Report of the 26th Session of the IOTC Working Party on Tropical Tunas

Seychelles, 28 October - 2 November 2024

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ACRONYMS

aFAD	anchored Fish Aggregating Device
ASAP	Age-Structured Assessment Program
ASPIC	A Stock-Production Model Incorporating Covariates
ASPM	Age-Structured Production Model
B	Biomass (total)
BDM	Biomass Dynamic Model
BET	Bigeye tuna
B_0	The estimate of the unfished spawning stock biomass
B_{curr}	The estimate of current spawning stock biomass
B_{MSY}	Biomass which produces MSY
B_{thresh}	Threshold level, the percentage of B0 below which reductions in fishing mortality are required
CE	Catch and effort
CI	Confidence Interval
C_{max}	Maximum catch limit
CMM	Conservation and Management Measure (of the IOTC; Resolutions and Recommendations)
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
dFAD	drifting Fish Aggregating Device
D_{max}	Maximum change in catch limit
EEZ	Exclusive Economic Zone
ENSO	El Niño–Southern Oscillation
E_{targ}	The estimate of the equilibrium exploitation rate associated with sustaining the stock at B_{targ}.
EU	European Union
F	Fishing mortality; F_{2011} is the fishing mortality estimated in the year 2011
FAD	Fish aggregating device
F_{MSY}	Fishing mortality at MSY
GLM	Generalised linear model
HBF	Hooks between floats
I_{max}	Maximum fishing intensity
IO	Indian Ocean
IOTC	Indian Ocean Tuna Commission
IWC	International Whaling Commission
K2SM	Kobe II Strategy Matrix
LL	Longline
M	Natural Mortality
MSC	Marine Stewardship Council
MSE	Management Strategy Evaluation
MSY	Maximum sustainable yield
n.a.	Not applicable
PS	Purse seine
q	Catchability
ROS	Regional Observer Scheme
RTTP-IO	Regional Tuna Tagging Project in the Indian Ocean
RTSS	RTTP-IO plus small-scale tagging projects
SC	Scientific Committee, of the IOTC
SB	Spawning biomass (sometimes expressed as SSB)
SB_{MSY}	Spawning stock biomass which produces MSY (sometimes expressed as SSB_{MSY})
SCAA	Statistical-Catch-At-Age
SKJ	Skipjack tuna
SS3	Stock Synthesis III
Taiwan, China	Taiwan, Province of China
VB	Von Bertalanffy (growth)
WPTT	Working Party on Tropical Tunas of the IOTC
YFT	Yellowfin tuna

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 26th Session of the Indian Ocean Tuna Commission's (IOTC) Working Party on Tropical Tunas (WPTT), was held at Seychelles from 28 October - 2 November 2024. The meeting was opened by the Chairperson, Dr Gorka Merino (EU, Spain) who welcomed participants and Vice-Chair, Dr M. Shiham Adam (IPNLF). A total of 130 participants attended the Session (cf. 91, in 2023, 113 in 2022, and 108 in 2021). The list of participants is provided at Appendix I.

The following are the recommendations from the WPTT26 to the Scientific Committee, which are provided at Appendix VIII.

Yellowfin tuna Stock Assessment

WPTT26.01 (para 37): The WPTT **RECOMMENDED** that the work towards the implementation of the Indian Ocean Digital Atlas (IODA) be continued to consolidate the proposal before the Scientific Committee.

WPTT26.02 (para 96): The WPTT **NOTED** that the proposal to adjust MSY-based/benchmark reference points using recent average recruitment is new and has major implications for the yellowfin tuna assessment and other IOTC assessments. Therefore, the WPTT **RECOMMENDED** that the SC discuss this approach thoroughly and if appropriate, request the development of further guidance on this from the WPM.

WPTT26.03 (para 100): After in-depth discussions on different aspects of the modelling work, the WPTT **AGREED** and **RECOMMENDED** additional research and actions to further refine future yellowfin stock assessments. These will also address the suggestions and requests raised during the detailed discussions. These recommended action points are listed in Appendix IX

WPTT26.04 (para 122): The WPTT **ADOPTED** the stock status advice developed for yellowfin tuna as provided in the draft resource stock status summary and **REQUESTED** that the IOTC Secretariat update the draft stock status summary for yellowfin tuna with the latest 2023 catch data (if necessary), and **RECOMMENDED** for the summary to be provided to the SC as part of the draft Executive Summary, for its consideration:

- Yellowfin tuna (*Thunnus albacares*) – Appendix VI

WPTT26.05 (para 125): The WPTT **NOTED** that the K2SM short-term projections of 3 years for management advice is challenging to implement given the 2-year lag between stock assessment data and the ability for the Commission to implement any management actions. As such, the WPTT **RECOMMENDED** that the Scientific Committee consider amending the standard short-term reporting period when using the K2SM, for example, from 3 to 5 years.

Bigeye tuna Management Procedure

WPTT26.06 (para 132): The WPTT **NOTED** that exceptional circumstances of adopted MPs need to be considered at both species WPs and WPM. The WPTT also **NOTED** that there is benefit in species WPs being held before WPM to allow discussions on issues such as new information on biology before the consideration of potential modelling implications and as such **RECOMMENDED** that in the future the WPM be held after the WPTT.

Update on MSE for Tropical Tunas

WPTT26.07 (para 162): The WPTT **NOTED** that the yellowfin MSE has been inactive for several years (awaiting revision of the stock assessment) and **RECOMMENDED** that the SC resume the process.

FAD related topics

WPTT26.08 (para 165): The WPTT **NOTED** that after the recent resolutions on FAD were adopted, CPCs seem less inclined to submit papers to WGFAD. This led to the shortening of WGFAD06 to a single day and the cancellation of WGFAD07 this year due to a shortage of papers. Therefore, the WPTT **RECOMMENDED** that the SC advise the Commission to schedule only one WGFAD meeting in 2025. The WPTT also suggests that this meeting should take place before the WPEB, as FAD issues are relevant to WPEB, to allow the findings to be reported to both WPEB and WPTT.

Revision of the WPTT Program of Work (2025–2029)

WPTT26.09 (para. 170): The WPTT **RECOMMENDED** that the SC consider and endorse the WPTT Program of Work (2025–2029), as provided in Appendix VII.

Date and place of the 27th and 28th Sessions of the WPTT (Chair and IOTC Secretariat)

WPTT26.10 (para. 173) The Secretariat will continue to liaise with CPCs to determine their interest in hosting these meetings in the future. The WPTT **RECOMMENDED** the SC consider late October 2025 as a preferred time period to hold the WPTT27 meeting in 2025. It was also **AGREED** that the WPTT Assessment meeting should continue to be held back-to-back with the WPM.

Review of the draft, and adoption of the report of the 26th session of the WPTT

WPTT26.11 (para. 174): The WPTT **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPTT26, provided at Appendix VIII, as well as the management advice provided in the draft resource stock status summary for each of the three tropical tuna species under the IOTC mandate, and the combined Kobe plot for the three species assigned a stock status in 2024 (Figure 1):

- Bigeye tuna (*Thunnus obesus*) – Appendix IV
- Skipjack tuna (*Katsuwonus pelamis*) – Appendix V
- Yellowfin tuna (*Thunnus albacares*) – Appendix VI

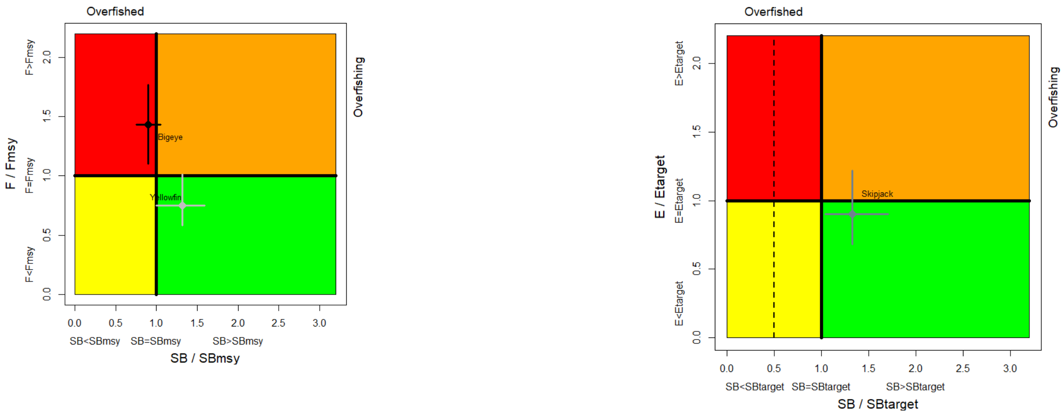

Figure 1. (Left) Combined Kobe plot for bigeye tuna (black: 2022), and yellowfin tuna (grey: 2024) showing the estimates of current stock size (SB) and current fishing mortality (F) in relation to optimal spawning stock size and optimal fishing mortality. (Right) Kobe plot for skipjack tuna showing the estimates of the current stock status (dark grey: 2023). The dashed line indicates the limit reference point at 20%SB0). Cross bars illustrate the range of uncertainty from the model runs with an 80% CI.

Table 1. Status summary for species of tropical tuna under the IOTC mandate.

Stock	Indicators		2016	2017	2018	2019	2020	2021	2022	2023	2024	Advice to the Commission
Bigeye tuna *Thunnus obesus*	Catch in 2023 (t) Average catch 2019–2023 (t) MSY (1,000 t) (80% CI) F_{MSY} (80% CI) SB_{MSY} (1,000 t) (80% CI) F_{2021} / F_{MSY} (80% CI) SB_{2021} / SB_{MSY} (80% CI) SB_{2021} / SB_0 (80% CI)	105,369 94,691 96 (83 – 108) 0.26 (0.18 – 0.34) 513 (332 – 694) 1.43 (1.10 – 1.77) 0.90 (0.75 – 1.05) 0.25 (0.23 – 0.27)		84%*			38%		79%			No new stock assessment was carried out in 2024 and so the advice is based on the 2022 assessment. Two models were applied to the bigeye stock (Statistical Catch at Size; SCAS) and Stock Synthesis (SS3), with the SS3 stock assessment selected to provide scientific advice. The reported stock status is based on a grid of 24 model configurations designed to capture the uncertainty on stock recruitment relationship, longline selectivity, growth and natural mortality. On the weight-of-evidence available in 2022, the bigeye tuna stock is determined to be **overfished** and subject to **overfishing.** A management procedure for Indian Ocean Bigeye tuna was adopted under Resolution 22/03 by the IOTC Commission in May 2022 and was applied to determine a recommended TAC for Bigeye tuna for 2024 and 2025. The TAC recommended from the application of the MP specified in Resolution 22/03 is 80,583t / year for the period 2024-2025. The recommended TAC is 15% below the 2021 catch. The management procedure was scheduled to be run in 2024 to recommend the TAC for 2026-2028, but has been delayed until the required CPUE is available and TAC advice can be considered by a proposed additional short SC meeting in February 2025. <Click here for full stock status summary>
Skipjack tuna *Katsuwonus pelamis*	Catch in 2023 (t): Average catch 2019-2023 (t): $E_{40\%SSB0}$ (t)**: SB_0 (t) SB_{2022} (t) SB_{2022} / SB_0 SB_{2022} / $SB_{40\%SB0}$ SB_{2022} / $SB_{20\%SB0}$ SB_{2022} / SB_{MSY} F_{2022} / F_{MSY} F_{2022} / $F_{40\%SB0}$	688 680 630 120 0.55 (0.48–0.65) 2 177 144 (1 869 035–2 465 671) 1 142 919 (842 723–1 461 772) 0.53 (0.42–0.68) 1.33 (1.04–1.71) 2.67 (2.08–3.42) 2.30 (1.57–3.40) 0.49 (0.32–0.75) 0.90 (0.68–1.22)			47%			60%		70%		No new stock assessment was carried out for skipjack tuna and so the advice is based on the 2023 assessment using Stock Synthesis with data up to 2022. The outcome of the 2023 stock assessment model is more optimistic than the previous assessment (2020) despite the high catches recorded in the period 2021-2022, which exceeded the catch limits established in 2020 for this period. The final assessment indicates that: (1) The stock is above the adopted target for this stock (40%SB0) and the current exploitation rate is below the target exploitation rate. Current spawning biomass relative to unexploited levels is estimated at 53%. (2) The spawning biomass remains above SBMSY and the fishing mortality remains below FMSY with a probability of 98.4 %. (3) Over the history of the fishery, biomass has been well above the adopted limit reference

Stock	Indicators		2016	2017	2018	2019	2020	2021	2022	2023	2024	Advice to the Commission
	MSY (MT)	584 774 (512 228–686 071)										point (20%SB0). Subsequently, based on the weight-of-evidence available in 2023, the skipjack tuna stock is determined to be not overfished and not subject to overfishing. The catch limit calculated by applying the HCR specified in Resolution21/03 is [628, 605t] for the period 2024-2026. The [SC] noted that this catch limit is higher than for the previous period. This is attributed to the new stock assessment which estimates a higher productivity of the stock in recent years and a higher stock level relative to the target reference point, possibly due to skipjack life history characteristics and favourable environmental conditions. <Click here for full stock status summary>
Yellowfin tuna *Thunnus albacares*	Catch in 2023 (t) Average catch 2019–2023 (t) MSY_{recent} (1000)(80% CI)) F_{MSY} (80% CI) $SB_{MSYrecent}$ (1000) (80% CI) F_{2020} / F_{MSY} (80% CI) SB_{2023}/ $SB_{MSYrecent}$ (80% CI) SB_{2023} / SB_0 (80% CI)	402,002 423,143 421 (416–430) 0.20 (0.16–0.26) 1,063 (890–1,361) 0.75 (0.58–1.01) 1.32 (1.00–1.59) 0.42 (0.33–0.50)		68%		94%			68%		89%	A new stock assessment was carried out for yellowfin tuna in 2024. The 2024 stock assessment was carried out using Stock Synthesis III (SS3), a fully integrated model that is currently used to provide scientific advice for the three tropical tunas stocks in the Indian Ocean. The model used in 2024 is based on the model developed in 2021 with a series of revisions that were discussed during the WPTT in 2024. The new model represents a marked improvement over the previous model available in 2021, as demonstrated using a number of statistical diagnostic analyses These revisions addressed many of the recommendations of the independent review of the yellowfin stock assessment carried out in 2023. The model uses four types of data: catch, size frequency, tagging and CPUE indices. The proposed final assessment model options correspond to a combination of model configurations, including alternative assumptions about the selectivity of longline CPUE (2 options on size frequency data prior to and post 2000), longline catchability (effort creep (0% and 0.5% per year)) and steepness values (0.7, 0.8, and 0.9). The model ensemble (a total of 12 models) encompasses a range of plausible hypotheses about stock and fisheries dynamics. <Click here for full stock status summary>
Stock	**Indicators**		**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**Advice to the Commission**

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

**E is the annual harvest rate

1. OPENING OF THE MEETING

1. The 26th Session of the Indian Ocean Tuna Commission's (IOTC) Working Party on Tropical Tunas (WPTT), was held in Seychelles from 28 October - 2 November 2024. The meeting was opened by the Chairperson, Dr Gorka Merino (EU, Spain) who welcomed participants. A total of 130 participants attended the Session (cf. 91, in 2023, 113 in 2022, and 108 in 2021). The list of participants is provided at Appendix I.

2. ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION

2. The WPTT **ADOPTED** the Agenda provided in Appendix II. The documents presented to the WPTT26 are listed in Appendix III.

3. UPDATE OF ANY NEW DATA AVAILABLE AT THE SECRETARIAT FOR TROPICAL TUNA SPECIES SINCE THE DATA PREPARATORY MEETING

3.1 DATA AVAILABLE AT THE SECRETARIAT

3. The WPTT **NOTED** papers IOTC–2024–WPTT26–03.1 and IOTC–2024–WPTT26–03.2 which provide a review of the statistical data and fishery trends for tropical tunas and yellowfin tuna, respectively, as received by the IOTC Secretariat for the period 1950–2023. The papers cover data on retained catches, catch and effort, size-frequency, and provide a range of fishery indicators, including catch and effort trends and (estimated) average weights for fisheries catching yellowfin tuna in the IOTC area of competence.

4. The WPTT **CONGRATULATED** the Secretariat on its work and **ACKNOWLEDGED** the value of the data review papers.

5. The WPTT **NOTED** that due to staff shortages the Secretariat prioritised the production of raised catch datasets for yellowfin tuna. Raised catch datasets for bigeye and skipjack tunas should be available by the first quarter of 2025.

6. The WPTT **NOTED** that the total catches of the three tropical tuna species (bigeye tuna, skipjack tuna, and yellowfin tuna) in the IOTC area of competence, estimated for 2023, were close to 1.2 million tonnes – a level similar to that estimated for 2022.

7. The WPTT **NOTED** that two-thirds of the tropical tuna catch in 2023 were taken by industrial fisheries, i.e., fisheries consisting of vessels listed in the IOTC Record of Authorised Vessels (Res. 19/04: 24 metres in length overall or above, or in case of vessels less than 24 meters, those operating in waters outside the Economic Exclusive Zone of the flag State).

8. The WPTT **NOTED** that the purse seine fisheries, including both industrial and coastal purse seines and other surrounding nets operating in both coastal and high seas, has dominated the tropical tuna catch in recent years, amounting to approximately 520,000 tonnes and contributing around 45% of the total catch from 2019 to 2023.

9. The WPTT **NOTED** that catches of tropical tunas from line fisheries (i.e., handlines, trolling lines, and coastal longlines) are largely dominated by yellowfin tuna and have significantly increased since the early 2010s, now representing approximately 20% of the total catch of yellowfin in recent years. These catches predominantly come from Oman, Yemen, Maldives, Sri Lanka, India, Indonesia, and the Islamic Republic of Iran.

10. The WPTT **ACKNOWLEDGED** the interest in describing data reporting quality, **NOTING**, however, that the indicators reflect only completeness and adherence to IOTC reporting standards.

11. The WPTT **NOTED** that the data reporting quality assessments of the datasets do not account for precision or potential biases which are difficult to assess in absence of ancillary sources of information.

12. The WPTT **RECALLED** that certain procedures are implemented by the Secretariat, under the SC's oversight, to check and consolidate the annual retained catch data submitted by CPCs (e.g., IOTC–2012–SC15–38). The reporting quality scores indicate the level of processing applied to each dataset, with a score of 8 representing the lowest quality when catches are fully estimated.

13. The WPTT **REQUESTED** that the WPDCS explore optimal methods for estimating accuracy and precision in retained catches (e.g., via subsampling techniques). It was **NOTED** that some variability can be incorporated into stock assessment models (using a standard deviation), and alternative catch time series may be used in sensitivity analyses. The WPTT further **RECALLED** that time series of retained catches serve as the primary input for data-limited models used for neritic species under IOTC management.

14. The WPTT **NOTED** that the reporting quality scores were used to weight the size-frequency datasets in the yellowfin tuna assessment model (see paper IOTC-2024-WPTT26-11_Rev1), and **AGREED** on the interest in further considering this approach and expanding it to the CPUE data.

15. The WPTT **RECALLED** that Resolution 15/02 requires CPCs to submit a report describing the data collection and processing system to assess its quality, which will provide insights into the precision and potential biases of the data collected (see document IOTC-2021-WPDCS17-27).

16. The WPTT **NOTED** that the jump in catches from other longline fisheries since 2013 is due to improvements in data reporting by Sri Lanka. Starting in 2014, catches were reported separately for each fishery, rather than being aggregated under the category of longline gillnet.

17. The WPTT **NOTED** a decline in reporting quality for some CPCs with purse seine fisheries in 2023. This reduction was attributed to minimal or no data submissions from certain CPCs with newly developed large-scale purse seine operations, specifically Tanzania and Oman. However, Oman highlighted the fact that it has recently submitted data of the purse seiners including catches of yellowfin, skipjack and bigeye related to two purse seiners. However, catches of Oman are not so relevant as the first purse seiner only started operations in mid-2022 and the second purse seiner only started operations in 2024.

18. The WPTT **NOTED** that CPC that have chartered vessels may need some time to adjust their monitoring systems to accommodate to the new requirements and make the necessary arrangements prior to facilitating a Chartering arrangement.

19. The WPTT **NOTED** that CPCs with purse seine fisheries have usually reported two sets of size data for tropical tunas, one including raw samples and the other raised catch-at-size. However, in recent years, only raw size frequency data have been reported.

