Report of the 2024 ICCAT Yellowfin Tuna Data Preparatory Meeting
(hybrid/Madrid, Spain, 8-12 April 2024)

1. Opening, adoption of agenda and meeting arrangements

The hybrid meeting was held in person at the ICCAT Secretariat in Madrid Spain, and online, from 8 to 12 April 2024. Dr Shannon Cass-Calay (U.S.), Yellowfin Tuna Rapporteur and meeting Chair, opened the meeting and welcomed participants ("the Group"). Mr Camille Manel, ICCAT Executive Secretary, welcomed the participants and wished them success in their meeting.

The Chair proceeded to review the Agenda which was adopted with some changes (**Appendix 1**). The List of participants is included in **Appendix 2.** The List of papers and presentations presented at the meeting is attached as **Appendix 3.** The abstracts of all SCRS documents and presentations presented at the meeting are included in **Appendix 4**. The following participants served as rapporteurs:

Sections	Rapporteur
Items 1 and 11	M. Ortiz
Item 2	S. Cass-Calay, D. Angueko
Item 3	C. Mayor, F. Fiorellato, J. Garcia, M. Ortiz
Item 4	M. Nuttall, G. Diaz, A. Kimoto
Item 5	M. Lauretta, G. Merino
Item 6	R. Sant'Ana, G. Merino
Item 7	S. Wright, M. Neves dos Santos
Item 8	D. Die, M. Ortiz
Item 9	S. Cass-Calay
Item 10	S. Cass-Calay, C. Brown

2. Review of historical and new information on biology

a. AOTTP Program Update

No new information on analyses from the AOTTP Program data was presented.

b. Natural Mortality

Document SCRS/2024/037 presents estimates of natural mortality (M) of yellowfin tuna (*Thunnus albacares*) in the Atlantic and Indian Oceans. The authors combined 4 empirical estimators, including one based on longevity, two based on growth, and one based on taxonomy. M values varied according to the estimators used for this species in the two oceans. The basic composite values of M obtained were estimated at 0.46 yr^{-1} and 0.47 yr^{-1} for this species in the Atlantic and Indian Oceans, respectively. Furthermore, for the case of Atlantic Ocean yellowfin tuna, values derived from M-at-age were higher than those considered by ICCAT in the latest (2019) Yellowfin Tuna Stock Assessment (Anon., 2019), which assumed a baseline M value of 0.35 yr^{-1} after following the equation of Then *et al.* (2015) and using a maximum age (A_{MAX}) = 18 yr (Anon., 2020).

The authors highlighted current information gaps. These gaps prevent more accurate estimates of M. Therefore, it was recommended that a broader biological sampling of yellowfin tuna could help reduce uncertainties associated with this parameter. Also, focusing sampling on the largest size ranges available could be particularly useful for estimating A_{MAX} from otolith samples, as well as focusing on areas where fishing mortality is low and areas where fishing pressure is known to be high.

With regard to the results of document SCRS/2024/037, the Group recognized the value of the attempt to more fully explore M estimation and its uncertainty using a variety of empirical approaches, and also the recommendations provided. The Group generally did not support the M obtained from the application of the von Bertalanffy growth curve from Pacicco *et al.* (2021), because that growth curve did not have a good representation of the growth of young ages 0 and 1. For this reason, it was rejected in favor of Richards growth function (Richards, 1959). Similarly, the Group expressed concerns regarding the Then *et al.* (2015) approach to estimate natural mortality from longevity because it has since been improved upon and superseded by Hamel and Cope (2022). Finally, the Group expressed concerns about the Fish Base database approach as it used only one estimate of the maximum observed age of yellowfin tuna from the Pacific, which was very low (9) compared to the Atlantic (18), and it was from a population experiencing significant fishing pressure. Of the models presented, the most reliable empirical estimate was based on longevity with an A_{MAX} of 18, resulting in a base M = 0.3 (Hamel and Cope, 2022). During the meeting, it was also noted that the relationship between A_{MAX} and M was determined by fitting estimates from populations that were mostly unfished or where the fishing impact has been small, excluding heavily exploited populations.

A related presentation was provided (SCRS/P/2024/012) concerning the recommendations from a workshop on best practices from the Center for the Advancement of Population Assessment Methodology (CAPAM). A keynote presentation by Hoyle on natural mortality during the Tuna Stock Assessment Best Practices Workshop focused on global yellowfin tuna assessments and emphasized that the 2019 ICCAT Atlantic yellowfin tuna assessment was closely aligned with current best practices (https://capamresearch.org/recordings-tuna-stock-assessment-good-practices-workshop; https://www.youtube.com/watch?v=eJFmOOt3MUk&list=PLKeH-azh54PVgOjmJ1Gw4gmaCBQ0PDrz3&index=5). The authors concluded that Hamel and Cope's (2022) study on estimating natural mortality was most consistent with the best practices, as described by the CAPAM workshop, and recommended that this approach (M = 5.40/A_{MAX}) be used whenever reasonable estimates of A_{MAX} are available. Furthermore, the authors noted that the conclusions of the Pacicco *et al.* (2021) study also support the base M obtained using the Hamel and Cope (2022) estimator, at least as applied to age, growth, and mortality estimates of yellowfin tuna in the northern Gulf of Mexico.

Finally, a summary of the external review of the 2019 Yellowfin Tuna Stock Assessment was presented (Methot, 2020). The Group was reminded that the reviewer emphasized an important innovation of the 2019 assessment on the application of a Lorenzen approach to estimate M-at-age using a base M based on the Then *et al.* (2015) estimator and an A_{MAX} of 18. In conclusion, the presenter suggested the Group continue following the best practice recommendations for tuna stock assessments (e.g. Lorenzen M, with base M based on longevity). To better inform its decisions, the Group requested additional information about the interpretation of maximum age, as the maximum age of 18 in the 2019 Yellowfin Tuna Stock Assessment raised questions about the representativeness of this age in the population.

Following the presentation and a consultation with two experts on the estimation of M in stock assessment (Pers. Comm, Hoenig and Cope), the Group decided to estimate the base M using the Hamel and Cope (2022) estimator with an A_{MAX} of 18 and scaling the M-at-age assuming a Lorenzen function internally in stock synthesis (SS3). Additionally, to incorporate uncertainty around base M, the Group recommended drawing from a lognormal prior distribution. This approach allows correlated parameters to be estimated consistently and internally in the stock assessment model. The Group also noted that this approach would be consistent with the method applied to the 2023 Atlantic Albacore Stock Assessment (Anon., 2023).

c. Age and growth

A study on the age and growth of yellowfin tuna in the U.S. Gulf of Mexico and Western Atlantic was published in 2021 (Pacicco *et al.*, 2021). The age estimate was based on the reading of sections from over 3,000 otoliths from the U.S. recreational fishery and the U.S. Pelagic Observer Program for longline vessels.

Age determination in this study took into account the updated criteria defined at the International Workshop on the Ageing of Yellowfin and Bigeye Tuna in 2019 (Allman *et al.*, 2020), on the fact that if the margin is narrow and translucent, the number of rings equals the calendar age (every month). Concerning sex-specific growth, the likelihood ratio tests indicated that growth curves from males and females were statistically different in both size-modified models (Richards: P<0,001; VBGM: P<0,001) with males reaching a greater asymptotic length (L_∞), and similar L_∞ compared to other studies were annual ages were estimated from sectioned otoliths. The maximum age has been validated as 16-18 for six individuals. The Richards model (Richards, 1959) was the most parsimonious growth model with the size-modified growth being most appropriate given the large amount of fishery-dependent data collected. Also, sex-specific natural mortality was similar since longevity estimates were similar. The author recommended scaling natural mortality by age class.

A preliminary version of this document was used to define the Richards growth function used in the 2019 Yellowfin Tuna Stock Assessment. The author noted that this information has been updated, peer-reviewed, and published since the 2019 Yellowfin Tuna Stock Assessment, but that there had been little change to the reported growth functions. Therefore, the Group decided to retain the 2019 growth function for the continuity model, but that growth estimation within SS3 will be attempted to best account for the various fleet selectivities.

d. Reproduction

A study by Pacicco *et al.* (2023) on the reproductive biology of yellowfin tuna (*T. albacares*) in the northcentral U.S. Gulf of Mexico was presented. Most (93%) of the samples were from the recreational fishery and gonads were processed using standard histological procedures. The results suggest that the maturity threshold plays a potentially significant role when estimating size at maturity for yellowfin tuna. To this purpose, the author recommends that a functional maturity threshold (i.e. vitellogenic 1 and 2) is the most appropriate to be used when estimating length at maturity (L50) for stock assessment purposes (Pacicco *et al.*, 2023). According to the author, yellowfin tuna females can spawn daily, especially during peak spawning months.

A preliminary version of this document was available during the 2019 Yellowfin Tuna Stock Assessment (Anon., 2020). The author noted that the information has been updated, peer-reviewed, and published since then, but there has been little change in the results, which still support the maturity ogive and L_{50} value used in the 2019 assessment (Diaha *et al.*, 2016). During the meeting, it was noted that the L_{50} value of 115.1 cm does not appear in the document Diaha *et al.* (2016), but the Group confirmed that it corresponds to the vitellogenic 1 and 2 threshold, functional maturity as recommended by Pacicco *et al.* (2023).

3. Review of fishery statistics/indicators

The Group examined the latest information provided by the Secretariat regarding yellowfin tuna fishery statistics, including Task 1 nominal catches (T1NC), Task 2 catch & effort (T2CE), Task 2 size samples (T2SZ) and reported catch-at-size (T2CS), as well as tagging data. The SCRS catalogue for yellowfin tuna stock was also presented and is available in **Table 1**. The Group reiterated the importance of the SCRS catalogues as tools to identify gaps and inconsistencies by CPCs in both Task 1 and Task 2 datasets.

The Group was informed of the Secretariat's efforts to automatically produce the catalogues for Task 1 and Task 2 datasets, which now include computed metadata useful for cross verifying the information contained within the ICCAT database. Additionally, the Group was presented with the most recent CATDIS estimates on tropical species covering the period from 1950 to 2022.

After a thorough review, all information was adopted by the Group for assessment purposes, and all updates were recorded in the ICCAT database system (ICCAT-DB). During the meeting, the Group reviewed updates on fisheries statistics provided by CPCs and proposed estimates for identifying missing yellowfin tuna catch data.

Six documents were also presented in this section to the Group updating information on fisheries which resulted in the improvements of Atlantic yellowfin Task 1 and Task 2 statistics. These are briefly discussed below.

SCRS/2024/038 provided Estimation of Ghana Tasks 1 and 2 purse seine and baitboat catch 2019 – 2022: data input 2024 Yellowfin Stock Assessment. The document discusses the use of data from the AVDTH Ghana database to estimate fisheries statistics for the Ghanaian tuna baitboat and purse seine fisheries from 2019 to 2022. Catch and landing data collected by the Marine Fisheries Research Division (MRFD) of Ghana from 2005 to 2022 were also utilized. Total Ghana catches, catch composition, and quarterly spatial distribution were estimated following recommendations from the SCRS Tropical Tunas Species Group. Sampling methods for species composition and size distribution were reviewed to ensure appropriate sampling for different components of the Ghana fleets based on major gear types.

SCRS/2024/045 provided statistics of the French purse seine fishing fleet targeting tropical tunas in the Atlantic Ocean (1991-2022). This document provides a current overview of the French purse seine fleet's activities targeting tropical tunas in the Atlantic Ocean. It includes details regarding drifting FAD (dFAD) data, which will be integrated into a designated section of the ICCAT statistics report. The statistics cover the period 1991-2022 and focus on the fishing activities of 2022.

SCRS/2024/051 provided fisheries statistics of the Spanish tuna fleets in the tropical Atlantic Ocean (1990-2022). The data presented concern the Spanish tropical fleet, detailing fishing areas, catches, effort, performance (CPUEs), and size distribution for purse seiners and baitboats.

The document indicated that the fleet deployed more purse seine sets on FADs than on free schools. Fishing effort declined initially in 2019 but recovered afterwards, notably in Gabon's EEZ in 2022. Yellowfin tuna dominated purse seine catches, peaking at 40% in 2020. Additionally, the Group noted a decrease in the number of Spanish-flagged baitboat vessels operating in the area, from 7 in 2019 to 3 in 2020. This decline was mainly due to the establishment of a Marine Protected Area (MPA) that impeded access to live bait. The MPA, established in 2019 under special legislation from the Senegalese government, grants access to the area to smaller, artisanal vessels only.

SCRS/2024/047 presented a revision of historical catch statistics of yellowfin tuna caught by the Mexican fishing fleet in the Gulf of Mexico. This document outlines the background and outcomes of a revision of yellowfin tuna catch statistics from the Mexican longline fishery in the Gulf of Mexico using observer data collected in the Longline Tuna Fishery Information System (SIA). The revision aims to update the ICCAT-DB catch series from 1993 to 2021 by identifying Mexico's data sources and correcting historical catches. The revision replaces longline data (2002-2021) with minimal catch differences, integrating cruises spanning two years. The Group acknowledges Mexico's ongoing efforts to ensure consistent, updated, and harmonized data provision to ICCAT for tuna species, including historical information.

SCRS/2024/046 provided conversion factors for tropical tunas caught with purse seine in the Atlantic Ocean, as an update of Fily and Duparc (2023). The paper suggests updating the length-weight relationship for major tuna species caught by tropical purse seine fisheries, a conversion that has not been updated in over 40 years. They tested an additional predictor, fishing mode, and conducted analyses to show the robustness of the new relationship. While fishing mode had some impact, it was minimal compared to other factors. Their findings support using a simple length-weight relationship for converting length to weight in tropical purse seine fisheries.

The discussions from the Group revealed uncertainties in the current L-W relationship that must be further investigated. The Group agreed that further research is needed before the current yellowfin tuna L-W relationship adopted by the SCRS is replaced.

a. Task 1 catches and discards data and spatial distribution of catches

The Secretariat informed the Group that only minor yellowfin tuna data updates were made to T1NC since the 2023 SCRS annual meeting, and that only catches for the period 1950-2022 were analyzed. Following the 2021 SCRS recommendation, the Secretariat also presented the T1NC dashboard (screenshot **Figure 1**) with interactive querying facilities aiming to simplify the exploration of the T1NC dataset. During the presentation of the statistics, following the issue of attributing catches to the YFT-E and YFT-W regions, the Group agreed to present yellowfin tuna fishery statistics as a single Atlantic-wide stock including the Mediterranean Sea.

While analyzing the nominal catches presented to the Group, significant purse seine catches reported by Brazil in 2022 were observed, indicating a potentially emerging fishery that requires clarification on operations and areas in collaboration with national scientists. Additionally, it was noted that Liberia reported substantial (1730 t) yellowfin tuna catches in 2020 from two industrial purse seiners (flagged by Ghana in 2022), but there were no catches reported by the same fishery before 2020, only 9 t in 2021 and no catches in 2022. This prompted discussions on estimating catches for 2021 and 2022, leading to the agreement of repeating catches from 2020 for 2021 only instead of performing a three-year carryover estimation. The Group received information that the Liberian purse seine fleet did not operate in 2022.
Furthermore, the Group identified a gap in reported catches for Grenada's longline and troll line fisheries from 2011 to 2014, which represented significant portions of the overall catches. While a three-year carryover to reconstruct missing catch levels was proposed for consistency, the Group recalled the recommendation by the Subcommittee on Statistics (SC-STAT) to develop a standardized method for such approaches across all species.

Efforts by Ghana and the Secretariat to enhance the accuracy of catch statistics for tropical tunas were acknowledged, highlighting the combination of two components of catches from Ghana: one from a national fleet of smaller vessels and another from larger Ghana-flagged industrial vessels, reported separately. The Group also noted a higher proportion of yellowfin tuna catches in areas closer to the coast within fishing grounds but with seasonal variability in species composition and individual size, particularly on FAD sets.

The Secretariat informed the Group about the revision of T1NC for yellowfin tuna (YFT) from the Venezuelan artisanal fishery (2018 to 2022), known for its use of drift gillnets and focus on billfishes within the La Guaira billfish hotspot.

The Group was informed that the historical catch estimates of the so-called "faux-poisson" allocated to the "Mixed Trop" (2015-2020) have been reviewed by several CPCs that have now provided specific catch updates of this component (EU-Spain, EU-France, Cabo Verde). Other CPCs with tropical catches of purse seine (PS) fleet(s) had indicated that catches of aggregated catches of *faux-poisson* were already reported as part of their Task 1NC catch reports (Guatemala, Panama, El Salvador, Belize, and Curaçao) as indicated during the 2022 Skipjack Stock Assessment (Anon., 2022). Since 2021, Guatemala, Panama, El Salvador, Belize, and Curaçao have also reported length frequency samples for this component as well as the disaggregated Task 1 component of *faux poisson*. Therefore, to avoid potential double counting of some catches, the Group decided to update the estimates of the yellowfin tuna "Mixed Trop" estimates 2015-2020 discounting from this fleet the catch reports from EU-Spain, EU-France, and Cabo Verde. This update of the "Mixed Trop" was also applied to bigeye and skipjack as the initial estimates applied to all 3 species. The Group encourages CPCs to complete the disaggregation of *faux poisson* from the historical Task 1NC submitted.

The Group was informed that at present all landed catches from tropical tuna fisheries are being monitored and reported, although the methodology and estimation of the catch component of *faux poisson* may differ among CPCs. The Secretariat also clarified that in Task 2 it is possible to define size measures for *faux poisson* sampling source.

The adopted total catches of yellowfin tuna are presented in **Table 2**. The yellowfin tuna catch trends by gear are presented in **Figure 2**. The temporal-spatial distribution of yellowfin tuna catches (CATDIS 1950-2022) is shown by gear and decade 1950-2023 (**Figure 3**).

b. Task 2 catch/effort and size data

All the existing information on T2CE, T2SZ, and T2CS was made available to the Group. This included detailed catalogs with important metadata on each series, the very data in standard SCRS formats, and specific, custom extractions (e.g. T2CE detailed dataset with PS catches by fishing mode fish aggregating device (FAD) / free-swimming school (FSC) as required by the Tropical Tunas Species Group.

The Group recalled how catches of Brazilian handlines in the last 10 years were high, while size-frequency data for the fishery in the same period are lacking, with information only available for 3 years. As this is the only fishery of this kind in the western Atlantic Ocean, the Group agreed on the importance of liaising with national statistical correspondents to determine if historical size data could be recovered.

The Secretariat also informed the Group that updated information was received for Task 2 specifically size data from Mexico for the years 1993 to 2021 (SCRS/2024/047), size data from Senegal for the years 2021 to 2022, updates of Task 2 Catch and Effort (T2CE) and size data (T2SZ) from Ghana (SCRS/2024/038), which have all been incorporated into the ICCAT database.

c. Tagging data

The Secretariat presented a summary of yellowfin tuna conventional and electronic tagging updates, including the last recoveries of 2024 and a summary of the extension of the Atlantic Ocean Tropical Tuna Tagging Programme (AOTTP) tagging project in the Northwest Atlantic.

Table 3 shows releases and recoveries per year and **Table 4** shows the number of recoveries grouped by number of years at liberty. Four additional figures summarized (geographically) the yellowfin tuna conventional tagging data available in ICCAT. The density of releases in 5x5 squares (**Figure 4**), the density of recoveries in 5x5 squares (**Figure 5**), and the yellowfin tuna apparent movements (arrows from release to recovery locations) are shown in **Figure 6**. **Figure 7** represents the release points (triangles) and the apparent movements (lines) of the update database, differentiating in colour red those of the AOTTP project and in blue the rest. As well as the dots (in yellow) of the yellowfin tunas tagged during the extension of the AOTTP project in the Northwest Atlantic.

Additionally, two yellowfin tuna dashboards were prepared to examine dynamically and interactively the tagging data. The first one (**Figure 8**) with conventional tags, showed a summary of released and recovered tags. The second one (**Figure 9**) with electronic tags, showed a summary with data extracted from the meta-database held in ICCAT. The dashboards for the conventional tagging and electronics tags metadata are published on the ICCAT website. The Secretariat thanked scientists for supporting the presented dashboards.

The Secretariat updated the Group on an agreement made with the Centre for Environment, Fisheries and Aquaculture Science (CEFAS) (UK) last year to utilize Lotek internal electronic tags from the AOTTP programme. Most of these tags were reused, having been deployed for only a few days and still in good condition, while a few were new replacements for failed tags. Out of 30 tags sent, 15 have already been deployed in Sta Helena, with one recovered so far, and the remaining tags expected to be deployed in the coming months. CEFAS is also working on creating tracks for electronic tags recovered from the AOTTP project in Sta Helena. Additionally, efforts to enhance conventional tagging information will continue alongside the maintenance and improvement of the conventional tagging database (CTAG) and the development of a new electronic tagging database (ETAG). The main aim of the ETAG project is to integrate all information obtained from electronic tags and associated metadata into a centralized relational database system (PostgreSQL).

d. Updates to US tagging statistics

The Secretariat informed the Group of the current difficulties in the incorporation of the conventional tagging data reported by the U.S. between 2009 and 2019 (all species including yellowfin tuna) due to several reasons. Aiming to solve this situation in the mid-term, collaborative work has begun involving the Secretariat and the U.S. tagging correspondents, to work on the full cross-validation of both conventional and electronic tagging databases, with the main objective of correcting all the discrepancies and missing information across all species. As a result, around 1500 new conventional tags from the cooperative Tagging Program (NOAA) and Billfish Foundation were added to the ICCAT database.

e. New information from the AOTTP program

A review of the available tagging data was conducted to consider the use of AOTTP tag recapture information to estimate natural mortality directly in the stock assessment. A major assumption to model the tagging data is the ability to accurately age the fish at the time of release, which requires age-length keys, cohort slicing, or an alternative approach. It was demonstrated that the range of fish sizes released can span multiple age classes, making the application of cohort slicing problematic since there is a high overlap in the size distribution across those ages. Since no age-length keys or other approach is available to age the tag releases, it will not be possible to incorporate the AOTTP data in the assessment to model mortality. Additionally, the high proportion of short-term recaptures and relatively low return rates at longer times-at-liberty, combined with uncertainty in reporting rates across fleets prevents accurate estimation of mortality.

4. Review of available indices of relative abundance by fleet

The Group was provided with standardized longline indices from multiple CPCs and a multi-national joint standardized index. After reviewing all provided information related to longline fisheries, the Group agreed to use the joint CPUE Longline index between Japan, U.S., Brazil, Korea, and Chinese Taipei for the 2024 stock assessment, namely that developed for Region 2 with no subsampling (SCRS/2024/036).

The Group also recommended using a standardized index from the EU Purse Seine fleet targeting free-swimming schools of adult yellowfin tuna (SCRS/2024/041) and a refined index developed from echosounder buoy acoustic data assuming to represent juvenile yellowfin tuna abundance (SCRS/2024/044).

The Group made suggestions to improve novel indices developed for the Venezuelan Purse Seine (SCRS/2024/042) and Bait Boat fleets (SCRS/2024/043), the latter of which may be considered as a sensitivity analysis if provided before the stock assessment meeting in July 2024. As an additional sensitivity analysis, the Group also recommended consideration of the juvenile index constructed from EU Purse Seine data for those vessels operating around fish aggregating devices (FADs), as estimated from the generalized linear mixed models (GLMM) approach (SCRS/2024/052). A number of novel indices were also reviewed that have more explicit treatment of spatiotemporal trends than traditional approaches (SCRS/2024/034, SCRS/2024/049, SCRS/2024/052), but the presented work from these studies was preliminary and not ready for consideration in the 2024 stock assessment.

