



## Report of the 27<sup>th</sup> Session of the IOTC Working Party on Tropical Tunas

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Seychelles, 21 - 25 October 2025

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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 $B_0$ 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                                                                                   |
| HPB           | Hooks per Basket                                                                                       |
| $I_{max}$     | 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 27th Session of the Indian Ocean Tuna Commission's (IOTC) Working Party on Tropical Tunas (WPTT), was held in Seychelles from 21-25 October 2025. The meeting was opened by the Chairperson, Dr Gorka Merino (EU, Spain) who welcomed participants. A total of 65 participants attended the session, consisting of 40 in person 25 online (cf. 130 in 2024, 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 WPTT27 to the Scientific Committee, which are provided at [Appendix VIII](#).

***Bigeye tuna Stock Assessment***

WPTT27.01 (para 102): WPTT **REQUESTED** that the IOTC Secretariat update the draft stock status summary for bigeye tuna with the latest 2024 catch data, if necessary. The WPTT **RECOMMENDED** that the SC develop the stock status advice as part of the Executive Summary, following the review of the final assessment results intersessionally.

- Bigeye tuna (*Thunnus obesus*) – [Appendix VI](#)

***Bigeye tuna Management Procedure***

WPTT27.02 (para 107): **NOTING** the provision in Resolution 23/04 that sets catch limits for some CPCs, including a mechanism to deduct any over catch (as well as a provision to set catch limits for other CPCs if their catches exceed 2000 t), the WPTT **RECOMMENDED** that the Commission review 2024 catches of bigeye tuna as soon as possible and enact, as appropriate, the relevant catch limit setting mechanisms adopted in the Resolution 23/04.

***Yellowfin Tuna – Update on the standardised CPUE indices***

WPTT27.03 (para 179): The WPTT **NOTED** concerns regarding the current process for developing the joint CPUE analysis, specifically related to transparency and reproducibility, and also **NOTED** suggestions for areas where improvements can be made. The WPTT **RECOMMENDED** that future analyses be initiated with adequate lead time to allow for thorough development, review, and consultation. It was further **ENCOURAGED** the code used in the analysis to be standardised, well-documented, version-controlled, and made publicly available to ensure transparency and reproducibility.

WPTT27.04 (para 159): The WPTT **RECOMMENDED** that the SC review the updated CPUE and updated preliminary assessment grid and analyses and evaluate the need to undertake a new full stock assessment (including potentially projections) for yellowfin tuna in 2026 (thus amending the Program of Work if necessary).

***Revision of the WPTT Program of Work (2026–2030)***

WPTT27.05 (para. 222): The WPTT **RECOMMENDED** that the SC consider, amend as necessary, and then endorse the WPTT Program of Work (2026–2030), as provided in [Appendix VII](#).

***Date and place of the 27<sup>th</sup> and 28<sup>th</sup> Sessions of the WPTT (Chair and IOTC Secretariat)***

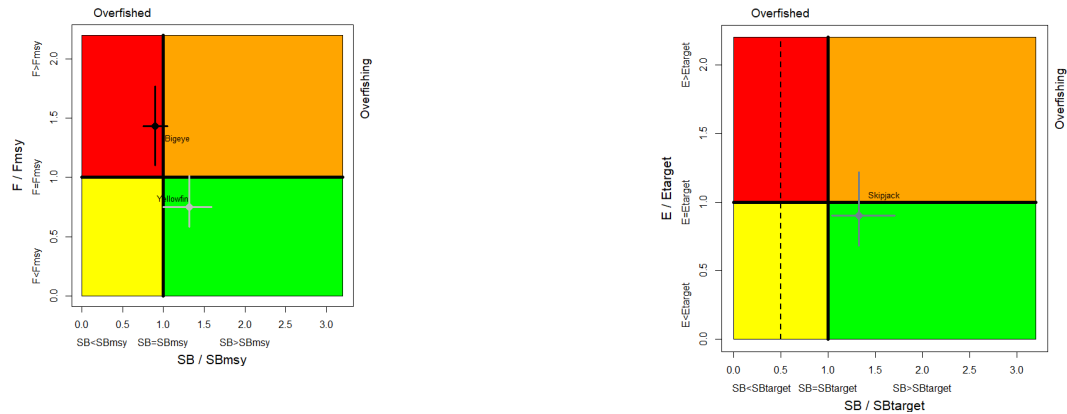
WPTT27.06 (para. 229): The Secretariat will continue to liaise with CPCs to determine their interest in hosting these meetings in the future. The WPTT **RECOMMENDED** the SC consider late October 2026 as a preferred time period to hold the WPTT28 meeting in 2026. It was also **AGREED** that the WPTT Assessment meeting should continue to be held back-to-back with the WPM.

***Review of the draft, and adoption of the report of the 27<sup>th</sup> session of the WPTT***

WPTT27.07 (para. 231): The WPTT **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPTT27, 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 2025 (Figure 1), noting that the final assessment model runs of the bigeye tuna will be completed after the meeting, therefore, the status advice for bigeye tuna should be developed by the SC following the review of the final stock assessment results and update of the Kobe plot intersessionally:

- 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) (TO BE UPDATED BY THE SC for status in 2025), 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 (bigeye tuna status to be finalized intersessionally and advice to be developed at the SC28).

| Stock                                      | Indicators                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | Advice to the Commission                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|------|------|------|------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Bigeye tuna<br><i>Thunnus obesus</i>       | Catch in 2024 (t)<br>Average catch 2020–2024 (t)<br>MSY (1,000 t) (80% CI)<br>F <sub>MSY</sub> (80% CI)<br>SB <sub>MSY</sub> (1,000 t) (80% CI)<br>F <sub>2021</sub> / F <sub>MSY</sub> (80% CI)<br>SB <sub>2021</sub> / SB <sub>MSY</sub> (80% CI)<br>SB <sub>2021</sub> / SB <sub>0</sub> (80% CI)                                                                                                         | 101,722<br>88,541<br>96 (83 – 108)<br>0.26 (0.18 – 0.34)<br>513 (332 – 694)<br>1.43 (1.10 – 1.77)<br>0.90 (0.75 – 1.05)<br>0.25 (0.23 – 0.27)                                                                                                                   |      |      | 38%  |      |      | 79%  |      |      |      | A new stock assessment was carried out for bigeye tuna in 2025. Due to an issue identified at the WPTT meeting, the assessment will be finalised during an intersessional meeting, and the advice will be developed by the SC. 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. On the weight-of-evidence available in 2022, the bigeye tuna stock is determined to be <b>overfished</b> and subject to <b>overfishing</b> .<br><br><Click here for full stock status summary>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Skipjack tuna<br><i>Katsuwonus pelamis</i> | Catch in 2024 (t):<br>Average catch 2020-2024 (t):<br>E <sub>40%SB0</sub> (t)**:<br>SB <sub>0</sub> (t)<br>SB <sub>2022</sub> (t)<br>SB <sub>2022</sub> / SB <sub>0</sub><br>SB <sub>2022</sub> / SB <sub>40%SB0</sub><br>SB <sub>2022</sub> / SB <sub>20%SB0</sub><br>SB <sub>2022</sub> / SB <sub>MSY</sub><br>F <sub>2022</sub> / F <sub>MSY</sub><br>F <sub>2022</sub> / F <sub>40%SB0</sub><br>MSY (MT) | 624,609<br>636,078<br>0.55 (0.48–0.65)<br>2 177 144 (1 869 035–2 465 671)<br>1 142 919 (842 723–1 461 772)<br>0.53 (0.42–0.68)<br>1.33 (1.04–1.71)<br>2.67 (2.08–3.42)<br>2.30 (1.57–3.40)<br>0.49 (0.32–0.75)<br>0.90 (0.68–1.22)<br>584 774 (512 228–686 071) | 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 point (20%SB0). Subsequently, based on the weight-of-evidence available in 2023, the skipjack tuna stock is determined to be <b>not overfished</b> and <b>not subject to overfishing</b> .<br><br>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.<br><a href="#">&lt;Click here for full stock status summary&gt;</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Yellowfin tuna<br><i>Thunnus albacares</i> | Catch in 2024 (t)<br>Average catch 2020–2024 (t)<br>MSY <sub>recent</sub> (1000)(80% CI)<br>F <sub>MSY</sub> (80% CI)<br>SB <sub>MSYrecent</sub> (1000) (80% CI)<br>F <sub>2020</sub> / F <sub>MSY</sub> (80% CI)<br>SB <sub>2023</sub> /SB <sub>MSYrecent</sub> (80% CI)<br>SB <sub>2023</sub> / SB <sub>0</sub> (80% CI) | 489,742<br>440,206<br>421 (416–430)<br>0.20 (0.16–0.26)<br>1,063 (890–1,361)<br>0.75 (0.58–1.01)<br>1.32 (1.00–1.59)<br>0.42 (0.33–0.50) |      | 94%  |      |      | 68%  |      |      | 89%  |      | No new stock assessment was carried out for yellowfin tuna and so the advice is based on the 2024 assessment using Stock Synthesis with data up to 2023. 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.<br><a href="#">&lt;Click here for full stock status summary&gt;</a> |
| Stock                                      | Indicators                                                                                                                                                                                                                                                                                                                 |                                                                                                                                          | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 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 27th Session of the Indian Ocean Tuna Commission's (IOTC) Working Party on Tropical Tunas (WPTT), was held in Seychelles from 21-25 October 2025. The meeting was opened by the Chairperson, Dr Gorka Merino (EU, Spain) who welcomed participants. A total of 65 participants attended the session, consisting of 40 in person and 25 online (cf. 130 in 2024, 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 WPTT27 are listed in [Appendix III](#). The WPTT **NOTED** a number of papers were provided after the deadline for submission, significantly hindering productive and comprehensive discussion at the meeting. The WPTT reminded the authors of the submission deadlines established by the Commission.

## 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** the presentation [IOTC-2025-WPTT27-03\\_Rev2](#), which provided an updated review of the statistical data and fishery trends for tropical tunas and bigeye tuna, as received by the IOTC Secretariat for the period 1950–2024. The WPTT **NOTED** that a comprehensive review of the data available at the Secretariat had been undertaken during the Data Preparatory Meeting held in June 2025, and that the presentation focused only on data updates since that meeting. A few minor data updates were made for the fisheries of Kenya, Japan, and Timor-Leste prior to 2024.
4. The WPTT **CONGRATULATED** the Secretariat on its work and **ACKNOWLEDGED** the value of the data review papers prepared for the meetings.
5. The WPTT **NOTED** that the main data source for the retained catch reported to the IOTC is the form [1RC](#), which has a submission deadline of 30 June each year, extended to 30 December for the final submission of longline fisheries data. It was further **NOTED** that, for various reasons, some CPCs submitted updated retained catch data after the deadline, delaying the process of finalising data for assessment purposes.
6. The WPTT **ACKNOWLEDGED** improvements in the quality and timeliness of tropical tuna retained catch data. However, it was noted that while catches have improved in quality for some, they remain very uncertain for other CPCs that report high catches of tropical tuna.
7. The WPTT **NOTED** that the annual catch of tropical tunas has remained relatively stable in recent years (2020-2024), at around 1.2 million tonnes. It was further **NOTED** that approximately 60% of the total catch originated from industrial fisheries (longline and surface – including purse seine), with large-scale purse seine fisheries contributing about 38%, with approximately 500,000 t in 2024. Among coastal fisheries, the main contributors were gillnet (16%) and line fisheries (23%), while coastal surrounding nets (purse seines and ringnets) together accounted for only 5% of the total tropical tuna catch in recent years.
8. The WPTT **NOTED** the top three (3) CPCs catching bigeye tuna are Indonesia (19.4%), European Union (20.7%), and Seychelles (15.7%).
9. The WPTT **NOTED** that, following the official submission of retained catch data in late June 2025, Indonesia submitted updated datasets for 2023 on 31 July 2025 and for 2024 on 19 October 2025. The WPTT **ACKNOWLEDGED** that these revisions were part of Indonesia's ongoing efforts to refine its catch estimation process. As the data review and validation process was still underway and some inconsistencies remained to be resolved, the Secretariat applied the IOTC legacy estimation procedure ([Moreno et al., 2012](#)) to generate provisional catch estimates by species and fishery for 2023, while the 2023 estimates were temporarily extended to 2024. The WPTT **ACKNOWLEDGED** that this step was necessary to ensure the availability of a complete and coherent dataset for the bigeye tuna stock assessment conducted in early October, representing the best scientific information available at the time. The WPTT **REQUESTED** the Secretariat to update the IOTC database to

incorporate Indonesia's final data submissions for 2023 and 2024, and to revise the input data for the stock assessment accordingly.

10. The WPTT **NOTED** that the Indonesia data revision resulted in a decrease in the total IOTC catch of bigeye tuna, from approximately 105,000 t to 95,000 t in 2023, and from 91,000 t to 87,000 t in 2024. The WPTT **ACKNOWLEDGED** that there are still some uncertainties associated with bigeye tuna catch, further **NOTING** that the revisions will also affect all other IOTC species.
11. The WPTT **NOTED** that the current procedure used to raise the geo-referenced catches relies on several Microsoft Access-based processes integrated with the central data system. The entire procedure, which involves many manual steps, is time-consuming and difficult to maintain, and will be reviewed and updated in 2026 to streamline the production of model inputs.
12. The WPTT **NOTED** that Somalia had submitted 2024 catch data, with 10,100 t of yellowfin tuna and 4,100 t of bigeye tuna being caught. The WPTT **CONGRATULATED** Somalia for its efforts in reporting catch data for coastal fisheries for the first time. **NOTING** that the data were well in accordance with the retained catch reporting requirements. The WPTT also **NOTED** that earlier national reports had also included catch estimates which had yet to be formally submitted.
13. The WPTT **NOTED** that catch data were comprehensively reported for the main Somali fisheries, namely gillnet, handline, and coastal longline. It was further **NOTED** that Somalia accounted for approximately 2% of the total tropical tuna catches, including 13% of the total bigeye tuna catch. The WPTT also **OBSERVED** that the Secretariat has no previous record of catch data from Somalia, and therefore this submission constitutes a single data point within the catch database.
14. The WPTT further **NOTED** that, in recent years, the World Bank has implemented a sampling programme in Somalia and has provided technical assistance in the collection and processing of fisheries statistics, **NOTING** that Somalia reported catch data for a five-year period (2019–2023) in its National Report to SC27 (2024).
15. However, the WPTT was **CONCERNED** that Somalia did not provide information on the sampling methodology or data processing procedures, which are required for the submission of new data.
16. The WPTT **REQUESTED** that Somalia collaborate with the Secretariat to develop estimates of historical catches for its coastal fisheries.
17. The WPTT **REQUESTED** the WPDCS to evaluate Somalia's 2024 reported catch and provide guidance on constructing an early catch history so this data can be incorporated into future assessments.

### 3.2 FISHERY INDICATORS

#### *Thailand fisheries*

18. The WPTT **NOTED** paper [IOTC-2025-WPTT27-06](#) which provide a summary of tropical tuna landings at fishing ports in Thailand during 2021-2024, with the following abstract provided by the authors:

*“Thailand's seafood and tuna processing industry is a large-scale and high-capacity industry. Thailand's key strength as the world's largest tuna processor and exporter, particularly canned tuna, gives Thailand a strong potential in the global market. The canned tuna industry has a relatively long value-added chain, starting with raw material sourcing. Thailand relies on imports for more than 90% of its domestic demand, both fresh and frozen. Tropical tuna is the primary tuna group used for canned tuna processing. Tropical tuna is the main tuna species used in canned tuna processing, which includes three main tropical tuna species: skipjack, yellowfin, and bigeye. This study compiles statistics on tropical tuna landings at Thai fishing ports over a four-year period from 2021 to 2024, import volumes and values, and tropical tuna fishing grounds in the Indian Ocean.”*

19. The WPTT **THANKED** the author for the paper highlighting the importance of tropical tunas from the Indian Ocean to Thailand's canning industry.

20. The WPTT **NOTED** that catch landings for canneries in Thailand consisted mainly of tropical tunas caught by purse seine and longline vessels, including catches from Maldivian fisheries. The WPTT further **NOTED** that, in 2024, landings in Thailand originated only from the Maldives EEZ and the high seas.
21. The WPTT **NOTED** that the decrease in the volume of landings in Thailand could be attributed to the increase in raw material costs.
22. The WPTT **NOTED** that catch data from the Seychelles EEZ and the high seas were obtained from the IOTC Port State Measure (ePSM) Program, which also contains information on catches unloaded from Panama-flagged carrier vessels.

### **Kenya fisheries**

23. The WPTT **NOTED** paper [IOTC-2025-WPTT27-07](#) which provide an analysis of the yellowfin, bigeye and skipjack tuna caught in 2024 by the industrial tuna fishery in Kenya, with the following abstract provided by the authors:

*“The paper looks at the spatial temporal distribution of the yellowfin tuna, bigeye tuna and skipjack tuna catches by the Kenyan industrial vessels during the year 2024. The data is from four longline vessels and two purse seiners. While the longliners were mainly focussing on swordfish, the purse seiners catches were mainly tunas. Yellowfin tuna and bigeye tuna catches composition of the total longline catches were 15% and 2% respectively while from the purse seine catches, yellowfin and skipjack tuna composed 50% and 44% of the total catches respectively. In terms of spatial distribution, the catches were both from the EEZ and the high seas. A total of 208 yellowfin tuna was sampled from the longliners an average fork length of  $136.7 \pm 1.24$  se (90, 185) cm while for the purse seiners a total of 177 fish were sampled with an average fork length of  $93.9 \pm 2.07$  se (40, 168) cm. For the bigeye tuna catches of, a total 161 fish were sampled, and the average length was  $128.5 \pm 1.69$  se (50, 179) cm while in the purse seiners, a total of 385 skipjack tuna were sampled with the average length of  $51.4 \pm 0.54$  se (33, 78) cm. In terms of seasonality, the longline catches were mainly from January to June while the purse seine datasets were from August to December”*

24. The WPTT **NOTED** that the catch composition of longline fisheries in the period under study (2019-2023 vs. 2024) remained stable with swordfish, yellowfin tuna, blue shark and bigeye tuna as the main species contributing to the total catch, while in the purse fisheries catches were dominated by yellowfin tuna and skipjack tuna.
25. The WPTT **NOTED** that tropical tuna catches in Kenya are from both industrial and coastal fisheries, further **NOTING** that the data are collected from logbooks and the Regional Observer Scheme (ROS), with grid positions verified against information from VMS.
26. The WPTT **NOTED** that size frequency data collection by observers at sea from purse seine and longline vessels is well-established in some oceans, while in others, only port samples are considered.

### **Madagascar ERS Data**

27. The WPTT **NOTED** paper [IOTC-2025-WPTT27-08](#) which provide a comparative analysis of ERS Data on tropical tuna fisheries in Madagascar, with the following abstract provided by the authors:

*“This study presents a comparative analysis of tropical tuna catches by the longline and purse seine fleets operating in Madagascar waters during 2024 and the first half of 2025. The analysis focuses on the temporal distribution of catches, species-specific catch rates, and the overall contribution of tropical tuna to total catches, using data from the Electronic Reporting System (ERS), which was introduced in Madagascar in 2024 as part of the implementation of the EU-Madagascar Sustainable Fisheries Partnership Agreement (SFPA). ....”*  
 , see full abstract in the paper

28. The WPTT **ACKNOWLEDGED** the review of the data from foreign vessels landing in Madagascar.
29. The WPTT **NOTED** that fisheries targeting pelagic species are socio-economically important to Madagascar, contributing to employment and the generation of foreign currency for the national economy.

30. The WPTT **NOTED** that Madagascar is in the process of implementing an Electronic Reporting System (ERS) for data collection, which will comply with the requirements of the main foreign fleets operating in Madagascar, the European Union. The WPTT further **NOTED** that the data collected through ERS could be utilised for analytical purposes.
31. The WPTT **NOTED** that the study data were collected from foreign vessels, comprising six longline vessels and twenty-two purse seine vessels operating in Madagascar's waters in 2024. The WPTT further **NOTED** that, although purse seine catches were recorded by fishing mode, this information was not included in the study.
32. The WPTT **NOTED** that information for non-EU fleets was obtained from logbooks and observer programme, **NOTING** that data are routinely collected by the national authority for all vessels operating in Madagascar. The WPTT further **NOTED** that the main bycatch species of these vessels were dolphinfish and billfishes, with lower occurrences of sharks.
33. The WPTT **NOTED** that vessels do not operate between September and November in Madagascar due to unfavourable sea conditions and the seasonal migration of target species, during which time the fleets operate in other areas.

### ***Pakistan fisheries***

34. The WPTT **NOTED** paper [IOTC-2025-WPTT27-09](#) which provide a summary of the status of tuna stocks with special reference to tropical tunas in Pakistan, with the following abstract provided by the authors:

*"Tuna and tuna like fishes are one of the components of pelagic resources. In Pakistan, mainly neritic and oceanic species are encountered in the tuna fishery. Tuna fishing fleet comprises of about 709 gillnet boats. The total production of tunas and tuna-like fishes, including Neritic and Oceanic tunas, Billfishes and Seerfishes during the year 2024 was 51, 163 m. tonnes"... see full abstract in the paper.*

35. The WPTT **THANKED** the authors for presenting the measures taken to reduce tropical tuna catches and **NOTED** the project currently underway to transform the fisheries.
36. The WPTT **NOTED** the decline in tropical tuna catches in recent years compared to 2017, and that this reduction could be attributed to several factors, including management measures to protect the stocks (such as seasonal closures and compliance with Resolution 21/01). The WPTT **NOTED** the impact of other external factors such as socio-economic conditions and the impacts of climate change on target species.
37. The WPTT **NOTED** that Pakistan is in the process of implementing an electronic logbook (e-logbook) system and establishing a data monitoring and research centre, which will facilitate the reporting of data through the IOTC reporting forms.
38. The WPTT **NOTED** the differences between the tropical tuna catch data presented in the study and those published by the Secretariat. The WPTT **NOTED** that aggregated tuna catch data are disaggregated for scientific purposes which may increase the reported individual tropical tuna catches.
39. The WPTT **NOTED** that the foreign longline vessels catching tropical tunas have ceased operations in Pakistan since 2009.

### ***Indonesia fisheries***

40. The WPTT **NOTED** paper [IOTC-2025-WPTT27-10](#) which provide a review of Indonesian tuna purse seine fisheries in Indian Ocean, with the following abstract provided by the authors:

*"The Indonesian tuna purse seine fishery has developed from small-scale operations in the late 1960s into one of the country's most significant fisheries in the Indian Ocean. Its growth was shaped by ecological conditions, government policy particularly the 1980–1981 trawl ban and technological advances, including the widespread*

*adoption of anchored fish aggregating devices (aFADs). Currently, more than 330 purse seiners, dominated by 120–200 GT wooden boats, operate from major fishing ports in Sumatra, Java, and Bali. The fishery primarily targets skipjack tuna, which accounts for over two-thirds of total landings, while yellowfin and bigeye tunas are taken mostly as bycatch. However, catch data reveal that a high proportion of landed tunas, especially skipjack and yellowfin, are immature, raising sustainability concerns. Bycatch mainly consists of small pelagic species associated with aFADs, which add economic value, while ecologically related species (ERS) such as sharks, rays, turtles, and dolphins occur at low frequencies and are generally released alive. Management combines national measures licensing, logbooks, observer programs, FAD regulations, and shark finning prohibition with Indonesia's obligations to the Indian Ocean Tuna Commission (IOTC). Although these frameworks support responsible exploitation, persistent juvenile catches highlight the need for strengthened monitoring, enforcement, and selective fishing practices to ensure long-term sustainability"*

41. The WPTT **EXPRESSED** its appreciation to the authors for the presentation on the development of purse seine fisheries and the management measures in place to promote sustainability in Indonesia.
42. The WPTT **NOTED** that small purse seine vessels in Indonesia target skipjack tuna using anchored fish aggregating devices (AFADs), with the assistance of technologies such as GPS, fish finders, and power blocks.
43. The WPTT **NOTED** that these vessels spend approximately 67% of their days at sea fishing.
44. The WPTT **NOTED** that each vessel is allowed to use three AFADs and, given that there are around 300 purse seine vessels, this amounts to approximately 900 AFADs in total.
45. The WPTT **NOTED** that AFADs undergo a three-month repair cycle, during which some parts are replaced, and AFADs are fully replaced every three years.
46. The WPTT **NOTED** that Indonesia's catch data are derived from three different sources, and further **NOTED** the decline in catches of some species in recent years.

