REPORT OF THE 2021 BIGEYE TUNA DATA PREPARATORY MEETING

(Online, 22 - 30 April 2021)

1. Opening, adoption of agenda and meeting arrangements

The meeting was held online due to the current pandemic situation. Dr. David Die (USA), the Tropical Tunas Species Group ("the Group") coordinator and BET rapporteur and meeting Chair, opened the meeting and welcomed participants. Mr. Camille JP Manel (ICCAT Executive Secretary) welcomed the participants and thanked the efforts made by all participants to remotely attend the meeting.

The Secretariat provided information on how to use the online platform for the meeting (Zoom application). The Chair reviewed the Agenda, which was adopted with changes (**Appendix 1**). On 24 April 2021, the meeting participants met in three subgroups (using the break-out room feature of Zoom) to advance the Agenda of the meeting. The Group returned to its plenary work on 26 April 2021.

The List of Participants is included in **Appendix 2**. The List of Documents and Presentations provided to the meeting is attached as **Appendix 3**. The abstracts of all SCRS documents and presentations provided at the meeting are included in **Appendix 4**. The following served as rapporteurs:

Sections	*Rapporteur*
Items 1, 11	M. Ortiz
Item 2	D. Gaertner, M. Santos, J. Garcia
Item 3	L. Ailloud, A. Norelli, N. Goñi, G. Merino
Item 4	C. Mayor, C. Palma, M. Ortiz, S. Cass-Calay, G. Diaz
Item 5	R. Santa Ana, A. Kimoto
Item 6	C. Palma, M. Ortiz
Item 7	S. Cass-Calay, M. Lauretta, A. Kimoto
Item 8	L. Ailloud, M. Schirripa, M. Lauretta
Item 9	G. Diaz
Item 10	G. Merino

2. Review of the progress of AOTTP (excluding analysis of biological data)

The Secretariat provided a presentation SCRS/P/2021/011 on the progress of the AOTTP activities until the close of the programme on 28 February 2021, with a particular focus on the tagging related activities throughout the Atlantic Ocean (i.e. conventional and electronic tagging, tag recoveries, time at liberty and movements). In addition, it provided an overview of the ongoing activities on maintenance and development of the tagging database by the Secretariat, aiming for the dissemination of available data collected within AOTTP. Finally, information was provided related to the ongoing fieldwork (i.e. awareness campaigns, tag recovery, and tag seeding experiments).

The Group acknowledged the work being carried out by the Secretariat to further strengthen the work developed within AOTTP, which will facilitate access, management, and analyses of the available data. The Secretariat also informed the Group about the ongoing tag seeding experiments being carried out by the recovery teams in Senegal and Côte d'Ivoire. As specified in the signed contracts, this activity will be carried out until the end of 2021. In addition, the Group was informed that some additional tag seeding experiments are being conducted in Ghana and EU-Purse seines. It is recommended that national scientists report these activities and data to the SCRS and the Secretariat.

The Group was also informed that the AOTTP Symposium webpage now has available links to most of the presentations (https://www.iccat.int/aottp/en/aottp-symposium.html).

A dashboard of the AOTTP Tagging data was presented and it was requested that the dashboard be available through the ICCAT web.

The SCRS Chair informed the Group that the deadline for the submission of AOTTP papers to the special issue of the *Fisheries Research* journal was extended until 30 May 2021. It was mentioned that several authors faced some problems during the submission process of the papers to the journal portal. It was suggested the Secretariat in coordination with the SCRS Chair (and guest editor for the special issue) notifies the journal of the full list of submitted papers.

SCRS/P/2021/013 provided an update on a number of studies that were recently presented at the AOTTP symposium, including on parameters estimates of tag-shedding rate, tag-reporting rate, tagging failure [i.e. tagging induced mortality], an analysis of the efficiency of the dFAD moratorium from AOTTP data, and exploratory analysis on potential miscodification on seamounts at release or recapture in the tagging database.

Several questions were made, and clarifications were provided by the authors, including the relevance for the next bigeye stock assessment to calculate the reporting rate for the same groups of fleets used in the structure of the SS3 model. Questions were also raised on the shape of the tagging failure estimate and on the comparison with values estimated by Hoyle *et al.* (2015) in the Indian Ocean.

A suggestion was made on the use of some of the results (tag-shedding and tag-reporting rates) presented to estimate the potential number of tags that could be recovered within the next few years, which would help the SCRS estimating the costs associated with tag rewarding.

Additional information on the use of AOTTP data for the assessment of bigeye tuna can be found in section 3 of this report.

Future AOTTP tagging activities

The Group was informed by the Secretariat on the existence of both conventional and electronic tags that remain available after the closure of the AOTTP. Specifically, there are available 6,735 conventional tags (of which 250 are red tags used for tagging specimens that are also marked with OTC) and 15 electronic internal tags (4 are new and 11 have been previously used). In addition, there are also 13 internal archival tags, though their battery levels are below the level recommended by the manufacturer.

The Group suggested using the red tags for additional OTC marking of released specimens for the ongoing ageing studies. The waters around St. Peter and St. Paul Islands were suggested as a potentially good area to carry out these activities.

The Group agreed that that electronic tagging should be restricted to the use of electronic tags with good battery levels.

The Group also suggested that contacts should be made with US recreational fishers that have on their possession conventional tags, for them to keep tagging and reporting to the Secretariat their activities. However, it was recognized that since those were initially distributed by the contractor some level of coordination would be needed at the national level, US scientists offered to help with this effort.

The Secretariat also informed the Group that a proposal was received from the University of Maine, which acted as a previous contractor within AOTTP, to carry out additional tagging activities aiming to reach the targets that were initially agreed by the SCRS, but that for a number of reasons could not be achieved. Specifically, the proposal intent to tag a total of 975 specimens for a total cost of €68,250. The Group supported the proposal and requested the Secretariat to seek possible funding by ICCAT CPCs.

EU-Spain scientists from the Canary Islands also proposed to keeping tagging both juvenile and adult bigeye tuna specimens around the archipelago. These additional tagging activities will have a small financial cost, as payment will only be needed for adult fishes (i.e. €20-30/specimen). The Group supported the proposal and requested the Secretariat to seek possible funding by ICCAT CPCs.

The Secretariat also informed that limited funding is available for tagging activities on the AOTTP exit strategy for 2021, as the funds approved by the Commission were mostly devoted to carrying out the ongoing ageing studies, awareness, and recovery campaigns by the teams in the field in Senegal, Côte d'Ivoire, and Ghana. However, since no contract could be signed with Ghana, the initially allocated funds are being used to pay for the rewards related to tag recoveries.

Finally, the Group agreed that new proposals for tagging activities using the available tags should be presented to the Group for discussion and possible recommendation to the 2021 SCRS Plenary. These proposals shall include an estimation of the associated costs including rewards. Moreover, it was also suggested that a small group lead by the Tropical Tuna coordinator work with the Secretariat to estimate potential recoveries costs for the upcoming years of 2022 and 2023.

3. Review of historical and new data on bigeye biology (including analysis of AOTTP data)

3.1 Age and Growth

Two documents were presented in this section. The first, SCRS/P/2021/010, presented age estimates using otolith macro-increments for 234 bigeye fish captured in shelf slope regions of the northeast U.S. by recreational surface and commercial longline fisheries. The majority of ages included 2-5 year old (overall range 1-17) with straight fork lengths of 80-160 cm (overall range 70-174 SFL cm). Fractional ages calculated from marginal increment ratios were explored using birth dates of 1 July and 1 January. Noting the restricted geographical range of sampling, the Group asked to see how these data compare with data from other regions of the Atlantic. The Group asked if the data would be made available for use in the stock assessment. The authors confirmed their willingness to share their data with ICCAT after these have undergone strict data quality control checks.

The second document, SCRS/P/2021/012, presented results from the AOTTP program as it relates to age and growth. This included the set of age estimates available from the AOTTP reference collection (based on micro-increment counts) as well as age estimates and results from the otolith micro and macro increment count validation work carried out on OTC marked fish, which suggest annual ageing is the preferred method for estimating age in bigeye tuna older than 1.5 years. The Group asked for clarification on what was needed to continue improving the workflow of the age and growth technicians financed through the AOTTP exit strategy. The laboratories in question pointed out that they have experienced logistical challenges over the last year (worsened by the pandemic) but that now their equipment is working and they can proceed with the age and validation work. However, they insisted that they require expert support to provide a quality check on the age and OTC readings being produced to ensure that high-quality data be made available to the assessment team. The laboratories also expressed the need to obtain the physical reference collection to continue their training and quality control. The author confirmed that these samples would be sent to them now that the work is complete (the author will coordinate with ICCAT). The author confirmed that the latest algorithm by Farley *et al.,* (2020) was used to convert integer ages into decimal ages but indicated that more work is needed, and should be prioritized, to define the timing of the annual opaque growth zone formation. The AOTTP did not have time to explore this question but the data are available and this question could be answered using AOTTP samples in the future. The Group also suggested to compare the growth information obtained from the AOTTP tagging records with that obtained from otolith reading to check if the current growth assumptions of the assessment are appropriate.

Otolith ages and tagging data from the AOTTP and SCRS/P/2021/010 study were plotted against the previously adopted bigeye tuna growth curve by Hallier *et al.,* 2005 (**Figure 1 and 2**). These data appeared consistent with the growth curve used in the previous assessment. Since no new growth estimates are currently available the only alternative (maybe as a trial) would be to estimate the growth curve inside Stock Synthesis using the data points generated in these studies. However, the data are most likely to be too scarce for proper estimation and may not be fully representative.

The Group proposes to keep the current parameterization of growth (Hallier *et al.,* 2005, Richards) and provide new-age data to the stock assessment team to aid with diagnostics.

3.2 Natural Mortality

No documents were presented in this section. However, natural mortality was discussed in a subgroup and presented to the plenary. The following paragraphs reflect the discussions and decisions by the Group.

One important change compared to the last assessment is new evidence that the maximum age observed (17) is higher than the maximum age used in the 2018 BET tuna stock assessment (Anon. 2019) (15) and this may have implications for the selectivity (logistic vs. dome-shaped) and natural mortality (M) assumptions.

The Group agreed that the evidence of the new maximum age would suggest that natural mortality needs to be re-evaluated from the values used in the uncertainty grid of the 2018 assessment. Adapting the M vector to the new maximum age found with the bomb radiocarbon aged samples (17 years) would not imply a large effort, and be consistent with using the best available data.

The Group was reminded that the regression from Hoenig *et al.*, (1983) was used to obtain the baseline M in the 2018 BET assessment and that one option could be to move to use the Then *et al.* (2015) M estimator. The Then *et al.* (2015) study uses the same regression approach as Hoening *et al.* (1983) but relies on a much larger and more up-to-date database of natural mortality estimates and maximum ages (200+ species), which justifies the switch. The Then *et al.* (2015) M estimator was also used for the 2019 Yellowfin stock assessment (Anon. 2020).

The Group discussed the vectors of natural mortality resulting from new maximum age of 17 and using the Then *et al.,* (2015) estimator (**Figure 3**). Based on this, the Group agreed to extend the maximum age to 17 and recalculate M using the Then *et al.* (2015) estimator, and using the Lorenzen (2006) scaling approach with the BET tuna Hallier *et al.* 2005 (Richards) growth curve to estimate the M vector by age for the base case scenario for the 2021 assessment.

The uncertainty grid of the 2018 assessment was reviewed and the options to update the range of M in the uncertainty grid were discussed. The uncertainty grid from 2018 included two options for natural mortality, three for steepness, and three for sigmaR.

Natural mortality (M), from Walter *et al.,* v2 (Walter *et al.* 2018):

- *M=0.28:* It was noted that the M vector was parameterized with a Lorenzen (2006) function where M was scaled according to the growth curve externally to Stock Synthesis. The baseline M (0.28) assumed a maximum age of 15 using the Hoenig *et al.* (1983) estimator. The scaling of M used the Hallier *et al.* (2005), Richards function.

- *M=0.35:* One of the sensitivity runs was to profile natural mortality. This was achieved by replacing the fixed vector of M at age parameters with the Lorenzen (2006) scaling option in Stock Synthesis, and putting in a parameter for M at age 4. The value of M 0.35 had the lowest negative log-likelihood and corresponded to a steepness estimate of 0.7, the lowest value in the sensitivities of steepness. This baseline M was selected as an alternative scenario for the uncertainty grid.

The Group discussed why only two M vectors were used in the uncertainty grid in 2018 (a base vector and a high M vector). The Group noted that Walter *et al.,* (2018) indicate that the high M vector was used because modelling results indicated that the length composition data favored higher natural mortality, but this was negatively correlated with the estimated steepness. The Group noted that this was likely the reason for only two vectors being used in 2018.

Alternative options were discussed, like creating an M vector that is slightly lower and slightly higher than the M vector that will be used in the base case scenario, e.g. increasing and reducing M by 20% (or other value). However, the Group could not find a justification for the choice of a multiplier.

The Group acknowledged that the source of uncertainty in the M vector was on the choice of maximum age. The Group felt that using 17 as the maximum age should be the reference case in the 2021 assessment model and that additional maximum age options older than 17 should be selected for alternative vectors. The reason for this being that the two observed BET 17 year-old fish came from a sample of just over 200 fish from an already heavily depleted stock. As such, if the sampling was increased, the maximum age would likely increase. However, if the ageing error is present, lower values of maximum age could also be possible. One proposal for alternative vectors for the uncertainty grid is shown in **Figure 4** and would be fairly comparable to the values selected in the BET 2018 assessment, with a slightly wider uncertainty than was considered in the last assessment.

The Group discussed whether to retain 2 or 3 M vectors for the uncertainty grid as increasing the number of vectors to consider increases the number of model runs required. The assessment team reminded the group that more options in the uncertainty grid is not an issue and can in fact simplify the process. As such, the Group decided to retain the following three M vectors in the uncertainty grid: i) Then *et al.* 2015 based on the maximum age of 17, ii) 20, and iii) 25, with Lorenzen 2006 scaling to the Hallier *et al.,* 2005 Richards growth curve.

3.3 Reproduction and sex ratio

SCRS/2021/057 described sex ratios for catches in Abidjan by size and by maturity. The study used information from 1,124 specimens from 40.8-173.3 SFL cm. Of the 1,124 specimens, 387 were undetermined, 333 were males and 404 were females. The sex ratio of the sample was significantly different from 1:1 ($p < 0.05$) with females dominating. When broken into 10 SFL cm size bins, males dominated in sizes greater than 150 SFL cm while females dominated in size bins less than 60 SFL cm. Finally, when assuming a size at first maturity at 100 SFL cm, the immature fish had a sex ratio of 1:1.28 and the mature fish had a sex ratio of 1:1.7.

The Group proposed two possible hypotheses for the sex ratios seen in this study: i) there is sex differential growth, or ii) there is a difference in natural mortality between the sexes. The Group agreed that these hypotheses should be explored in future growth and natural mortality studies. In addition, it was noted the difficulties of correctly identify the gender on small size BET fish (< 60 SFL cm).

The Group discussed if these BET study sex ratios match the sex ratios seen in growth studies or AOTTP results. It was confirmed that male dominance at larger sizes was also seen in YFT growth studies.

There were no new papers or presentations for reproduction presented. The Group recommended retaining the assumptions for maturity and fecundity from the 2018 assessment.

3.4 Length-weight relationship and its variability

No documents were presented in this section. However, the length-weight relationship assumptions were discussed in the subgroup and presented to the plenary.

The Group discussed whether or not the length-weight relationship should be updated with more recent references. It is important to communicate this to the Secretariat because it would have implications for the preparation of data for the assessment. In the 2018 assessment, the length-weight relationship from Parks *et al.* (1982) was used. Newer studies are available but were already reviewed in 2018 (Mas *et al.* 2018) and the Group at the time decided to continue with the Parks et al (1982) length-weight relationship.

3.5 Movement and stock structure

The presentation by Goñi *et al.,* (SCRS/P/2021/015) aimed at describing the movements of bigeye tunas tagged with conventional tags in the Atlantic Ocean, comparing the historical period (1959-2014) with the AOTTP period, and applying to each period a tag-attrition model to estimate movements rates and fishing mortalities in the study regions defined. The main conclusions included an important increase of the fishing mortality in the Gulf of Guinea region between the two periods, an overall low proportion of long-range migrations, and apparent higher mobility of bigeye during the AOTTP vs the historical period.

Limits to the comparison between periods include (1) the different region definitions in each period, (2) the variability of reporting rates among fleets and the absence of estimation of historical reporting rates, (3) the recent effort in awareness rising campaigns compared with the historical period, (4) uncertainties related to the historical tagging data (e.g. missing individuals in some release positions, uncertainties on the condition of fish released from recreational vessels). Suggestions for further analyses included (1) additional sensitivities runs on reporting rates, which were assumed equal to 0.8 across regions in the model, to assess robustness in estimates of migration and fishing mortality rates, (2) analysing separately tag returns of individuals with different ranges of time at liberty in order to deal separately with short ones and longer ones, and (3) using data from electronic tags to validate the observed movement rates.

The earlier presentation of the AOTTP data (SCRS/P/2021/011) shows mixing between the North and South (**Figure 5**). The AOTTP data shows more movement than the historical data (**Figure 6**). Additionally, the Group was reminded that there is a continuous spatial distribution of LL mean CPUE across the equatorial area (Hoyle *et al.* 2019).

A small subgroup further discussed the assumptions for BET movement and stock structure. It was determined there were no major changes in the literature for stock structure or movement (including a review of documents presented at the AOTTP symposium), suggesting that there is no enough new information to change the current assumptions on the stock structure.

4. Review of fishery statistics

The Secretariat presented to the Group up-to-date fisheries statistics available (T1NC: Task 1 nominal catches; T2CE: Task 2 catch and effort; T2SZ Task 2 size frequencies; T2CS: Task 2 catch-at-size) on bigeye tuna in the ICCAT database system (ICCAT-DB) covering the period 1950 to 2020 (**Table 2** and **Figure 7**). This information includes all the revisions and new data reported until the beginning of the meeting. Ten CPCs have provided data for 2020. At present, the reported Task 1 NC corresponds to about 38% of the total catches when compared to the average total annual catches in the previous 4 years (2016-2019). Some CPCs expressed that it was not possible to submit for BET 2020 catch statistics due to the early timing of the meeting. It was noted the importance of having these statistics available given the current status of the stock and the importance of the upcoming assessment. After consultation with the national scientists on the likelihood of data submission, the Group established a deadline (30 April 2021) from which no more BET fisheries statistics will be accepted for the stock assessment.

Several documents were presented to the Group with various updates on fisheries statistics. Document SCRS/2021/051 presented a review of the Japanese longline fishery in the Atlantic Ocean since 1956, whereas document SCRS/2021/053 provided a review of the Korean longline fishery in the Atlantic since 1964. EU-Spain presented a historical (1926-1965) review of the tuna cannery factories in the Canary Islands including BET catch landed by the Spanish surface fleets targeting BET primarily. Chinese Taipei presented also a review of the longline fishery in the Atlantic Ocean since 1995 with a focus on the size distribution of the catch collected by fishers versus data collected by observers on board (SCRS/2021/061). Finally, SCRS/2021/064 presented a report of the ongoing development, data flow, and structure of the database from the tuna factory sale records submitted by ISSF participating companies to the ICCAT Secretariat. The following paragraphs detail the discussions and recommendations of the Group on each presentation.

