniques (Catch-MSY and OCOM). The OCOM model, which was considered the more robust of the two catch-only models in terms of assumptions and treatment of priors, indicated that overfishing was not occurring and the stock was not overfished. The continuing uncertainty in catches (37% estimated) for this species, combined with the highly variable and uncertain estimates of growth parameters used to estimate model priors, warrant caution in interpreting the model results for Indo-Pacific king mackerel. Given that no new assessment was undertaken in 2019, the WPNT considered that stock status in relation to the Commission's B_{MSY} and F_{MSY} target reference points remains **unknown** (Table1).

Outlook. Total annual catches for Indo-Pacific king mackerel have increased steadily over time, reaching a peak of 53,000 t in 2009 and have since fluctuated between 42,000 t and 53,000 t. There is considerable uncertainty about stock structure and total catches. Aspects of the fisheries for this species, combined with the limited data on which to base a more complex assessment (e.g., integrated models), are a cause for concern. Although data-poor methods are yet to be used to provide stock status advice, further refinements to the catch-only methods and application of additional data-poor approaches may improve confidence in the results. Research emphasis should be focused on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.).

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

The following should be also noted:

- Limit reference points: The Commission has not adopted limit reference points for any of the neritic tunas under its mandate.
- Research emphasis should be focused on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.).
- Further work is needed to improve the reliability of the catch series. Reported catches should be verified or estimated, based on expert knowledge of the history of the various fisheries or through statistical extrapolation methods.
- Data collection and reporting urgently needed to be improved, given the limited information submitted by CPCs on total catches, catch and effort and size data for neritic tunas, despite their mandatory reporting status. In the case of 2017 catches 37% of the total catches were either fully or partially estimated by the IOTC Secretariat, which increases the uncertainty of the stock assessments using these data. Therefore the management advice to the Commission includes the need for CPCs to comply with IOTC data requirements per Resolution 15/01 and 15/02.
- **Main fishing gear (average catches 2013-17)**: Indo-Pacific King mackerel are caught mainly by gillnets (≈69%), however significant numbers are also caught trolling (Fig. 1).
- **Main fleets (average catches 2013–17)**: Almost two-thirds of catches are accounted for by fisheries in India and Indonesia; with important catches also reported by I.R. Iran.

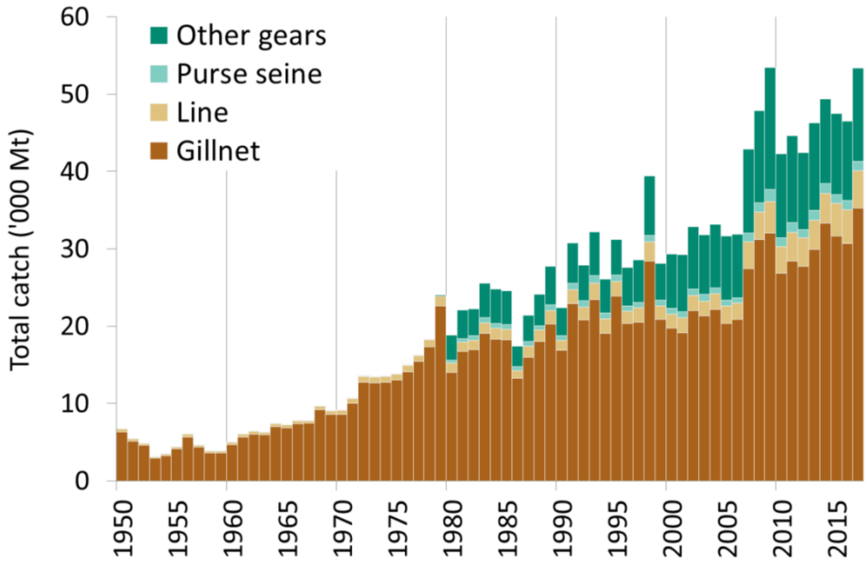
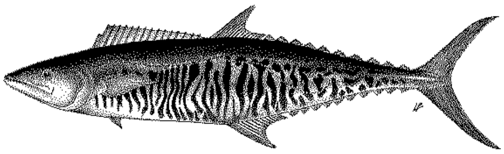


Fig. 1. Indo-Pacific king mackerel: Annual catches of Indo-Pacific king mackerel by gear recorded in the IOTC database (1950–2017)[34].