### **Sri Lanka fisheries**

47. The WPTT **NOTED** paper [IOTC-2025-WPTT27-11](#) which assesses catch rate dynamics of yellowfin tuna in Sri Lanka's longline fishery using linear and non-linear approaches, with the following abstract provided by the authors:

*"Yellowfin tuna (Thunnus albacares) plays a central role in Sri Lanka's longline fishery, contributing the highest share of both catch and economic return. However, catch rates are highly variable, reflecting the combined influence of fishing practices and possible changes in stock abundance. This study examined catch per unit effort (CPUE) dynamics using port sampling data collected between 2013 and 2023. Explanatory variables included temporal (year, month), operational (vessel type, vessel length, days fished, number of hooks, gear operation time), spatial (fishing area), and gear-related factors (bait type). Multiple linear regression (MLR) and generalized additive models (GAMs) were employed to describe both linear and non-linear relationships, while a Random Forest model was utilized to assess variable importance. The analysis showed that CPUE varied significantly with vessel type, fishing effort, and gear operation time, with higher catches generally recorded during night sets than day sets. Both linear and non-linear models indicated that fishing effort and operational characteristics accounted for a significant portion of the observed variability in CPUE. These findings highlight the value of integrating statistical and machine learning approaches to better understand catch rate dynamics in the yellowfin tuna longline fishery of Sri Lanka."*

48. The WPTT **THANKED** the authors for their presentation, which improves the understanding of CPUE and could be incorporated into stock assessment models in the future.
49. The WPTT **NOTED** that for the data coming from logbooks, the effort component was fishing days and **SUGGESTED** to use number of hooks as effort units for a future review of this study (and for the mandatory catch and effort data to submit to the Secretariat) including potential use of CPUE at the operation/set level rather than day/trip.
50. The WPTT **NOTED** that the study results show that vessel size, number of hooks deployed, and days fished are the dominant factors influencing yellowfin tuna CPUE in the Sri Lankan longline fishery.

51. The WPTT **NOTED** that the study indicates evidence of some spatial and temporal influences with month having a significant seasonal effect with some areas producing lower CPUE and **SUGGESTED** that the authors evaluate the potential year effect into the model.

### **China Observer Data**

52. The WPTT **NOTED** paper [IOTC-2025-WPTT27-25](#) which provides a summary of spawning features of yellowfin and bigeye tuna in the Indian Ocean revealed by decadal Chinese longline observer data, with the following abstract provided by the authors:

*“Reproductive dynamics of tropical tunas are critical for stock assessment and management in the Indian Ocean. Using over ten years of biological data collected from Chinese longline observers, this study analyzed the spatial and temporal patterns of spawning activity and environmental effects for bigeye tuna and yellowfin tuna. The estimated length at 50% maturity ( $L_{50}$ ) was 109.3 cm for bigeye and 106.2 cm for yellowfin tuna. Spawning seasons were identified as October–January for bigeye and October–March for yellowfin tuna. Spatial models revealed consistent high spawning probability areas in the equatorial western Indian Ocean (10°N–10°S, 40°–70°E). Sea surface temperature (SST) as the most important habitat factors showed the strongest positive influence on spawning probability for both species. These results complement histological studies and provide new evidence for spatially structured reproduction.”*

53. The WPTT **THANKED** the author for highlighting the reproductive dynamics of tropical tunas based on observer data.

54. The WPTT **NOTED** that bigeye tuna is generally found in offshore areas, whereas yellowfin tuna occurs in both offshore and coastal areas of the Indian Ocean. The WPTT further **NOTED** that the biological research on bigeye tuna is primarily based on longline fishery catches, although most previous studies have focused on data from purse seine fisheries.

55. The WPTT **NOTED** that higher catch rates near coastal areas were observed and mostly male specimens were found and **SUGGESTED** that incorporating smaller spatial data could yield a smoother catch distribution. The WPTT **NOTED** that NASA data were utilized in the research, enabling the calculation of distances from the coastline, including from the nearest islands.

56. The WPTT **NOTED** the use of different evaluation methods, microscopy versus maturity staging, and further **NOTED** the differences in age at maturity between males and females. The estimated length at 50% maturity ( $L_{50}$ ) was found to be close to the values used in stock assessments.

57. The WPTT **NOTED** that an integrated approach should be developed to reconcile information on maturity stages derived from both longline and purse seine fisheries for stock assessment purposes.

58. The WPTT further **NOTED** that the study applied a random sampling strategy, and that no stratified sampling design was implemented.

59. The WPTT **NOTED** that  $R_{50}$  values may vary among different regions (tropical and temperate), and that tissue samples such as muscle, liver, and gonad could be collected from various regions to support future research.

60. The WPTT **NOTED** that biological data for males, which can be used to calculate the somatic index, were collected and will be incorporated into future research.

### **India fisheries**

61. The WPTT **NOTED** paper [IOTC-2025-WPTT27-26](#) which provide a summary of status, trends, and biological insights of tropical tuna fisheries in Indian Waters, with the following abstract provided by the authors:

*“Tropical tunas, especially skipjack (*Katsuwonus pelamis*) and yellowfin (*Thunnus albacares*), are vital to India’s oceanic and coastal fisheries, supporting thousands of fishers, contributing significantly to seafood exports, and playing an important ecological role in the Indian Ocean. An analysis of tropical tuna landings along the Indian coast from 2007 to 2024 revealed annual landings ranging from 16,125 tonnes in 2007 to 57,191 tonnes*

*in 2019, with an average of 30,329 tonnes. During this period, tropical tunas accounted for 24.2% to 54.8% of total tuna landings in India, with an average contribution of 34.2%. The fishery is primarily supported by mechanized (69.5%) and motorized (29.0%) fishing units, with a negligible contribution from non-mechanized units (1.5%), all operating within India's Exclusive Economic Zone (EEZ). Gillnetters are the dominant gear, responsible for more than half of the tropical tuna landings along the Indian coast. Among the tropical tuna species, *T. albacares* contributed between 44.6% and 78.7% (average 55.2%), while *K. pelamis* accounted for 20.9% to 55.4% (average 44.5%) of the total tropical tuna landings during the 2007–2024 period...."*

62. The WPTT **THANKED** the authors for presenting the study on tropical tuna fisheries of India, which provides crucial baseline information for formulating sound management programmes in India. WPTT **NOTED** the significant amount of biological (gonad and maturity information) collected that could provide useful information for future assessments
63. The WPTT **NOTED** the increase in tropical tuna catches from India, rising from 14,000 tonnes in 2014 to 44,000 tonnes in 2024, with yellowfin tuna being the dominant species.
64. The WPTT **NOTED** the multi-faceted nature of Indian fisheries, where multiple fisheries target multiple species. The WPTT further **NOTED** that tropical tuna species are harvested through small-scale line fisheries as well as modern mechanized vessels employing gillnet, longline, and purse seine gears.
65. The WPTT further **NOTED** the socio-economic importance of Indian fisheries, which provide livelihoods for fishers along the coastline and generate foreign exchange through the export of fishery products.
66. The WPTT **NOTED** the growth patterns of tropical tunas derived from the biological characteristics of the species and further **NOTED** the dominance of males in yellowfin tuna and skipjack tuna samples.

#### 4. BIGEYE TUNA STOCK ASSESSMENT

##### 4.1 Review any new information on bigeye tuna biology, stock structure, fisheries and associated environmental data since the data preparatory meeting

67. The WPTT **NOTED** that there have been no updates with any new information on bigeye tuna biology, stock structure, fisheries and associated environmental data since the data preparatory meeting in June.

##### 4.2 Update on the nominal and standardised CPUE indices presented at the data preparatory meeting

68. 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

69. The WPTT **NOTED** paper [IOTC-2025-WPTT27-15rev2](#) describing the preliminary Indian Ocean Bigeye tuna stock assessment 1950-2023 (Stock Synthesis), including the following summary provided by the author:

*"The stock assessment for bigeye tuna in the Indian Ocean is commissioned every three years, according to the schedule set out within the workplan of the Working Party for Tropical Tunas (WPTT) within the Indian Ocean Tuna Commission (IOTC). In 2025, the stock assessment is based on an update of the 2022 stock assessment model and is a spatially structured age-based integrated model that uses catch rate indices, length-compositions, and tagging data to inform estimates of spawning stock biomass (SSB) and fishing mortality (F), relative to estimated maximum sustainable yield (MSY). The assessment was completed using Stock Synthesis 3.30 and incorporates all newly available data since the previous assessment, including updated abundance indices, and updated age and length data that informs a newly estimated growth curve for bigeye tuna in the Indian Ocean". See the document for the full summary.*

70. The WPTT **THANKED** Genevieve Phillips, the IOTC Stock Assessment Officer, for her excellent work and congratulated her on completing her first IOTC tropical tuna assessment.

### Preliminary model update

71. The WPTT **NOTED** that the overall assessment approach begins with a stepwise process to update the previous assessment model using new observational data and biological parameters. This is followed by a comprehensive sensitivity analysis to evaluate the impact of key model assumptions, and then the development of a model ensemble to incorporate major uncertainties.
72. The WPTT **NOTED** that the overall model structure remains consistent with the previous assessment. The model is a single-sex model with 40 quarterly age classes, encompassing four regions and 15 fishing fleets. It uses an annual quarter structure covering the years 1975 to 2025 and is fitted to CPUE (longline and purse seine operating on log schools), size frequency, and tagging data.
73. The WPTT **NOTED** that, in developing a preliminary reference model, the previous reference model was sequentially updated with catch, CPUE, size frequency, growth, and natural mortality parameters. As in the last assessment, bias correction for recruitment deviates ([Methot and Taylor, 2011](#)) was performed using the built-in routine in the Stock Synthesis package. Two alternative preliminary reference models were proposed, assuming either a zero or 0.5% annual catchability increase in longline regional CPUE.
74. The WPTT **NOTED** that the preliminary reference models adopted the new von Bertalanffy growth curve from Eveson et al. (2025) and a natural mortality schedule based on the 'MHamel15' option. The Eveson et al. (2025) growth curve was derived from a validated aging study using otoliths and is considered more accurate than previous growth estimates based on tagging data. The 'MHamel15' option ([IOTC-2022-WPTT24\(DP\)-17](#)) defines a M-at-age schedule using a Lorenzen curve, with adult (4+ years) reference M derived from a maximum age of 14.7, based on observations from the Indian Ocean and following the method proposed by Hamel and Cope (2022). The WPTT **NOTED** that the new growth curve results in relatively higher biomass estimates, while the new natural mortality leads to relatively lower biomass estimates. The implications for the assessment were unclear and the WPTT **NOTED** that this should potentially be explored further in future.
75. The WPTT **DISCUSSED** the model fits and diagnostics of the preliminary model runs. It was noted that the model generally provides reasonable fits to the observations, including regional longline CPUE, the time series of mean length, and aggregated length frequency by fleet.
76. The WPTT **NOTED** a declining trend in the observed average length data from the PSLS1S and PSLS1N fisheries, which was not well captured by the model predictions. The WPTT **RECALLED** that this issue had been identified and explored in previous assessments, including the use of time-varying selectivity. The cause of the decline in mean fish length in the purse seine FAD fishery remains unclear—it could reflect changes in size composition due to fishing or recruitment, or changes in fishing or sampling practices. The WPTT **NOTED** that the opposite was observed for the LL2 fishery, where the model-predicted mean length showed a larger decline than the observations.
77. The WPTT **NOTED** that, in recent years, the predicted CPUE in region 1S has shown an upward trend, which is inconsistent with the observed CPUE.
78. The WPTT **NOTED** that there were trends in the residuals of the LL CPUE indices in region 1S and 1N which will result in over estimation of abundance within the model.

### Exploratory model runs

79. The WPTT **NOTED** the sensitivity analysis performed on preliminary reference models, including models that examined the utility of purse seine CPUE indices from EU FAD fisheries (both long and short time series), models that estimated growth and/or M, and models that assumed logistic selectivity for LL2 and LL3 fisheries (as opposed to double normal). The WPTT **NOTED** that these sensitivities did not result in substantially different stock estimates.
80. The WPTT **NOTED** that the sensitivity models generally fitted the purse seine CPUE reasonably well although there appears to be a slight deterioration in the fits to some length data. Analyses showed that overall, the purse seine CPUE is positively correlated with the longline CPUE index. The WPTT further **NOTED** that there was no discernible

difference in model results when either the long or short purse seine CPUE series was included, likely due to consistency between the two series in overlapping years. The WPTT **AGREED** that the short purse seine CPUE should be included in the final models along with longline CPUE, as the short time series allows for more covariates in the standardization process to capture technological changes (it was pointed out by the CPUE developer that the additional covariates don't appear to have a noticeable impact), and earlier data tend to be less reliable.

81. The WPTT **NOTED** that estimating growth within the model using conditional age at length did not produce significantly different results; however, it was suggested that this is not yet a feasible option, as the length-age dataset fitted in the model is still relatively small and must be allocated across many fisheries, and time periods, following the model's internal structure, often based on subjective or arbitrary decisions due to gaps in the raw data. It would be better to revisit this option when a much larger dataset with sufficient samples is available.
82. Given the relatively large influence of natural mortality (M) in the assessment, the WPTT extensively **DISCUSSED** the assumptions and parameterization of M. Sensitivity models estimated M within the model using option 6 of Stock Synthesis, where the model internally calculates an M-at-age vector following the Lorenzen form ([Lorenzen 2005](#)), with M at a reference age range (4 to 10+ years) estimated. The sensitivity models examined three starting values—low=0.30, medium=0.37, and high=0.45—for the reference M. These starting values are based on the 50% quantile range of the M prior following the method presented in [Cope & Hamel \(2022\)](#), assuming a maximum age of 14.7 yr for bigeye tuna.
83. The WPTT **NOTED** that the estimated M at the reference age range tends to differ depending on starting values, indicating some model instability with respect to M. Although the differences are relatively small, they have a large impact on the scale of biomass estimates, but not on the stock status.

#### **Discussions of catch data**

84. The WPTT **NOTED** that:
- (a) for the catch data used in the preliminary and exploratory models, the 2023 Indonesian catch was based on the Secretariat's estimate (using Indonesia's reported catch), not on Indonesia's revised submissions (see para. 9);
  - (b) the 2024 Indonesian catch was assumed to be the same as in 2023. The assessment catch dataset production did not consider Indonesia's subsequent submissions;
  - (c) Indonesia's most recent submission on 19 October was considered more reliable and agreed that the revised catch for 2023 and 2024 in this submission should be used in the assessment;
  - (d) taking into account time constraints, the Secretariat should rerun the catch production procedure so the assessment can be updated with the revised catch series during this meeting (see para. 9).
85. The WPTT **NOTED** that the reported 2024 catch for Somalia was included in the preliminary assessment. The WPTT further **NOTED** that Somalia was yet to report catches for years prior to 2024 for its coastal artisanal fishery with a potentially substantial catch history. The WPTT **NOTED** that including only the 2024 catch in the model, without considering any prior catch history, could over-estimate recent fishing mortality, since catches prior to 2024 are not reflected in historical stock productivity estimates. Therefore, it was **AGREED** not to include the 2024 Somali catch in the current assessment.

#### **Revised model runs.**

86. The WPTT **AGREED** to conduct new model runs using revised catch data, including the Indonesian submission from 19 October 2025. The models also incorporated the PS (short) CPUE as agreed by the WPTT. The WPTT **SUGGESTED** conducting runs in which adult M is fixed at 0.30, 0.37, 0.38, and 0.45, as well as runs where adult M is estimated with or without a prior developed from Hamel & Cope (2022). These runs were subsequently reviewed by the WPTT as the basis for constructing the final model grid.

87. The WPTT **NOTED** that, in general, there appears to be a slight deterioration in model fits to some datasets with the new reference model, although the reasons are unclear.
88. The WPTT **NOTED** that estimating M with and without the prior distribution produced similar results. The biomass estimates were also broadly similar to those from model runs where M was fixed at the agreed values. Jittering analyses suggested that the model estimation (minimisation of negative log-likelihood) was unstable and estimates of SSB were variable when M was estimated, possibly due to a flat likelihood surface and/or potential conflicts between observations. The retrospective analysis also showed some instability; however, it was suggested that this is not unexpected for models estimating productivity when data containing productivity information are sequentially removed. Furthermore, profile likelihood analyses were unable to reveal sources of information about M or conflicting information: the profile was not smooth with various peaks and troughs observed across fixed values of M in the profile. The WPTT **NOTED** that the profile for M was likely not informative given model-instability and issues with negative log-likelihood minimisation.
89. The WPTT **SUGGESTED** that it is important to check the bounds of parameters. Based on the analysis conducted so far, the WPTT **AGREED** that it is preferable to fix M at the suggested values at this stage.
90. The WPTT **NOTED** that using logistic selectivity in LL2 and LL3 resulted in poorer fits to mean length observations in these fisheries, which appear to capture smaller fish compared to regions 1N and 1S. Fits improved with double normal selectivity. However, previous assessments indicated that double normal selectivity can create cryptic biomass, leading to significant differences in total and vulnerable biomass in these regions. It is also unclear whether the smaller average size in the two regions is due to vulnerability, availability, or fish growth. Given this uncertainty, the WPTT **AGREED** to retain both selectivity assumptions to capture possible scenarios, as in the previous assessment.

#### **Reference model and final model grid**

91. Based on the examination of these sensitivity model runs and thorough discussion, the WPTT **AGREED** that the new base model run, where adult M is fixed at 0.37, using option 6 in SS3, can be considered the reference model. Based on this reference model, a final model grid was proposed, including the following uncertainty axes (Table 2).
92. Following the presentation of the final model grid results, the WPTT was **INFORMED** of an error detected in the configuration of effort creep (a 0.5% annual increase in LL CPUE catchability), which affected half of the models in the grid. Due to time constraints, it was not possible to rerun the models during the meeting. The WPTT **AGREED** that the grid will be rerun with the corrected effort creep configuration after the meeting, and the updated results will be presented at a 2-hour intersessional meeting to be organized in early-November, prior to the Scientific Committee meeting.
93. The WPTT **REQUESTED** the Secretariat to document the updated results of the final grid in the revised version of [IOTC-2025-WPTT27-15rev2](#), along with a summary of changes and additions to the model runs (which are now based on catch input incorporating revised Indonesian catch data submitted on 17 October). The WPTT also **REQUESTED** that standard diagnostics be performed on the grid models. A few additional sensitivities were requested:
- Inclusion of Somali catch data for 2024;
  - Re-running the likelihood profile on natural mortality;
  - Examination of a scenario where regional recruitment proportions were allowed to change over time.
94. The WPTT **AGREED** that the revised assessment document will be reviewed by the Scientific Committee in December.

**Table 2:** Final model grid configuration.

| Model options | Description |
|---------------|-------------|
|---------------|-------------|

|                                 |                                                                     |
|---------------------------------|---------------------------------------------------------------------|
| <b>Steepness (h) in SRR</b>     | h70: h = 0.70                                                       |
|                                 | <b>h80:</b> h = 0.80                                                |
|                                 | h90: h = 0.90                                                       |
| <b>Growth</b>                   | <b>Gnew:</b> VB growth parameters estimated by Eveson et al. (2025) |
| <b>Natural Mortality</b>        | <b>MBase2025</b> – MLorHam6Q – Opt. 6; M = 0.37; fixed.             |
|                                 | MLorHam6Qlo – Opt. 6; M = 0.30; fixed.                              |
|                                 | MLorHam6Qhi – Opt. 6; M = 0.45; fixed.                              |
| <b>Selectivity in LL2 + LL3</b> | <b>sL:</b> logistic selectivity for LL2 and LL3                     |
|                                 | <b>sD:</b> double normal selectivity for LL2 and LL3                |
| <b>Catchability</b>             | <b>Qq:</b> 0.5% discount in LL CPUE                                 |
|                                 | <b>LL:</b> 0 % discount on LL CPUE                                  |

### State-space assessment models

95. The WPTT **NOTED** paper [IOTC-2025-WPTT27-23](#) which reviews advances in the use of state-space assessment models for tuna stocks: application to the Indian Ocean bigeye tuna, including the abstract:

*“The use of the state-space approach in fish stock assessments has received more attention in recent years and is considered as an essential feature for the next-generation stock assessment platforms. However, age-structure state-space assessment models (SSAMs) are still uncommon for stocks with scarce age information, like tunas. In this study, we aimed to apply an age structured SSAMs (the Woods Hole Assessment Model-WHAM) to the Indian Ocean bigeye tuna using data inputs that are common for tuna stocks: aggregated catch, indices of abundance, and marginal length compositions. Our models suggest that the SSB has decreased from values around 1.3 million mt in 1979 to values around 400 thousand mt in 2024. Also, the most likely stock status is not overfished and not subject to overfishing in 2024, although there is a high probability ( $\sim 0.45$ ) of being subject to overfishing for most models. We also provided some diagnostics (e.g., retrospective analysis, likelihood profile, jitter analysis) for the implemented models, and ran some model projections to show the capabilities of WHAM. We hope that this study may increase the visibility of age-structured SSAMs and their application to other tuna stocks as an alternative platform”*

96. The WPTT **NOTED** that state-space modelling platforms are developing multi-area capabilities (e.g., the “multi” platform) to address the limitations caused by the lack of spatial structure in current models. This improvement will be particularly valuable for tuna assessments, which typically require spatially-structured approaches.
97. The WPTT **NOTED** that, in the example model, the purse seine CPUE data were not fitted very well, and that this was due to greater weight being placed on the longline CPUE for demonstration purposes. The fit to purse seine CPUE is expected to improve if more weight is allocated to the purse seine CPUE data.
98. The WPTT **NOTED** that the model is currently structured annually, and questioned whether this is sufficient to capture the rapid growth and continuous recruitment typical of tuna. While the fits are generally good for most datasets and the model is consistent and converged, a seasonal model would be preferable. Initial attempts to implement a quarterly step model encountered difficulties, as this significantly increased the number of parameters for random effects. The plan is to incorporate a seasonal component in the next stage of model development.

### **4.4 Selection of stock status indicators for bigeye tuna**

99. In view of the fact that the final assessment model grid run had to be completed after the meeting, the WPTT was not able to develop the draft stock status summary during the meeting. The stock assessment results were reviewed intersessionally on the 5<sup>th</sup> November and the main results of this review can be found in [Appendix IX](#) (the full results of the revised version of the assessment document can be found in [IOTC-2025-WPTT27-15rev4](#)). The results can form the basis of developing the Executive Summary which will be available to be reviewed by the SC.

100. The WPTT **REQUESTED** that the IOTC Secretariat update the draft stock status summary for bigeye tuna with the latest 2024 catch data, if necessary. The WPTT **RECOMMENDED** that the SC develop the stock status advice as part of the Executive Summary, following the review of the final assessment results intersessionally:

- Bigeye tuna (*Thunnus obesus*) – [Appendix VI](#)

## 5. BIGEYE TUNA MANAGEMENT PROCEDURE

### 5.1 Consideration of exceptional circumstances

101. The WPTT **NOTED** paper [IOTC-2025-WPTT27-16](#) which reviewed the evidence available in 2025 for exceptional circumstances for the bigeye tuna MP with the following abstract provided by the author:

*“The IOTC’s adopted management procedure (MP) for bigeye tuna is used to recommend the Total Allowable Catch (TAC) of bigeye in the Indian Ocean. As part of the implementation schedule, the Commission adopted an annual review of evidence for exceptional circumstances that could make the application of the TAC advice risky to the stock or fishery.*

*The Exceptional Circumstances Guidelines specify a three-stage process: (i) examining evidence for exceptional circumstances, (ii) determining severity and impact, and (iii) recommending any management or research action that should be taken. A wide range of information is reviewed to examine if there is evidence for exceptional circumstances, e.g., the data inputs to the MP, changes in the knowledge of stock or fishery uncertainties against which the MP was tested, and implementation of MP TAC advice.” See the document for further information.*

102. The WPTT **NOTED** that there were no exceptional circumstances related to knowledge on the population dynamics, status of the stock, or changes in fisheries or fishing operations.

103. The WPTT **NOTED** the small amendment to the CPUE standardisation used to run the bigeye MP in early 2025, which is technically an exceptional circumstance, but the severity and impact were considered to be minor. The WPTT **RECALLED** the recommendation from the SC in 2024 that fixed code (e.g. the method should be fixed) should be established for use in CPUE standardisation for the bigeye MP.