3.2 FISHERY INDICATORS

20. The WPTT **NOTED** paper IOTC-2024-WPTT26-6 which provide a summary of tropical tuna landings at fishing ports in Thailand During 2021-2023, with the following abstract provided by the authors:

> "*The seafood processing industry in Thailand is an industry with high export value. The main export product of the processing industry is canned tuna. Each year, a large amount of tuna is*

imported as the main raw material in the industry. Most of the imported tuna is tropical tuna, with three main species: Skipjack tuna Yellowfin tuna and Bigeye tuna. The imported tuna is caught from fishing grounds in both the Indian Ocean and the Pacific Ocean. The vessels that import tuna to the fishing ports of Thailand are carrier and fishing vessels, from purse seiners and longliners fisheries. This study will discuss the trends of Tropical tuna landings in Thai fishing ports, the volume and value of imports, as well as fishing grounds of tuna in the Indian Ocean area"

21. The WPTT **ACKNOWLEDGED** the paper by Thailand on landings by foreign fleets in Thailand of tropical tuna originating from the Indian Ocean for canning and export purposes, indicating the importance of the tropical tuna fisheries for the processing industries in the country.

22. The WPTT **NOTED** the decrease in imports/landings in 2023 at Thailand's Ports, particularly for the import of tuna catches from Seychelles, in contrast to the imports from Maldives, **NOTING** that the information provided in the paper comes from import statistics coming from carrier vessels, with no details on the operational areas.

23. Furthermore, WPTT **NOTED** that while the value of yellowfin tuna is higher, a greater volume of skipjack tuna is being landed.

24. The WPTT **NOTED** paper IOTC-2024-WPTT26-7 which provide a summary of Review of Oman's data collection system and statistics, with the following abstract provided by the authors:

"*In the last meeting of the 26th Session of the Working Party on Tropical Tunas Data Preparatory Meeting, Oman reported that 'is internally reviewing its sampling protocol, with adjustments to data from 2014 where catches may have been underestimated' in relation to yellowfin catches, as was included in the Minutes of the Meeting. During the last months and until now, the Department of Fisheries Statistics and Information of the Ministry of Agriculture, Fisheries and Water Resources, Directorate General of Fisheries Research, has been working on this task with a view to present a full report to the WP of Data Collection and Statistics to take place in Cape Tome by the end of November 2024. This document has been prepared by the External Expert with the support of the MAFWR, with a view of presenting the preliminary results of the on-going review (which started in August 2024) of Oman's fisheries statistical programme and on artisanal fisheries. The review is evaluating the current data collection system to verify its compliance with regional and international standards. It has already evaluated the related Oracle database and the statistical reports resulting from the collected information and data. Based on these findings a catch/effort analysis has been conducted and a retrospective revision of catch/effort figures for 2014-2022 is currently in progress*."

25. The WPTT **ACKNOWLEDGED** the paper by Oman, which outlined the ongoing efforts to review the catch data from Omani fisheries. The WPTT **NOTED** that Oman is working with a consultant to audit its catch data, mainly focusing on the data from the period 2015 to most recent estimated data. The consultant will review the sampling protocol, adjust as needed, and assess the data collection system and database. The WPTT was **INFORMED** that a detailed review of the data collection and statistics, and results from the retrospective analysis will be presented at the WPDCS20. The WPTT further **NOTED** that Oman does not provide effort data supplementing catch, which is important for assessing fishing pressure on stocks and for formulating CPUE's. Size frequency data are also not supplied, possibly because the officers in Oman who are responsible for collection of size data are not also responsible for data submission.

26. The WPTT **NOTED** that Oman does not have length measurements of species landed, rather collects fish weight, which could be converted to length. However, while some institutes collect size data for certain species, this data is not submitted to the Ministry.

27. The WPTT **NOTED** that the absence of catch and effort data from Oman may be due to the separate collection of effort information from catch data, with fishers providing activity details through land-based surveys. The WPTT **NOTED** that the absence of effort data in data submissions is not related to the operational scheme for the collection of effort data and Oman simply has to include existing effort data in the data submission process.

28. The WPTT **NOTED** that outdated fleet census data can significantly influence catch effort estimates and that recent estimates still rely on vessel information from the most recent (2015) census.

29. The WPTT **NOTED** the large number of landing sites and the established sampling protocols which are determined on the basis of numbers of fishing units and the desired level of sampling accuracy. The WPTT **NOTED** that the detailed methodology will be further explained at the WPDCS.

30. The WPTT **NOTED** that the increase in fishing effort, driven by a rise in fishing days by skiffs and dhows, has contributed to higher catches since 2015. The WPTT further **NOTED** that while there is an increasing demand for tuna in the Omani market, the export of tuna is limited to whole fish or cut portions.

4. YELLOWFIN TUNA STOCK ASSESSMENT

4.1 Review any New Information on Yellowfin tuna Biology, Stock Structure, Fisheries and Associated Environmental Data Since the Data Preparatory Meeting

31. The WPTT **NOTED** paper IOTC–2023–WPTT26–09 on a proposal of an Indian Ocean online Digital Atlas (IODA) for the Indian Ocean, including the following abstract:

> "*Resolution 24/01 of the IOTC, adopted at the 28th session of the Commission, calls for a better integration of ocean and climate change information in the development of conservation and management measures. In this context, a design for a digital ocean atlas for the area of competence of the IOTC (IODA) is proposed. The atlas would produce interactively maps, time series, transects, spacetime plots (hovmoller) and vertical profiles, from a set of 18 physical and biogeochemical oceanic variables, from surface to 900 m in depth. Different options are discussed on the required datasets to optimize the disk space. The Fisheries and Aquatic Resource Department of Sri Lanka is candidate to support hosting the server and deploying IT team, to perform the maintenance of the system and to have IODA running routinely. These suggestions must be discussed at the current session of the WPTT26 to devise on a roadmap for the atlas, in accordance with Res 24/01*"

32. The WPTT **AGREED** that a tool like an online atlas would help to draft environmental summaries, and assist discussions of the potential for impacts of climate variability and climate change on the status of tuna stocks and their associated fisheries.

33. The WPTT **NOTED** the importance of the work that could be included in the IODA, **NOTING** that the data sets are in netCDF, with R-Shiny used for visualization, where the IOTC area of competence is considered. **NOTING** that Copernicus is the main data source, there is continuity in the quality of the products delivered. The project utilizes two models, for physical and biogeochemical variables respectively, and satellite observations for surface chlorophyll and sea level anomalies.

34. The WPTT **SUGGESTED** several improvements to the current proposal, such as 1) that climatic indices, the IOD and the ENSO, could be included in the atlas; 2) that the depth range where the current shear is calculated be reduced from 130 m to around 60 m to better reflect the actual depth

range of shallow longline sets for swordfish; and 3) that the reduction of depth levels from 35 to 20 is a good option which allows a good description of the properties of the water column at a reduced cost in terms of data.

35. The WPTT **NOTED** that Sri Lanka has expressed interest in hosting the atlas application and the data server, as well ensuring the maintenance of the system and datasets over time. The WPTT however **NOTED** that an alternate plan should be considered in case Sri Lanka does not confirm its commitment in this project. The WPTT **AGREED** that information on the validation (and associated uncertainty) of the ocean models outputs used in the atlas, as well as metadata about the datasets used, should be included in the web portal of the atlas.

36. In parallel to the development of the atlas, the WPTT **AGREED** that a research plan should be devised to ensure the best use of the information on environmental conditions in the Indian Ocean.

37. The WPTT **RECOMMENDED** that the work towards the implementation of the Indian Ocean Digital Atlas (IODA) be continued to consolidate the proposal before the Scientific Committee.

38. The WPTT **NOTED** paper IOTC-2024-WPTT26-INF05 which presents environmental indicators to inform on the past and ongoing trends and variability of ocean conditions in the Indian Ocean, with the following summary provided by the author:

- *"that the IOD is likely to remain in its neutral phase until April 2025, which indicates a steady and moderate ocean productivity for that period (as biological enhancement is generally triggered by negative IOD).*
- *that the chlorophyll concentration does not exhibit long-term trends, rather multi-year oscillations. A focus on the ocean productivity off Oman revealed a substantial decline from 2020 to 2021 when the Oman tuna catch experienced a dramatic increase, which discards the hypothesis that high tuna catches were triggered by anomalous conditions in ocean productivity.*
- *that the space occupied by temperature above 25°C has been expanding by 3% during the past 30 years, approaching 88% (of the whole tropical IO) in 2023, that indicates the optimal spawning habitat for tropical tunas is increasing spatially.*
- *that the DO level in the North Indian Ocean has been increasing from 1993 to 2005: the 2.5 ml l^{-1} level (considered as a threshold in hypoxia stress for tropical tunas) was never reached before 2005; since then, DO levels in Quarter 2 have always been above 2.5 ml l^{-1} whereas it remained below 2.5 ml l^{-1} for the rest of the year.*
- *that the DO level in the equatorial belt (10°N-10°S) which fluctuated between 2.3 – 2.7 ml l^{-1} started to show a continuous decline from 2021 on (2.2 ml l^{-1} in early 2024); such a DO decline at 100 m indicates that the optimal habitat is presently restricted to a shallower part of the water column, potentially inducing increased catchability for surface gears.*
- *that the waters in the south tropical IO (10S-30°S) are always well-oxygenated (DO levels in the range of 4.25 - 4.6 ml l^{-1}); however a long-term decline has been noticed since 2007."*

39. The WPTT **NOTED** that the paper described the Indian Ocean Dipole (IOD), the chlorophyll concentration (an index of ocean productivity) in different regions of the Indian Ocean (from satellite observations), the proportion of space occupied by sea temperature above 25°C (a threshold defining tuna spawning habitat), and the dissolved oxygen (DO) content at 100m depth (from a global ocean model).

40. The WPTT **NOTED** that the ocean models (from the Copernicus system) used in the analysis encompass all types of observations and are qualified as "data-assimilated" models. The WPTT **NOTED** the dominance of the positive dipole since 2006, with two major positive events in 2019

and 2023, which have a negative impact on ocean productivity (notably in the Western Indian Ocean), in contrast with the negative dipole events, which occurred significantly in 2016 and 2022, and are associated with higher productivity. **NOTING** that the positive dipole is often linked to El Niño, while the negative dipole is related to La Niña, productivity fluctuates in response to these dipole shifts over the years. Furthermore, the current status indicates a mild negative dipole, which is predicted to transition towards a neutral phase throughout the upcoming boreal winter.

41. The WPTT **NOTED** the interannual variability in the different assessment areas. The ocean productivity was higher than normal in R4 since 2017, whereas it fluctuated between negative and positive anomalies in the R1b during the same period, and was positive in 2022-2023 in the area R1a (Arabian Sea).

42. The WPTT also **NOTED** a specific method used to assess habitat quality and proportion of space occupied by the changes, by counting grid points above a given threshold in the ocean model outputs.

43. The WPTT **ACKNOWLEDGED** that this type of analysis provides useful background information for the interpretation of some trends in biomass and recruitment from the assessment.

44. The WPTT **DISCUSSED** the manner whereby environmental information could be accounted for quantitatively in the stock assessment process. The WPTT **NOTED** that environmental information is presently used in a qualitative way in the outlook of the management advice (e.g. for skipjack). Incorporating climate data more formally would require considering factors related to recruitment, e.g. temperature and ocean productivity (a proxy of foraging conditions for the early life stages), and factors related to catchability, e.g. depth of thermocline and oxygen levels. The incorporation of environmental cues in models is, however, a regular practice in spatially-explicit ecosystem models (SEAPODYM, APECOSM…), and the WPTT **AGREED** that such an approach should be investigated in the IOTC.

45. The WPTT **ENCOURAGED** CPCs to conduct research on vessels by collecting climate data to better understand the relationship between population dynamics and recruitment.

46. The WPTT **NOTED** the continued work on ecosystem analysis, with the current analysis running habitat feature assessments for different species related to biomass. The WPTT also **NOTED** the work done by FAO Common Oceans to develop a model for projecting tuna habitat, which focused primarily on the Pacific Ocean, but could be expanded to other oceans, including the Indian Ocean

47. The WPTT also **NOTED** that environmental information could be particularly useful to explain/predict the recruitment in the short term (3-4 years ahead), rather than in the long term.

4.2 Update on the Nominal and Standardised CPUE Indices Presented at the Data Preparatory Meeting

48. The WPTT **NOTED** that there has been no update of the Standardised CPUE Indices since the data preparatory meeting in June.

4.3 Stock Assessment Results

49. The WPTT **NOTED** paper IOTC–2024–WPTT26–11_Rev1 describing the preliminary Indian Ocean Yellowfin tuna stock assessment 1950-2023 (stock synthesis), including the abstract:

> *"This report presents a preliminary stock assessment for Indian Ocean yellowfin tuna (Thunnus albacares) using Stock Synthesis 3. The assessment uses an age-structured spatially-explicit population model and is fitted to catch, catch per unit effort (CPUE) indices, length compositions, tagging data, and conditional age-at-length. The assessment covers 1950 – 2023 and represents an update of the previous assessment model, taking into account progress and improvements made since the previous assessment, including recommendations from the*

review of the previous assessment undertaken in 2023. The assessment assumes that the Indian Ocean yellowfin tuna constitute a single spawning stock, modelled as spatially disaggregated four regions, with twenty-one fisheries. Key biological parameters were revised, specifically growth and natural mortality. Standardized CPUE series from the main longline fleets 1975 – 2023 were included in the models as the relative abundance index of exploitable abundance in each region, including alternative assumptions regarding changes in the efficiency of the longline fleet ("effort creep"). The CPUE indices from EU purse seine sets on free schools were included in a subset of models. Indices based on associative and non-associative dynamics of yellowfin tuna with floating objects were also available, and the utility of these indices was examined in the assessment. Tag release and recovery data from the RTTP-IO program were included in the model to inform abundance, movement, and mortality rates"

CPUE discussions

50. The WPTT **NOTED** that regional Longline CPUE indices were provided by the Joint Workshop convened by Japanese, Taiwanese and Korean scientists. Two sets of CPUE indices were provided for yellowfin tuna: quarterly CPUE indices derived from aggregated vessel specific operational catch and effort data and annual indices derived from sub-sampled operational logbook data.

51. The WPTT **NOTED** a substantial difference between the current index and the 2021 index for Region 1 (both derived from aggregated data), with potential implications for the final assessment outcome. The current index shows a much flatter trend since the 1990s and is noticeably higher in recent years. There is a considerable increase in the Region 1 CPUE indices for recent years (since 2018).

52. The WPTT **NOTED** that the current quarterly index includes data from Region 1a (North Arabian Sea), which the previous index did not include. However, an alternative standardised annual index, also including data from Region 1a showed a very similar trend and was largely consistent with the previous (2021) index.

53. The WPTT also **NOTED** that this difference between the current and previous indices is apparent in other regions as well, with similar patterns but varying, and with smaller magnitudes. Therefore, it is unlikely that including the Region 1a data is the sole cause of the difference.

54. The WPTT further **NOTED** that the Arabian Sea (Region 1a) has different oceanic and productivity conditions. The trends and magnitude of the nominal CPUE are considerably different from other regions, which is why the Arabian Sea CPUE data were previously excluded. Additionally, the data are sporadic and were mainly contributed to by the Taiwanese fleet from the 1990s to the early 2000s.

55. The WPTT **NOTED** that while the quarterly index used aggregated data, the annual index used operation-level data. However, this does not explain the differences since the previous quarterly index also used aggregated data.

56. The WPTT **ACKNOWLEDGED** that discussions could not resolve the observed differences between the current and previous indices. The WPTT was informed that the standardisation methods have remained essentially the same. However, considering the importance of the longline CPUE in driving the key model results for the yellowfin assessment, the WPTT **REQUESTED** the modellers to dedicate further efforts to understanding the factors causing these significant differences between analyses. Additionally, the rationale for including Region 1a data requires more investigation.

Size data discussions

57. The WPTT **NOTED** that no geo-referenced size data have been reported for yellowfin tuna caught in the Omani handline fishery since 2009, while the reported catch levels have been substantial at

about 50,000 t per year during the period 2019-2023. It is believed that the sizes of fish caught in this fishery are likely similar to those in the Maldives handline fishery. Therefore, it was assumed in the model that the Oman handline fishery has the same selectivity as the Maldives handline fishery.

58. The WPTT **AGREED** on the need to validate the assumption of size composition of the handline fishery of Oman and **REQUESTED** Oman to develop and implement a system of data collection and reporting of size-frequency data to the Secretariat to improve the assessment model and comply with IOTC Res. 15/02.

59. The WPTT **NOTED** the differences in the average length of fish from early (prior to 1960) longline size data compared to the previous assessment. It has been verified that this is largely due to the updates on how fish weights have been converted to lengths during the data processing.

60. The WPTT **NOTED** that historical length frequency data available prior to 1960 for regions 1b, 2, 3, and 4 as well as data from all Taiwanese and Seychelles longline logbooks were removed from the model following recommendations made in IOTC-2021-WPTT23(AS)-07.

61. The WPTT **NOTED** that only size data collected by scientific observers were included in the model for the Taiwanese longline fishery. The WPTT further **NOTED** that the mean length of yellowfin caught in this fishery over the last decade was significantly larger than the mean length observed in the Japanese longline fishery in regions 1b and 4.

62. The WPTT **NOTED** that some model configurations tested time-variant selectivity in two blocks: before 2000 (double-normal parameterisation) and after 2000 (logistic parameterisation) for longline fisheries in regions 1b, 2, and 4, to account for changes in CPC contribution to length data.

63. The WPTT **NOTED** that an analysis conducted by the IATTC in 2016 indicated that there was a substantial change in the collection and reporting system of Japanese size-frequency data around 1990 in the eastern Pacific Ocean, which was associated with a shift in the unit of fish size (Satoh et al. 2016). The WPTT **ACKNOWLEDGED** that this change may also have impacted the length data available for yellowfin and bigeye tuna in the Indian Ocean, as data processing procedures are consistent across all oceans for the Japanese longline fishery.

64. The WPTT **NOTED** that the sources of Japanese size data in the Indian Ocean - namely, commercial vessels, training vessels, and scientific observers - have varied over time, with most data originating from commercial fisheries after 1990 (see IOTC-2013-WPTT15-22). Also, historical size data were collected in both weight (to the nearest kg) and length (to the nearest 1, 2, and 5 cm). The WPTT further **NOTED** that a comparison between data sources revealed that a mode of smaller fish was observed only in measurements taken by training vessels and/or scientific observers across several strata. **NOTING** that the historical size data available at the Secretariat do not include information on the source of data submitted, the WPTT **ENCOURAGED** the Secretariat to work with Japan to gain further information on the sources of these datasets.

65. The WPTT **NOTED** that the size distribution of purse seine free schools in region 2 (FS2) shows a more pronounced mode for younger fish (30–70 cm) compared to adults (>90 cm). This is unexpected, as free schools are typically composed primarily of larger yellowfin tuna. One possible explanation is that in the Mozambique Channel, especially in the southern areas, there are many mixed schools found near floating natural objects (which may not have been seen by the vessel). In these schools, small yellowfin tuna mix with skipjack and bigeye tuna, which might be reported as free schools. Similar free mixed schools composed of juvenile yellowfin tuna, skipjack tuna and juvenile bigeye tuna have also been observed in the Cape Lopez area of the Atlantic Ocean. The WPTT **NOTED** that there might also be some sampling bias, even though it was noted that fish under 10 kg are sampled separately. Nevertheless, the WPTT **REQUESTED** the EU scientists to look at this issue more closely.

Biological parameters

66. The WPTT **NOTED** that the assessment used a new growth curve, as agreed in the data preparation meeting. The updated growth curve was derived from otolith ageing data collected through the "GERUNDIO" project. In contrast, the previous growth curve was empirically calculated using tag increment data from the IOTTP tagging project, where initial age-size estimates were based on a very different ageing protocol. The WPTT **NOTED** that this new curve is significantly different from the one used previously, with a notably higher Linf, which may impact the fit of the model to the size data.

67. The WPTT **NOTED** that the assessment assumes stationary growth, but it's possible that growth may vary over time. The WPTT further **NOTED** that the data for these studies come from very different fisheries, some of which might not include enough large fish.

68. The WPTT **NOTED** that the skewed sex ratio towards larger male yellowfin in the size data might be due to differences in growth rates between sexes or varying natural mortality. The independent review leant towards sex-specific growth as the explanation, though the impact of mortality cannot be ruled out.

69. The WPTT **NOTED** that the mortality rate (M) is estimated from the method of Hamel and Cope (2022), which uses the maximum observed age from unexploited or lightly exploited stocks. The WPTT **NOTED** that the maximum observed age of yellowfin from the heavily fished area in Indian Ocean is 11.7 years, and that this might be an underestimate of the potential maximum age, given that the maximum observed age of yellowfin tuna is greater in the Pacific (15 years) and Atlantic (18 years) oceans. The WPTT **NOTED**, however, that the WPTT(DP) suggested that using the oldest (maximum) age from such a fishery as a proxy for the average age in an unexploited fishery is a reasonable method for estimating M.