Document SCRS/2021/051 presented a summary review of the Japanese longline fishery in the Atlantic Ocean since 1956. The review included catch of main target species including BET, fishing effort as indicated by the number of hooks deployed, number of BET caught, and nominal CPUEs in three main fishing areas: North Atlantic, Equatorial Tropical region, and the South Atlantic. Size distribution of BET and detail catch composition and by 5x5 lat-lon grid was reviewed by decades indicating the changes in this fishery that initially targeted YFT until early 1970's when the fleet shifted towards BET and since then is the main target species representing the higher proportion of the annual catch.

The Group acknowledges the extensive review noting that the shift from YFT to BET target species was achieved by changes in fishing strategies of the fleet; with increased depth of longline sets as indicated by the larger number of hooks per basket and changes in the spatial distribution of the fleet that moved towards the south Atlantic. It was noted that BET size distribution from the Longline fleet is wide (80-180 cm SFL) and has not varied much by decade even catching fish of sizes around the current L_{inf} growth parameter, although recent assessment indicated a substantial decline of the stock abundance.

Document SCRS/2021/053 Korean tuna longline fishery commenced to operate in 1964, and it had sharply increased total catches by about 33,000 t on average in the 1970s. Bigeye tuna has been the predominant species since the early 1970s. Since the late-1980, the Korean BET catch has decreased, and the average catch was about 566 t for the recent 5 years (2015-2019).

It was confirmed by authors that the analysis presented corresponds to the Korean fleet vessels, and it does not include catch with other associated fleets (e.g. Korea-Panama, etc.) that are present in the ICCAT database. The authors also noted that the shift in target species was achieved by changes in fishing strategies including deeper sets and changes in the spatial distribution of the fleet. Finally, it was inquired if the analyses included other non-target species such as sharks or billfishes, authors indicated that data included non-target species and the detailed information will be presented at the next meeting.

Document SCRS/2021/063 presented a historic review of the Canary fishery for bigeye tuna since the 1830s. The island of La Gomera in the Canary archipelago was the center of the main tuna cannery factories since 1831, reaching 19 canning factories by 1850, and having 9 active factories by 1934. Some historical catch records were recovered from 1926 to 1965 from one factory, that has been provided to the SCRS. However, these catches likely represent mixed tuna catches (BET, SKJ, BFT) and are only a part of the overall fishing activity in those years. The document presented also a review of the recent fisheries and trends of fishing effort, size distribution, and the seasonality of the Canary baitboat fishery targeting BET.

The Group acknowledges and recognized the importance of this historical review and the importance of this fishery in the region. The authors indicated that two main fishing strategies are currently used in the fishery; fishing on “la mancha” and fishing on free schools. Traditionally, these activities have not used FADs, however, in recent years some few vessels are starting to use FADs. It was noted that catches of BET in the Canary Islands show larger annual variations, for example in 1995, and 1998. The authors confirmed that in the region is common to see these large annual fluctuations and that are likely associated with oceanographic changes in the region that affect the availability of the fish, noting that these fluctuations coincided with similar opposite changes in the YFT catches. This information was also validated by fishers. The Group noted that since 1999, the catches of BET decreased to an annual average of 3,000 t, authors indicated that this period coincides with the restriction for the fleet to fish close to the West African coast after fishing agreements between EU-Spain and Morocco were suspended in 1999. The authors also indicated that the increase of the size of the vessels in the fleet has allowed this segment of the fleet to operate year-round even during the strong wind season and that shifts in the seasonal fishing effort and spatial distribution may contribute to observed changes in the size distribution of the catch. Finally, it was noted that current quota allocations have reduced the fishing effort of the fleet in recent years.

Document SCRS/2021/061 presented a review of the size composition of BET catches from the Chinese Taipei longline fishery in the Atlantic Ocean since 1995. The analysis compared the size distributions collected by fishers and by observers in the tropical area (15N-15S). The authors indicated a comparable size distribution when a sufficient number of measurements is collected by each source (100 thousand Fishers, and 10 thousand Observers). It was noted that the mean size of BET caught in this region has increased and the relative proportion of large fish (> 145 cm SFL) has increased, while the smaller fish (85-110 cm SFL) has decreased. The authors indicated that size analyses were done by vessel, and that increase in mean size correspond to shifts in the fishing strategy of the fleet, where larger fish are caught closer to the west coast of Africa and in southern latitudes, while the smaller fish are found mainly in the tropical open ocean waters. It was noted that this increase in the mean size of BET has been also observed in the Indian and Pacific Oceans and that perhaps it respond to market conditions. Thus, it was inquired what other changes in the fishing strategy have been observed that can account for this change, like the depth of sets, number of hooks per basket, etc. This information will be important for the modelers to correctly set changes in selectivity patterns for this fleet(s). The Group also inquired if there has been an increase in the discard of smaller size fish

Document SCRS/2021/064 presented a report of the development of the ICCAT tuna factory sales database based on data submitted by ISSF Participating Companies canneries on catches of tropical tunas. A compilation and harmonization of the data from 2015-2020 are in progress. The Group acknowledges the efforts for developing this database indicating that this data is useful to validate current catch statistics for tropical tunas. Authors indicating that preliminary estimates will be available later in the year, but not before the stock assessment.

4.1 Task 1 Catch data

After a revision of T1NC for the period 1950 to 2019, the Group also obtained preliminary estimations of 2020 nominal catches. **Table 2** presents the BET nominal catches adopted at the meeting by flag and major gear **Figure 7** shows the cumulative catches by gear between 1950 and 2019, catches for 2020 were considered incomplete and are not included in the plot.

During the meeting, the Group split into 3 subgroups to revise and present suggestions to the plenary on different input components for the assessment models. Subgroup 1 focused on the input data for catches (Task 1 NC), catch and effort, size samples, catch-at-size (Task 2), and derivative estimates (CAS, CAA). The following paragraphs report on the conclusions and recommendations from the Subgroup that have been revised by the Group.

It was noted that at present, submitted catch statistics of Task 1 NC for 2020 are at about 38% compared to the 2019 total catch. Therefore the Subgroup considered 2020 to be incomplete to be used as the terminal year in the assessment. It was suggested to review the catches for 2020 submitted by CPCs using the CP50 and compare them with Task 1. The Group consulted with the national scientist about the likelihood that CPCs will provide additional 2020 Task 1 and/or Task 2 data at the current meeting. In most cases, missing 2020 data could not be provided by the end of the meeting.

It was further noted, the following data revisions:

- EU-Portugal Azores catches by fleet/gear were revised in collaboration with national scientists during the meeting.
- There is an issue with Ghanaian PS landings that should be reviewed involving the year assigned to a catch from a trip overlapping consecutive years. It was indicated that in the database the date of departure and the date of unloading at the cannery/port is recorded. However, due to the sampling and estimation of the species composition of each trip, it is difficult to split catches from a fishing trip into 2 calendar years using the date of the fishing operation. It was informed that the landing date is normally used to assign the catch of that trip to a calendar year. It was recommended for a small technical group familiar with the estimation analyses to provide a proposal for how these catches should be allocated to a calendar year.
- Some uncertainty remains for the estimates of *faux poisson* by species: (i) Part of the Ghanaian *faux poisson* which is transborded and landed in Abidjan aboard steamers, could escape to the census in Ghana, and (ii) in the past it was recommended that the mix EU *faux-poisson* be reported by EU flag.
- Panama LL series is incomplete. Secretariat has requested information, but no new data has been provided.
- EU indicated a significant revision of the size data from BB and PS fisheries 1991-2019 that has been provided to the Secretariat during the meeting.
- BET catches of the Morocco LL fleet show an odd increase in one year in the data (100 t to 900 t). It appears to be a mixed report between HL and LL data. After reviewing the historic time series, it was suggested that the Secretariat use the historical average to assign 25% LL and 75% HL while waiting for confirmation from Morocco national scientists.
- Morocco reported BET PS catches (90 tons) in 2020 for the first time.

The Subgroup on catch statistics provided the following recommendations to the plenary:

- Deadlines and actions required before assessment:
  - Submission deadline for CPCs bigeye fisheries statistics up to 2019; Friday, 30 April 2021
  - Deadline for Secretariat to load final inputs to OwnCloud 22 May 2021.

The deadlines will allow time to integrate pending fisheries information and produce estimates of CatDis, CAS, CAA, and size frequencies including:

- Need to integrate Ghana Statistics (CE, size samples) by 1X1 area (2017-2020). The estimates will use the same protocols approved by the Group in previous assessments of tropical tunas (Anon. 2020).
- Need to update revised size data for France PS and BB. Revise size data 1991-2019. Data has been provided by EU scientists. It was noted that is expected an SCRS document to be presented at the next meeting as this update includes historical data.
- A revision for the Chinese Taipei size data is recommended that was presented at this meeting versus what the Secretariat has in the database. This would require action on the part of the Chinese Taipei scientists.

During the meeting, the Secretariat provided estimates of catches from the commercial catch monitoring requirements of the Rec. 19-02 para 13-14 (CP50). It was noted that recreational fisheries are not required to submit this information. The Group requested a comparison of BET Task 1 with the BET quarterly reports. The Secretariat presented this information, indicating that some CPCs provided monthly reports, others quarterly reports and some CPCs provided both. However, not all CPCs have submitted CP50 data. The CP50 data have no information on fleet/gear catch distribution.

Regarding the data decisions for the input of the stock assessment models, it was recommended:

- Carry-overs for 2019 total catch will be computed using 3 previous years (2016-2018).
- 2019 terminal year for stock assessment.
- The Group recommended not to use the CP50 data in the estimates for 2020/2021.
- The Group recommended that for estimating 2020 total catches the following criteria should follow:
    - For CPCs that have reported 2020 catches use the provided estimates
    - For CPCs that have not reported 2020 catches and are in the list of BET table catch limits produced by the Commission in 2019, use the allocated catches and split those catches by gear using the previous years (3 yr average by gear).
    - And for CPCs that are not in the prior 2 categories, use an average of the last 3 years to complete the estimated total catch.
    - Carryovers were not estimated for those flag/gears with less that 1-ton average catch for the last 3 years (2016-2018).
- The Group recommended that for 2021 projected catches use the same value and the distribution by the fleet structure in the SS3 model as in 2020.

4.2 Task 2 Catch-effort and size samples data

The SCRS catalogues for all tropical tuna species including BET (1991 to 2020) are presented in **Table 2**. For the 28 most important fisheries (covering 95% of the total catches in that period) the availability of Task 2 (T2CE, T2SZ, T2CS) has improved slightly since the last stock assessment. However, important gaps still exist in some important fisheries. For 2020 few CPCs have reported Task 2 information.

T2CE: catch and effort

The Working Group reviewed the available T2CE time series of bigeye tuna catch.

T2SZ: size frequencies

The Secretariat presented the available information on size and catch-at-size for BET. However, no further analyses were available as the Secretariat was waiting for the 2020 fisheries data following the adopted SCRS workplan for the tropical tunas.

Improvements to Ghana statistics (Task 1 and 2, 2006-2020)

The tropical tuna Species Group elaborated in 2011 a workplan, starting in 2012, to improve the Ghanaian Task 2 (T2CE and T2CS) statistics. The plan included technical support in port sampling and data analysis as well as the development of the software needed to obtain accurate Task 2 estimations. The plan also included the historical Task 2 estimations from 1996 to 2005, which have been already adopted by the Group (Anon. 2020, Moniz 2019). Task 2 estimations for the period 2012 to 2017 done by the Ghana national scientist and the Secretariat during 2019 (Hajjej 2019) have to be updated to include the last three years (2018 to 2020) using the same methodology as in 2019 YFT stock assessment (Anon. 2020). This update will be done intersessional as the data was available only a few days before this meeting.

4.3 Tagging conventional data BET ICCAT

As of today, the current conventional Tagging database contains 35,415 valid records with BET tagging release/recapture events (11,203 records compiled by ICCAT, and, 24,212 records obtained from the Atlantic Ocean Tropical Tuna Tagging Programme (AOTTP)). The AOTTP represents about 68% of the total of BET tagging records.

Following the BET workplan for 2021, the Secretariat made available to the Tropical Species Group both the ICCAT and AOTTP conventional tagging dataset for their analysis exclusively related to the 2021 BET assessment. The data included a variable to identify the source of information. From the total amount of 35,415 registers, there are 27,422 releases without recovery and 7,993 recoveries identified. The recoveries represent 23% of the total. Summary information is presented in **Tables 4 and Figures 6, 8, and 9** following standard formats normally presented to SCRS, **Table 4.3** shows the percentage of recoveries and the years at liberty of the recaptured fish by year. **Figure 8** shows the density of the release positions at 5x5 lat lon grids, and **Figure 9** shows a map with the density of the recovery positions at 5x5 degree strata. A map with the inferred straight displacement from the release to the recovery position of the recaptured fish is shown in **Figure 6**.

5. Fishery indicators

5.1 Average weight by gear type

There were no documents presented in this section.

5.2 Spatial distribution of catches

There were no documents nor discussions on the spatial distribution of catches related to FAD closures. Some information about the spatial distribution of catches by fisheries was provided together in item 4. This section captures only spatial distribution information from four documents.

Document SCRS/2021/051 provided a review of the fishing operation of Japanese longline fishery in the Atlantic Ocean. Regarding their spatial distribution of bigeye tuna catches, for the regions 1 North and 3 South used in the 2018 stock assessment (Anon. 2019) there was a perceived decrease in the proportion of bigeye tuna in total catches beyond the time. On the other hand, in Region 2 (central), it was observed a strong increasing trend in the proportion of bigeye tuna in total catches until the mid-1970s and the proportion remained high thereafter.

The Group asked the author if these trends could be explained by a change in target species over the years. The author explains that were some changes in target species over the areas, principally in the case of Area 2. In terms of spatial and seasonal distribution of bigeye catch, the author emphasized that bigeye tuna are caught all year round in the tropical and subtropical areas. However, the analysis shows that seems to have some seasonality for temperate tunas (e.g. albacore is mainly caught in the southeast area during the second and third quarters).

Document SCRS/2021/053 presented that the spatial distribution of the effort from the Korean tuna longline fleet had changed over the decades. In the 1970s, fishing vessels operated almost in the entire Atlantic Ocean, and their fishing efforts concentrated on the tropical area. In the 1980s, the effort remains concentrated in the tropical area, while the latitudinal range has decreased. After this period, they gradually move their effort to the southeast of the Atlantic Ocean, but part of the fleet remains in tropical areas.

Document SCRS/2021/059 provided the summary of Chinese Taipei distant water longline fishing operations. Their fishing ground was in the South Atlantic before 1989 but had shifted to tropical waters of the Atlantic Ocean since 1990 due to the change of targeting species from albacore tuna in temperate waters to bigeye tuna and yellowfin tuna in the tropical Atlantic Ocean, and even more close to the tropical area from 2007.

6. Estimation of Catch at size and catch at age

The Secretariat provided the available data on catch-at-size (T2CS_BET1590-20_v1.csv) and the size measurements (T2SZ_BET1950-20_v1.csv) submitted by CPCs before 22 April 2021. Overall, limited data were provided by CPCs for 2020 on CAS or SZ data.

The Secretariat informed the Group that it was working with the tropical tuna Species Group workplan approved during the 2020 SCRS meeting, thus waiting for the 2020 data submissions to produce the derived estimates of BET 1950-2020 of Catch at size (CAS) and catch at age (CAA). Due to the limited information submitted on time, the Secretariat did not provide preliminary estimates of CAS and CAA. Following the decisions of the Group during the meeting, it has been agreed to the following:

- 2019 will be the terminal year for the assessment input data;
- CPCs will submit fisheries statistics up to the 2019 calendar year on the catch, catch-effort, size, CAS, and CAA to the Secretariat by 30 April 2021;
- The Secretariat will provide to the Group updated estimates of catch, catch-effort, size, CAS, CAA, and size-frequency by the fleet structure of the SS3 model by 22 May 2021;
- The Secretariat will provide a size-frequency analysis of available size BET measurements as an SCRS document by the end of May to the Group for modelers to revise the fleet structure decisions and updates necessary as intersessional work in preparation for the stock assessment meeting.

7. Indices of relative abundance

The characteristics of each of the indices developed for this assessment, and the previous (2018) assessment of bigeye tuna are summarized in **Tables 5a-c, Table 6a-d** and **Figure 10**. The Group recognized the quality of each of the individual indices and commended the authors, but also noted that a major advancement in recent assessments of tropical tunas (2018 bigeye stock assessment (Anon. 2019) and 2019 yellowfin stock assesssment (Anon. 2020)) was the development of joint longline indices using high resolution catch and effort information from the main longline fleets operating in the Atlantic. For the purpose of the stock assessments, the Group agreed that joint indices of relative adult biomass are an improvement over the individual indices from the component fleets. The Group also considered two indices that were not included in the previous assessment, an EU Purse Seine index that is still under development, and an echosounder-based buoy associated index (BAI) that was assumed to represent the abundance of juvenile bigeye tuna. Discussions pertaining to these indices are summarized below. Recommendations for use in the 2021 BET stock assessment are as follows:

- Joint Index (SCRS/2021/052): Use the annual index for region 2 from 1979-2019 in all assessment model runs;
- Early Joint Index (Anon. 2019, Hoyle *et al.,* 2018): The 2018 bigeye stock assessment used an early period joint index (1959-1978) developed using data from the Japanese longline fleet. Continue to use this index in base model assessment runs as a separate CPUE series, and evaluate its influence by excluding this index in the one-off sensitivity runs;
- Korean Longline Index (SCRS/2021/053): Do not use in stock assessment base or sensitivity runs used to develop management advice. This catch effort information is included in the Joint CPUE index;
- Japanese Longline Index (SCRS/2021/054): Do not use in stock assessment base or sensitivity runs used to develop management advice. This catch effort information is included in the Joint CPUE index;
- Chinese Taipei Longline Index (SCRS/2021/059 and SCRS/2021/060): Do not use in stock assessment base or sensitivity runs used to develop management advice. This catch effort information is included in the Joint CPUE index;
- Brazilian Longline Index (SCRS/2021/062): Do not use in stock assessment base or sensitivity runs used to develop management advice;
- BAI-Echosounder Buoy Index (SCRS/2021/058): This is a juvenile index. Use this index in age-structured base model assessment runs;
- EU-PS Index (SCRS/P/2021/016): Not available to review during this data preparatory meeting. The Group encourages further development of this index.
- Dakar Baitboat (Santiago *et al.* 2019), Uruguay Longline (Forselledo *et al.* 2019), U.S. Longline (Walter and Lauretta 2019) Indices: Do not use in stock assessment base or sensitivity runs used to develop management advice.

7.1 For individual fleets

SCRS/2021/062 describes the standardized catch rate index for bigeye tuna caught by the Brazilian pelagic longline fleet from 1998 to 2020. The CPUE of the bigeye tuna was standardized by a GLM, using a Delta Lognormal approach proposed by Hoyle *et al.,* (2018).

The Group recognized the complexity of the fleet dynamics of this fishery and the quality of the standardization approach but did not recommend the use of this index for stock assessment because the relative abundance of adult fish is better characterized by the Joint LL index as it has a more extensive spatial/temporal coverage. The Group discussed the characterization of the fishing strategy using the cluster analysis and the inclusion of hooks between baskets as a model covariate. The authors demonstrated that the influence of these variables in explaining the model was significant and allowed the model to respond to the heterogeneity of the Brazilian fleets. The Group also questioned the inclusion of both hooks and hooks between floats in the model, as these variables are related. The authors explained that hooks are essentially a predictor of catch, whereas hooks between floats relate to targeting. The Group also emphasized that substantial improvements have been made for cleaning the data, resolving conflicting data, and updating the standardized method.