104. The WPTT **NOTED** that the total catch of bigeye tuna in 2024 (86,974 t) was greater than the adopted TAC for 2024 (80,583 t) and that this was an exceptional circumstance. To better evaluate the relative impact of differences between catch and the agreed TAC, the WPTT **REQUESTED** that the difference be reported as a percentage in future considerations of exceptional circumstances. The WPTT also **NOTED** that the comparison between catch and the agreed TAC should take into account the impact of the catch reported by Somalia for 2024, which is pending review by the WPDSC.

105. **NOTING** the provision in Resolution 23/04 that sets catch limits for some CPCs, including a mechanism to deduct any over catch (as well as a provision to set catch limits for other CPCs if their catches exceed 2000 t), the WPTT **RECOMMENDED** that the Commission review 2024 catches of bigeye tuna as soon as possible and enact, as appropriate, the relevant catch limit setting mechanisms adopted in the Resolution 23/04.

## 6. SKIPJACK TUNA MANAGEMENT PROCEDURE

### 6.1 Consideration of exceptional circumstances

106. The WPTT **NOTED** paper [IOTC-WPTT27-27](#) which considers the exceptional circumstances for the skipjack tuna management procedure adopted by the IOTC in 2023, with the following abstract provided by the author:

*“The IOTC adopted a Management Procedure for skipjack tuna during its Annual Meeting in 2024. This MP is used for the first time in 2025 to set catch limits for this important stock for the period 2027-2029. The application of the MP in 2025 is described in document IOTC-2025-WPM16-12 and this document reviews recent data to help the IOTC’s Scientific Committee evaluate if the implementation of the TAC for the period 2027-2029 may pose a risk to the sustainability of skipjack.”*

107. The WPTT **NOTED** that, with the latest data submission, this was the first time that catches of Indian Ocean skipjack tuna were below recommended TAC, following several years in which the TAC recommendation had been exceeded by an average of 26.2% since 2018.

108. The WPTT **NOTED** the importance of verifying that the CPUE values used for the current TAC advice remain within the range of operating models tested.
109. The WPTT **NOTED** a sharp decline in EU purse seine log school CPUE observed in one of the final quarters, which is likely due to data treatment rather than the data themselves. However, it was considered unlikely that this issue would affect the TAC determination, as the value remains above the threshold used for the TAC calculation.
110. The WPTT **NOTED** that EU purse seine log school CPUE series initially presented at the meeting, based on updated information, appeared to have recent points that were anomalous relative to the rest of the series. The WPTT **REQUESTED** that the CPUE data collation and standardisation be reviewed to check for any errors, and the finalised series should be provided and compared with the range observed in the operating models used in MSE when the MP was adopted, for consideration at WPM.

## 6.2 Implementation of the skipjack MP as per Resolution 24/07

111. The WPTT **NOTED** paper [IOTC-WPTT27-17](#) which summarises the running the IOTC skipjack tuna management procedure for 2025, with the following abstract provided by the author:

*“The Indian Ocean Tuna Commission (IOTC) adopted a Management Procedure (MP) for skipjack tuna in 2024 to recommend the total allowable catch (TAC) for consideration by the Commission (Resolution 24/07). Resolution 24/07 requires the MP to be implemented for the first time in 2025 to estimate the TAC for the period 2027–2029. The IOTC Scientific Committee, through the Working Party on Methods and the Working Party on Tropical Tunas, was tasked with running the MP and deriving a recommended TAC. The skipjack MP replaces the previously adopted harvest control rule (HCR) for skipjack tuna (Resolutions 16/02 and 21/03, now superseded by 24/07).”*

112. The WPTT **NOTED** that Resolution 24/07 requires the Management Procedure for skipjack tuna to be run in 2025 to estimate the Total Allowable Catch for the period 2027–2029, **REPLACING** the previous Harvest Control Rules established under Resolutions 16/02 and 21/03.
113. The WPTT **RECALLED** that Resolution 25/03 distributes a portion of the current TAC of 628,606 t among CPCs that account for highest SKJ catch, according to defined rules and **NOTED** that once a new TAC is established, the Commission may review the catch limit arrangements accordingly.
114. The WPTT **NOTED** that the MP is data-based and relatively straightforward, relying on two CPUE indices: the EU log school purse-seine CPUE and the Maldives pole-and-line CPUE, both of which have been updated to 2024. The WPTT **RECOGNISED** that methods for CPUE standardisation are defined within the model specifications and had been presented at the Data Preparatory meeting.
115. The WPTT **NOTED** the issues with CPUE to be resolved and the formal review of the recommended TAC from the MP was deferred to WPM.

## 6.3 Other

116. The WPTT **NOTED** paper [IOTC-2025-WPTT27-12](#) which provides a length-based assessment and biological review of skipjack tuna in the Indian EEZ, with the following abstract provided by the authors:

*“Skipjack tuna (*Katsuwonus pelamis*) constitutes an important component of tuna fisheries in the Indian Ocean, sustaining millions of livelihoods and feeding into the global tuna trade. This paper presents a length-based stock assessment of skipjack tuna in the Lakshadweep Sea of the Indian EEZ, based on length-frequency data analysed using TropFishR models. Fork length (FL) data ( $n=4,583$ ) collected from the pole-and-line fishery indicated a broad size range of 28–94 cm, with multiple cohorts demonstrating continuous recruitment. Growth analysis (ELEFAN-SA) yielded an asymptotic length ( $L_{\infty}$ ) of 99.68 cm and growth coefficient ( $K$ ) of  $0.50 \text{ yr}^{-1}$ . Mortality estimates showed natural mortality ( $M$ ) of  $0.55 \text{ yr}^{-1}$ , fishing mortality ( $F$ ) of  $0.37 \text{ yr}^{-1}$ , and exploitation rate ( $E_{\text{cur}}$ ) of 0.40, below the threshold for overfishing. Thompson and Bell models confirmed  $F_{\text{MSY}} = 0.65$  and  $E_{\text{MSY}} = 0.54$ , with current fishing pressure lower than sustainable reference points, indicating scope for increased harvests. Ecological review underscored skipjack’s pivotal trophic role as a high level predator and prey for apex predators. The findings highlight the resilience of the Lakshadweep skipjack stock under current exploitation, while stressing the importance of continued monitoring, ecosystem-based management, and regional cooperation under the IOTC framework.”*

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117. The WPTT **EXPRESSED** its appreciation to the authors for the presentation referring to the sustainability of tuna stocks in the Lakshadweep Islands area and the observation that skipjack tuna remains under-utilised in this region.
118. The WPTT **OBSERVED** that the analysis presented was based on a single year of sampling data (2024), and **NOTED** that the strength of such methods lies in their application across multiple years to form a time series. The WPTT **ENCOURAGED** future work to expand sampling to cover several years to improve the robustness of the results.
119. The WPTT **NOTED** that while the fishery is likely to have a low impact, concerns remain around the source of baitfish used in pole-and-line fisheries. The WPTT **RECOGNISED** that baitfish are often coastal species potentially subject to overfishing, with possible impacts on reef ecosystems. The WPTT **NOTED** that sprats are primarily used as live bait and that a programme has been established for live-bait propagation on three islands, though artificial breeding success has been limited and fishers have noted a growing scarcity of live bait.
120. The WPTT **NOTED** similarities between the Lakshadweep fishery and that of the Maldives, owing to their geographic proximity. Sampling for 2024 provided one year of length-frequency data, with reported fish lengths ranging from 28–94 cm (mode at around 48 cm).
121. The WPTT **NOTED** that the fishery does not use drifting FADs but that two data buoys are used by fishers to target tuna schools which often aggregate around them. The WPTT **NOTED** that one anchored FAD has been installed primarily for tourism purposes, with fishing not permitted there, though plans exist to install additional aFADs in future.
122. The WPTT **NOTED** that data collection is managed through fisheries department officers stationed on all ten inhabited islands, who collect landing data. However, the vessel logbook system remains underdeveloped due to the small scale of operations and the limited size of vessels.
123. The WPTT **NOTED** that catches have declined slightly over time—from historical levels of approximately 12,000 t SKJ (previously around 8,000 t skipjack and 3,000 t yellowfin). The WPTT **NOTED** that fishing activity is suspended during both monsoon seasons in the region so is not carried out year-round.
124. The WPTT **NOTED** that some small-scale tagging work has been undertaken but **ACKNOWLEDGED** that limited onboard facilities and vessel size constrain opportunities to collect data at sea, particularly for CPUE estimation.

## 7. YELLOWFIN TUNA

### 7.1 Update on the standardised CPUE indices

125. The WPTT **NOTED** presentation [IOTC-WPTT27-18 Rev1](#) which provides an update of joint CPUE indices for yellowfin tuna in the Indian Ocean based on Japanese, Korean and Taiwanese longline fisheries data (up to 2024).
126. The WPTT **NOTED** that no working paper was submitted in advance of the meeting, and that only a PowerPoint presentation was made available to participants one day prior to the session. This limited the ability of members to adequately review the methodology, results, and implications of the analysis.
127. The WPTT **NOTED** concerns regarding the current process for developing the joint CPUE analysis, specifically related to transparency and reproducibility, and also **NOTED** suggestions for areas where improvements can be made. The WPTT **RECOMMENDED** that future analyses be initiated with adequate lead time to allow for thorough development, review, and consultation. It was further **ENCOURAGED** the code used in the analysis to be standardised, well-documented, version-controlled, and made publicly available to ensure transparency and reproducibility.
128. The WPTT **RECALLED** the concerns previously expressed regarding the CPUE index used for the 2024 stock assessment and the Scientific Committee's request to evaluate potential inconsistency and to determine whether a new assessment will be necessary in 2026.
129. The WPTT **NOTED** that the analysis identified an issue in the 2024 standardization process, specifically: the extraction of the index from the binomial component of the delta model did not follow best practice. As a result, the final combined index does not adequately reflect trends in the proportion of zero catches over time. This has been corrected in the current standardization and will be referred to as the "missing delta component" in this report.
130. The WPTT **NOTED** the need to understand the implications of this correction upon the CPUE and subsequently upon the 2024 stock assessment, which was largely driven by the CPUE trend, and hence the current management advice.
131. The WPTT **NOTED** that the revised CPUE index from the 2025 analysis starts in 1979, whereas in the 2024 CPUE analysis the series began in 1975, and therefore any impacts resulting from the difference in starting year should be investigated and documented in a paper to SC. The WPTT **NOTED** that the joint CPUE group will attempt to extend the starting year back to 1975 in follow up analyses to be provided to the SC.
132. The WPTT **NOTED** that the 2024 CPUE analysis used aggregated data (and in the 2021 series) while the 2018 and 2025 analyses used a sub-sample of operational-level data. The WPTT **NOTED** that relatively minor differences were observed between the 2024 and 2025 series and that the use of operational data in 2025 (compared to aggregated data in 2024) did not substantially affect the final CPUE outcomes. Instead, the missing delta component appeared to have a greater influence and is believed to be the primary cause of the differences observed between the 2024 and 2025 CPUE series. The WPTT **REQUESTED** the author to run and show the effects of both 2024 (aggregated) and 2025 (operational) models, each with and without the delta component error.
133. The WPTT **NOTED** that the 2024 CPUE was estimated both quarterly and annually, with the annual series based on a sub-sample of operational data. The WPTT **NOTED** that the missing delta component issue was limited to the aggregated dataset in the 2024 analyses only. The operational data results, analysed at yearly timesteps, were not presented but are believed to have properly included the delta component and show a more pronounced decreasing trend compared to the 2025 series.
134. The WPTT **NOTED** that the joint-CPUE team decided to remove the data attributed to region R1a as it was not considered to be reliable. The joint-CPUE team considered that preliminary analyses conducted without these data suggested that this omission had only a small impact, further supporting the conclusion that the missing delta component was the main driver of the discrepancies.
135. The WPTT **NOTED** the high R1 region CPUE in the 2024 assessment. Some participants asked whether a LL-derived index is representative of the regions catches given the mixed-fleet nature of the region, where gillnet (GN) fleets with mixed size catches are significantly higher. The WPTT **RECALLED** that the assessment uses CPUE indices from longline fisheries which typically target larger individuals and therefore have different selectivity that may track

a different component of exploitable biomass to other gears. The indices are developed for pre-defined regions in the assessments.

136. The WPTT **NOTED** that data quality issues persist in other fisheries in region R1 and CPUE series have not yet been produced for gillnets and other fleets operating in the area. The WPTT **STRESSED** the importance of validated data for these analyses and so **ENCOURAGED** CPCs in this region to work with the IOTC Secretariat to see if CPUE series can be produced for non-longline fisheries in this region to improve the spatial coverage and representativeness of CPUE series from this region.
137. The WPTT **NOTED** that the 2024 analysis did not include hooks-per-basket (HPB) as a variable, utilizing instead cluster analyses, which likely contributed to some of the differences observed between the 2024 and 2025 CPUE series. The WPTT **NOTED** that HPB was treated as a categorical variable (three categories representing targeting information) despite being measured on a continuous scale; the modelling of HPB as a categorical variable was chosen after separate analyses of modal distributions in the HPB data identified three very clear modes, which were also related to different cluster.
138. The WPTT further **SUGGESTED** that impact analyses explicitly compare each of the changes from the previous approach (including treatment of HPB and data inputs) to clarify how methodological changes between 2024 and 2025 CPUE indices affect the results. The joint CPUE team member pointed out that it is important to be able to make changes to methods in between assessments if those changes improve the analyses. However, it is also important to document clearly how such changes represent an improvement. He indicated that the team's preference was in fact to use the cluster approach and not HPB.
139. The WPTT **NOTED** that modelling changes between the stock assessments conducted in 2018, 2021 and 2024 have included switching from GLM to GAM, adding linear regression alternatives, and performing clustering and exploratory analyses to address targeting.
140. The WPTT **ENCOURAGED** transparency in code and methods and **NOTED** that while code was shared with workshop participants and expert feedback was valuable, the WPTT **ENCOURAGED** making the analysis code publicly available (for example on GitHub) to facilitate reproducibility and broader expert review.
141. The WPTT also **NOTED** that it was challenging to conduct a review of the work when the work was not written up into a full paper for the meeting. The joint-CPUE team committed to producing a full technical paper for the SC and also **NOTED** that providing full access to the code would more likely be possible if the SC required such access for all code for all IOTC species assessments and associated analyses.
142. The WPTT **NOTED** that the delta-lognormal model was run independently for each region (i.e., completely separate regional fits) and that preliminary exploration of a sdmTMB model suggested that spatial distribution of effort may contribute to differences between series.
143. The WPTT **NOTED** spatial covariates have been included in some models but spatial effects were not fully presented to the WPTT. It was noted that traditional log-normal models assume a constant spatial effect (i.e. treating 5×5 cells as constant over long time periods), which is unlikely to be realistic, and that the earlier CPUE analyses (2018 and 2021) did not fully consider spatial or seasonal effects. The WPTT **SUGGESTED** that additional work is carried out to explore spatial and seasonal model structures.
144. The WPTT **NOTED** that the 2025 CPUE indices frequently returned zeros for R3 for many historical quarters, producing a pattern that was more extreme than observed in the 2018 series. The WPTT **RECALLED** that investigation focused more on R1 than R3, and that a marked contrast exists between recent R3 CPUE (including early-season high values followed by lower values) and the patterns in R1 and R4. The WPTT **NOTED** that there tend to be fewer fishing operations in R3 and the joint CPUE team indicated that they could consider increasing the proportion of sub-sampling in R3 to overcome the lower data availability relative to tropical areas. The joint CPUE team also stated they may need to look at revising the vessel screening process for that area also.
145. The WPTT **NOTED** that the multi-region stock assessment links regions through scaling and differential weightings, so each regional CPUE index has importance within the assessment framework, and so instability or bias in a single regional index (such as R3) can therefore influence assessment outcomes. The WPTT **ENCOURAGED** further investigation of R3 to produce more stable regional estimates prior to inclusion in further assessment runs.
146. The WPTT **NOTED** the potential role of changes in fleet behaviour and composition, partly driven by piracy, which resulted in vessels shifting regions (for example the Taiwanese fleet moved south), and **NOTED** that this shift in fleet behaviour may have altered CPUE patterns in R3 and contributed to declines observed in R2.

147. The WPTT **NOTED** that vessel-ID and clustering approaches were applied to detect and remove confounding vessel-level effects, but that such methods may fail to fully account for gradual, long-term changes in fleet composition. The WPTT **NOTED** that some small-scale fishery vessels have transitioned to larger-scale operations in recent years and further **NOTED** that the associated data were excluded to maintain comparability with prior analyses where these changes were detected.
148. The WPTT **SUGGESTED** that a stepwise comparison of all modifications made during CPUE standardization is an important aspect of the analysis and should be included. This should involve overlaid plots of CPUE indices resulting from each change to help illustrate their relative effects, as well as tables of relevant model statistics to quantify the impact of each adjustment.
149. The WPTT **NOTED** that aggregated datasets used to derive CPUE are one factor contributing to differing regional signals and that R1 data in particular appears to be incomplete, requiring further work to resolve data gaps. The WPTT **STRESSED** the need to quantify how these regional CPUE developments would affect the stock assessment and management advice.
150. The WPTT **NOTED** that in order to advise the SC on the potential effects of the revised 2025 CPUE on the 2024 yellowfin assessment it would be useful to update the 2024 assessment model grid runs with the revised CPUE, as a very preliminary means of understanding potential impacts.

## ***7.2 Preliminary analysis of yellowfin tuna assessment with updated CPUE indices***

151. The WPTT **RE-RUN** the 2024 yellowfin tuna stock assessment grid with the revised 2025 CPUE to investigate the likely impact of the changes in CPUE on stock assessment results. The WPTT **NOTED** the preliminary nature of this update, which simply replaced the CPUE series used in 2024 (due to the limited time available to conduct this work during the meeting) with the updated CPUE series for 2025 presented to the WPTT, without comprehensive checking for the impact of the revised CPUE on various model components, fits and parameters to ensure they are acceptable.
152. The WPTT **NOTED** that issues remain with the R3 CPUE, which require further exploration. The WPTT **NOTED** that the R3 region accounts for approximately 7% of total spawning biomass, making its influence on overall stock status limited. The WPTT **NOTED** that R3 clustering analyses suggest yellowfin tuna are not a primary target in this region, and that the stock assessment currently assumes a uniform coefficient of variation across all regions. The WPTT further **NOTED** that R1 and R2 remain the most influential regions for driving changes in spawning biomass estimates.
153. The WPTT **NOTED** that, when comparing impacts on SSB/SSB<sub>0</sub> of the 2024 stock assessment to the preliminary run with the 2025 CPUE series, depletion was less for the period 1975-1990 then slightly greater for the last 15 years when the 2025 CPUE series was used. This was also the case when comparing the SSB/SSB<sub>msy</sub>.
154. The WPTT **NOTED** that the F/F<sub>msy</sub> trends were slightly higher for the preliminary run with the 2025 CPUE series compared to the 2024 assessment.
155. The WPTT also **NOTED** that the preliminary run indicated that the probability of the stock being in the green quadrant (not overfished and not subject to overfishing) was lower than in the 2024 assessment (75.2% vs 89.2%). The WPTT **NOTED** that rescaled reference points, based on the average of the last 20 years, were used in both cases, with very similar overall estimates.
156. The WPTT **REQUESTED** that the joint CPUE working group, and the yellowfin tuna stock assessment team, conduct the following work to the degree possible in the given timeframe in order to develop and submit (15 days before the SC) the following two papers for review by the SC:
  1. **Revised 2025 joint CPUE indices for yellowfin tuna** - this paper is to be developed by the joint CPUE working group and should clearly document the work/methods conducted, errors found, and the improvements made in developing the revised 2025 joint CPUE indices for yellowfin tuna (up until 2023). This will include descriptions of:
    - a. Firstly as a top priority, the methods and comparative results of the investigations already conducted into each issue identified by the WPTT and SC in 2024 (e.g. as per Appendix IX of WPTT26 report) including but not limited to:
      - i. The inclusion of R1a (Arabian Sea) catch and effort data in the standardization;

- ii. The non-inclusion of Vessel ID in the positive component of the delta-LN model; and
    - iii. The extraction of the index from the binomial component (zero/non-zero) for producing std-CPUE.
  - b. Secondly, the methods and results relating to investigations of the new additional potential issues identified by WPTT, including:
    - i. The impact of the different start dates among 2024 and 2025 CPUE; and
    - ii. The potential impact on the stock assessment of the very low CPUE estimates for R3 (e.g., catch rates of 0) and the potential need for increased sub-sampling of operational data in R3.
  - c. If possible the paper should present a stepwise comparison of the different changes made (for all issues identified), ideally overlaying (via plots) the indices resulting from each change to help understand the relative effects of each change (as well as presenting tables of relevant model statistics to quantify the effects of changes).
  - d. Provision of final CPUE indices for the SC to evaluate the implications of the review undertaken.
2. **Revised 2024 Yellowfin stock assessment grid:** This paper to be developed by the yellowfin tuna stock assessment team should detail the methods undertaken and outcomes of preliminarily running the 2024 stock assessment with the new 2025 CPUE, including the following outputs and diagnostics as a minimum:
- a. Evaluation of the impact of the revised CPUE on the management advice developed in 2024. This includes stock status, productivity and probabilities.
  - b. The same diagnostic tests provided in 2024 including analyses of convergence, residuals, ASPM, trends in recruitment deviates and retrospective analyses.
  - c. Reference points updated with recent recruitment as well as the equilibrium based recruitment.
157. The WPTT **NOTED** several pending requests to the CPUE team and **ACKNOWLEDGED** the limited time available to complete the necessary work before the assessment can be rerun using the revised CPUE but **NOTED** that it was considered feasible by the scientists who will undertake the work.
158. The WPTT **NOTED** that there is no plan to include projections during the update assessment **NOTING** that the development of a new K2SM is quite time consuming and is normally undertaken following a full stock assessment, both of which would be very difficult to achieve before the SC. The WPTT **AGREED** that projections will be revisited when a full assessment is conducted and that the SC should provide advice as to the best timing of that.
159. The WPTT **RECOMMENDED** that the SC review the updated CPUE and updated preliminary assessment grid and analyses and evaluate the need to undertake a new full stock assessment (including potentially projections) for yellowfin tuna in 2026 (thus amending the Program of Work if necessary).

### 7.3 Update on the management strategy evaluation

160. The WPTT **NOTED** paper [IOTC-WPTT27-19](#) which provides an update of the conditioning of OMs and preliminary evaluation of MPs for Indian Ocean yellowfin, with the following abstract provided by the authors:
- “A preliminary conditioning of the Operating Model (OM) and an initial evaluation of Management Procedures (MPs) for yellowfin tuna (YFT) in the Indian Ocean were presented in this study. The objective was to reinitiate a process and discussion that had been stuck for several years. FLBEIA, an open source library, was used for the development of the MSE. The OM was conditioned using the 12 models developed for the uncertainty grid of the 2024 YFT stock assessment. And based on that OM, the performance of a model-based MP, incorporating a hockey-stick Harvest Control Rule (HCR) was tested. The assessment model used within the MP framework was SPiCT, a surplus production model adequate to use within an MSE framework. For input data, only the joint longline CPUE from the northwestern region was considered and simulated, given the higher biomass of YFT observed in that area. The preliminary results indicate that with a fishing mortality target set at  $0.8 \times F_{MSY}$  and a biomass threshold at  $0.8 \times B_{MSY}$ , the MP is capable of maintaining the stock within the green zone with a probability greater than 0.5.”*

161. The WPTT **ACKNOWLEDGED** the work and the project, funded by ISSF, to develop a preliminary Yellowfin MSE, designed to initiate and advance discussions on the development of a comprehensive MSE for this important species within the IOTC.
162. The WPTT **NOTED** that the Operating Models (OMs) will need to be updated using the newly developed CPUE indices and that this work will be undertaken at a later stage.
163. The WPTT **RECALLED** that ICCAT has been developing Management Strategy Evaluation frameworks for some time, including a multi-stock MSE for the Atlantic. The WPTT **NOTED** that the simulations presented illustrate how recruitment may be treated in the future, with a noticeable decline between the historical and projected periods due to reliance on the stock–recruitment relationship without additional scaling.
164. The WPTT **AGREED** that further development of the MSE will require structured discussions between scientists, managers, and the Commission to explore management options in a consultative manner. The WPTT **CONGRATULATED** the authors on their progress in initiating this process and **SUPPORTED** the development of a prototype to be presented to the WPM and subsequently incorporated into the regular MSE development roadmap involving the WPM, the MSE Task Force, and the TCMP.
165. The WPTT **RECALLED** that previous efforts to condition and develop OMs for yellowfin tuna had encountered technical difficulties and **ACKNOWLEDGED** that the current work represents a preliminary step to reinstate the process by providing materials for the WPM to consider and discuss potential approaches for developing an MSE for the species.
166. The WPTT **NOTED** that these discussions should include consideration of Harvest Control Rules and management objectives. However, the WPTT **REQUESTED** following the same structured approach used for other species and investing sufficient time in examining the underlying OMs before progressing to the specification of HCRs or management objectives, particularly given the historical challenges with OM conditioning.
167. The WPTT also **REQUESTED** that a trial specification document be developed in the future, detailing the OMs and associated technical elements once the system is operational and **NOTED** that should summarise the entire MSE process from start to finish. Such a document should include references to the individual decision papers and technical documents for transparency and traceability.
168. The WPTT **AGREED** that correctly defining the OM grid is fundamental and **NOTED** that particular attention should be given to recruitment assumptions. The WPTT **OBSERVED** that the range of projected recruitment used in the simulations appeared narrow relative to historical variability and **SUGGESTED** incorporating observed recruitment variability into future projections to better represent uncertainty. The WPTT **NOTED** that variability has not yet been introduced, as the initial aim was to understand OM behaviour under deterministic recruitment, and indicated that stochastic recruitment will be included in subsequent iterations based on stock assessment outputs.
169. The WPTT **RECOGNISED** that the IOTC is developing MSEs for multiple species simultaneously, involving several expert groups, and that this is a technically complex and resource-intensive process. The WPTT **REQUESTED** that the WPM allocate time to discuss MSE planning in detail, including funding and coordination aspects, to ensure consistent integration of these efforts within the broader IOTC MSE development framework.