Document SCRS/2024/036 presented a standardized index of abundance (CPUE) estimated using a delta-lognormal approach from operational (set) level data collected from Brazilian, Japanese, Korean, Chinese-Taipei, and U.S. Longline fleets between 1959-2022 across the Atlantic Ocean. Joint CPC indices were developed for three unique regions, each estimated from generalized linear models (GLMs) applying two modeling components: 1) probability of presence of yellowfin tuna in catch using a logistic link function and binomial error distribution and 2) log-transformed yellowfin tuna catch rates (CPUE) over positive sets using a normal distribution.

The Group observed that the trends in the joint index were similar to those from the individual (CPC) indices for each region, although some small differences were noted. The updated index was also similar to that produced for the 2019 yellowfin tuna assessment.

The Group discussed the different sub-sampling schemes used to treat the data and there was a general agreement to support the use of the indices estimated using all available data with no-sub-sampling. It was also noticed that the CPUE index for region 1 increased towards the end of the time series, which seems driven by data from Chinese Taipei. The Group agreed that the joint CPUE better deals with the conflicting trends of the individual CPUEs and highlighted that these types of concerns are part of the motivation for generating joint indices.

The authors recommended only using the Region 2 index for stock assessment purposes, as this region represents the core habitat of the stock and where fishing is most concentrated. The Group discussed that only using the indices from Region 2 might result in some hyper-stability, but acknowledged that this is somewhat speculative. Additionally, absolute effort has also been more variable in Regions 1 and 3, as compared to that in Region 2, which has been relatively consistent, and so including indices from Regions 1 and 3 may be problematic in the assessment models that do not include spatial considerations. In conclusion, the Group agreed to use the index from Region 2 with no subsampling as a continuity. The Group also agreed that this index should be used in place of any of the individual CPC indices.

Document SCRS/2024/034 presented a standardized index of abundance (CPUE) estimated from vector autoregressive spatiotemporal (VAST) generalized linear mixed models (GLMMs) fit to data collected from the Brazilian, Japanese, Korean, Chinese Taipei, and U.S. Longline fleets between 1979-2022 across the Atlantic Ocean. This work is meant to more explicitly model the spatial and temporal aspects of yellowfin tuna catch rates, as compared to the Joint Longline index (SCRS/2024/036).

The Group agreed that this is an excellent ongoing work that can be useful in the future to understand changes in spatial/temporal distribution. The Group agreed that the amount of available data is adequate to advance a VAST analysis. However, VAST analyses required significant computational time which limited the ability of the authors to explore all diagnostics and to further explore model behavior, identify which aspects of the current models are failing to converge and identify appropriate solutions. While the approach is very promising, the Group agreed that in its present state, the index is not ready for use in the stock assessment. The Group recommended that this work continue intersessionally, as development is likely to be iterative and take time.

Document SCRS/2024/049 presented a standardized index of abundance (CPUE) estimated using a Bayesian approach with Integrated Nested Laplace Approximations (INLA) from operational (set) level data collected between 1998 and 2022 from the Brazilian and Uruguayan Longline fleets, which operate in the southwestern Atlantic Ocean.

The authors noted that there is a moderate correlation between set-level observations vs. predictions, but the overall predictive power of the approach appears appropriate. There also appear to be patterns in the included spatiotemporal variables, which seem to be changing over time and space.

The Group discussed the appropriate spatial/temporal resolution for this analysis. The authors indicated that a seasonal and 1x1 degree resolution was used and that they found a high correlation between 1x1 degree cells at this level of resolution. Therefore, it was suggested that a lower resolution could be used which would still maintain the autocorrelation within the larger cells and no information would be lost. The Group also asked the authors to clarify whether the chosen spatiotemporal structure is consistent across seasons, but variable among years, and the authors confirmed it.

While the Group agreed that the index appears to be overall sufficient for consideration in this assessment, it was also agreed that this index should not be used in place of the Joint Longline Index (see SCRS/2024/036). The authors indicated that this index was produced to introduce the applied method as a potential tool in investigating fine-scale CPUE data for spatiotemporal patterns, which could then inform modeling in subsequent analyses (e.g., using fixed effects vs. interaction terms).

The analysis described in this document is similar to that of VAST (SCRS/2024/034), which is also trying to control for spatiotemporal trends in catch rate, but in a more stable and less computationally expensive modeling framework. The Group also discussed how consistent updates of indices using VAST can be, because inconsistencies could be problematic in an MSE framework. It was agreed that in an MSE framework, there is a need to produce stable indices which can be achieved with temporal-spatial GLMs like the ones used in this document.

The Group recognized the potential value of applying this approach in future assessments and management strategy evaluations and recommended that this approach be further discussed by the Working Group on Stock Assessment Methods (WGSAM). Furthermore, the Group acknowledged the significant contribution of this document about the importance of spatial-temporal autocorrelations in understanding variability in CPUE.

Document SCRS/2024/035 presented a standardized index of abundance (CPUE) estimated using a delta-lognormal approach from operational (set) level data collected from the Japanese distant water Longline fleet between 1959 and 2022 across the Atlantic Ocean. The overall aim of this paper was to compare the resultant index to previous indices and to the Joint Longline index (SRCS/2024/036), which includes data from and is meant to represent the Japanese Longline fleet. Indices were developed for three unique regions (SCRS/2024/035 Figure 2), each estimated from generalized linear models (GLMs) applying two modeling components: 1) probability of presence of yellowfin tuna in catch using a logistic link function and binomial error distribution and 2) log-transformed yellowfin tuna catch rates (CPUE) over positive sets using a normal distribution.

The Group evaluated the indices during the discussion of the CPUE table. Concern was raised that while the authors tried to account for changes in selectivity/catchability, there may be other factors that influence CPUE for which data are unavailable and so unaccounted for. The Group acknowledged that the authors followed best practices, for example using clustering approaches to identify targeting and associated catch rates, which is likely the best that can be done. In conclusion, the Group did not support the use of these indices given the availability of the Joint Longline abundance index (see SCRS/2024/036).

Document SCRS/2024/056 presented a standardized index of abundance (CPUE) estimated from operational (set) level data collected from the Chinese Taipei distant water Longline fleet between 1995 and 2022 across the Atlantic Ocean. Indices were provided for three separate regions using a delta-lognormal approach.

The Group agreed not to use this index in favor of the Joint Longline index (SCRS/2024/036).

Document SCRS/2024/041 presented a standardized index of abundance (CPUE) estimated using a delta-lognormal approach from free-swimming school sets (FSCs) of the EU (France and Spain) Purse Seine data collected in all months between 1993 and 2022 across the Atlantic Ocean. Indices were developed from generalized additive mixed-effects models (GAMMs) applied to three modeling components using two different approaches.

The Group inquired which one of the indices presented in the document is recommended to use in the stock assessment. The authors recommend approach 1 as the preferred option due to concerns with the beta distribution predicting the observed proportions of tropical tuna catch that is composed of adult yellowfin tuna, which tended to be zero or one. The Group then requested the authors to provide a table with the values of the recommended standardized index and include the estimated annual CVs.

The Group inquired how the 'adult' stage was defined since that information is important for inclusion in the integrated assessment models. It was indicated that 'adults' were defined as fish heavier than 10 kg. If ultimately included in the assessment model, the Group recommends that this index be fit using a selectivity mirrored from the purse seine fleet, with a cut-off over 10 kg.

The Group asked about the species composition of the PS catches over time. It was observed that in the early part of the time series, large components of FSC catches were mostly composed of skipjack. But over time, skipjack became less abundant and the proportion of yellowfin tuna in the PS sets significantly increased. After controlling for spatiotemporal effects, the marginal effect plot (effect of year-month) shows larger effects on 2008+ and so may somewhat account for this "disappearance" of skipjack.

The Group discussed the quantile–quantile (Q-Q) plot of component 1, which showed residuals with high divergence in the upper quantile that the authors attributed to too many multi-set days. This divergence is a "rare event" in the dataset and so should have a relatively minor impact on the final standardized index, but the Group did suggest looking into this issue a bit closer (e.g. perhaps look to see if these residuals have a temporal component). While the authors expressed no concerns regarding the Q-Q plot, they agreed that the temporal component should be further explored. The Group also suggested an additional analysis to investigate the potential effects of closure period and time-zones on FSC encounter rates and tuna catch rates.

The Group indicated that generalized additive mixed models (GAMMs) can become relatively unstable when fit to sparse data, and under this condition GAMMs are not good predictors. The authors indicated that while a decline in effort has occurred, the absolute amount of set observations is still high. The authors also noted that spatial strata with patchy/limited data were removed to ensure indices are estimated from strata with adequate data.

The Group also discussed that the Index shows some instability in the southern region of the study area (i.e. Angola/Gabon). It was hypothesized that this effect might be the result of the school composition of both species and sizes being mixed and not just adult yellowfin tuna in this region. The author agreed that the southern area used in the analysis is different from the rest and that might explain some of the instability observed in the models.

The Group also noted the increase in the fraction of positive FSC sets with adult yellowfin tuna in 2010, which the authors indicate may coincide with technological advancements that would allow for selective targeting of FSCs (SCRS/2024/041). The Group concluded that the proposed indices might be improved by incorporating such drivers into the standardization (e.g. increased FAD fishing).

Document SCRS/2024/042 presented a standardized index of abundance (CPUE) estimated using a delta-lognormal approach from operational (set) level data collected in all months between 1987-2022 from the Venezuelan Purse Seine fleet, which largely operates in the Caribbean and adjacent waters of the western central Atlantic. Indices were developed from generalized linear models (GLMs) applied to two modeling components: 1) probability of presence of yellowfin tuna in catch using a binomial error distribution and (2) yellowfin tuna catch rates (CPUE) over positive sets using a lognormal distribution.

The Group raised concerns regarding the unit of effort that was defined as a 'set' and that search time may not be properly accounted for in the index. This approach might result in hyper-stability of the index. In addition, the Group was also concerned regarding the inconsistency in effort units amongst vessels that differ in their respective fishing strategies (e.g. short trips with lots of sets vs. longer trips with less frequent sets). To further evaluate the index, the Group requested that the authors provide summaries on the 1) number of vessels, 2) number of sets/vessel/month, and 3) number of boats per purse seiner-category over time. As requested by the Group, the authors verified that there was no sampling in Area 2 after 2016. The authors also showed that the number of vessels and the number of sets/year has consistently declined.

However, the average number of sets per vessel and relative composition of large vs. small/medium vessels has remained relatively stable.

The Group acknowledged that this is valuable work, but at this time does not support the use of this index in the assessment. In addition to hyperstability, the Group is concerned that because the assessment model is not spatial, the indices included in the model should represent the entire range of the population. The Group also recognized that the number of vessels that are providing these data is relatively small. Additionally, this index is somewhat redundant with the Venezuelan Baitboat index (SCRS/2024/043), which operates in the same general area.

The Group also recognized that this concern of hyperstability is not limited to this index, and is a concern in all Purse Seine indices. As a specific example, the Group decided to recommend the use of the EU purse seine FSC index in the base model of this assessment (SCRS/2024/041), however, this PS index includes an offset to account for search time. The Group highlighted the need to be consistent in the criteria being applied in deciding which Purse Seine indices to include/exclude from consideration in ICCAT stock assessments.

Document SCRS/2024/043 presented a novel, standardized index of abundance (CPUE) estimated using a delta-lognormal approach from operational (set) level data collected in all months between 1987 and 2022 from the Venezuelan Baitboat fleet, which largely operated in the Caribbean and adjacent waters of the western central Atlantic. Indices were developed from generalized linear models (GLMs) applied to two modeling components: 1) probability of presence of yellowfin tuna in catch using a binomial error distribution and 2) yellowfin tuna catch rates (CPUE) over positive sets using a lognormal distribution.

The Group noted that since 2003 the standardized CPUE was higher than the nominal CPUE in all years. The Group inquired if the authors had any sense of what might be causing this divergence. The authors indicated that such divergence might be due to some factor not being available during this period, particularly that there was no fishing in Area 2 after 2003 (e.g. if "Area 2" is more productive with higher catch rates, the lack of fishing in this area would explain this trend). The authors further explained that the lack of fishing in Area 2 after 2003 was most probably due to economic reasons since it's more expensive to fish in these areas. The Group noted that this divergence may therefore be real, which the index is appropriately capturing.

The Group also requested that the authors expand their diagnostic plots to include residuals across all the factors included in the standardization, which the authors provided. Given that the unit of effort was defined as a 'fishing operation', the Group inquired whether the fishing operation may have changed over time (e.g. number of poles, bait type, vessel capacity, etc.) and whether the applied units of effort in the standardization have remained stable. The authors noted the number of days fished has not changed much over time, but they will have to check on fishing power (e.g. number of anglers or poles).

It was noted that the number of vessels operating in the baitboat fishery significantly declined in the final years of the time series (i.e. 2 vessels after 2018). It was noted that some baitboat conducted joint fishing operations with purse seine vessels. Since the baitboat index only included vessels that did not fish together with purse seiners, the Group inquired if the reduction in the number of baitboat participating in the fishery was due to an increase in the number of vessels fishing jointly with purse seiners. Given the very low number of baitboat vessels operating towards the end of the time series, the Group also discussed removing index values after 2018 or 2019. However, no final decision was made about this suggestion. To potentially account for changes in fishing operations over time, the Group requested the authors to include vessel ID as a factor in the standardization procedure. The authors indicated that such analyses will be conducted intersessionally.

The authors showed that the number of vessels and number of sets/year have shown declines since 2003. The average number of operations/vessels also shows a decline, although this decline is not as strong as that in the other two. The Group noted that these trends are fine as the unit of effort in the CPUE response variable is an individual fishing operation, and so it does not matter if the number of operations has changed, but biases can be introduced if changes are occurring within a given fishing operation (e.g. changes in number of poles). The authors acknowledge that such data have not been traditionally collected in this fishery, but did note some variability in the size of baitboats over time, which is being included as a factor in the standardization and so accounted for. Regardless, the authors acknowledge that some technological creep may be occurring, but this fishery is not associated with FADs and so believe such effects may have a relatively minor effect on the associated catch rates. The authors also noted that these fisheries have operated in the same general area and used the same basic fishing strategies over time. However, as the number of vessels has decreased in recent years, communication may have improved over vessels, driving up catch rates for the few vessels still in operation. Overall, the authors acknowledge that some changes in effort could be possible in this fleet, but believe it is unlikely to have a large effect on the index.

In conclusion, the authors indicated that a revised index including vessel ID as a factor in the standardization procedure will be made available to the Group intersessionally. The Group agreed to consider the inclusion of the revised index as a sensitivity run as part of the stock assessment. The selection of an appropriate selectivity trend will be explored once the revised index has been provided and can be tested within the assessment model. The Group also recommends that the last few years of the index be truncated when only a couple of baitboats were in operation.

Document SCRS/2024/044 presented a standardized index of abundance (CPUE) for juvenile yellowfin tuna estimated from echosounder buoy data collected between 2010 and 2023 across the eastern Atlantic Ocean. These acoustic data were combined with associated ICCAT fishery (catch and size) data to obtain specific indicators for yellowfin tuna. Given the low percentage of echosounder measurements with biomass less than 0.1 t, indices were developed from a generalized linear mixed model (GLMM) that assumed a lognormal distribution.

The authors noted a steady increase in the standardized index over the time series but highlighted that acoustic data for the analysis have been relatively limited over the last two years. The Group also highlighted the relatively high index estimate for 2023 quarter 3, which may be anomalous given the low sample sizes that appear to be coming from a single area. This estimate could be further investigated (e.g. to see if it is well supported by the data), but it may also be treated as a sensitivity in the final assessment model.

The Group also asked about the relatively high values of the standardized index over the middle of the time series, over which time the authors noted that there was a reduction in the number of observations. The Group inquired that while the document described 5 different buoy types used by the PS fleet, the analysis showed that only 3 levels of the 'buoy' factor were used. The authors explained that some buoy types have similar technical specifications and, therefore for analysis purposes, they were grouped into 3 categories.

Regarding the FOB colonization, the authors clarified that the 20-35 day colonization assumption was the same across the entire dataset, and does not change, for example, by area to account for spatial patterns in species abundance. The Group expressed some concern that the authors were inadvertently removing some of the abundance signals from the index, which is not the case.

As a rough estimate, the authors stated that about 30% of the data was provided by the highest resolution strata (i.e. $1^{o}x1^{o}$ spatial grids by month), about 30% at the second strata (i.e. $1^{o}x1^{o}$ spatial grids by quarter), and the remaining 40% at the third strata (i.e. regional strata by quarter). While acknowledging the data limitations, at the same time the Group expressed concern regarding this approach and indicated that this aspect needs to be further investigated. This is a critical aspect of the analysis because species composition can differ significantly at different strata levels.

The authors recommended the use of this index in the assessment, but they also identified several potential improvements that could be made in constructing future indices (e.g. geospatial approaches, and machine learning). Given that the index estimated quarter/year values, the Group inquired if annual estimates could be estimated. The authors indicated that they could provide an index at an annual time step if needed. However, it was then confirmed that this index was only used in the Stock Synthesis platform in a quarterly time step. Therefore, no additional changes were requested to the temporal resolution of this index.

The Group asked the authors what is the range of ages covered by this recruitment index. The authors indicated that they needed to investigate this issue. However, the Group was informed that in the 2019 assessment, the size selectivity of the PS fleet using floating objects (FOBs) was applied to the BAI index. The Group indicated that this approach is good if the spatial operation of these fleets is similar to those fleets operating on FOBs and it was agreed that this was the case.

The Group agreed to the use of this index in the continuity case, which is estimated from data collected from the core habitat of juvenile yellowfin tuna and so appears suitable as a recruitment index. As was done in the 2019 assessment, the Group recommends mirroring the selectivity of the purse seine FAD fleet for this index.

Document SCRS/2024/052 presented a novel, standardized index of abundance (CPUE) estimated from data collected from EU purse seine vessels targeting floating objects (FOBs) across all months between 2010 and 2022 across the eastern Atlantic Ocean. Indices were constructed using multiple approaches: 1) delta-lognormal GLMMS, 2) delta-lognormal generalized additive model (GAMs), and 3) spatiotemporal GLMMs (sdmTMB), which includes the construction of a spatial random field. By their nature, FOB fleets tend to target smaller fish than FSC fleets and so the FOB index is being considered as a recruitment index.

In approach 3, the Group clarified that authors excluded zero sets so the associated index may be hyper stable. The authors indicated that the proportion of zero sets in the data was very low (~3%) so this exclusion had little effect on the overall dataset. However, hyperstability is still a concern with this index, given the vast majority of records are positive sets and so the fitted data provide little information on presence/absence (i.e. encounter rates).

The Group also asked for clarification on some of the candidate variables, namely the number of buoys and mean buoy density across a certain distance, and how these could be calculated at a set level to match the associated resolution of the purse seine data. The authors clarified that these data come from position data provided by the fleet, which include the position of buoys across the entire fleet which have been interpolated into spatial maps at an hourly resolution. The Group also expressed concern that the candidate variables for buoys are not strictly independent. The authors responded that they considered the variance-inflation factors for these variables, which were not high.

The Group inquired if management regulations were taken into consideration when constructing these indices. The authors indicated that management regulations should not affect the estimation of the delta-lognormal GLMM and GAM indices. Similarly, the spatial/temporal models are not affected either because they can use information from before the closures. However, the authors acknowledged the need to further explore the potential effect of management measures on CPUEs.

The Group discussed that the large concentration of fishing effort off Gabon due to access agreements could have a large influence on the results. The authors replied that further exploration of the spatial/temporal component could consider this concentration of effort. Alternatively, future iterations of these indices could exclude data from this area.

The Group also discussed the general approach to estimating the indices described in this document. Historically, what has been done in index standardization is that year effects are predicted as a proxy for annual trends in stock abundance (i.e. density covariates). Conversely, the proposed approach predicts CPUEs using the observations and based on a variety of catchability covariates. The authors clarified that this was not the case, as the provided CPUE indices are being generated from accepted best practices (Hoyle *et al.*, 2024) that use externally defined prediction grids to construct abundance indices (i.e. not contingent on the observed data). Fishery-dependent data are not random, so they try to remove factors that can affect catchability like areas, season, gear, etc., and expect that the remaining trend will reflect stock biomass. But when using models like GAMs we can fit the data very well but cannot test if we are removing the effects of such factors. Catch per set and sets are almost always positive, there is still a potential issue with hyperstability in this index.

The Group agreed with the authors that highlighted that results from the spatial/temporal GLMM model are preliminary and, therefore, should not be considered for the assessment. However, the Group agreed to use the delta-lognormal GLMM index as a sensitivity during the stock assessment. Selectivity for this index should be mirrored from the purse seine FAD fleet.

The Group also recognized the potential value of the spatial-temporal approach being developed in this study (i.e. approach 3) and identified a number of potential improvements. The Group recommended expanding these models to include density covariates (e.g. yellowfin tuna concentrate in high chlorophyll-a areas) and to account for potential improvements in echosounder technology or changes in vessel configurations. The authors also identified a need to isolate the temporal effect from (for example) time-area interactions, which complicate associated predictions that are only specific to time. The authors also plan on exploring the use of vessel ID information in their standardization (vs. vessel size/age) and compare future iterations of their index to the base recruitment index (BAI, SCRS/2024/044).

Discussion on CPUE selection

Based on the revisions of the CPUE documents presented above, the Group discussed the CPUE evaluation criteria for each series (**Table 5**). The annual estimates of relative abundance, and the coefficients of variation for available CPUE time series are provided in **Table 6**. The Group further discussed which CPUEs among all available indices should be used in the 2024 stock assessment, and the following indices were recommended (**Table 7**):

- Initial runs
  - Joint Longline index Region 2 no subsampling: 1959 – 2022
  - Bouy derived FOB index: 2010 – 2022
  - EU PS Free School index: 1993 – 2022

- Sensitivity analysis
  - EU PS FOBs index: 2010 – 2022
  - Venezuela BB index with Vessel ID factor: 1987 – 2022

A comparison of the available indices from the 2019 assessment and current available indices is shown in **Figures 10** and **11**.

5. Review of assessment models for evaluation, specifications of data inputs, and modeling options

The Group discussed the assumptions to be applied to the 2024 yellowfin tuna stock assessment models, and outlined the following protocols:

- A seasonal, one-area, combined-sex model will be constructed in Stock Synthesis 3 (SS3) covering a timeframe from 1950 to 2022.
- Annual time-step biomass surplus production models (JABBA and MPB) may also be used for comparison, validation, and consideration for advice.
- Initial stock biomass in 1950 will be assumed to be in an unfished, virgin stock condition.
- Fleet structure will be comprised of 25 fleets, including eleven purse seine fleets, a Ghana baitboat and purse seine combined fleet, four baitboat fleets, six longline fleets, two handline fleets, and one fleet for other gears combined (**Table 8**).
- The fleet structure definitions are similar to the 2019 yellowfin tuna assessment and consistent with the stock assessments for Atlantic bigeye and eastern Atlantic skipjack tunas to facilitate the multi-stock management strategy evaluation.