SCRS/2021/053 presents the standardized CPUE of bigeye tuna landed by the Korean longline fishery, which was standardized using lognormal constant, and delta lognormal models. Clustering analysis was conducted to address target changes through time, and cluster factor was used as a categorical variable in the models. The indices were high in the 1980s, but since then they have decreased and remained at a low level.

The Group noted that the nominal CPUE was almost identical to the standardized despite the strong influence of clustering. The author responded that more than half of the data comes from cluster 1 (higher proportion of BET), and it is dominant in the data fits and drives the CPUE. The relative decline in the standardized series is much larger than in the nominal in the first 3 years of the series. The Group did not recommend the use of this index for stock assessment because the relative abundance of adult fish is better characterized by the Joint LL index, and data from this fishery was included in the development of the joint index.

SCRS/2021/054 describes the standardization of the bigeye tuna CPUE series from the Japanese longline fleet in the Atlantic Ocean. The indices were constructed using generalized linear models (GLM) with a lognormal error structure. The models incorporated fishing power based on vessel ID and used cluster analysis to account for targeting.

The Group inquired about the benefits of using the 10-day periods in the cluster analysis. The author responded that shorter periods seem to have a different effect on targeting than longer (30 day) periods. The Group also noted that in Area 3 there is a departure between nominal and standardized, which might imply a poleward shift in the spatial distribution of the catch. There also appears to be a shift in targeting toward ALB. The Group did not recommend the use of this index for stock assessment because the relative abundance of adult fish is better characterized by the Joint LL index, and data from this fishery was included in the development of the joint index.

SCRS/2021/058 presents a novel index of abundance of juvenile bigeye tuna in the Atlantic Ocean derived from echosounder buoys for the period 2010-2020. Echosounder buoys have the potential to be used as observation platforms to evaluate abundances of tunas and accompanying species using acoustic detections and logbook species composition data. Current echosounder buoys provide a single acoustic value without discriminating the species or size composition of the fish underneath the FAD. Therefore, it has been necessary to combine the echosounder buoys data with fishery data, species composition, and average size, to develop a specific indicator of abundance for bigeye tuna.

The Group recognizes the value of catch-independent indices and indices of juvenile abundance, particularly for species like bigeye tuna with high catches of age 0 and 1 individuals. Despite concerns, the Group strongly recommended the continued development and improvement of this index. The Group expressed concerns about the inability to directly discriminate the species or size composition of the fish underneath the FAD. Size and species composition may influence backscatter, and target strength. The development of this index also requires proxy catch composition derived from logbook data which could introduce unexpected biases. In particular, the Group noted that indices developed for the three tropical species (BET, YFT, SKJ) produce similar trends (**Figure 11**), implying that the trends in relative abundance are similar for the three species. A similar pattern can be observed when examining the Joint longline indices (**Figure 12** from Hoyle *et al.,* 2018/19). The Group recommended that the underlying mechanism for this process be identified for potential inclusion in future CPUE standardization and or stock assessment models of tropical tunas (e.g. environmental covariates).

SCRS/2021/059 describes regional abundance indices of bigeye tuna developed for the Chinese Taipei longline using generalized linear models (GLM). The targeting effect was derived from a cluster analysis based on catch composition and was accounted for in the GLM analysis. For the main fishing ground in the tropical area, the trend showed a slightly decreasing trend in recent years.

The Group noted that targeting was examined using a cluster approach but that the cluster variable did not appear to be very influential, unlike previous indices developed for this fishery. The author noted that in previous attempts to develop this index, the earlier part of the time series did not include the variable hooks per basket which was a strong indicator of targeting. The early time period was eliminated from the current index, and the remaining series has relatively consistent hooks per basket, and likely represents a period where targeting was fairly constant. The Group did not recommend the use of this index for stock assessment because the relative abundance of adult fish is better characterized by the Joint LL index, and data from this fishery was included in the development of the joint index.

SCRS/2021/060 presented an alternative standardization approach to the generalized linear model used for the Chinese Taipei longline index, based on a boosted regression tree analysis. The alternative standardization showed similar model performance, significant factors, interaction terms, and overall index to the GLM. The primary difference was in the index values for the first three years of the time series, which showed higher values and steeper decline compared to the GLM.

The Group did not recommend the use of this index for stock assessment because the relative abundance of adult fish is better characterized by the Joint LL index, and data from this fishery was included in the development of the joint index.

SCRS/2021/P016 presented standardized indices from the EU purse seine fleet. Data were evaluated for free school and FAD sets, with adult size classes represented in the former, and predominantly juveniles sizes in the latter. Juvenile detections were also evaluated between randomly encountered FADs and ones targeted by known geolocation from buoy and echo sounders. The authors highlighted additional data needs for the study, and presented a proposed timeline for completion of the index work, which was anticipated to be late-July at the earliest. Potential indices and associated model diagnostics were not available to review during the data preparatory meeting, therefore the data will not be used in the stock assessment.

The Group recognized the large proportion of removals from PS, therefore the Group encourages further development of these indices.

SCRS/2021/P/017 Presentation provided complimentary analysis results of the vector-autoregressive spatiotemporal model (VAST) model related to the Joint LL index (SCRS/2021/052). Two types of indices, an age aggregated index and an age-specific index (age 2, 3, 4, and 5+), were developed using only the Japanese longline data. This work was originally a part of the joint index but the development of the VAST model had faced a convergence problem for the size aggregated index, thus the results of the VAST model were not included in the paper of the Joint LL index. There were three models tested for each age aggregated model and the age specific model, considering the combination of catchability covariates and a vessel effect. Three age aggregated models did not converge to a solution, while three age specific models did converge but one model showed a large estimated standard error of index. The time series of size (age)-specific indices showed reasonable one-year lag between adjacent age index for some peaks, but other peaks could not be traced. Size segregation was observed in the geographic distribution of mean predicted log density, by fish size category from 1975 to 2019.

The Group agreed that this method has considerable potential for the development of age specific relative abundance index for longline fisheries. Such indices will be useful for future stock assessments and make improve the model's ability to explain a change in the size distribution of the longline fleets.

7.2 Combined indices

SCRS/2021/052 presented an update of the Joint-CPC longline indices. Delegates from Japan, Chinese Taipei, and Korea collaborated to compile catch rate data for each of the three regions defined during the 2018 assessment. The team encountered some difficulties in implementing the study, due to the pandemic and the inability of scientists to meet in person to work under the terms of agreement for data compilation and analysis. The team members engaged in one in-person workshop in December 2019, and a series of more than a dozen online meetings. A path forward was agreed on to submit aggregated data to a lead analyst, who then followed the approach outlined during the previous joint analysis (Hoyle *et al.,* 2019). The primary difference between the current analysis and previous Joint index analysis was that data were provided in an aggregated format, summarized to monthly 1x1 lat-lon records. The previous Joint index combined set-by-set level data for the index. Overall, the updated index showed similar long-term trends as the previous study, despite the difference in data resolution. The team also explored a spatially explicit GLM using program VAST, and indicated that future work is recommended on this approach to improve model performance. The updated Joint LL index was provided up to the year 2019 for use in the 2021 stock assessment.

The Group discussed the differences in the approach used to construct the joint LL dataset (e.g., aggregated versus set-by-set data), but also noted the similarity of the index for region 2 (tropical Atlantic) in the recent period (**Figure 13**), for which the majority of information from CPCs involved in the 2018 bigeye tuna joint index was available. The exception was the U.S. LL logbook data. However, the Group noted that the number of longline sets for the U.S. LL fleet in region 2 was minimal for the historical period compared to the other CPCs fishing effort, and no longline operations have been conducted there in the recent decade. The Group noted that the previous reference model used a continuous time series for the period 1959 to 2017, but at that time the vessel ID was available only for the period 1979 to present.

The final decision was to use two separate series for the reference case, which included the early period index used in the 2018 assessment (1959-1978), and the updated index for the recent period index presented in document SCRS/2021/052 (**Figure 14**). It was also recommended that a sensitivity run in the assessment be conducted with the early period index removed. The Joint indices for regions 1 North and 3 South will not be used for the 2021 stock assessment.

8. Specifications of data inputs required for the different assessment models and advice framework

The Group discussed the modeling frameworks that should be brought to the 2021 assessment meeting. Several frameworks were discussed including the fully integrated statistical model (Stock Synthesis) and two Stock Production Models, (JABBA and MPB). The determination of which modeling platform would be used for management advice was left to be determined at the stock assessment meeting in July 2021, after the assumptions and diagnostics of the models could be evaluated.

The Group determined that one continuity model would be produced using the following configuration (comparable to the 2018 assessment model #8): (1) This model will use Stock Synthesis version 3.30; (2) the new 2021 fleet structure (see item 8.1); (3) the 2018 natural mortality vector, steepness (h = 0.80, sigma_r = 0.4, and the lambda on length composition of 0.10); (4) and the new joint CPUE index. The objective of this model is to use it only for comparison with the new model configuration and not for management advice. The summary of this model specification is available in **Table 7**.

The possibility of explicitly accounting for bigeye tuna discards was discussed. While there were suggestions from the Group that discards, in general, likely result from some CPCs day-to-day fishing activities, a quantification (either in terms of catch or length compositions) was not readily available at the time of the meeting. Consequently, discards will not be modeled separately in the assessment.

The Group concluded that assessment models would use (1) the joint longline index, region 2, broken into an early period (1959-1978; developed using data from the Japanese LL fleet and used in the 2018 assessment, Anon. 2019) and a recent period (1979-2019; new joint longline index presented in SCRC/2021/052), mirrored to the Japanese_LL2 fleet, and (2) the buoy-echosounder buoys index presented in SCRS/2021/058. The buoy-derived index was suggested to have a selectivity that was mirrored to the PS FAD fishery.

The Group decided to continue with the use of the uncertainty grid approach to quantifying model uncertainty. The axes and specific values of the grid are shown in **Table 8**. The Group agreed with the proposal of using the diagnostic tests outlined in the background document Carvalho *et al.,* 2021. The modeling team has the discretion to make necessary changes to the model configuration based on identified issues or diagnostic performance. Further screening of selected sensitivities runs based on diagnostics using these tools outlined above will be assessed for their potential for model misspecification, and some scenarios may be excluded from further analysis.

At the 2019 YFT stock assessment (Anon. 2020), time blocks were proposed based on the influence plots (Hoyle *et al.,* 2019) which indicated a substantial shift (i.e. changes in the number of vessels in each fleet as well as changes in targeting, fleet composition and set depth) of the tropical longline fleets ("Japan" and "Other" as they were defined in the 2019 YFT stock assessment), likely associated with the observed changes in selectivity. The BET modeling team will consider these time-varying selectivity specifications and justification used in the 2019 YFT stock assessment for their appropriateness for inclusion in the 2021 BET assessment.

The Group defined three Working Groups that will work on the stock assessment modeling. These groups are as follows:

- JABBA: R. Santa Ana*, B. Mourato, H. Winker, A. Kimoto, M. Ortiz
- mpb: G. Merino*, A. Kimoto, and
- SS3: M. Lauretta*, M. Schirripa, A. Urtizberea, L. Ailloud, T. Kitakado, K. Satoh, P. Pascual, S. Cass-Calay, N. Taylor, A. Kimoto, M. Ortiz.

The Group encourages other scientists to join this effort.

8.1 Fleet structure for assessment models

For the 2018 BET stock assessment, the SS3 model used 15 different fleets (**Table 1**). To better harmonize the BET and YFT stock assessments for future MSE work, the BET fleet structure was compared to the 25 fleets of the 2019 YFT stock assessment (Anon. 2020, Table 6). In the 2019 YFT stock assessment there were 3 changes to the fleets that should be applied to the BET stock assessment in 2021:

1. Fleet 5_GhanaBB_PS: Comparable to the YFT Fleet 11_GhanaBB_PS. In the 2019 YFT stock assessment, this fleet was divided into 4 selectivity time blocks and 1996-2008 was removed. There is a large shift in the size composition between these two periods suggesting the selectivity needs to be split. For the BET assessment, the Group suggested applying 2 selectivity time blocks: prior to 1996 and 1996-2019. Additionally, size composition from 1996 to 2008 should be not used in the assessment input because available size data were computed from the EU PS size sampling.

2. Fleet 3_Late PS Free School: Seasonality was introduced to the PS fleets in the YFT stock assessment improving cases where fishing occurred on spawning aggregations. This was discussed by the Group and agreed that the evidence available for BET does not warrant using quarterly periods for selectivity.

3. Fleet 13_Other LL North and Fleet 15_Other LL South: Fleets 13 and 15 contain Chinese Taipei data with selectivity toward large fish. In the 2019 YFT stock assessment size composition from Chinese Taipei LL from Fleet 20_(Other_LL_TRO) were removed for the years 2005-2018. A change in the size composition of the CTP LL was apparent for bigeye tuna in the recent period, like YFT. There was a strong residual pattern in the 2018 BET SS3 fit to the data for the recent period. The Group suggested creating separate fleets for Chinese Taipei North and South using size composition data from 2007-2019. Section 4.2 provide an additional description of the treatment of Chinese Taipei size data required for the BET assessment

4. During the 2018 BET stock assessment (Anon. 2019), the Canary Islands catch was included in BB Fleets 8 and 9 of the 2018 fleet structure 2018 BET SA with EU.ESP (EU-Spain Canary fleet). Based

* Denotes model team leader

on new information from SCRS/2021/063, there is a seasonality in the BB Canary Island fishery. During Q1 larger fish were observed in free schools, Q2 and Q3 saw medium sized fish, and Q4 has a mixture of small and large fish. There evidence that the seasonal size composition for this fishery has been changing in recent years. The Group proposes combining the BB Canary Islands with Azores and Madeira BB fisheries (Fleet 9 in the 2018 BET SA).

5. It was recommended to remove the South Africa BB size composition data from fleet 6 Tropical BB South.

6. The acoustic buoy index should mirror the selectivity of the late PS-FAD fleet.

Following concerns from the MSE Tropical Tuna Working Group, the Group investigated how Brazil HL/BB and the PS fisheries of Belize, Cabo Verde, Guatemala, Salvador, Curaçao, and Panama were treated in the 2018 BET stock assessment (Anon. 2019). The Group suggested splitting the PS fleets into the free school and FAD PS fleets. The 2019 YFT stock assessment (Anon. 2020) had a western fleet containing Brazil HL, it was recommended similar treatment for the 2021 BET assessment.

1. Recommendations

9.1 Recommendations with financial implications

The Group recommends that an external expert be contracted to review the July 2021 BET stock assessment *post haste*.

The Group supported the proposal from the University of Maine to carry out additional tagging activities to tag a total of 975 specimens for a total cost of €68,250. In addition, the Group requested the Secretariat to seek possible funding by ICCAT CPCs.

The Group supported the proposal from the EU-Spain Canary Islands scientists to continue tagging both juvenile and adult bigeye tuna specimens around the archipelago. These additional tagging activities will have a small financial cost, as payment will only be needed for adult fishes (i.e. €20-30/specimen). In addition, the Group requested the Secretariat to seek possible funding by ICCAT CPCs.

The Group also suggested that a small group lead by the Tropical Tuna coordinator work with the Secretariat to estimate potential costs for AOTTP tagging recoveries for the upcoming years of 2022 and 2023 to be included in the next year research funding request.

9.2 Recommendations without financial implications

The Group considers that a collaboratively developed joint LL index such as has been used in recent BET and YFT assessments is a better representation of stock abundance for use in stock assessment models than a collection of separate LL indices developed by individual CPCs. The Group recommends that such collaborative work, following a similar process to that established for the 2018 BET stock assessment (Anon. 2019), be continued, to produce such joint indices for future YFT and BET stock assessments. The preferred approach is to develop such indices from set level data, while taking into account data confidentiality concerns, and to include the participation and data from as many CPCs with longline fleets as possible

The Group recommended that the Secretariat work with those CPCs that are reporting Task 1 and 2 data using F.A.O gear codes instead of ICCAT gear codes to standardize their data submissions using the correct gear codes.

The Group recommends that the AOTTP ageing laboratories work with experts to ensure that their results pass the appropriate quality control checks required for input in stock assessment.

The Group recommends that the AOTTP ageing laboratories use the existing otolith data to explore the timing of the annual growth zone formation.

1. Other matters

Under this item of the agenda, the Group reviewed and discussed recent advances on the Tropical Tunas MSE development.

10.1 Uncertainties MSE Tropical Tunas

SCRS/2021/055 document presented a summary of the discussions and agreements reached during the Tropical Tuna MSE Technical Group (29-31 March 2021) (Anon. 2021) related to the axes of uncertainty to be included in the tropical tuna MSE. Also, the document includes options for additional axes of uncertainty from MSEs other than tropical tunas and the next steps for the conditioning of Operating Models.

The Group noted the importance to include non-stationarity ecological processes in the uncertainty grid. It was noted that there are two ways to do this, one is to change one parameter (for example the virgin recruitment (R0)) for the future projections and the other is to assume that there have been different periods of productivity in the past.

The Group briefly discussed the R library for diagnostics *ss3diags,* and it was agreed that this is a promising tool that would help to provide a structured set of diagnostics for the Stock Synthesis configurations and filtering the OMs.

The Group noted the importance to discuss the appropriate fleet structure for the MSE and recommended for the Tropical Tunas SG to consider this at the next meeting(s). It was requested that the groups developing the Tropical Tuna MSEs continue to update the tropical tuna group through the periodic meetings ahead.

11. Adoption of the report and closure

The report was adopted during the meeting. The Chair and the Secretariat thanked all the participants for their efforts to work effectively and efficiently throughout the meeting. The meeting was adjourned.

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Table 1. The 15 fleet structure used during the 2018 BET stock assessment.

Fishery	Region	Name	Fleets	Gear	Years
1	2	Early PS	21, 8, 73, 29, other	PS	1965-1985
2	2	Transition PS	21, 8, 73, 29, other	PS	1986-1990
3	2	Late PS Free School	21, 8, 73, 29, other	PS	1991-2017
4	2	Late PS FAD	21, 8, 73	PS	1991-2017
5	2	Ghana BB+PS	27	BB+PS	1965-2017
6	2 (S of 10N)	TRO-South BB	21, 8, 73, other	BB	1962-2017
7	2 (N of 10N)	TRO-North BB early	21, 8, 73, 50, 53, 65, other	BB	1965-1979
8	2 (N of 10N)	TRO-North BB late	21, 8, 73, 50, 53, 65, other	BB	1980-2017
9	1	Northern BB	45,153, 154, other	BB	1965-2017
10	1	Japan LL North	12	LL	1961-2017
11	2	Japan LL TRO	12	LL	1961-2017
12	3	Japan LL South	12	LL	1961-2017
13	1	Other LL North	5, others	LL + others	1965-2017
14	2	Other LL TRO	3, 5, others	LL + others	1965-2017
15	3	Other LL South	3, 5, 20, others	LL + others	1961-2017

Table 2. Estimated catches (t) of bigeye tuna (*Thunnus obesus*) by area, gear, and flag.