#### 7.4 Other

170. The WPTT **NOTED** paper [IOTC-2025-WPTT27-13](#) which provides a length-based assessment of yellowfin tuna in the Tanzania EEZ, with the following abstract provided by the authors:  
*“Yellowfin tuna (*Thunnus albacares*) is an economically and ecologically important species exploited within the United Republic of Tanzania's Exclusive Economic Zone (EEZ). However, assessment efforts are constrained by data limitations common in tropical tuna fisheries. This study employed length-based approaches, specifically the Length-Based Spawning Potential Ratio (LB-SPR) models, to assess the status of yellowfin stocks using length-frequency data collected in 2024. Fork lengths of sampled individuals ranged from 42 to 150 cm, with seasonal size shifts indicating clear recruitment pulses. The estimated length at 50% maturity ( $L_{50}$ ) was 92.3 cm, lower than global references but consistent with the expected maturity range for the species, between 78 and 158. Growth parameter estimates included an asymptotic length ( $L_{\infty}$ ) of 161.3 cm, a growth coefficient ( $K$ ) of  $0.10 \text{ year}^{-1}$ , and a natural mortality rate ( $M$ ) of  $0.14 \text{ year}^{-1}$ . Selectivity analysis revealed that fishing gears*

*capture individuals at a size (SL50 = 59.5 cm) substantially smaller than the size at maturity, indicating significant fishing pressure on juveniles. The LB-SPR analysis yielded a spawning potential ratio of 0.29, which is below the precautionary (0.40) and the critical (0.30) but relatively above the critical (0.2) reference points. This SPR, combined with the fishing-to-natural mortality ratio ( $F/M = 0.8$ ), suggests moderate fishing pressure. These findings highlight an unsustainable exploitation pattern driven by the high capture of immature fish. We recommend implementing size-based management measures, such as minimum size limits or gear modifications, to reduce juvenile mortality and rebuild the spawning stock. This study demonstrates the practical use of length-based methods for data limited fisheries and provides actionable insights for the sustainable management of yellowfin tuna in Tanzania."*

171. The WPTT **CONGRATULATED** the author on the analysis presented and **ENCOURAGED** similar studies in the future, recognising the value of such work for improving the understanding of artisanal and small-scale fisheries within the IOTC area.
172. The WPTT **NOTED** that while the analysis was based on data from Tanzania, the species concerned are highly migratory, and therefore the applicability of these methods at this small scale may be limited. The WPTT **ACKNOWLEDGED** that the study aimed to understand the activity of fishers within Tanzania's EEZ specifically rather than at the regional scale and **SUGGESTED** assessing whether similar patterns are observed more widely across the region.
173. The WPTT **RECOGNISED** that the area analysed represents only a portion of the overall stock distribution but **COMMENDED** the effort as an important initiative, particularly given the limited documentation of artisanal fisheries data submitted to the IOTC.
174. The WPTT **NOTED** the apparent inconsistency between the low natural mortality and high fishing mortality rates estimated in the analysis compared with those from other stock assessments, suggesting that some confusion or bias may exist in parameter estimation.
175. The WPTT **ENCOURAGED** the incorporation of additional information, including length-frequency data covering the same period as that used in the stock assessments, to enhance representativeness, facilitate estimation of selectivity patterns and better quantify the potential impact of small-scale fisheries on the wider stock and improve understanding of these fisheries' contribution to total stock dynamics.
176. The WPTT **ENCOURAGED** continued work in this direction and efforts to integrate artisanal and coastal fishery data into regional stock assessment frameworks.
177. The WPTT **NOTED** paper [IOTC-2025-WPTT27-20](#) on Catch level projections and management benchmarks in the face of non-stationarity - an application to Indian Ocean yellowfin tuna, with the following abstract provided by the authors:

*"Catch level projections developed from stock assessments are the basis of fisheries management advice. Assumptions on future recruitment and management benchmarks can be highly influential in the results of projections and thus, produce large differences on the recommended catch levels to achieve management objectives, particularly over the medium-long term. However, the way that projections are configured and interpreted is not homogenous across scientific advice providers. We overview the assumptions made to configure catch level projections and interpret results in tuna stock assessments and propose a methodology that equates the recent dynamics of the stock with the projection period and preserves the relationship between spawners and recruits when assessing the effects of different management strategies and in MSE. This methodology was first used in the stock assessment of Indian Ocean yellowfin tuna in 2024 and was specifically developed to address trends in the estimated recruitment and the consequent change in reference points and benchmarks. We consider this methodology is suitable for catch level projections developed for management advice from integrated stock assessment models and for simulations within Management Strategy Evaluation."*

178. The WPTT **NOTED** the utility of the presented work in helping to understand the implications of different ways of addressing recruitment trends within the stock assessment framework. The WPTT **NOTED** the comparative approach adopted, which allowed the visualisation of recruitment deviates across time under different model assumptions.

179. The WPTT **NOTED** that exploring non-linear trends in addition to the linear trend could help to identify potential variations across different time periods and highlight that recruitment may not have been constantly increasing. The WPTT **NOTED** that incorporating linear trends and projecting on recent recruitment may implicitly assume that recent environmental or productivity conditions will persist into the future. The WPTT **RECOGNISED** that if such changes are environmentally driven, projecting them forward could be misleading, whereas if they are catch-driven, maintaining the current level of productivity in projections would be more defensible.
180. The WPTT **NOTED** that reference points become more complex when declining recruitment trends are observed and **AGREED** that adjustments to reference points must be approached carefully to maintain precaution. The WPTT **HIGHLIGHTED** that failing to address the trend appropriately could lead to underestimation of risk and overestimation of productivity.
181. The WPTT **AGREED** on the importance of distinguishing whether observed trends including the large differences observed in estimates of dynamic  $SSB_0$  and the trend in unfished biomass for each level of recruitment are driven by environmental factors and reflect true changes in recruitment or are actually model misspecification, as this will influence how the issue should be treated in future assessments. The WPTT **ACKNOWLEDGED** that these trends can be related to model misspecification.
182. The WPTT **SUGGESTED** that additional analyses, such as comparing longline and purse-seine indices (particularly those targeting juveniles), could help clarify whether the patterns observed are due to changes in the environment or limitations of the model.
183. The WPTT **NOTED** that dealing with recruitment trends is one of the key challenges in stock assessments globally, with various approaches being explored to address this. The WPTT **NOTED** that within the IOTC context, there remains a strong focus on MSY-based reference points, which motivates the need for continued development of methods to appropriately handle such trends.
184. The WPTT **ENCOURAGED** further research to investigate potential environmental drivers, model misspecifications, data quality issues, and abundance time-series biases that could contribute to these trends.
185. The WPTT **ACKNOWLEDGED** the fact that previous management advice has captured uncertainty regarding the potential persistence of recent recruitment levels, by also including results from projections assuming long term average recruitment (MSY equilibrium levels). The WPTT **ENCOURAGED** future advice to continue to include caveats related to uncertainties in recruitment projections.
186. The WPTT **NOTED** that the early years of the fishery, particularly before the expansion of the longline fishery and the development of the purse-seine fishery in the 1990s, provide limited information on recruitment. The WPTT **HIGHLIGHTED** that this lack of data complicates estimation of virgin biomass and the distribution and movement of recruits between regions. The WPTT **SUGGESTED** that greater attention be given to assessing the reliability of early-period data to determine how far back the available information provides meaningful estimates of stock productivity.
187. The WPTT **NOTED** that recruitment bias correction is a key consideration for projections and **SUGGESTED** that the approach used to handle recruitment trends in the projection phase be consistent with the treatment applied during the main model period. The WPTT **NOTED** that SS3 does not handle recruitment projections particularly well, and that explicit documentation of how recruitment bias correction is implemented would improve transparency and consistency in future assessments.
188. The WPTT **NOTED** paper [IOTC-2025-WPTT27-21](#) on Analysis of the recoveries by sex of adult yellowfin and bigeye in the Indian Ocean, including the following abstract provided by the authors:

*“This paper analyzes the recoveries of 99 adult YFT and 104 BET recovered during the 2009-2016 period with an identification of their sex, sizes and exact time at liberty, following the IOTTP tagging program ran in the Indian Ocean by the IOTC in 2005-2009. These recoveries clearly show a distinct growth between the 2 sexes and a lower asymptotic size of the females for both species. They also show that natural mortality of adult male and female are very similar for BET, while the natural mortality of adult female YFT appears to be significantly higher. These two biological parameters are of key importance in all the analytical stock assessments analysis, and the paper recommends to study the feasibility to incorporate sexes in future SS3 stock assessment models and to evaluate the consequences of using these more realistic parameters in the models.”*

189. The WPTT **NOTED** that the difference in tag recoveries (and so estimated mortality) between males and females became most obvious at age 11 where more males were recaptured.
190. The WPTT **NOTED** that the IATTC began considering sex-specific natural mortality rates for yellowfin tuna many years ago based on video observations of yellowfin spawning behaviour within their facilities. These observations, combined with data showing a decreasing proportion of females, led to the conclusion that increased natural mortality in females could be plausible, as spawning appeared to be particularly stressful for them.
191. The WPTT **NOTED** that it may be premature to conclude that females experience higher natural mortality simply because fewer are caught, as this pattern could also reflect differences in catchability between sexes.
192. The WPTT **NOTED** that the number of recovered tagged fish was relatively low and that most recoveries were from purse-seine operations rather than longline fisheries, which could influence the apparent sex-related differences in mortality.
193. The WPTT **SUGGESTED** that tag recovery analyses by sex should be extended to other species to further investigate potential sex-specific differences in natural mortality.
194. The WPTT **NOTED** presentation [IOTC-2025-WPTT27-28](#) on Preliminary evaluation of Seychelles longline length, catch and effort data: summary of finding.
195. The WPTT **NOTED** that the presented results are based on logbook data reported by Seychelles-registered vessels, not data from observers.
196. The WPTT **NOTED** that while catch and length data are most likely unbiased overall, their precision is low. The WPTT **AGREED** that further work is needed to distinguish between observation error and true variation in catches, taking into account factors such as time period and fishing location.
197. The WPTT **RECALLED** that this work forms part of a broader project funded by the IOTC. The WPTT **NOTED** that an initial consultancy study conducted in 2018 reviewed IOTC size data, focusing primarily on data from the fleet of Taiwan, China and further **NOTED** that this review recommended removing Taiwan, China size data from tropical tuna assessments due to concerns about non-compliance with standard measurement protocols and data reliability across several species. The WPTT **NOTED** that this initial review was extended to data from Seychelles, due to linkages between the Seychelles and Taiwan, China fleets, though it did not conduct a detailed evaluation of Seychelles data itself and so **NOTED** that this current project is now conducting that more detailed analysis.
198. The WPTT **ACKNOWLEDGED** that a substantial volume of size data has since been collected from Seychelles vessels and that revisiting data quality is therefore timely. The WPTT **NOTED** that while the recommendation from the 2018 analysis resulted in the exclusion of certain size data from assessments, the quality of data collected since that time remains uncertain. The WPTT **NOTED** that this study could provide valuable insights into whether data quality has improved post-2018, which could in turn influence future decisions on data inclusion in stock assessments.
199. The WPTT **DISCUSSED** the relationship between catch, fish length, and mean weights, **NOTING** that if only the largest bigeye tuna and yellowfin tuna are measured, it could artificially create correlations between species weights and obscure potential biases. The WPTT **NOTED** that the study had attempted to detect any such relationships by analysing residuals and slope consistency, however the WPTT 2018 **NOTED** that this was an exploratory rather than a rigorous analytical approach.
200. The WPTT **WELCOMED** the possibility of developing a new dataset that could be used in future assessments and **ENCOURAGED** further examination of catch and effort data from Seychelles (and other CPCs) to derive standardised CPUE indices. Given the limited data currently used to provide CPUE series, the WPTT **AGREED** that identifying and validating alternative data sources such as this would be valuable for future stock assessments.

## 8. FAD RELATED TOPICS

### 8.1 Update from the FAD Working Group

201. The WPTT **NOTED** that the 7th Working Group on FADs meeting (WPFAD07) was held online 9th to 10th June. The WPTT **ENDORSED** all the recommendations from the WPFAD07.

## 8.2 Commission requests to the SC on FADs

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

202. The WPTT **NOTED** paper [IOTC-2025-WPTT27-22](#) which provides a summary of a DFAD retrieval project, with the following abstract provided by the authors:

*“This paper presents the results of a pioneering pilot project designed to mitigate the environmental risk associated with derelict Drifting Fish Aggregating Devices (dFADs) in the Indian Ocean. Driven by regulatory measures that have significantly curtailed the operational capacity of the tuna fleet's supply vessels, this initiative sought to demonstrate the essential role of these specialized vessels in dFAD management. The project utilized the supply vessel Archanda for a 51-day campaign (October to December 2024) in the High-Seas eastern Indian Ocean (east of 065°00'E), focused exclusively on retrieving dFADs before potential stranding. The methodology included continuous electronic monitoring and material assessment upon recovery. The campaign successfully retrieved a total of 128 dFADs, confirming the high efficiency of dedicated supply vessels for this task. Subsequent analysis of the recovered components showed high material integrity, with 80% of reusable materials requiring no maintenance, thus strongly supporting circular economy principles within the fishery. These findings establish that dedicated supply or dFAD retrieval vessels are indispensable for minimizing the environmental footprint of dFAD fisheries, primarily by enhancing recovery mechanisms and ensuring the comprehensive management of these fishing devices”*

203. The WPTT **NOTED** that in 51 operational days conducting retrieval activities exclusively, 128 buoys and dFADs were successfully recovered before they could be lost or potentially strand in sensitive coastal areas.

204. The WPTT **NOTED** that the vessel was equipped with a functional VMS, tracked and monitored and 100% observer coverage through an independent, continuous electronic observation system.

205. The WPTT **ACKNOWLEDGED** the work initiative and the project carried out, and considered it an interesting approach to address the issue of lost FADs previously discussed on this working party and WGFAD. The WPTT also **NOTED** the need for shared efforts among companies to ensure more efficient use of support vessels.

206. The WPTT **AGREED** that when buoys are deactivated, they should be automatically transferred to a pool of buoys monitored by an independent body to further optimize retrieval operations.

207. The WPTT **NOTED** that the motivation of the paper was to address the concerns raised by the Commission that the dFAD recovery vessel may effectively increase the capacity of existing supply/support vessels. The WPTT **NOTED** the absence empirical evidence or documented analysis that would substantiate the assertion by the authors that the operational capacity of supply/support vessels remains unaffected by the activities of dFAD recovery vessel.

208. Therefore WPTT **ENCOURAGED** the authors to focus on collecting data to enable to estimate changes in capacity of supply/support vessels and/or further analyse the data and present indicators related to retrieval operations in response to requests from the group and the Commission, and to assess the ecological suitability of the activity, particularly regarding carbon footprint, and indicators such as fuel consumption during FAD recovery.

209. The WPTT **RECALLED** the first international workshop on FAD retrieval held in Galápagos (2024) identified the potential use of dedicated FAD recovery vessels and recommended that the RFMOs allow “FAD recovery vessels” to recover FADs provided that they are not involved in fishing activities.

210. The WPTT **NOTED** paper [IOTC-2025-WPTT27-INF03](#) which provides a revision and updates of IOTC Data Collection Form related for reporting the recovery of abandoned, discarded or lost fishing gears (ADLFG).

211. The WPTT **NOTED** that following the IOTC Recommendation 24/11, the Secretariat developed the 3LG form and reporting protocols for abandoned, lost, or discarded fishing gear. This form was presented to the FADs Working Group (IOTC-2025-WGFAD07-10) and reviewed considering guidelines to evaluate impacts of ADLFG in corals (IOTC-2025-WGFAD07-11).

212. The WPTT **NOTED** that the main considerations discussed for the completion of the final form, include avoiding double reporting, ensuring entanglement data is captured, assessing integration with FAD Watch project data, and enabling the reporting of diverse gear materials.

213. The WPTT **NOTED** that the evolving FAD management and the related data to be reported according to the provisions in Resolution 24/02 implies that the 3DA form requires updates.
214. The WPTT **ENCOURAGED** the participants to review the draft 3LG form available online and contribute to its revision, with the aim of adopting a final version in the next Working Party on Data Collection and Statistics (WPDCS21).

### 8.2.2 Resolution 23/01 on the management of anchored fish aggregating devices (AFADs)

215. The WPTT **NOTED** paper [IOTC-2025-WPTT27-INF02](#) which provides a description of the project AFICHE, with the following abstract provided by the authors:

*“This note present a synthetic description of the project AFICHE: Abundance, visiting frequency, interactions, fishery connectivity and economics of exploitation of pelagic species by Réunion's artisanal fishery on anchored FADs: a research project implying tagging of dolphinfish, wahoo and tuna. This project is funded by the EU under the European Funds for Maritime Affairs, Fishery and Aquaculture (EFMAFA). We provide the project objectives, means, and technics, which will be carried out including a publicity posters and tag return rewards”.*

216. The WPTT **NOTED** that while adult ALB and YFT are known for their wide distribution, there is limited information on the behaviour and movements of juveniles, and dolphinfish, and wahoo and this project will investigate fish aggregation patterns around anchored Fish Aggregating Devices, with a particular focus on artisanal fisheries.
217. The WPTT **NOTED** that posters have been developed for wide distribution of the information about the tagging program to facilitate information exchanges and promote tag return.
218. The WPTT **NOTED** that tagging will be conducted exclusively on selected monitored FADs in collaboration with local fishers for data collection and the evaluation of biomass changes will be monitoring the echosounder buoys over time.

## 9. WPTT PROGRAM OF WORK

### 9.1 Revision of the WPTT Program of Work (2026–2030)

219. The WPTT **NOTED** paper [IOTC-2025-WPTT27-05](#), which provided an opportunity to consider and revise the WPTT Program of Work (2026–2030), by taking into account the specific requests of the Commission, Scientific Committee, and the resources available to the IOTC Secretariat and CPCs.
220. 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).*
221. 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 and the SC for considerations.
222. The WPTT **RECOMMENDED** that the SC consider, amend as necessary, and then endorse the WPTT Program of Work (2026–2030), as provided in [Appendix VII](#).

### 9.2 Development of priorities for an Invited Expert at the next WPTT meeting

223. The WPTT **NOTED** that a consultant (Dr Philipp Neubauer) has been contracted to provide a review of the bigeye tuna management strategy evaluation and has also participated in the current WPTT meeting. The WPTT **ACKNOWLEDGED** Dr Neubauer for his work, which has contributed to improving the MSE work of bigeye tuna and **SUGGESTED** that he is invited to future IOTC WPTT tropical tuna stock assessment meetings.
224. 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.

## 10. OTHER BUSINESS

### 11. Election of the Chairperson and Vice-Chairperson of the WPTT for the next biennium

#### *Chairperson*

225. The WPTT **NOTED** that the second term of the current Chairperson, Dr Gorka Merino (EU,Spain) expires at the close of the WPTT meeting and, as per the IOTC Rules of Procedure (2014), participants are required to elect a new Chairperson of the WPTT for the next biennium.
226. **NOTING** the Rules of Procedure (2014), the WPTT **CALLED** for nominations for the position of Chairperson of the IOTC WPTT for the next biennium. Dr David Kaplan (EU,France) was nominated, seconded and elected as Chairperson of the WPTT for the next biennium.

#### *Vice-Chairperson*

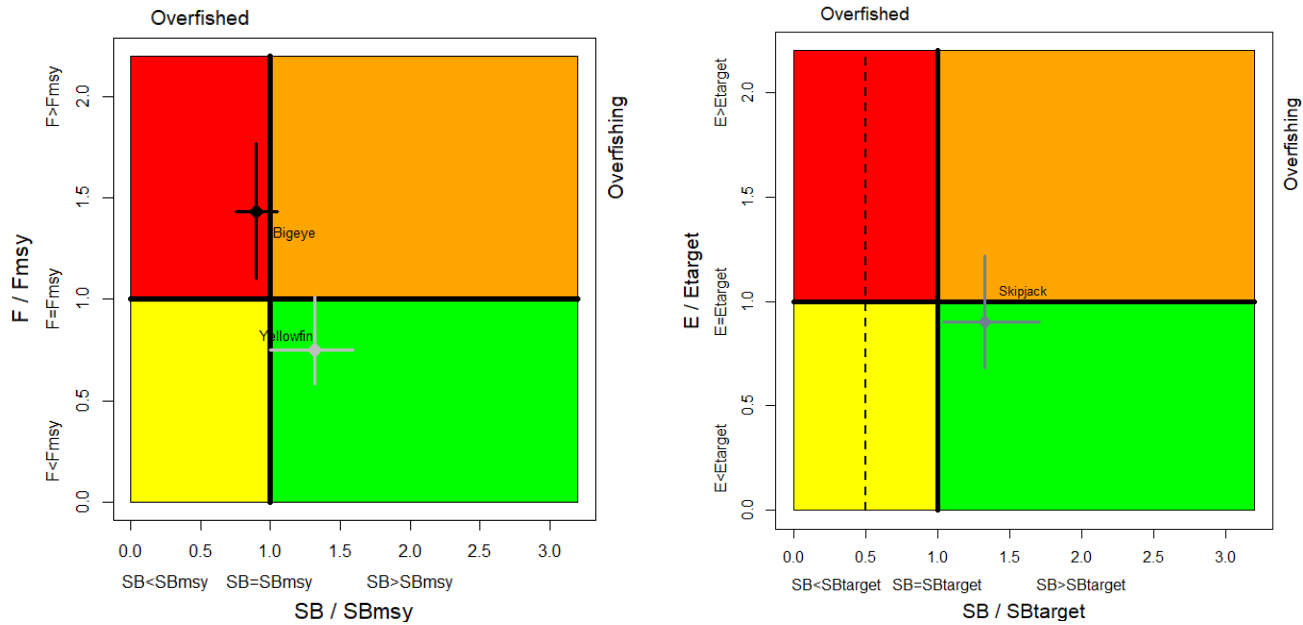
227. The WPTT **NOTED** that the second term of the current Vice-Chairperson, Dr Shiham Adam (IPNLF) expires at the close of the WPTT meeting. As per the IOTC Rules of Procedure (2014), participants are required to elect a new Vice-Chairperson of the WPTT for the next biennium.
228. **NOTING** the Rules of Procedure (2014), the WPTT **CALLED** for nominations for the positions of Vice-Chairperson of the IOTC WPTT for the next biennium. Mr Mohamed Shimal (Maldives) was nominated, seconded and elected as Vice-Chairperson of the WPTT for the next biennium.

#### 11.1 *Date and place of the 28th and 29th Sessions of the WPTT*

229. 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 2026 as a preferred time period to hold the WPTT28 meeting in 2026. It was also **AGREED** that the WPTT Assessment meeting should continue to be held back-to-back with the WPM.
230. The WPTT **NOTED** that EU.Spain offered to host the next WPTT and WPM meetings in IEO-Tenerife, Spain. The WPTT **THANKED** EU,Spain for this kind offer.