Model update runs

70. The WPTT **NOTED** that the assessment began using the 2021 reference model. It was then updated sequentially with new catches, size data, and CPUE, and with biological data as agreed upon during the WPTT(DP):

- Natural mortality: M Lorenzen function: M = 0.462 at age 16.28 (quarter)
- Growth: Farley et al. 2023
- Maturity: functional maturity curve of Zudaire et al. 2022 (L50=101.7cm)

71. The WPTT **NOTED** that the updated model estimated the main recruitment deviations from 1972 to 2021, and regional recruitment deviations from 1977 to 2021. The optimal bias correction for recruitment has been recalculated. Additionally, revisions were made to the PS selectivity function and the prior and boundaries for certain parameters. Following these updates and revisions, the WPTT **DISCUSSED** the following reference models that had been developed (see Table 3 for explanations of 'Split' vs 'NoSplit', 'tag1' vs 'tag01'; 'EC0' vs 'EC1', etc):

- RM1: 1_NoSplit_tag1_ECO_h08. Regional longline selectivities parameterised with logistic function, and no split of LL fishery
- RM2: 2_Split_tag1_EC0_h08: LL fishery Split into two periods (around 2000s). LL selectivity for the equatorial fisheries (and CPUE) parameterised as a double normal function prior to 2000; logistic selectivity post 2000. The selectivity of the LL CPUE is assumed to follow the selectivity in the early period.
- RM3: 3_SplitCPUE_tag1_EC0_h08: LL fishery Split into two periods (around 2000s) – the selectivity of the LL CPUE is assumed to follow the selectivity in the corresponding period.

- RM4: 4_Split_tag01_EC0_h08: Down-weighted tagging data (tag likelihood lambda set to 0.1).
- RM5: 5_Split_tag01_EC1_h08: Effort creep, with 0.5% yr^{-1} increase in LL CPUE catchability.

72. During the step-wise model updates, the WPTT **NOTED** that the estimated stock dynamics remain very stable and similar amongst models. This stability results from certain key parameters like steepness, M, and growth being fixed, restricting the model's ability to explore different dynamics. A more flexible configuration for M and its impact was examined subsequently during the meeting. The WPTT **SUGGESTED** that freeing up some of other productivity parameters should also be investigated in future assessments to gain more insights into the model dynamics.
73. Concerning longline length data trends, the WPTT **NOTED** some inconsistencies when comparing the general model dynamics with the increase in average length over time. The WPTT also **NOTED** that there appears to be more confidence in recent data since it comes primarily from observers and generally aligns closely with logbook reports, unlike earlier, where data originated from less reliable port sampling data which have now been excluded from the stock assessment.
74. The WPTT **NOTED** that applying two different selectivity curves — a dome-shaped one for the early period before the 2000s and a logistic selectivity for recent years—may better account for the observed trend in the average length for the LL fishery. However, the WPTT **ADVISED** caution when interpreting this change in selectivity to avoid introducing artefacts into the model. For instance, the longline fishery appeared to catch a broader size range in the early period, including large fish similar to those caught in the later period. On the other hand, size data in the past originated mostly from research and training vessels, which did not operate in the same areas as the commercial vessels. It was further noted that the shift in LL fish sizes coincides with the development of purse seine (PS) fishing, as such, a possibility that the early LL fishery may have targeted the same surface schools as PS was also hypothesized.
75. The WPTT **AGREED** that splitting the LL fishery data is necessary to reflect the change in average size before and after the 2000s. However, further investigation is needed to understand and justify the cause of this change in selectivity. Additionally, connecting the early and later CPUE selectivity with the LL fishery's selectivity during the same periods (RM3 scenario) is considered a better choice for two reasons: (1) It aligns the CPUE's selectivity more closely with the underlying size data; and (2) It could prevent the model from creating potential cryptic biomass in later periods by assuming a full asymptotic selectivity, which would improve the model stability.
76. The WPTT **NOTED** that several diagnostics were performed for the range of initial model options including runs test, profile likelihood, hindcasting, and retrospective analysis.
77. The WPTT **NOTED** a strong retrospective pattern in fishing mortality. The WPTT further **NOTED** that this is likely linked to the higher-than-average recruitment in recent years, influenced by LL CPUE trends, indicating that it's not due to a systematic bias in the estimation of recent biomass. However, there are concerns about the inconsistent CPUE trends between seasons in region 1.
78. Regarding the likelihood profile, the WPTT **DISCUSSED** how different pieces of information in the model data affect the estimation of sigmaR (recruitment variability), steepness, natural mortality (M), and unfished spawning biomass (R0). The WPTT **SUGGESTED** that the modellers develop a two-dimensional likelihood profile contour to examine how these key productivity parameters interact.
79. The WPTT **NOTED** that several exploratory/sensitivity analyses were conducted and found that:
    - The model using the annual, operational level CPUE index didn't converge, and the reason for this is unclear. It could be due to the significant conflict between the CPUE index of regions 1 and 2.

- The estimation of low recruitment deviates in the last few quarters seems to be persistent and unaffected by removing either the longline or purse seine log school size data. The purse seine free school size data might have an effect since it shows multiple modes. This requires further investigation.
- The revised Indonesia yellowfin catches (explained in paper IOTC-2024-WPTT26-INF02) appear to have a minimal impact. These estimates are preliminary and still need to be reviewed and endorsed by the WPDCS and SC.
- An exploratory run of the current reference model (R3) using the 2021 CPUE to better understand the impact of the revised 2024 CPUE indices on assessment uncertainty. The use of the 2021 CPUE in the current model results in a substantially more pessimistic biomass estimate (about 20% lower in depletion terms) up to 2020 compared to the run using the current index and produces a very different trend in recent biomass.

80. Exploratory tests were also carried out with different spatial structures. These included a single-area model covering the entire Indian Ocean and a two-area model for the eastern and western Indian Ocean. The WPTT **NOTED** that the existing spatial dividing boundaries might not match the actual ocean conditions or the habitat of yellowfin tuna. The WPTT **SUGGESTED** using the ecoregion study currently being reviewed by the WPEB, along with various ecosystem models, to more accurately define and adjust these regional boundaries.

81. The WPTT **SUGGESTED** examining alternative values of M as there is evidence that older fish might have a higher M than what is currently assumed, based on the predicted size, and older age estimates in other oceans. However, the WPTT **NOTED** that tagging data seems to imply lower M values. The WPTT further **NOTED** that the uncertainty around M could be somewhat linked with the uncertainty related to steepness.

82. The WPTT **NOTED** the presentation by the modelling team that summarises the key recommendation from the yellowfin peer review. The WPTT **THANKED** the assessment team for their hard work in responding to the review recommendations and **RECALLED** that the review touched on various topics such as stock structure, how complex the model should be, definitions of fisheries, what goes into the model, biological factors, future projections, and how reference points should be calculated. The WPTT then **DISCUSSED** how the current assessment deals with these recommendations and suggestions and **NOTED** that many of the peer-review suggestions were incorporated into the new stock assessment.

Assessment model grid

83. The WPTT **DISCUSSED** the setup of the assessment model grid, focusing on whether to include models RM1, RM2, and RM3 as starting points. The WPTT **AGREED** that dividing the LL fishery is essential to account for the change in average size before and after the 2000s and that linking the early and later CPUE selectivity with the LL fishery's selectivity from the same period (RM3) is a reasonable option.

84. The WPTT also **AGREED** that RM2's selectivity assumption (the selectivity of the recent LL CPUE is assumed to follow the selectivity of the size data in the early period) seems unrealistic and therefore this model grid was excluded from the final options. Meanwhile, WPTT **ACKNOWLEDGED** that there is ongoing uncertainty about the reliability of size data across different periods, with no definitive evidence pointing to which data set is more credible. Exploring different scenarios related to possible changes in selectivity (i.e., RM1 vs. RM3 scenario) allows for examining various hypotheses about the size data. The WPTT therefore **AGREED** to keep RM1 and RM3 in the final model grid.

85. The WPTT **NOTED** that the tag weighting lambda in RM1 and RM3 should be revised to 0.1 to down-weight these data in the model, following the recommendations from the yellowfin peer

review (the assumption that the tagged fish were fully mixed with the rest of population in the region is unlikely to be met).

86. Additionally, the WPTT **AGREED** to incorporate two alternative assumptions of effort creep (0 or 0.5%) for the LL CPUE index and three alternative steepness values (0.7, 0.8, and 0.9). In total there are 12 models in the model grid (Table 3).

The WPTT **NOTED** that the 0.5% effort creep assumption came from the WPTT(DP) based on estimates from the Southern Bluefin Tuna fishery. The WPTT **CONSIDERED** possible reasons to also consider the 0% effort creep option, **NOTING** that while effort creep is generally expected in the longline fishery, various factors could also negatively impact the catch efficiency of yellowfin—such as imposed catch limits, reduction in the number of vessels shifting their targeting to bigeye tuna by some fleets, and piracy effects. Climate change and changes in fishing dynamics might also reduce effective fishing effort. The WPTT **AGREED** that more research is needed to understand the potential factors influencing changes in catchability and how they might change over time and across the different fisheries.

Table 3: Description of the final model options for the 2024 assessment.

Model options	**Description**
Selectivity option	• **NoSplit –** Constant longline selectivity throughout
	• **Split –** LL fishery Split into two periods (around 2000s) – the selectivity of the LL CPUE is assumed to follow the selectivity in the corresponding period
Tag weighting option catchability	• **Tag01** – tag likelihood lambda set to 0.1 (as such, the tag dataset was downweighed by 90%)
Effort creep	• **EC0** – Constant LL CPUE catchability throughout
	• **EC1** – with 0.5% yr^{-1} increase in LL CPUE catchability
Steepness	• **h70** – Steepness value of 0.7
	• **h80** – Steepness value of 0.8
	• **h80** – Steepness value of 0.9

Projection and reference points

87. The WPTT **NOTED** that reference models show a trend of increasing recruitment over time, with lower-than-average numbers in the early period and higher numbers in more recent years. The WPTT **DISCUSSED** the possible reasons for this trend and its impact on model projections and reference point estimates (e.g., MSY). The WPTT further **NOTED** that this topic was also discussed at this year's WPM meeting. Additionally, the WPTT **NOTED** a study by Merino et al. (2022)[1] that explored this issue.

88. Following these discussions, the modelling team **SUGGESTED** using the average estimated recruitment from recent years e.g., 12 years (2010 – 2021) or 20 years (2002 – 2021) for model projections. The modelling team also proposed adjusting the MSY and BMSY estimates based on

[1] Merino et al. 2022. Investigating trends in process error as a diagnostic for integrated fisheries stock assessments https://doi.org/10.1016/j.fishres.2022.106478

the productivity of these periods. For instance, if recent recruitment is above average, then MSY would increase proportionally.

89. The WPTT **NOTED** that using recent recruitment for projections and reference points benchmark calculations was advised by the yellowfin expert panel review.

90. The WPTT **NOTED** that using recent recruitment for short-term projection is practiced in some RFMOs (e.g., it is commonly done in SPC assessments), although there is debate over how to choose the reference period for calculating the recent recruitment.

91. However, the WPTT **NOTED** diverging opinions on whether benchmark reference points like MSY and BMSY should be adjusted to recent productivity. The WPTT **NOTED** that SPC does not rescale estimates of MSY or BMSY based on recent conditions – only for estimation of the depletion reference point.

92. The WPTT **NOTED** that one key argument is that benchmarks relate to long-term average productivity and should only change if there is clear evidence of a shift in productivity. In the case of yellowfin, there is no evidence for a regime shift that will continue into the future, and this is not considered to be the most probable explanation of the recent high recruitment. The WPTT **NOTED** that it is possible that the observed recruitment trend might be an artefact of the model setup rather than a real change in productivity (i.e., large observed catches with decreasing or stable CPUE).

93. For example, the shift in recruitment coincided with the development of fisheries catching small sized fish, suggesting that the model may be compensating for a mis-estimated mortality rate (M) for young fish, and a stable longline CPUE through the 1990s and 2000s.

94. The counterargument is that adjusting the reference points does not necessarily indicate a regime shift but aims to align benchmark calculations with short-term projections. The WPTT **NOTED** views that it is arguably a more consistent approach, as past yellowfin assessments have shown that projections assuming a long-term average productivity regime would not be able to sustain current observed catches.

95. The WPTT **NOTED** that the proposal to adjust MSY-based/benchmark reference points using recent average recruitment is new and has major implications for the yellowfin tuna assessment and other IOTC assessments. Therefore, the WPTT **RECOMMENDED** that the SC discuss this approach thoroughly and if appropriate, request the development of further guidance on this from the WPM.

96. The WPTT explored three scenarios of the 10 year projections:
    (1) Future recruitment is assumed to be equal to long-term average recruitment and long-term productivity is used to estimate benchmark reference points for stock status;
    (2) Future recruitment assuming the average recruitment deviates from the recent 12 years (2010 – 2021) and adjusting the benchmark reference points accordingly with a scalar based on this period productivity.
    (3) Future recruitment assuming the average recruitment deviates from the recent 20 years (2002 – 2021) and adjusting benchmark reference points accordingly with a scalar based on this period productivity.

97. The WPTT **AGREED** to set the reference period to the recent 20 years (2002-2021) for providing the stock status and performing the projections. This 20-year period was selected on the basis that the period encompassed the most reliable series of catch and size composition data and, as such, provided the best available information regarding the prevailing productivity of the stock.

98. Additionally, the WPTT **AGREED** to report current stock status estimates from the assessment model grid against the scaled benchmark reference points in the stock status table of the Executive

Summary. Noting concerns that this scaled benchmark approach was completely new for reporting stock status in the IOTC, the WPTT **AGREED** that current stock status against the unadjusted benchmark reference points will also be provided in the executive summary.

99. After in-depth discussions on different aspects of the modelling work, the WPTT **AGREED** and **RECOMMENDED** additional research and actions to further refine future yellowfin stock assessment. These will also address the suggestions and requests raised during the detailed discussions. These recommended action points are listed in Appendix IX

100. The WPTT **NOTED** paper IOTC–2024–WPTT26–13 describing a stock assessment for Indian Ocean Yellowfin tuna using Bayesian surplus production model (JABBA), including the abstract:

"In this assessment, Bayesian State-Space Surplus Production Model was constructed to assess the status of yellowfin tuna (Thunnus albacares) stock in the Indian Ocean from 1950 to 2023. This assessment was carried out in the open-source stock assessment environment, JABBA (Just Another Bayesian Biomass Assessment). Eighteen scenarios were tested using various surplus production models and CPUE scenarios. The results showed no significant differences in model fit or outcomes, particularly regarding the forecast of stock biomass. According to the fitting results, the CPUE selected by the base case model is the jointed of R1 and R2, and the jointed of R3 and R4 and FSC. B2023 was estimated to be 2,512,635 t, while BMSY estimate was 2,991,096t. Catch in 2023 is 400,951t, while MSY was estimated to be 516,484 (395,027~679,094) t for median and 95% confidence interval. The results of JABBA Base case indicated that the stock of yellowfin tuna in the Indian Ocean is overfished but does not subject to overfishing. Sensitivity analysis was conducted for r and K with different prior Settings, and the results showed that different scenarios had little difference in the assessment results of relative biomass B/BMSY, but had big difference in relative fishing mortality F/FMSY".

101. The WPTT **NOTED** that there are some scenarios in which the stock passed from not being overfishing and overfishing is not occurring (i.e., green Kobe quadrant) to overfished and subject to overfishing (i.e., red Kobe quadrant) without a phase where the stock was subject to overfishing (i.e., F>Fmsy). The WPTT **NOTED** that this could indicate some process error in the model and may represent an artifact of the model. The WPTT **NOTED** that this has also occurred in the past in SS3 modelling where recruitment failure was observed after the larger catches of 2003-2006, which moved the stock from green to red.

102. The WPTT **NOTED** that it is considered a best practice to have different stock assessment models to contrast and compare model behaviour, performance and results. However, the WPTT **NOTED** the preliminary nature of this stock assessment.

103. The WPTT **NOTED** that the prior and the posterior of carrying capacity (K) is unchanged, so the WPTT **QUESTIONED** the rationale for choosing the prior for K. The authors answered that they used the K calculated by Rishi and Kell in 2019 (maximum catch * 1.2). The WPTT **SUGGESTED** to use a different prior of K to check if the same posterior is estimated and thus, evaluate the sensitivity of the model to the selection of K prior.

104. The WPTT **NOTED** paper IOTC–2024–WPTT26–14_Rev1 describing a preliminary stock assessment for yellowfin tuna in the Indian Ocean using age structured assessment program, including the abstract:

"This study conducted a stock assessment for Indian Ocean yellowfin tuna (Thunnus albacares) using Age Structured Assessment Program (ASAP), based on fishery-specific catch and catch-at-age data (1976-2022). The assessment considered that the yellowfin tuna stock were subject to 4 fisheries, i.e., Longline fishery (LL), Purse seine with free school (PS-FS), Purse seine with log school (PS-LS), and Other fisheries (OT) . Joint catch-per-unit-effort (CPUE) series from longline fisheries of Japan, Korea, and Taiwan,China were used as abundance indices for fitting the model. In addition to base case model, sensitivity analysis was conducted as to two key

parameters (i.e., steepness of Beverton-Holt stock-recruitment relationship and CPUE index in different regions). The assessment results, including MSY and related biological reference points, were sensitive to the steepness and CPUE assumptions. However, both the base case and sensitivity analyses suggested that the Indian Ocean yellowfin tuna was experiencing overfished and overfishing" - See paper for full abstract

105. The WPTT **ACKNOWLEDGED** the authors for this preliminary stock assessment of yellowfin based on age-based state space model.

106. The WPTT **NOTED** that the model estimated very low MSY values compared to catches in recent years and questioned how the model can explain the current catches with such low values of MSY.

107. The WPTT **NOTED** that the selectivities are very different from the SS3 which could explain the differences between model MSY values. The WPTT **NOTED** that the logistic selectivity considered for PS FADs does not reflect the PS FAD fishery catch of small fish and thus, the selectivity should be dome shaped.

108. The WPTT **NOTED** that the model is very sensitive to the steepness value assumed and the CPUE inputs.

109. The WPTT **NOTED** paper IOTC–2024–WPTT26–INF01 describing multi-gear length-based catch curve analysis (BLICC) for Indian Ocean yellowfin tuna stock. This method uses length-frequency data (similar to LBSPR with variable growth) and fits a catch curve model through Bayesian estimation using MCMC in Stan. It allows for flexible selectivity functions and accommodates multiple gears. The method has been implemented in the R package "fishblicc" (https://github.com/PaulAHMedley/fishblicc).

110. The WPTT **NOTED** that the presentation explained the model and presented an illustrative example applied to Indian Ocean yellowfin tuna. The package performs similarly to LBSPR with logistic selectivity but can estimate different selectivities to different gears demonstrated with the yellowfin assessment.

111. The WPTT **NOTED** that the method shares similar assumptions with the LBSPR (length-based Spawning Potential Ratio) model, e.g., the equilibrium population state. It was noted that for the Linf parameter, the LBSPR model assumes a normal distribution, whereas the BLICC model uses a gamma distribution. It was also pointed out that the length-based version of LBSPR comes from an age-structured model, while the BLICC model is entirely based on length.

112. The WPTT **NOTED** that the BLICC model employs a mixture of simple selectivity functions, such as logistic and normal, to model more complex functions. These can fit length distributions that have multiple modes. This was intended to achieve a balance between complexity and parsimony of the selectivity function, allowing for greater flexibility and to avoid overfitting. Additionally, it enables selectivity to be informed by actual fishery characteristics and facilitates information sharing across different fishing gears.

113. The WPTT **NOTED** that when it comes to compound (mixture) selectivity, sometimes the model struggles to distinguish selectivity parameters (e.g., location and spread) among gears, especially when there's significant overlap. However, the modelling software Stan generally handles this well. The author pointed out that it is important to test different combinations of selectivity to evaluate how accurately they are estimated and to understand their potential impact on estimates of the Spawning Potential Ratio.

114. The WPTT **NOTED** paper IOTC–2024–WPTT26–INF03 describing a method for standardising composition data for non-representative sampling and climate influences, with applications to WCPFC shark and tuna stocks. The following abstract is provided by the author:

"*This paper presents a novel approach to standardizing composition data, particularly length-frequency (LF) data, for use in fisheries stock assessments. The method addresses key challenges in using composition data, specifically non-representative sampling and controlling for confounding variables, such as climate influences. Using a multinomial decomposition technique, the approach factorizes the data into two independent Poisson distributions, allowing for standardization that parallels CPUE standardization methods. The methodology can account for both spatial-temporal influences and over-dispersion through random effects. The approach has been implemented as an R package called ComPoM (Composition standardisation using Poisson-factorised Multinomial GLMMs), utilizing a full Bayesian implementation via BRMS. The effectiveness of the method is demonstrated through case studies including silky shark in WCPFC purse seine fisheries and albacore tuna in New Zealand troll fisheries. In both cases, the standardization successfully addressed environmental influences (such as ENSO effects) and improved the treatment of length-frequency data in stock assessments. The method has been applied successfully to various fisheries, including New Zealand shellfish stocks, Western and Central Pacific Ocean sharks, and the New Zealand albacore troll fishery, demonstrating its versatility and practical utility in fisheries management*"

115. The WPTT **CONGRATULATED** the author on his work and **ACKNOWLEDGED** the value of such approaches for standardizing the size-frequency datasets used as inputs in IOTC stock assessments.