A continuity model will be updated following the assumptions of the 2019 assessment and will be modified as outlined by the SCRS to integrate the alternative assumptions and configurations described below. The following sections list the primary data and parameterization assumptions for the SS3 and biomass surplus production models.

Indices of abundance

The indices of abundance and associated selectivity will be consistent with the 2019 assessment. Three abundance indices will be modeled, 1) the Joint CPC Longline index for the tropical Atlantic (region 2) broken into two periods 1959-1978 and 1979-2022, 2) the Seasonal Acoustic Echosounder Buoy index associated with FADs covering the period 2010-2022, and 3) the Free School Purse Seine index covering the period 1993-2022. The Joint LL index will be assumed to have a selectivity of older fish, equivalent to the Japan longline fleet in the tropical Atlantic (fleet 17, **Table 8**). The acoustic buoy index will be assumed to have the same selectivity as the purse seine fleet operating on FADs in the recent period season 1 (fleet 7, **Table 8**). The Free School Purse Seine index will be assumed to have the same selectivity as the free school purse seine fleet in the recent period (fleet 3, **Table 8**). Index CVs will initially be scaled to an average CV = 0.2 or higher if required across the time series while retaining the relative interannual variability estimated by the standardization models (i.e. CVs will be normalized to a mean = 0.2). The three indices will be modeled in SS3 and surplus production models.

Length composition

Length data for each fleet, year, and season will be provided by the Secretariat after all CPC size data updates are completed following the data preparatory meeting. Length compositions will be input as the number of fish observed per 4cm size bin. Other bin sizes (e.g. 2 cm bins) may be considered as needed to facilitate growth estimation within SS3. The effective sample sizes will be equal to the log10 (of number of observations), to reduce the effect of pseudo-replication in sampling and decrease weighting in the overall model likelihood. This approach is consistent with the treatment of size composition data for the other tropical tuna assessments and the 2019 assessment for yellowfin.

Size and weight-at-age

The assumption of growth will remain unchanged from the previous assessment, modeled as a combined-sex Richards curve published by Pacicco *et al.* (2021). Growth parameters were fixed in the 2019 assessment model due to the difficulty encountered in direct parameter estimation, but growth estimation in SS3 will be attempted with the conditional size-at-age observations input into the model. Informative priors will be included as required to allow some flexibility in growth estimation while maintaining model stability. This is particularly important to account for potential gear selectivity bias from fishery sampling. Weight in kilograms will be estimated from straight fork length (cm) converted to weight assuming the current SCRS length-weight relationship for yellowfin tuna (Caverivière, 1976) $Wt = (2.1527e\text{-}05)*FL^{2.976}$.

Maturity and fecundity

Maturity and fecundity assumptions will remain unchanged from the 2019 assessment. Fecundity will be modeled as a direct relationship to female body weight. Maturity will be assumed to follow a logistic function of fish body size, with an assumed 50% maturity at 115 cm straight fork length (Diaha *et al.* 2016, Pacicco *et al.*, 2023).

Natural mortality (M)

Consistent with the 2019 assessment, age-specific natural mortality will be modeled assuming a Lorenzen function (Lorenzen, 2005) to account for decreasing mortality with increased age. The estimate of base natural mortality rate will be equal to 0.3, based on the Hamel and Cope (2022) longevity estimator with an assumed maximum age estimate of 18 years old (Andrews *et al.*, 2020; Pacicco *et al.*, 2021). The base estimate of 0.3 M will be modeled as the median across fully selected ages, which can be considered age 2, 3, and 6-10 years old, provisionally, based on the selectivity estimates from the 2019 assessment. To incorporate uncertainty around the base M estimate, it was suggested to model M using a lognormal prior distribution with a CV=0.31 (Hamel and Cope, 2022), and potentially integrate the full distribution in the stock assessment using Monte Carlo resampling (at least 100 iterations). Natural mortality-at-age will be parameterized in SS3 (as opposed to a fixed input vector) to allow for model flexibility to alternative assumptions and consistent parameterization of M across trials. The distribution of M-at-age will be incorporated in the growth rate r parameter priors for surplus production models.

Fleet selectivity

The initial selectivity parameterization will follow the assumptions of the 2019 assessment (**Table 8**). Selectivity will be estimated directly for fleets 1-3, 7, 11-14, 16-17, 19-20, and 23-25. A cubic spline function will be fit to compositions for fleets 1-3, 7, and 11 to model multimodality of length observations. Fleets 12-14, 16, 19, and 23-25 will be modeled as double normal functions. Fleets 17 and 20 will be assumed to have asymptotic logistic selectivity. To reduce model complexity the following fleet selectivities will be mirrored: fleet 4 mirrored to fleet 1, fleet 5 mirrored to fleet 2, fleet 6 mirrored to fleet 3, fleets 8-10 mirrored to fleet 7, fleet 15 mirrored to fleet 14, fleet 18 mirrored to fleet 16, fleet 21 mirrored to fleet 19, and fleet 22 mirrored to fleet 14. The fleet selectivity assumptions may be modified when necessary to improve model fit to length compositions, convergence, parsimony, or overall performance.

Stock recruitment

Stock recruitment will be modeled with the Beverton-Holt function with virgin recruitment (R_0) and log-mean recruitment deviation (sigma R) freely estimated across a range of fixed steepness (h=0.7, 0.8, and 0.9), which will define the axis of the uncertainty grid. Annual recruitment deviations will be initially estimated for the period 1974 to 2021, and modified, when necessary, based on model diagnostics. The lognormal bias correction ($-0.5\sigma2$) for the mean stock recruitment will be applied following the recommendations of Methot and Taylor (2011).

Data weighting

The final model will apply a data reweighting procedure for the fleet length compositions following the method of Francis (2011), consistent with the approach of the 2019 assessment and other tropical tunas (bigeye tuna and skipjack). Indices of abundance will be equally weighted.

Intersessional work calendar

The Group agreed to the following schedule for the intersessional work tasks in preparation for the assessment meeting:

- 26 April - Provision of size and catch data by fleet by the Secretariat to be posted for modeler teams by the Secretariat.
- 20 May - To revise the progress of the assessment models and if required a possible informal online intersessional meeting.
- 20 May - CPCs to provide CAS to the Secretariat for the 3 species.
- 30 June - CAS of the 3 species completed and validated (1 week before the yellowfin tuna stock assessment).
- 1 July - SCRS documents and presentations to be submitted to the Secretariat.

6. Review progress toward tropical tuna Management Strategy Evaluations

The two ongoing MSE processes for Atlantic tropical tunas were discussed under this item of the agenda, the western skipjack MSE (SKJ-W MSE) and the multi-stock MSE for eastern skipjack, bigeye and yellowfin tunas.

a. Progress of SKJ-W MSE

SCRS/2024/050 presented a summary of the First Intersessional Meeting of Panel 1 on Western Skipjack MSE in February 2024 and proposed an updated workplan for further developments of the SKJ-W MSE. The authors emphasized the importance of continuing the SKJ-W MSE development by the Group. To seek transparency in the process of the SKJ-W MSE methodology and analysis, the authors proposed a series of meetings with different themes that should be discussed this year, and to start discussion within the Tropical Tunas Technical Sub-group on MSE.

Among the main discussion points, as a start, it was suggested to the Group that the Tropical Tunas Technical Sub-group on MSE could discuss which indices will be used for each CMP to generate the total allowable catch (TAC) in the closed-loop simulations including the actual TAC for the first management cycle. However, for these discussions to take place, the Group understands that the structure of the Tropical Tunas Technical Sub-group on MSE needs to be better defined first.

The Group felt that it has not been providing sufficient feedback to the SKJ-W MSE team due to the workload during the assessments, despite several opportunities for discussion. The Group recommended the Tropical Tunas Technical Subgroup on MSE as a solution to receive more timely and detailed feedback as the MSE is finalized this year.

b. Progress of tropical tuna multi-stock MSE

For this MSE, the first development of the simulation framework was presented noting that it was at preliminary stages. The focus was on describing how the three most recent stock assessments for tropical tunas were integrated into a multi-stock framework. The Group provided feedback for the next stages of development for this MSE, including the development of a trial specification document similar to what was done for bluefin, albacore and swordfish MSE processes.

Options for provisional multi-stock management objectives were discussed by the Group, with an understanding that the three tropical tunas stocks should remain at or above B_{MSY}. The Group will request specific input from the Commission on management objectives for the multi-stock MSE, including probabilities and timelines.

The Group agreed that the Tropical Tunas Technical Sub-group on MSE must be better structured and with responsibilities well defined. The general idea of this ad hoc working group is to monitor the steps in developing the MSE simulation frameworks under the Tropical Tunas Species Group. Thus, as a form to try to achieve this minimal organization, there was a small meeting with the Tropical Tunas Species Group scientists interested in contributing and participating in this ad hoc working group. During this intersessional meeting, a general term of reference was presented, discussed, and accepted by the Group to be used as a guide to the Tropical Tunas Technical Sub-group on MSE (**Appendix 5**). The Group recommends that a chair for the Tropical Tunas Technical Sub-group on MSE be nominated.

SCRS/2024/017 presented a summary of the workshops for capacity building for MSE that were focused on tropical tunas and took place in 2023. Two one-day online workshops, one for scientists in June and one for managers in October, were attended by participants from 20 ICCAT CPCs. Workshops were meant to provide an introduction to management procedures, management strategy evaluation, the current state of development of these for tropical tunas, and some exposure to practical tools aimed at understanding the MSE process. The paper also presented recommendations for future capacity building based on participants' responses to the workshop surveys.

The Group discussed the recommendations made about capacity training presented in SCRS/2024/017 and agreed it would be beneficial to provide broader access to the SCRS of the materials presented in ICCAT sponsored training workshops. This could be done by providing links to these materials on the ICCAT webpage, e.g. by having a new training TAB on the webpage. As these workshops have been approved by the SCRS and funded by the Commission there is no need to seek additional approvals for providing such access. Providing this access and modifying the ICCAT webpage will have some cost (e.g. software licenses for learning platform and surveying tools) that should be considered by the SCRS.

The Group also supported the recommendation about including in the Terms of Reference (ToRs) of capacity building for MSE a request to develop a new programme that would facilitate the training of selected scientists through their incorporation in the existing ICCAT MSE technical development teams. The Group discussed that building technical capacity for the implementation of MSEs requires a significant amount of time to be devoted to it. It is therefore important to recognize that participation in such training will have financial implications. Other recommendations for future MSE training included in the presentation of SCRS/2024/017 are consistent with previous recommendations from this Group about the need for training in MSE for tropical tunas.

It was also pointed out that if CPC scientists take an active role in the development of MSEs and Management Procedures (particularly when going beyond reviewing the work to participate in the development), this represents a very substantial commitment in terms of time and labour cost. Also, there are costs involved in the long-term commitments of maintaining and reviewing MPs, and potential problems that may be encountered in maintaining contracts over the long term (e.g. dealing with the limitation of 1 year contracts, maintaining contractors if the contractors are responsible for maintaining the operating models and the analysis tools). It was suggested that this issue be taken up by the Working Group on Stock Assessment Methods; all SCRS Officers are encouraged to participate in the meetings of the Working Group on Stock Assessment Methods.

7. Development of Tropical Tuna Research Plan

7.1 Tropical Tuna Research Plan

SCRS/P/2024/015 presented a workplan for the review of the Tropical Tuna Research and Data Collection Program. The plan is to pursue a comprehensive multi-year research programme which will be reviewed annually.

The Group agreed to develop this plan in 2024 according to the following steps: 1) approving a template and re-initiating the Tropical Tunas Species Group; 2) populating the template with the Group and species leads; 3) presenting the plan and finalizing at the Tropical Tunas Species Group meeting in September 2024; and 4) approving of the funding request for the next two years of work by the SCRS plenary.

The template agreed by the Group is provided as **Table 9**, and a request was made for meeting participants to contact the Tropical Tunas Species Group Coordinator if they were willing to be part of the working group to develop this intersessionally.

7.2 Contracts

There were a number of discussions about contracts which are summarised below including an ongoing tagging contract in the North-West Atlantic.

During the AOTTP a contract was signed with the University of Maine to tag 5000 tropical tunas in the NW Atlantic. Due to the limited availability of tagging opportunities the contractor requested that the original target number be reduced from 5000 to 2000, and by the end of this contract 1025 fish were tagged. In 2021 there was a request from the SCRS to sign a contract to continue tagging off the NW Atlantic, aiming to reach the target for the region. A Call for Tenders was launched, and a new contract was therefore signed with the same contractor with a completion date of 31 December 2022. However, the Contractor was unable to reach the target (1400), and a change request was made linked to the limited availability of fish in specific areas. The change in the ToRs was accepted by the Group in February 2023, with the approval of new targets by geographical area and agreeing an extension which was sent to the Contractor in July 2023. However, this amendment was never signed since, although the Contractor contacted the Executive Secretary in mid-November 2023, due to an e-mail issue the message never reached the relevant Secretariat staff.

The Secretariat requested guidance from the Group on the way forward. The Group agreed that there is value in tagging in the Northwest Atlantic. However, based on the continued lack of communication, non-compliance with the Terms of Reference of the contract (e.g. non-attendance of SCRS meetings to provide an update on activities and achievements), and limited updates over the last few years, the Group requested that the contract be cancelled. Moreover, the Group agreed to review how to continue this work in the future as part of the Tropical Tuna Research and Data Collection Program.

7.3 Data collection proposal

The SCRS Chair presented the draft Terms of Reference (ToRs) of a proposal for the improvement of data collection and reporting in the Caribbean. This work will be fully supported through voluntary financial contributions from the United States, using funds secured through a financial settlement with the company responsible for the 2010 Deepwater Horizon oil spill in the Gulf of Mexico to support restoration projects to address damage to natural resources. This project would address the restoration of highly migratory species stocks through improvements in data collection and reporting to support the management of the fisheries, with the Caribbean region identified as the focus.

The Group acknowledged that this proposal addresses the need to improve data collection and reporting in the Caribbean which was previously identified as a priority by the SCRS. The Group also highlighted the need to engage other SCRS working groups in the discussions of the ToRs. Accordingly, it was agreed that further intersessional work is required to allow relevant parties to review and contribute to the ToRs.

It was agreed that the ToRs will be circulated to the relevant SCRS officers, before being circulated by the Secretariat to the CPCs in the Caribbean region for their input (in the three ICCAT languages), aiming to get an approved version at the Yellowfin Tuna Stock Assessment Meeting. In addition to developing and finalising the ToRs, the Group agreed that further information is required to clarify budgets available and timelines. There was also an acknowledgment by the Group that capacity building and improving data reporting remain an important priority for other CPCs.

7.4 Budget

The Secretariat presented a summary of the 2023 and 2024 spending to date including the remaining budget balance. After review, a number of areas were identified as ongoing or still requiring ToRs. The Secretariat agreed to summarise the outstanding ToRs which have not been drafted yet, with the tropical tuna rapporteurs agreeing to develop the ToRs as soon as possible.

8. Recommendations

a. Research and statistics

The Group recommended that CPCs consider the new iTUNNES research programme funded by the EU to identify opportunities for coordinating their respective sampling programme of biological studies on tropical tunas.

The Group recommended that a workshop be held for tropical tunas PS fisheries on the implementation and use of the updated TT3R version in 2025. The objective is to present the new features of TT3R and the updated AVDTH SQL database, aiming to promote the use and standardization of all tropical tunas for the estimation of catch composition and total catch by all fleets.

The Group recommended that CPCs with tropical fisheries targeting yellowfin, bigeye and skipjack tunas present a summary of current sampling methodologies used on the field, sampling coverage, and what statistical methods are used to estimate catch, catch composition, and size distribution of the catch.

The Group recommended to the Subcommittee of Statistics to consider:

- Eliminating the need to separate reports of task 1NC YFT catches between the East and West sampling areas.

- Whether it is possible to effectively report in Task 1 the lack of activity of a fleet that had catches in the past, recognizing that activity is best reported in Task 2 Catch and Effort.

The Group recommended to improve the research on incorporating spatio-temporal factors in the estimation of standardized CPUE indices of relative abundance. This will permit to better test, among other things, whether abundance and distribution of yellowfin tuna is changing through history and whether such changes may be related to climate change.

The Group recommended the activation of the Tropical Tunas Technical Sub-Group on MSE following the terms of reference, as indicated in **Appendix 5**.

The Group recommended that training materials from ICCAT capacity building workshops be made available to the SCRS through the website. As this has some associated costs, the Group recommends that a budget be prepared that reflects such costs for consideration by ICCAT.

The Group recommended that the TORs for the next capacity building workshop(s) for MSE be prepared in accordance with the recommendations of the Group (Section 6b) and SCRS/2024/017.

b. Management

The Group recommended to the SCRS to request specific input from the Commission on management objectives for the multi-stock MSE, including probabilities and timelines.

9. Responses to the Commission

The Group reviewed the spreadsheet of Active Responses maintained by the Secretariat and also considered a comprehensive list of questions prepared by Panel 1 (**Appendix 6**). The Group noted three active responses to the Commission.

9.1 A response pertaining to the completion of the SKJ-W MSE

The Group will prepare a response describing the progress of the SKJ-W MSE before the SCRS Annual Meeting.

9.2 An update of the MSE Roadmap

The Group will prepare an update of the MSE Roadmap before the SCRS annual meeting.

9.3 An update of the historical FAD set data

With regard to this response, the Secretariat noted that it has already received all the data that are likely to be available from CPCs, and that there may be no new information to improve upon our previous responses. The Group discussed various approaches to inform the Commission about the maximum number of FADs (or FAD sets) that could be deployed and determined that the data to make statistically rigorous evaluations are very limited. The Tropical Tuna Rapporteurs and the Secretariat will explore the available information prior to the Yellowfin Tuna Stock Assessment Meeting in July and will prepare a draft response if possible.

9.4 Panel 1 questions not included in official responses

With regard to the extensive list of requests developed by Panel 1 in 2023 (**Appendix 6**), the Group expressed concerns about the number and complexity of the questions. The SCRS Chair noted that there was little time to discuss, prioritize, or refine the questions before the 2023 SCRS meeting. Moreover, he agreed to bring this to the attention of Second Intersessional Meeting of Panel 1 in May 2024, to determine whether this list can be refined to develop a manageable list of requests. It was also noted the importance of including all these Commission requests under the annual Tropical Tunas Workplan and in coordination with the Secretariat.

10. Other matters

a. Update on SCRS Workshop recommendations

The SCRS Workshop was held from 18-20 March 2024 in Madrid, and included discussion of a broad range of topics relevant to how the SCRS conducts its work. The report of that workshop is being adopted by correspondence, but a list of recommendations that emerged from the discussion was adopted during the workshop. The SCRS Chair provided an overview of those recommendations, highlighting particular recommendations that had relevance to discussions that took place during this Yellowfin Tuna Data Preparatory Meeting or were relevant to this year's stock assessment process.

These highlighted recommendations related to discussions at this meeting included, for example, a call for materials from ICCAT training workshops to be maintained and made available for the use of the SCRS and the Commission. There was also a call for working groups to provide ToRs for research funding requests at the September Species Group meetings, or the latest by the annual Commission meeting so that calls for tender for funded projects can be disseminated early in the following calendar year. There were relevant recommendations that called for reactivating the Ad Hoc Working Group on Tagging and provided additional guidance on the use of electronic tags.

One recommendation emerging from the SCRS Workshop generated discussion during this (Yellowfin Tuna Data Preparatory) meeting. This recommendation called for Working Groups to structure their workplans to allow for modelers to meet online with the other scientists involved in the assessment meeting 2 or more weeks before scheduled assessment meetings. The intent would be to inform Working Groups of any preliminary results or any unplanned decisions that modelers made to improve model performance and to allow the other scientists to request alternative approaches as appropriate.

The Group expressed several concerns regarding this recommendation. There were also concerns that if the time between the online meeting and the assessment meeting was too short, there would be no time to address any requests for additional or modified analyses; therefore, the timing should be greater than two weeks in advance of the assessment meeting. There was also concern that the time available for analysis between the finalization of data for this assessment and any online meeting with the modelers may be too short to advance the analyses sufficiently.

The SCRS Chair clarified that this recommendation was provided for the Group's consideration as a possible approach this year, and has not been adopted by the SCRS as mandatory. In addition, the recommendation calls for this to be considered during the development of the workplan, so in the future perhaps more time between meetings could be considered to facilitate holding this online meeting.

b. Plan for intersessional work related to data improvements

A progress report of the update to the T3 (Tropical Tuna Treatment) process was presented as requested by the Group (SCRS/P/2024/025). This process aims to estimate the catch per species of tropical tuna PS fisheries, based on routine sampling programmes at landings. A summary of historical changes to the procedure can be found in the scientific document by Pianet *et al.* (2000). This document also explains and justifies the changes that have occurred throughout recent history to correctly obtain a specific composition of PS fleet catch. Due to the changing fishing strategy increasing sets on floating objects beginning in 1991, along with the later use of beacons and echosounders, it was necessary to review the sampling programmes at landings. Thus, in the years 1996-97 (Pallarés and Nordstrom, 1997 and Pallarés and Petit, 1998), the specific composition, statistics, size distributions, and conversion procedures from size measure of the 1st dorsal (LD1) to standard fork length (LF) were improved. The T3 programme was originally developed in the Fortran language associated with an ACCESS databases and has been used to correct major tuna catch since then. From 2020, the development of the T3 is performed by the Intersessional Subgroup (ISSG) Tropical Tuna of the EU Regional Coordination Group for Large Pelagics (RCG-LP). This group is composed of EU-Spain, EU-France, Senegal, and the Seychelles scientists who shared a common sampling design, databases, and treatment, including the T3 process.

The T3 process was recently coded in the form of an R package to facilitate its collaborative development and open access to the scientific community. The 2024 version of the package can handle various databases or files as inputs, aiming to be used by any PS fishery having the required data for catch estimation. In particular, a robust sampling of landings is a fundamental piece for the process to be successful. Outputs of the T3 process were formatted to give catch and size distribution data according to the tuna RFMOs standards (ICCAT and IOTC). Preliminary trials on the historical time series have demonstrated consistency in the estimations in comparison with time-series estimates using the previous versions of the T3 process. EU-Spain, EU-France, Senegal, and the Seychelles aim to submit the 2023 catch estimation using the new T3R version.

It was noted that some analyses needed for responses to the Commission rely on catch-at-size (CAS) for all three species and that therefore CPCs should provide CAS for all three tropical tuna species, not just for yellowfin tuna. The Secretariat confirmed that it will provide CAS before the stock assessment meeting. The Group also noted that if the Commission is interested in the effect of changes in selectivity, there are various approaches that could be used, some of which have been loaded into the background documents references (Correa *et al.*, 2023).

11. Adoption of the report and closure

The report was adopted during the meeting. The Chair of the Group thanked all the participants and the interpreters for their efforts. The meeting was adjourned.

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Table 1. YFT-A+M standard SCRS catalogue on statistics (Task 1 and Task 2) by stock, major fishery (flag/gear combinations ranked by order of importance) and year (1993 to 2022). Only the most important fisheries (representing ±97.5% of Task-1 total catch) are shown. For each data series, Task 1 (DSet= "t1", in t) is visualized against its equivalent Task 2 availability (DSet= "t2") scheme. The Task 2 colour scheme, has a concatenation of characters ("a"= T2CE exists; "b"= T2SZ exists; "c"=T2CS exists) that represents the Task 2 data availability in the ICCAT-DB.