## 12. REVIEW OF THE DRAFT, AND ADOPTION OF THE REPORT OF THE 27<sup>TH</sup> SESSION OF THE WPTT

231. WPTT **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPTT27, 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 2025 (Figure 1), noting that the final assessment model runs of the bigeye tuna will be completed after the meeting, therefore, the status advice for bigeye tuna should be developed by the SC following the review of the final stock assessment results and update of the Kobe plot intersessionally:
- o Bigeye tuna (*Thunnus obesus*) – [Appendix IV](#)
  - o Skipjack tuna (*Katsuwonus pelamis*) – [Appendix V](#)
  - o 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%SB<sub>0</sub>. Cross bars illustrate the range of uncertainty from the model runs with an 80% CI.

232. The report of the 27th Session of the Working Party on Tropical Tunas Meeting (IOTC-2025-WPTT27 –R) will be adopted by correspondence.

**APPENDIX I**  
**LIST OF PARTICIPANTS**

| <b>Chairpersons</b> |                   |                  |                            |                |                                                                        |
|---------------------|-------------------|------------------|----------------------------|----------------|------------------------------------------------------------------------|
| <b>Title</b>        | <b>First name</b> | <b>Last name</b> | <b>Affiliation</b>         | <b>CPC</b>     | <b>E-mail</b>                                                          |
| Dr.                 | Gorka             | Merino           | AZTI-EU                    | EUROPEAN UNION | gmerino@azti.es                                                        |
| Dr.                 | M Shiham          | Adam             | IPNLF                      |                | shiham.adam@ipnlf.org                                                  |
| <b>Title</b>        | <b>First name</b> | <b>Last name</b> | <b>Affiliation</b>         | <b>CPC</b>     | <b>E-mail</b>                                                          |
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**APPENDIX II****AGENDA FOR THE 27TH WORKING PARTY ON TROPICAL TUNAS, ASSESSMENT MEETING****Date:** 21– 25 October 2025**Location:** Laïla Resort, 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. BIGEYE TUNA STOCK ASSESSMENT (Chair)**

4.1 Review any new information on bigeye tuna biology, stock structure, fisheries and associated environmental data including climate change issues 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

**5. BIGEYE TUNA MANAGEMENT PROCEDURE**

5.1 Consideration of exceptional circumstances

**6. SKIPJACK TUNA MANAGEMENT PROCEDURE**

6.1 Consideration of exceptional circumstances

6.2 Implementation of the skipjack MP as per Resolution 24/07

6.3 Other

**7. YELLOWFIN TUNA**

7.1 Update on the standardised CPUE indices

7.2 Update on the Management Strategy Evaluation

7.3 Other

**8. FAD RELATED 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 23/01 on the management of anchored fish aggregating devices (AFADs)

**9. WPTT PROGRAM OF WORK**

9.1 Revision of the WPTT Program of Work (2026–2030)

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

**10. OTHER BUSINESS**

10.1 Election of a Chairperson and a Vice-Chairperson of the WPTT for the next biennium (Secretariat)

10.2 Date and place of the 28th and 29th Sessions of the WPTT (Chair and IOTC Secretariat)

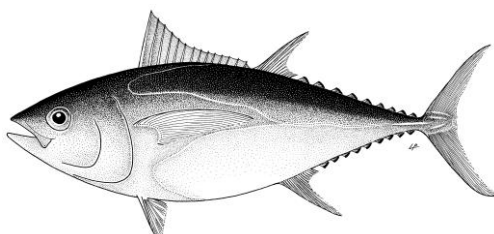
**11. ADOPTION OF THE REPORT**11.1 Review of the draft, and adoption of the Report of the 27<sup>TH</sup> Session of the WPTT (Chair)

**APPENDIX III**  
**LIST OF DOCUMENTS FOR THE 27<sup>TH</sup> WORKING PARTY ON TROPICAL TUNAS**

| Document             | Title                                                                                                                                                                                                                       |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| IOTC-2025-WPTT27-01a | Draft: Agenda of the 27 <sup>th</sup> Working Party on Tropical Tunas                                                                                                                                                       |
| IOTC-2025-WPTT27-01b | Draft: Annotated agenda of the 27 <sup>th</sup> Working Party on Tropical Tunas                                                                                                                                             |
| IOTC-2025-WPTT27-02  | Draft: List of documents for the 26th Working Party on Tropical Tunas                                                                                                                                                       |
| IOTC-2025-WPTT27-3   | Overview of Indian Ocean tropical tuna fisheries (Secretariat)                                                                                                                                                              |
| IOTC-2025-WPTT27-05  | Revision of the WPTT program of work (IOTC Secretariat)                                                                                                                                                                     |
| IOTC-2025-WPTT27-06  | Statistics on tropical tuna landings at Thai fishing ports (Prasertsook O, Sanboonpeng J)                                                                                                                                   |
| IOTC-2025-WPTT27-07  | Analysis of the yellowfin tuna ( <i>Thunnus albacares</i> ), bigeye tuna ( <i>Thunnus obesus</i> ) and skipjack tuna ( <i>Katsuwonus pelamis</i> ) caught in 2024 by the industrial tuna fishery in Kenya (Ndegwa S et al.) |
| IOTC-2025-WPTT27-08  | Comparative analysis of ERS Data on tropical tuna fisheries in Madagascar: longline and purse seine fleets, 2024–2025 (Fanazava R)                                                                                          |
| IOTC-2025-WPTT27-09  | The status of tuna stocks with special reference to tropical tunas in Pakistan (Sheikh U, Khan M)                                                                                                                           |
| IOTC-2025-WPTT27-10  | Review of Indonesian tuna purse seine fisheries in Indian Ocean (Widodo et al.)                                                                                                                                             |
| IOTC-2025-WPTT27-11  | Assessing catch rate dynamics of yellowfin tuna in Sri Lanka's longline fishery: linear and non-linear approaches (Haputhantri S, Jayasinghe G)                                                                             |
| IOTC-2025-WPTT27-12  | Length-based assessment and biological review of skipjack tuna ( <i>Katsuwonus pelamis</i> ) in the Indian EEZ: Insights into stock status and trophic ecology (Varghese S)                                                 |
| IOTC-2025-WPTT27-13  | Length-Based Assessment of Yellowfin Tuna ( <i>Thunnus albacares</i> ) in the Tanzania EEZ: Applying LBB and LB-SPR Methods for Data-Limited Fisheries Management (Silas M)                                                 |
| IOTC-2025-WPTT27-15  | Preliminary stock assessment of Indian Ocean Bigeye tuna ( <i>Thunnus obesus</i> ) using Stock Synthesis (2025) (Phillips G)                                                                                                |
| IOTC-2025-WPTT27-16  | An update on consideration of exceptional circumstances for the bigeye tuna MP 2025 (Preece Z)                                                                                                                              |
| IOTC-2025-WPTT27-17  | Running the IOTC skipjack tuna management procedure for 2025                                                                                                                                                                |
| IOTC-2025-WPTT27-18  | Update of joint CPUE indices for bigeye tunas in the Indian Ocean based on Japanese, Korean and Taiwanese longline fisheries data (up to 2024) (Kitakado et al. 2025)                                                       |
| IOTC-2025-WPTT27-19  | Conditioning of OMs and preliminary evaluation of MPs for Indian Ocean yellowfin (Urtizberea A, Correa M, Merino G, Murua H)                                                                                                |
| IOTC-2025-WPTT27-20  | Catch level projections and management benchmarks in the face of non-stationarity - an application to Indian Ocean yellowfin tuna (Merino et al 2025)                                                                       |
| IOTC-2025-WPTT27-21  | Analysis of the recoveries by sex of adult yellowfin and bigeye in the Indian Ocean (Fonteneau A, Hallier J)                                                                                                                |
| IOTC-2025-WPTT27-22  | A dFAD retrieval project: A case study on the utility of retrieval vessels (Alzorriz N)                                                                                                                                     |
| IOTC-2025-WPTT27-23  | Advances in the use of state-space assessment models for tuna stocks: application to the Indian Ocean bigeye tuna (Correa G, Merino G, Agurtzane Urtizberea A, Wang Y)                                                      |
| IOTC-2025-WPTT27-25  | Spawning features of yellowfin ( <i>Thunnus albacares</i> ) and bigeye tuna ( <i>Thunnus obesus</i> ) in the Indian Ocean revealed by decadal Chinese longline observer data (Wang Y)                                       |
| IOTC-2025-WPTT27-26  | Status, Trends, and Biological Insights of Tropical Tuna Fisheries in Indian Waters (Rajesh K)                                                                                                                              |

| Document               | Title                                                                                                                                                                                                                                                           |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| IOTC-2025-WPTT27-27    | Consideration of Exceptional Circumstances for the skipjack tuna Management Procedure adopted by the IOTC in 2023 (Merino G)                                                                                                                                    |
| IOTC-2025-WPTT27-28    | Preliminary evaluation of Seychelles longline length, catch and effort data: summary of findings                                                                                                                                                                |
| IOTC-2025-WPTT27-INF01 | Is my red the same as your red? Improving the communication of stock status and support for management in the Indian Ocean Tuna Commission with specific recommendations for Indian Ocean skipjack (Merino et al., 2025)                                        |
| IOTC-2025-WPTT27-INF02 | Abundance, visiting frequency, interactions, fishery connectivity and economics of exploitation of pelagic species by Réunion's artisanal fishery on anchored FADs (AFICHE): a research project implying tagging of dolphinfish, wahoo and tuna (Romanov et al) |

**APPENDIX IV**  
**RESOURCE STOCK STATUS SUMMARY (TO BE UPDATED BY THE SC)**  
**BIGEYE TUNA (BET : THUNNUS OBESUS)**



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

| Area <sup>1</sup> | Indicators                                     |                    | 2022 stock status determination <sup>4</sup> |
|-------------------|------------------------------------------------|--------------------|----------------------------------------------|
| Indian Ocean      | Catch 2024 <sup>2</sup> (t)                    | 101,722            | 79%                                          |
|                   | Mean annual catch 2020-2024 (t) <sup>3</sup>   | 88,541             |                                              |
|                   | MSY (1,000 t) (80% CI)                         | 96 (83 – 108)      |                                              |
|                   | F <sub>MSY</sub> (80% CI)                      | 0.26 (0.18 – 0.34) |                                              |
|                   | SB <sub>MSY</sub> (1,000 t) (80% CI)           | 513 (332 – 694)    |                                              |
|                   | F <sub>2021</sub> /F <sub>MSY</sub> (80% CI)   | 1.43 (1.10–1.77)   |                                              |
|                   | SB <sub>2021</sub> /SB <sub>MSY</sub> (80% CI) | 0.9 (0.75 – 1.05)  |                                              |

<sup>1</sup>Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence

<sup>2</sup>Proportion of 2024 catch fully or partially estimated by IOTC Secretariat: 0.1%

<sup>3</sup>Including re-estimations of EU PS species composition for 2018 (only requested for stock assessment purposes)

<sup>4</sup>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 <sub>2021</sub> / SB <sub>MSY</sub> < 1) | Stock not overfished (SB <sub>2021</sub> / SB <sub>MSY</sub> ≥ 1) |
|-----------------------------------------------------------------------------|---------------------------------------------------------------|-------------------------------------------------------------------|
| Stock subject to overfishing (F <sub>2021</sub> / F <sub>MSY</sub> ≥ 1)     | 79%                                                           | 17%                                                               |
| Stock not subject to overfishing (F <sub>2021</sub> / F <sub>MSY</sub> ≤ 1) | 2%                                                            | 2%                                                                |
| Not assessed / Uncertain / Unknown                                          |                                                               |                                                                   |

#### INDIAN OCEAN STOCK – MANAGEMENT ADVICE

**Stock status.** A new stock assessment was carried out for bigeye tuna in 2025. Due to an issue identified at the WPTT meeting, the assessment will be finalised during an intersessional meeting, and the advice will be developed by the SC (1-5 December 2025). 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  $F_{MSY}$  (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.

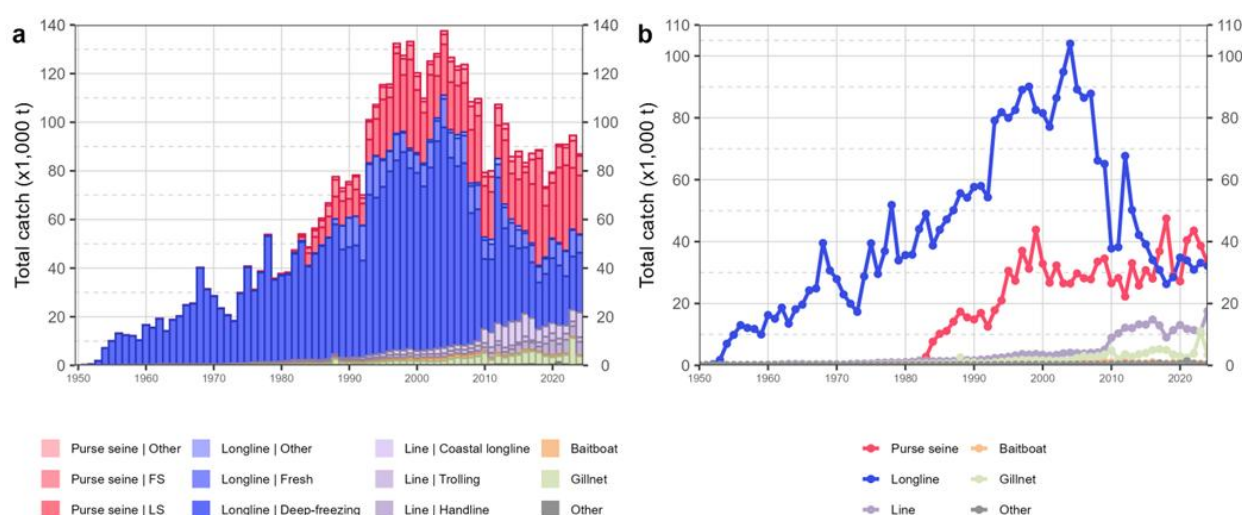
**Management Procedure.** A management procedure for Indian Ocean Bigeye tuna was adopted under Resolution 22/03 by the IOTC Commission in May 2022 and was applied to determine a recommended TAC for Bigeye tuna for 2024 and 2025. A review of evidence for exceptional circumstances, was also conducted 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.

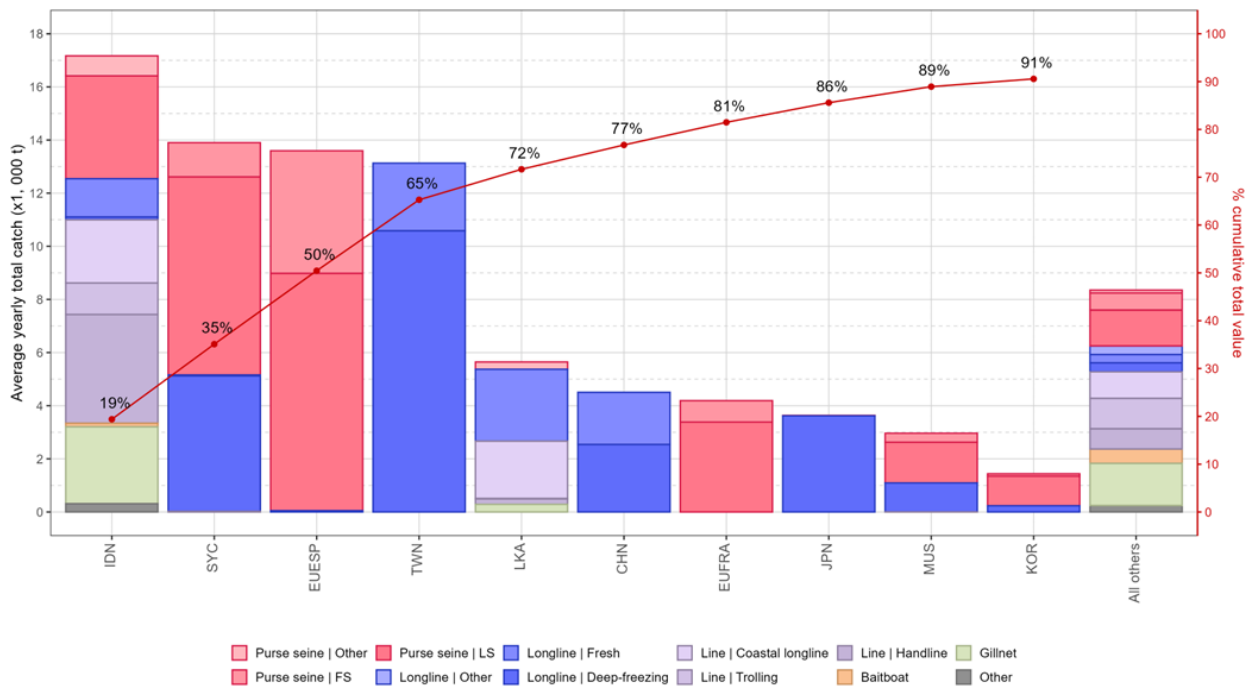
**Management advice.** The TAC recommended from the application of the MP specified in Resolution 22/03 and Resolution 23/04 is 80,583t / year for the period 2024-2025. The recommended TAC is 15% below the 2021 catch (this is constrained by the maximum TAC change). The TAC advice will be updated at the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

The following key points should also be noted:

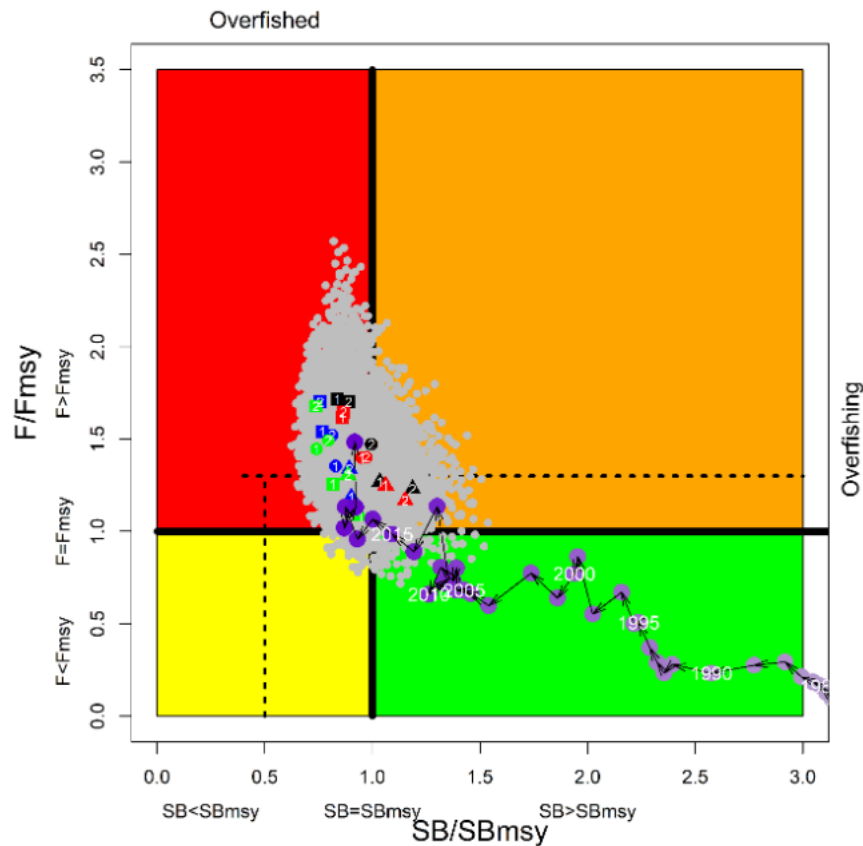
- **Main fisheries (mean annual catch 2019-2024):** bigeye tuna are caught using purse seine (41.3%), followed by longline (37.3%) and line (14.6%). The remaining catches taken with other gears contributed to 6.8% of the total catches in recent years (Fig. 1).
- **Main fleets (mean annual catch 2020-2024):** the majority of bigeye tuna catches are attributed to vessels flagged to Indonesia (19.4%) followed by Seychelles (15.7%) and EU (Spain) (15.4%). The 30 other fleets catching bigeye tuna contributed to 49.5% 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 1950-2024.



**Fig. 2.** Mean annual catches (metric tonnes; t) of bigeye tuna by fleet and fishery group between 2020 and 2024, with indication of cumulative catches by fleet.

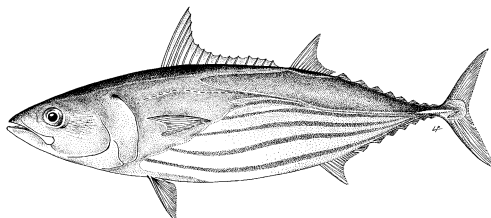


of cumulative catches by fleet.

**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 ( $SB_{lim} = 0.5 SB_{MSY}$  and  $F_{lim} = 1.4 F_{MSY}$ )

**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 <sup>1</sup> | Indicators                                         |                                 | 2023 stock status determination <sup>3</sup> |
|-------------------|----------------------------------------------------|---------------------------------|----------------------------------------------|
| Indian Ocean      | Catch 2024 <sup>2</sup> (t)                        | 624,609                         | 70%*                                         |
|                   | Mean annual catch 2020-2024 (t)                    | 636,078                         |                                              |
|                   | E <sub>40%SB0</sub> <sup>4</sup> (80% CI)          | 0.55 (0.48–0.65)                |                                              |
|                   | SB <sub>0</sub> (t) (80% CI)                       | 2 177 144 (1 869 035–2 465 671) |                                              |
|                   | SB <sub>2022</sub> (t) (80% CI)                    | 1 142 919 (842 723–1 461 772)   |                                              |
|                   | SB <sub>2022</sub> / SB <sub>0</sub> 80% CI        | 0.53 (0.42–0.68)                |                                              |
|                   | SB <sub>2022</sub> / SB <sub>40%SB0</sub> (80% CI) | 1.33 (1.04–1.71)                |                                              |
|                   | SB <sub>2022</sub> / SB <sub>20%SB0</sub> (80% CI) | 2.67 (2.08–3.42)                |                                              |
|                   | SB <sub>2022</sub> / SB <sub>MSY</sub> (80% CI)    | 2.30 (1.57–3.40)                |                                              |
|                   | F <sub>2022</sub> / F <sub>MSY</sub> (80% CI)      | 0.49 (0.32–0.75)                |                                              |
|                   | F <sub>2022</sub> / F <sub>40%SSB0</sub> (80% CI)  | 0.90 (0.68–1.22)                |                                              |
|                   | MSY (t) (80% CI)                                   | 584 774 (512 228–686 071)       |                                              |

<sup>1</sup>Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence

<sup>2</sup> Proportion of 2024 catch fully or partially estimated by IOTC Secretariat:4.1 %

<sup>3</sup>2022 is the final year that data were available for this assessment.

<sup>4</sup> E<sub>40%SB0</sub> is the equilibrium annual exploitation rate (E<sub>targ</sub>) associated with the stock at B<sub>targ</sub>, 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 B<sub>lim</sub>

\*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 <sub>2022</sub> / SB <sub>40%SB0</sub> <1) | Stock not overfished (SB <sub>2022</sub> / SB <sub>40%SB0</sub> ≥ 1) |
|--------------------------------------------------------------------------------|-----------------------------------------------------------------|----------------------------------------------------------------------|
| Stock subject to overfishing (F <sub>2022</sub> / F <sub>40%SB0</sub> ≥ 1)     | 8%                                                              | 21%                                                                  |
| Stock not subject to overfishing (F <sub>2022</sub> / F <sub>40%SB0</sub> ≤ 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=5 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**.