[34] **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		2019 stock status determination
Indian Ocean	Catch 2017[2]: Average catch 2013-2017:	158,290 t 164,490 t	**89%**
	MSY (1,000 t) [*]: F_{MSY} [*]: B_{MSY} (1,000 t) [*]: F_{2015}/F_{MSY} [*]: B_{2015} B_{MSY} [*]: B_{2015}/B_0 [*]:	131 [96–180] 0.35 [0.18–0.7] 371 [187–882] 1.28 [1.03–1.69] 0.89 [0.63–1.15] 0.44 [0.31–0.57]	

[1]Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2] Proportion of catch estimated or partially estimated by IOTC Secretariat in 2017: 57%
Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.
*Range of plausible values of biologically realistic OCOM model realizations (IOTC-2017-WPNT07-R)

Colour key	Stock overfished(SB_{year}/SB_{MSY}< 1)	Stock not overfished (SB_{year}/SB_{MSY}≥ 1)
Stock subject to overfishing(F_{year}/F_{MSY}> 1)	89%	11%
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)	0%	0%
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. Analysis using the Optimised Catch-Only Method (OCOM) indicates that the stock is being exploited at a rate exceeding F_{MSY} in recent years, and the stock appears to be below B_{MSY}. An analysis undertaken in 2013 in the Northwest Indian Ocean (Gulf of Oman) indicated that overfishing is occurring in this area and that localised depletion may also be occurring[35], though the degree of connectivity of the stock remains unknown. Stock structure remains to be clarified for this stock. Based on the weight-of-evidence available, the stock appears to be **overfished** and **subject to overfishing** (Table 1, Fig. 2). Catches since 2009 and also recent average catches for 2013-2017 are well above the current MSY estimate of 131,000 t (Fig. 1).

Outlook. There is considerable uncertainty about stock structure and the estimate of total catches. The continued increase in annual catches in recent years has further increased the pressure on the Indian Ocean narrow-barred Spanish mackerel stock. The apparent fidelity of narrow-barred Spanish mackerel to particular areas/regions is a matter for concern as overfishing in these areas can lead to localised depletion. Research emphasis should be focused on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.). There is a very high risk of exceeding MSY-based reference points by 2018

[35] IOTC-2013-WPNT03-27

and 2025 if catches are maintained at or even reduced by 10 % from current (2015) levels at the time of the assessment (100% risk that $B_{2018}<B_{MSY}$, and 100% risk that $F_{2018}>F_{MSY}$) (Table 2).

Management advice. There is a continued high risk of exceeding MSY-based reference points by 2025, even if catches are reduced to 80% of the 2015 levels (73% risk that $B_{2025}<B_{MSY}$, and 99% risk that $F_{2025}>F_{MSY}$). The modelled probabilities of the stock achieving levels consistent with the MSY reference levels (e.g. $B > B_{MSY}$ and $F<F_{MSY}$) in 2025 are 93% and 70%, respectively, for a future constant catch at 70% of current catch level. If catches are reduced by 30% of the 2015 levels at the time of the assessment, which corresponds to catches below MSY, the stock is expected to recover to levels above the MSY reference points with at least a 50% probability by 2025 (Table 2).