		1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
A+M		808	1651	2018	2951	2932	4808	2779	8720	4290	7732	9113	17060	23132	26039	23631	39394	25386	25252	23911	36735	41880	55029	46972	56662	63703	60627	44668	54735	52431	45830	63597	67773	73557	59435	70978	78010	65433	57323	66375	78722
	Bait boat	808	1651	2018	2951	2932	4808	2769	8266	3837	6254	6127	5805	7112	10927	5698	9822	5320	11434	3792	9660	10296	11617	9296	13620	17922	14632	10380	13469	14708	9725	12350	10124	6950	9853	11480	17518	15661	13444	9747	12673
	Longline	0	0	0	0	0	0	10	454	453	1478	2986	11255	16020	15112	17928	29572	20046	13726	19683	24149	28526	39904	33293	38453	39535	41347	27847	29531	28796	27560	41787	41658	51851	33757	43303	52595	39942	35570	47766	58420
	Other surf.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	90	346	256	315	244	163	247	415	550	626	469	605
	Purse seine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	20	92	436	2926	3058	3508	4383	4589	6246	4648	6441	11730	8837	8199	9204	15560	14351	15503	15870	7435	9231	7069	7792	6380
	Purse seine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	116	161	158	77	46	48	613	600	644
	Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Purse seine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CP	Angola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Barbados	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Brazil	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	37	28	70	197	181	678	1183	812	782	698	505	776	521	698	419	873	756	946	512
	Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	0	0	0	0	0	0	0	0	0	11	144	95	31
	Cape Verde	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	111	95	146	142	131	115	50	47	464	45	27	72	200	293	167	112	86	60	117	100
	China PR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	130	0	339	721	0	6	1640	1129	1295	628	1425	1308	1041	450	76	0	0	0	0
	EU-España	0	0	0	0	0	0	0	0	0	0	0	0	98	491	144	1017	1145	1272	1399	1810	4072	7418	4015	5681	4515	8882	7436	9736	6849	5419	8430	10010	9332	8794	13617	10340	10884	9702	8475	8263
	EU-France	0	0	0	0	0	0	0	0	0	0	0	0	400	2400	840	10	60	1740	155	3346	3088	2828	3624	3224	4007	4079	5821	7076	7407	5775	5612	6456	5601	6923	3585	4226	4122	3435	4024	3261
	EU-Ireland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	EU-Italy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	EU-Poland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
	EU-Portugal	808	1651	2018	2951	2932	4808	2769	8266	3837	6254	6127	5805	6588	8021	4684	8670	4133	8051	1597	5620	5133	2892	3962	5855	10945	6813	2929	4522	5350	3483	3706	3086	1861	4075	4354	6457	7428	5036	2818	5295
	El Salvador	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	FR-St Pierre et Miquelon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Gabon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	Ghana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	73	84	170	237	124	238	332	780	791	491	2162	1887	1720	1178	1214	2158
	Great Britain	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Grenada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Guinea Ecuatorial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Guinée Rep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Honduras	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Iceland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Japan	0	0	0	0	0	0	10	454	453	1478	2904	11044	15746	14505	17366	28663	17578	9012	11345	11783	9504	21299	19665	22014	22946	17548	8170	10144	9863	12150	20922	22091	33513	15212	24870	32103	23081	18961	32064	39540
	Korea Rep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	289	320	263	1857	4079	7353	5730	6018	7831	10493	6923	8090	9716	8022	10235	12274	10809	9383	8989	10704	6084	4438	4919	7896
	Liberia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	206
	Libya	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Maroc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	170	324	394	414	387	622	625	552	120	30	0	8	2	8
	Mauritania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Namibia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Nigeria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Norway	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	0
	Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	182	2710	2081	2091	2135	1493	2127	513	4518	2500	3182	3930	3322	4461	5173	5701	3865	3242
	Philippines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Russian Federation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	S Tomé e Príncipe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	8
	Senegal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	145	241	177	15	550	83	148	24	109	187	93	43	43	40	9	26	61	132	377	102	2
	Sierra Leone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	South Africa	0	0	0	0	0	0	0	0	0	0	0	0	0	286	214	0	0	0	0	0	0	0	0	1	0	0	0	0	0	19	422	381	137	187	60	102	168	200	561	367
	St Vincent and Grenadines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Trinidad and Tobago	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	191	41	22	0	0	1	19
	UK-Bermuda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	UK-Sta Helena	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	22	8	9	14	23	14	19	0	0	5	1	1
	UK-Turks and Caicos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	USA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	18	148	195	544	212	113	865	67	28	331	248	212	202	158	422	315	539	639	1085	1074	1127	847
	USSR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	385	680	1820	1677	2200	2580	2729	1637	2961	3367	3652	4907	4086	2202	2229	2813	2832	635	352	1233	870	1071	1887	1077	424
	Uruguay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	86	397	605	714	597	177	204	120	55
	Venezuela	0	0	0	0	0	0	0	0	0	0	26	48	67	54	137	160	329	224	185	143	136	92	117	15	24	0	21	464	244	347	661	1684	1027	4284	4142	2918	1136	349	332	115
NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	20	47	54	0	672	2521	6039	8456	8538	6191	5639	4314	3499	4464	3701	3364	2970	2486	2561	1887	2147	1623	925	1220	1125	1488	1469	940
	Guyana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCO	Argentina	0	0	0	0	0	0	0	0	0	0	56	163	213	235	187	400	200	75	347	200	100	44	0	25	18	95	176	84	23	0	0	0	0	0	0	100	41	72	50	17
	Benin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	45	0	0	0	15	6	7	8
	Cambodia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Congo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	8	19	10	10	14
	Cuba	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	89	300	217	886	1027	4100	3200	2000	2600	2400	1900	1300	1800	2300	2300	1385	711	521	421	447	239	171	190	151	87
	Dominica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Faroe Islands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	NEI (ETRO)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	NEI (Flag related)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	46	369	354	758	1406	2155	4650
	Saint Kitts and Nevis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Seychelles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sta Lucia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Togo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	52	18	24	22	7	12
	Vanuatu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CP	Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cape Verde	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	EU-España	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	41	24	34	355	204	192
	EU-France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96	93	14	3	8	154	233	281
	Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Guinée Rep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCO	Mixed flags (EU tropical)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	116	65	58	23	20	7	103	164	172
CP	Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	EU-France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Japan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Korea Rep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	South Africa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	UK-Bermuda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

are incomplete and represent those reported by CPCs up to Apr 30 2021

		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*
A+M		85264	97197	100117	113861	134933	128148	120803	110280	107994	121541	103510	91051	75658	87487	89981	67956	59192	69998	63172	76426	76048	76749	71317	66976	75019	79542	79132	78617	72971	75669	36899
	Bait boat	18283	17743	16258	16472	20358	25697	18352	21289	19190	22200	12149	14391	8455	11235	20259	13124	10631	10333	6335	11565	7853	12849	10510	9214	8726	8020	6787	8436	7977	7344	3440
	Longline	56537	61655	62484	62891	78908	74872	74930	68312	71857	77227	72011	56123	47351	55356	49400	37961	34182	46231	41063	43533	42516	37899	34930	32245	36769	40378	36344	35186	32062	34226	20807
	Other surf.	284	332	513	622	967	551	353	534	428	672	451	766	221	447	286	716	527	431	192	241	476	957	961	2764	4950	5958	6395	7146	4571	5873	5375
	Purse seine	9413	15527	19227	31586	32668	25361	26628	19152	15531	20258	17537	19516	19418	19582	19016	15129	13310	12311	14810	20007	24209	23767	24080	22122	23965	24159	28418	26838	27284	28200	7260
	Purse seine	747	1941	1636	2290	2032	1667	540	993	989	1184	1363	257	214	867	1019	1026	542	692	772	1081	994	1277	823	632	609	989	1187	972	1049	0	
	Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	2	0	0	26	15	17
	Purse seine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	0	38	2	10	
CP	Angola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	253	
	Barbados	0	0	0	0	0	0	0	24	17	18	18	6	11	16	19	27	18	14	14	7	12	7	15	11	26	30	19	16	29	14	
	Belize	0	0	0	0	0	10	0	5	195	0	134	96	0	0	0	0	4	60	70	234	249	1218	1242	1336	1502	1877	1764	1961	2135	2307	
	Brazil	591	350	790	1256	601	1935	1707	1237	776	2024	2768	2659	2582	2455	1496	1081	1479	1593	958	1189	1173	1841	2120	3623	6456	7750	7660	7258	5096	6249	5913
	Canada	10	26	67	124	111	148	144	166	120	263	327	241	279	182	143	187	196	144	130	111	103	137	166	197	218	257	171	214	237	193	102
	Cape Verde	52	151	305	319	385	271	299	228	140	9	2	0	1	1	1	1077	1406	1247	444	545	554	1037	713	1333	2271	2764	1680	1107	1418	880	
	China PR	0	0	0	70	428	476	520	427	1503	7347	6564	7210	5840	7890	6555	6200	7200	7399	5686	4973	5489	3720	3231	2371	2232	4942	5852	5514	4823	5718	
	Curaçao	0	0	0	0	0	0	1893	2890	2919	4016	3098	3757	2221	3203	3526	27	416	252	1721	2348	2688	3441	2890	1964	2315	2573	3598	2844	3530	2787	
	Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	790	576	47	507	635	441	12	544	1239	384	2334	
	EU-España	10355	14705	14656	16782	22096	17849	15393	12513	7110	13739	11250	10133	10572	11120	8365	7618	7454	6675	7494	11966	11272	13100	10914	10082	10736	10058	11469	11544	8400	9117	
	EU-France	5023	5576	6888	12719	12263	8363	9171	5980	5624	5529	5949	4948	4293	3940	2926	2816	2984	1629	1130	2313	3329	3507	3756	3222	3549	2548	4566	4039	4055	5118	2036
	EU-Ireland	0	0	0	0	0	0	0	4	0	0	0	10	0	0	0	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	EU-Italy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	
	EU-Poland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	EU-Portugal	6233	5718	5796	5616	3099	9662	5810	5437	6334	3314	1498	1605	2590	1655	3204	4146	5071	5505	3422	5605	3682	6920	6128	5345	3869	3135	2187	3146	4405	3146	3055
	El Salvador	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	992	1450	1826	2634	2464	
	FR-St Pierre et Miquelon	0	0	0	0	0	0	0	0	0	0	0	90	21	0	28	6	0	2	3	0	2	0	0	0	0	0	0	0	0	0	
	Gabon	0	0	0	1	87	10	0	0	0	184	150	121	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Ghana	5031	4090	2866	3577	4738	5517	4751	10174	10647	11704	5632	9864	6480	9061	17888	8860	2307	2559	3372	4515	6253	3541	4468	2963	4175	5918	5194	3838	3636	2940	2933
	Great Britain	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	32	0	0	0	0	0	0	0	0	0	0	
	Grenada	0	65	25	20	10	10	0	1	0	0	0	0	0	0	0	0	0	10	31	0	0	0	0	0	0	18	23	33	27	26	
	Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	0	736	831	998	949	836	998	913	1011	282	262	163	993	340	1103	1602	1488	1623	
	Guinea Ecuatorial	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	50	0	58	0	3	10	17	4	11	7	8	
	Guinée Rep	0	0	0	0	0	334	2394	885	0	0	0	0	0	0	0	0	0	0	0	0	328	322	1516	1429	902	0	0	0	0	0	
	Honduras	0	0	44	0	0	61	28	59	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Iceland	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Japan	35231	30356	34722	35053	38503	35477	33171	26490	24330	21833	24605	18087	15306	19572	18509	14026	15735	17993	16684	16395	15205	12306	15390	13397	13603	12390	10365	10994	9854	9477	9285
	Korea Rep	2690	802	866	377	386	423	1250	796	163	124	43	1	87	143	629	770	2067	2136	2599	2134	2646	2762	1908	1151	1039	675	562	432	623	540	587
	Liberia	16	13	42	65	53	57	57	57	57	57	57	57	57	57	0	0	0	0	0	0	0	0	0	0	0	0	27	98	1	3	
	Libya	0	0	508	1085	500	400	400	400	400	400	400	31	593	593	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Maroc	68	206	81	774	977	553	654	255	336	1444	1160	1181	1154	1399	1145	786	929	700	802	795	276	300	300	308	300	309	350	410	500	850	1033
	Mauritania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	
	Mexico	0	0	0	1	4	0	2	6	8	6	2	2	7	4	5	4	3	3	1	1	3	1	1	2	1	2	2	3	3	3	3
	Namibia	0	0	0	0	715	29	7	46	16	423	589	640	274	215	177	307	283	41	146	108	181	289	376	135	240	465	359	141	109	79	
	Nigeria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	
	Norway	0	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Panama	6150	7446	9991	10138	13234	9927	4777	2098	1252	580	952	562	211	0	1521	2310	2415	2922	2263	2405	3047	3462	1694	2774	2315	1289	2337	1664	2067	3052	
	Philippines	0	0	0	0	0	0	0	0	1154	2113	975	377	837	855	1854	1743	1816	2368	1874	1880	1399	1267	532	1323	1964	0	0	0	0	0	
	Russian Federation	0	0	5	0	0	0	13	38	4	8	91	0	0	0	0	1	1	26	73	43	0	0	0	0	0	0	0	0	0	0	
	S Tomé e Príncipe	6	3	4	4	3	6	4	5	6	5	4	4	4	4	11	6	4	0	92	94	97	100	103	107	110	633	421	393	2	6	
	Senegal	0	10	5	8	123	357	190	272	789	1372	915	1159	497	322	490	770	1318	1293	734	1144	969	479	436	606	369	1031	1500	2978	2870	2272	2700
	Sierra Leone	0	0	0	0	0	0	0	0	0	0	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	South Africa	296	72	43	88	79	27	7	10	53	55	249	239	341	113	270	221	84	171	226	159	145	153	47	435	332	193	121	257	282	432	
	St Vincent and Grenadines	0	154	818	1740	812	519	596	545	1937	2940	1921	1143	130	103	18	0	114	567	171	293	396	38	25	16	30	496	622	889	428	504	
	Trinidad and Tobago	57	263	0	3	29	27	37	36	24	19	5	11	30	6	5	9	12	27	69	56	40	33	33	37	59	77	37	25	17	13	10
	UK-Bermuda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	UK-Sta Helena	3	3	10	6	6	10	10	12	17	6	8	5	5	4	6	18	25	18	28	17	11	190	51	19	17	44	77	70	45	4	
	UK-Turks and Caicos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2	0	0	0	0	0	
	USA	623	975	813	1090	1402	1209	882	1138	929	1263	574	1085	601	482	416	484	991	527	508	515	578	866	727	903	892	1082	568	836	921	832	
	USSR	95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Uruguay	38	20	56	48	37	80	124	69	59	28	25	51	67	59	40	62	83	22	27	201	23	15	2	30	0	0	0	0	0	0	
	Venezuela	161	476	270	809	457	457	189	274	222	140	221	708	1241	847	1060	243	261	318	122	229	85	264	98	94	169	132	156	318	165	28	
NCC	Chinese Taipei	5755	13850	11546	13426	19680	18023	21850	19242	16314	16837	16795	16429	18483	21563	17717	11984	2965	12116	10418	13252	13189	13732	10805	10316	13272	16453	13115	11845	11630	11288	9226
	Guyana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	25	34	53	2	
NCO	Argentina	78	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Benin	10	10	7	8	9	9	9	30	13	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Cambodia	0	0	0	0	0	0	0	0	0	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Congo	15	12	12	14	9	9	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Cuba	62	34	56	36	7	7	5	0	0	0	0	0	16	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Dominica	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Faroe Islands	0	0	0	0	0	0	0	0	0	11	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	NEI (ETRO)	0	357	364	42	356	915	0	7	0	0	0	362	68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	NEI (Flag related)	5856	8982	6146	4378	8964	10697	11862	16565	23484	22190	15092	7907	383	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Saint Kitts and Nevis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	0	0	
	Seychelles	0	0	0	0	0	0	0	0	0	0	58	0	162	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Sta Lucia	0	0	1	0	0	0	0	0	0	0	0	1	2	2	0	2	0	0	0	0	0	0	0	0	0	6	10	24	13	13	
	Togo	12	6	2	86	23	6	33	33	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Vanuatu	0	470	676	1807	2713	2610	2016	828	0	314	0	0	0	0	104	109	52	132	91	34	42	39	23	9	4	0	0	0	0	0	
CP	Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	46	42	16	41	23	0	0	0	0	0	
	Cape Verde	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	75	28	37	38	61	102	40	22	45	97	0	0	0	0	0	
	Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	25	20	13	117	59	46	60	34	42	0	0	0	0	0	
	Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	95	45	0	0	0	0	0	0	
	EU-España	242	625	571	764	605	371	58	255	328	487	474	0	0	223	244	143	88	49	190	250	211	216	98	80	143	0	0	0	0	0	
	EU-France	352	653	686	1032	970	713	314	437	467	553	607	229	205	446	397	222	79	26	51	150	122	394	192	56	54	0	0	0	0	0	
	Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	56	28	15	26	9	18	6	11	5	15	0	0	0	0	0	
	Guinée Rep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	72	0	60	20	22	74	203	288	245	209	0	0	0	0	0	
	Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	151	106	135	97	85	38	70	41	80	27	0	0	0	0	0	
NCO	Mixed flags (EU tropical)	153	663	379	494	457	582	169	301	193	143	281	28	8	198	378	294	189	348	337	375	324	257	0	0	0	989	1187	972	1049	1069	
CP	Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	EU-France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	0	38	2	10	0
	Japan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26	15	17
	Korea Rep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	
	South Africa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	UK-Bermuda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	

are incomplete and represent those reported by CPCs up to Apr 30 2021

2021 BET DATA PREPARATORY MEETING

Table 3. SCRS standard catalogues on statistics (task 1 and task 2) of BET by stock, major fishery, and year (1990-2020). The table shows fisheries that account for 95% of the total catches in descendent order Data for 2020 is provisional as submitted before 30 April 2021.