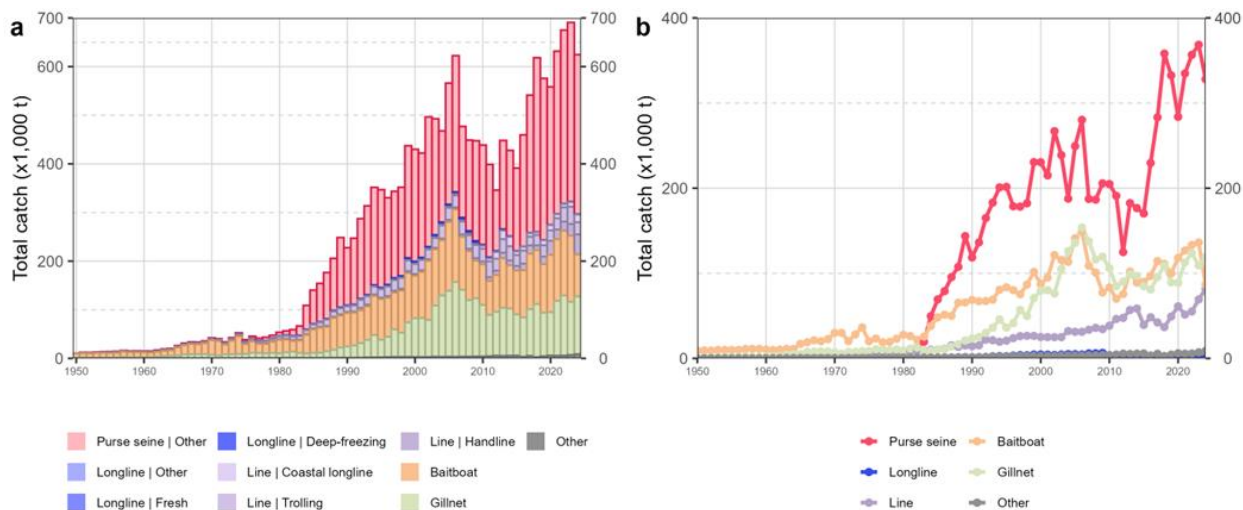
### Outlook.

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%

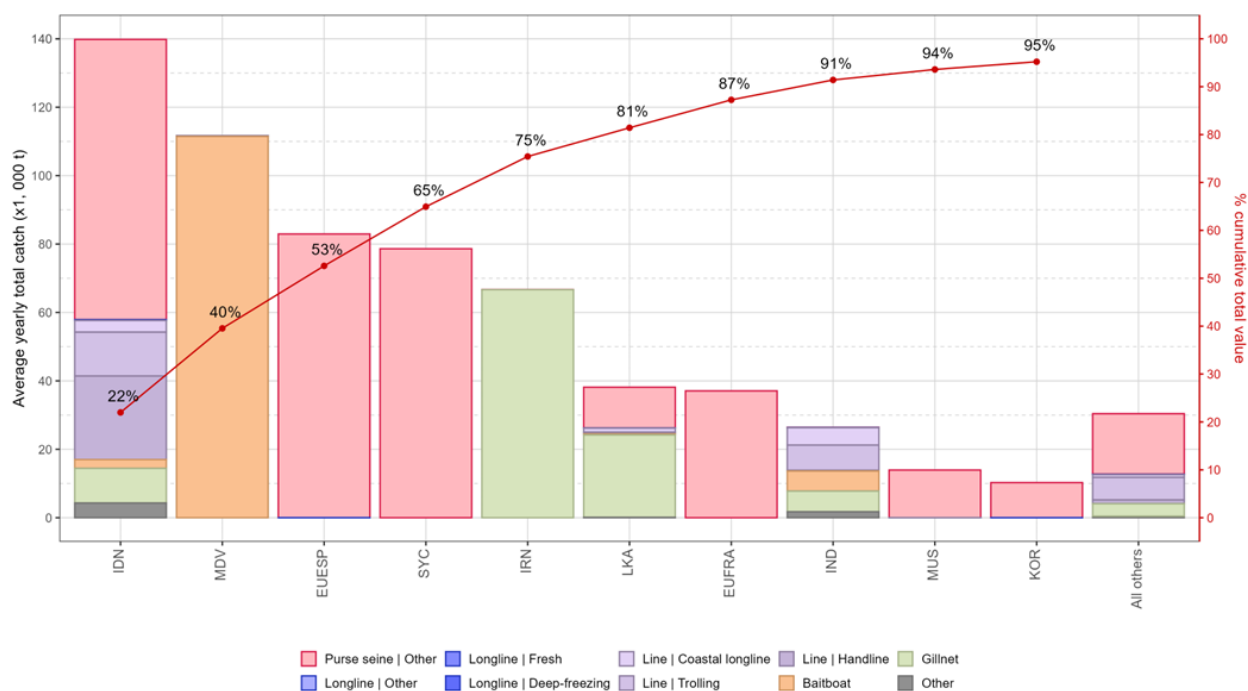
**Management advice.** The catch limit calculated by applying the HCR specified in Resolution 21/03 is [628, 606t] for the period 2024-2026. The SC noted that this catch limit is higher than for the previous period. This is attributed to the new stock assessment which estimates a higher productivity 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. In 2024, the Commission adopted Resolution 24/07 on a management procedure for skipjack. The MP is scheduled to be implemented in 2025 to provide TAC advice for 2027-2029.

The following key points should also be noted:

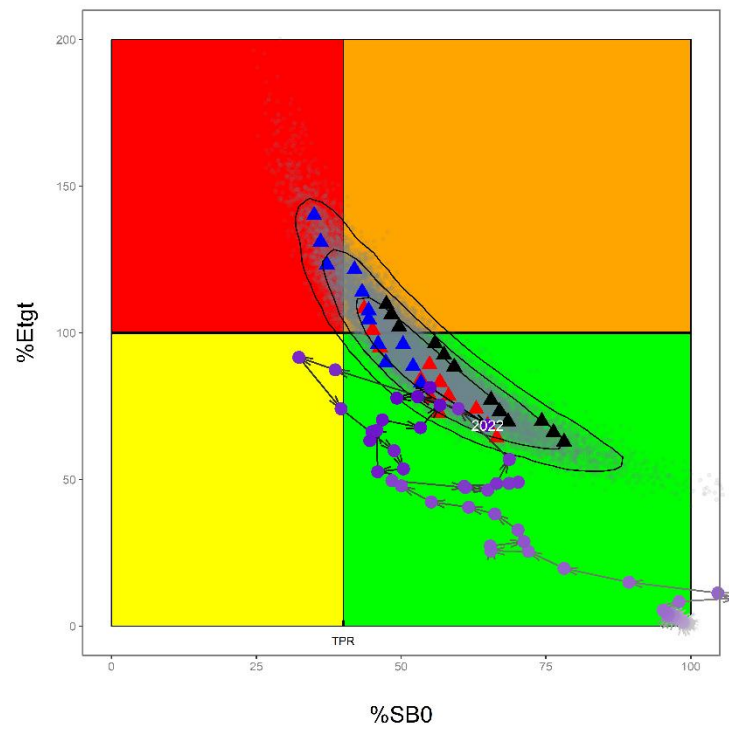
- **Reference points:** Commission in 2016 agreed to Resolution 16/02 on harvest control rules for skipjack tuna in the IOTC area of competence (superseded by Resolution 21/03).
- **Biomass:** Current spawning biomass was considered to be above the target reference point of 40% of  $SB_0$ , and above the limit reference point of  $0.2 \cdot SB_0$  as per Resolution 16/02 (**Fig. 2**).
- **Main fisheries (mean annual catch 2020-2024):** skipjack tuna are caught using purse seine (52.6%), followed by baitboat (18.9%) and gillnet (17.4%). The remaining catches taken with other gears contributed to 11.1% 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 (22%) followed by Maldives (17.6%) and EU (Spain) (13%). The 33 other fleets catching skipjack tuna contributed to 47.4% 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 skipjack tuna during 1950-2024.

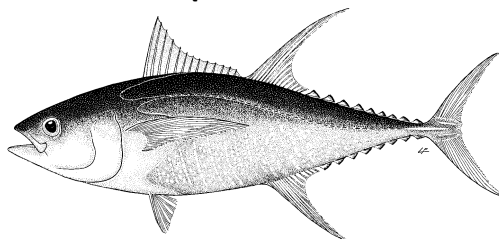


**Fig. 2.** Mean annual catches (metric tonnes; t) of skipjack tuna by fleet and fishery group between 2020 and 2024, with indication of cumulative catches by fleet.



**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% confidence region.

**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 <sup>1</sup>                                                                                        | Indicators                                               |                   | 2024 stock status determination <sup>3</sup> |
|----------------------------------------------------------------------------------------------------------|----------------------------------------------------------|-------------------|----------------------------------------------|
| Indian Ocean                                                                                             | Catch 2024 <sup>2</sup> (t)                              | 489,742           | 89%*                                         |
|                                                                                                          | Mean annual catch 2020-2024 (t)                          | 440,206           |                                              |
|                                                                                                          | MSY <sub>recent</sub> <sup>4</sup> (1,000 t) (80% CI)    | 421 (416-430)     |                                              |
|                                                                                                          | F <sub>MSY</sub> (80% CI)                                | 0.2 (0.16-0.26)   |                                              |
|                                                                                                          | SB <sub>MSY_recent</sub> <sup>4</sup> (1,000 t) (80% CI) | 1,063 (890-1,361) |                                              |
|                                                                                                          | F <sub>2023</sub> / F <sub>MSY</sub> (80% CI)            | 0.75 (0.58-1.01)  |                                              |
|                                                                                                          | SB <sub>2023</sub> / SB <sub>MSY_recent</sub> (80% CI)   | 1.32 (1.00-1.59)  |                                              |
|                                                                                                          | SB <sub>2023</sub> / SB <sub>0</sub> (80% CI)            | 0.44 (0.40-0.50)  |                                              |
| <sup>1</sup> Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence |                                                          |                   |                                              |
| <sup>2</sup> Proportion of 2024 catch fully or partially estimated by IOTC Secretariat: 13.9 %           |                                                          |                   |                                              |
| <sup>3</sup> 2023 is the final year that data were available for this assessment                         |                                                          |                   |                                              |
| <sup>4</sup> Recent refers to the most recent 20 years (2003-2022)                                       |                                                          |                   |                                              |

| Colour key                                                                  | Stock overfished (SB <sub>2023</sub> / SB <sub>MSY</sub> < 1) | Stock not overfished (SB <sub>2023</sub> / SB <sub>MSY</sub> ≥ 1) |
|-----------------------------------------------------------------------------|---------------------------------------------------------------|-------------------------------------------------------------------|
| Stock subject to overfishing (F <sub>2023</sub> / F <sub>MSY</sub> ≥ 1)     | 7.9%                                                          | 3.3%                                                              |
| Stock not subject to overfishing (F <sub>2023</sub> / F <sub>MSY</sub> ≤ 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 fisheries (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 understand additional uncertainties not captured in the model grid, 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, the influence of the tagging data and the revised catch information for Indonesia. In general, the sensitivity runs did not suggest that other parameters should be included in the reference grid and the group decided not to include any additional axes of uncertainty.

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 (this is further discussed, below). 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 recruitment 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 of 401,000 t are 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 t). 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 <sup>2</sup> (t)                        | 400,950          |
| Mean annual catch 2019-2023 (t)                    | 423,142          |
| MSY <sub>eq</sub> (1,000 t) (80% CI)               | 374 (350-411)    |
| SB <sub>MSY_eq</sub> (1,000 t) (80% CI)            | 987 (791-1,247)  |
| SB <sub>2023</sub> / SB <sub>MSY_eq</sub> (80% CI) | 1.47 (1.21-1.65) |

The recent 20 year period was selected for the estimation of recent benchmarks (SB<sub>MSY</sub> and MSY) 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 2007 to 2019 (**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 F<sub>MSY</sub> 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 on average 44% 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<sub>2023</sub>/SB<sub>MSY</sub> = 1.32). Current fishing mortality is estimated to be 25% lower than F<sub>MSY</sub> (F<sub>2023</sub>/F<sub>MSY</sub> = 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 relating to 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 which are recognised in the SCs catch limit advice (in the stock status summary and SC general recommendations). The use of the 2021 CPUE index in the current model results in a significantly more pessimistic biomass up to 2020 compared to the 2024 CPUE indices ( $-23\% SB_{2021}/SB_{MSY}$ ), but there is no clear understanding or agreement for why the two indices are significantly different (especially in Region 1). However, it is noted that the exploratory runs discussed during the SC meeting indicate that the other data used in the stock assessment (catch and length frequency data) also indicate an increase in biomass in recent years, albeit a smaller increase (21% and 11% respectively) than the increase driven by the 2024 CPUE index (+79%).

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). 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.

### Management advice

Noting the pending advice to be provided by the SC to the 2026 Commission meeting on the need, if any, to update the yellowfin tuna stock assessment in 2026, results of the K2SM should not be considered as catch advice until the uncertainties in the CPUE index are resolved. As such, the following advice was recommended:

- If catches are maintained within the estimated MSY range (416,000-430,000 tons) there is more than a 50% probability that the stock will remain above  $SB_{MSY}$  in 2033.
- 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.
- However, in order to account for the uncertainty of the projections (e.g., relating to whether estimated high recruitment will be maintained) and uncertainty not captured in the assessment grid (e.g. relating to the new CPUE indices), the Commission should set an initial one year (2026) TAC that does not exceed the median recent MSY estimate, , task the SC to investigate and resolve CPUE uncertainty in 2025, and advise the 2026 Commission on future catch levels.

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.

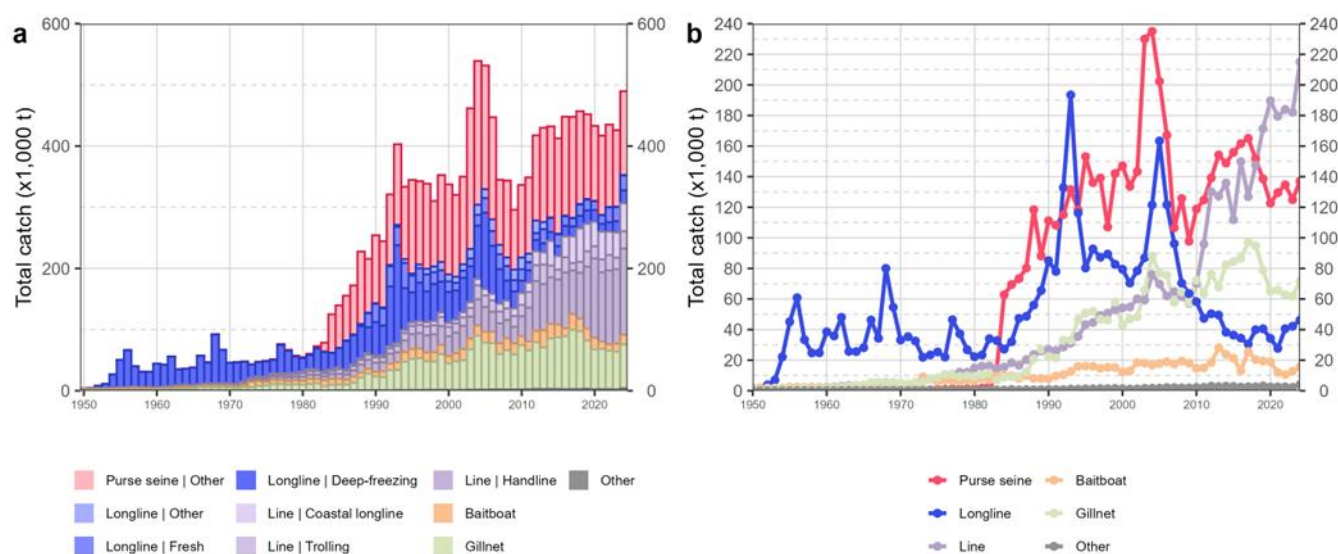
The following key points should also be noted:

- **Maximum Sustainable Yield (MSY):** estimate for the Indian Ocean stock is 421,000 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 adopted 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  $0.4 \cdot SB_{MSY}$  (**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 2020-2024):** yellowfin tuna are caught using line (43.2%), followed by purse seine (29.5%) and gillnet (14.9%). The remaining catches taken with other gears contributed to 12.5% of the total catches in recent years (**Fig. 1**). The fishery impact plot is shown in **Fig. 8**.
- **Main fleets (mean annual catch 2020-2024):** the majority of yellowfin tuna catches are attributed to vessels flagged to Sultanate of Oman (17.3%) followed by Indonesia (11.4%) and I. R. Iran (9.6%). The 35 other fleets catching yellowfin tuna contributed to 61.7% of the total catch in recent years (**Fig. 2**).

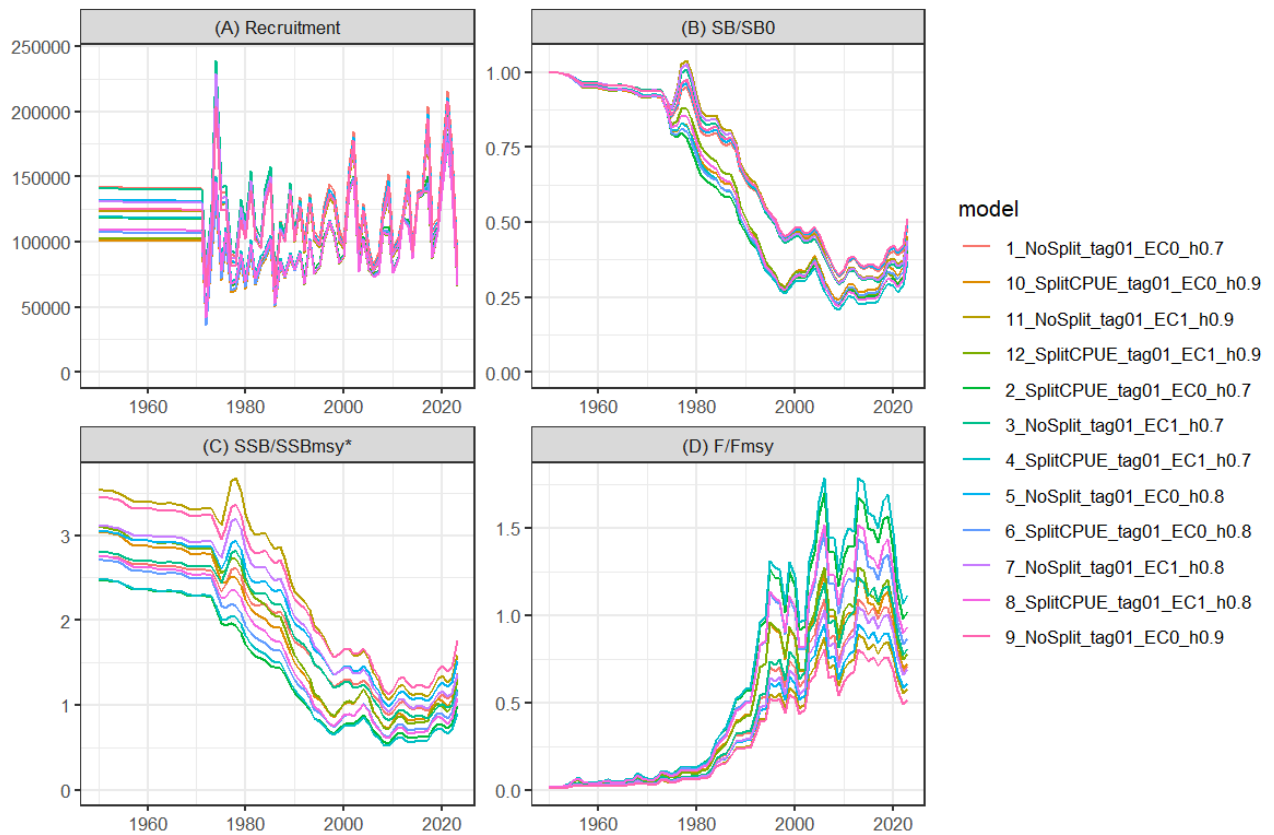
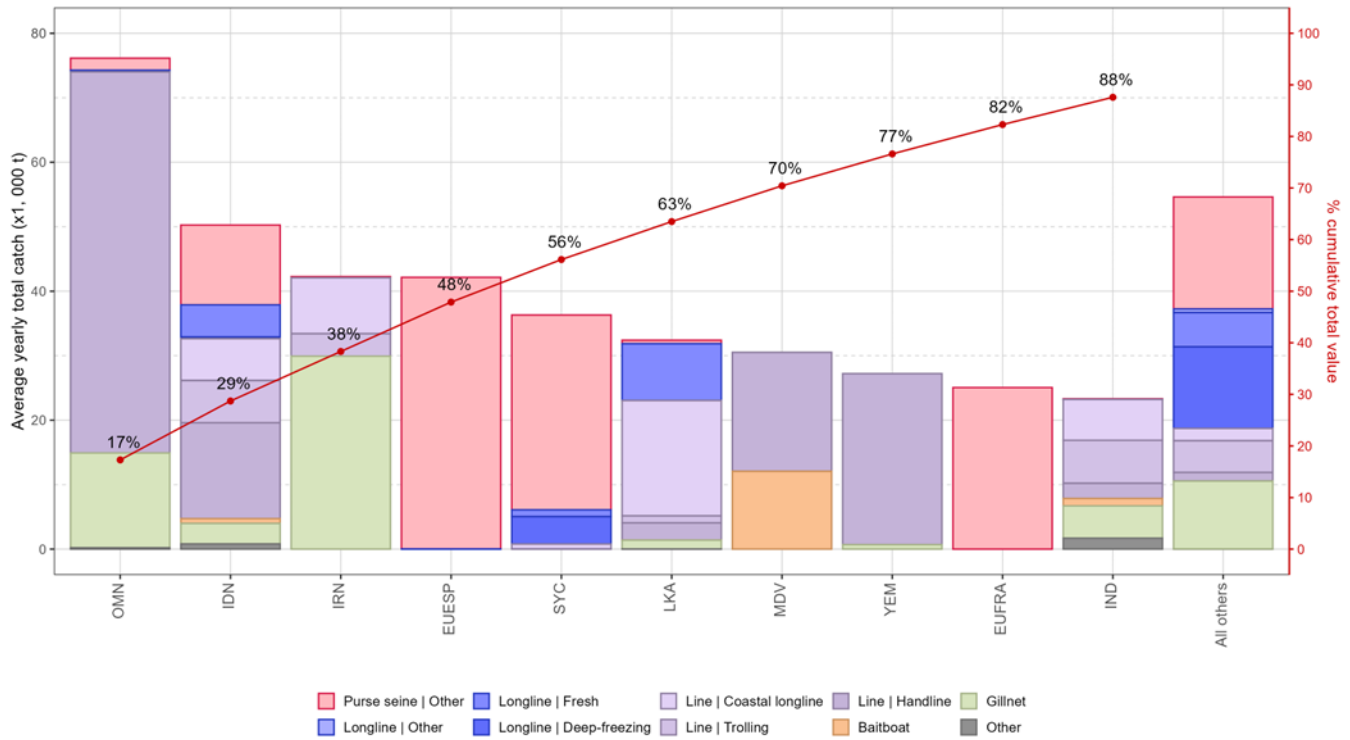
## References

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

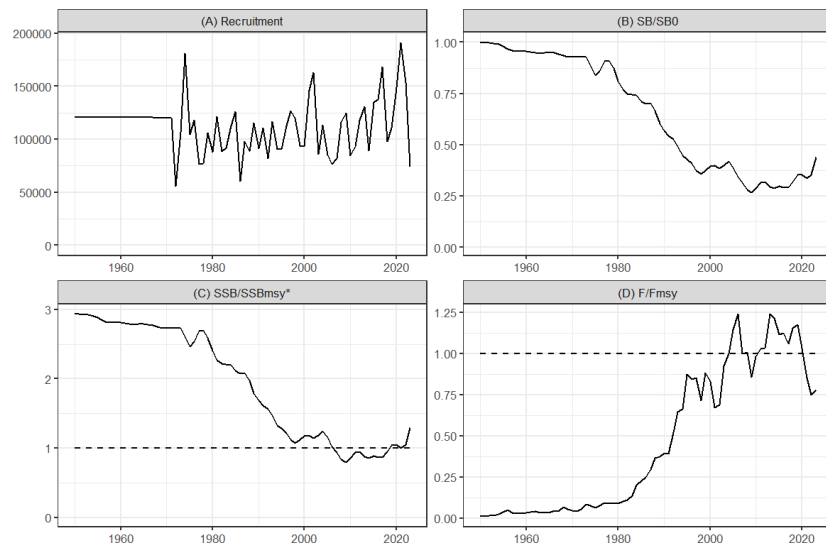


**Fig. 3.** Annual time series of (a) cumulative nominal catches (metric tonnes; t) by fishery and (b) individual nominal catches (metric tonnes; t) by fishery group for yellowfin tuna during 1950-2024.