116. The WPTT **NOTED** that access to operational data is essential for the effective application of these methods and encouraged CPCs to grant access to such data under strict confidentiality rules, as outlined in IOTC Resolution 12/02. This access is fundamental to fostering collaborative work and enhancing the accuracy and reliability of assessments.

117. The WPTT asked about some technical aspects of the Poisson factorization of the multinomial distribution, which is fundamental to this method. The WPTT **NOTED** that this approach treats the number of fish in each bin as an actual count rather than a proportion. This allows the impact of external variables on fish in each length bin to be modelled independently. Poisson factorization makes this process easier, which is challenging with a standard multinomial distribution.

118. The WPTT **NOTED** that the method employs Bayesian estimation, enabling the use of uncertainty estimates from the length frequency's posterior distribution to determine relative weighting or sample size in the stock assessment.

119. The WPTT **NOTED** that environmental variables are included in the model as random effects.

4.4 Selection of Stock Status Indicators for yellowfin tuna

120. The WPTT **AGREED** that stock status indicators should be derived from the final SS3 assessment model grid. The WPTT further **AGREED** that current stock status be estimated in relation to the scaled benchmark reference points (with a scalar based on the average recruitment from the recent 20 years 2002 – 2021) (data for this period was considered most reliable) in the stock status table of the Executive Summary. The current stock status (i.e., against the unadjusted benchmark reference points) will also be provided in the Executive Summary.

121. The WPTT **ADOPTED** the stock status advice developed for yellowfin tuna as provided in the draft resource stock status summary and **REQUESTED** that the IOTC Secretariat update the draft stock status summary for yellowfin tuna with the latest 2023 catch data (if necessary), and **RECOMMENDED** for the summary to be provided to the SC as part of the draft Executive Summary, for its consideration:

- Yellowfin tuna (*Thunnus albacares*) – Appendix VI

4.5 Development of Management Advice for Yellowfin tuna

122. The WPTT **AGREED** to perform the final projections of the assessment model grid, with future recruitment assuming the average recruitment from the recent 20 years (2002 – 2021), and to calculate the K2SM statistics using the scaled benchmark reference points (with a scalar based on the average recruitment from the recent 20 years 2002 – 2021). A request to also run additional projections using the long-term recruitment (on the basis that recent higher estimated recruitment was not guaranteed in future) was discussed but ultimately not agreed by WPTT.

123. The WPTT **NOTED** that the management advice for yellowfin is described in the draft Executive Summary.

124. The WPTT **NOTED** that the K2SM short-term projections of 3 years for management advice is challenging to implement given the 2-year lag between stock assessment data and the ability for the Commission to implement any management actions. As such, the WPTT **RECOMMENDED** that the Scientific Committee consider amending the standard short-term reporting period when using the K2SM, for example, from 3 to 5 years.

5. Bigeye Tuna Management Procedure

5.1 Consideration of exceptional circumstances

125. The WPTT **NOTED** paper IOTC–2024–WPM15–10 (presented to WPM) which reviewed the evidence available in 2023 for exceptional circumstances for the bigeye tuna MP.

126. The WPTT **THANKED** the authors for the paper. The WPTT **NOTED** that the paper has been discussed in detail during WPM.

127. The WPTT **NOTED** that the 2024 review has not detected evidence for exceptional circumstances in relation to the 2025 TAC.

128. The WPTT **NOTED** that however, an exceptional circumstance has been detected in relation to running the MP in 2024 because the specified standardised CPUE is not yet available.

129. The WPTT further **NOTED** that the impact of this exceptional circumstance is that the TAC advice is postponed. The WPTT also **NOTED** the proposed action by the WPM (see Section 5.2).

130. The WPTT **NOTED** that following the adoption of the Bigeye tuna and Skipjack tuna MPs, the WPTT would have two species to review exceptional circumstances for each year.

131. The WPTT **NOTED** that exceptional circumstances of adopted MPs need to be considered at both species WPs and WPM. The WPTT also **NOTED** that there is benefit in species WPs being held before WPM to allow discussions on issues such as new information on biology before consideration of potential modelling implications and as such **RECOMMENDED** that in the future the WPM be held after the WPTT.

5.2 The Implementation of the Bigeye MP as per Resolution 22/03

132. The WPTT **NOTED** paper IOTC–2024–WPM15–09 (presented to the WPM) which described the process of running the IOTC bigeye tuna management procedure for 2024.

133. The WPTT **THANKED** the authors for the paper. The WPTT **NOTED** that the paper has been discussed in detail during the WPM.

134. The WPTT **NOTED** that a joint CPUE standardisation was presented to the WPTT Data Prep meeting in June 2024. However, it was not derived using the prescribed approach required for running the MP. The WPM agreed that this is considered an exceptional circumstance and hence,

that it would not be appropriate to run the MP using this CPUE index. The WPTT **NOTED** the way forward proposed by the WPM:

- The Joint CPUE team reconvene early Feb 2025 to complete CPUE standardisation using the prescribed approach.
- The WPM (MSE Task Force) will run the MP and present results to an ad-hoc SC session in Feb 2025.
- IOTC–2024–WPM15–09 will then be updated with details from running the MP and present to TCMP in April 2025

135. The WPTT **AGREED** with this approach proposed by the WPM.

6. Other Tropical Tunas

Skipjack tuna

136. The WPTT **NOTED** paper IOTC–2024–WPTT26–14_Rev1, which provided an analysis of enhancing Precision in age estimation of Indian ocean skipjack tuna using refined otolith and fin spine criteria, including the following abstract:

> "*This document presents results of revised annual age estimates from otolith and matched spines sections after progress on the "crucial follow-up actions" recognized by the group was achieved. As result, a standardized method for age determination of SKJ in the western IO has been produced for both spine and otolith-based ageing. We discuss the progress on some of the difficulties, pros and cons for either structure being suitable for annual ageing in this species*".

137. The WPTT **CONGRATULATED** the authors on their work, **NOTING** its essential role in assessing the stock status of skipjack tuna.

138. The WPTT also **NOTED** and **THANKED** the authors for developing and making available detailed ageing protocols for spines (IOTC-2024-WPTT26-19) and otoliths (IOTC-2024-WPTT26-20).

139. The WPTT **NOTED** that the authors have also developed a video tutorial on the tuna ageing protocol for otolith thin sections and **ENCOURAGED** WPTT participants to view it.

140. The WPTT **NOTED** significant progress in ageing skipjack tuna through otolith and spine readings. The authors presented progress in addressing some challenges, as well as the advantages and disadvantages of using each structure for annual ageing in this species. They highlighted the importance of standardising age estimation methods for skipjack tuna to ensure comparable data across regions and laboratories. The WPTT **NOTED** the results of a precision analysis of skipjack tuna age estimates, based on revised ageing criteria that address key factors previously causing inconsistencies in age estimates using otoliths and fin spines. The new criteria led to a significant improvement in agreement and precision.

141. The WPTT **NOTED** that good progress has been made in epigenetic ageing for several tuna species and **QUERIED** whether this progress included skipjack tuna. The WPTT **NOTED** that epigenetic ageing is not yet feasible for skipjack tuna, as it requires known-age individuals and/or validated age estimates. Once validation is achieved, epigenetic techniques could potentially be applied to skipjack tuna in the future.

142. The WPTT **NOTED** that age validation for skipjack tuna using otoliths and spines is not yet available and **ACKNOWLEDGED** that access to otoliths and spines from OTC-marked fish with

extended time at liberty would provide critical information on the periodicity of increments in both structures, helping to reduce uncertainty in age estimation for this species.

143. The WPTT **QUERIED** whether skipjack age and growth estimates from otoliths and spines are consistent with the skipjack growth curve developed by Eveson et al. (2015) using tagging data alone, which was used in the assessment. The WPTT **NOTED** that this comparison has not yet been conducted but is planned for the next assessment once age data analysis is complete.

144. The WPTT **NOTED** the plan to further compare and calibrate skipjack ageing methods using both otoliths and spines, with the goal of developing a new growth curve based on age readings rather than tagging data only.

Bigeye tuna

145. The WPTT **NOTED** paper IOTC–2024–WPTT26–15, which presents the use of YouTube videos to aid in the identification of yellowfin and bigeye tuna.

146. The WPTT **CONGRATULATED** the authors and **ENCOURAGED** them to continue developing such materials, as video-based identification tools are crucial for distinguishing bigeye and yellowfin tuna, even for experienced observers.

147. The WPTT **THANKED** OFCF for its continued support in translating the IOTC species ID guides and producing videos on species identification, **NOTING** that the guides are now available in multiple languages. Furthermore, the scoping study on data collection systems in coastal fisheries indicates that over 80% of coastal countries are using tablets for data collection. In this context, the species identification videos could be integrated into these tablets as part of the data collection tools.

148. The WPTT **NOTED** that the identification videos comparing bigeye and yellowfin tuna for large species have been completed. The WPTT **NOTED** that side-by-side comparisons facilitate species identification but **SUGGESTED** further development of images and/or slides for inclusion in the videos, focusing on a single species at a time, with identification results provided afterwards. This approach would enhance the learning potential of the guide, as side-by-side comparisons improve identification accuracy. The WPTT **NOTED** that the YouTube video is one of the tools in the kit, primarily focused on general differentiation aspects. However, the online guidebook will offer more detailed information, including single-species images that will aid in identification.

149. The WPTT **NOTED** that further work is required to develop identification resources for species under 40 cm, and that a photo library has been created for each species.

150. The WPTT was **INFORMED** that the Secretariat is organising a species identification workshop in December 2025 in Sri Lanka, aimed at training trainers in IOTC species identification. The workshop will be conducted by two consultants in collaboration with the Sri Lankan Department of Fisheries and Aquatic Resources (DFAR) and the National Aquatic Resources Research and Development Agency (NARA) and will involve national staff from 10 CPCs in the western Indian Ocean. A similar workshop, involving CPCs from the eastern Indian Ocean region, is expected to be organised in June 2025 in Indonesia, with the support of the Ministry of Marine Affairs and Fisheries.

151. The WPTT **AGREED** on the value of developing a public library of images of IOTC species to be hosted on the IOTC website. This library could play a crucial role in supporting the development of Artificial Intelligence (AI) algorithms aimed at automatically identifying species from images collected through EMS.

152. The WPTT **ENCOURAGED** the authors to present their work at the WPDCS and WPNT and to expand it to include other species, such as neritic tunas and seerfish.

153. The WPTT **NOTED** paper IOTC–2024–WPTT26–16_Rev1 which summarises an analysis of the Influence of bait type on bigeye tuna catch rates in Sri Lanka, with the following abstract provided by the authors:

"*Among the three dominant oceanic tuna species in Sri Lanka, bigeye tuna (Thunnus obesus) contributes around 9 % to the total tropical tuna catch in the country. Longline is the prominent fishing method which significantly contributes to catching bigeye tuna in the country. It is obvious that specific factors which directly influence the catches of different tuna species including bigeye tuna are fundamental in managing the tuna longline fisheries. The present study was based on 24,331 fishing operations in logbook records of the Sri Lankan longline fishery from 2016 to 2019, with an aim of assessing the catch efficiency of bigeye tuna with respect to the bait types. During the period of study, it was noted that there were seven popular bait types; squid (Loligo spp.), bigeye scad (Selar crumenophthalmus), milkfish (Chanos chanos), flying fish (family Exocoetidae), Indian scad (Decapterus spp.), artificial bait and Sardine (Sardinella spp.) which represented 97.30 % in the fishery. Use of artificial baits in the fishery has been abandoned since 2018, and low-cost milkfish bait production has been started locally. Among the rest, squid was the most common bait while Sardinella spp. showed the least frequency in usage*" (see the paper for the full abstract)

154. The WPTT **THANKED** the authors for the study which highlights the importance of bait type in Sri Lankan fisheries catching bigeye tuna. **NOTING** that few studies on bait are generally presented at the WPTT and that bait may affect both catchability and operation costs, the WPTT **ENCOURAGED** the CPCs to conduct and report such analyses to the next WPTT meetings.

155. The WPTT **NOTED** that bait species used in Sri Lanka are typically low-cost and form part of the local human diet, with squid being the primary bait species. The WPTT further **NOTED** that catch rates vary according to bait type and, given the rising price of squid, it may be prudent to explore alternative species. However, this should be done with consideration for fisheries that primarily depend on squid. The WPTT also **NOTED** that artificial baits are commonly used in Sri Lanka as substitutes for live bait.

156. The WPTT **NOTED** that limited information is available on the locally caught bait species used in the Sri Lankan fishery, including their stock status, as no assessments are conducted for these species.

157. The WPTT **NOTED** that the authors also have information on bycatch species (e.g., sharks, turtles) associated with different bait types (see document IOTC-2024-WPEB20(AS)-20). The WPTT further **NOTED** that sea turtle bycatch is higher when squid is used as bait compared to other types.

158. The WPTT **NOTED** that, due to rising squid bait prices, longline fleets worldwide are shifting to other bait types (e.g., fish, artificial bait), which may also help reduce bycatch.

159. The WPTT **NOTED** the importance of longline fleets recording bait type used, as it impacts catch rates and CPUE for bigeye tuna. This information should be considered in future CPUE standardisations.

160. The WPTT **ACKNOWLEDGED** that information on bait type and species must be collected and reported to the IOTC following the ROS data collection forms (see https://iotc.org/science/regional-observer-scheme-science). These data have, for instance, been

systematically collected and reported for the semi-industrial longline fishery of Réunion Island, which includes a component of fisher self-reporting.

7. Update on MSE For Tropical Tunas

Yellowfin tuna

161. The WPTT **NOTED** that the yellowfin MSE has been inactive for several years (awaiting revision of the stock assessment) and **RECOMMENDED** that the SC resume the process.

8. FAD RELATED TOPICS

8.1 UPDATE FROM THE WORKING GROUP

162. The WPTT **NOTED** that the 6th Working Group on FADs meeting (WPFAD06) was held online 11st to 12nd June. The WPTT **ENDORSED** all the recommendations from the WPFAD06.

163. The WPTT **NOTED** that the 7th Working Group on FADs meeting (WPFAD07), originally scheduled to be held in October was cancelled.

164. The WPTT **NOTED** that after the recent resolutions on FAD were adopted, CPCs seem less inclined to submit papers to WGFAD. This led to the shortening of WGFAD06 to a single day and the cancellation of WGFAD07 this year due to a shortage of papers. Therefore, the WPTT **RECOMMENDED** that the SC advise the Commission to schedule only one WGFAD meeting in 2025. The WPTT also suggests that this meeting should take place before the WPEB, as FAD issues are relevant to WPEB, to allow the findings to be reported to both WPEB and WPTT.

8.2 COMMISSION REQUESTS TO THE SC ON FADS (ALL)

8.2.1 Resolution 24/02 On Management of Drifting Fish Aggregating Devices (DFADs) in the IOTC Area of Competence

165. The WPTT **NOTED** that Resolution 24/02 tasked the Secretariat to create a dFAD register. It was also noted that the EU has provided a grant to help the Secretariat start a design study and develop a prototype for the FAD register. This study is planned for 2025.

9. WPTT Program of Work

10. Revision of the WPTT Program of Work (2025–2029)

166. The WPTT **NOTED** paper IOTC–2024–WPTT25–05, which provided the WPTT26 with an opportunity to consider and revise the WPTT Program of Work (2025–2029), by taking into account the specific requests of the Commission, Scientific Committee, and the resources available to the IOTC Secretariat and CPCs.

167. The WPTT **RECALLED** that the SC, at its 18th Session, made the following request to its working parties:

> *"The SC REQUESTED that during the 2016 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." (SC18. Para 154).*

168. The WPTT **REQUESTED** that the Chairperson and Vice-Chairperson of the WPTT, in consultation with the IOTC Secretariat, develop Terms of Reference (TOR) for each of the high priority projects that are yet to be funded, for circulation to potential funding sources.

169. The WPTT **RECOMMENDED** that the SC consider and endorse the WPTT Program of Work (2025–2029), as provided in Appendix VII.

11. Development of priorities for an Invited Expert at the next WPTT meeting

170. The WPTT **NOTED** that a consultant (Adam Langley) has been contracted to provide technical assistance to the yellowfin assessment and has also participated in the current WPTT meeting. The WPTT **ACKNOWLEDGED** Adam for his work, which has contributed to improving the stock assessment of yellowfin and **SUGGESTED** that he is invited to future IOTC WPTT tropical tuna stock assessment meetings.

171. The WPTT **AGREED** to the following core areas of expertise and priority areas for contribution that need to be enhanced for the next meeting of the WPTT in 2025, by an Invited Expert:

o **Expertise**: Stock assessment; including from regions other than the Indian Ocean; and CPUE standardization, familiarity with the Indian Ocean yellowfin stock assessment.

o **Priority areas for contribution**: Providing expert advice on stock assessments; refining the input information base, historical data series and indicators for tropical tuna species for stock assessment purposes.

12. OTHER BUSINESS

13. Date and place of the 27th and 28th Sessions of the WPTT

172. The Secretariat will continue to liaise with CPCs to determine their interest in hosting these meetings in the future. The WPTT **RECOMMENDED** the SC consider late October 2025 as a preferred time period to hold the WPTT27 meeting in 2025. It was also **AGREED** that the WPTT Assessment meeting should continue to be held back-to-back with the WPM.

14. Review of the draft, and adoption of the Report of the 26th Session of the WPTT

173. The WPTT **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPTT26, provided at Appendix VIII, as well as the management advice provided in the draft resource stock status summary for each of the three tropical tuna species under the IOTC mandate, and the combined Kobe plot for the three species assigned a stock status in 2024 (**Figure 1**):

- Bigeye tuna (*Thunnus obesus*) – Appendix IV
- Skipjack tuna (*Katsuwonus pelamis*) – Appendix V
- Yellowfin tuna (*Thunnus albacares*) – Appendix VI

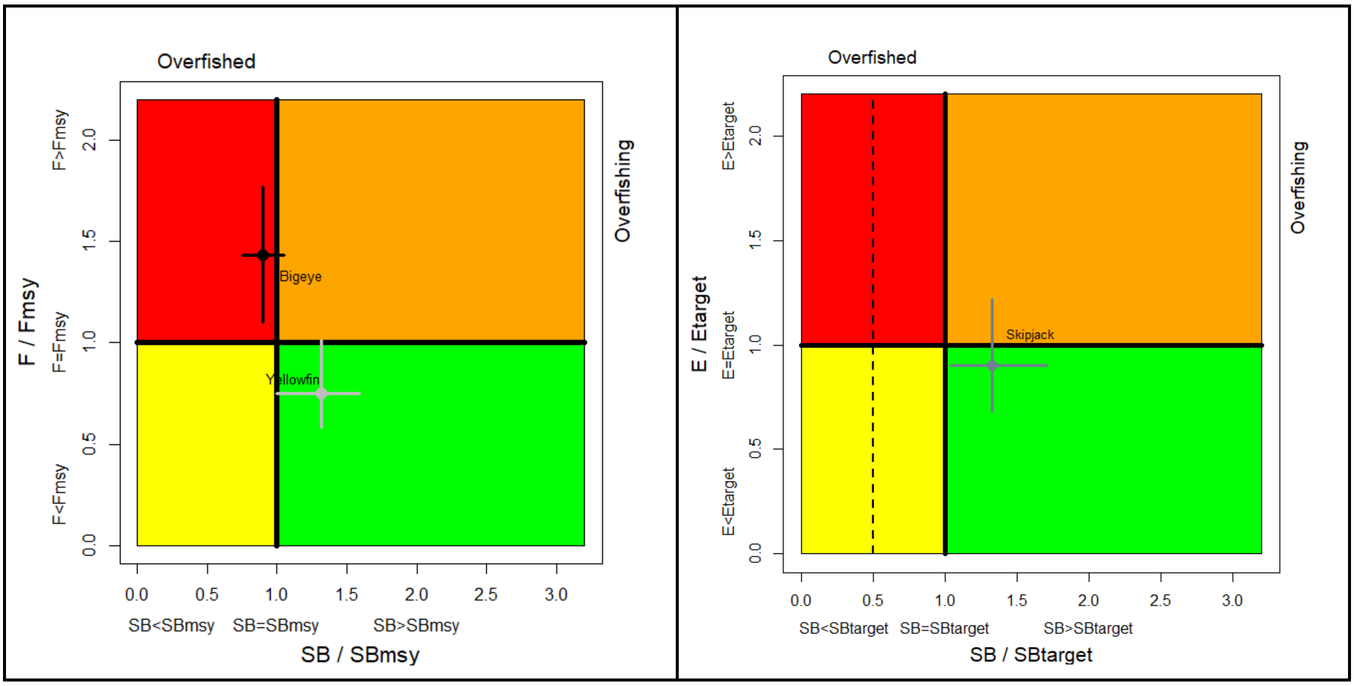

Figure 1. (Left) Combined Kobe plot for bigeye tuna (black: 2022), and yellowfin tuna (grey: 2024) showing the estimates of current stock size (SB) and current fishing mortality (F) in relation to the target spawning stock biomass and fishing mortality reference points. (Right) Kobe plot for skipjack tuna showing the estimates of the current stock status (dark grey: 2023). The dashed line indicates the limit reference point at 20%SB0. Cross bars illustrate the range of uncertainty from the model runs with an 80% CI.