Speci	Sto	Stat	FlagName	GearG	DS	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	Rank	%	%cum
				T1 Total		97197	100117	113861	134933	128148	120803	110280	107994	121541	103510	91051	75658	87487	89981	67956	59192	69998	63172	76426	76048	76749	71317	66976	75019	79542	79132	78617	72971	75669	36899			
BET	A+M	CP	Japan	LL	t1	29488	34128	35053	38503	35477	33171	26490	24330	21833	24605	18087	15306	19572	18509	14026	15735	17993	16684	16395	15205	12306	15390	13397	13603	12390	10365	10994	9881	9492	9302	1	22.5%	23%
BET	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	abc	abc	abc	abc	abc	ab	ab	a	1		
BET	A+M	NCC	Chinese Taipei	LL	t1	13850	11546	13426	19680	18023	21850	19242	16314	16837	16795	16429	18483	21563	17717	11984	2965	12116	10418	13252	13189	13732	10819	10316	13272	16453	13115	11845	11630	11288	9226	2	16.4%	39%
BET	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	ab	ab	abc	abc	abc	abc	abc	abc	2		
BET	A+M	CP	EU-España	PS	t1	9395	9362	12495	12700	9971	8970	6240	4863	5508	6901	5923	7038	6595	4187	3155	3416	3359	5456	8019	7910	8050	7485	6849	6464	5574	6808	6064	4925	5084		3	7.6%	47%
BET	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	ab	ab		3		
BET	A+M	NCO	NEI (Flag related)	LL	t1	8982	6146	4378	8964	10697	11862	16565	23484	22190	15092	7907	383																			4	5.2%	52%
BET	A+M	NCO	NEI (Flag related)	LL	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1																			4		
BET	A+M	CP	EU-España	BB	t1	5484	5518	4901	9848	8073	6248	6260	2165	8563	4084	3897	3164	4158	3838	4417	3783	3007	1959	3868	2819	4506	2913	2389	3463	3508	3835	4811	2991	3631		5	4.9%	57%
BET	A+M	CP	EU-España	BB	t2	ac	ac	ac	ac	ac	ac	abc	ac	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc		5		
BET	A+M	CP	EU-France	PS	t1	3971	5682	11733	11046	7076	7128	4671	4149	4056	4620	3584	3668	3628	2736	2135	2481	1157	1039	2193	3294	3663	3766	3253	3528	2531	4184	3629	3882	4877	1957	6	4.8%	61%
BET	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	a	abc	-1	6		
BET	A+M	CP	EU-Portugal	BB	t1	5598	5639	5493	3036	9629	5810	5437	6334	3314	1498	1605	2420	1572	3161	3721	4626	4872	2738	5121	2872	6470	5986	5240	3737	3012	1677	2698	3870	2917	2392	7	4.7%	66%
BET	A+M	CP	EU-Portugal	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	ab	ab	ab	b	7		
BET	A+M	CP	China PR	LL	t1			70	428	476	520	427	1503	7347	6564	7210	5840	7890	6555	6200	7200	7399	5686	4973	5489	3720	3231	2371	2232	4942	5852	5514	4823	5718		8	4.6%	71%
BET	A+M	CP	China PR	LL	t2			-1	b	b	b	-1	a	a	a	ab	ab	a	ab	ab	ab	a	ab	ab	ab	ab	ab	ab	abc	ab	abc	abc	abc	ab		8		
BET	A+M	CP	Ghana	PS	t1						1328	2970	3138	6648	3468	5621	5606	5330	6201	5444	2136	2369	2868	3558	5370	3030	4111	2503	3373	5336	4856	3524	3111	2752	2719	9	3.7%	75%
BET	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	abc	abc	abc	a	-1	-1	9		
BET	A+M	CP	Ghana	BB	t1	4090	2866	3577	4738	5517	3423	7204	7509	5056	2164	4242	873	3731	11687	3416	171	190	504	957	883	511	358	460	802	582	338	314	525	188	214	10	3.0%	77%
BET	A+M	CP	Ghana	BB	t2	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	a	-1	-1	10		
BET	A+M	CP	Curaçao	PS	t1						1893	2890	2919	3428	2359	2803	1879	2758	3343	13	441	272	1734	2465	2747	3488	2950	1998	2357	2573	3598	2844	3530	2787		11	2.2%	80%
BET	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		11		
BET	A+M	CP	Panama	PS	t1	1013	2517	4113	5378	4304	1934	431	175	319	378	89	63		1521	2461	2521	3057	2360	2490	3085	3531	1736	2853	2341	1289	2022	1559	1664	2555		12	2.2%	82%
BET	A+M	CP	Panama	PS	t2	ab	a	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		12		
BET	A+M	CP	Brazil	LL	t1	350	790	1256	596	1935	1707	1237	644	2024	2762	2534	2582	2374	1453	1015	1423	927	785	1009	1055	1452	1165	1377	1966	2606	2322	2171	1595	1630	1139	13	1.8%	84%
BET	A+M	CP	Brazil	LL	t2	ab	ab	ab	ab	ab	a	a	a	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	a	a	a	a	ab	ab	ab	-1	13		
BET	A+M	CP	Panama	LL	t1	6320	7474	5998	7709	5623	2843	1667	1077		484	473	148														315	105	404	497		14	1.6%	85%
BET	A+M	CP	Panama	LL	t2	-1	a	-1	-1	-1	-1	-1	-1		a	-1	-1														-1	-1	-1	a		14		
BET	A+M	CP	Brazil	HL	t1																3	7	0	69	22	210	555	2012	4332	4967	5336	5086	3401	4563	4260	15	1.3%	87%
BET	A+M	CP	Brazil	HL	t2																-1	-1	-1	-1	a	-1	-1	-1	a	-1	-1	ab	ab	a	-1	15		
BET	A+M	CP	Korea Rep	LL	t1	802	866	377	386	423	1250	796	163	124	43	1	87	143	629	770	2067	2136	2599	2134	2646	2762	1908	1151	1039	677	562	432	623	540	587	16	1.1%	88%
BET	A+M	CP	Korea Rep	LL	t2	ab	ab	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	a	16		
BET	A+M	CP	EU-France	BB	t1	2258	1892	2018	2187	2000	2357	1746	1942	1998	1921	1593	786	758	587	597	571	261	141	269	156	238	175	25	74	51	135	127	171	195	79	17	1.0%	89%
BET	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	a	abc	-1	17		
BET	A+M	CP	Philippines	LL	t1								1154	2113	975	377	837	855	1854	1743	1816	2368	1874	1880	1399	1267	532	1323	1964							18	0.9%	90%
BET	A+M	CP	Philippines	LL	t2								a	a	a	-1	-1	a	a	a	a	a	a	ab	ab	abc	abc	abc	abc							18		
BET	A+M	CP	Cape Verde	PS	t1															1151	1433	1283	482	605	655	1076	734	1377	2361	2757	1679	1106	1416	878		19	0.7%	90%
BET	A+M	CP	Cape Verde	PS	t2														b	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	ab	ab	abc	ab		19		
BET	A+M	CP	USA	LL	t1	855	564	836	943	982	713	795	696	930	532	682	536	284	310	312	521	381	428	430	443	603	582	509	584	574	386	568	389	578		20	0.6%	91%
BET	A+M	CP	USA	LL	t2	ab	ab	ab	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		20		
BET	A+M	CP	Senegal	BB	t1	5		4	8	180	136	218	735	1372	915	1159	497	322	490	770	1318	1292	734	1143	954	455	432	599	359	501	577	287	159	222	513	21	0.6%	92%
BET	A+M	CP	Senegal	BB	t2	a		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	21		
BET	A+M	CP	Guatemala	PS	t1													736	831	1054	977	851	1024	922	1029	288	273	168	1007	340	1103	1602	1488	1623		22	0.6%	92%
BET	A+M	CP	Guatemala	PS	t2													ab	ab	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ac	abc		22		
BET	A+M	CP	Belize	PS	t1								195		87	96								186	246	704	1246	1274	1362	1654	1290	1366	1782	1986		23	0.5%	93%
BET	A+M	CP	Belize	PS	t2								a		ab	ab		b						abc	ab	ab	ab	ab	ab	ab	ab	abc	a	a		23		
BET	A+M	CP	EU-España	LL	t1	451	347	150	153	176	233	268	385	116	598	211	333	427	417	104	337	346	268	327	751	700	585	865	928	868	604	594	468	398		24	0.5%	93%
BET	A+M	CP	EU-España	LL	t2	ab	ab	ab	ab	ab	ab	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	b	b	b	b	b	-1		24		
BET	A+M	NCO	Mixed flags (EU tropical)	PS	t1	663	379	494	457	582	169	301	193	143	281	28	8	198	378	294	189	348	337	375	324	257				989	1187	972	1049	1069		25	0.4%	94%
BET	A+M	NCO	Mixed flags (EU tropical)	PS	t2	-1	-1	-1	-1	-1	-1	-1	b	b	-1	-1	-1	-1	-1	-1	-1	b	b	b	b	b	b	b	b	-1	-1	-1	-1	-1		25		
BET	A+M	NCO	Vanuatu	PS	t1	470	676	1807	2713	2610	2016	828		314																						26	0.4%	94%
BET	A+M	NCO	Vanuatu	PS	t2	a	a	a	a	a	a	a		a																						26		
BET	A+M	CP	Senegal	PS	t1																									429	895	2686	2707	1826	2188	27	0.4%	95%
BET	A+M	CP	Senegal	PS	t2																									abc	abc	ac	ac	ac	ac	27		
BET	A+M	CP	Maroc	LL	t1									700	770	857	913	889	929	519	887	700	802	795	276	99	90	88	80	100	100	100	122	212	291	28	0.4%	95%
BET	A+M	CP	Maroc	LL	t2									-1	-1	-1	-1	b	abc	abc	abc	abc	ab	ab	-1	-1	-1	-1	b	ab	a	ab	a	-1	a	28		

Table 4. Summary of the BET conventional tag information by year of release. Values represent the number of tag releases and the corresponding tag recoveries reported after given years at liberty.

Number of tag Bigeye tuna (*Thunnus obesus*)										
			Years at liberty							
Year	Releases	Recaptures	< 1	1 - 2	2 - 3	3 - 4	4 - 5	5-6	Unk	% recapt*
1960	2	0								
1962	9	0								
1963	45	0								
1964	34	0								
1965	4	0								
1966	21	0								
1967	3	0								
1969	2	0								
1971	4	4	2	2						100.0%
1972	17	17	14						3	100.0%
1973	126	125	124	1						99.2%
1974	17	16	11	1					4	94.1%
1975	16	16	14	1					1	100.0%
1977	9	9	9							100.0%
1978	108	107	101	5		1				99.1%
1979	11	0								
1980	939	92	72	10					10	9.8%
1981	690	208	189	8	1				10	30.1%
1982	7	0								
1983	5	3	3							60.0%
1984	23	5	3	1					1	21.7%
1985	5	0								
1986	96	90	87						3	93.8%
1987	23	0								
1988	10	0								
1989	28	2	1	1						7.1%
1990	69	0								
1991	215	1		1						0.5%
1992	255	1	1							0.4%
1993	220	3		2	1					1.4%
1994	257	32	27	4					1	12.5%
1995	157	12	10	1				1		7.6%
1996	119	21	18	3						17.6%
1997	609	243	233	8	2					39.9%
1998	45	7	6	1						15.6%
1999	3659	1464	1381	58	9	1			15	40.0%
2000	1414	189	171	14	2	1			1	13.4%
2001	356	14	9	4					1	3.9%
2002	1212	138	129	6	1				2	11.4%
2003	272	45	42	3						16.5%
2004	4	0								
2005	24	1							1	4.2%
2006	11	0								
2007	3	0								
2008	1	1				1				100.0%
2009	8	0								
2011	8	2	1				1			25.0%
2013	18	0								
2014	1	1	1							100.0%
2016	9146	2555	2394	129	26	5			1	27.9%
2017	6403	1683	1599	74	9	1				26.3%
2018	5642	522	435	84	1				2	9.3%
2019	2004	295	292	3						14.7%
2020	1029	60	60							5.8%
Total	35415	7984	7439	425	52	10	1	1	56	22.5%

Table 5a Summary of the evaluation CPUE table for the Atlantic bigeye tuna 2021 stock assessment.

	Paper	SCRS/2021/052	SCRS/2021/053	SCRS/2021/054	SCRS/2021/059
	Index	2021 Joint LL	Korea LL	Japan LL	Chinese-Taipei LL
1	Diagnostics	4 (diagnostic plots provided)	4 (Diagnostic plots provided)	5 (Comprehensive diagnostics provided)	4 (diagnostic plots provided)
2	Appropriateness of data exclusions and classifications (e.g. to identify targeted trips).	4 (Clusering to account for target)	4 (Data exclusions are explicitly addressed and justified. Targetting factor is included as cluster variables.)	3 (cluster analysis was done to identify targetting)	4 (Data exclusions are explicitly addressed and justified. Targetting factor is included)
3	Geographical Coverage	5 (Almost entire Atlantic)	4 (Tropical area in Atlantic)	5 (Almost entire Atlantic)	5 (Almost entire Atlantic)
4	Catch Fraction to the total catch weight	5 around 45-50 % of catches (See the information on each fleet (JP, KOR, CTP))	2 (less than 5% catches in weight from 2000)	4 (15-20 % catches in weight from 2000, around 15 % in recent years	4 (15-25 % catches in weight from 2000, around 20 % in last years
5	Length of Time Series relative to the history of exploitation.	4 (1975-2019)	3 (1987-2019)	4 (1975-2019)	5 (series is divided into time periods, but data is available since 1967)
6	Are other indices available for the same time period?	5 (Separate resulst by Japan, Korea and Taiwan)	2 (Almost all other series are longer)	4 (Conparatively long series)	4 (Few other series are longer)
7	Does the index standardization account for Known factors that influence catchability/selectivity ?	4 (Gear or Target depending on the fleet is included).	4 (Quarter, area, vessel ID and cluster are considered as factors)	4 (Quarter, Lat/lon blocks, vessel ID and cluster information are included.)	4 (month, area and fleet and targeting information are all included.)
8	Are there conflicts between the catch history and the CPUE response?	3 (No noticebale conflicts)	3 (Most of CPUE time series track the catches.)	3 (For most of the time series CPUE tracks catches, but that's because catches were derived from CPUE)	3 (for most of the time series CPUE tracks catches)
9	Is the interannual variability within plausible bounds (e.g. SCRS/2012/039)	3 (There is a sharp increase before 1979 in R2 and variabilityrecent period in R1 and R3)	3 (There is a different between the unstndardized and the standardized indices in the first part of the period)	4 (No major variability with a few exceptions)	4 (no major fluctuations noted)
10	Are biologically implausible interannual deviations severe? (e.g. SCRS/2012/039)	3 (not many)??	2 (relatively severe during the timeframe mentioned above)	2 (relatively severe during the timeframe mentioned above)	2 (relatively severe during the timeframe mentioned above)
11	Assessment of data quality and adequacy of data for standardization purpose (e.g. sampling design, sample size, factors considered)	4 (Descriptions of the different data sources used have been provided and explained)	3 (Descriptions of the different data sources used have been provided and explained, and the data used have a low coverage in recent years)	4 (descriptions of the different data sources used have been provided and explained)	4 (Descriptions of the different data sources used have been provided and explained)
12	Is this CPUE time series continuous?	5 (Series is continuous)	5 (Series is continuous)	5 (Series is continuous)	5 (Series is continuous)

Table 5b Continued.

	Paper	SCRS/2021/058	SCRS/2021/062	SCRS/2018/058	SCRS/2018/060	SCRS/2018/049	SCRS/2018/054
	Index	Buoy-derived Abundance Index	Brazil LL	2018 Joint LL	Dakar BB	Uruguay LL	U.S. LL
1	Diagnostics	4 (Comprehensive diagnostics provided)	5 (Comprehensive diagnostics provided)	5 (Comprehensive diagnostics provided)	4 (Comprehensive diagnostics provided)	4 (Comprehensive diagnostics provided)	5 (Comprehensive diagnostics provided)
2	Appropriateness of data exclusions and classifications (e.g. to identify targeted trips).	5 (Data exclusions are explicitly addressed and justified)	4 (Cluster to identify fleet strategy; also HBF is proxy of targeting)	5 (Data exclusions are explicitly addressed and justified. Targetting factor is included)	3 (No data exclusions mentioned)	3 (Data exclusions are explicitly addressed and justified)	4 (Data exclusions are discussed and justified and classifications appear appropriate. Targetting is included as a factor, although the targeting proxy is not without its limitations)
3	Geographical Coverage	4 (Eastern Tropical Area)	4 (Mainly in the southwestern Atlantic Ocean – 10ºN – 55ºS)	5 (Almost entire Atlantic)	2 (Limited region in West Africa)	3 (restricted to Southwestern Atlantic, but mainly concentrated in smaller area near Uruguay)	3 (Covers Western North Atlantic)
4	Catch Fraction to the total catch weight		2 (LL catches in weight is about 3% of the total catches 1998-2019)	5 around 45-50 % of catches (See the information on each fleet (JP, US, KOR, CTP))	2 (less than 3% but covering small fish	1 (Catches less than 1 %)	1 (Catches less than 1 %)
5	Length of Time Series relative to the history of exploitation.	2 (2010-2020)	4 (Series runs from 1998)	5 (1958-2017)	2 (2005-2017)	2 (2002-2011)	4 (1986-2017)
6	Are other indices available for the same time period?	3 (No for juveniles)	3 (Few other series are longer)	5 (none other available over entire length of dataset)	3 (Many of other CPUE's time series are longer)	3 (Japanese series and Taiwanese time series are longer)	2 (Almost all other series are longer)
7	Does the index standardization account for Known factors that influence catchability/selectivity ?	4 (Yes)	4 (Year, quarter, area, strategy, HBF, hooks, vesselid)	4 (Gear or Target depending on the fleet is included. Quarter and Area were also considered as factors. Vessel ID is also included). SST no included	4(Year, month, vessel, area, environental factors are used)	4 (SST and Gearare included. Quarter and Area were also considered as factors)	2 (model uses targeting as a fraction of SWO/total catch and operations code, other gear characteristics not significant)
8	Are there conflicts between the catch history and the CPUE response?	3 (No noticebale conflicts)	3 (No noticebale conflicts)	3 (No noticebale conflicts)	3 (No noticebale conflicts)	3 (No noticebale conflicts)	3 (No noticebale conflicts)
9	Is the interannual variability within plausible bounds (e.g. SCRS/2012/039)	4 (No major variability)	4 (No major variability)	3 (There is variability in the first part of the period)	3 (There is variability in the first part of the period)	4 (No major variability)	4 (CPUE shows seasonal oscillations)
10	Are biologically implausible interannual deviations severe? (e.g. SCRS/2012/039)	3 (not many)	3 (not many)	3	3 (not many)	2 (relatively severe during the timeframe mentioned above)	2 (relatively severe during the timeframe mentioned above)
11	Assessment of data quality and adequacy of data for standardization purpose (e.g. sampling design, sample size, factors considered)	4 (Descriptions of the different data sources used have been provided and explained)	4 (descriptions of the different data sources used have been provided and explained)	4 (Descriptions of the different data sources used have been provided and explained)	4 (Descriptions of the different data sources used have been provided and explained)	4 (Descriptions of the different data sources used have been provided and explained)	4 (descriptions of the different data sources used have been provided as well as caveats regarding the different input data sets are mentioned)
12	Is this CPUE time series continuous?	5 (Series is continuous)	5 (Series is continuous)	5 (Series is continuous)	5 (Series is continuous)	5 (Series is continuous)	5 (Series is continuous)

Table 6a. Available indices of abundance for the 2021 Atlantic bigeye tuna stock assessment; a) annual indices, and b) quarterly indices.