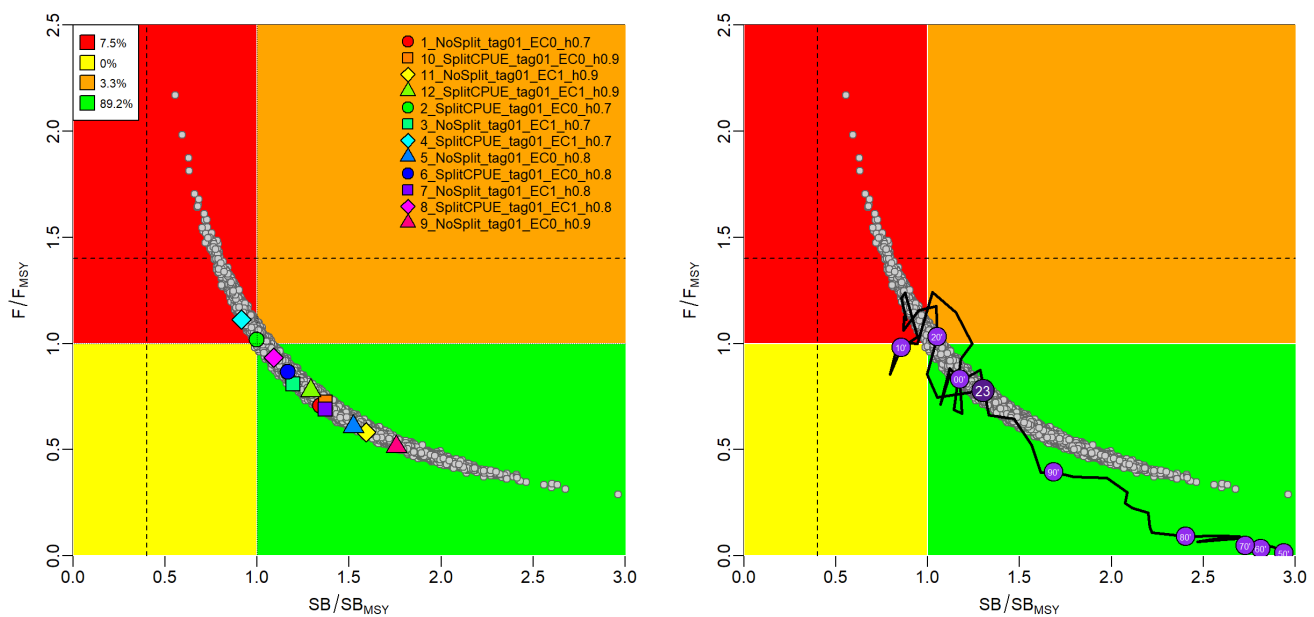
**Fig. 4.** Mean annual catches (metric tonnes; t) of yellowfin tuna by fleet and fishery between 2019 and 2024, with indication of cumulative catches by fleet.



**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.



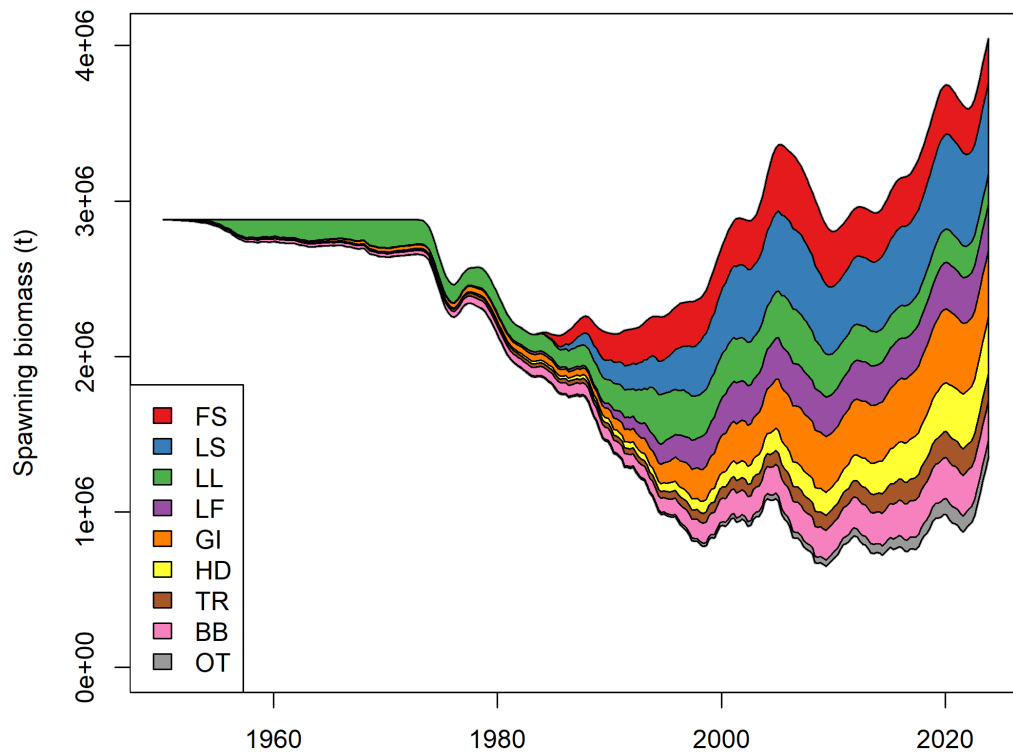
**Fig. 5.** Yellowfin tuna: SS3 Indian Ocean assessment Kobe plot: (left): current (2023) stock status, relative to  $SB_{MSY}$  (x-axis) and  $F_{MSY}$  (y-axis) reference points for the final model options. Coloured symbols represent Maximum posterior density (MPD) estimates from individual models. Grey dots represent the statistical uncertainty from individual models (20,000 replicates from each). 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<br>( $SB_{\text{targ}} = SB_{\text{MSY}}$ ; $F_{\text{targ}} = F_{\text{MSY}}$ )      |     |     |     |     |      |      |      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|------|------|------|
| Reference point and projection timeframe                                                                                                                                                                                   | 60% | 70% | 80% | 90% | 100% | 110% | 120% |
| $SB_{2026} < SB_{\text{MSY}}$                                                                                                                                                                                              | 0   | 0   | 0.1 | 0.1 | 0.6  | 1.3  | 4    |
| $F_{2026} > F_{\text{MSY}}$                                                                                                                                                                                                | 0   | 0   | 0   | 0   | 2.5  | 11.2 | 30.9 |
| Alternative catch projections (relative to the catch level from 2023) and probability of violating MSY-based limit reference points<br>( $SB_{\text{lim}} = 0.4 SB_{\text{MSY}}$ ; $F_{\text{lim}} = 1.4 F_{\text{MSY}}$ ) |     |     |     |     |      |      |      |
| Reference point and projection timeframe                                                                                                                                                                                   | 60% | 70% | 80% | 90% | 100% | 110% | 120% |
| $SB_{2026} < SB_{\text{lim}}$                                                                                                                                                                                              | 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 (2026–2030)**

The following is the Draft WPTT Program of Work (2026–2030) 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 bycatch species in the Indian Ocean.

| Topic in order of priority                                                    | Sub-topic and project                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | TIMING |      |      |      |      |
|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------|------|------|------|
|                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 2026   | 2027 | 2028 | 2029 | 2030 |
| Abundance indices development                                                 | <p>Address the additional recommendations made by the WPTT in 2024 regarding the CPUE indices for yellowfin.</p> <p>In view of the coming assessments of yellowfin, bigeye, and skipjack develop abundance time series for each tropical tuna stock for the Indian Ocean</p> <ul style="list-style-type: none"> <li>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.</li> <li>Explore and support the development of gillnet CPUE indices for fleets (e.g., Iran, Pakistan and Oman)</li> <li>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</li> </ul>                                                                                                                                                                      |        |      |      |      |      |
| Fisheries Independent Monitoring                                              | <p>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).</p> <p>Plan for a staged approach for implementation of a YFT CKMR project</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |        |      |      |      |      |
| Biological and ecological information (incl. parameters for stock assessment) | <p>Biological sampling</p> <p>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.</p> |        |      |      |      |      |
|                                                                               | <p>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.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |      |      |      |      |

|                                   |                                                                                                                                                                                                        |  |  |  |  |  |
|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|
| 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) |                                                                                                                                                                                                                                                                      |      |      |      |      |      |
|---------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|------|
|                                                               |                                                                                                                                                                                                                                                                      | 2026 | 2027 | 2028 | 2029 | 2030 |
| 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 Stock assessment priorities                                 | 2.1 Address the outstanding issues identified as priorities by the yellowfin tuna peer review panel (February 2023). Address any recommendations made by the WPTT or SC in 2025.                                                                                     |      |      |      |      |      |
| 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 | <p>Fishery monitoring</p> <p>6.1 Develop fishery independent estimates of stock abundance to validate the abundance estimates of CPUE series.</p> <p>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 currently under development need to be promoted, as proposed below:</p> <p>Acoustic FAD monitoring, with the objective of deriving abundance indices based on the biomass estimates provided by echo-sounder buoys attached to FADs</p> <p>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</p> <p>6.3 Aerial surveys, potentially using remotely operated or autonomous drones</p> <p>6.4 Studies (research) on flux of tuna around anchored FAD arrays to understand standing stock and independent estimates of the stock abundance.</p> <p>6.5 Investigate the possibility of conducting ongoing ad hoc, low level tagging in the region</p> |  |  |  |  |
| 7 | <p>Target and Limit reference points</p> <p>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</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |  |  |  |
| 8 | <p>Fisheries Indicators</p> <p>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.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |  |  |  |

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

| Species        | 2026                                               | 2027                                                   | 2028                                               | 2029                                               | 2030                                               |
|----------------|----------------------------------------------------|--------------------------------------------------------|----------------------------------------------------|----------------------------------------------------|----------------------------------------------------|
| Bigeye tuna    | Indicators                                         | Data Prep and MP<br>to be run                          | Data preparatory<br>meeting<br><br>Full assessment | Indicators<br><br>MP to be run                     | Data Prep and MP<br>to be run                      |
| Skipjack tuna  | Data preparatory<br>meeting<br><br>Full assessment | Indicators                                             | Data Prep for MP<br>and MP to be run               | Data preparatory<br>meeting<br><br>Full assessment | Indicators                                         |
| Yellowfin tuna | [Indicators]                                       | [Data preparatory<br>meeting]<br><br>[Full assessment] | Indicators                                         | Indicators                                         | Data preparatory<br>meeting<br><br>Full assessment |



## **APPENDIX VIII**

### **CONSOLIDATED RECOMMENDATIONS OF THE 27<sup>TH</sup> SESSION OF THE WORKING PARTY ON TROPICAL TUNAS**

**Bigeye tuna Stock Assessment**

WPTT27.01 (para 102): WPTT **REQUESTED** that the IOTC Secretariat update the draft stock status summary for bigeye tuna with the latest 2024 catch data, if necessary. The WPTT **RECOMMENDED** that the SC develop the stock status advice as part of the Executive Summary, following the review of the final assessment results intersessionally.

- Bigeye tuna (*Thunnus obesus*) – [Appendix VI](#)

**Bigeye tuna Management Procedure**

WPTT27.02 (para 107): **NOTING** the provision in Resolution 23/04 that sets catch limits for some CPCs, including a mechanism to deduct any over catch (as well as a provision to set catch limits for other CPCs if their catches exceed 2000 t), the WPTT **RECOMMENDED** that the Commission review 2024 catches of bigeye tuna as soon as possible and enact, as appropriate, the relevant catch limit setting mechanisms adopted in the Resolution 23/04.

**Yellowfin Tuna – Update on the standardised CPUE indices**

WPTT27.03 (para 127): The WPTT **NOTED** concerns regarding the current process for developing the joint CPUE analysis, specifically related to transparency and reproducibility, and also **NOTED** suggestions for areas where improvements can be made. The WPTT **RECOMMENDED** that future analyses be initiated with adequate lead time to allow for thorough development, review, and consultation. It was further **ENCOURAGED** the code used in the analysis to be standardised, well-documented, version-controlled, and made publicly available to ensure transparency and reproducibility.

WPTT27.04 (para 159): The WPTT **RECOMMENDED** that the SC review the updated CPUE and updated preliminary assessment grid and analyses and evaluate the need to undertake a new full stock assessment (including potentially projections) for yellowfin tuna in 2026 (thus amending the Program of Work if necessary).

**Revision of the WPTT Program of Work (2026–2030)**

WPTT27.05 (para. 222): The WPTT **RECOMMENDED** that the SC consider, amend as necessary, and then endorse the WPTT Program of Work (2026–2030), as provided in [Appendix VII](#).

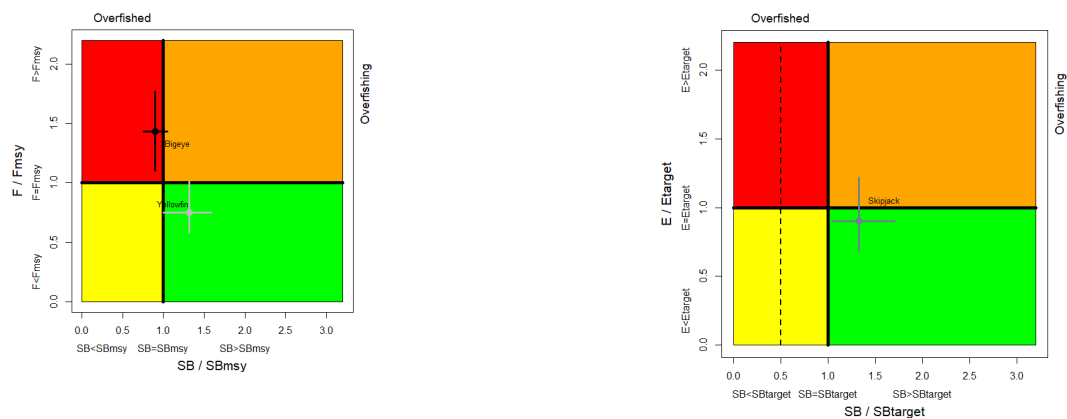
**Date and place of the 27<sup>th</sup> and 28<sup>th</sup> Sessions of the WPTT (Chair and IOTC Secretariat)**

WPTT27.06 (para. 231): 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 2026 as a preferred time period to hold the WPTT28 meeting in 2026. 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 27<sup>th</sup> session of the WPTT**

WPTT27.07 (para. 231): The WPTT **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPTT27, 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 2025 (Figure 1), noting that the final assessment model runs of the bigeye tuna will be completed after the meeting, therefore, the status advice for bigeye tuna should be developed by the SC following the review of the final stock assessment results and update of the Kobe plot intersessionally:

- 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) (TO BE UPDATED BY THE SC for status in 2025), 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%SB<sub>0</sub>). Cross bars illustrate the range of uncertainty from the model runs with an 80% CI.

## Appendix IX

### Grid run for stock status for Indian Ocean bigeye tuna (*Thunnus obesus*) in 2025<sup>1</sup>

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1. Indian Ocean Tuna Commission Secretariat, FAO
2. AZTI, Spain, European Union.

## Introduction

This paper presents the grid run of the 2025 stock assessment of bigeye tuna (*Thunnus obesus*; BET) in the Indian Ocean (IO). As in previous assessments, the objectives of the 2025 bigeye tuna assessment are to estimate population level parameters which indicate the stock status and the impacts of fishing, such as time series of recruitment, spawning stock biomass, biomass depletion, and fishing mortality. The stock status is summarised using reference points that are adopted by the Indian Ocean Tuna Commission (IOTC).

In the 2025 assessment, there are only a few changes and/or improvements to the 2022 analyses in addition to the usual updates to the data. The changes are discussed in detail in the relevant sections of the report and included here briefly for clarity. The model development included testing various methods, including:

- Internal estimation of natural mortality, and application of the Lorenzen form of natural mortality (recommendation in the 2023 CAPAM Tuna Good Practices Workshop). This was carried out by the WCPFC assessment of bigeye tuna in 2023 and the ICCAT assessment of bigeye tuna in 2025.
- An update to growth parameters from a new ageing study (Eveson et al., 2025) that builds on the results presented prior to the 2022 assessment, including changing the model structure from a von Bertalanffy growth model with age-specific  $k$  parameters to a classical von Bertalanffy growth model.
- Internal estimation of growth parameters was tested to understand the sensitivity of the model to this method (using conditional-age-at-length, CAAL within Stock Synthesis), and to check for any potential model misspecification with relation to growth parameters currently estimated externally.
- Inclusion of both the updated joint CPUE longline indices from Japan, Korea, and Taiwan, China, and European (Spain) purse seine CPUE indices from tuna associated sets in two regions of the model.

Most of these sensitivity runs are included in rev2 of the report, and the initial presentation of the stock assessment at the 27<sup>th</sup> WPTT(AS). On the first day of the assessment meeting, a new, updated catch dataset were presented to the WP by the IOTC Secretariat. This dataset included revised catches from Indonesia that reduced the catches in 2023 and 2024 by a total of ~ 20,000 t, and excluded Somalia catch reported only for 2024. It was agreed by the 27<sup>th</sup> WPTT(AS) to use this new catch dataset in the 2025 assessment.

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<sup>1</sup> Presented at an intersessional meeting of the 27<sup>th</sup> WPTT(AS) online on 5<sup>th</sup> November 2025.

The assessment was re-run, including a range of sensitivity runs that focussed on the key biological parameter that the model is sensitive to (M), and these sensitivities runs are outlined in rev4 of the assessment report. A grid of models was developed around a reference model, and 36 models were run to determine the stock status. On the last morning of the meeting, directly after presenting the final grid run, an error was found in half of the models in the grid, requiring the grid to be re-run. Due to time constraints, **this was completed in an intersessional period, alongside two new sensitivity runs that encompassed some additional concerns by the 27<sup>th</sup> WPTT(AS).**

The first sensitivity was the inclusion of catch data submitted in 2024 by Somalia (the first such data to be submitted for bigeye tuna, representing 4,100 t in the terminal year (2024) of the assessment. The second sensitivity run allowed recruitment to vary between the four areas of the model (as opposed to being fixed proportionally between the four areas, as in the reference model). These runs, and results are described in detail in rev4 of the report and were presented at an intersessional meeting of the WPTT on 5<sup>th</sup> November 2025.

In summary, this report documents the grid run of the 2025 stock assessment of the Indian Ocean bigeye tuna stock after consideration of various models during the 27<sup>th</sup> WPTT(AS). The stock assessment is based on the 2022 modelling framework and has incorporated revised and updated data up to the end of 2024, and newly available biological information. The assessment implements a length-based, age-structured and spatially explicit population model fitted to catch per unit effort (CPUE, abundance indices), length composition data, and tagging data. The assessment is implemented in Stock Synthesis (v3.30.24).

### ***Final model options for grid / ensemble***

On basis of the results of sensitivity runs, and preliminary sensitivity runs completed using the previous iteration of the reference models (see rev2 and rev4), final options were configured to capture the uncertainty related to assumptions on the biological parameters of natural mortality, stock-recruitment steepness, selectivity configurations, and ‘effort creep’ which are shown to have contributed to the main sources of uncertainty around the key model estimates.

The final models involved running a combination of options on, LL 2 and 3 selectivity configurations (2 scenarios), steepness (3 values), natural mortality (3 values), and ‘effort creep’ on the joint longline CPUE indices (Table 8, rev4). The final model grid is, therefore almost the same as the 2022 assessment, providing a degree of continuity. Final models included the purse seine CPUE indices (short indices). The model **io\_h80\_Gnew\_MBase2025\_sD\_LL** can be considered as a reference model in the final model ensemble. These models encompass a wide range of stock trajectories, with low steepness values generally yielding lower estimates of biomass (Table 1).

These results presented below are considered the final run of the grid for 2025, based on extensive modelling updates, and discussions at the 27<sup>th</sup>WPTT (AS).

## **Stock Status**

### ***Current status and yields***

MSY based estimates of stock status were determined for the final model options, including alternative assumptions on selectivity, alternative values of SRR steepness, “effort creep”, and natural mortality. Stock status was determined for individual models (Table 1), as well as for all (36) models combined incorporating uncertainty from individual models based on estimated variance-covariance matrix of parameters (Table 2).

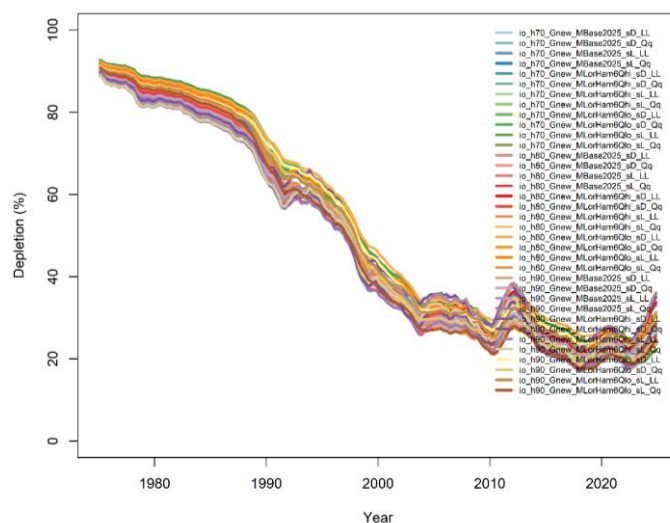
For the selected model options, point estimates of  $MSY$  ranged from 90,984 to 114,675 t (Table 1) which are all above the current estimates of catch in 2023 and 2024 (Table 2, Table 3). Model options with lower natural mortality generally yielded comparatively lower estimates of  $MSY$ . On average fishing mortality rates have remained well below the  $F_{MSY}$  through to 1990s and 2000s, increased significantly after 2015 where  $F$  was estimated to be greater than  $F_{MSY}$ , and declined afterward below  $F_{MSY}$  (Figure 4). Biomass was estimated to have declined considerably from the late 1990s before stabilizing through the 2000s and declined again following a small increase after 2011 – 12 (Figure 1). Since 2020, the biomass is estimated to have stabilised and is now increasing, in line with a decrease in fishing mortality.

Models that had selectivity estimated as double normal on LL2 and LL3 fleets estimate similar levels of  $SSB_0$  compared to those with logistic selectivity (Table 1), however  $MSY$  estimates are lower with logistic selectivity, and estimates of stock status are slightly higher.

The grid encompasses a wide range of uncertainty in initial biomass estimates (Figure 2), with the rate of depletion varying between models, as current estimates of biomass are relatively similar between model options.

Diagnostic tables are provided for all models in the grid, using code developed by G. Correa in Appendix D of rev4 of the report.

Current fishing mortality ( $F_{2024}$ ) was estimated to be lower than  $F_{MSY}$  for 23 out of 36 models, and current biomass ( $SSB_{2024}$ ) was estimated to be between 67.1% and 157.5 % of  $SSB_{MSY}$  (Table 1). In general, current stock status relative to the  $MSY$  based benchmarks is not fundamentally different for the range of model options, although the proximity to the  $MSY$  benchmarks is sensitive to the different of model assumptions. Current spawning biomass was estimated to be below the  $SSB_{MSY}$  level ( $SB_{2024}/SB_{MSY} < 1.0$ ) for 19 models, while 17 models estimated it to be above. Current fishing mortality ( $F_{2024}$ ) is estimated to be below  $F_{MSY}$  for 23 models, and above for 13 models. Estimates were combined across from the 36 models to generate the final KOBE stock status plot (Figure 3). For individual models, the uncertainty is characterised using the multivariate lognormal Monte-Carlo approach (Walter et al. 2019, Walter & Winker 2019, Winker et al. 2019), based on the maximum likelihood estimates and variance-covariance of the untransformed quantities  $F/F_{MSY}$  and  $SSB/SSB_{MSY}$ . Thus, estimates of stock status included both within and across model uncertainty. Combined across the model ensemble, as a median value,  $SSB_{2024}$  was estimated to be at 0.98  $SSB_{MSY}$  (0.71-1.25), and  $F_{2024}$  was estimated 0.94  $F_{MSY}$  (0.69-1.18) (Table 2).