Table 8. YFT-A stock (AT + MD)

					T1 Total	162844	172763	154552	148697	136653	144076	134165	131964	152905	136464	123236	119574	105091	105912	102844	111874	117915	117424	113186	114389	107007	115698	129859	150311	136863	135914	136213	153913	122367	149137			
Score:	6.159																																					
Species	Stock	Status	FlagName	GearGrp	DSet	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Rank	%	%cum
YFT	A+M	CP	EU-France	PS	t1	35143	33841	28923	32651	29723	31172	29666	30420	31528	33291	32940	24010	22317	18480	13279	15981	18748	20155	21772	18590	20390	22307	20525	26036	25877	24869	17877	15992	12920	17412	1	18.4%	18%
YFT	A+M	CP	EU-France	PS	t2	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	1		
YFT	A+M	CP	EU-España	PS	t1	40854	39734	37707	31866	23901	28282	19332	24764	30433	30343	23665	20454	11121	10607	12833	23557	32140	24191	18238	17898	11336	13463	20436	18654	11521	10332	14092	18957	9979	11000	2	16.3%	35%
YFT	A+M	CP	EU-España	PS	t2	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	a	abc	abc	2		
YFT	A+M	CP	Ghana	PS	t1				2542	5628	4710	9640	5222	12240	11120	9127	5502	6364	4865	5396	9197	9602	13951	11730	10697	9400	12890	13269	13457	14738	18479	21714	22367	17045	25374	3	7.8%	42%
YFT	A+M	CP	Ghana	PS	t2				abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ab	abc	abc	abc	abc	abc	abc	abc	ab	ab	ab	ab	ab	ab	a	a	3		
YFT	A+M	CP	Ghana	BB	t1	13283	9984	9268	5640	9459	9139	11810	7451	11605	7426	6711	9943	6655	9173	10174	7325	6257	6301	6771	5774	4521	6049	6391	6761	5661	5868	4529	4068	4219	4176	4	5.6%	48%
YFT	A+M	CP	Ghana	BB	t2	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ab	abc	abc	abc	abc	abc	abc	abc	ab	ab	ab	ab	ab	ab	a	a	4		
YFT	A+M	CP	Venezuela	PS	t1	12659	19587	6338	10777	11653	9157	6523	7572	13934	11573	4852	3185	2634	4439	2341	2067	1363	2722	2253	3291	3635	2581	1920	2367	3373	1527	760	725	591	669	5	4.0%	52%
YFT	A+M	CP	Venezuela	PS	t2	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	5		
YFT	A+M	CP	Panama	PS	t1	7781	8548	10854	5759	3137	1753	775	1087	574	1022		1887	6325	8682	9539	6289	5911	5102	4459	5058	4062	4646	3412	4331	5090	4071	5870	8213	8408	10904	6	3.9%	56%
YFT	A+M	CP	Panama	PS	t2	ab	ab	ab	ab	ab	ab	a	ab	ab	ab		ab	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ac	ab	abc	abc	abc	6		
YFT	A+M	CP	Curaçao	PS	t1				3183	6082	6110	3962	5441	4793	4035	6185	4161	15	1964	1390	7367	6469	5397	4501	6906	3813	5230	6267	8012	6661	7615	7773	9081	7796	3122	7	3.6%	60%
YFT	A+M	CP	Curaçao	PS	t2				ab	ab	ab	a	ab	ab	ab	ab	ab	b	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ac	abc	abc	abc	abc	7		
YFT	A+M	CP	Japan	LL	t1	3096	4783	5227	5250	3539	5173	3405	4061	2691	2105	2754	6260	4247	4643	9037	6252	4994	4580	4454	4661	4577	3824	3470	3376	3123	3099	4056	2662	3073	4232	8	3.2%	63%
YFT	A+M	CP	Japan	LL	t2	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ab	ab	ab	ab	ab	ab	a	a	8		
YFT	A+M	CP	Brazil	HL	t1		60	18	69	156						272			30	22	25	2	61	415	1570	5208	10415	12123	13658	16878	15159	10993	11038	11052	11982	9	3.1%	66%
YFT	A+M	CP	Brazil	HL	t2		b	-1	-1	-1						-1			-1	-1	-1	-1	a	-1	-1	-1	a	-1	-1	ab	ab	a	ab	a	a	9		
YFT	A+M	CP	USA	RR	t1	1898	4523	4053	4032	3569	2927	3967	3862	4185	2887	5328	3759	3657	4908	2966	1033	1011	1400	1802	2405	2532	1621	1660	2743	2904	1770	1669	2808	3189	6898	10	2.3%	68%
YFT	A+M	CP	USA	RR	t2	ab	ab	ab	ab	ab	ab	ab	abc	ab	abc	ab	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	10		
YFT	A+M	CP	Belize	PS	t1						963		321	406								377	1820	3154	5888	5295	7070	7125	5620	5791	8121	9142	8688	7571	9036	11	2.2%	70%
YFT	A+M	CP	Belize	PS	t2						a		ab	ab		b						abc	ab	ab	ab	ab	ab	ab	ab	abc	a	a	a	a	a	11		
YFT	A+M	NCC	Chinese Taipei	LL	t1	4196	6660	4698	6653	4466	5328	4411	5661	4805	4659	6486	5824	3596	1260	1947	1122	1391	824	1768	1071	1259	1041	1220	942	776	945	736	870	468	669	12	2.2%	73%
YFT	A+M	NCC	Chinese Taipei	LL	t2	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	12		
YFT	A+M	CP	Cape Verde	PS	t1							0	6	12	884	246	356	5110	4443	3556	7295	3620	4954	5260	3469	6424	3591	6967	5111	1627	4085	2280	4846	818	78	13	1.9%	75%
YFT	A+M	CP	Cape Verde	PS	t2	a						a	a	a	a	a	ab	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	ab	ab	abc	ab	a	a	a	13		
YFT	A+M	CP	Brazil	LL	t1	2044	1365	1378	734	849	1285	2930	2754	4954	3323	1941	4115	4987	2543	4093	2326	2906	2989	1954	2558	1141	1112	1206	2579	1118	842	1296	1287	1617	1299	14	1.7%	76%
YFT	A+M	CP	Brazil	LL	t2	a	ab	a	a	a	a	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	a	a	a	a	ab	ab	ab	ab	ab	ab	14		
YFT	A+M	CP	Guatemala	PS	t1											2207	1588	2963	5300	3478	3768	2612	3158	2811	2961	4036	3773	5200	2720	3718	2539	2957	2594	1883	4264	15	1.6%	78%
YFT	A+M	CP	Guatemala	PS	t2											ab	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ac	abc	abc	abc	abc	15		
YFT	A+M	CP	USA	LL	t1	3886	3246	3645	3320	3773	2449	3541	2901	2200	2573	2164	2492	1746	2010	2395	1394	1686	1218	1462	2270	1544	1446	1041	1300	1431	855	877	795	721	797	16	1.6%	79%
YFT	A+M	CP	USA	LL	t2	ab	ab	ab	ab	ab	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	16		
YFT	A+M	CP	Venezuela	BB	t1	3296	4350	2684	2604	2632	4267	4152	3660	4296	3166	2475	2030	1631	1481	951	489	929	809	1068	788	673	395	428	771	500	339	244	48	46	149	17	1.3%	81%
YFT	A+M	CP	Venezuela	BB	t2	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	17		
YFT	A+M	CP	El Salvador	PS	t1									933														2781	8633	6318	5574	3976	8813	6337	6322	18	1.3%	82%
YFT	A+M	CP	El Salvador	PS	t2									ab														abc	abc	abc	ac	abc	abc	abc	abc	18		
YFT	A+M	NCO	NEI (Flag related)	LL	t1	2671	4404	4202	5962	6100	8339	6760	5269	2784	57	578																				19	1.2%	83%
YFT	A+M	NCO	NEI (Flag related)	LL	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1																				19		
YFT	A+M	CP	Senegal	PS	t1																							1230	6017	3685	4726	7352	7411	7509	8673	20	1.2%	84%
YFT	A+M	CP	Senegal	PS	t2																							abc	abc	ac	ac	ac	ac	a	a	20		
YFT	A+M	CP	Brazil	BB	t1	3087	2744	2613	1956	1643	1229	1197	3093	1276	2843	1289	2838	2236	1214	1353	397	402	627	1243	511	928	118	315	445	366	376	618	778	983	1922	21	1.0%	85%
YFT	A+M	CP	Brazil	BB	t2	ab	ab	a	a	a	a	a	-1	a	a	a	a	a	a	ab	a	a	a	a	a	a	a	a	a	ab	a	a	a	a	a	21		
YFT	A+M	CP	Panama	LL	t1	3134	3422	2588	1954	1156	358	390	219	72	118				2804	227	153	288	2134	1126	1630	1995	902	1370	1837	1604	2104	2375	2163	1304	1110	22	1.0%	86%
YFT	A+M	CP	Panama	LL	t2	-1	-1	-1	-1	-1	-1	-1	a	-1	-1				a	a	a	a	-1	-1	-1	a	a	-1	-1	-1	-1	a	a	a	a	22		
YFT	A+M	CP	Cape Verde	HL	t1	1344	1560	1362	1289	1299	1145	1185	1388	1374	918	1617	1501	985	1218	1048	648	1121	1054	800	1164	1167	1167	1167	2057	1265	1572	1459	1448	1212	872	23	0.9%	87%
YFT	A+M	CP	Cape Verde	HL	t2	ab	ab	ab	ab	ab	ab	ab	ab	ab	a	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	-1	a	-1	b	a	b	ab	ab	23		
YFT	A+M	CP	EU-España	BB	t1	1498	1767	1101	3069	996	3509	1311	601	504	917	1379	1292	798	928	769	1055	874	1561	3010	973	593	1043	1068	1393	1416	696	914	742	303	452	24	0.9%	88%
YFT	A+M	CP	EU-España	BB	t2	ac	ac	ac	ac	ac	ac	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ac	abc	abc	abc	abc	a	abc	abc	24		
YFT	A+M	CP	Maroc	PS	t1	2396	3017	2290	3430	1947	2276	2307	2441	3000	2032	1567	719	1757	127					9	8	21	17	11	35	27	35	69	104	312	405	25	0.8%	89%
YFT	A+M	CP	Maroc	PS	t2	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab					-1	-1	-1	-1	-1	-1	-1	-1	-1	a	a	a	25		
YFT	A+M	CP	St Vincent and Grenadines	LL	t1							649	1956	1341	1151	543	4241	3430	2734	3180	2615	2304	847	927	551	325	481	124	434	713	307	67	83	3	106	26	0.7%	90%
YFT	A+M	CP	St Vincent and Grenadines	LL	t2							-1	-1	-1	a	a	a	-1	a	a	a	a	a	ab	ab	ab	a	a	a	ab	ab	abc	abc	ab	a	26		
YFT	A+M	CP	Mexico	LL	t1	138	671	953	262	175	303	631	900	888	1135	1356	1209	1066	963	898	961	1220	925	1185	1422	1006	1047	963	1282	1244	1033	763	821	885	609	27	0.7%	90%
YFT	A+M	CP	Mexico	LL	t2	ab	abc	ab	ab	ab	ab	a	ab	abc	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	abc	abc	abc	abc	abc	abc	27		
YFT	A+M	CP	St Vincent and Grenadines	PS	t1	5391	2476	2142	2969	3017	3327	1916	1987	3640								1														28	0.7%	91%
YFT	A+M	CP	St Vincent and Grenadines	PS	t2	ab	ab	ab	ab	ab	ab	ab	ab	ab	b	b						-1														28		
YFT	A+M	CP	Venezuela	LL	t1	707	850	687	383	381	560	504	421	451	266	323	559	828	593	613	712	898	1249	1090	736	738	790	773	1060	1181	878	1024	1159	1337	2350	29	0.6%	92%
YFT	A+M	CP	Venezuela	LL	t2	a	a	a	a	ab	ab	ab	a	-1	-1	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	29		
YFT	A+M	CP	Russian Federation	PS	t1	2160	1503	2936	2696	4275	4931	4359	737						42	211	42	33														30	0.6%	92%
YFT	A+M	CP	Russian Federation	PS	t2	-1	b	b	-1	b	b	-1	-1						-1	abc	-1	a														30		
YFT	A+M	CP	Grenada	LL	t1	858	385	409	523	302	484	430	403	759	593	749	460	492	502	633	756	630	673	686	663	674	675	1108	1535	1177	1297	708	739	287	957	31	0.5%	93%
YFT	A+M	CP	Grenada	LL	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	a	a	a	a	a	a	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	31		
YFT	A+M	CP	EU-France	BB	t1	2588	2533	1765	1658	887	319	1071	417	686	1444	772	549	606	588	488	186	381	360	609	258	26	383	404	432	283	171	213	185	37	217	32	0.5%	93%
YFT	A+M	CP	EU-France	BB	t2	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	32		
YFT	A+M	CP	Senegal	BB	t1	9	1	94	77	152	248	663	194	279	558	253	576	1106	1347	1068	682	1024	895	1199	1839	1052	491	583	692	241	290	779	731	663	721	33	0.5%	94%
YFT	A+M	CP	Senegal	BB	t2	a	a	a	ac	a	a	ab	a	ab	ab	ab	ab	ac	ac	ac	ac	ac	ac	ac	ac	ac	ac	ac	ac	ac	ac	ac	ac	a	-1	33		
YFT	A+M	CP	China PR	LL	t1	139	156	200	124	84	699	2190	1674	1056	697	1050	1305	1185	1085	1124	649	462	427	346	264	211	92	170	468	578	359	321	461	140	529	34	0.5%	94%
YFT	A+M	CP	China PR	LL	t2	-1	-1	-1	-1	-1	a	a	a	a	a	a	a	a	ab	a	ab	ab	ab	ab	ab	ab	abc	ab	abc	abc	abc	ab	abc	abc	abc	34		
YFT	A+M	CP	Trinidad and Tobago	LL	t1	4	120	79	183	223	213	163	112	122	125	186	224	295	459	615	520	629	788	798	930	1128	1141	1179	1057	889	1214	982	973	1244	1080	35	0.4%	95%
YFT	A+M	CP	Trinidad and Tobago	LL	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	a	a	a	a	a	a	a	a	a	a	a	a	ab	ab	ab	ab	ab	b	ab	ab	35		
YFT	A+M	NCO	Colombia	PS	t1	2404	3418	7172																												36	0.3%	95%
YFT	A+M	NCO	Colombia	PS	t2	-1	-1	-1																												36		
YFT	A+M	CP	Côte d'Ivoire	GN	t1					2			673	213	99	302	565	175	482	216	626	483	340	80	591	1714	172	124	260	925	10	1632	466	379	1650	37	0.3%	95%
YFT	A+M	CP	Côte d'Ivoire	GN	t2					-1			-1	-1	-1	-1	-1	-1	-1	a	-1	-1	-1	a	a	a	ab	a	a	ab	-1	a	-1	-1	a	37		
YFT	A+M	CP	Guinée Rep	PS	t1			208	1956	820								72		66	20	67	393	682	2435	1970	1283							322	1327	38	0.3%	96%
YFT	A+M	CP	Guinée Rep	PS	t2			a	a	a								-1		-1	-1	-1	-1	a	ac	ac	ac							a	a	38		
YFT	A+M	CP	Korea Rep	LL	t1	180	436	453	381	257	23	94	142	3	8	209	984	[illegible]	283	573	993	433	380	490	498	212	116	48	368	411	455	507	579	373	481	39	0.3%	96%
YFT	A+M	CP	Korea Rep	LL	t2	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	ab	ab	a	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ab	39		
YFT	A+M	CP	South Africa	BB	t1	262	473	183	139	102	192	264	129	230	77	256	139	339	444	264	108	213	159	552	160	369	1351	783	599	235	242	378	526	209	848	40	0.3%	96%
YFT	A+M	CP	South Africa	BB	t2	a	a	a	a	a	-1	a	abc	a	abc	abc	a	a	a	a	a	ab	ab	ab	ab	ab	ab	ab	ab	ab	a	a	a	a	a	40		
YFT	A+M	CP	Belize	LL	t1			1		3			5						143	1164	1160	988	288	131	41	60	35	7	39	378	623	965	653	626	1082	41	0.2%	96%
YFT	A+M	CP	Belize	LL	t2			a		a			a						a	a	a	ab	ab	ab	ab	ab	ab	ab	a	ab	abc	abc	abc	abc	ab	41		

Table 2. YFT total T1NC catches (t) landings and dead discards by stock and gear group between 1950 and 2022.

	ATL+M														
Year	BB	GN	HL	HP	HS	LL	PS	RR	TL	TN	TP	TR	TW	UN	TOTAL
1950	1176										24				1200
1951	1176		158								24				1358
1952	2548		187								52				2787
1953	3528										72				3600
1954	3332										68		7		3407
1955	4218										82				4300
1956	5723					612					111		151		6597
1957	9187					13886					323		302		23698
1958	10304					29949					45		283		40581
1959	5775					51882					112				57769
1960	11247					57121					125				68493
1961	9839					48762					202				58803
1962	10557					46692					274				57523
1963	17785					45254	1499				60				64598
1964	21116					40427	7351				34				68928
1965	18486					40943	8279				13				67721
1966	15050					28016	15658				12				58736
1967	16761					24523	18940				1				60225
1968	22135					32329	29859								84323
1969	15645					34579	44362				5				94591
1970	9787		48			31094	33525	100			15			151	74720
1971	10701		48			31334	32391	100			21			151	74746
1972	13304		48			30820	51029	100			10			151	95462
1973	14773		51			33613	47238	106			3			151	95935
1974	20977		51			32430	53520	97			6			151	107232
1975	10041		54			29838	84359	69						154	124515
1976	12814		69			25839	85871	125						224	124942
1977	10949		67			27832	91998	135			202			152	131335
1978	10002		108			21237	102013	162			312			183	134017
1979	14832	5	507		43	16636	94979	281			111			173	127568
1980	9411	30	35	1	65	20129	100772	127			20	5		173	130769
1981	11935	2	4463		98	19610	118163	1364			211	6	0	179	156031
1982	16181	3	2731		110	20492	124415	1064			5	19	0	271	165291
1983	15110	5	3448		44	14597	129491	2383				44	1	296	165419
1984	18455	9	2040	0	56	18330	74801	507			2	77	0	213	114491
1985	21664	941	1459		60	20801	107964	3544			11	45	5	333	156827
1986	17644	11	2343	0	18	25522	95701	4964				256	1	366	146827
1987	22181	1	2167		3	21268	95171	4073				415	0	419	145698
1988	21856	3	2255	0	2	28819	80357	2028			71	245	0	439	136076
1989	17050	14	2130	0	16	25419	115302	2066	7		0	154	1	306	162465
1990	24343	27	1804		1	30002	135944	663				370	1	429	193584
1991	23102	9	1463		2	24707	114840	1546	1		1	282	504	1071	167528
1992	21371	11	1388	0	14	25613	113549	1175			0	139	99	328	163687
1993	24680	14	1506		2	22037	111951	2131			3	190	60	270	162844
1994	22590	92	1847	0	1	27080	115811	4730			0	247	45	320	172763
1995	18687	22	1615		1	25322	103798	4294	4		1	334	321	154	154552
1996	15810	21	1570		1	26589	99352	4268	1		1	330	358	396	148697
1997	16804	8	1656		3	21985	91524	3747	0		2	273	450	199	136653
1998	19591	13	1486		1	25812	93095	3182	0		9	225	393	268	144076
1999	21808	8	1527		1	26837	79038	4171	1		1	38	254	479	134165
2000	16584	683	1805		1	27266	80840	4069	0		2	33	200	482	131964
2001	19522	229	1819			23079	103176	4310	0		0	24	347	399	152905
2002	17407	133	1162	0		17793	95786	3036	0		1	107	597	441	136464
2003	13720	310	2121			19394	81210	5545	0		0	164	380	391	123236
2004	19379	586	1798	0		29705	62598	4304	1		0	252	668	283	119574
2005	13407	179	1195			25393	59115	4572			0	291	663	276	105091
2006	15187	489	1498			22728	59342	5849	0		0	163	379	276	105912
2007	15099	227	1305			29551	52647	3861	0			144	2	7	102844
2008	10342	630	853			22347	76198	1352			0	140	1	10	111874
2009	10080	492	1430	0		22105	82468	1157			0	178	2	2	117915
2010	10741	345	1388	0		20059	82897	1502			0	261	209	21	117424
2011	14531	144	1422			18973	75732	1966				267	145	7	113186
2012	10328	698	3019	0		19014	78537	2555			0	203	21	15	114389
2013	8350	1809	6583			16401	71043	2585			0	232	2	2	107007
2014	9872	320	11784	0		14478	77214	1794			0	180	1	55	115698
2015	9983	242	13467	0		14365	89443	1853				330	150	25	129859
2016	11100	384	15857	0		17992	101660	2933				359	1	25	150311
2017	8710	1050	18320	1		16296	88815	3152	0		2	481	3	34	136863
2018	8016	51	16845	0		16272	92234	1969			1	464	0	63	135914
2019	7676	1681	12633	0	20	17653	94070	1979		0		408	0	93	136213
2020	7180	480	16503	0	35	16135	110094	2896		0		570	0	19	153913
2021	6463	406	14170		12	13578	83249	3916		0		546	0	28	122367
2022	8571	1660	14810		22	16854	99122	7508				556		33	149137
2023			103			8037	352								8492

Table 3. Summary of YFT conventional tagging data available in ICCAT. Number of YFT releases by year and associated recoveries by year. Also shown, the number of recoveries without recovery dates (unk).

Year	Releases Total	Recoveries Total	1966	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Unk
1940	4	2																1	1																																			
1956	102	0																																																				
1957	1	0																																																				
1960	59	0																																																				
1961	18	0																																																				
1962	4	0																																																				
1963	28	0																																																				
1964	104	0																																																				
1965	17	0																																																				
1966	25	1	1																																																		
1967	50	0																																																				
1968	26	0																																																				
1969	14	0																																																				
1970	12	0																																																				
1971	36	0																																																				
1972	13	0																																																				
1973	17	0																																																				
1974	28	1		1																																																	
1975	24	1				1																																															
1976	68	1			1																																																
1977	138	6				4	1		1																																												
1978	96	15					15																																														
1979	91	2						2																																													
1980	1123	106							24	67	10																																										5
1981	469	319								194	55	4																																									66
1982	195	7									2	2		1	1		1																																				
1983	342	38										20	15		1		1																																				1
1984	318	31											23	5	2			1																																			
1985	178	8												2	3	3																																					
1986	394	73													59	6	1	3	1																																		3
1987	214	11														5	3	1	1																																		1
1988	321	8															2	3		3																																	
1989	308	13																3	2	6		1	1																														
1990	629	18																	3	9	2	2	1	1																													
1991	1039	35																		14	15	2	3							1																							
1992	560	18																			9	7	1		1																												
1993	943	46																				18	18	7	1	1		1																									
1994	1604	149																					94	41	6	4	1			2																							1
1995	832	55																						36	9	5	4	1																									
1996	370	33																							25	4	1	1																									2
1997	429	80																								69	9	2																									
1998	564	24																									8	14	2																								
1999	1128	135																										117	13		1																						4
2000	913	44																											40	3	1																						
2001	2041	37																												27	7	1																					2
2002	1929	216																													209	2																					5
2003	209	16																														5	5																				6
2004	232	11																															6		1																		4
2005	134	8																																3	3																		2
2006	50	4																																	1																		3
2007	55	5																																		3	1	1															
2008	55	5																																			4																1
2009	141	2																																				1	1														
2010	125	5																																					5														
2011	130	8																																						1	5		1	1										
2012	126	2																																							1	1												
2013	94	5																																								4	1											
2014	101	9																																									4	4	1									
2015	73	9																																											9									
2016	6568	2138																																											1329	751	22	1	2					33
2017	14118	3456																																												3135	228	17	6	2	1			67
2018	11837	1477																																													848	451	27	4	10		1	136
2019	8109	1815																																														1634	89	18	6	2	1	65
2020	1916	322																																															279	27	2			14
2021	1236	73																																																59	14			
2022	790	52																																																	27	25		
2023	170	11																																																		11		
Unk	4	3																1																												1	1							
(blank)	6	1																																																		1		
Total	64097	10970	1	1	1	5	16	2	25	261	67	26	38	8	66	14	8	13	8	32	26	30	118	85	42	83	23	136	55	33	218	8	11	3	5	3	5	2	6	1	6	5	6	5	1339	3887	1099	2103	403	110	60	39	2	421

Table 4. Summary of YFT conventional tagging data: number of recoveries grouped by number of years at liberty in each release year. The last column shows the recovery rate (%) in each release year.