174. The report of the 26th Session of the Working Party on Tropical Tunas Meeting (IOTC–2024–WPTT26 –R) will be adopted by correspondence.

APPENDIX I
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APPENDIX II

AGENDA FOR THE 26TH WORKING PARTY ON TROPICAL TUNAS, ASSESSMENT MEETING

Date: 28 October – 2 November 2024

Location: Eden Bleu Hotel, Seychelles

Time: 09:00 – 17:00 (Seychelles time)

Chair: Dr Gorka Merino (European Union); **Vice-Chair:** Dr Shiham Adam (IPNLF)

1. OPENING OF THE MEETING (Chair)

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

3. UPDATE OF ANY NEW DATA AVAILABLE AT THE SECRETARIAT FOR TROPICAL TUNA SPECIES SINCE THE DATA PREPARATORY MEETING (IOTC Secretariat**)**

3.1 Data available at the Secretariat
3.2 Fishery Indicators

4. YELLOWFIN STOCK ASSESSMENT (Chair)

4.1 Review any new information on yellowfin tuna biology, stock structure, fisheries and associated environmental data since the data preparatory meeting (all)
4.2 Update on the nominal and standardised CPUE indices presented at the data preparatory meeting.
4.3 Stock assessments results
- Stock Synthesis (SS3)
- Other models

4.4 Selection of Stock Status indicators for yellowfin tuna

5. BIGEYE TUNA MANAGEMENT PROCEDURE

5.1 Consideration of exceptional circumstances
5.2 The Implementation of the Bigeye MP as per Resolution 22/03

6. OTHER TROPICAL TUNAS

- Skipjack tuna
- Bigeye tuna

7. UPDATE ON MSE FOR TROPICAL TUNAS

- Yellowfin

8. FAD RELEATED TOPICS

8.1 UPDATE FROM THE FAD WORKING GROUP
8.2 COMMISSION REQUESTS TO THE SC ON FADS (All)

8.2.1 Resolution 24/02 On Management of Drifting Fish Aggregating Devices (DFADs) in the IOTC Area of Competence
8.2.2 Resolution 23/03 On Establishing a Voluntary Fishing Closure in the Indian Ocean for the Conservation of Tropical Tunas
8.2.3 Resolution 23/01 on the management of anchored fish aggregating devices (AFADs)

9. WPTT PROGRAM OF WORK

9.1 Revision of the WPTT Program of Work (2025–2029)
9.2 Development of priorities for an Invited Expert at the next WPTT meeting

10. OTHER BUSINESS

10.1 Date and place of the 27th and 28th Sessions of the WPTT (Chair and IOTC Secretariat)

11. ADOPTION OF THE REPORT

11.1 Review of the draft, and adoption of the Report of the 26TH Session of the WPTT (Chair)

APPENDIX III
LIST OF DOCUMENTS FOR THE 26TH WORKING PARTY ON TROPICAL TUNAS

Document	Title
IOTC-2024-WPTT26-01a	Draft: Agenda of the 26th Working Party on Tropical Tunas
IOTC-2024-WPTT26-01b	Draft: Annotated agenda of the 26th Working Party on Tropical Tunas
IOTC-2024-WPTT26-02	Draft: List of documents for the 26th Working Party on Tropical Tunas
IOTC-2024-WPTT26-3.1 IOTC-2024-WPTT26-3.2	Overview of Indian Ocean tropical tuna fisheries (Secretariat) Review of Indian Ocean skipjack tuna statistical data (Secretariat)
IOTC-2024-WPTT26-05	Revision of the WPTT program of work (IOTC Secretariat)
IOTC-2024-WPTT26-06	Tropical Tuna Landings at Fishing Ports in Thailand (Prasertsook O, Sanboonpeng J)
IOTC-2024-WPTT26-07	Review of Oman's data collection system and statistics
IOTC-2024-WPTT26-09	Proposal of an online digital ocean atlas for the Indian Ocean (Marsac F, Gunawardane N)
IOTC-2024-WPTT26-11	Preliminary 2024 stock assessment of yellowfin tuna in the Indian Ocean (Correa G, Urtizberea A, Merino G)
IOTC-2024-WPTT26-12	Stock assessment for Indian Ocean Yellowfin tuna (Thunnus albacares) using Bayesian surplus production model (JABBA). (Li Y)
IOTC-2024-WPTT26-13	Preliminary stock assessment for yellowfin tuna Thunnus albacares in the Indian Ocean using age structured assessment program (ASAP) (Wang Y, Geng Z, Zhu J)
IOTC-2024-WPTT26-14	Enhancing Precision in Age Estimation of Indian Ocean Skipjack Tuna Using Refined Otolith and Fin Spine Criteria (Luque P, Krusic-Golub K, Artetxe-Arrate I, Da Silva G, Fraile I, Farley J, Clear N, Eveson P, Zudaire I)
IOTC-2024-WPTT26-15	YouTube video to facilitate the identification of Yellowfin and Bigeye tuna (Fujino T)
IOTC-2024-WPTT26-16	Influence of bait type on bigeye tuna catch rates in Sri Lanka (Gunasekera S, Bandaranayake K, Jayasinghe R)
IOTC-2024-WPTT26-19	Protocol for age estimation of skipjack tuna (Katsuwonus pelamis) in the western Indian Ocean using first dorsal fin spines (Luque P, Artetxe-Arrate I, Serrano N, Fraile I, Zudaire I)
IOTC-2024-WPTT26-20	Indian Ocean skipjack tuna ageing protocol for otolith thin sections (Krusic-Golub K, Luque P, Farley J, Clear N)
IOTC-2024-WPTT26-INF01	Estimating yellowfin selectivity using a multigear length-based catch curve
IOTC-2024-WPTT26-INF02	Technical report on the re-estimation of Indonesia's annual catch data for the period 1950-2022
IOTC-2024-WPTT26-INF03	Standardising composition data for non-representative sampling and climate influences: application to WCPFC shark and tuna stocks (Neubauer P)
IOTC-2024-WPTT26-INF04	Independent review of recent IOTC yellowfin tuna assessment
IOTC-2024-WPTT26-INF05	Environmental indicators to inform ocean trends and state (Marsac F)

Appendix IV
Draft resource stock status summary
Bigeye Tuna (BET : *Thunnus obesus*)

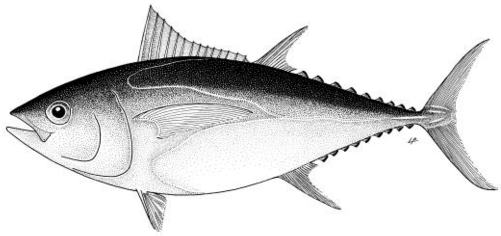

Table 1. Status of bigeye tuna (*Thunnus obesus*) in the Indian Ocean

Area[1]	**Indicators**		**2022 stock status determination**[4]
Indian Ocean	Catch 2023[2] (t) Mean annual catch 2019-2023 (t)[3]	105,369 94,691	**79%**
	MSY (1,000 t) (80% CI) F_{MSY} (80% CI) SB_{MSY} (1,000 t) (80% CI) F_{2021}/F_{MSY} (80% CI) SB_{2021}/SB_{MSY} (80% CI)	96 (83 – 108) 0.26 (0.18 – 0.34) 513 (332 – 694) 1.43 (1.10–1.77) 0.25 (0.23 – 0.27)	

[1]Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence
[2]Proportion of 2023 catch fully or partially estimated by IOTC Secretariat: 18.9%
[3]Including re-estimations of EU PS species composition for 2018 (only requested for stock assessment purposes)
[4]2021 is the final year that data were available for this assessment
*Estimated probability that the stock is in the respective quadrant of the Kobe Plot (**Table 2**), derived from the confidence intervals associated with the current stock status.

Table 2. Probability of stock status with respect to each of four quadrants of the Kobe plot. Percentages are calculated as the proportion of model terminal values that fall within each quadrant with model weights taken into account

	Stock overfished (SB_{2021} / SB_{MSY}<1)	Stock not overfished (SB_{2021} / SB_{MSY}≥ 1)
Stock subject to overfishing (F_{2021} / F_{MSY}≥ 1)	79%	17%
Stock not subject to overfishing (F_{2021} / F_{MSY}≤ 1)	2%	2%
Not assessed / Uncertain / Unknown		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. No new stock assessment was carried out for bigeye tuna in 2024 and so the advice is based on the 2022 assessment. In the 2022 assessment, two models were applied to the bigeye stock (Statistical Catch at Size (SCAS) and Stock Synthesis (SS3)), with the SS3 stock assessment selected to provide scientific advice. The reported stock status is based on a grid of 24 model configurations designed to capture the uncertainty on stock recruitment relationship, longline selectivity, growth and natural mortality. Spawning biomass in 2021 was estimated to be 25% (80% CI: 23-27%) of the unfished levels (**Table 1**) and 90% (75-105%) of the level that can support MSY. Fishing mortality was estimated at 1.43 (1.1-1.77) times the F_{MSY} level. Considering the characterized uncertainty, the assessment indicates that SB2021 is below SBMSY and that F_{2021} is above FMSY (79%). On the weight-of-evidence available in 2022, the bigeye tuna stock is determined to be **overfished** and **subject to overfishing** (**Table 2**).

As IOTC agreed on a bigeye Management Procedure (Res. 22/03) it should be noted that the stock assessment is not used to provide a recommendation on the TAC.

Management Procedure. A management procedure for Indian Ocean Bigeye tuna was adopted under Resolution 22/03 by the IOTC Commission in May 2022 and was applied to determine a recommended TAC for Bigeye tuna for 2024 and 2025. A review of evidence for exceptional circumstances, was also conducted following the adopted guideline (ref SC 2021 report appendix 6A) as per the requirements of Resolution 22/03. The review covered information pertaining to i) new knowledge about the stock, population dynamics or biology, ii) changes in fisheries or fisheries operations, iii) changes to input data or missing data, and iv) inconsistent implementation of the MP advice. The evaluation concluded that there were no exceptional circumstances requiring either further research or management action on the TAC calculated by the MP. Application of the MP in 2022 results in a recommended TAC of 80,583t per year for the period 2024-2025. The recommended TAC is 15% below the 2021 catch The MP was scheduled to be run in time for the 2024 SC, however, exceptional circumstances in relation to the CPUE series has delayed the TAC advice. The revised plan is to run the MP in early 2025 following new standardisation of the CPUE as specified for the adopted MP (see section 5.2). A special session of the SC is proposed for late February 2025 to update the TAC advice for 2026-2028 prior to the TCMP.

Outlook. Catch in 2021 (94,803 t) and 2022 (102,266 t), and 2023 (105,369 t) of bigeye tuna were above the recommended TAC for 2024 and 2025 from the application of the bigeye tuna MP. Achieving the objectives of the Commission for this stock will require effective implementation of the MP TAC advice by the Commission going forward, a requirement further emphasised by the current status of the stock estimated from the stock assessment to be overfished and subject to overfishing.

Management advice. The TAC recommended from the application of the MP specified in Resolution 22/03 and Resolution 23/04 is 80,583t / year for the period 2024-2025. The recommended TAC is 15% below the 2021 catch (this is constrained by the maximum TAC change).

The following key points should also be noted:

- **Main fisheries (mean annual catch 2019-2023)**: bigeye tuna are caught using purse seine (44.9%), followed by longline (35.1%) and line (13.3%). The remaining catches taken with other gears contributed to 6.8% of the total catches in recent years (**Fig. 1**).

- **Main fleets (mean annual catch 2019-2023)**: the majority of bigeye tuna catches are attributed to vessels flagged to Indonesia (26.7%) followed by EU (Spain) (15.1%) and Seychelles (15%). The 29 other fleets catching bigeye tuna contributed to 43.4% of the total catch in recent years (Fig. 2).

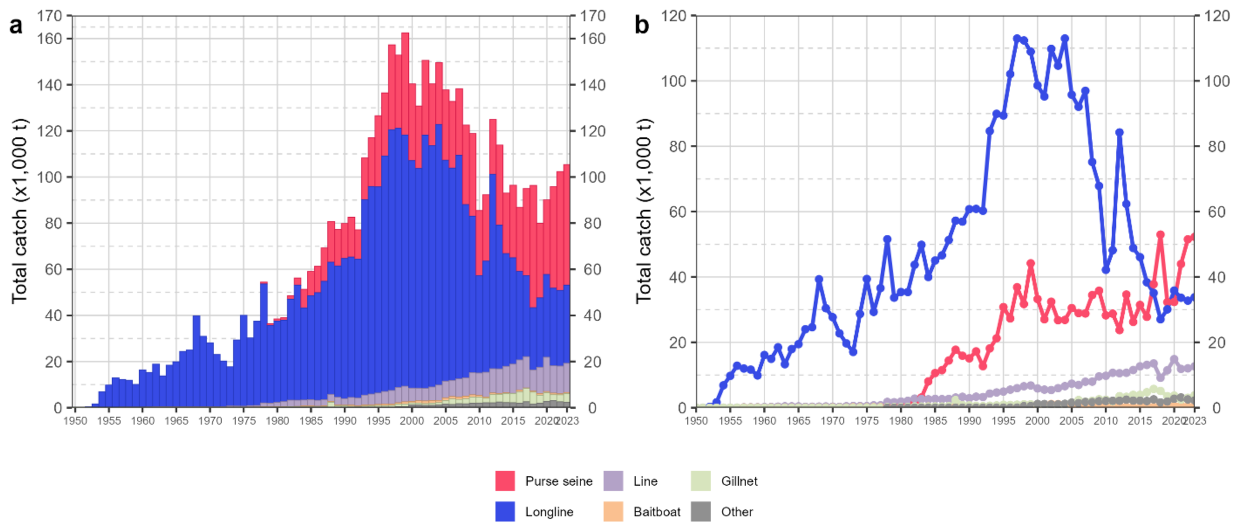

Fig. 1. Annual time series of (a) cumulative nominal catches (metric tonnes; t) by fishery group and (b) individual nominal catches (metric tonnes; t) by fishery group for bigeye tuna during 1950-2023.

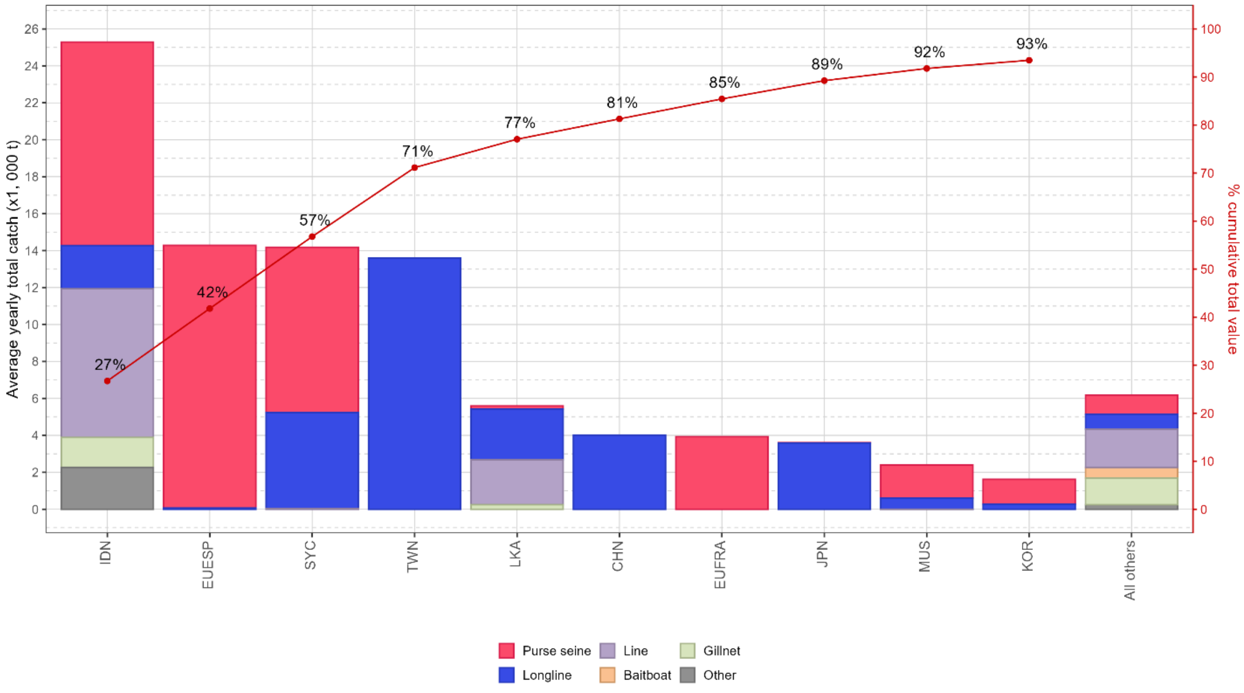

Fig. 2. Mean annual catches (metric tonnes; t) of bigeye tuna by fleet and fishery group between 2019 and 2023, with indication of cumulative catches by fleet.

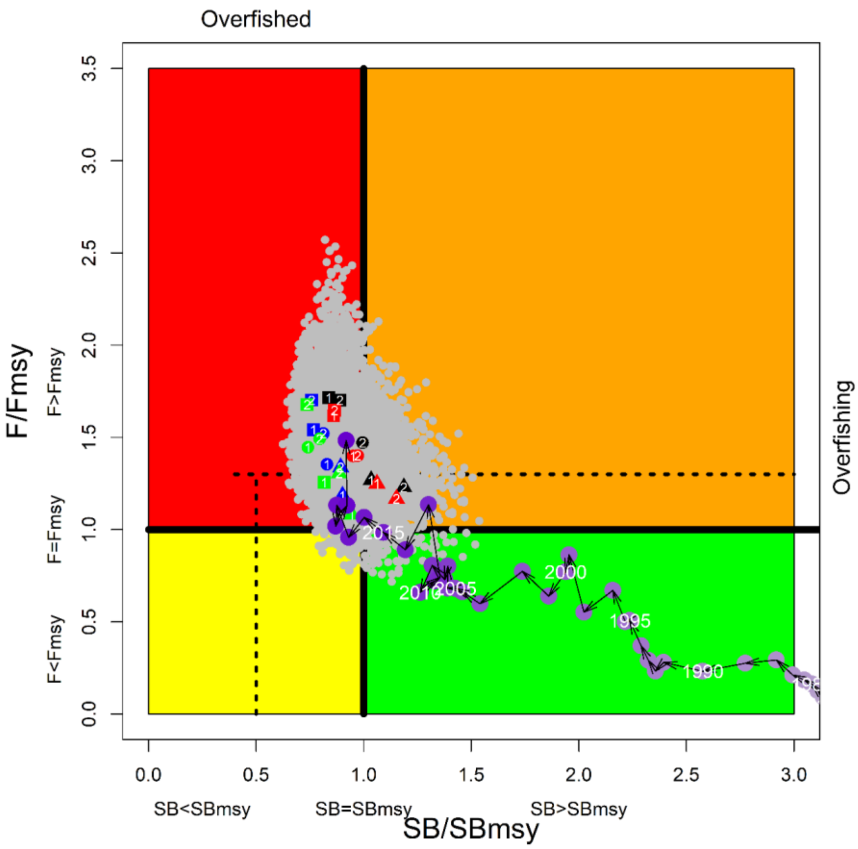

Fig. 3. Bigeye tuna: SS3 Aggregated Indian Ocean assessment Kobe plot. The coloured points represent stock status estimates from the 24 model options. Coloured symbols represent Maximum posterior density (MPD) estimates from individual models: square, circle, and Triangles represents alternative steepness options; black, red, blue, and green represents alternative growth and natural mortality option combination; 1,2, represents alternative selectivity options. The purple dot and arrowed line represent estimates of the reference model (the last purple dot represents the terminal year of 2021). Grey dots represent uncertainty from individual models. The dashed lines represent limit reference points for IO bigeye tuna (SBlim = 0.5 SBMSY and Flim = 1.4 FMSY)

APPENDIX V
DRAFT RESOURCE STOCK STATUS SUMMARY
SKIPJACK TUNA (SKJ: KATSUWONUS PELAMIS)

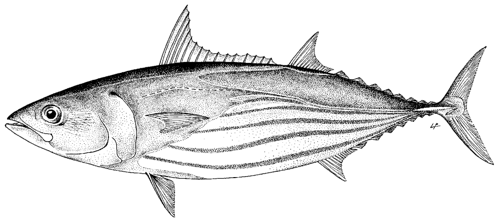

Table 1. Status of skipjack tuna (*Katsuwonus pelamis*) in the Indian Ocean

Area[1]	**Indicators**		**2023 stock status determination**[3]
Indian Ocean	Catch 2023[2] (t)	688,680	**70%***
	Mean annual catch 2019-2023 (t)	630,120	
	$E_{40\%SB0}$ [4] (80% CI)	0.55 (0.48–0.65)	
	SB_0 (t) (80% CI)	2 177 144 (1 869 035–2 465 671)	
	SB_{2022} (t) (80% CI)	1 142 919 (842 723–1 461 772)	
	SB_{2022} / SB_0 80% CI)	0.53 (0.42–0.68)	
	SB_{2022} / $SB_{40\%SB0}$ (80% CI)	1.33 (1.04–1.71)	
	SB_{2022} / $SB_{20\%SB0}$ (80% CI)	2.67 (2.08–3.42)	
	SB_{2022} / SB_{MSY} (80% CI)	2.30 (1.57–3.40)	
	F_{2022} / F_{MSY} (80% CI)	0.49 (0.32–0.75)	
	F_{2022} / $F_{40\%SSB0}$ (80% CI)	0.90 (0.68–1.22)	
	MSY (t) (80% CI)	584 774 (512 228–686 071)	

[1]Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence

[2] Proportion of 2023 catch fully or partially estimated by IOTC Secretariat: 17.5%

[3]2022 is the final year that data were available for this assessment.