The following should also be noted:

- Maximum Sustainable Yield estimate for the Indian Ocean stock was estimated at 131,000 t, while 2017 catches (158,920 t) are exceeding this level.
- Limit reference points: The Commission has not adopted limit reference points for any of the neritic tunas under its mandate.
- Further work is needed to improve the reliability of the catch series. Reported catches should be verified or estimated, based on expert knowledge of the history of the various fisheries or through statistical extrapolation methods.
- Improvement in data collection and reporting is required if the stock is to be assessed using integrated stock assessment models.
- Given the increase in narrow-barred Spanish mackerel catch in the last decade, measures need to be taken to reduce catches in the Indian Ocean (Table 2).
- Research emphasis should be focused on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.).
- There is a lack of information submitted by CPCs on total catches, catch and effort and size data for neritic tunas, despite their mandatory reporting status. In the case of 2017 catches 57% of the total catches were either fully or partially estimated by the IOTC Secretariat, which increases the uncertainty of the stock assessments using these data. Therefore the management advice to the Commission includes the need for CPCs to comply with IOTC data requirements per Resolution 15/01 and 15/02.
- **Main fishing gear (average catches 2013-17)**: Narrow-barred Spanish mackerel are caught mainly using gillnet (≈58%), however significant numbers are also caught using troll lines (Fig. 1).
- **Main fleets (average catches 2013-17)**: Fisheries in Indonesia, India, and I.R. Iran account for around two-thirds of catches of Spanish mackerel, while the species is also targeted throughout the Indian Ocean by artisanal and sports/recreational fisheries.

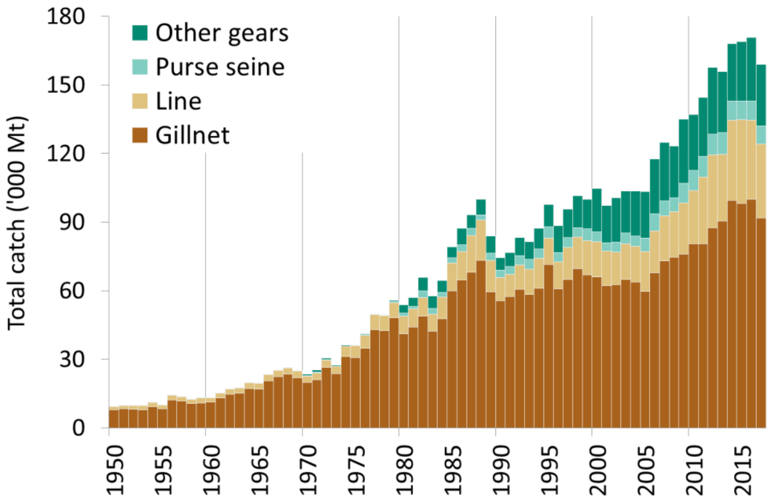


Fig. 1. Narrow-barred Spanish mackerel: Annual catches of narrow-barred Spanish mackerel by gear recorded in the IOTC database (1950–2017)[36].

[36] **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.