Number of tag Yellowfin tuna (*Thunnus albacares*)											
			Years at liberty								
Year	Releases	Recaptures	< 1	1 - 2	2 - 3	3 - 4	4 - 5	5 - 10	10+	Unk	% recapt*
1974	28	1	1								3.6%
1975	24	1		1							4.2%
1976	68	1	1								1.5%
1977	138	6	5			1					4.3%
1978	96	15	15								15.6%
1979	91	2	2								2.2%
1980	1123	106	79	21	1					5	9.4%
1981	469	319	216	34	3					66	68.0%
1982	195	7	2	2		2		1			3.6%
1983	342	38	28	7	1			1		1	11.1%
1984	318	31	26	3	1		1				9.7%
1985	178	8	2	4	2						4.5%
1986	394	73	64	1	2	3				3	18.5%
1987	214	11	7	2	1					1	5.1%
1988	321	8	4	1	2	1					2.5%
1989	308	13	5	5	1	1		1			4.2%
1990	629	18	9	5	1	2		1			2.9%
1991	1039	35	24	7	3				1		3.4%
1992	560	18	12	5		1					3.2%
1993	943	46	29	12	3	1		1			4.9%
1994	1604	149	102	36	7	1		2		1	9.3%
1995	832	55	42	6	3	3	1				6.6%
1996	370	33	27	2	2					2	8.9%
1997	429	80	75	3	2						18.6%
1998	564	24	16	7	1						4.3%
1999	1128	135	129	1	1					4	12.0%
2000	913	44	42	2							4.8%
2001	2041	37	31	4						2	1.8%
2002	1929	216	209	2						5	11.2%
2003	209	16	10							6	7.7%
2004	232	11	6	1						4	4.7%
2005	134	8	3	3						2	6.0%
2006	50	4	1							3	8.0%
2007	55	5	4		1						9.1%
2008	55	5	4							1	9.1%
2009	141	2	1	1							1.4%
2010	125	5	5								4.0%
2011	130	8	1	4	1	1	1				6.2%
2012	126	2	1	1							1.6%
2013	94	5	4	1							5.3%
2014	101	9	4	5							
2015	73	9		9							12.3%
2016	6568	2138	1434	650	18	1	2			33	32.6%
2017	14118	3456	3149	215	17	5	3			67	24.5%
2018	11837	1477	893	409	25	13		1		136	12.5%
2019	8109	1815	1639	85	21	2	3			65	22.4%
2020	1916	322	280	26	2					14	16.8%
2021	1236	73	70	3							5.9%
2022	790	52	49	3							6.6%
2023	170	11	11								
Unk	4	3								3	75.0%
Grand Total	64091	10969	8774	1589	122	38	11	8	1	426	17.1%

Table 5. Index evaluation criteria and advice for use in stock assessment.

To be USE In the 2024 Stock Assessment	Yes	Yes	NOT	NOT	Yes	Yes Sensitivity	NOT	NOT	NOT	NOT	YES sensitivity with Vess ID factor	NOT
If Use … specifications	Continuity run SA Region 2 w/o subsampling	Continuity run, recruitment index by Qtr. Sensitivity run removing 2022Q3				to use index # from doc.	Included in the Joint Index	Promising Method for account spatio temporal interactions				
Unit of index	Number	Weight	Number	Number	Weight	Weight	Number	Number	Number	Weight	Weight	Number
SCRS Doc No.	**SCRS/2024/036**	**SCRS/2024/044**	**SCRS/2024/034**	**SCRS/2024/035**	**SCRS/2024/041**	**SCRS/2024/052**	**SCRS/2024/056**	**SCRS/2024/049**	**SCRS/2019/117**	**SCRS/2024/042**	**SCRS/2024/043**	**SCRS/2019/078**
Index Name:	Joint longline	Buoy-derived Abundance Index	Joint longline VAST	Japanese longline	EU_PS_Free School (FS)	EU_PS_Floating Objects (FOBs)	Chinese Taipei longline	Brazilian Uruguayan longline	Venezuelan longline	Venezuelan PS	Venezuelan BB	US longline
Data Source (state if based on logbooks, observer data etc)	logbooks	acoustic data from echosunders buoys, TaskII	logbooks	logbooks	logbooks	logbooks	logbooks	logbooks	Observer data	logbooks	logbooks	logbooks
Do the authors indicate the percentage of total effort of the fleet the CPUE data represents?	Yes	NA	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No
If the answer to 1 is yes, what is the percentage?	91-100%		21-30%	81-90%	91-100%	91-100%	71-80%	71-80%	0-10%	91-100%	91-100%	
Are sufficient diagnostics provided to assess model performance??	Sufficient	Sufficient	None	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient	Incomplete	Sufficient
How does the model perform relative to the diagnostics ?	Well	Well	Poorly	Well	Well	Well	Well	Well	Mixed	Well	Mixed	Well
Documented data exclusions and classifications?	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Data exclusions appropriate?	Yes	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Data classifications appropriate?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geographical Area	Atlantic	Tropical	Atlantic	Atlantic	Atlantic	Atlantic	Atlantic	Atl S	Tropical	Tropical	Tropical	Atl NW
Data resolution level	Set	OTH	Set	Set	Set	Set	Set	Set	Set	Set	Set	Set
Ranking of Catch of fleet in TINC database (use data catalogue)	6-10		6-10	6-10			11 or more	11 or more	11 or more	11 or more	11 or more	11 or more
Length of Time Series	longer than 20 years	11-20 years	longer than 20 years	longer than 20 years	longer than 20 years	11-20 years	11-20 years	11-20 years	longer than 20 years	longer than 20 years	longer than 20 years	longer than 20 years
Are other indices available for the same time period?	Few	Few	Many	Many	Few	Many	Many	Few	Many	Many	Many	Few
Are other indices available for the same geographic range?	None	Few	Many	Many	Few	Many	Many	Few	Few	Few	Few	Few
Does the index standardization account for Known factors that influence catchability/selectivity? (eg. Type of hook, bait type, depth etc.)	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Estimated annual CV of the CPUE series	Variable	Low		Low	Medium	Low	Low	Low	High	Medium	Variable	Low
Annual variation in the estimated CPUE exceeds biological plausibility	Unlikely	Unlikely	Possible	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely	Possible	Possible	Possible	Unlikely
Is data adequate for standardization purposes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Is this standardised CPUE time series continuous?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
For fisheries independent surveys: what is the survey type?		Acoustic										
For 19: Is the survey design clearly described?		Yes										
Other Comments	multi-national joint longline index from Brazil, Japan, Korea, Chinese-Taipei, and USA		multi-national joint longline index from Brazil, Japan, Korea, Chinese-Taipei, and USA. Authors indicate to be Work on Development/ Not fully evaluated yet		100% of EU PS effort over the time period, but I have not tried to estimate what fraction that is of the total PS effort, though it is definitely the dominant component. For the CV, I have made an effort to be as honest as possible regarding CV, leading to perhaps somewhat larger values than other indices.	only quartely index						The data used for this index are also utiled in the combined index.

Table 6. Relative abundance estimates and coefficient of variation for available indices.

Use in 2024 assessment														
series	Joint LL early Region1		Joint LL early Region2		Joint LL early Region3		Joint LL Region1		Joint LL Region2		Joint LL Region3		EU_PS_FS	
units	Number		Number		Number		Number		Number		Number		Weight	
area	North Temprate		Tropical		South Temprate		North Temprate		Tropical		South Temprate		Tropical	
method	Delta lognormal		Delta lognormal		Delta lognormal		Delta lognormal		Delta lognormal		Delta lognormal		Delta model	
source	SCRS/2024/036		SCRS/2024/036		SCRS/2024/036		SCRS/2024/036		SCRS/2024/036		SCRS/2024/036		SCRS/2024/041	
Year	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV
1959	4.91		3.63		6.70									
1960	1.55		2.94		4.76									
1961	1.86		1.92		2.56									
1962	1.99		1.74		1.71									
1963	1.67		1.30		1.16									
1964	1.08		0.97		0.83									
1965	0.33		0.90		0.71									
1966	0.56		0.74		0.51									
1967	1.13		0.87		0.50									
1968	0.50		0.90		0.62									
1969	1.07		0.76		0.64									
1970	0.42		0.56		0.40									
1971	0.42		0.52		0.45									
1972	0.51		0.56		0.56									
1973	0.43		0.58		0.68									
1974	0.41		0.96		0.53									
1975	0.31		0.42		0.30									
1976	0.30		0.51		0.61									
1977	0.43		0.55		0.42									
1978	0.55		0.54		0.47									
1979	0.43		0.56		0.52		1.44		1.32		0.93			
1980							0.59		1.43		0.55			
1981							0.64		1.22		0.57			
1982							0.83		1.35		0.71			
1983							0.66		1.16		0.49			
1984							1.08		1.43		0.89			
1985							0.80		1.23		0.74			
1986							0.90		1.42		0.84			
1987							0.82		1.68		0.82			
1988							1.44		1.58		1.44			
1989							0.95		1.40		0.91			
1990							0.89		1.42		0.87			
1991							1.16		1.15		1.10			
1992							0.96		0.90		0.95			
1993							0.82		1.09		0.86		0.84	0.21
1994							0.90		1.14		0.96		0.66	0.19
1995							1.21		1.19		1.16		0.59	0.15
1996							1.11		1.03		1.10		0.62	0.30
1997							0.74		0.82		0.81		0.71	0.15
1998							1.20		0.88		1.07		0.80	0.20
1999							0.96		0.97		0.91		0.75	0.15
2000							1.00		0.89		1.08		0.66	0.14
2001							1.02		0.79		1.01		0.63	0.19
2002							1.19		0.74		1.19		0.66	0.16
2003							1.10		0.81		1.34		0.68	0.13
2004							1.09		0.88		1.16		0.66	0.20
2005							1.25		0.84		1.23		0.68	0.15
2006							1.05		0.95		1.21		0.75	0.14
2007							0.96		0.93		1.40		0.82	0.13
2008							0.79		0.72		0.80		0.84	0.13
2009							0.82		0.73		0.87		0.77	0.22
2010							0.83		0.63		0.73		0.62	0.15
2011							0.99		0.67		0.99		0.47	0.15
2012							1.21		0.64		1.35		0.40	0.17
2013							1.21		0.71		1.22		0.40	0.15
2014							0.87		0.65		0.88		0.45	0.14
2015							0.99		0.69		0.96		0.53	0.14
2016							0.95		0.63		1.17		0.54	0.27
2017							1.02		0.67		0.84		0.49	0.15
2018							1.11		0.64		0.92		0.43	0.15
2019							1.19		0.67		1.49		0.41	0.18
2020							1.09		0.73		1.23		0.38	0.22
2021							1.04		0.79		1.06		0.34	0.16
2022							1.09		0.83		1.54		0.33	0.16

Use in 2024 assessment		NO		NO						Sensitivity (remove last 2yr)		NO		NO		NO	
series	Joint LL early Region1	BRA_URY LL Region2		BRA_URY LL Region 3		Ven_LL		Ven_PS		Ven_BB		Joint LLVAST-Region1		Joint LLVAST-Region2		Joint LLVAST-Region3	
units	Number	Number		Number		Number		Weight		Weight		Number		Number		Number	
area	orth Tempra	South Temprate		South Temprate		North Temprate		North Temprate		North Temprate		North Temprate		Tropical		South Temprate	
method	Delta lognormal	Integrated Nested Laplace		Integrated Nested Laplace		Delta lognormal		Delta lognormal		Delta lognormal		VAST		VAST		VAST	
source	CRS/2024/03	SCRS/2024/049		SCRS/2024/049		SCRS/2019/117		SCRS/2024/042		SCRS/2024/043		SCRS/2024/034		SCRS/2024/034		SCRS/2024/034	
Year	Std. CPUE					Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV
1959	4.91																
1960	1.55																
1961	1.86																
1962	1.99																
1963	1.67																
1964	1.08																
1965	0.33																
1966	0.56																
1967	1.13																
1968	0.50																
1969	1.07																
1970	0.42																
1971	0.42																
1972	0.51																
1973	0.43																
1974	0.41																
1975	0.31																
1976	0.30																
1977	0.43																
1978	0.55																
1979	0.43											1.83		1.71		0.98	
1980												1.45		1.05		0.55	
1981												0.99		1.91		0.57	
1982												1.34		1.63		0.52	
1983												1.47		1.94		0.76	
1984												1.81		2.24		1.06	
1985												1.24		2.18		1.80	
1986												1.24		2.43		0.98	
1987								4.41	0.02	2.11	0.35	1.42		2.23		1.69	
1988								5.28	0.02	2.91	0.40	1.15		2.21		2.25	
1989								9.35	0.02	3.10	0.24	0.97		1.58		1.36	
1990								6.37	0.02	2.92	0.22	1.24		1.58		0.75	
1991								6.87	0.03	3.14	0.24	1.06		1.10		1.61	
1992						1.03	0.62	5.25	0.03	2.43	0.20	1.39		0.90		0.33	
1993						0.77	0.46	5.03	0.03	2.61	0.16	0.90		0.99		0.52	
1994						0.59	0.50	5.88	0.02	3.01	0.27	0.85		0.81		0.61	
1995						0.55	0.43	4.01	0.02	2.64	0.19	1.05		0.76		0.77	
1996						0.42	0.68	5.76	0.02	2.23	0.32	0.60		0.77		0.65	
1997						0.62	0.43	3.01	0.04	2.90	0.15	0.64		0.66		0.44	
1998		1.69	0.13	1.45	0.06	0.51	0.46	2.70	0.04	2.94	0.14	0.94		0.62		0.83	
1999		2.55	0.12	1.36	0.06	0.66	0.48	4.15	0.02	3.01	0.25	1.07		0.64		0.98	
2000		1.93	0.13	1.76	0.06	0.89	0.35	4.51	0.03	2.11	0.30	0.86		0.46		0.79	
2001		0.99	0.09	1.50	0.06	0.59	0.49	3.67	0.03	2.80	0.21	1.02		0.47		0.77	
2002		1.65	0.05	1.43	0.06	0.56	0.65	4.00	0.04	3.08	0.21	0.73		0.50		1.14	
2003		1.30	0.06	1.29	0.07	0.61	0.72	2.31	0.03	2.88	0.22	0.66		0.56		1.21	
2004		0.64	0.05	1.42	0.08	0.73	0.85	2.15	0.03	2.37	0.26	0.71		0.56		0.44	
2005		0.70	0.04	1.35	0.06	0.82	0.95	1.96	0.03	2.84	0.11	0.58		0.59		0.65	
2006		0.90	0.04	1.28	0.08	1.42	0.76	2.87	0.02	2.75	0.14	0.55		0.73		1.48	
2007		0.96	0.04	1.10	0.08	1.02	0.73	1.95	0.01	2.05	0.23	0.81		0.70		1.79	
2008		0.98	0.04	0.94	0.11	2.19	0.32	1.68	0.02	1.93	0.25	0.62		0.58		0.89	
2009		0.73	0.04	0.80	0.15	1.68	0.24	2.39	0.02	3.13	0.18	0.81		0.60		0.77	
2010		0.44	0.04	1.62	0.13	1.41	0.39	2.22	0.02	2.04	0.08	0.48		0.46		1.06	
2011		0.38	0.05	0.88	0.11	1.19	0.33	2.53	0.02	2.35	0.26	0.82		0.71		1.61	
2012		0.47	0.05	0.99	0.10	1.19	0.12	3.08	0.02	2.37	0.34	0.93		0.51		2.07	
2013		0.65	0.09	0.73	0.13	1.13	0.23	2.50	0.03	1.87	0.17	0.72		0.69		1.51	
2014		0.50	0.05	0.63	0.11	1.17	0.31	2.58	0.03	1.85	0.12	0.98		0.54		0.61	
2015		0.57	0.06	0.84	0.11	1.29	0.17	3.09	0.04	2.34	0.12	0.81		0.87		0.90	
2016		0.46	0.04	0.62	0.15	1.35	0.23	3.13	0.04	1.87	0.28	0.64		0.59		0.85	
2017		0.62	0.07	0.60	0.18	1.24	0.19	4.53	0.03	1.25	0.21	0.66		0.65		0.69	
2018		0.50	0.04	0.74	0.11	1.19	0.06	3.01	0.03	1.46	0.16	1.02		0.52		0.95	
2019		0.57	0.04	0.48	0.12	1.17	0.15	2.13	0.04	1.61	0.17	1.35		0.53		1.10	
2020		0.61	0.07	0.70	0.13			1.53	0.02	2.25	0.66	1.20		0.60		1.06	
2021		0.67	0.05	0.90	0.11			2.79	0.02	0.67	0.40	0.82		0.76		0.86	
2022		0.56	0.04	0.84	0.10			2.13	0.02	1.08	0.62	1.60		0.91		0.81	

Use in 2024 assessment														NO		NO		NO	
series	Joint LL early Region1	JPN LL early Region1		JPN LL early Region2		JPN LL early Region3		JPN LL late Region1		JPN LL late Region2		JPN LL late Region3		CTP LL Region1		CTP LL Region2		CTP LL Region3	
units	Number	Number		Number		Number		Number		Number		Number		Number		Number		Number	
area	orth Temprat	North Temprate		Tropical		South Temprate		North Temprate		Tropical		South Temprate		North Temprate		Tropical		South Temprate	
method	Delta lognormal	Delta lognormal		Delta lognormal		Delta lognormal		Delta lognormal		Delta lognormal		Delta lognormal		Delta lognormal		Delta lognormal		Delta lognormal	
source	CRS/2024/03	SCRS/2024/035		SCRS/2024/035		SCRS/2024/035		SCRS/2024/035		SCRS/2024/035		SCRS/2024/035		SCRS/2024/056		SCRS/2024/056		SCRS/2024/056	
Year	Std. CPUE	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV
1959	4.91			2.93		1.46													
1960	1.55	1.61		2.54		4.62													
1961	1.86			1.71		3.12													
1962	1.99	2.19		1.67		2.24													
1963	1.67	2.19		1.34		1.39													
1964	1.08	1.46		1.03		1.04													
1965	0.33	0.42		0.94		0.85													
1966	0.56	0.68		0.87		0.60													
1967	1.13	1.17		0.93		0.58													
1968	0.50	0.59		0.96		0.76													
1969	1.07	1.15		0.85		0.76													
1970	0.42	0.56		0.67		0.47													
1971	0.42	0.56		0.66		0.50													
1972	0.51	0.60		0.72		0.62													
1973	0.43	0.55		0.62		0.76													
1974	0.41	0.52		0.79		0.57													
1975	0.31	0.40		0.56		0.33													
1976	0.30	0.41		0.59		0.71													
1977	0.43	0.57		0.68		0.88													
1978	0.55	0.61		0.72		0.52													
1979	0.43							1.47		1.31		0.93							
1980								1.09		1.35		0.55							
1981								0.97		1.04		0.57							
1982								0.76		1.26		0.71							
1983								1.26		1.01		0.49							
1984								1.38		1.45		0.89							
1985								1.00		1.30		0.74							
1986								1.20		1.52		0.84							
1987								1.30		1.77		0.82							
1988								1.60		1.56		1.44							
1989								1.25		1.39		0.91							
1990								1.55		1.40		0.87							
1991								1.80		1.17		1.10							
1992								1.63		0.92		0.95							
1993								0.96		1.09		0.86							
1994								1.51		1.17		0.96							
1995								1.75		1.20		1.16							
1996								1.00		1.03		1.10							
1997								0.94		0.82		0.81							
1998								1.07		0.93		1.07							
1999								1.07		0.91		0.91							
2000								0.87		0.84		1.08							
2001								0.91		0.79		1.01							
2002								0.61		0.75		1.19							
2003								0.68		0.81		1.34							
2004								0.89		0.93		1.16							
2005								0.70		0.83		1.23							
2006								0.82		0.90		1.21		1.08	0.28	0.79	0.08	0.15	0.13
2007								0.74		0.85		1.40		0.69	0.32	0.58	0.08	0.15	0.13
2008								0.67		0.65		0.80		0.11	0.36	0.42	0.08	0.08	0.14
2009								0.65		0.68		0.87		0.15	0.36	0.40	0.08	0.11	0.14
2010								0.59		0.58		0.73		0.21	0.33	0.30	0.08	0.14	0.14
2011								0.82		0.65		0.99		0.26	0.32	0.36	0.08	0.18	0.13
2012								0.98		0.61		1.35		0.22	0.31	0.30	0.08	0.16	0.14
2013								1.13		0.69		1.22		0.43	0.31	0.49	0.08	0.27	0.14
2014								0.64		0.72		0.88		0.12	0.42	0.32	0.08	0.14	0.14
2015								0.53		0.74		0.96		0.27	0.30	0.26	0.08	0.23	0.15
2016								1.34		0.65		1.17		0.17	0.32	0.29	0.08	0.14	0.15
2017								1.15		0.65		0.84		0.36	0.34	0.34	0.08	0.16	0.15
2018								1.72		0.58		0.92		0.78	0.31	0.33	0.08	0.16	0.16
2019								2.22		0.66		1.49		0.28	0.32	0.33	0.08	0.20	0.15
2020								0.68		0.63		1.23		0.97	0.31	0.47	0.08	0.14	0.15
2021								0.44		0.82		1.06		0.90	0.33	0.58	0.10	0.12	0.16
2022								0.35		0.85		1.54		1.29	0.33	0.45	0.09	0.13	0.17

Table 7. Relative abundance estimates and coefficient of variation for indices to be used in the stock assessment models.