a) Annual indices

series	2021 Joint LL_R1		2021 Joint LL_R2		2021 Joint LL_R3		Korea LL_R2		Japan LL_R1		Japan LL_R2		Japan LL_R3		China-Taipei LL_R1		China-Taipei LL_R2		China-Taipei LL_R3		Brazil LL	
indexing	Number		Number		Number		Number		Number		Number		Number		Number		Number		Number		Number	
area	Region 1		Region 2		Region 3		Region 2		Region 1		Region 2		Region 3		Region 1		Region 2		Region 3		Region 2	
method	lognormal		lognormal		lognormal				lognormal		lognormal		lognormal		lognormal		lognormal		lognormal		Delta lognormal	
time of the year	Season 3		Season 3		Season 3																	
source	SCRS/2021/052		SCRS/2021/052		SCRS/2021/052		SCRS/2021/053		SCRS/2021/054		SCRS/2021/054		SCRS/2021/054		SCRS/2021/059		SCRS/2021/059		SCRS/2021/059		SCRS/2021/062	
Use in 2021 assessment	no		yes but starts in 1979		no		no		no		no		no		no		no		no		sensitivity	
Year	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	Std. CPUE	CV	Std. CPUE	CV
1950																						
1951																						
1952																						
1953																						
1954																						
1955																						
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1965																						
1966																						
1967																						
1968																						
1969																						
1970																						
1971																						
1972																						
1973																						
1974																						
1975	1.77	0.06	0.82	0.04	1.48	0.09			4.20	0.43	3.44	0.20	10.35	1.61								
1976	1.47	0.07	0.96	0.04	1.64	0.11			3.75	0.39	3.19	0.20	10.61	1.80								
1977	1.66	0.07	1.49	0.04	1.59	0.09			4.03	0.42	5.21	0.31	12.42	1.98								
1978	1.56	0.07	1.26	0.04	1.70	0.11			3.70	0.39	5.22	0.33	16.04	2.94								
1979	1.85	0.07	1.56	0.04	1.17	0.12			3.68	0.38	6.09	0.36	7.64	1.33								
1980	1.95	0.07	1.50	0.04	0.88	0.10			4.11	0.42	5.84	0.31	5.16	0.77								
1981	1.35	0.07	1.26	0.04	1.36	0.08			3.19	0.33	4.87	0.25	7.61	1.07								
1982	1.70	0.07	1.28	0.04	0.81	0.09			3.77	0.39	4.92	0.25	4.47	0.65								
1983	1.79	0.07	1.25	0.04	0.87	0.12			3.36	0.35	4.87	0.26	5.57	0.95								
1984	1.68	0.07	1.47	0.04	1.62	0.10			3.26	0.34	5.70	0.28	7.01	1.10								
1985	1.44	0.07	1.55	0.03	1.51	0.08			3.21	0.33	6.07	0.29	6.96	0.94								
1986	0.91	0.09	1.46	0.04	1.21	0.09			2.48	0.27	5.97	0.30	6.73	0.93								
1987	1.14	0.08	1.84	0.03	1.76	0.08	2.47	0.19	2.66	0.28	7.09	0.35	8.13	1.10								
1988	0.99	0.08	1.73	0.03	1.02	0.08	3.01	0.18	2.52	0.27	6.90	0.33	5.79	0.79								
1989	0.90	0.08	1.42	0.03	0.91	0.09	2.05	0.17	2.22	0.24	5.48	0.27	5.11	0.71								
1990	1.29	0.08	1.18	0.04	1.10	0.08			2.90	0.30	4.48	0.22	5.77	0.78								
1991	1.11	0.08	1.20	0.04	0.85	0.08	0.97	0.17	2.80	0.29	4.71	0.23	4.75	0.64								
1992	1.07	0.08	1.06	0.04	0.81	0.09	0.89	0.18	2.70	0.28	4.19	0.21	4.65	0.63								
1993	0.83	0.09	1.18	0.04	0.99	0.08	0.89	0.17	2.46	0.26	4.44	0.22	6.35	0.84								
1994	1.01	0.09	1.09	0.04	0.93	0.08	0.84	0.27	2.92	0.31	4.29	0.21	5.33	0.70								
1995	0.98	0.09	1.22	0.04	1.01	0.07	0.96	0.16	2.44	0.26	4.45	0.22	5.18	0.69	0.10	0.21	7.69	0.05	0.96	0.12		
1996	0.87	0.09	0.85	0.04	1.03	0.08	0.70	0.15	2.45	0.26	3.21	0.17	5.06	0.68	0.37	0.23	6.19	0.04	1.19	0.12		
1997	1.04	0.08	0.76	0.04	0.81	0.09	0.66	0.13	2.53	0.27	2.87	0.15	4.27	0.59	0.21	0.21	4.92	0.04	0.53	0.12		
1998	1.13	0.08	0.79	0.04	0.60	0.10	0.47	0.16	2.78	0.29	3.31	0.17	4.12	0.57	0.19	0.18	4.08	0.05	0.53	0.14	2.10	0.05
1999	0.89	0.09	0.78	0.04	0.74	0.09	0.44	0.22	2.17	0.24	3.34	0.17	4.94	0.67	0.24	0.17	4.22	0.04	0.56	0.12	1.34	0.04
2000	0.97	0.08	0.79	0.04	0.69	0.08	0.00	0.25	2.30	0.24	3.49	0.18	3.69	0.52	0.20	0.19	4.34	0.04	0.64	0.12	1.48	0.04
2001	0.84	0.08	0.66	0.04	0.61	0.09			2.20	0.23	2.82	0.15	4.13	0.58	0.35	0.17	4.21	0.04	0.66	0.12	1.19	0.04
2002	0.58	0.11	0.70	0.04	0.94	0.08	1.93	0.16	1.59	0.19	2.90	0.16	4.82	0.76	0.25	0.18	4.82	0.04	0.87	0.12	0.89	0.05
2003	0.75	0.09	0.72	0.04	0.89	0.08	0.59	0.12	1.83	0.20	3.03	0.16	3.97	0.57	0.16	0.19	5.18	0.04	0.43	0.13	0.77	0.04
2004	0.53	0.12	0.58	0.04	0.73	0.08	0.56	0.13	1.67	0.19	2.47	0.14	4.06	0.57	0.15	0.20	4.57	0.04	0.66	0.12	0.71	0.04
2005	0.68	0.09	0.67	0.04	0.85	0.09	0.51	0.16	1.94	0.21	2.59	0.14	6.13	0.93	0.26	0.19	5.46	0.04	0.69	0.12	0.71	0.04
2006	0.43	0.19	0.75	0.04	0.75	0.09	1.56	0.16	1.32	0.19	3.03	0.16	4.46	0.70	0.37	0.21	5.63	0.05	0.59	0.12	1.11	0.05
2007	0.75	0.13	0.76	0.04	0.63	0.10	1.37	0.16	1.89	0.24	3.04	0.16	5.87	0.96	0.30	0.22	5.21	0.04	0.46	0.12	0.97	0.04
2008	0.45	0.14	0.64	0.04	0.82	0.09	0.79	0.16	1.44	0.18	2.75	0.15	5.01	0.72	0.18	0.22	4.41	0.04	0.70	0.12	1.07	0.08
2009	0.41	0.17	0.58	0.04	0.65	0.09	0.85	0.16	1.45	0.19	2.43	0.13	4.09	0.59	0.14	0.29	4.28	0.04	0.53	0.12	1.51	0.06
2010	0.74	0.12	0.61	0.04	0.56	0.10	0.85	0.15	1.89	0.22	2.39	0.13	4.23	0.60	0.08	0.24	4.27	0.04	0.47	0.12	0.68	0.06
2011	0.75	0.18	0.59	0.04	0.48	0.10	0.99	0.15	1.76	0.22	2.18	0.12	3.46	0.49	0.12	0.22	4.13	0.04	0.55	0.12	1.07	0.07
2012	0.58	0.21	0.62	0.04	0.84	0.08	0.80	0.16	1.68	0.27	2.57	0.14	5.09	0.68	0.13	0.23	3.84	0.04	0.65	0.12	1.04	0.05
2013	1.02	0.19	0.79	0.04	1.14	0.07	0.93	0.16	2.12	0.34	3.03	0.16	6.22	0.81	0.93	0.23	5.55	0.05	1.00	0.12	1.21	0.07
2014	0.34	0.30	0.84	0.04	0.83	0.08	1.07	0.16	1.19	0.19	3.38	0.18	4.36	0.62	1.26	0.24	4.41	0.07	0.74	0.12	1.02	0.06
2015	1.23	0.15	0.86	0.04	1.01	0.08	0.88	0.14	4.80	0.72	3.41	0.18	5.67	0.75	0.20	0.21	5.49	0.05	0.72	0.12	0.66	0.05
2016	0.24	0.39	0.79	0.04	1.22	0.08	0.74	0.11	0.77	0.15	3.49	0.18	5.84	0.82	0.10	0.19	4.61	0.04	0.74	0.12	0.83	0.04
2017	0.26	0.46	0.76	0.04	1.18	0.08	0.62	0.11	0.87	0.18	3.27	0.17	5.62	0.76	0.07	0.19	5.00	0.04	0.68	0.12	0.75	0.06
2018	0.71	0.17	0.66	0.04	0.78	0.09	0.67	0.11	1.25	0.23	2.78	0.16	5.00	0.68	0.39	0.18	4.66	0.04	0.57	0.12	0.76	0.05
2019	0.32	0.37	0.71	0.04	1.01	0.08	0.93	0.12	1.20	0.22	3.19	0.17	5.80	0.80	0.21	0.21	4.40	0.04	0.65	0.12	0.71	0.05
2020									1.26	0.22	3.41	0.20	6.94	0.91							0.93	0.06

Table 6b ... Continued**.**
a) Annual indices

series	2018 Joint LL_early_R2		Dakar BB		Uruguay LL		U.S. LL	
indexing	Number		Weight				Number	
area	Region 2		Region 2		Region 2		Region 2	
method	Delta lognormal		Delta lognormal					
time of the year	Season 3		Season 2					
source	SCRS/2018/058		SCRS/2018/060		SCRS/2018/049		SCRS/2018/054	
Use in 2021 assessment	yes (remove for sensitivity run)		no		no		no	
Year	**Std. CPUE**	**SE**	**Std. CPUE**	**SE**	**Std. CPUE**	**CV**	**Std. CPUE**	**CV**
1950								
1951								
1952								
1953								
1954								
1955								
1956								
1957								
1958								
1959	0.84	0.23						
1960	0.92	0.18						
1961	1.17	0.16						
1962	1.00	0.15						
1963	1.15	0.13						
1964	1.17	0.12						
1965	1.23	0.11						
1966	1.08	0.15						
1967	1.04	0.15						
1968	1.19	0.17						
1969	1.07	0.17						
1970	0.94	0.17						
1971	0.84	0.17						
1972	0.85	0.23						
1973	0.88	0.26						
1974	0.82	0.32						
1975	0.66	0.23						
1976	0.71	0.25						
1977	1.04	0.31						
1978	0.87	0.33						
1979								
1980								
1981								
1982								
1983								
1984								
1985								
1986							1.51	0.21
1987							2.16	0.14
1988							1.61	0.14
1989							1.68	0.14
1990							1.50	0.14
1991							1.57	0.14
1992							1.29	0.14
1993							1.03	0.14
1994							0.94	0.14
1995							0.94	0.14
1996							0.99	0.14
1997							0.87	0.14
1998							0.96	0.14
1999							1.42	0.14
2000							1.02	0.14
2001							1.08	0.14
2002					8.62	2.00	0.73	0.14
2003					1.69	2.28	0.53	0.15
2004					2.00	2.91	0.53	0.16
2005			57.50	0.15	8.84	1.27	0.82	0.15
2006			121.50	0.20	8.97	0.94	0.90	0.15
2007			178.50	0.20	14.20	1.18	0.74	0.16
2008			8.20	0.21	19.70	0.90	0.78	0.15
2009			23.10	0.20	4.06	2.40	0.67	0.15
2010			93.20	0.20	25.52	1.40	0.59	0.15
2011			53.60	0.20	16.87	1.16	0.62	0.15
2012			22.70	0.20			0.64	0.15
2013			17.00	0.21			0.69	0.15
2014			8.90	0.21			0.84	0.14
2015			18.20	0.20			0.91	0.14
2016			52.50	0.20			0.64	0.15
2017			53.70	0.20			0.81	0.15
2018								
2019								
2020								

Table 6c. Continued.

b) Quarterly indices (1959-1991)

series		2018 Joint LL_early_R2	
indexing		Number	
area		Region 2	
method		Delta lognormal	
time of the year		quartely	
source		SCRS/2018/058	
Use in 2021 assessment		no	
Year	**Quarter**	**Std. CPUE**	**CV**
1959	**1**	0.50	0.06
1959	**2**	0.87	0.04
1959	**3**	0.85	0.04
1959	**4**	1.25	0.03
1960	**1**	0.74	0.04
1960	**2**	0.92	0.03
1960	**3**	0.93	0.03
1960	**4**	1.20	0.03
1961	**1**	0.79	0.04
1961	**2**	1.21	0.03
1961	**3**	1.61	0.03
1961	**4**	1.18	0.03
1962	**1**	0.75	0.03
1962	**2**	1.06	0.02
1962	**3**	1.10	0.03
1962	**4**	1.21	0.03
1963	**1**	0.81	0.03
1963	**2**	1.34	0.02
1963	**3**	1.38	0.03
1963	**4**	1.18	0.02
1964	**1**	1.07	0.02
1964	**2**	1.47	0.02
1964	**3**	0.97	0.02
1964	**4**	1.26	0.02
1965	**1**	1.34	0.02
1965	**2**	1.26	0.02
1965	**3**	1.20	0.02
1965	**4**	1.22	0.02
1966	**1**	1.14	0.02
1966	**2**	0.98	0.03
1966	**3**	1.15	0.03
1966	**4**	1.15	0.03
1967	**1**	1.20	0.03
1967	**2**	1.07	0.03
1967	**3**	0.77	0.03
1967	**4**	1.23	0.02
1968	**1**	1.19	0.03
1968	**2**	1.16	0.03
1968	**3**	1.22	0.03
1968	**4**	1.30	0.03
1969	**1**	1.15	0.04
1969	**2**	1.03	0.03
1969	**3**	1.07	0.03
1969	**4**	1.15	0.03

series		2018 Joint LL_early_R2		2021 Joint LL_R2	
indexing		Number		Number	
area		Region 2		Region 2	
method		Delta lognormal		lognormal	
time of the year		quartely		quartely	
source		SCRS/2018/058		SCRS/2021/052	
Use in 2021 assessment		no		no	
Year	**Quarter**	**Std. CPUE**	**CV**	**Std. CPUE**	**CV**
1970	**1**	1.09	0.03		
1970	**2**	0.90	0.03		
1970	**3**	0.86	0.03		
1970	**4**	1.00	0.04		
1971	**1**	0.96	0.03		
1971	**2**	0.88	0.03		
1971	**3**	0.78	0.03		
1971	**4**	0.85	0.03		
1972	**1**	0.89	0.03		
1972	**2**	0.75	0.04		
1972	**3**	0.93	0.04		
1972	**4**	0.93	0.06		
1973	**1**	1.14	0.04		
1973	**2**	0.76	0.05		
1973	**3**	0.93	0.05		
1973	**4**	0.80	0.04		
1974	**1**	1.05	0.06		
1974	**2**	0.72	0.10		
1974	**3**	0.66	0.04		
1974	**4**	0.93	0.05		
1975	**1**	0.71	0.04	0.94	0.04
1975	**2**	0.70	0.04	0.69	0.04
1975	**3**	0.70	0.03	0.77	0.04
1975	**4**	0.63	0.05	0.85	0.04
1976	**1**	0.72	0.05	0.94	0.05
1976	**2**	0.67	0.04	0.68	0.04
1976	**3**	0.61	0.04	0.69	0.04
1976	**4**	0.96	0.06	1.76	0.04
1977	**1**	1.31	0.07	1.71	0.04
1977	**2**	0.96	0.07	1.30	0.05
1977	**3**	0.85	0.05	1.20	0.04
1977	**4**	1.16	0.04	1.77	0.04
1978	**1**	1.17	0.07	1.14	0.04
1978	**2**	0.77	0.06	0.95	0.05
1978	**3**	0.97	0.05	1.50	0.04
1978	**4**	0.65	0.06	1.47	0.05
1979	**1**			1.71	0.05
1979	**2**			1.50	0.04
1979	**3**			1.37	0.04
1979	**4**			1.60	0.04
1980	**1**			1.58	0.04
1980	**2**			1.85	0.04
1980	**3**			1.34	0.04
1980	**4**			1.26	0.04

series		2021 Joint LL_R2	
indexing		Number	
area		Region 2	
method		lognormal	
time of the year		quartely	
source		SCRS/2021/052	
Use in 2021 assessment		no	
Year	**Quarter**	**Std. CPUE**	**CV**
1981	**1**	1.42	0.04
1981	**2**	1.22	0.04
1981	**3**	1.05	0.04
1981	**4**	1.32	0.04
1982	**1**	1.60	0.03
1982	**2**	1.12	0.04
1982	**3**	1.04	0.04
1982	**4**	1.37	0.03
1983	**1**	1.16	0.04
1983	**2**	1.08	0.04
1983	**3**	1.25	0.04
1983	**4**	1.50	0.03
1984	**1**	1.61	0.03
1984	**2**	1.30	0.04
1984	**3**	1.32	0.04
1984	**4**	1.62	0.03
1985	**1**	1.74	0.03
1985	**2**	1.29	0.03
1985	**3**	1.48	0.03
1985	**4**	1.67	0.03
1986	**1**	1.56	0.04
1986	**2**	1.38	0.04
1986	**3**	1.32	0.04
1986	**4**	1.56	0.03
1987	**1**	1.86	0.03
1987	**2**	1.65	0.04
1987	**3**	1.76	0.04
1987	**4**	2.07	0.03
1988	**1**	2.03	0.04
1988	**2**	1.60	0.03
1988	**3**	1.64	0.03
1988	**4**	1.63	0.03
1989	**1**	1.77	0.03
1989	**2**	1.47	0.03
1989	**3**	1.31	0.03
1989	**4**	1.14	0.04
1990	**1**	1.49	0.04
1990	**2**	1.11	0.04
1990	**3**	1.07	0.04
1990	**4**	1.06	0.04
1991	**1**	1.29	0.04
1991	**2**	1.16	0.04
1991	**3**	1.14	0.04
1991	**4**	1.17	0.04

Table 6d. Continued.