**Figure 1: Spawning biomass trajectories (depletion %) from the proposed final model options in the grid**

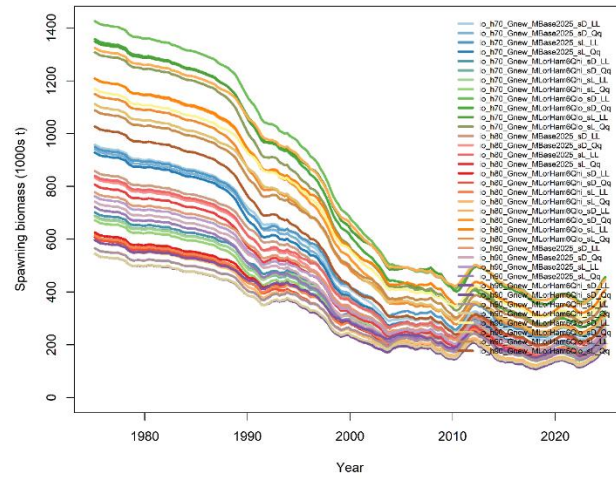


Figure 2: Spawning biomass trajectories (1000 t) from the proposed final model options in the grid

Table 1: Estimates of management quantities for the stock assessment model options. Current yield (mt) represents yield in 2024 corresponding to fishing mortality at the FMSY level.

|                               | SSB <sub>0</sub> | SSB <sub>MSY</sub> | SSB <sub>2024</sub> | SSB <sub>2024</sub> /SSB <sub>0</sub> | SSB <sub>2024</sub> /SSB <sub>MSY</sub> | F <sub>MSY</sub> | F <sub>2024</sub> | F <sub>2024</sub> /F <sub>MSY</sub> | C <sub>MSY</sub> |
|-------------------------------|------------------|--------------------|---------------------|---------------------------------------|-----------------------------------------|------------------|-------------------|-------------------------------------|------------------|
| io_h70_Gnew_MBase2025_sD_LL   | 1,046,270        | 327,181            | 280,726             | 0.2683110                             | 0.8580136                               | 0.2179288        | 0.2372557         | 1.0886843                           | 97,120           |
| io_h70_Gnew_MBase2025_sD_Qq   | 1,026,110        | 315,169            | 228,504             | 0.2226896                             | 0.7250205                               | 0.2033628        | 0.2691715         | 1.3236025                           | 98,443           |
| io_h70_Gnew_MBase2025_sL_LL   | 1,034,920        | 317,099            | 304,286             | 0.2940189                             | 0.9595931                               | 0.2269980        | 0.2212861         | 0.9748372                           | 95,596           |
| io_h70_Gnew_MBase2025_sL_Qq   | 1,013,230        | 307,355            | 241,980             | 0.2388204                             | 0.7872981                               | 0.2175632        | 0.2573424         | 1.1828398                           | 95,788           |
| io_h70_Gnew_MLorHam6Qhi_sD_LL | 770,352          | 227,629            | 241,577             | 0.3135924                             | 1.0612729                               | 0.2279372        | 0.2020500         | 0.8864283                           | 101,745          |
| io_h70_Gnew_MLorHam6Qhi_sD_Qq | 756,608          | 221,102            | 197,652             | 0.2612347                             | 0.8939415                               | 0.2139224        | 0.2294719         | 1.0726878                           | 101,817          |
| io_h70_Gnew_MLorHam6Qhi_sL_LL | 753,261          | 221,990            | 248,472             | 0.3298614                             | 1.1192925                               | 0.2326096        | 0.2030031         | 0.8727200                           | 99,607           |
| io_h70_Gnew_MLorHam6Qhi_sL_Qq | 739,271          | 217,180            | 203,268             | 0.2749567                             | 0.9359402                               | 0.2183216        | 0.2302725         | 1.0547397                           | 99,357           |
| io_h70_Gnew_MLorHam6Qlo_sD_LL | 1,539,800        | 516,848            | 425,981             | 0.2766466                             | 0.8241891                               | 0.1998400        | 0.2243282         | 1.1225390                           | 97,704           |
| io_h70_Gnew_MLorHam6Qlo_sD_Qq | 1,470,030        | 465,278            | 312,464             | 0.2125564                             | 0.6715646                               | 0.1987616        | 0.2823895         | 1.4207450                           | 97,438           |
| io_h70_Gnew_MLorHam6Qlo_sL_LL | 1,456,120        | 455,949            | 433,194             | 0.2974990                             | 0.9500937                               | 0.2242984        | 0.2151367         | 0.9591538                           | 91,202           |
| io_h70_Gnew_MLorHam6Qlo_sL_Qq | 1,414,290        | 440,799            | 346,075             | 0.2446986                             | 0.7851078                               | 0.2171064        | 0.2474439         | 1.1397358                           | 90,984           |
| io_h80_Gnew_MBase2025_sD_LL   | 945,276          | 266,455            | 264,356             | 0.2796596                             | 0.9921206                               | 0.2622152        | 0.2425414         | 0.9249707                           | 99,564           |
| io_h80_Gnew_MBase2025_sD_Qq   | 918,894          | 255,275            | 217,337             | 0.2365199                             | 0.8513828                               | 0.2488980        | 0.2752288         | 1.1057895                           | 99,766           |
| io_h80_Gnew_MBase2025_sL_LL   | 925,627          | 251,628            | 265,484             | 0.2868156                             | 1.0550664                               | 0.2723068        | 0.2389532         | 0.8775148                           | 98,250           |
| io_h80_Gnew_MBase2025_sL_Qq   | 890,561          | 244,051            | 213,199             | 0.2393980                             | 0.8735818                               | 0.2550876        | 0.2768714         | 1.0853975                           | 97,036           |
| io_h80_Gnew_MLorHam6Qhi_sD_LL | 693,800          | 178,365            | 220,551             | 0.3178884                             | 1.2365150                               | 0.2842376        | 0.2087201         | 0.7343157                           | 105,393          |
| io_h80_Gnew_MLorHam6Qhi_sD_Qq | 674,977          | 173,451            | 180,780             | 0.2678310                             | 1.0422526                               | 0.2635132        | 0.2336398         | 0.8866342                           | 104,458          |
| io_h80_Gnew_MLorHam6Qhi_sL_LL | 682,131          | 176,060            | 227,289             | 0.3332043                             | 1.2909747                               | 0.2896388        | 0.2116922         | 0.7308835                           | 103,447          |
| io_h80_Gnew_MLorHam6Qhi_sL_Qq | 663,226          | 170,661            | 184,520             | 0.2782151                             | 1.0812048                               | 0.2664760        | 0.2374979         | 0.8912543                           | 102,617          |
| io_h80_Gnew_MLorHam6Qlo_sD_LL | 1,437,400        | 454,646            | 427,654             | 0.2975191                             | 0.9406307                               | 0.2336812        | 0.2192412         | 0.9382065                           | 98,342           |
| io_h80_Gnew_MLorHam6Qlo_sD_Qq | 1,320,830        | 399,832            | 298,201             | 0.2257679                             | 0.7458157                               | 0.2333520        | 0.2851369         | 1.2219175                           | 97,328           |
| io_h80_Gnew_MLorHam6Qlo_sL_LL | 1,314,920        | 370,203            | 386,905             | 0.2942420                             | 1.0451151                               | 0.2682196        | 0.2295334         | 0.8557668                           | 94,087           |
| io_h80_Gnew_MLorHam6Qlo_sL_Qq | 1,256,510        | 352,182            | 301,323             | 0.2398097                             | 0.8555896                               | 0.2562104        | 0.2660021         | 1.0382172                           | 93,070           |
| io_h90_Gnew_MBase2025_sD_LL   | 863,369          | 208,328            | 242,708             | 0.2811176                             | 1.1650294                               | 0.3238832        | 0.2527422         | 0.7803498                           | 102,701          |
| io_h90_Gnew_MBase2025_sD_Qq   | 827,162          | 198,151            | 191,667             | 0.2317167                             | 0.9672787                               | 0.2986104        | 0.2863667         | 0.9589977                           | 102,197          |
| io_h90_Gnew_MBase2025_sL_LL   | 848,271          | 200,543            | 242,670             | 0.2860754                             | 1.2100622                               | 0.3327540        | 0.2495264         | 0.7498825                           | 101,309          |
| io_h90_Gnew_MBase2025_sL_Qq   | 805,375          | 192,087            | 195,513             | 0.2427596                             | 1.0178331                               | 0.3071344        | 0.2874472         | 0.9359005                           | 99,238           |
| io_h90_Gnew_MLorHam6Qhi_sD_LL | 664,233          | 141,812            | 219,685             | 0.3307345                             | 1.5491267                               | 0.3645244        | 0.1983389         | 0.5441033                           | 114,675          |
| io_h90_Gnew_MLorHam6Qhi_sD_Qq | 612,904          | 133,279            | 168,734             | 0.2753021                             | 1.2660190                               | 0.3454384        | 0.2366442         | 0.6850547                           | 107,218          |
| io_h90_Gnew_MLorHam6Qhi_sL_LL | 633,139          | 135,830            | 214,002             | 0.3380020                             | 1.5755154                               | 0.3780436        | 0.2158811         | 0.5710483                           | 108,659          |
| io_h90_Gnew_MLorHam6Qhi_sL_Qq | 612,632          | 131,836            | 175,900             | 0.2871218                             | 1.3342334                               | 0.3481380        | 0.2384701         | 0.6849873                           | 107,116          |
| io_h90_Gnew_MLorHam6Qlo_sD_LL | 1,281,920        | 356,308            | 364,063             | 0.2839980                             | 1.0217642                               | 0.2945592        | 0.2487266         | 0.8444027                           | 99,434           |
| io_h90_Gnew_MLorHam6Qlo_sD_Qq | 1,222,100        | 332,082            | 290,875             | 0.2380122                             | 0.8759124                               | 0.2746828        | 0.2877322         | 1.0475073                           | 100,983          |
| io_h90_Gnew_MLorHam6Qlo_sL_LL | 1,194,970        | 295,803            | 344,284             | 0.2881110                             | 1.1638962                               | 0.3205020        | 0.2449494         | 0.7642680                           | 96,484           |
| io_h90_Gnew_MLorHam6Qlo_sL_Qq | 1,133,040        | 277,093            | 262,824             | 0.2319636                             | 0.9485047                               | 0.3043076        | 0.2850927         | 0.9368570                           | 95,330           |

Table 2: STOCK STATUS INDICATORS FROM MODEL ENSEMBLE

|                                 |                  |
|---------------------------------|------------------|
| Catch in 2024:                  | 82,874 t         |
| Average catch 2020–2024:        | 87,721 t         |
| MSY (1000 t) (plausible range): | 100 (94-106)     |
| $F_{MSY}$                       | 0.27 (0.21-0.33) |
| $SSB_0$ (1000 t) (80% CI):      | 985 (623-1346)   |
| $SSB_{2024}$ (1000 t) (80% CI): | 266 (172-359)    |
| $SSB_{MSY}$                     | 276 (143-409)    |
| $SSB_{2024}/SSB_0$ (80% CI):    | 0.27 (0.23-0.32) |
| $SSB_{2024}/SSB_{MSY}$          | 0.98 (0.71-1.25) |
| $F_{2024}/F_{MSY}$              | 0.94 (0.69-1.18) |

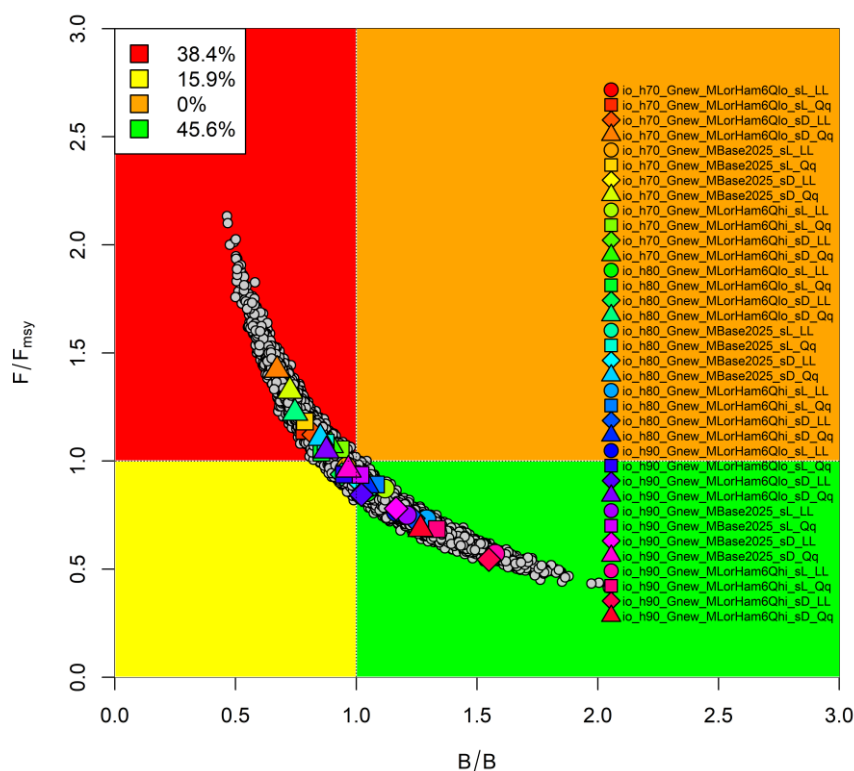
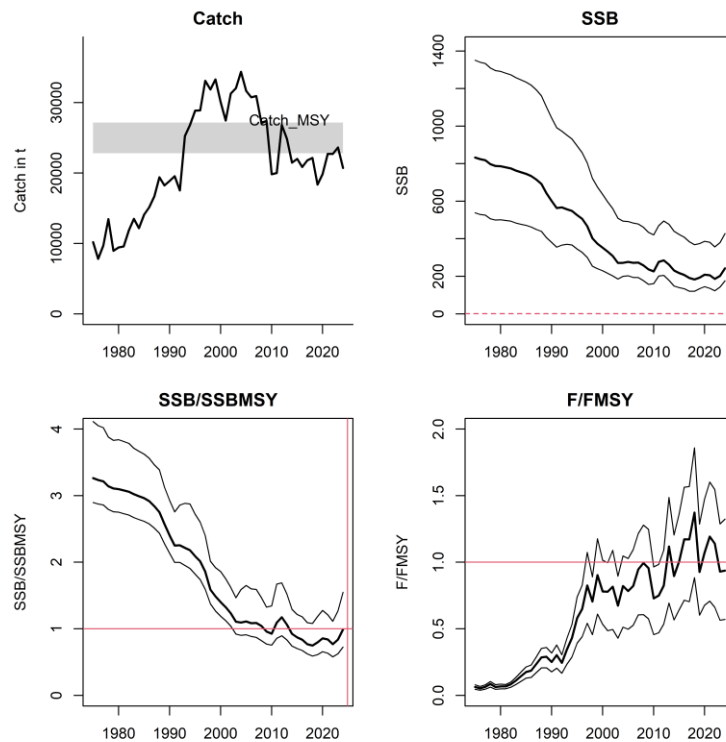


Figure 3: KOBE PLOT FROM GRID RUNS

In the 2022 assessment (using data up to 2021) the model ensemble estimated that the stock was **overfished** and **subject to overfishing** in 2021, this was a change from the 2019 assessment when the stock was estimated to be **not overfished** but subject to **overfishing**.

The estimated biomass trajectory shows a decline from exploited but equilibrium spawning stock biomass levels in 1975 to 2012 (Figure 4). Biomass levels appear to have stabilised after a decline from 2012 to 2021 and are increasing in the final years of the model, providing a more positive outlook for the stock, presumably as there are now several years of catch at or below that of MSY and fishing mortality is cycling around and above that of  $F_{MSY}$ . As there is a significant lack of representative biological data (length data, and representative ages), the model is forced to fit

closely to the main abundance indices from the longline fleets. As there have been increases in these indices in the three most recent years (2022-2024 inclusive), the CPUE indices alongside decreased catches, are driving the increase in estimated biomass in the model.



**Figure 4: Management outputs from the ensemble of models (grid) used in 2024. Bounds around the main darker line represent the highest and lowest values from the grid of models. The grey band on the catch graph represents estimated optimal catch at MSY (80 % confidence interval). The horizontal red lines indicate limit or reference points for  $SSB/SSB_{MSY}$  and  $F/F_{MSY}$ .**

## Discussion

This report presents the final grid runs for the stock assessment for Indian Ocean bigeye tuna using a spatially explicit, age structured model. It represents an update and revision of the 2022 assessment model with newly available information.

The overall stock status estimates obtained from a range of model options is similar to the previous assessment: current median spawning biomass is slightly below  $SSB_{MSY}$  ( $SSB_{2024}/SSB_{MSY} = 0.98$ ), and the median fishing mortality is estimated to be below  $F_{MSY}$  ( $F_{2024}/F_{MSY} = 0.94$ ) (Mean SSB was estimated to be above  $SSB_{MSY}$  in the 2019 assessment, and at 0.90 in the 2022 assessment). This has been mostly caused by changes in CPUE indices for all regions, which have shown increases in the most recent years, and relatively stable catches in the last 5 years, which are below estimates of  $C_{MSY}$ .

Table 3: Diagnostics for the grid models used in the 2025 bigeye tuna assessment

| Model                         | No.<br>pars | Max<br>gradient | Hessian<br>invertible? | NLL     | No. pars<br>on<br>bounds | Mohn<br>rho SSB | Mohn<br>rho F | Mohn<br>rho Rec | Mohn<br>rho<br>Bratio | Trend in<br>recdevs? |
|-------------------------------|-------------|-----------------|------------------------|---------|--------------------------|-----------------|---------------|-----------------|-----------------------|----------------------|
| io_h70_Gnew_MBase2025_sD_LL   | 313         | < 1e-04         | FALSE                  | 1042.3  | 3                        | -0.01           | 0.11          | 0.09            | -0.01                 | FALSE                |
| io_h70_Gnew_MBase2025_sD_Qq   | 313         | < 1e-04         | FALSE                  | 1027.25 | 2                        | -0.03           | 0.11          | 0.2             | -0.03                 | FALSE                |
| io_h70_Gnew_MBase2025_sL_LL   | 309         | < 1e-04         | FALSE                  | 1077.62 | 3                        | -0.03           | 0.06          | -0.05           | -0.01                 | FALSE                |
| io_h70_Gnew_MBase2025_sL_Qq   | 309         | < 1e-04         | FALSE                  | 1069.17 | 4                        | 0.01            | 0.04          | 0.09            | 0.01                  | FALSE                |
| io_h70_Gnew_MLorHam6Qhi_sD_LL | 313         | < 1e-04         | FALSE                  | 1035.96 | 2                        | -0.06           | 0.1           | 0.14            | -0.04                 | FALSE                |
| io_h70_Gnew_MLorHam6Qhi_sD_Qq | 313         | < 1e-04         | FALSE                  | 1033.81 | 2                        | -0.03           | 0.05          | 0.27            | -0.03                 | FALSE                |
| io_h70_Gnew_MLorHam6Qhi_sL_LL | 309         | < 1e-04         | FALSE                  | 1057.06 | 2                        | -0.04           | 0.09          | -0.08           | -0.02                 | FALSE                |
| io_h70_Gnew_MLorHam6Qhi_sL_Qq | 309         | < 1e-04         | FALSE                  | 1048.01 | 3                        | -0.01           | 0.04          | 0.03            | -0.01                 | FALSE                |
| io_h70_Gnew_MLorHam6Qlo_sD_LL | 313         | 2.00E-04        | FALSE                  | 1049.71 | 1                        | -0.02           | 0.05          | 0.19            | -0.01                 | FALSE                |
| io_h70_Gnew_MLorHam6Qlo_sD_Qq | 313         | 1.00E-04        | FALSE                  | 1033.3  | 3                        | 0.04            | 0.02          | 0.43            | -0.03                 | FALSE                |
| io_h70_Gnew_MLorHam6Qlo_sL_LL | 309         | < 1e-04         | FALSE                  | 1109.85 | 4                        | -0.01           | 0.03          | 0.18            | -0.01                 | FALSE                |
| io_h70_Gnew_MLorHam6Qlo_sL_Qq | 309         | < 1e-04         | FALSE                  | 1106.45 | 3                        | 0.01            | 0             | 0.38            | 0.01                  | FALSE                |
| io_h80_Gnew_MBase2025_sD_LL   | 313         | < 1e-04         | FALSE                  | 1031.34 | 2                        | -0.04           | 0.08          | 0.18            | -0.03                 | FALSE                |
| io_h80_Gnew_MBase2025_sD_Qq   | 313         | < 1e-04         | FALSE                  | 1034.75 | 3                        | -0.08           | 0.12          | 0.28            | -0.07                 | FALSE                |
| io_h80_Gnew_MBase2025_sL_LL   | 309         | < 1e-04         | FALSE                  | 1075.97 | 4                        | -0.01           | 0.06          | -0.02           | -0.02                 | FALSE                |
| io_h80_Gnew_MBase2025_sL_Qq   | 309         | < 1e-04         | FALSE                  | 1069.83 | 4                        | 0               | 0.04          | 0.12            | -0.01                 | FALSE                |
| io_h80_Gnew_MLorHam6Qhi_sD_LL | 313         | < 1e-04         | FALSE                  | 1076.81 | 4                        | -0.11           | 0.11          | 0.3             | -0.07                 | TRUE                 |
| io_h80_Gnew_MLorHam6Qhi_sD_Qq | 313         | < 1e-04         | FALSE                  | 1045.2  | 4                        | -0.02           | 0.04          | 0.43            | -0.02                 | FALSE                |
| io_h80_Gnew_MLorHam6Qhi_sL_LL | 309         | < 1e-04         | FALSE                  | 1055.88 | 2                        | -0.01           | 0.07          | 0.02            | 0                     | FALSE                |
| io_h80_Gnew_MLorHam6Qhi_sL_Qq | 309         | < 1e-04         | FALSE                  | 1050.74 | 3                        | 0.01            | 0.01          | 0.18            | 0                     | FALSE                |
| io_h80_Gnew_MLorHam6Qlo_sD_LL | 313         | < 1e-04         | FALSE                  | 1047.71 | 3                        | -0.21           | 0.18          | 0.13            | -0.12                 | FALSE                |
| io_h80_Gnew_MLorHam6Qlo_sD_Qq | 313         | 0.0078          | FALSE                  | 1046.85 | 3                        | -0.04           | 0.17          | 0.33            | -0.06                 | FALSE                |
| io_h80_Gnew_MLorHam6Qlo_sL_LL | 309         | < 1e-04         | FALSE                  | 1109.23 | 4                        | 0.01            | 0.01          | 0.28            | 0                     | FALSE                |
| io_h80_Gnew_MLorHam6Qlo_sL_Qq | 309         | < 1e-04         | FALSE                  | 1106.5  | 3                        | 0.03            | -0.02         | 0.41            | 0.01                  | FALSE                |
| io_h90_Gnew_MBase2025_sD_LL   | 313         | < 1e-04         | FALSE                  | 1037.94 | 3                        | -0.05           | 0.08          | 0.28            | -0.05                 | FALSE                |
| io_h90_Gnew_MBase2025_sD_Qq   | 313         | < 1e-04         | FALSE                  | 1036.72 | 2                        | -0.01           | 0.02          | 0.41            | -0.03                 | FALSE                |
| io_h90_Gnew_MBase2025_sL_LL   | 309         | < 1e-04         | FALSE                  | 1075.93 | 4                        | -0.01           | 0.05          | 0.01            | -0.01                 | FALSE                |
| io_h90_Gnew_MBase2025_sL_Qq   | 309         | < 1e-04         | FALSE                  | 1065    | 2                        | 0               | 0.04          | 0.14            | -0.02                 | FALSE                |
| io_h90_Gnew_MLorHam6Qhi_sD_LL | 313         | < 1e-04         | FALSE                  | 1086.08 | 3                        | -0.08           | 0.09          | 0.44            | -0.05                 | TRUE                 |
| io_h90_Gnew_MLorHam6Qhi_sD_Qq | 313         | < 1e-04         | FALSE                  | 1053.09 | 3                        | 0.01            | 0.03          | 0.57            | 0.02                  | TRUE                 |
| io_h90_Gnew_MLorHam6Qhi_sL_LL | 309         | < 1e-04         | FALSE                  | 1057.76 | 2                        | -0.03           | 0.07          | 0.14            | -0.02                 | TRUE                 |
| io_h90_Gnew_MLorHam6Qhi_sL_Qq | 309         | < 1e-04         | FALSE                  | 1056.09 | 4                        | 0.01            | 0.02          | 0.35            | 0                     | TRUE                 |
| io_h90_Gnew_MLorHam6Qlo_sD_LL | 313         | < 1e-04         | FALSE                  | 1042.18 | 2                        | -0.08           | 0.16          | 0.23            | -0.07                 | FALSE                |
| io_h90_Gnew_MLorHam6Qlo_sD_Qq | 313         | < 1e-04         | FALSE                  | 1053.93 | 2                        | -0.03           | 0.11          | 0.43            | -0.09                 | FALSE                |
| io_h90_Gnew_MLorHam6Qlo_sL_LL | 309         | < 1e-04         | FALSE                  | 1109.46 | 3                        | 0.02            | 0             | 0.27            | 0.01                  | FALSE                |
| io_h90_Gnew_MLorHam6Qlo_sL_Qq | 309         | < 1e-04         | FALSE                  | 1107.13 | 3                        | 0.04            | -0.03         | 0.39            | 0.01                  | FALSE                |