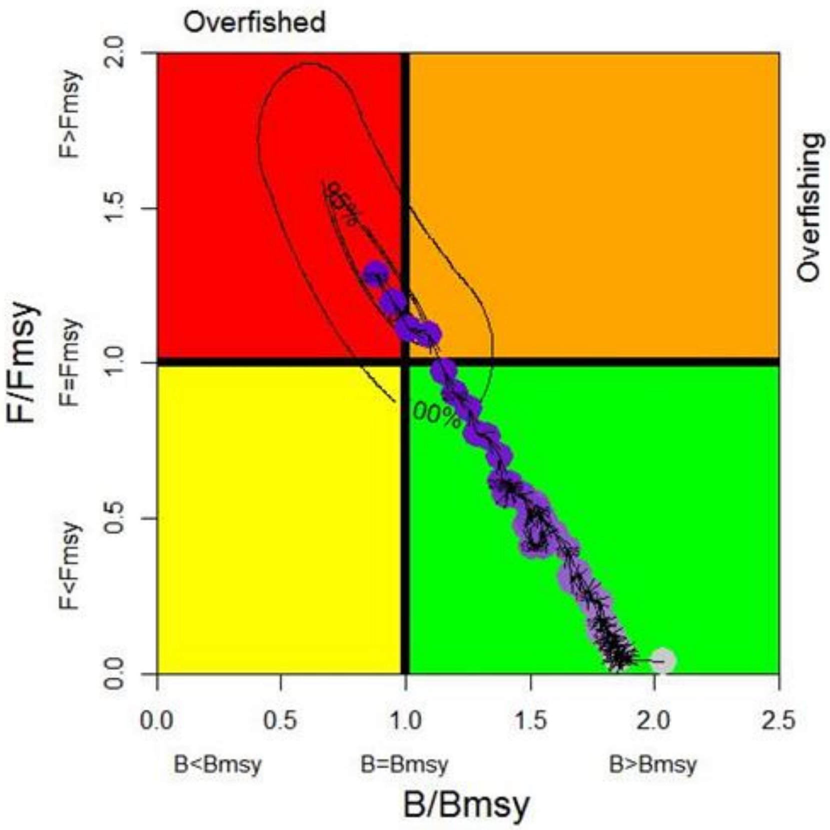


Fig. 2. Narrow-barred Spanish mackerel. OCOM Indian Ocean assessment Kobe plot. Blue circles indicate the trajectory of the point estimates for the B ratio and F ratio for each year between 1950 and 2015 (the black lines represent all plausible model runs shown around 2015 estimate).

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

Reference point and projection timeframe	**Alternative catch projections (relative to 2015) and weighted probability (%) scenarios that violate MSY-based reference point**					
	70% (107,924 t)	**80%** (123,342 t)	**90%** (138,759 t)	**100%** (154,177 t)	**110%** (169,595 t)	**120%** (185,012 t)
$B_{2018} < B_{MSY}$	71	90	99	100	100	100
$F_{2018} > F_{MSY}$	100	100	100	100	100	100
$B_{2025} < B_{MSY}$	7	73	100	100	100	100
$F_{2025} > F_{MSY}$	30	99	100	100	100	100

APPENDIX XIII
CONSOLIDATED RECOMMENDATIONS OF THE 9TH SESSION OF THE WORKING PARTY ON NERITIC TUNAS

Note: Appendix references refer to the Report of the 9th Session of the Working Party on Neritic Tunas (IOTC–2019–WPNT09–R)

Data-limited stock assessment: Improving catch-only methods

WPTmT09.01 (para 32) The WPNT **DISCUSSED** the potential diagnostics for catch-only methods and **RECOMMENDED** that the retrospective or hindcasting analysis be incorporated into the modelling as diagnostics tools. These analyses are helpful in revealing whether the catch series is consistent with respect to the stock productivity and if the model results are driven by more recent data.

Review of the statistical data available for neritic tunas: IOTC database

WPTmT09.02 (para 38) The WPNT **RECOMMENDED** the SC to provide strong management advice for neritic species, **NOTING** that that catches of some species have reached their highest levels in the Indian Ocean in recent years, while catch statistics remain uncertain.

Revision of the WPNT Program of Work (2020–2024)

WPTmT09.03 (para 76) The WPNT **RECOMMENDED** that the SC consider and endorse the WPNT Program of Work (2020–2024), as provided in Appendix VI.

Date and place of the 10th and 11th Working Party on Neritic Tunas

WPTmT09.04 (para 79) The WPNT **NOTED** that Kenya expressed interest in potentially hosting the 10th Session of the WPNT and **RECOMMENDED** the SC consider as preferred dates for the first week of July 2020. The WPNT further **NOTED** that Sri Lanka and Malaysia have expressed an interest in potentially hosting the 11th Session of the WPNT in 2021, with dates yet to be agreed.

Meeting participation fund (MPF)

WPTmT09.05 (para 81) The WPNT **RECOMMENDED** that the SC and Commission note the following:

7) 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 8).
8) 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.
9) 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 9th Working Party on Neritic Tunas

WPTmT09.06 (para 87) The WPNT **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPNT09, 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 2019 (Fig. 1):

- 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