b) Quarterly indices (1992-2020)

series	2021 Joint LL_R2		
indexing	Number		
area	Region 2		
method	lognormal		
time of the year	quartely		
source	SCRS/2021/052		
Use in 2021 assessment	no		
Year	Quarter	Std. CPUE	CV
1992	1	1.29	0.04
1992	2	0.87	0.04
1992	3	1.00	0.04
1992	4	1.08	0.04
1993	1	1.26	0.04
1993	2	1.18	0.04
1993	3	1.13	0.04
1993	4	1.13	0.04
1994	1	1.22	0.04
1994	2	1.10	0.04
1994	3	0.90	0.04
1994	4	1.14	0.04
1995	1	1.39	0.03
1995	2	1.12	0.04
1995	3	1.20	0.04
1995	4	1.13	0.04
1996	1	0.95	0.04
1996	2	0.92	0.04
1996	3	0.77	0.04
1996	4	0.75	0.04
1997	1	0.88	0.04
1997	2	0.70	0.04
1997	3	0.69	0.04
1997	4	0.74	0.04
1998	1	0.89	0.04
1998	2	0.82	0.04
1998	3	0.75	0.04
1998	4	0.70	0.04
1999	1	0.89	0.04
1999	2	0.73	0.04
1999	3	0.64	0.04
1999	4	0.83	0.04
2000	1	1.03	0.04
2000	2	0.77	0.04
2000	3	0.71	0.04
2000	4	0.66	0.04
2001	1	0.89	0.04
2001	2	0.72	0.04
2001	3	0.53	0.04
2001	4	0.51	0.04
2002	1	0.76	0.04
2002	2	0.66	0.04
2002	3	0.77	0.04
2002	4	0.60	0.04

series	2021 Joint LL_R2			BAI index	
indexing	Number				
area	Region 2			Region 2	
method	lognormal				
time of the year	quartely			quartely	
source	SCRS/2021/052			SCRS/2021/058	
Use in 2021 assessment	no			yes	
Year	Quarter	Std. CPUE	CV	Index	CV
2003	1	0.98	0.04		
2003	2	0.86	0.04		
2003	3	0.67	0.04		
2003	4	0.44	0.04		
2004	1	0.67	0.04		
2004	2	0.60	0.04		
2004	3	0.52	0.04		
2004	4	0.53	0.04		
2005	1	0.68	0.04		
2005	2	0.73	0.04		
2005	3	0.60	0.04		
2005	4	0.67	0.04		
2006	1	0.74	0.04		
2006	2	0.83	0.04		
2006	3	0.68	0.04		
2006	4	0.71	0.04		
2007	1	0.88	0.04		
2007	2	0.77	0.04		
2007	3	0.68	0.04		
2007	4	0.68	0.04		
2008	1	0.56	0.04		
2008	2	0.63	0.04		
2008	3	0.64	0.04		
2008	4	0.72	0.04		
2009	1	0.65	0.04		
2009	2	0.51	0.04		
2009	3	0.47	0.04		
2009	4	0.67	0.04		
2010	1	0.60	0.04	0.36	0.18
2010	2	0.53	0.04	0.23	0.18
2010	3	0.61	0.04	0.27	0.18
2010	4	0.68	0.04	0.43	0.18
2011	1	0.59	0.04	0.32	0.19
2011	2	0.55	0.04	0.22	0.18
2011	3	0.53	0.04	0.16	0.18
2011	4	0.66	0.04	0.18	0.18
2012	1	0.62	0.04	0.15	0.19
2012	2	0.60	0.04	0.15	0.18
2012	3	0.49	0.04	0.14	0.18
2012	4	0.79	0.04	0.13	0.18
2013	1	0.78	0.04	0.15	0.18
2013	2	0.75	0.04	0.11	0.16
2013	3	0.63	0.04	0.13	0.14
2013	4	1.00	0.04	0.22	0.14

series	2021 Joint LL_R2			BAI index	
indexing	Number				
area	Region 2			Region 2	
method	lognormal				
time of the year	quartely			quartely	
source	SCRS/2021/052			SCRS/2021/058	
Use in 2021 assessment	no			yes	
Year	Quarter	Std. CPUE	CV	Index	CV
2014	1	0.94	0.04	0.19	0.15
2014	2	0.78	0.04	0.12	0.14
2014	3	0.65	0.04	0.19	0.13
2014	4	0.98	0.04	0.20	0.12
2015	1	0.98	0.04	0.18	0.13
2015	2	0.90	0.04	0.12	0.14
2015	3	0.65	0.04	0.21	0.11
2015	4	0.90	0.04	0.20	0.10
2016	1	0.83	0.04	0.17	0.12
2016	2	0.70	0.04	0.13	0.16
2016	3	0.75	0.04	0.22	0.13
2016	4	0.85	0.04	0.20	0.11
2017	1	0.80	0.04	0.17	0.13
2017	2	0.70	0.04	0.19	0.14
2017	3	0.66	0.04	0.26	0.14
2017	4	0.88	0.04	0.32	0.11
2018	1	0.67	0.04	0.32	0.13
2018	2	0.58	0.04	0.34	0.14
2018	3	0.55	0.04	0.38	0.13
2018	4	0.84	0.04	0.36	0.13
2019	1	0.63	0.04	0.41	0.15
2019	2	0.71	0.04	0.28	0.16
2019	3	0.64	0.04	0.35	0.16
2019	4	0.84	0.04	0.34	0.15
2020	1			0.20	0.15
2020	2			0.21	0.16
2020	3			0.17	0.16
2020	4			0.28	0.15

Table 7. Summary of model specifications for the 2021 Atlantic bigeye tuna stock assessment.

Model specifications	**Assumptions**	**Source (see also ICCAT Manual)**	**Notes**
Growth model of size at age	Richards growth model* Linf=178.63, K=0.424, b=-7.185 and m=2280.4	Hallier et al. (2005)	
Length-weight relationship	RW = 2.396 10^{-05} *SFL $^{2.9774}$ kg and cm	Parks et al. (1982)	
Natural mortality	Lorenzen function of size (translated to age using the Hallier et al. (2005) Richards growth curve), scaled to the Then et al. (2015) point estimate of mortality assuming a maximum age of 17, 20, and 25 years.	Lorenzen (2006) Hallier et al. (2005) Richards growth curve Then et al. (2015)	More details in section 8 of this report
Longevity	At least 17 years	Andrews et al. 2020	
Spawning-at-age	50% spawning at age 3 Starting at age 1: 0, 0, 0.5, 1 (ages 4 and older)	2015 Atlantic bigeye tuna assessment report	
Spawning area	Spawning takes place in a vast zone in the vicinity of the equator	ICCAT manual	
Spawning season	January to June to the south of Brazil, from December to April in the Gulf of Guinea, and during the third quarter	ICCAT manual	
Indices	1. Joint index region 2 1958-1978 (Mod2018)+1979-2019 (Mod2021) 2. Buoy-echosounder index		
Selectivity of Joint LL index	Mirrored to JP_LL region 2		
Selectivity buoy-echosounder index	Mirrored to PS_ESFR_FAD		
Weighting length composition	0.1		

Table 8. Uncertainty grid be considered for the 2021 Atlantic bigeye tuna stock assessment.

Natural mortality vector	M max Age=17	M max Age=20	M max Age=25
Steepness	0.7	0.8	0.9
SigmaR	0.2	0.4	0.6

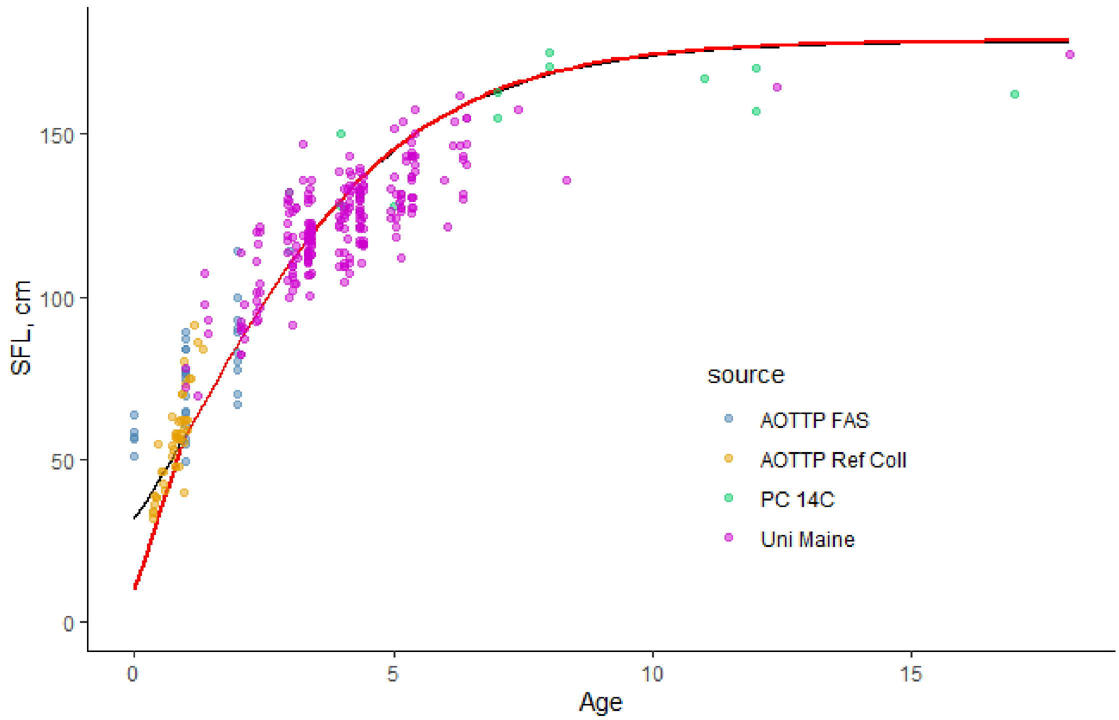

Figure 1. Direct ageing (otolith) data plotted against the Atlantic bigeye tuna growth curve (black solid line, Hallier *et al.* 2005). The red line represents the stock synthesis version of the growth curve, where the size of fish at birth is made to match the lowest length bin (10 cm used in the 2018 assessment). FAS= Fish Ageing Services, Ref Coll= References Collection, PC 14C = bomb radiocarbon aged otoliths (Andrews et al. 2020), Uni Maine = otoliths presented in SCRS/P/2021/010.

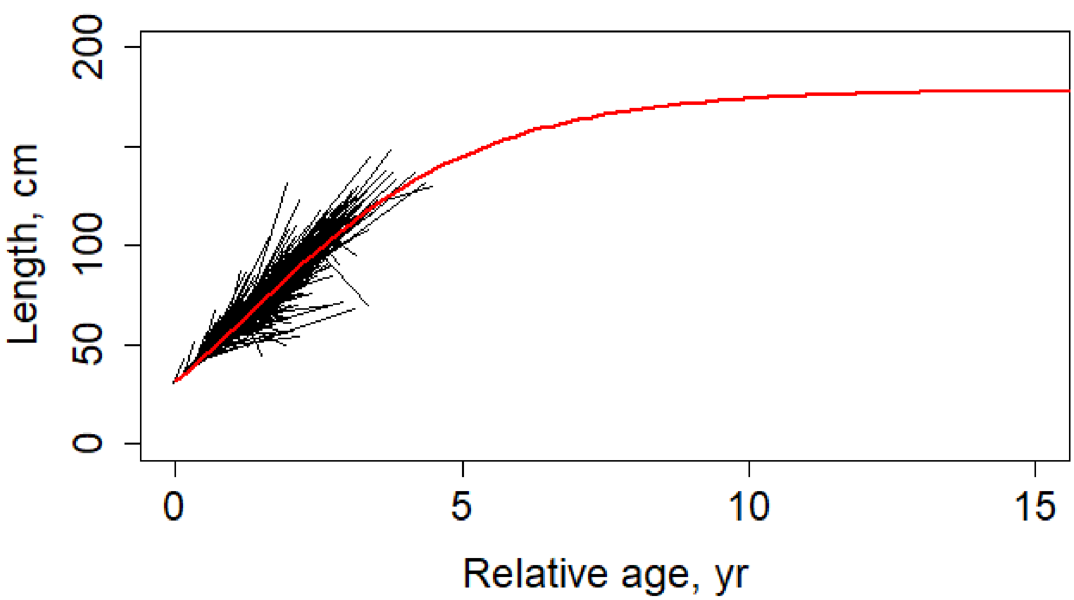

Figure 2. Growth trajectories (black solid lines) of AOTTP tagged fish plotted against the Atlantic bigeye tuna growth curve (red solid line, Hallier *et al.* 2005). Data from fish at liberty more than 60 days and whose lengths were physically measured are plotted here.

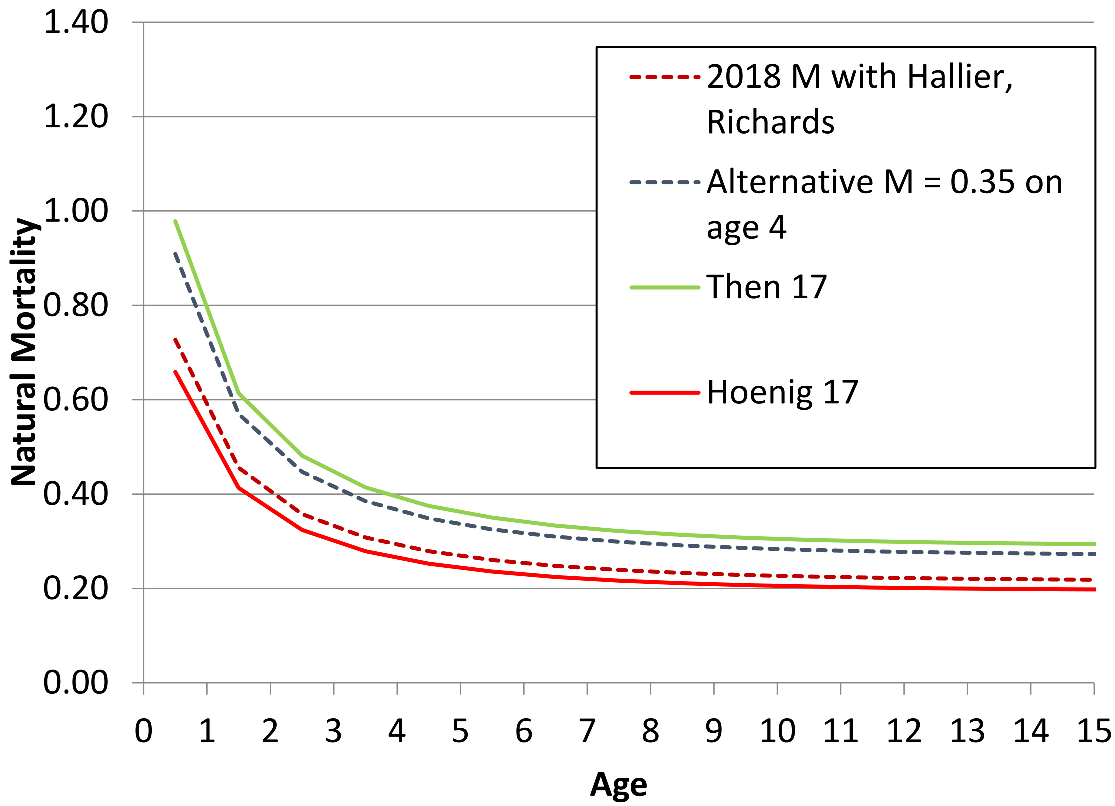

Figure 3. Natural mortality (M) base vector used in the 2018 assessment (dashed red line) plotted against the high M vector used in the sensitivity runs (dashed blue line), the M vector resulting from simply updating the maximum age to 17 (red solid line), and the M vector resulting from moving to the Then *et al.* 2015 M estimator and updating the maximum age to 17 (green solid line).

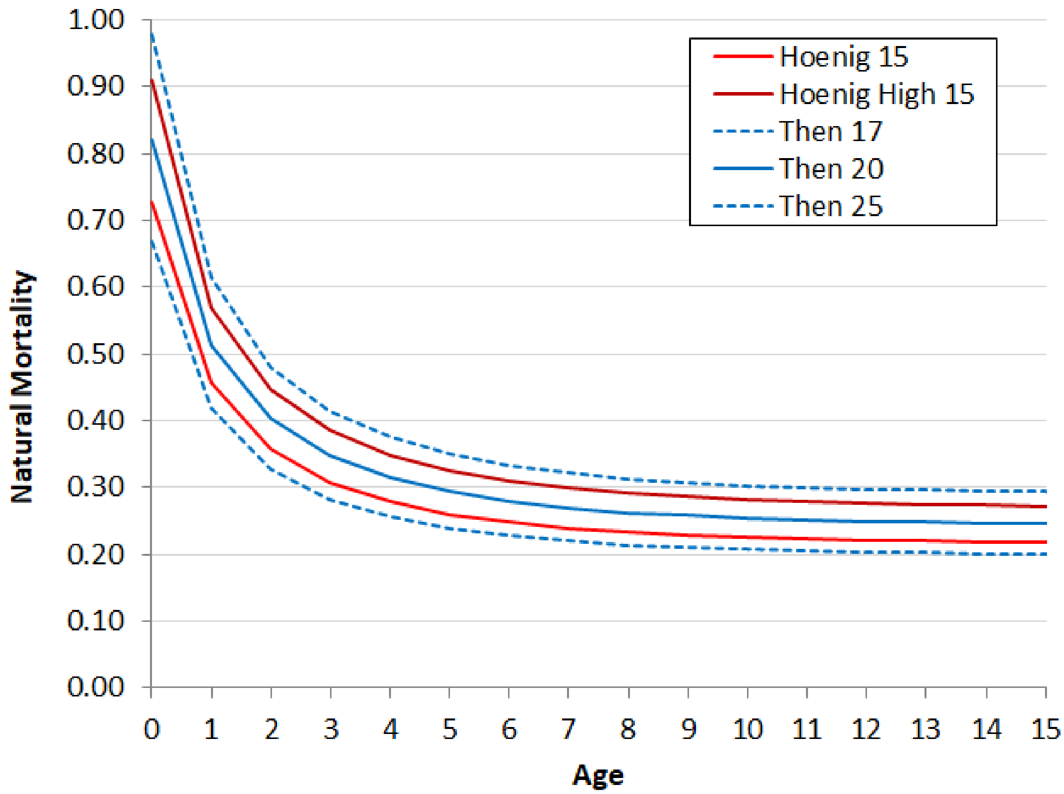

Figure 4. Proposed option of alternative M vectors for the uncertainty grid (blue) plotted against the base M and high M vectors used in the 2018 BET assessment (red).

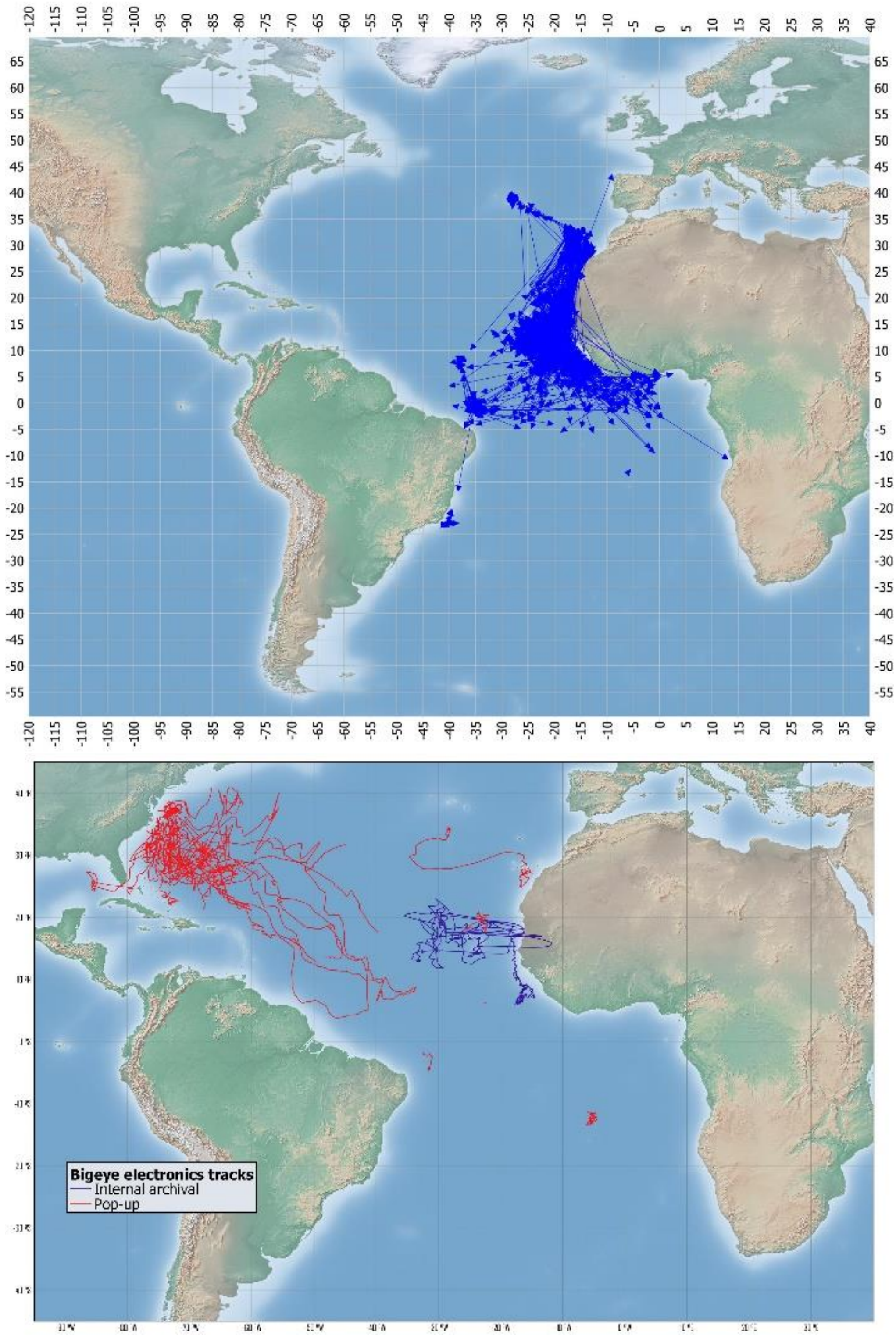

Figure 5. AOTTP conventional tag inferred displacement (top) and pop-up tags (bottom) estimated tracks from the tagging data for bigeye tuna.