[4] $E_{40\%SB0}$ is the equilibrium annual exploitation rate (Etarg) associated with the stock at Btarg, and is a key control parameter in the skipjack harvest control rule as stipulated in Resolution 21/03. Note that Resolution 23/03 did not specify the exploitation rate associated with the stock at Blim

*Estimated probability that the stock is in the respective quadrant of the Kobe plot (defined in resolution 21/03 and shown below), derived from the confidence intervals associated with the current stock status

Table 2. Probability of stock status with respect to each of four quadrants of the Kobe plot. Percentages are calculated as the proportion of model terminal values that fall within each quadrant with model weights taken into account, as defined in resolution 21/03

	Stock overfished (SB_{2022} / $SB_{40\%SB0}$<1)	Stock not overfished (SB_{2022} / $SB_{40\%SB0}$≥ 1)
Stock subject to overfishing (F_{2022} / $F_{40\%SB0}$≥ 1)	8%	21%
Stock not subject to overfishing (F_{2022} / $F_{40\%SB0}$≤ 1)	1%	70%
Not assessed / Uncertain / Unknown		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. No new stock assessment was carried out for skipjack tuna in 2024 and so the advice is based on the 2023 assessment using Stock Synthesis with data up to 2022. The outcome of the 2023 stock assessment model is more optimistic than the previous assessment (2020) despite the high catches recorded in the period 2021-2022, which exceeded the catch limits established in 2020 for this period.

The final assessment indicates that:

i) The stock is above the adopted target for this stock (40%SB_0) and the current exploitation rate is below the target exploitation rate with the probability of 70%. Current spawning biomass relative to unexploited levels is estimated at 53%.
ii) The spawning biomass remains above SB_{MSY} and the fishing mortality remains below F_{MSY} with a probability of 98.4 %
iii) Over the history of the fishery, biomass has been well above the adopted limit reference point (20%SB_0).

Subsequently, based on the weight-of-evidence available in 2023, the skipjack tuna stock is determined to be **not overfished** and **not subject to overfishing**.

Outlook.

There has been a substantial increase of fishery dependent abundance index in recent years: the CPUE from the Pole and line fishery increased by 75% from 2019 to 2022, and the PSLS also increased by over 30% between 2019 and 2021. Total catches in 2022 were 30% larger than the resulting catch limit from the skipjack HCR for the period 2021-2023 (513,572 t). The increase in abundance despite catches exceeding the recommended limits was primarily driven by an increase in recent recruitment which was estimated to be well above the long-term average. Environmental conditions (such as sea surface productivity (chlorophyll)) are believed to significantly influence recruitment of skipjack tuna and can produce high variability in recruitment levels between years. The high recruitment anomaly estimated in 2022 appears to be supported by the strong increasingly positive phase of sea surface productivity which began from a below average level in 2015. Climate model predictions suggest that the positive productivity phase will end by the start of 2024 resulting in a period of lower productivity. There is also considerable uncertainty in the stock assessment models due to the potential caveats of using PL and PSLS CPUE as index of basin-level abundance and uncertainty in stock productivity parameters of skipjack tuna (e.g., steepness and growth, natural mortality). The model runs analyzed illustrate a wide range of stock status (SB_{2022} / SB_0) to be between 35% and 78%. In 2024 a management procedure was adopted for skipjack tuna (Res 24/07). The MP is scheduled to be implemented in 2025 to provide TAC advice for 2027-2029.

Management advice. The catch limit calculated by applying the HCR specified in Resolution 21/03 is [628, 606t] for the period 2024-2026. The SC noted that this catch limit is higher than for the previous period. This is attributed to the new stock assessment which estimates a higher productivity of the stock in recent years and a higher stock level relative to the target reference point, possibly due to skipjack life history characteristics and favorable environmental conditions. Noting that the environmental conditions are predicted to enter a less favorable period, it is important that the Commission ensures that catches of skipjack tuna during this period do not exceed the agreed limit, as occurred in recent years. In addition, the SC recognizes the potential impact on other associated stocks (bigeye and yellowfin) of exceeding the catch limits of skipjack. The following key points should also be noted:

- **Reference points**: Commission in 2016 agreed to Resolution 16/02 on *harvest control rules for skipjack tuna in the IOTC area of competence (superseded by Resolution 21/03)*.
- **Biomass**: Current spawning biomass was considered to be above the target reference point of 40% of SB_0, and above the limit reference point of 0.2*SB_0 as per Resolution 16/02 (**Fig. 2**).
- **Main fisheries (mean annual catch 2019-2023):** skipjack tuna are caught using purse seine (53.9%), followed by baitboat (19.5%) and gillnet (17.5%). The remaining catches taken with other gears contributed to 9.2% of the total catches in recent years (Fig. 1).
- **Main fleets (mean annual catch 2019-2023):** the majority of skipjack tuna catches are attributed to vessels flagged to Indonesia (21.8%) followed by Maldives (18%) and EU (Spain) (14.8%). The 32 other fleets catching skipjack tuna contributed to 45.3% of the total catch in recent years (Fig. 2).

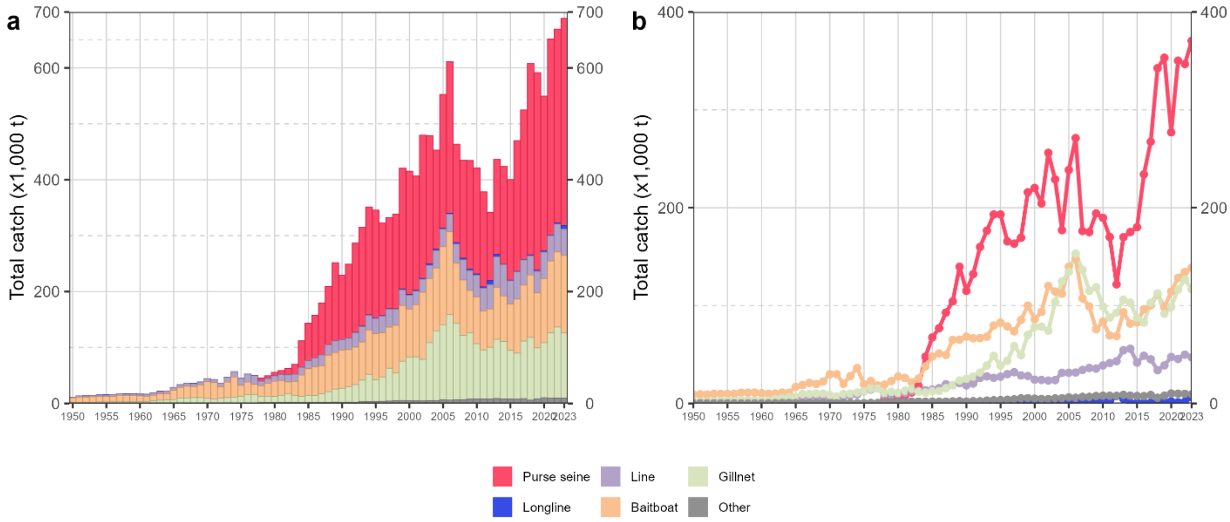

Fig. 1. Annual time series of (a) cumulative nominal catches (metric tonnes; t) by fishery group and (b) individual nominal catches (metric tonnes; t) by fishery group for skipjack tuna during 1950-2023.

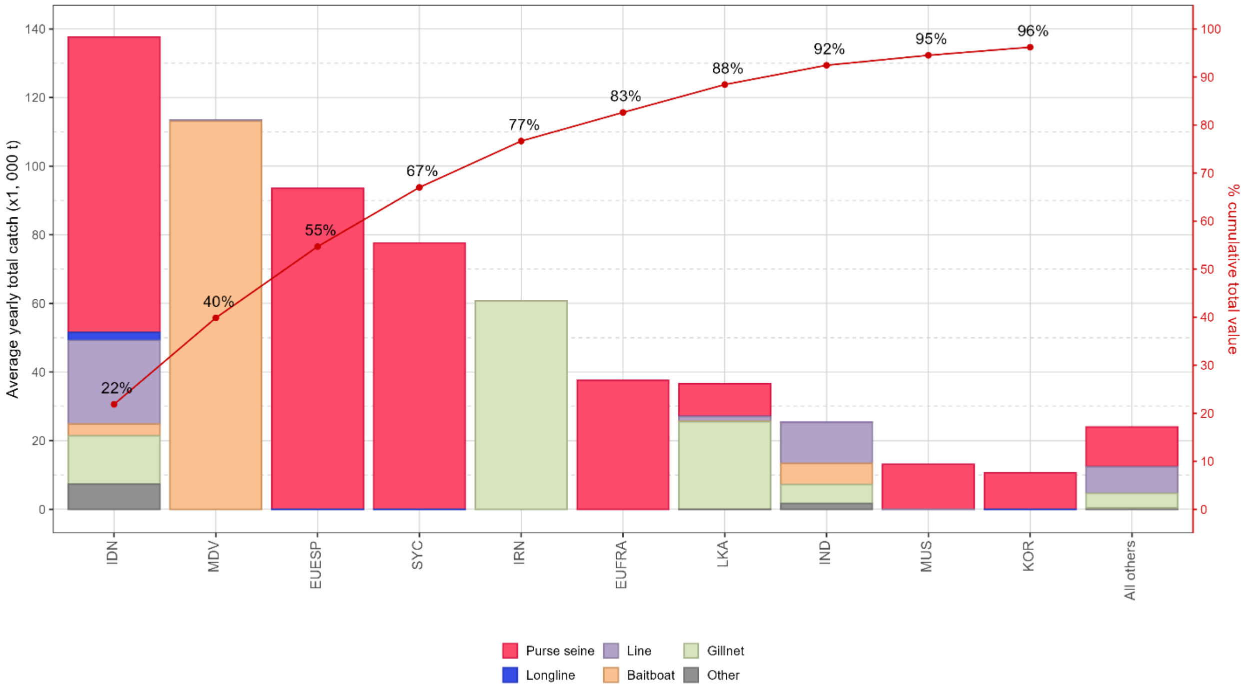

Fig. 2. Mean annual catches (metric tonnes; t) of skipjack tuna by fleet and fishery group between 2019 and 2023, with indication of cumulative catches by fleet.

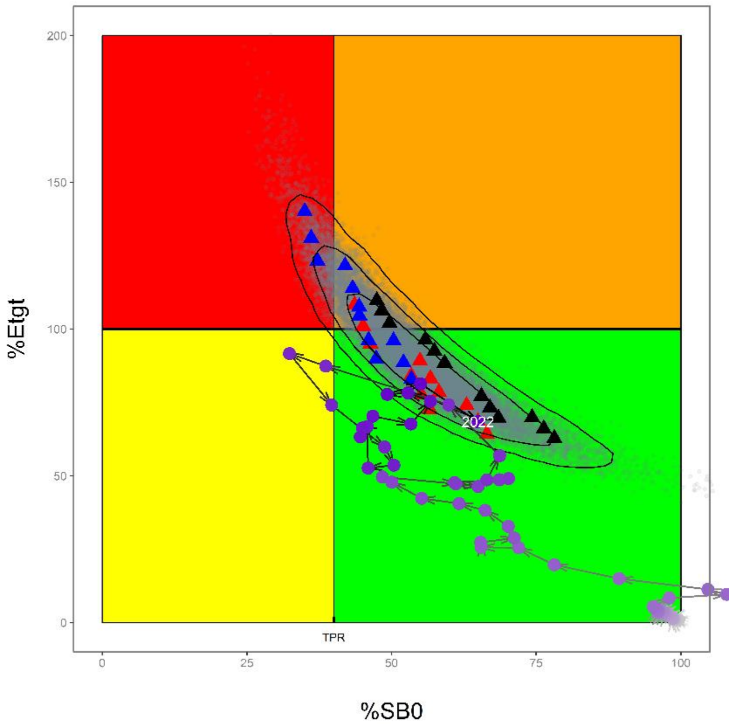

Fig. 3. Skipjack tuna: SS3 Aggregated Indian Ocean assessment Kobe plot of the 2023 uncertainty grid. Left - current stock status, relative to SB0 and F (x-axis) and $F_{40\%B0}$ (y-axis) reference points for the final model grid. TPR indicates 40% B0; Triangles represent MPD estimates from individual models (black, models based on PL index; red, models based on PSLS index; blue, models based on and both PSLS and ABBI index). Grey dots represent uncertainty from individual models. The arrowed line represents time series of historical stock trajectory for model PSLS. Contours represents 50, 80, and 90% confide

APPENDIX VI
DRAFT RESOURCE STOCK STATUS SUMMARY
YELLOWFIN TUNA (YFT: *THUNNUS ALBACARES*)

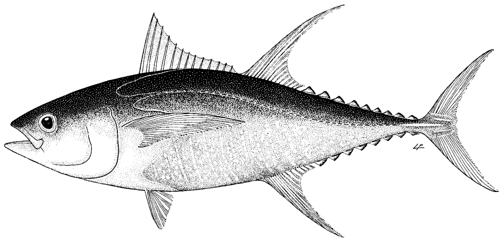

Table 1. Status of yellowfin tuna (*Thunnus albacares*) in the Indian Ocean

Area[1]	Indicators		2024 stock status determination[3]
Indian Ocean	Catch 2023[2] (t) Mean annual catch 2019-2023 (t)	400,950 423,142	**89%***
	MSY_{recent}[4] (1,000 t) (80% CI) F_{MSY} (80% CI) SB_{MSY_recent} (1,000 t) (80% CI) F_{2023} / F_{MSY} (80% CI) SB_{2023} / SB_{MSY_recent} (80% CI) SB_{2023} / SB_0 (80% CI)	421 (416-430) 0.2 (0.16-0.26) 1,063 (890-1,361) 0.75 (0.58-1.01) 1.32 (1.00-1.59) 0.44 (0.40-0.50)	

[1]Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence
[2]Proportion of 2023 catch fully or partially estimated by IOTC Secretariat: 33.4%
[3]2023 is the final year that data were available for this assessment
[4] Recent refers to the most recent 20 years

Colour key	Stock overfished (SB_{2020} / SB_{MSY}<1)	Stock not overfished (SB_{2020} / SB_{MSY}≥ 1)
Stock subject to overfishing (F_{2023} / F_{MSY}≥ 1)	7.9%%	3.3%
Stock not subject to overfishing (F_{2023} / F_{MSY}≤ 1)	0%	88:8%
Not assessed / Uncertain / Unknown		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. A new stock assessment was carried out for yellowfin tuna in 2024. The 2024 stock assessment was carried out using Stock Synthesis III (SS3), a fully integrated model that is currently used to provide scientific advice for the three tropical tunas stocks in the Indian Ocean. The model used in 2024 is based on the model developed in 2021 with a series of revisions that were discussed during the WPTT in 2024. The new model represents a marked improvement over the previous model available in 2021, as demonstrated using a number of statistical diagnostic analyses These revisions addressed many of the recommendations of the independent review of the yellowfin stock assessment carried out in 2023. The model uses four types of data: catch, size frequency, tagging and CPUE indices. The proposed final assessment model options correspond to a combination of model configurations, including alternative assumptions about the selectivity of longline CPUE (2 options on size frequency data prior and post 2000), longline catchability (effort creep (0% and 0.5% per year)) and steepness values (0.7, 0.8, and 0.9). The model ensemble (a total of 12 models) encompasses a range of plausible hypotheses about stock and fisheries dynamics.

A number of sensitivity runs were conducted to address additional uncertainty, including two alternative natural mortalities (based on maximum age of 18 years and the natural mortality used in 2021), the CPUE used in 2021, a model that started in 1975 and influence of the tagging data and the revised catch information for Indonesia. Nothing in the sensitivity runs suggested that any other parameters should be included in the reference grid. The group decided not to include any additional axes of uncertainty based on the sensitivity runs.

The model estimates of current stock status are predominantly informed by the new abundance index derived from the Joint CPUE estimated for longline fleets. It was noted that the new index was significantly different to the index used in 2021 (**Fig. 6**), especially for the Northwestern region of the Indian Ocean for the periods 2005-2015 and 2019-2020. In addition, the new index suggests a marked increase of abundance for yellowfin in the last three years (2021-2023).

With regards to the differences in the modelling choices, the new SS3 model includes a new growth model, natural mortality and maturity. All these have been updated from recent biological studies, as agreed by the WPTT in the 2024 data preparatory meeting.

For the 2024 model, a new approach was applied to the derivation of the MSY and associated biomass-based reference point (SBMSY) based on the magnitude of recruitments estimated for the recent 20-year period (see Para 89–100 of IOTC-2024-WPTT26-R for details). The derivation of MSY is in line with the recommendations of the 2023 review. MSY was estimated to be 421,000 t. Recent annual catches of401,000 t is below the estimated MSY. Differences in the estimates of MSY and BMSY using recent and long-term recruitment levels introduce additional uncertainty in the estimates of stock status relative to BMSY. This is highlighted in Tables 2 and 3 which indicate, for example, that while SB/SBMSY is estimated to be higher (1.47 under long-term recruitment assumption), MSY is estimated to be lower (374,000). However, fishing mortality-based estimates of stock status are insensitive to those assumptions.

Table 2. Reference points for yellowfin tuna (*Thunnus albacares*) in the Indian Ocean based on long term and 20 year conditions

Long term MSY (t)	Recent 20 yr MSY (t)	Long term SSBmsy (t)	Recent 20 yr SSBMSY (t)
374,421	420,623	986,599	1094,844

Table 3. Status of yellowfin tuna (*Thunnus albacares*) in the Indian Ocean using equivalent (i.e. long-term) recruitment trends

Indicators	
Catch 2023[2] (t) Mean annual catch 2019-2023 (t)	400,950 423,142
MSY_{eq} (1,000 t) (80% CI) SB_{MSY_eq} (1,000 t) (80% CI) SB_{2023} / SB_{MSY_eq} (80% CI)	374 (350-411) 987 (791-1,247) 1.47 (1.21-1.65)

The recent 20 year period was selected on the basis that the period encompassed the most reliable series of catch and size composition data and, as such, provided the best available information regarding the prevailing productivity of the stock.

According to the information available to the 2024 assessment, the total catch has remained within the estimated recent (20 year average) MSY since 2007 (i.e., between 402,000 t and 427,000 t), with the exception of 2018 (443,252 t) and 2019 catch (450,586 t), the latter being the largest since 2006 and above the estimated recent MSY (for details see WPTT23 report).

Overall stock biomass declined substantially during the 1980s and 1990s. The stock is estimated to have been in an overfished state from the early 2000s to the late 2010s (**Fig. 4**). Spawning biomass increased considerably after 2021 following recent strong recruitment (informed by the recent increase in LL CPUE). Correspondingly, overfishing was occurring from 2003 until 2020. Fishing mortality was estimated to be below the FMSY level in 2021-2023. The recent strong recruitments also contribute to a continued increase in projected biomass in the forthcoming years. The magnitude of the recent annual recruitments (2020-2022) is unprecedented in the time series.

Overall stock status estimates differ substantially from the previous assessment. Spawning biomass in 2023 was estimated to be 44% on average of the initial (1950) levels (**Table 1**). Spawning biomass in 2023 was estimated to be 32% higher than the level that supports the maximum sustainable yield (SB_{2023}/SB_{MSY} = 1.32). Current fishing mortality is estimated to be 25% lower than F_{MSY} (F_{2023}/F_{MSY} = 0.75). The probability of the stock being in the green Kobe quadrant in 2023 is estimated to be 89%. On the weight-of-evidence available in 2024, the yellowfin tuna stock is determined to be **not-overfished** and **not-subject to overfishing** (**Table 1** and **Fig. 4**).