Use in 2024 assessment		YES for continuity run, and sensitivity run removing 2022Q3					
series		Buoy-derived Abundance Index		EU_PS_FS		EU_PS_Floating Objects (FOBs)	
units		Weight		Weight		Weight	
area		Tropical		Tropical		Tropical	
method		Delta lognormal		Delta model		GLMM_hurdle	
source		SCRS/2024/044		SCRS/2024/041		SCRS/2024/052	
Year	**Quarter**	**Std. CPUE**	**CV**	**Std. CPUE**	**CV**	**Std. CPUE**	**CV**
1993	1			1.25	0.46		
1993	2			1.15	0.24		
1993	3			0.66	0.26		
1993	4			0.28	0.29		
1994	1			1.06	0.38		
1994	2			0.76	0.25		
1994	3			0.62	0.25		
1994	4			0.20	0.37		
1995	1			1.03	0.25		
1995	2			0.57	0.29		
1995	3			0.60	0.28		
1995	4			0.18	0.39		
1996	1			1.18	0.59		
1996	2			0.53	0.28		
1996	3			0.59	0.32		
1996	4			0.17	0.38		
1997	1			1.50	0.22		
1997	2			0.60	0.29		
1997	3			0.57	0.26		
1997	4			0.18	0.38		
1998	1			1.78	0.32		
1998	2			0.70	0.24		
1998	3			0.52	0.27		
1998	4			0.20	0.34		
1999	1			1.64	0.22		
1999	2			0.72	0.28		
1999	3			0.42	0.33		
1999	4			0.22	0.32		
2000	1			1.34	0.21		
2000	2			0.71	0.26		
2000	3			0.38	0.37		
2000	4			0.22	0.32		
2001	1			1.14	0.36		
2001	2			0.68	0.26		
2001	3			0.45	0.33		
2001	4			0.25	0.31		
2002	1			1.05	0.28		
2002	2			0.67	0.24		
2002	3			0.61	0.32		
2002	4			0.30	0.31		
2003	1			1.00	0.21		
2003	2			0.72	0.26		
2003	3			0.67	0.31		
2003	4			0.33	0.28		
2004	1			0.94	0.49		
2004	2			0.83	0.21		
2004	3			0.55	0.30		
2004	4			0.33	0.35		
2005	1			0.95	0.25		
2005	2			0.95	0.21		
2005	3			0.46	0.35		
2005	4			0.36	0.41		
2006	1			1.03	0.21		
2006	2			0.98	0.24		
2006	3			0.53	0.28		
2006	4			0.46	0.33		
2007	1			1.15	0.21		
2007	2			0.92	0.24		
2007	3			0.69	0.29		
2007	4			0.53	0.29		
2008	1			1.31	0.20		
2008	2			0.85	0.27		
2008	3			0.71	0.28		
2008	4			0.49	0.27		
2009	1			1.36	0.42		
2009	2			0.77	0.24		
2009	3			0.56	0.29		
2009	4			0.37	0.27		
2010	1	0.93	0.17	1.13	0.24	0.64	0.09
2010	2	0.92	0.16	0.67	0.24	1.05	0.05
2010	3	0.83	0.17	0.39	0.30	1.28	0.07
2010	4	1.11	0.17	0.30	0.30	1.03	0.05
2011	1	0.85	0.17	0.79	0.23	1.09	0.07
2011	2	0.84	0.17	0.55	0.27	1.12	0.06
2011	3	0.55	0.17	0.30	0.33	0.97	0.07
2011	4	0.52	0.17	0.27	0.28	0.82	0.06
2012	1	0.38	0.17	0.62	0.29	0.81	0.06
2012	2	0.66	0.17	0.44	0.29	1.08	0.07
2012	3	0.52	0.16	0.29	0.32	0.68	0.07
2012	4	0.38	0.16	0.26	0.32	1.43	0.06
2013	1	0.38	0.16	0.62	0.23	0.89	0.06
2013	2	0.47	0.15	0.37	0.29	0.98	0.06
2013	3	0.45	0.14	0.35	0.30	1.11	0.06
2013	4	0.65	0.13	0.26	0.32	1.02	0.06
2014	1	0.44	0.15	0.74	0.23	0.66	0.07
2014	2	0.49	0.14	0.36	0.29	1.18	0.06
2014	3	0.66	0.12	0.44	0.29	1.14	0.04
2014	4	0.61	0.11	0.28	0.29	1.02	0.05
2015	1	0.48	0.13	0.84	0.21	0.64	0.05
2015	2	0.47	0.13	0.43	0.29	1.02	0.05
2015	3	0.57	0.11	0.53	0.29	1.38	0.08
2015	4	0.52	0.10	0.30	0.29	0.96	0.04
2016	1	0.38	0.12	0.77	0.72	0.48	0.07
2016	2	0.48	0.15	0.52	0.29	1.35	0.06
2016	3	0.63	0.13	0.56	0.28	1.08	0.05
2016	4	0.50	0.11	0.32	0.27	1.09	0.04
2017	1	0.36	0.13	0.66	0.25	0.79	0.06
2017	2	0.46	0.14	0.57	0.26	0.93	0.05
2017	3	0.66	0.13	0.43	0.27	1.01	0.05
2017	4	0.64	0.11	0.30	0.29	1.27	0.04
2018	1	0.51	0.12	0.64	0.24	1.00	0.05
2018	2	0.73	0.13	0.60	0.24	0.97	0.07
2018	3	0.80	0.13	0.25	0.42	0.89	0.06
2018	4	0.67	0.12	0.23	0.34	1.14	0.06
2019	1	0.63	0.14	0.69	0.30	1.09	0.08
2019	2	0.61	0.14	0.62	0.27	1.26	0.05
2019	3	0.70	0.15	0.16	0.40	0.81	0.09
2019	4	0.64	0.14	0.18	0.35	0.84	0.05
2020	1	0.57	0.16	0.70	0.43	0.94	0.08
2020	2	0.76	0.14	0.51	0.29	1.08	0.06
2020	3	0.61	0.14	0.15	0.43	0.92	0.06
2020	4	0.61	0.14	0.16	0.36	1.06	0.04
2021	1	0.80	0.14	0.62	0.26	0.66	0.41
2021	2	0.68	0.15	0.36	0.28	1.32	0.06
2021	3	0.96	0.16	0.20	0.35	1.03	0.05
2021	4	0.65	0.16	0.16	0.33	0.99	0.04
2022	1	0.69	0.16	0.50	0.26	0.91	0.11
2022	2	0.99	0.17	0.29	0.31	1.03	0.05
2022	3	1.67	0.17	0.33	0.35	0.78	0.05
2022	4	0.76	0.14	0.18	0.35	1.27	0.04

Table 8. Proposed fleet structure, time blocks, and selectivity settings for the yellowfin tuna stock assessment.

Fleet	Fleet Name	Season	Gear	Region/Area	Country	Selectivity	Time blocks	Notes
1	PS_ESFR2_6585		PS	Areas 1, 2n, 2s, 3		5 node cubic spline		Include US PS Catch
2	PS_ESFR2_8690		PS	Areas 1, 2n, 2s, 3		5 node cubic spline		Include US PS Catch
3	PS_ESFR2_9118_S1	1	PS	Areas 1, 2n, 2s, 3		5 node cubic spline		
4	PS_ESFR2_9118_S2	2	PS	Areas 1, 2n, 2s, 3		mirrored to 3		
5	PS_ESFR2_9118_S3	3	PS	Areas 1, 2n, 2s, 3		mirrored to 3		
6	PS_ESFR2_9118_S4	4	PS	Areas 1, 2n, 2s, 3		mirrored to 3		
7	ESFR_FADS_PS_9118_S1	1	PS	Areas 1, 2n, 2s, 3		5 node cubic spline	2003 2018 (switch to FADs)	
8	ESFR_FADS_PS_9118_S2	2	PS	Areas 1, 2n, 2s, 3		mirrored to 7	2003 2018 (switch to FADs)	
9	ESFR_FADS_PS_9118_S3	3	PS	Areas 1, 2n, 2s, 3		mirrored to 7	2003 2018 (switch to FADs)	
10	ESFR_FADS_PS_9118_S4	4	PS	Areas 1, 2n, 2s, 3		mirrored to 7	2003 2018 (switch to FADs)	
11	BB_PS_Ghana_6518		PS/BB	Areas 1, 2n, 2s, 3	Ghana	double norm	2003 2018 (switch to FADs)	Exclude Size 1996-
12	BB_area2_Sdak		BB	Areas 2n, 3		double norm, smooth	2010 2018 (selex change)	Exclude South Africa
13	BB_DAKAR_62_80		BB	Area 2n		double norm, smooth		
14	BB_DAKAR_81_18		BB	Area 2n		double norm, smooth		
15	North_BB_Azores		BB	Area 1		mirrored to 14		
16	Japan_LL_N		LL	Region 1	Japan	double normal, smooth		
17	Japan_LL_TRO		LL	Region 2	Japan	logistic	1950-1979, 1980-1991,1992-2018 (selex change)	
18	Japan_LL_S		LL	Region 3	Japan	mirrored to 16		
19	Other_LL_N		LL	Region 1	except Japan	double norm, smooth increase		Exclude Chinese Taipei Size after 2005
20	Other_LL_TRO		LL	Region 2	except Japan	logistic	1950-1979, 1980-1991,1992-2018 (selex change)	Exclude Chinese Taipei Size after 2005
21	Other_LL_S		LL	Region 3	except Japan	mirror 19		Exclude Chinese Taipei Size after 2005
22	HL_Braz_N		HL	Area 1	Brazil	AOTTP tagging		
23	US_RR		RR	Area 1	USA	double norm, smooth	1998 2018 (69 cm SL)	
24	PS_WEST		PS	Area 2n	USA, Venezuel	double normal		Exclude US PS Catch and Size
25	OTH_OTH		others	All		double normal	lower lambda (0.001)	Include South Africa Catch and Size,

Table 9. Proposed template for the Tropical Tuna Research and Data Collection Program plan including preliminary timing of when work could be undertaken. The content is subject to review intersessionally by the Tropical Tuna Research and Data Collection Program working group.

Theme	***2025***	***2026***	***2027***	***2028***	***2029***	***2030***
Tagging						
Continue funding for AOTTP offices	***X***					
Analysis of collected data from AOTTP						
Environmental habitat definition [Analysis of electronic tagging data (started during the AOTTP but incomplete)] (YFT/BET)						
Reproduction						
Maturation assessment using mucus swabs (YFT/All)	***X***				`	
Age and Growth						
Improve mortality estimates (All)						
Resolve issues with biologically implausible outcomes in the YFT uncertainty grid (YFT)						
Improved estimation of growth curves and maximum age with targeted sampling of small YFT & BET and large BET	***X***					
Direct comparison of otoliths and fin spines from the same fish (e.g., IOTC-2021-SC24-INF02) (SKJ)						
Genetics						
Scoping to assess if epigenetic approaches work for tropical tunas						
Other (biology)						
Check the validity of stock unit (BET & SKJ)						
Changes in productivity of tropical tunas in relation to the environment (e.g., Productivity linked to FADs and tagging data) (ALL)						
Assessment						
Joint longline indices (YFT/BET)						
Changes in Chinese Taipei LL (YFT)						
Venezuelan data (YFT)						
Acoustic biomass index (ALL)						
Spatio-temporal modelling – VAST (All)						
MSE						
Identify and incorporate sources of uncertainty (multi-stock)						
Develop, and test CMPs (multi-stock)	***X***					
External review (multi-stock & W SKJ)	***X***					
Workshops						
Improving Ghanaian statistics (workshop)						
Other (statistics)						
Data improvements (Secretariat reviewing size data to look at outliers) (YFT)						
Discards (YFT)						
Development of indicators for FAD fishery for the evaluation of effort change (e.g., effort creep) and assessment of different impacts						

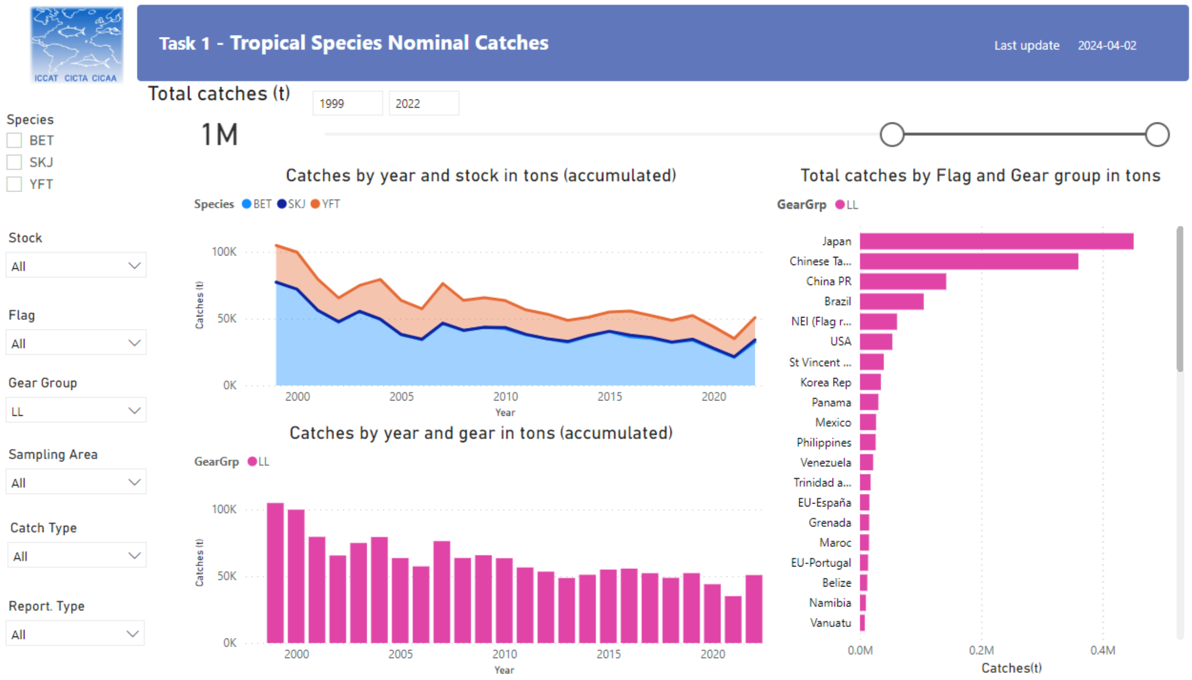

Figure 1. Screenshot of the dashboard developed for T1NC with the three major tropical tuna species (BET, SKJ, and YFT).

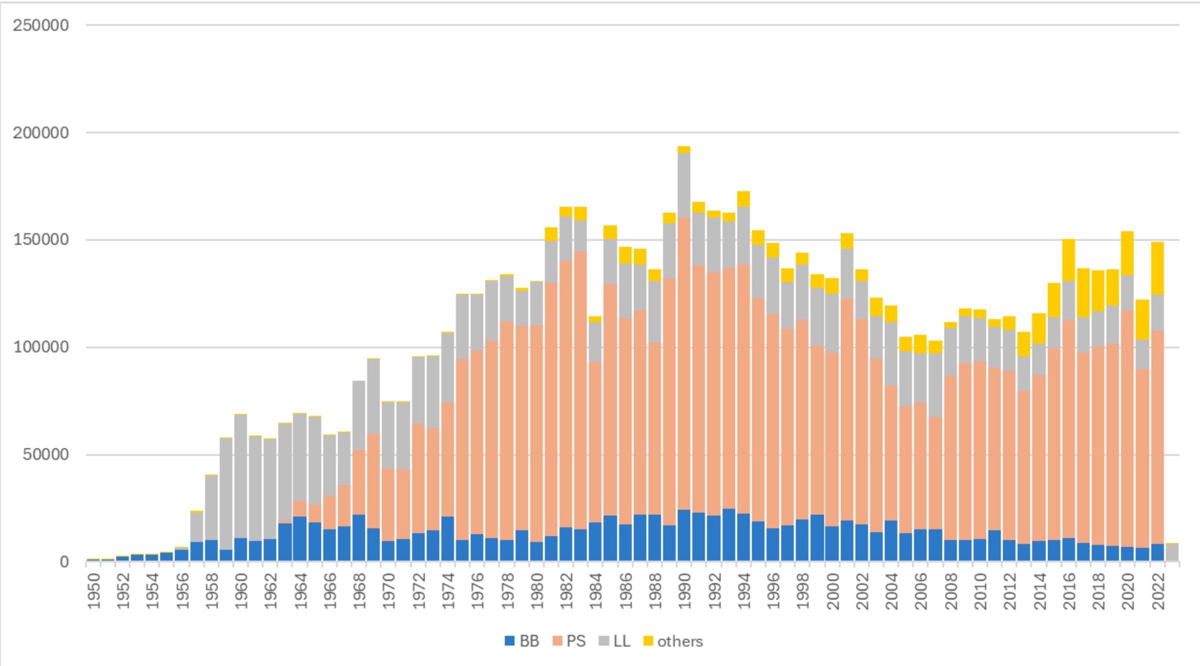

Figure 2. Yellowfin tuna cumulative T1NC catches (t) by major gear between 1950 and 2023* (*2023 is provisional and incomplete).

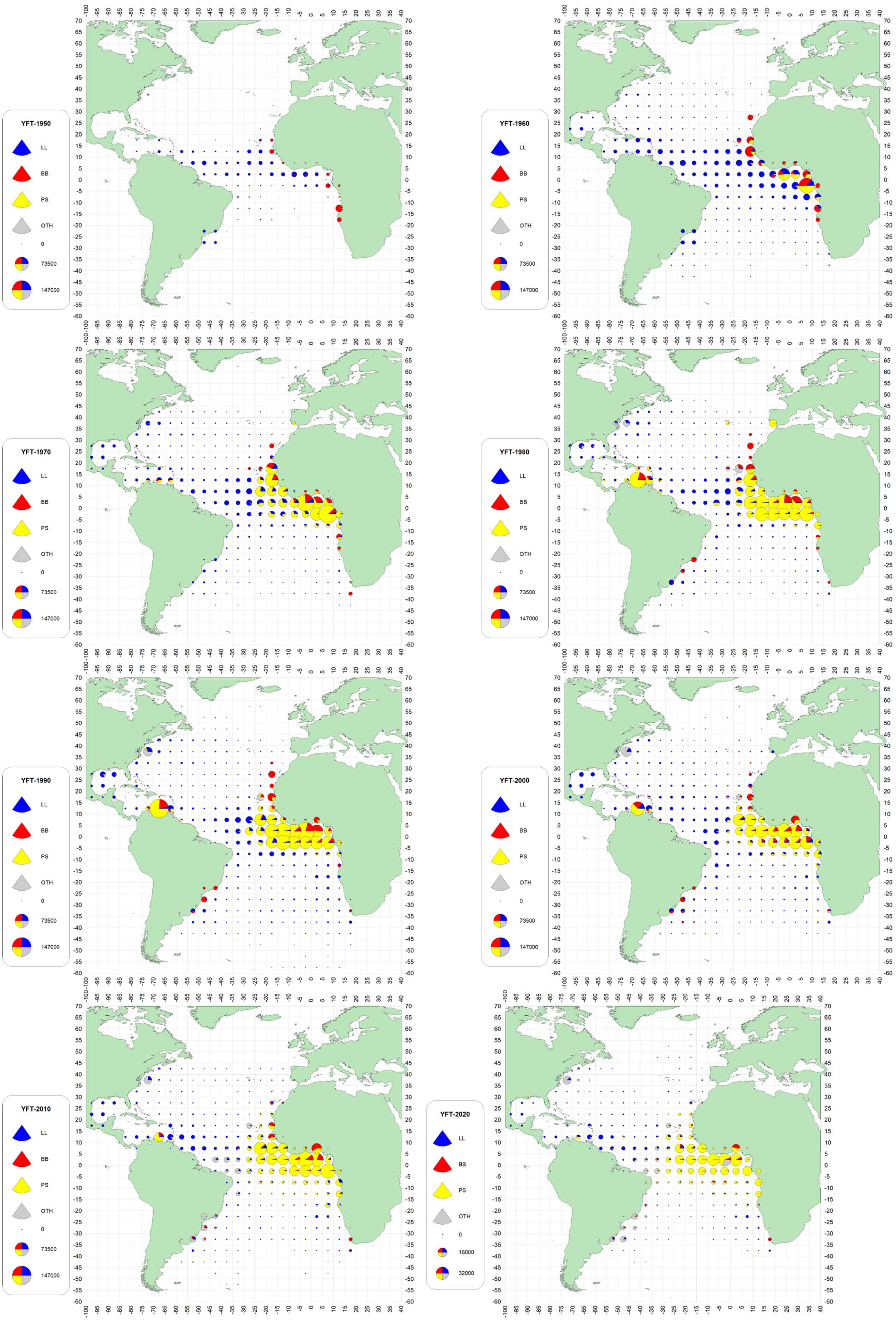

Figure 3. Yellowfin tuna CATDIS maps by decade 1950-2020.

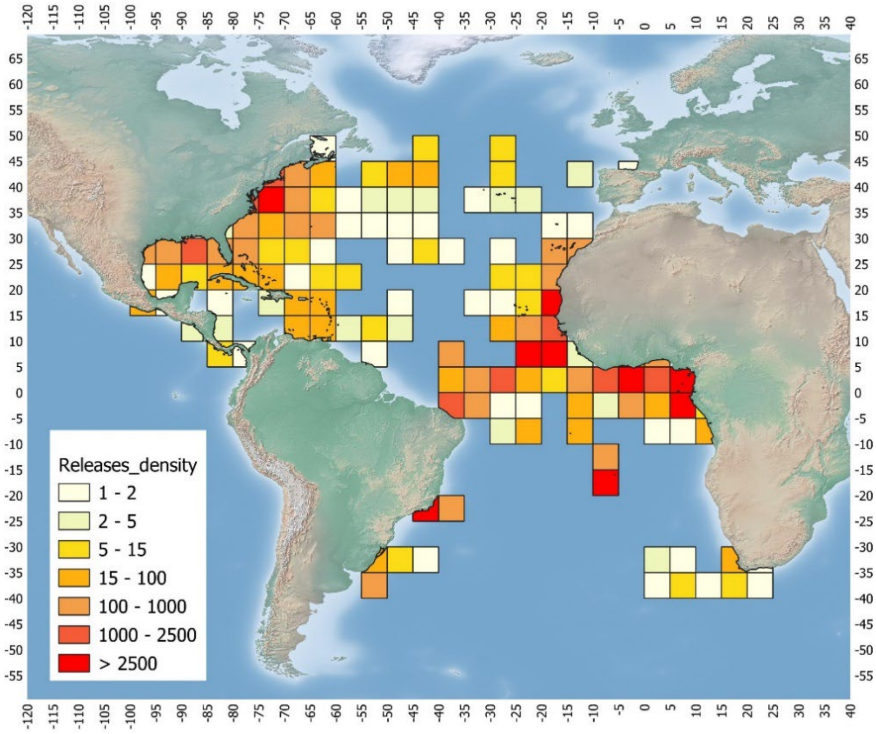

Figure 4. Density of YFT conventional tags released in a 5x5 square grid, in the ICCAT area.

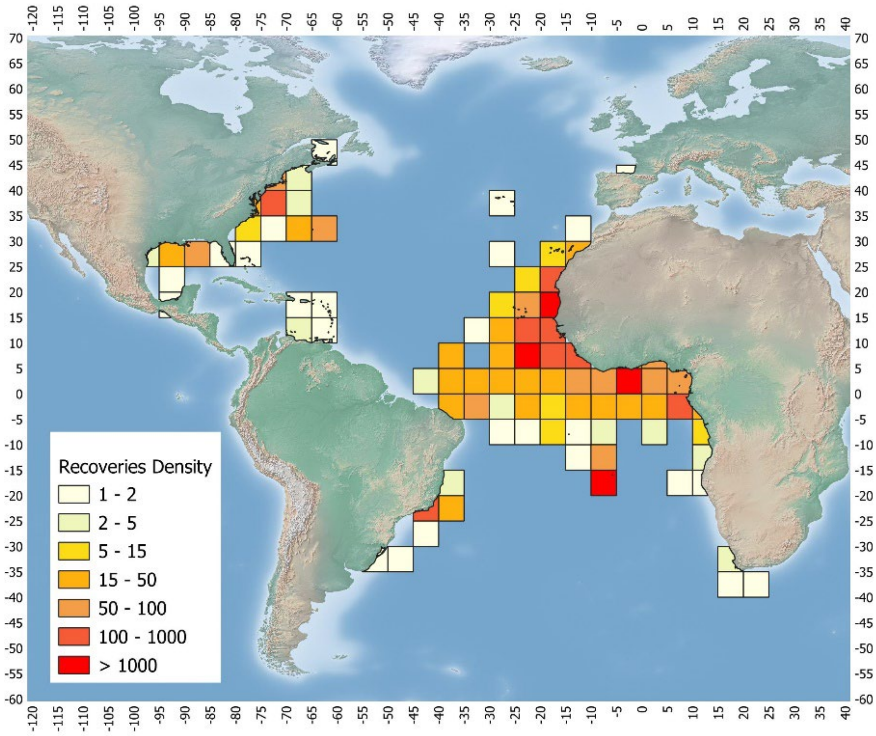

Figure 5. Density of YFT conventional tags recovered in a 5x5 square grid, in the ICCAT area.

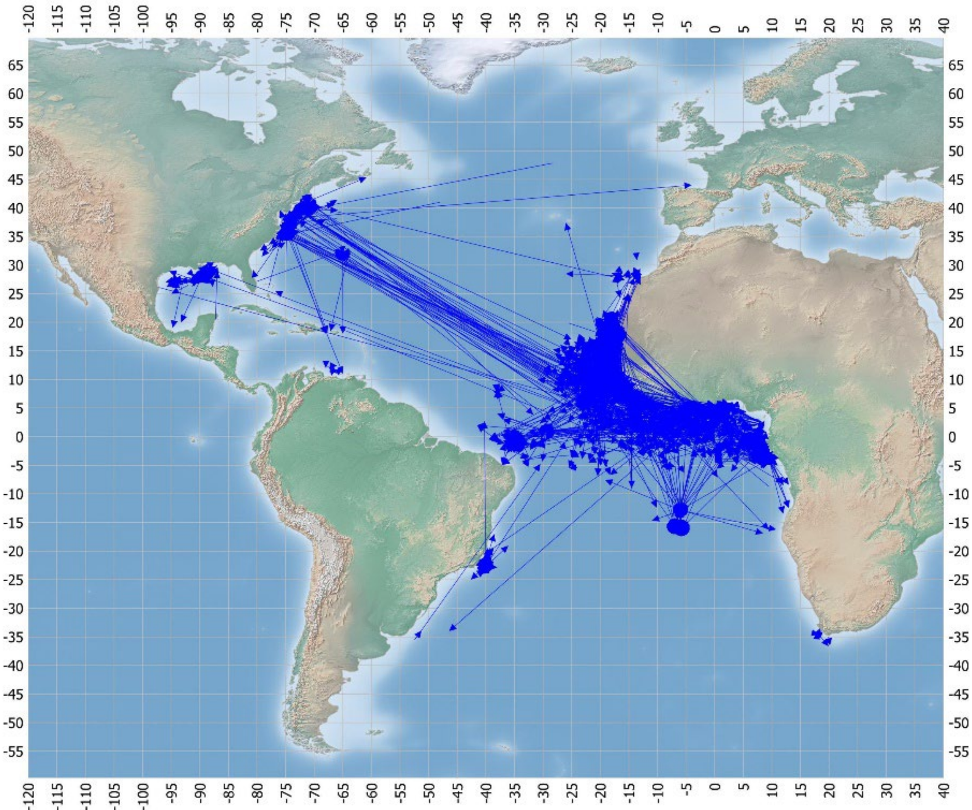

Figure 6. Apparent movement (arrows: release to recovery location) of the YFT conventional tagging.

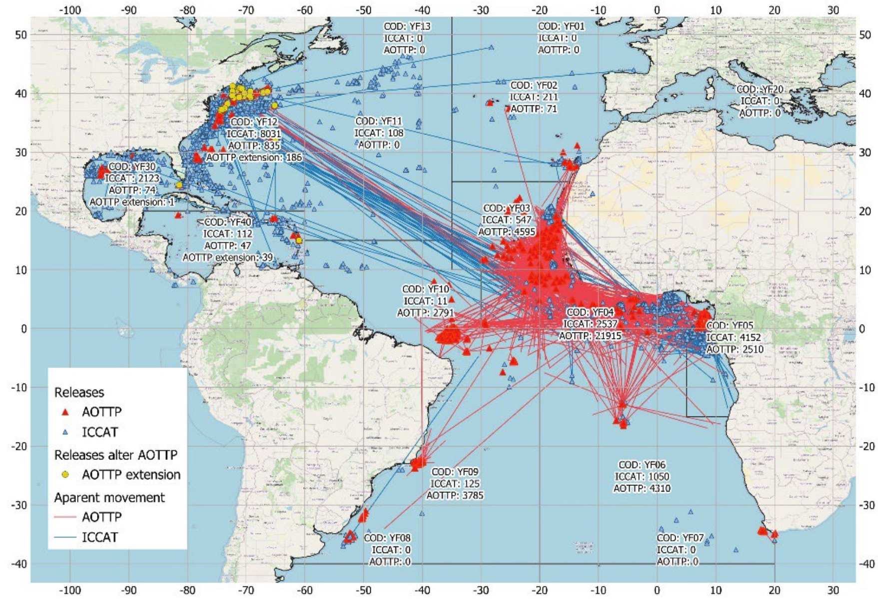

Figure 7. YFT releases and the apparent movement of the update database (red color those of the AOTTP project and in blue the rest; dots (in yellow) represent fish tagged during the extension of the AOTTP project in the Northwest Atlantic.

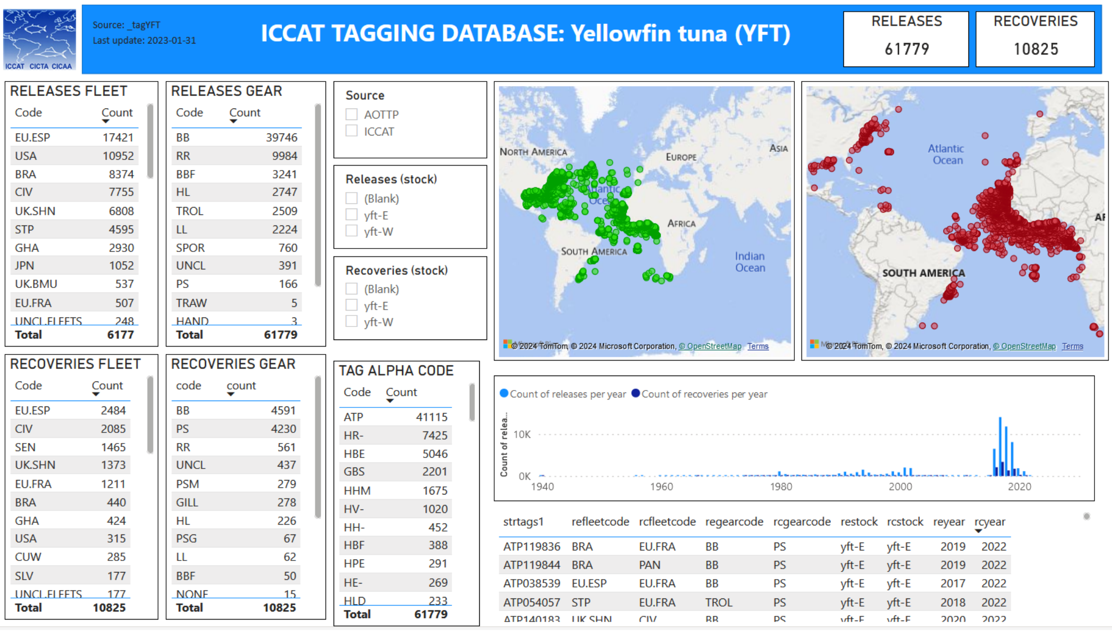

Figure 8. Snapshot of the dashboard on Conventional Tagging (YFT).

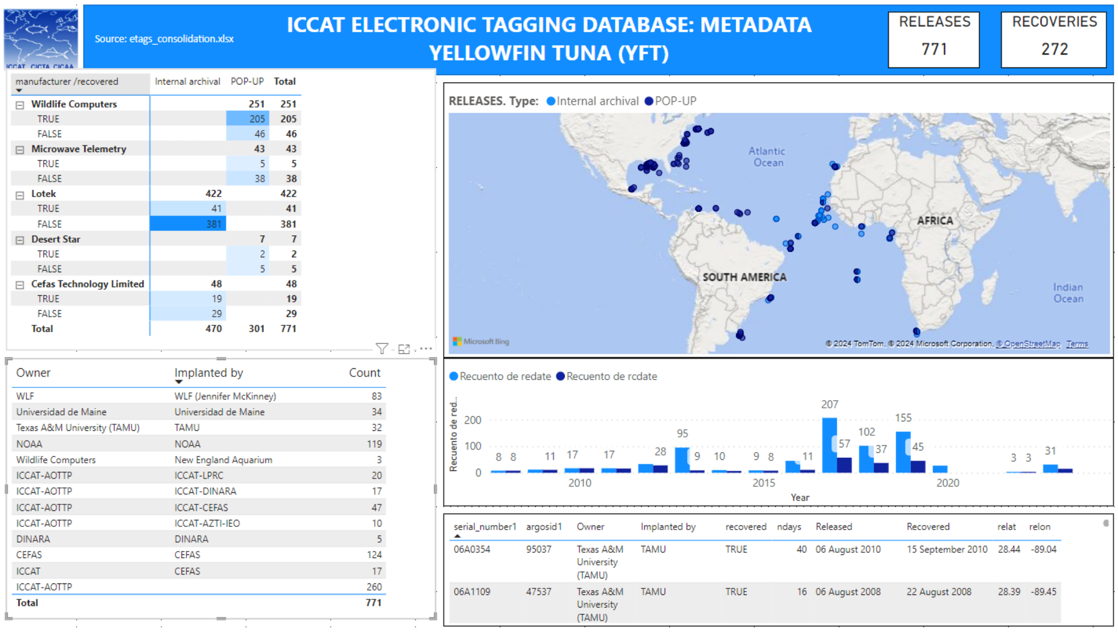

Figure 9. Snapshot of the dashboard on Electronic Tagging (YFT).

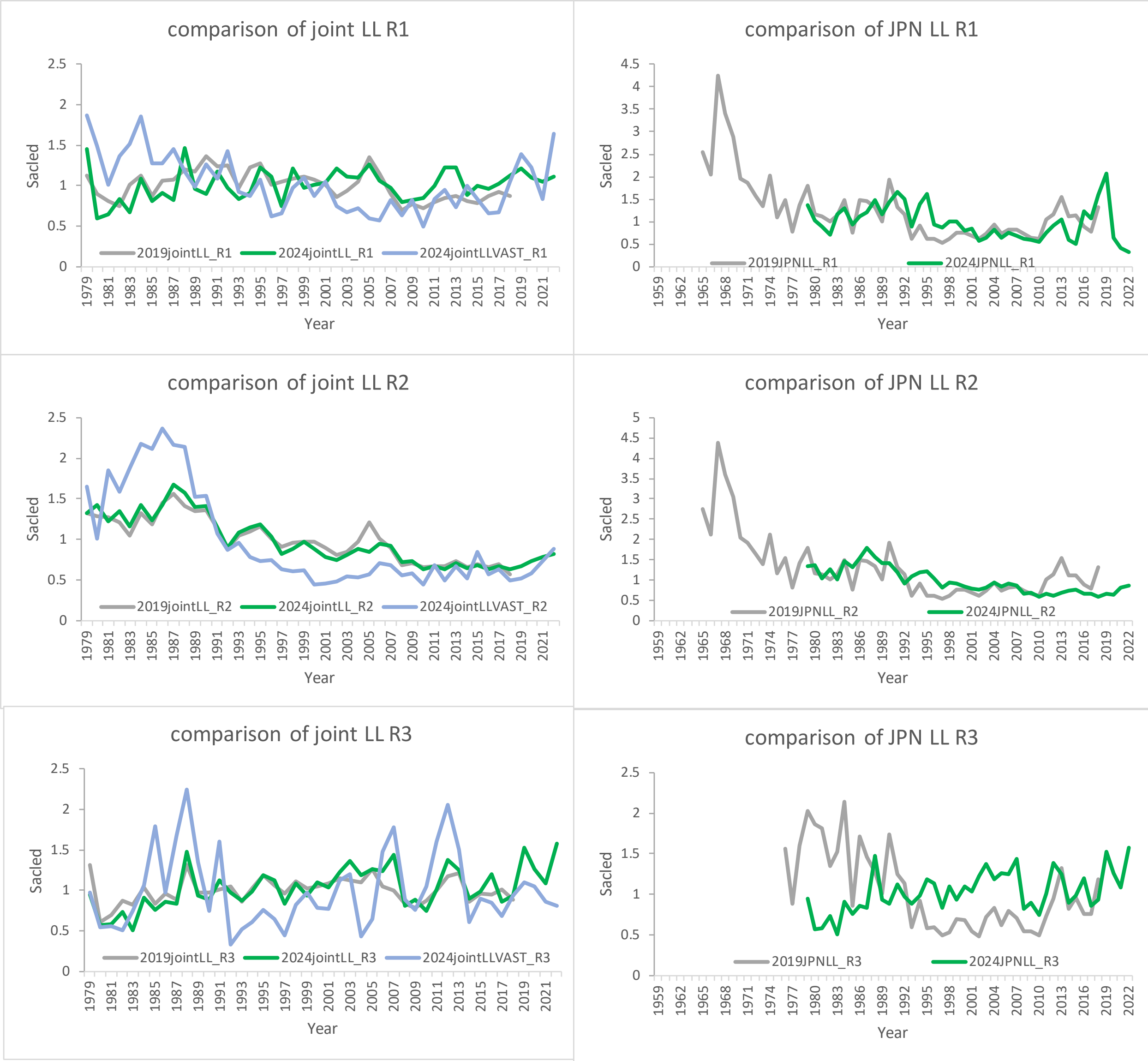

Figure 10. Relative indices of abundance prepared for the 2024 Yellowfin Tuna Stock Assessment compared to the 2019 indices.

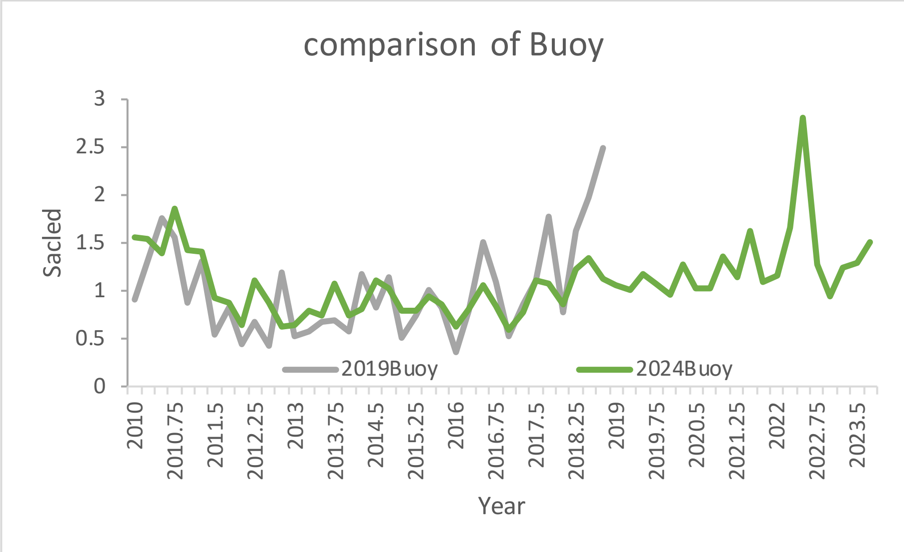

Figure 11. Comparison of the yellowfin tuna Bouy derived index of abundance from the FOBs deployed by the EU PS fleets.

Appendix 1

Agenda

1. Opening, adoption of Agenda and meeting arrangements
2. Review of historical and new information on biology
    a. AOTTP Program Update
    b. Natural Mortality
    c. Age and Growth
    d. Reproduction
3. Review of fishery statistics/indicators
    a. Task 1 catches and discards data and spatial distribution of catches
    b. Task 2 catch/effort
    c. Task 2 size data
    d. Tagging data
    e. Plan for intersessional work related to data improvements
4. Review of available indices of relative abundance
5. Review of potential assessment models, specifications of data inputs, and modeling options
    a. Production models
    b. Age Structured Models
    c. Other methods
    d. Plan for intersessional work related to the stock assessment
6. Review progress toward tropical tuna Management Strategy Evaluations
    a. Progress of SKJ-W MSE
    b. Progress of Multi-stock MSE
    c. Plan for intersessional work related to the MSE, including the establishment of a technical team
7. Development of Tropical Tuna Research Plan
8. Recommendations
    a. Research and statistics
    b. Management
9. Responses to the Commission
10. Other matters
    a. Update on SCRS Workshop Recommendations
    b. Plan for intersessional work related to data improvements
11. Adoption of the report and closure

Appendix 2

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Appendix 3

List of papers and presentations

DocRef	Title	Authors
SCRS/2024/017	Report of ICCAT capacity building workshops for management strategy evaluation in tropical tuna fisheries	Die D., Sant'Ana R., Mourato B.
SCRS/2024/034	Standardized yellowfin tuna CPUE of the multiple longline fleets by vector autoregressive spatiotemporal GLMM in the Atlantic Ocean	Satoh K., Sant'Ana R., Wang S.P., Tsai W.P., Su N.J., Chang S.T., Chang F.C., Matsumoto T., Park H., Lim J., Kwon Y., Lee S.I., Lauretta M., Kitakado T.
SCRS/2024/035	Standardization of yellowfin tuna CPUE in the Atlantic Ocean by the Japanese longline fishery	Matsumoto T., Satoh K.
SCRS/2024/036	Collaborative study of yellowfin tuna CPUE from multiple Atlantic Ocean longline fleets in 2024	Matsumoto T.
SCRS/2024/037	Natural mortality estimates of yellowfin tuna (*Thunnus albacares*) in the Atlantic and Indian Oceans	Artetxe-Arrate I., Lastra-Luque P., Fraile I., Zudaire I., Morón Correa G., Merino G., Urtizberea A.
SCRS/2024/038	Estimation of Ghana Tasks 1 and 2 purse seine and baitboat catch 2019 – 2022: data input 2024 Yellowfin Stock Assessment	Ortiz M., Ayivi S., Kwame Dovlo E., Mayor C.
SCRS/2024/041	Standardized CPUE abundance indices for adult yellowfin tuna caught in free-swimming school sets by the European purse-seine fleet in the Atlantic Ocean, 1993-2022	Kaplan D., Moron Correa G., Ramos Alonso M.L., Duparc A., Uranga J., Floch L., Rojo Méndez V., Pascual Alayón P., Merino G.
SCRS/2024/042	Standardized catch rates for yellowfin tuna (*Thunnus albacares*) from the Venezuelan purse seine fishery in the Caribbean Sea and adjacent waters of the western central Atlantic for the period of 1987-2022	Narvaez M., Evaristo E., Marcano J.H., Gutiérrez X., Arocha F.
SCRS/2024/043	Standardized catch rates for yellowfin tuna (*Thunnus albacares*) from the Venezuelan bait boat fishery in the Caribbean Sea and adjacent waters of the western central Atlantic for the period of 1987-2022	Narvaez M., Evaristo E., Marcano J.H., Gutiérrez X., Arocha F.
SCRS/2024/044	Index of abundance of yellowfin tuna in the Atlantic Ocean derived from echosounder buoys (2010-2023)	Uranga J., Goienetxea I., Grande M., Quincoces I., Merino G., Boyra G., Urtizberea A., Santiago J.
SCRS/2024/045	Statistics of the French purse seine fishing fleet targeting tropical tunas in the Atlantic Ocean (1991-2022)	Floch L., Cauquil P., Depetris M., Duparc A., Imzilen T., Lerebourg C., Sabarros P.S., Lebranchu J.
SCRS/2024/046	Conversion factors for tropical tunas caught with purse seine in the Atlantic Ocean. Update of the article SCRS/2023/148	Fily T., Duparc A.
SCRS/2024/047	Revision of historical catch statistics of yellowfin tuna (*Thunnus albacares*) caught by the Mexican fishing fleet in the Gulf of Mexico	Ramirez-Lopez K., Rojas González R.I., Mayor C.
SCRS/2024/049	CPUE Standardization of Yellowfin tuna (*Thunnus albacares*) caught by Brazilian and Uruguayan longline fleets in South West Atlantic Ocean using integrated nested laplace approximation	Sant'Ana R., Mourato B., Forselledo R., Domingo A.

SCRS/2024/050	2024 Workplan for the development of the western Atlantic skipjack tuna MSE	Sant'Ana R., Mourato B.L.
SCRS/2024/051	Estadísticas de las pesquerías atuneras españolas en el océano Atlántico tropical (1990-2022)	Rojo V., Déniz S., Abascal F. J., N'Gom F., Yala D., Casañas I., Ramos M.L., Báez J.C., Pascual-Alayón P.J.
SCRS/2024/052	Standardized catch per unit effort of yellowfin tuna in the Atlantic Ocean for the European purse seine fleet operating on floating objects	Moron Correa G., Kaplan D.M., Grande M., Uranga J., Ramos Alonso M.L., Pascual Alayón P., Rojo V., Merino G., Santiago J.
SCRS/2024/056	Standardized CPUE of yellowfin tuna (*Thunnus albacares*) by region for the Chinese Taipei tuna longline fleet in the Atlantic Ocean using delta approach	Nan-Jay S., Chi-Xuan C.
SCRS/P/2024/012	A Summary of recommendations for Natural Mortality assumptions in tuna stock assessments	Lauretta M., Ailloud L.
SCRS/P/2024/015	Workplan for the revision of the tropical tuna research and data collection plan	Wright S.
SCRS/P/2024/023	iTunnes Project: **I**mproving tropical **TuN**a biological knowledge for e**N**d-us**E**rS	Zudaire I., Lastra P., Juan-Jordá M.J., Duparc A., Erkoreka O., Barrena A., Lebranchu J., Cauquil P., Fily T., Canha A., Silva Sousa R.J., Mattlet A.F., Diaha C., Murua H., Ruiz J., Fraile I., Díaz-Arce N., Artetxe-Arrate I., Urtizberea A., Merino G.
SCRS/P/2024/025	The Package T3R development	Duparc A.

Appendix 4

SCRS documents and presentations abstracts as provided by the authors

SCRS/2024/017 - Two one day online Management Strategy Evaluation workshops were conducted in 2023, one primarily for scientists on June 13, and one for fishery managers on October 13. Three instructors provided the training in three official ICCAT languages, English, French and Spanish, with the support of simultaneous translation. All documents and course materials were provided through Google Classrooms and mostly included published documents from ICCAT and Harveststrartegies.org. Google Classroom proved to be an efficient way of supporting ICCAT training. A pre-workshop questionnaire of the participants provided a view of the expectations for the workshop. These expectations matched those assumed by the instructors in designing the workshop. A post-workshop questionnaire attempted to evaluate workshop success. Information from the post-workshop survey is of limited use as the number of responses to this survey was much lower than the pre-workshop survey. The report contains recommendations to improve future workshop delivery, content, and evaluation.