It is noted that there are still important uncertainties on the data used for this stock assessment. There are uncertainties in relation to the CPUE standardisation in 2024 that could not be addressed during the meeting due to limitations in access to the data to be examined. The use of the 2021 CPUE index in the current model results in a more pessimistic biomass up to 2020 compared to the 2024 CPUE indices.

It is noted that there is also considerable uncertainty in the reported catches by some fisheries. In particular, catch estimates for several artisanal fisheries have increased substantially in recent years, the implication of which should be further investigated.

Outlook.

Assumptions on recent productivity were used to make 10 year projections and evaluate the impact of alternative catch levels. The results of these projections are shown in **Fig. 7** and summarized in the K2SM (**Table 3**).

Management advice (*)

For each catch scenario, the probability of the biomass being below the SB_{MSY} level and the probability of fishing mortality being above F_{MSY} were determined over the projection horizon using the delta-MVLN estimator (Walter & Winker 2020), based on the variance-covariance derived from estimates of SB/SB_{MSY} and F/F_{MSY} across the model grid. According to the K2SM (**Table 3**):

- If catches are maintained within the estimated MSY range (416000-430000 tons) there is more than a 50% probability that the stock will remain above SB_{MSY} in 2033. In order to account for the uncertainty of the projections (e.g., relating to recruitment), the Commission should ensure that the catch levels for the next 3 years do not exceed the estimated MSY.
- Higher levels of catch are predicted to lead the stock to an overfished state in the long term.
- The probability of breaching the biological limit reference point ($0.4SB_{MSY}$) with recent catches is 0% by 2033. The probability of breaching the F limit reference point ($1.4\ F_{MSY}$) with recent catch is 0% by 2033.

The Commission has an interim plan for the rebuilding the yellowfin stock, with catch limitations based on 2014 and other reference levels (Resolution 21/01 which superseded 19/01, 18/01 and 17/01). Some of the fisheries subject to catch reductions have achieved a decrease in catches in 2023 in accordance with the levels of reductions specified in the Resolution; however, these reductions were offset by increases in the catches from CPCs exempt from and some CPCs subject to limitations on their catches of yellowfin tuna.

The following key points should also be noted:

- Maximum Sustainable Yield (MSY): estimate for the Indian Ocean stock is 421,00 t with a range between 416,000 and 430,000 t (**Table 1**). The 2021-2023 average catches (413,000 t) were within the estimated recent MSY level.
- **Interim reference points**: Noting that the Commission in 2015 agreed to Resolution 15/10 on target and limit reference points and a decision framework, the following should be noted:
- **Fishing mortality**: 2023 fishing mortality is considered to be 25% below the interim target reference point of F_{MSY}, and below the interim limit reference point of $1.4*F_{MSY}$ (**Fig. 4**).
- **Biomass**: 2023 spawning biomass is considered to be 32 % above the interim target reference point of SB_{MSY} and above the interim limit reference point of $0.4*SB_{MSY}$ (**Fig. 4**).
- **Catch data uncertainty:** the overall quality of the nominal catches of yellowfin tuna shows some large variability between 1950 and 2023. In some years, a large portion of the nominal catches of yellowfin tuna had to be estimated, and catches reported using species or gear aggregates had to be further broken down. The data quality was particularly poor between 1994 and 2002 when less than 70% of the nominal catches were fully or partially reported, with most reporting issues coming from coastal fisheries. The reporting rate has generally improved over the last decade however detailed information on data collection procedures, which determines the quality of fishery statistics, is still lacking.
- **Main fisheries (mean annual catch 2019-2023)**: yellowfin tuna are caught using line and coastal longline (40%), followed by purse seine (33%) and gillnet (15%). The remaining catches taken with other gears contributed to 12% of the total catches in recent years (**Fig. 1**). The fishery impact plot is shown in **Fig. 8**.

- **Main fleets (mean annual catch 2019-2023)**: the majority of yellowfin tuna catches are attributed to vessels flagged to Sultanate of Oman (15%) followed by I. R. Iran (11%) and EU (Spain) (10%). The 32 other fleets catching yellowfin tuna contributed to 64% of the total catch in recent years (**Fig. 2**).

References

Walter, J., Winker, H., 2020. Projections to create Kobe 2 Strategy Matrices using the multivariate log-normal approximation for Atlantic yellowfin tuna. Collect. Vol. Sci. Pap. ICCAT, 76(6): 725-739

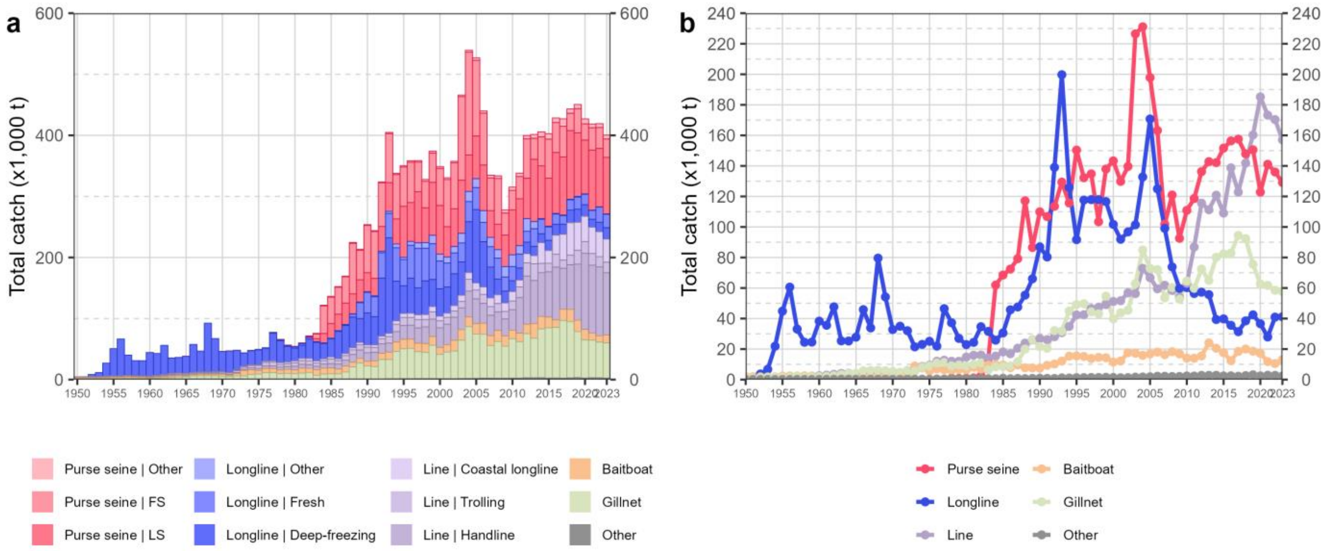

Fig. 3. Annual time series of (a) cumulative nominal catches (metric tonnes; t) by fishery and (b) individual nominal catches (metric tonnes; t) by fishery group for yellowfin tuna during 1950-2023. FS = free-swimming school; LS = school associated with drifting floating objects. Purse seine | Other: coastal purse seine, purse seine of unknown association type, ring net; Longline | Other: swordfish and sharks-targeted longlines; Other: all remaining fishing gears

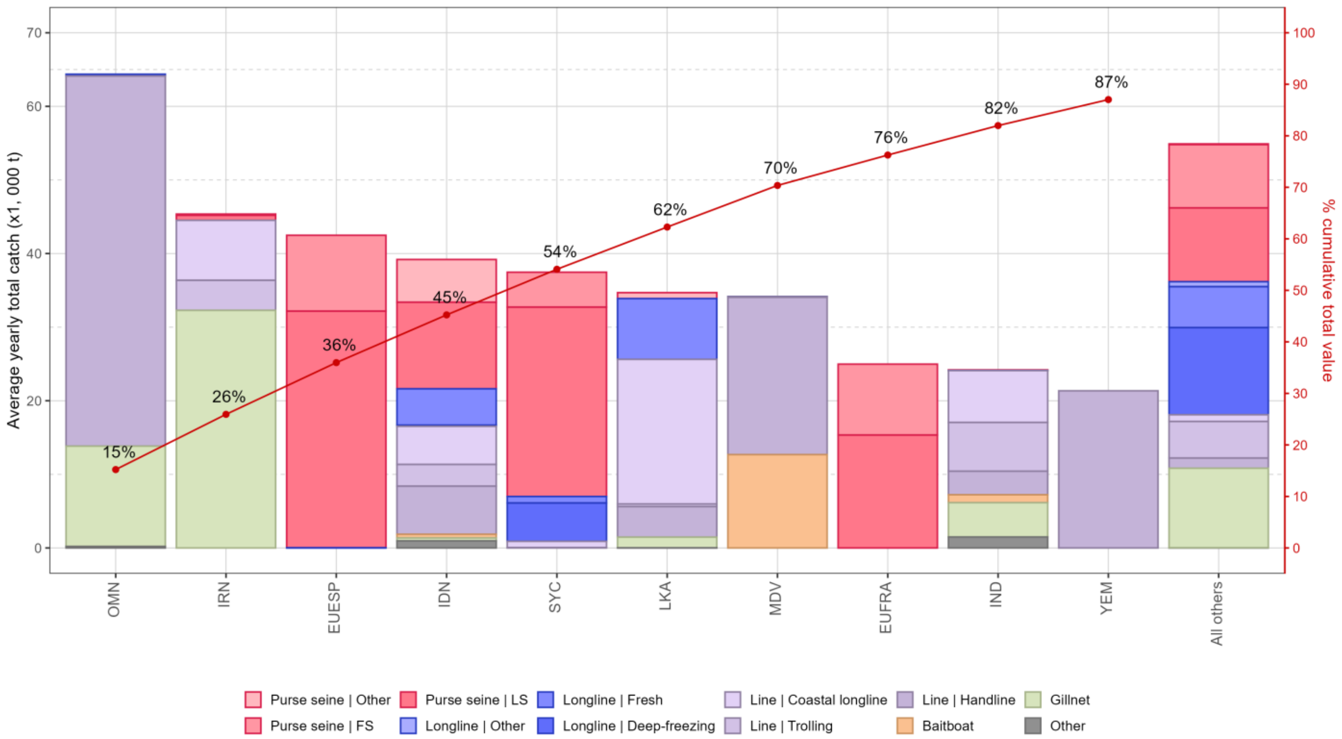

Fig. 4. Mean annual catches (metric tonnes; t) of yellowfin tuna by fleet and fishery between 2019 and 2023, with indication of cumulative catches by fleet. FS = free-swimming school; LS = school associated with drifting floating objects. Purse seine | Other: coastal purse seine, purse seine of unknown association type, ring net; Longline | Other: swordfish and sharks-targeted longlines; Other: all remaining fishing gears

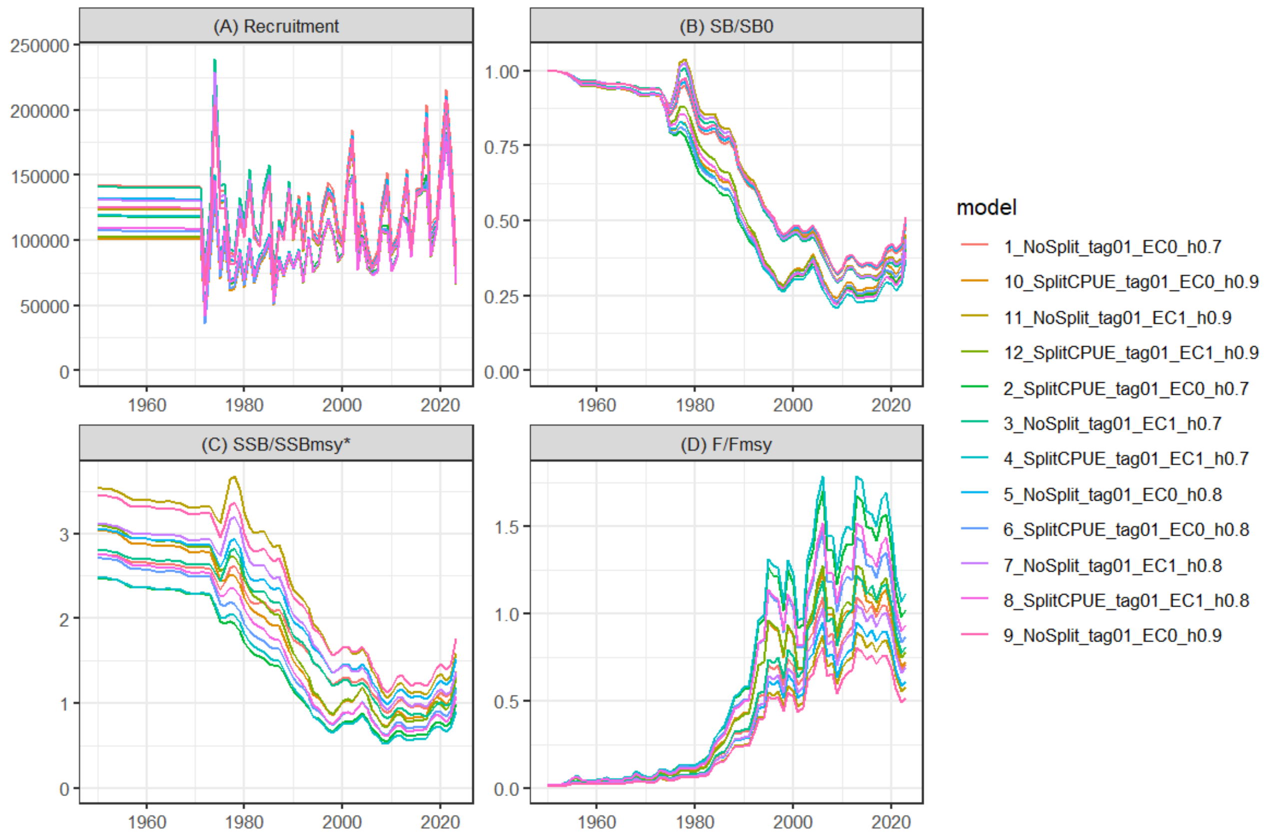

Fig 3. Estimated time series (1950-2023) of recruitment, spawning stock biomass relative to virgin biomass and to spawning stock biomass at MSY and fishing mortality relative to fishing mortality at MSY of yellowfin tuna from the reference models of the 2024 assessment.

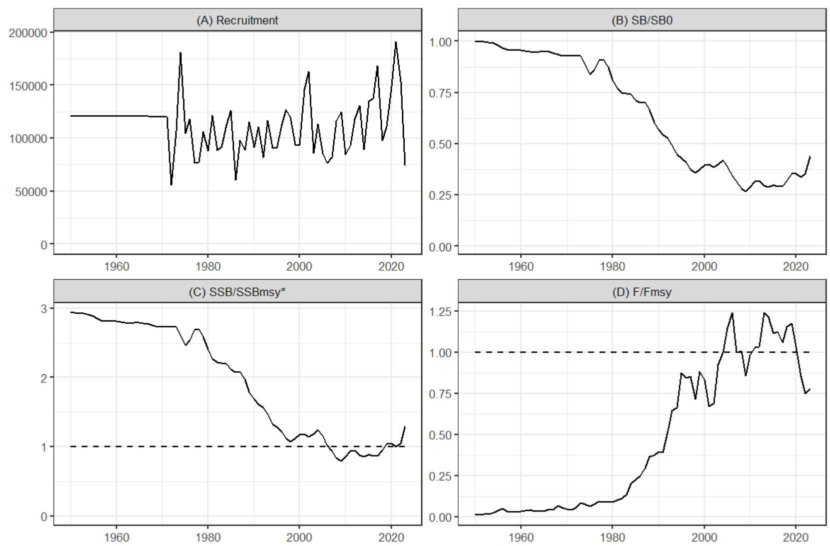

Fig 4. Estimated time series (1950-2023) of recruitment, spawning stock biomass and fishing mortality of yellowfin tuna from the reference model of the 2024 assessment.

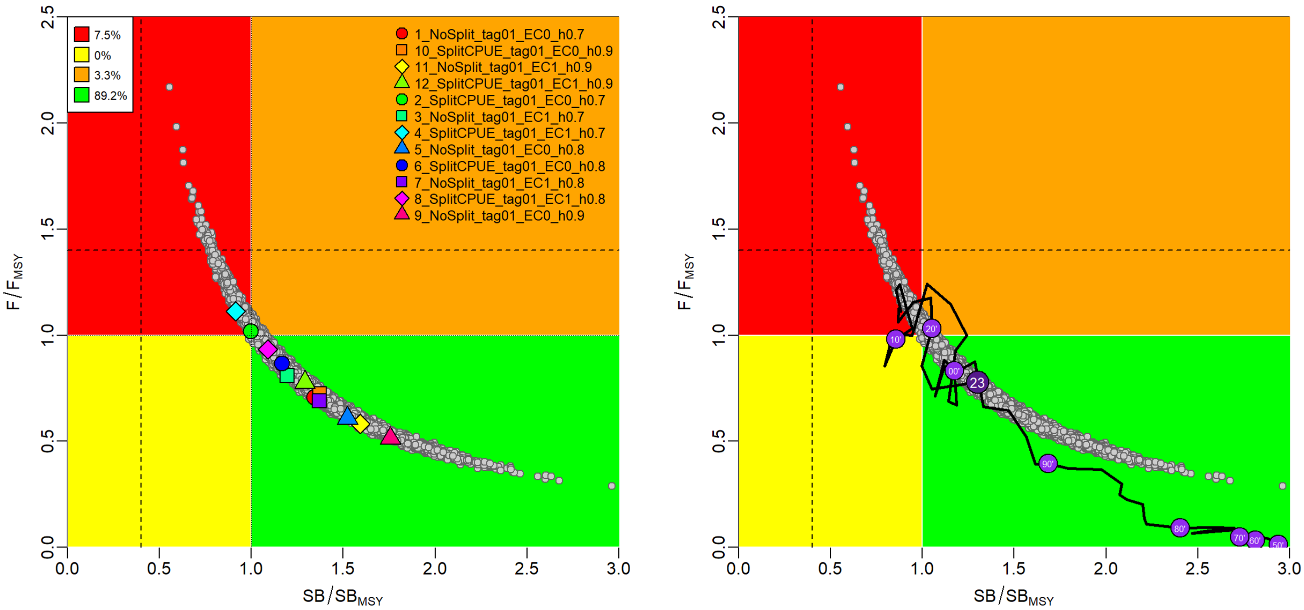

Fig. 5. Yellowfin tuna: SS3 Indian Ocean assessment Kobe plot: (left): current (2023) stock status, relative to SB_{MSY} (x-axis) and F_{MSY} (y-axis) reference points for the final model options. Coloured symbols represent Maximum posterior density (MPD) estimates from individual modelsGrey dots represent uncertainty from individual models. The dashed lines represent limit reference points for IO yellowfin tuna (SBlim = 0.4 SB_{MSY} and Flim = 1.4 F_{MSY}); (right) mean stock trajectory from the model grid.

Fig 6. Standardised CPUE indices used in the final assessment models: Joint longline CPUE indices by region 1975-2023 (The red lines are indices used in 2021 assessment 1975 – 2020).