SCRS/2024/034 - From 26 February to 3 March 2024 a collaborative working group of longline CPUE standardization for yellowfin tuna was conducted between scientists with expertise in Brazilian, Chinese Taipei, Japanese, Korean, and US fleets, and an independent scientist. The purpose of this collaborative study is to develop an abundance index of yellowfin tuna in the Atlantic Ocean for the upcoming stock assessment in 2024. Annual abundance index by vector autoregressive spatio-temporal GLMM (VAST) approach was successfully developed and compared it with current and previous GLM results, which revealed that the abundance index of the VAST analysis showed greater variability than those of the GLMs.

SCRS/2024/035 - Standardization of yellowfin tuna CPUE by Japanese longline in the Atlantic Ocean was conducted using generalized linear models (GLM) delta lognormal. The models incorporated fishing power based on vessel ID and used cluster analysis to account for targeting. The variables year-quarter, vessel ID, latlong5 (five degree latitude-longitude block), hooks between floats, cluster, and number of hooks were used in the standardization. The number of clusters was 4 per region. Dominant species differed among clusters. The trend of CPUE was similar between region 2 (central) and 3 (south) with some differences. The CPUE trends were similar to those in the previous study.

SCRS/2024/036 - From January to March 2024, a collaborative study was conducted between national scientists with expertise in Brazilian, Japanese, Korean, Chinese Taipei, and USA longline fleets. The objectives of the study were to update the Joint CPC longline standardized indices for Atlantic yellowfin tunas, and explore alternative analyses to account for different data subsampling approaches and standardization models. The continuity model applied the same methods used for the last stock assessment, while alternative models evaluated the entire dataset versus various subsampling approaches. Joint standardization allowed the comparison of data from all fleets using identical methods. Comparison of the joint index to individual CPC indices showed the influence of methods and data series. Within each region (as defined in the last assessment), the CPUE trends were similar among fleets. A Joint CPUE index was produced for each region based on combined operational level data from the Japanese, Korean, Chinese Taipei, Brazilian, and US fleets and covering the period 1979 to 2022.

SCRS/2024/037 - Natural mortality (M) is considered one of the most influential parameters in fisheries stock assessment and management, as it relates directly to stock productivity and reference points used for fisheries management advice. However, M is very uncertain and difficult to be estimated reliably and directly, and modelers have often to make choices about the values, or range of values to be assumed. Other vital parameters, such as growth equations, and maximum observed age, are commonly used as proxies of mortality. In the case of yellowfin tuna (*Thunnus albacares*) from the Atlantic and Indian Oceans, all currently available methods to estimate baseline M are likely subject to bias and/or imprecision mainly due to incomplete data focused on specific study areas and/or extrapolation of parameters outside the ranges used for their calculation. Here we applied a combination of 4 empirical estimators (one longevity-based, two growth-based and one taxonomically-based) to obtain composite baseline M values, which were estimated 0.46 year-1 and 0.47 year-1 for yellowfin tuna the in the Atlantic and Indian Oceans, respectively. In the case of Atlantic Ocean yellowfin tuna, derived M-at-age values were higher than those considered by ICCAT in the last 2019 stock assessment. In the case of Indian Ocean yellowfin tuna, estimated M-at-age values were higher than those used in the latest IOTC assessment for the first two years of life, being lower thereafter. Overall, the present study highlights the current information gaps that prevent to obtain more accurate estimates of M and calls for the need of a dedicated sampling that can help to reduce the uncertainty related to this parameter, consequently enhancing the effectiveness of conservation measures, and promoting the resilience of yellowfin tuna populations.

SCRS/2024/038 - Information from the AVDTH Ghana fisheries was used to estimate Task 1 and 2 fisheries statistics for the Ghanaian tuna baitboat and purse seine fisheries during 2019 – 2022. Catch and landing data collected and managed by the Marine Fisheries Research Division (MRFD) of Ghana included landings and logbook information from 2005 to 2022. The estimation of total Ghana catches, catch composition, and quarterly-spatial (1°x1°) distribution followed the recommendations from the SCRS Tropicals working group agreed at previous meetings. Sampling for species composition and size distribution were reviewed to determine appropriate sampling for the different components of the Ghana fleets by major gear type.

SCRS/2024/041 - The time series of EU purse seine fleet free-swimming school (FSC) catches per unit effort (CPUE) of adult (>=10 kg) yellowfin tuna (YFT) from the Atlantic Ocean for the period 1993-2022 were standardized using a "Delta" modeling approach consisting of three components. These components are: 1) the detection rate of schools per unit of searching time, 2) the total catch of tropical tunas per non-null FSC set, and 3) the fraction of biomass that is adult YFT per non-null FSC set. Each of these components was modeled using general additive mixed-effects models (GAMMs) including spatial, temporal, vessel and environmental factors as explanatory variables. Models for each component were predicted on a standard prediction grid encompassing the core fishing areas of the fishery, multiplied together and then aggregated over years or quarter to develop final abundance indices. Estimates include robust indicators of uncertainty based on prediction, as opposed to confidence, intervals for model predictions. Results indicate a reasonable fit of models to the raw data, and the final abundance index shows a more or less stable or gradually increasing population trend between 1993 and ~2008, followed by an initially quite steep decline in population levels between ~2008 and ~2012 and a more gradual decline after that.

SCRS/2024/042 - Standardized index of relative abundance for yellowfin tuna (*Thunnus albacares*) was estimated using Generalized Linear Models approach assuming a delta lognormal model distribution. For this, logbooks registers were used (1987-2022), considering as categorical variables year, season(quarter), area, association with whales, association with whale shark, seiner capacity and help (help by bait boat, without help) during the fishing set. As indicators of overall model fitting, diagnostic plots were evaluated. Standardized yellowfin tuna catch rates during the early period (1987-2005), were decreasing; thereafter its values showed a relatively stable trend, with its lowest value at 2020.

SCRS/2024/043 - Using Generalized Linear Models with a delta lognormal approach standardized index of relative abundance was estimated for yellowfin tuna from the Venezuelan bait boat fishery (1987-2022). The data came from logbooks registers and the explanatory variables for the model were year, season, area, association with whales, association with whale sharks and the category of bait boat according to its capacity. As indicators of overall model fitting, diagnostic plots were evaluated. A decreasing trend in the standardized CPUE was observed for the early period of the time series, with stabilization for the most recent years.

SCRS/2024/044 - Collaboration between Spanish vessel-owner associations and buoy-providers companies has facilitated the retrieval of data from satellite-linked GPS tracking echosounder buoys deployed by Spanish tropical tuna purse seiners and associated fleets in the Atlantic since 2010. These buoys remotely relay precise geolocation information of Fish Aggregating Devices (FADs) and the presence of fish aggregations beneath them in real-time. Echosounder buoys serve as valuable platforms for assessing tuna and accompanying species abundances using catch-independent data. However, current buoys provide a generalized acoustic reading without distinguishing species or size composition of the fish beneath FADs. To address this limitation, the integration of echosounder buoy data with fishery information, including species composition and average size, is essential to generate specific indicators. This study introduces an updated index of juvenile yellowfin tuna abundance in the Atlantic Ocean derived from echosounder buoy data spanning 2010 to 2023.

SCRS/2024/045 - This document presents an up-to-date summary of the French purse seine fleet targeting tropical tunas in the Atlantic Ocean. It contains information about dFAD data that will be incorporated into a specific section of the ICCAT statistics report. The statistics cover the period 1991-2022 and focus in this document on the fishing activities of 2022.

SCRS/2024/046 - In this paper, we proposed an update of the length weight relationship of major and neritic tunas caught by the tropical tuna purse seine fisheries for which the conversion was not revised for more than 40 years. Based on previous study SCRS/2023/148, we further tested for an additional predictor, the fishing mode and performed sensitive analyses on spatio-temporal predicators to demonstrate the robustness of the new estimated relationship. Although the fishing mode was significantly selected, its effect on prediction was marginal and the lowest of all the predictors conserved in the optimal model. Sensitive analyses demonstrated the robustness of the estimates for the LWR of major tuna species even with a strict filtering minimum of 50 data by 5° square and year. The LWR parameters estimate in the simple linear model remained unchanged whatever the filtering intensity. Regarding the predictions of the two models, their relative differences were also very small. Consequently, the authors recommend the use of simple length-weight relation to convert length to weight for the purse seine tropical fisheries.

SCRS/2024/047 - Yellowfin tuna is caught by longline in the Gulf of Mexico. This fishery began in the 1980s and the commercial fishing fleet comprised of larger vessels reached its full potential in 2012. Yellowfin tuna (*Thunnus albacares*) catch data are presented to review historical catch (landings) statistics in the database of ICCAT.

SCRS/2024/049 - Presented a standardized index of abundance (CPUE) estimated using a Bayesian approach with Integrated Nested Laplace Approximations (INLA) from operational (set) level data collected between 1998 and 2022 from the Brazilian and Uruguayan Longline fleets, which operate in the southwestern Atlantic Ocean.

SCRS/2024/050 - This document summarizes the current decisions taken by Panel 1 regarding the western Atlantic skipjack tuna management strategy evaluation (W-SKJ MSE) and presents the 2024 workplan and proposed methodology to address the remaining steps for the development of W-SKJ MSE.

SCRS/2024/051 - Data are presented on the Spanish fleet, fishing areas, catches, fishing effort, performance (CPUEs) and size distribution for purse seiner and bait boat. It shows a tendency for the Spanish purse seine fleet in the Atlantic to decrease in carrying capacity and total catch. In 2022 it decreased by 5% compared to 2021. Skipjack tuna (SKJ) is the species that represents this decrease in 2022, on the contrary, yellowfin tuna (YFT) catch has increased and bigeye tuna has been maintained compared to 2021. In 2022 with 74% of sets to "Objects" and 26 % to "Free School", they represent a slight increase in the % of sets to free schools compared to 2021. In the case of the baitboat fleet, the trend towards less fishing is even more pronounced than in purse seiners, with a loss of more than 40% of carrying capacity in 2021, total catches decreased by about 50% compared to 2020, a year that had already shown a significant decrease compared to 2019.

SCRS/2024/052 - Abundance indices for yellowfin tuna (*Thunnus albacares*) in the Atlantic Ocean were derived from the European purse seine CPUE series (2010-2022) for fishing operations made on floating objects. We used three modelling approaches for CPUE standardization: a generalized linear mixed model (GLMM), a generalized additive model (GAMs), and a spatiotemporal model (ST). Moreover, we implemented a hurdle method, which separates the probability of a positive set, and the catch (kg) per set in different models. These three CPUE series were compared to the nominal CPUE. To account for effort creep, several candidate variables were tested to be included as explanatory variables. We did not observe a temporal trend, but a high temporal variability in the standardized CPUE by all models. Also, all models predicted similar standardized CPUE series.

SCRS/2024/056 - presented a standardized index of abundance (CPUE) estimated from operational (set) level data collected from the Chinese Taipei distant water Longline fleet between 1995 and 2022 across the Atlantic Ocean. Indices were provided for three separate regions using a delta-lognormal approach.

SCRS/P/2024/012 - A presentation concerning the recommendations from a workshop on best practices from the Center for the Advancement of Population Assessment Methodology (CAPAM). This presentation summarized a keynote presentation by Hoyle on natural mortality during the Tuna Stock Assessment Best Practices Workshop focused on global yellowfin tuna assessments.

SCRS/P/2024/015 - Presented a workplan for the review of the tropical tuna research and data collection plan.

Appendix 5

Terms of Reference for the Tropical Tunas Technical Sub-group on MSE

The SCRS Tropical Tunas Working Group (TT-WG) created a Tropical Tunas Technical Sub-group on MSE (TT-MSE) with the main objective of advancing, guiding, and overseeing the development of the different MSE processes for the Mix Fisheries MSE (MF-MSE) and the western skipjack tuna MSE (SKJ-W MSE).

The TT-MSE will follow the guidance from the TT-WG under the agreed annual workplan for the development, testing, review, and preliminary evaluation of the projects on MF-MSE and SKJ-W MSE.

The terms of reference for the overall activities of the TT-MSE will be as follows:

- The TT-MSE group is open to all interested scientists from the TT-WG and overall SCRS.
- The TT-MSE will meet regularly preferentially online.
- The TT-MSE will oversee the implementation of development, testing, review of results, summary, and consolidation of results from contracts for effective presentation to the TT-WG.
- The TT-MSE will support the development of presentations to the COMM/PA1 and help to facilitate response to COMM/PA1 input.
- The TT-MSE should have direct communication with the external contractors that support the tropical tunas MSE projects.
- The TT-MSE will assist the TT-WG with developing terms of reference for contracts, tools for communication, capacity building, inventory, and storage of code, inputs, and outputs related to the Tropical Tunas MSE projects.
- The TT-MSE will implement the annual workplan agreed by the TT-WG on MSE-related matters and report regularly to the TT-WG on progress and tasks accomplished.

The TT-WG recommends that scientists with expertise in MSE both within the SCRS and externally consider participating in this TT-WG to guide on technical aspects, alternative models, and communication of results aiming to have a common or consistent approach for ICCAT MSE.

Appendix 6

List of requests to the SCRS relevant to the management of tropical tunas

(Appendix 4 from the Report of the Third Intersessional Meeting of Panel 1, hybrid/Madrid, Spain, 20-22 June 2023)

No.	***Request***	***Origin***	***Comments***
Analysis of (trends in) composition of catches			
1	Analyse the percentage of juveniles in the catches of purse seiners fishing under FADs and those not using FADs at least for a given period.	Raised by CPC at Panel 1 June 2023 (Morocco).	This question is not clear because all purse seiners targeting tropical tunas fish using FADs.
2	Summarise adult and juvenile catch by gear and whether on FOBs/FADs. - Provide data on catches on FOBs/FADs vs. catches on free schools/other. - Update responses provided at June PA1 Intersessional Meeting to include 2020 and 2021 data (to consider the periods where the full time/area closure was in place). - Provide analysis by weight and by number of fish.	Question raised by CPC at Panel 1 June 2023 (Curaçao/ Gabon; additional questions in bullets from the UK).	We understand that this question refers to ALL gears and fishing modes, not only purse seine. The Commission should know the assessment of juvenile catches in order to assess the need for amendment of existing measures.
3	Conduct a comparative analysis of the contribution of all fishing gears to the mortality of tropical tunas (over a time period which, if the data allow, show the effect of the development of the DFAD fishery) which shall include both absolute and relative contributions. This shall, where possible, be broken down into adult and juvenile mortality, by weight and by number of fish. The comparative analysis shall also assess the potential effects of foreseeable changes in selectivity on other species in the event of additional measures aimed at reducing catches of juvenile in tropical tuna fisheries.	Suggested by UK.	The aim of making this request is to ensure a comprehensive request regarding (trends in) catch composition. There is some overlap with the questions from Morocco, Curaçao, and Gabon). Given the indication that there is some overlap in the proposals, and that the SCRS Chair has called for clarity as regards what is required by Panel 1, all the issues should be incorporated into a single question that encompasses the requirements of all the proponents. In this regard it should be kept in mind that: As most tropical tuna fisheries are multi-species, we consider that this study should cover the four tropical tuna stocks, not just bigeye tuna, and take into account the impacts of all fisheries/fishing modes on these stocks. As bigeye tuna represents between 5-12% of the purse seine fishery catches, only assessing the impact on bigeye tuna is not very informative. For this reason, question 3.b should be included.

<table>
<tr><td>3b</td><td>Prospects of the effects on other species of foreseeable change in selectivity in the event of additional restrictions on the juvenile catch in tropical tuna fisheries.

Assess and compare the merits and shortcomings of management measures based on output (e.g., catch) and input control (e.g., effort, capacity…) from both a scientific and MCS perspectives.</td><td></td><td></td></tr>
<tr><td colspan="4">Impact of harvesting juveniles on stocks and yields</td></tr>
<tr><td>4</td><td>What is the annual percentage of catches of BET juveniles (less than 3 years of age) between 2014-2016?

If the BET fishery takes XX% of its TAC in juveniles (less than 3 years of age) and the remainder as adults, does this have lower future yields (10-year projection) than a BET fishery that took YY% juveniles (less than 3 years of age) with the remainder being adults?

- Use the mean 2014-2016 percentage of catches of juveniles (less than 3 years of age) as the XX%. For the YY% in targets, use half the amount of the XX% value. Please assume management to 60% probability of being in the green quadrant of the Kobe matrix at the end of the 10-year projection.

Using an annual of 70,000 t for the BET fishery, what would be the F/F_{MSY} and the B/B_{MSY} over the first 10 years of the projections in scenario 1 (juvenile percentage is XX%) versus scenario 2 (juvenile percentage is YY%)?</td><td>Question raised by CPC at the Panel 1 meeting in June 2023 (Canada).</td><td>We consider that these questions are not clear and could put the SCRS in a position of giving an opinion outside of its remit. The SCRS can carry out an analysis and submit information to the Commission on the impact on MSY of different levels of fishing for juvenile fish, but not express an opinion on that impact. That is up to the Commission. Since an objective has not been established, we consider that these questions are not appropriate and could put the SCRS in a delicate situation.

We consider the first question to be imprecise because it does not quantify what "predominantly" is (20%, 40%, 60%, 80%). For this reason, we request that the SCRS answer question 4 b) below.

The second question contains the same imprecision since "mainly of juveniles in number" is not defined.

The third question is a factor of risk not described in the context of the question and the SCRS is not called on to weigh up management risks.</td></tr>
</table>

4b	Evaluate whether the proposed TAC (73,000 t) may represent a risk in terms of future exploitation of the bigeye stock, assuming various selectivity scenarios (projecting the catch allocation proposals on the table and other intermediate scenarios, depending on recent selectivity).	Suggested by Central America and Curaçao group.	
5	Quantify the impact on maximum sustainable yield (MSY) and SSB_{MSY} for tropical tunas resulting from different catch scenarios for the major fishing gear types (e.g. longline, DFAD fisheries, AFAD fisheries, purse seine on free school, other fisheries). Provide this based on both changes over a given time period and for potential different future catch scenarios. This shall include analysis of the impacts on both target and bycatch species.	Suggested by UK.	The aim is to provide a clear indication of how MSY and SSB_{MSY} are affected by changes in levels of utilisation of different gear types. There is some overlap with the question posed by Canada. Although complementarity of the questions could be identified and not necessarily an overlap, we consider that the SCRS should not be restricted to the information provided by any CPC. We consider that this question is better framed, and should replace the previous one. However, we consider that this study should not contemplate the substitution of one gear for another, but rather different catch scenarios for the different fishing gears. In addition, the feasibility of substitution of these catches and the impacts that this substitution could have on other target or bycatch species of the fisheries affected (those that receive or lose catches) must be analyzed. As noted previously, we do not see the interest for the Commission in treating bigeye tuna in isolation, without evaluating the collateral damage (impacts) that the adoption of measures by the Commission may have, based on the information provided by the SCRS.

6	Assess the impact that different levels of reduction in catches of each of the respective age classes of BET would have on the BET MSY as well as the consequences on tropical tuna catches as a whole.	Received from the EU on 5 July 2023. Updated 12 July.	Recognise this question is similar to 4 but is slightly more specific. We agree that this assessment should be conducted for the four tropical tuna stocks, and the potential impacts of the different scenarios explored on other species, target and bycatch should be evaluated.
6bis	Assess whether there is a specific period/spatial element of FAD closure that would particularly benefit juveniles.		
Advice on the appropriateness of measures to reduce juvenile catches			
7	Analyse the assessment of the impact of the current closure of the FAD fishery (72 days) across the Atlantic on the recovery of the bigeye tuna stock during the most recent period (beyond 2019).	Question raised by CPC at Panel 1 meeting in June 2023 (Morocco).	This and question 7 are similar to questions 17.25 & 17.29 in the Responses to the Commission which were to review and if required revise the FAD closure period and to assess the efficacy of the full closure period. It may be useful for these questions to be reconsidered and utilise more recent data. We consider that this impact cannot be assessed independently of the impact of other measures, such as the bigeye TAC and other measures. Only what was not caught during the closure days can be assessed, taking into account historical data. However, taking into account that the effort levels have changed considerably throughout the historical series, we consider it essential that the SCRS present capacity estimates for the different fleets targeting tropical tunas, and their evolution in recent years. This could be done following the IATTC model for purse seine (cubic meters of hold (or GT in its absence) of purse seine vessels multiplied by the days of activity/fishing in each year) and a similar one for other fishing gears (longline, pole and line, etc.); or estimation of total number of fishing days for surface fisheries and of hooks for longline fisheries, representing the total activity each year.

			Capacity trends are important for assessing the potential impacts of each fishery in the future, and the potential impacts of changes in management measures. This is something that the WCPFC evaluates, using various scenarios for its projections, and we consider that it is something that the SCRS should do as well (ref. SC19-MI-WP-08 CMM_eval_update_table 9_Hamer *et al.*pdf).
8	Consider the efficacy of different DFAD management options, in particular limits on FAD sets and DFAD closures (including the area, period and other details), with the objective of achieving a high probability of reducing fishing mortality of juvenile tropical tuna, in particular bigeye and yellowfin tuna. If the SCRS concludes that it does not currently possess access to sufficient scientific data to provide this analysis to the Commission, it shall provide advice on the data necessary for science-based analysis. In producing this analysis, the SCRS shall take into account, inter alia: a) available fisheries data including differentiating between FAD and non-FAD fishing; b) experiences of implementing similar management measures with similar objectives, from other RFMOs; and c) fishing behaviours/patterns, both historically and those anticipated as a consequence of the implementation of any new management measures including the time/area closure.	Suggested by UK.	Aim is to ensure a comprehensive request is given to the SCRS. There is some overlap with the question posed by Morocco. This is similar to questions 17.25 & 17.29 (see response above) and is also covered by questions 17.26 & 17.27 which were to establish a max number of FAD sets per vessel/CPC and to analyse historical FAD set data. Although we understand that problems with data hampered the response to these questions in the past. A reduction target has not been established. We consider that this question cannot be answered by the SCRS and that it is more appropriate to wait for the current situation to be evaluated, so that the Commission can determine the type of measures that could be evaluated by the SCRS. We consider that it is necessary to combine the above questions, based on the comments from Central America, to facilitate the task of the SCRS and avoid the risk of forcing the SCRS to decide which management measures are more appropriate (hence the need to include the impacts of such measures on other species, since the Commission must evaluate all the impacts before making a decision).

9	Assess how different levels of fishing with each gear affect the achievement of the management objectives set for BET and/or YFT.	Received from the EU on 12 July 2023.	
10	Undertake a comparative analysis of different FADs (including both anchored and drifting FADs) management options such as full closures, FAD closures, FAD sets limits etc., from both a scientific and MCS perspective.	Received from the EU on 12 July 2023.	We agree with the EU on the desirability of comparative analysis of different management options. Although the focus of the assessment of the effects is FAD fishing, this analysis should also include other fishing gears and, regarding the monitoring, control and surveillance perspective, we emphasize that it is important that the information is reliable, which is affected by the insufficient information from longline as a consequence of the extremely low on-board observer coverage in this fishery.