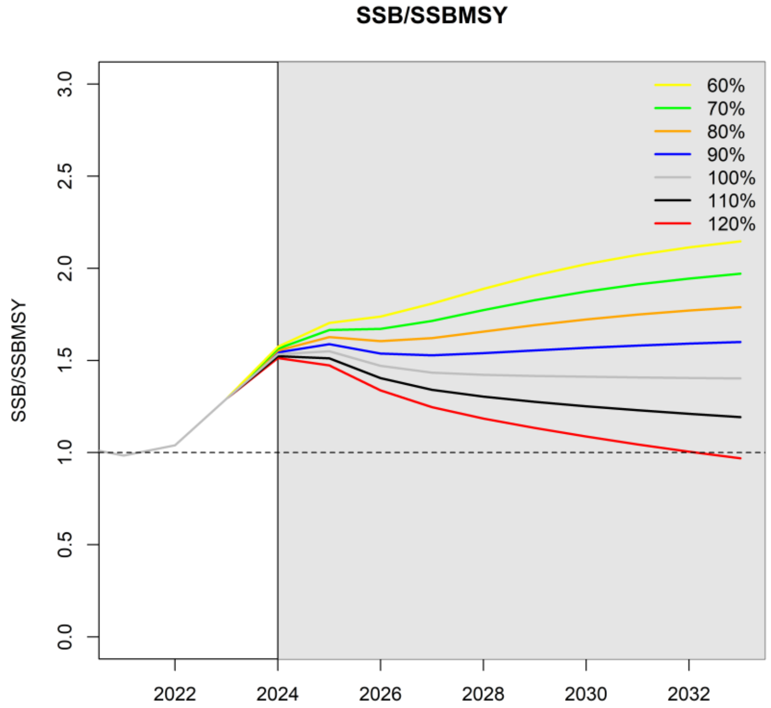

Fig 7. Trajectory showing the impact of alternative catch levels on spawning stock biomass relative to spawning stock biomass at MSY relative to the catch level from 2023

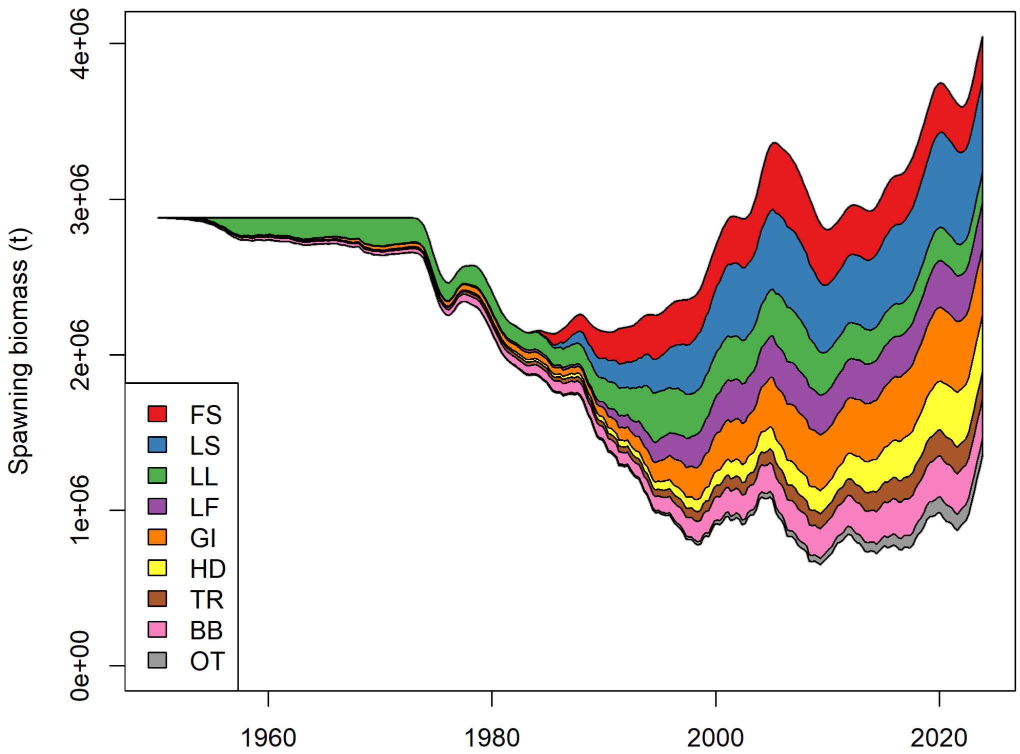

Fig 8. Fishery Impact Plot: Estimates of reduction in spawning biomass due to fishing over all regions attributed to various fishery groups for the assessment model.

TABLE 3. Yellowfin tuna: Stock synthesis assessment Kobe II Strategy Matrix. Probability of violating the MSY-based target (top) and limit (bottom) reference points for constant catch projections (relative to the catch level from 2023 -40%, - 30%, -20%, -10%, 0%, +10%, +20%) projected for 3 and 10 years

Alternative catch projections (relative to the catch level from 2023) and probability of violating MSY-based target reference points ($SB_{targ} = SB_{MSY}$; $F_{targ} = F_{MSY}$)							
Reference point and projection timeframe	60%	70%	80%	90%	100%	110%	120%
$SB_{2026} < SB_{MSY}$	0	0	0.1	0.1	0.6	1.3	4
$F_{2026} > F_{MSY}$	0	0	0	0	2.5	11.2	30.9
$SB_{2033} < SB_{MSY}$	0	0	0	0	0.1	13.1	66.7
$F_{2033} > F_{MSY}$	0	0	0	0	1.3	31.6	84.9
Alternative catch projections (relative to the catch level from 2023) and probability of violating MSY-based limit reference points ($SB_{lim} = 0.4\ SB_{MSY}$; $F_{Lim} = 1.4\ F_{MSY}$)							
Reference point and projection timeframe	60%	70%	80%	90%	100%	110%	120%
$SB_{2026} < SB_{Lim}$	0	0	0	0	0	0	0
$F_{2026} > F_{Lim}$	0	0	0	0	0	0.1	0.9
$SB_{2033} < SB_{Lim}$	0	0	0	0	0	0	0
$F_{2033} > F_{Lim}$	0	0	0	0	0	0.3	24.1

APPENDIX VII
WORKING PARTY ON TROPICAL TUNAS PROGRAM OF WORK (2025–2029)

The following is the Draft WPTT Program of Work (2025–2029) and is based on the specific requests of the Commission and Scientific Committee. 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 tropical tunas in the Indian Ocean;
- **Table 2**: Stock assessment schedule.

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

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

Topic in order of priority	Sub-topic and project	TIMING				
		2025	2026	2027	2028	2029
Stock assessment priorities	Address the outstanding issues identified as priorities by the yellowfin tuna peer review panel (February 2023). Address the additional recommendations made by the WPTT in 2024.					
Abundance indices development	Address the additional recommendations made by the WPTT in 2024 regarding the CPUE indices for yellowfin. In view of the coming assessments of yellowfin, bigeye, and skipjack develop abundance time series for each tropical tuna stock for the Indian Ocean • Continue to develop CPUE indices from Longline, purse seine, Pole and line fisheries, and fishery independent indices of abundance such as those derived from echosounder buoys. • Explore and support the development of gillnet CPUE indices for fleets (e.g., Iran, Pakistan and Oman) • Evaluate effect of changes of spatial coverage on the longline CPUE through the Joint CPUE workshop and estimate spatial temporal abundance distribution through VAST modelling approach					
Fisheries Independent Monitoring	Use of Close Kin Mark Recapture (CKMR) methods which can provide estimates of absolute spawning biomass, mortality, stock structure, and connectivity based on genotyping individuals to a level that can identify close relatives (e.g. parent-offspring or half-siblings). Plan for a staged approach for implementation of a YFT CKMR project					
Analysis of tagging and size frequency data	Analyze data from IOTC tagging programs outside stock assessment models and evaluate its utility and impact on stock assessments. Standardisation of size frequency data.					
Analysis of environmental factors	Evaluate the impact of environmental factors on the dynamics of tropical tuna stocks and the possible role of climate change on changes to selectivity, recruitment deviates and fishing productivity.					

Other Future Research Requirements (not in order of priority)

			2025	2026	2027	2028	2029
1	Stock structure (connectivity and diversity)	1.1 Genetic research to determine the connectivity of tropical tuna species throughout their distribution (including in adjacent Pacific Ocean waters as appropriate) and the effective population size.					
		1.2 Population genetic analyses to decipher intraspecific connectivity, levels of gene flow, genetic divergence and effective population sizes based on genome-wide distributed Single Nucleotide Polymorphisms (SNPs).					
		1.3 Connectivity, movements, and habitat use, including identification of hotspots and investigate associated environmental conditions affecting the tropical tuna species distribution, making use of conventional and electronic tagging (P-SAT). 1.4 Investigation into the degree of local or open population in main fishing areas (e.g,, the Maldives and Indonesia – archipelagic and open ocean) by using techniques such flux in FAD arrays or used of morphological features such as shape of otoliths.					
2	Biological and ecological information (incl. parameters for stock assessment)	2.1 Biological sampling					
		2.1.1 Design and develop a plan for a biological sampling program to support research on tropical tuna biology. The plan would consider the need for the sampling program to provide representative coverage of the distribution of the different tropical tuna species within the Indian Ocean and make use of samples and data collected through observer programs, port sampling and/or other research programs. The plan would also consider the types of biological samples that could be collected (e.g. otoliths, spines, gonads, stomachs, muscle and liver tissue, fin clips, etc.), the sample sizes required for estimating biological parameters, and the logistics involved in collecting, transporting and processing biological samples. The specific biological parameters that could be estimated include, but are not limited to, estimates of growth, age at maturity, fecundity, sex ratio, spawning season, spawning fraction and stock structure.					
		2.1.2 Collect gonad samples from tropical tunas to confirm the spawning periods and location of the spawning area that are presently hypothesized for each tropical tuna species.					

3	Historical data review	3.1 Changes in fleet dynamics need to be documented by fleet					
		3.1.1 Provide an evaluation of fleet-specific fishery impacts on the stock of bigeye tuna, skipjack tuna and yellowfin tuna. Project potential impact of realizing fleet development plans on the status of tropical tunas based upon most recent stock assessments.					
4	Alternative indices	4.1 That methods be developed for standardising purse seine catch species composition using operational data, so as to provide alternative indices of relative abundance (see Terms of Reference, Appendix IXb IOTC-2017-WPTT19-R).					
		4.2 Investigate the potential to use the Indian longline survey as a fishery-independent index of abundance for tropical tunas.					
5	Stock assessment stock indicators	5.1 Develop and compare multiple assessment approaches to determine stock status for tropical tunas 5.2 Scoping of ongoing age composition data collection for stock assessment 5.3 Develop a high resolution age structured operating model that can be used to test the spatial assumptions including potential effects of limited tags mixing on stock assessment outcomes (see Terms of Reference, Appendix IXa IOTC-2017-WPTT19-R).					
6	Fishery monitoring	6.1 Develop fishery independent estimates of stock abundance to validate the abundance estimates of CPUE series. All of the tropical tuna stock assessments are highly dependent on relative abundance estimates derived from commercial fishery catch rates, and these could be substantially biased despite efforts to standardise for operational variability (e.g. spatio-temporal variability in operations, improved efficiency from new technology, changes in species targeting). Accordingly, the IOTC should continue to explore fisheries independent monitoring options which may be viable through new technologies. There are various options, among which some are already under test. Not all of these options are rated with the same priority, and those being currently under development need to be promoted, as proposed below: Acoustic FAD monitoring, with the objective of deriving abundance indices based on the biomass estimates provided by echo-sounder buoys attached to FADs					

		6.2 Longline-based surveys (expanding on the Indian model) or “sentinel surveys” in which a small number of commercial sets follow a standardised scientific protocol 6.3 Aerial surveys, potentially using remotely operated or autonomous drones 6.4 Studies (research) on flux of tuna around anchored FAD arrays to understand standing stock and independent estimates of the stock abundance. 6.5 Investigate the possibility of conducting ongoing ad hoc, low level tagging in the region					
7	Target and Limit reference points	7.1 To advise the Commission, on Target Reference Points (TRPs) and Limit Reference Points (LRPs). Used when assessing tropical tuna stock status and when establishing the Kobe plot and Kobe matrices					
8	Fisheries Indicators	8.1 Examination of additional fisheries indicators and their discussion at WP meetings. Perhaps a section in report to accommodate these. See how this is being addressed in other RFMOs.					

Table 2. Assessment schedule for the IOTC Working Party on Tropical Tunas (WPTT)

Species	2025	2026	2027	2028	2029
Bigeye tuna	**Data preparatory meeting** **Full assessment**	Indicators	Indicators Data prep for MP MP to be run	**Data preparatory meeting** **Full assessment**	Indicators
Skipjack tuna	Indicators Data prep for MP MP to be run	**Data preparatory meeting** **Full assessment**	Indicators	Indicators Data prep for MP MP to be run	**Data preparatory meeting** **Full assessment**
Yellowfin tuna	Indicators	Indicators	**Data preparatory meeting** **Full assessment**	Indicators	Indicators

APPENDIX VIII
CONSOLIDATED RECOMMENDATIONS OF THE 26TH SESSION OF THE WORKING PARTY ON TROPICAL TUNAS

Note: Appendix references refer to the Report of the 26th Session of the Working Party on Tropical Tunas (IOTC–2024–WPTT26–R

Yellowfin tuna Stock Assessment

WPTT26.01 (para 37): The WPTT **RECOMMENDED** that the work towards the implementation of the Indian Ocean Digital Atlas (IODA) be continued to consolidate the proposal before the Scientific Committee.

WPTT26.02 (para 96): The WPTT **NOTED** that the proposal to adjust MSY-based/benchmark reference points using recent average recruitment is new and has major implications for the yellowfin tuna assessment and other IOTC assessments. Therefore, the WPTT **RECOMMENDED** that the SC discuss this approach thoroughly and if appropriate, request the development of further guidance on this from the WPM.

WPTT26.03 (para 100): After in-depth discussions on different aspects of the modelling work, the WPTT **AGREED** and **RECOMMENDED** additional research and actions to further refine future yellowfin stock assessment. These will also address the suggestions and requests raised during the detailed discussions. These recommended action points are listed in Appendix IX

WPTT26.04 (para 122): The WPTT **ADOPTED** the stock status advice developed for yellowfin tuna as provided in the draft resource stock status summary and **REQUESTED** that the IOTC Secretariat update the draft stock status summary for yellowfin tuna with the latest 2023 catch data (if necessary), and **RECOMMENDED** for the summary to be provided to the SC as part of the draft Executive Summary, for its consideration:

- Yellowfin tuna (*Thunnus albacares*) – Appendix VI

WPTT26.05 (para 125): The WPTT **NOTED** that the K2SM short-term projections of 3 years for management advice is challenging to implement given the 2-year lag between stock assessment data and the ability for the Commission to implement any management actions. As such, the WPTT **RECOMMENDED** that the Scientific Committee consider amending the standard short-term reporting period when using the K2SM, for example, from 3 to 5 years.

Bigeye tuna Management Procedure

WPTT26.06 (para 132): The WPTT **NOTED** that exceptional circumstances of adopted MPs need to be considered at both species WPs and WPM. The WPTT also **NOTED** that there is benefit in species WPs being held before WPM to allow discussions on issues such as new information on biology before consideration of potential modelling implications and as such **RECOMMENDED** that in the future the WPM be held after the WPTT.

Update on MSE for Tropical Tunas

WPTT26.07 (para 162): The WPTT **NOTED** that the yellowfin MSE has been inactive for several years (awaiting revision of the stock assessment) and **RECOMMENDED** that the SC resume the process.

FAD related topics

WPTT26.08 (para 165): The WPTT **NOTED** that after the recent resolutions on FAD were adopted, CPCs seem less inclined to submit papers to WGFAD. This led to the shortening of WGFAD06 to a single day and the cancellation of WGFAD07 this year due to a shortage of papers. Therefore, the WPTT **RECOMMENDED** that the SC advise the Commission to schedule only one WGFAD meeting in 2025. The WPTT also suggests that this meeting should take place before the WPEB, as FAD issues are relevant to WPEB, to allow the findings to be reported to both WPEB and WPTT.

Revision of the WPTT Program of Work (2025–2029)

WPTT26.09 (para. 170): The WPTT **RECOMMENDED** that the SC consider and endorse the WPTT Program of Work (2025–2029), as provided in Appendix VII.

Date and place of the 27th and 28th Sessions of the WPTT (Chair and IOTC Secretariat)

WPTT26.10 (para. 173) The Secretariat will continue to liaise with CPCs to determine their interest in hosting these meetings in the future. The WPTT **RECOMMENDED** the SC consider late October 2025 as a preferred time period to hold the WPTT27 meeting in 2025. It was also **AGREED** that the WPTT Assessment meeting should continue to be held back-to-back with the WPM.

Review of the draft, and adoption of the report of the 26th session of the WPTT

WPTT26.11 (para. 174): The WPTT **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPTT26, provided at Appendix VIII, as well as the management advice provided in the draft resource stock status summary for each of the three tropical tuna species under the IOTC mandate, and the combined Kobe plot for the three species assigned a stock status in 2024 (Figure 1):

- Bigeye tuna (*Thunnus obesus*) – Appendix IV
- Skipjack tuna (*Katsuwonus pelamis*) – Appendix V
- Yellowfin tuna (*Thunnus albacares*) – Appendix VI

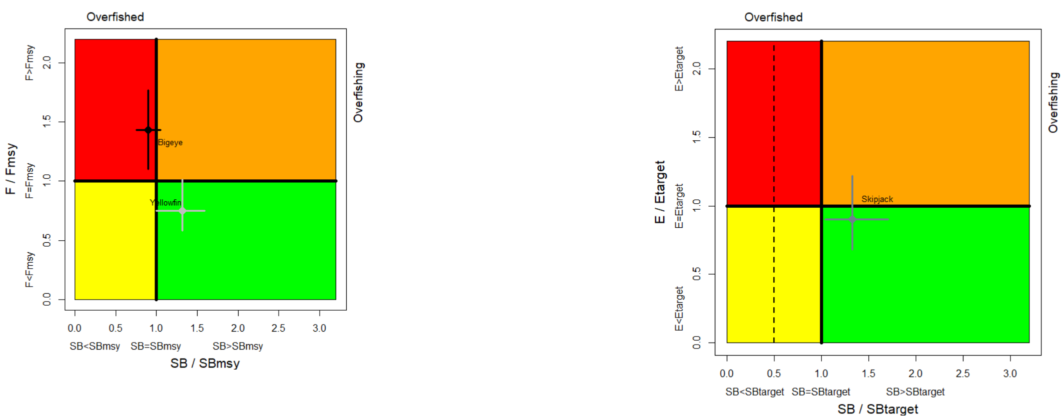

Figure 1. (Left) Combined Kobe plot for bigeye tuna (black: 2022), and yellowfin tuna (grey: 2024) showing the estimates of current stock size (SB) and current fishing mortality (F) in relation to optimal spawning stock size and optimal fishing mortality. (Right) Kobe plot for skipjack tuna showing the estimates of the current stock status (dark grey: 2023). The dashed line indicates the limit reference point at 20%SB0). Cross bars illustrate the range of uncertainty from the model runs with an 80% CI.

APPENDIX IX

RECOMMENDED ACTIONS POINTS TO IMPROVE THE YELLOWFIN STOCK ASSESSMENT

Recommended action points related to Joint CPUE standardizations

(1) Prioritization of key sets of analyses/indices required for specific assessments and management procedures. Improved coordination with the relevant stock assessment team.

(2) Increased transparency in the data modeling process, including dissemination of scripts used in data processing and modeling, participation of an external observer in the data workshop (IOTC secretariat participation), improved documentation and dissemination of results (including data description, key model diagnostics).

(3) Improved resourcing of current data modeling team. Currently constrained by available hardware and constraints of data confidentiality.

(4) Investigate the potential to undertake analysis of logsheet data outside the current workshop structure. For example, it may be possible to conduct external analyses of the logsheet data excluding the more recent data (last 10 years).

(5) Ongoing development of the spatial temporal modeling of longline catch and effort data. Initially, these approaches can be developed using aggregated catch and effort data (rather than relying on operational logsheet data). The modeling results are likely to inform the conceptual model for the yellowfin tuna stock and structural assumptions of the current stock assessment model (especially spatial structure and movement).

(6) Characterisation of potential factors influencing changes in fishing efficiency for key species (temporally and spatially) to improve consideration of the likely extent of "effort creep" for longline fisheries.

Recommended action points related to assessment modelling in general

(1) Develop a guideline to deal with retrospective errors: when does a retrospective error need to be corrected in stock status determination and projection? If yes, how should it be corrected?

(2) Explore DYNAMIC reference points to reflect prevailing conditions in a changing ecosystem.

(3) Evaluate possible temporal and spatial non-stationarity in life history and fisheries, likely induced by climate change and changing ecosystem and fishing fleet dynamics, and explore state-space models (e.g., Woods Hole Assessment Model, WHAM) to account for the non-stationary process errors in life history processes (e.g., survival, recruitment, and M) and selectivity (e.g., non-stationary stock availability to fisheries).

(4) Identify major biological and statistical assumptions, both explicit and implicit, associated with the stock assessment (key assumptions should be listed in the stock assessment report for transparency).

(5) Evaluate possible spatial inconsistency/consistency in estimated population dynamics (e.g., SSB, Recruitment) among regions (may use this to check stock structure, biological realisms or spatial shifting).

(6) Organize the presentations in the WPTT meeting to make sure models of different complexities and assumptions be presented prior to the finalization of the reference grid (or base case scenario).

(7) Develop a protocol or guideline to select scenarios to be included in the reference grid, making the process more transparent and consistent.

Top priorities for the modelling team:

(1) Explore alternative fleet and area structures using spatiotemporal modelling.
(2) Progress on the CPUE standardization and coordinate with Joint CPUE work group to agree on indices to be produced based on the model structure.
(3) Develop size based CPUE for the longline fleets to better understand possible changes in selectivity.
(4) Develop alternative abundance indices.
(5) Standardize length composition data.
(6) Investigate age structure of catches from key fisheries.
(7) Review and analyze tagging data externally.
(8) Investigate recruitment signals based on the ABBI index, and examine how the estimated recruitment deviates are related to oceanographic conditions and environmental factors.
(9) Improve data collection parallel to future model development and better quantify the uncertainty of the catch history (e.g., unreported catch, catch re-estimation, etc.)