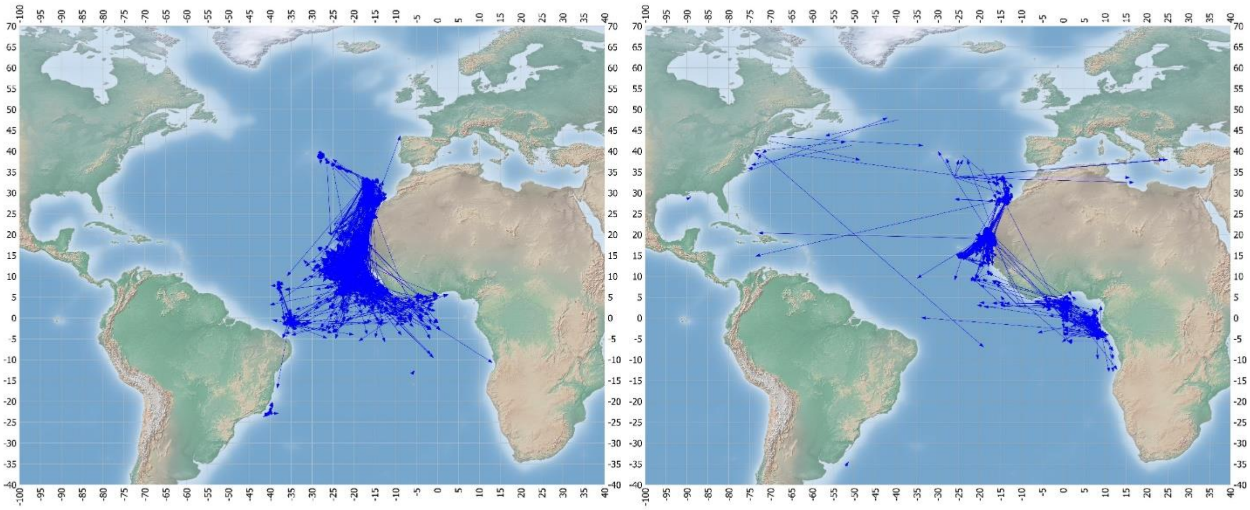

Figure 6. BET conventional tag estimated displacement between the points of release and recovery (arrow marker) from the AOTTP (left) and the ICCAT Historical (right) tagging data.

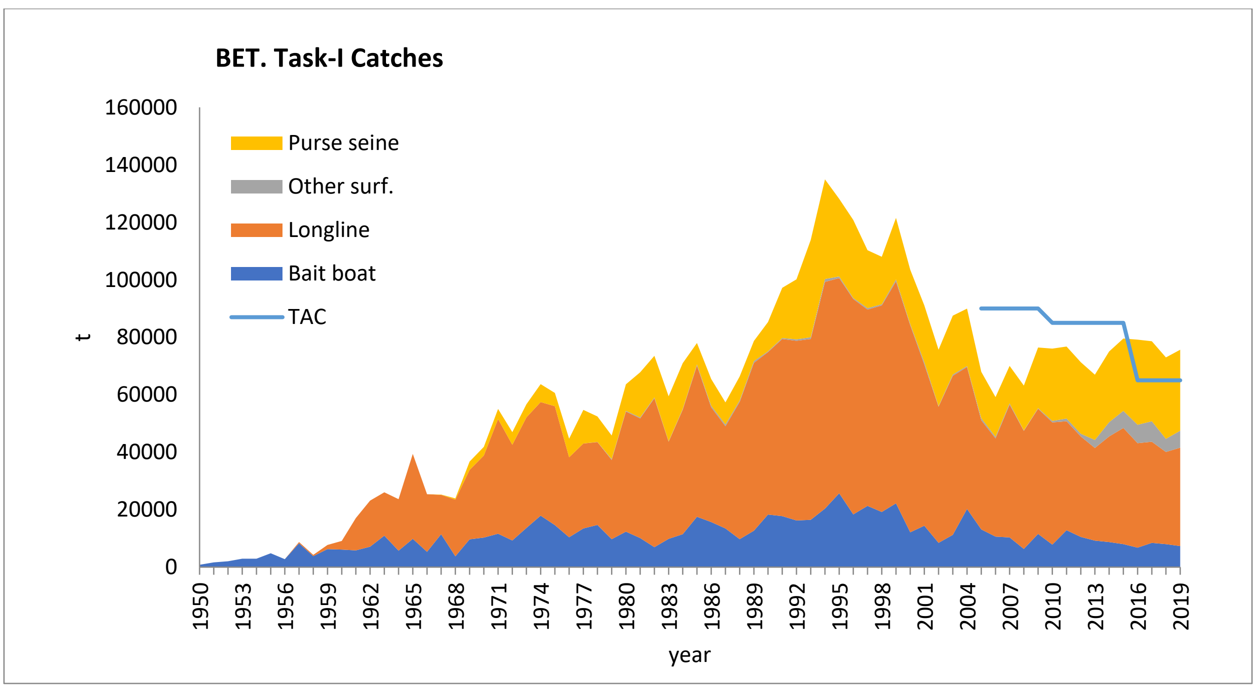

Figure 7. Annual catches of Bigeye tuna (BET) from the Task 1 NC 1950 – 2019 by main fishing gears. Solid line shows the recommended TACs by the Commission.

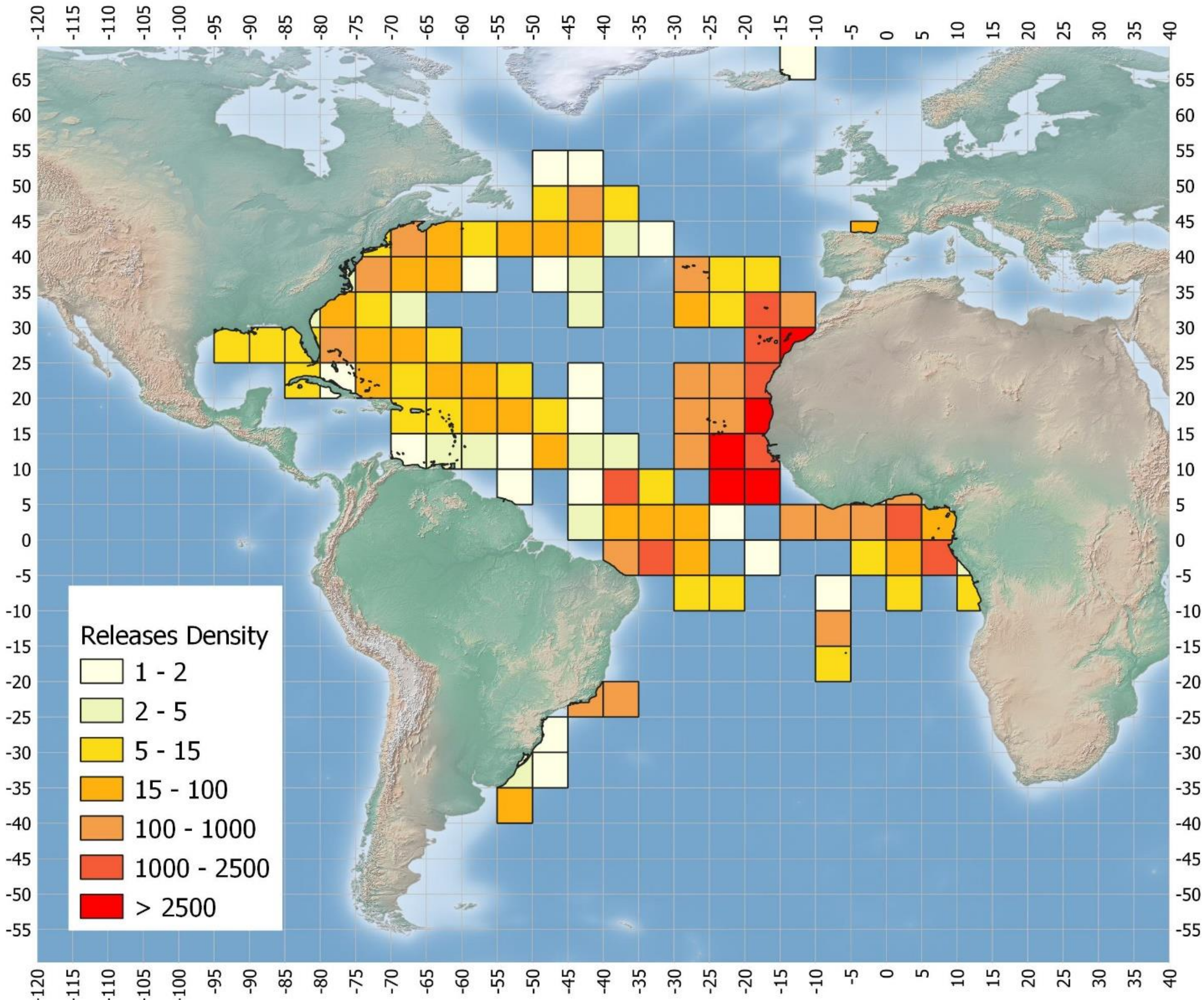

Figure 8. BET conventional tagging (AOTTP and historical ICCAT data) density of the release positions at 5x5 lat lon grids.

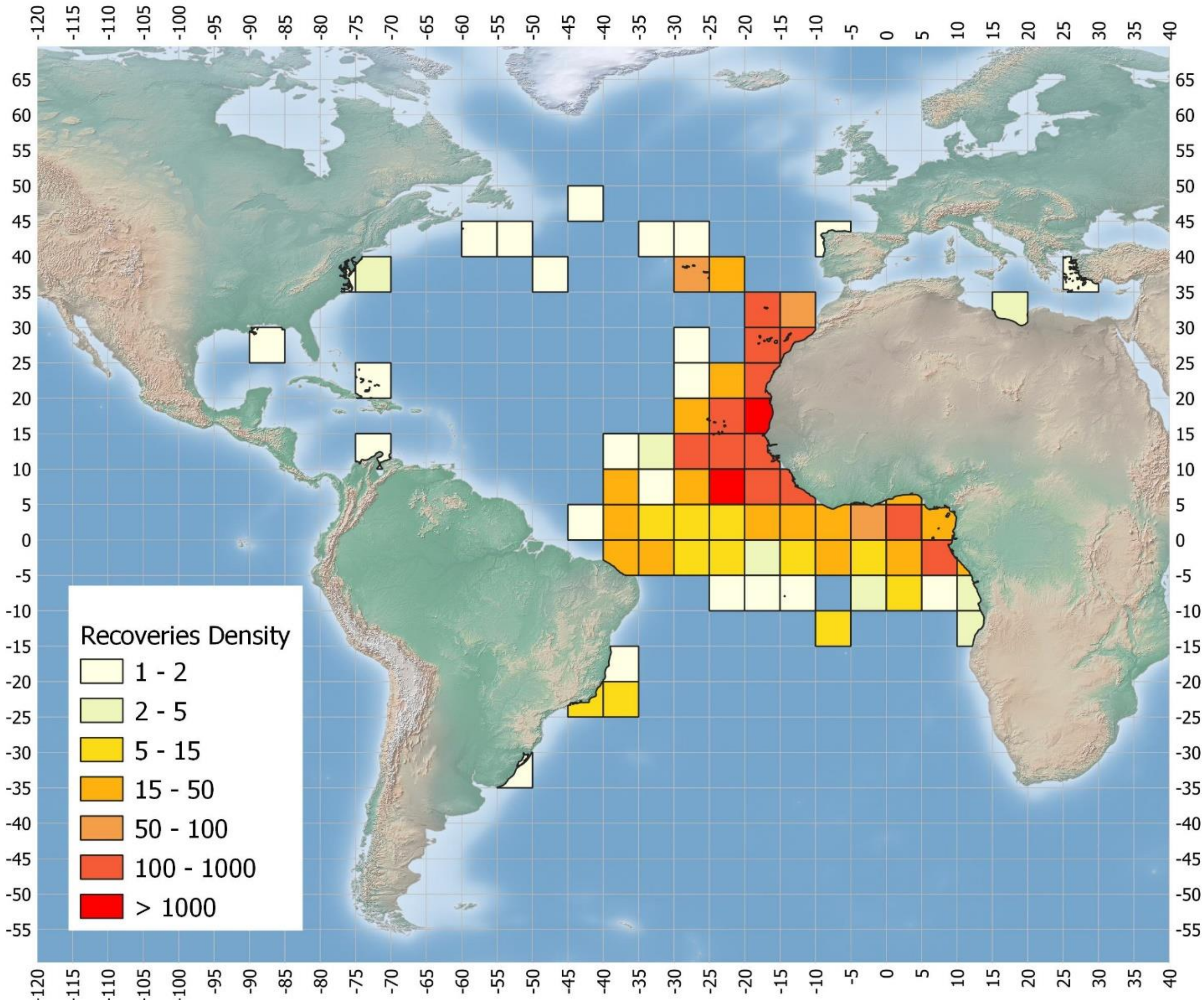

Figure 9. BET conventional tagging (AOTTP and ICCAT historical data) density of the recovery positions at 5x5 lat lon grids.

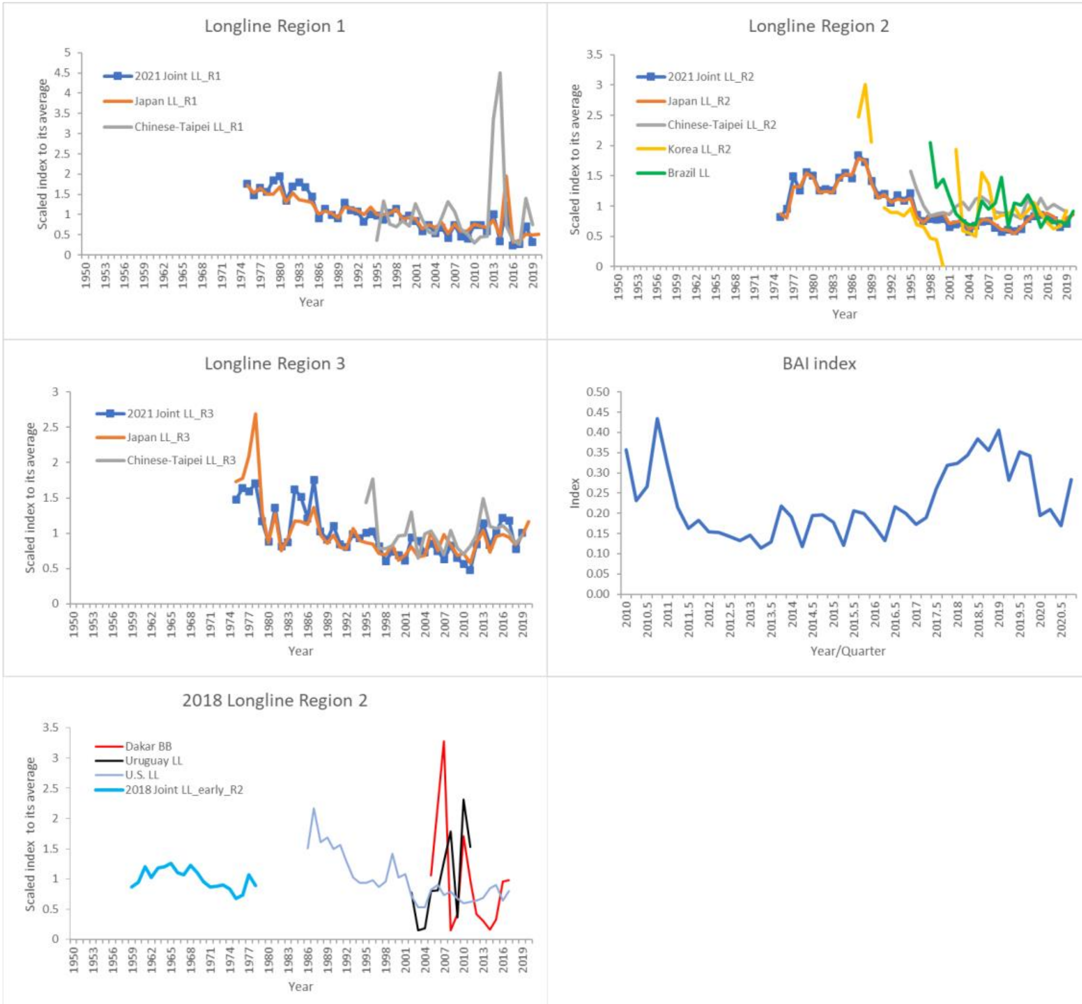

Figure 10. Available indices of abundance for the 2021 Atlantic bigeye tuna stock assessment.

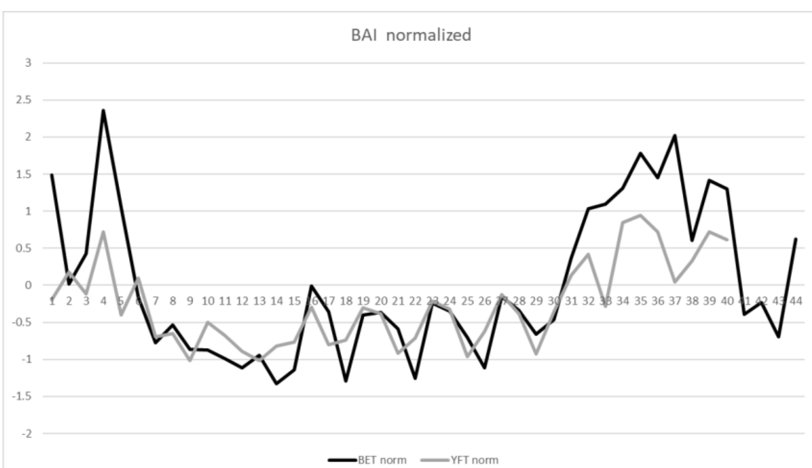

Figure 11. Estimated quarterly trends of the indices of abundance for BET (black line) and YFT (grey line) from the FAD echosounder bouys for 2010-2020.

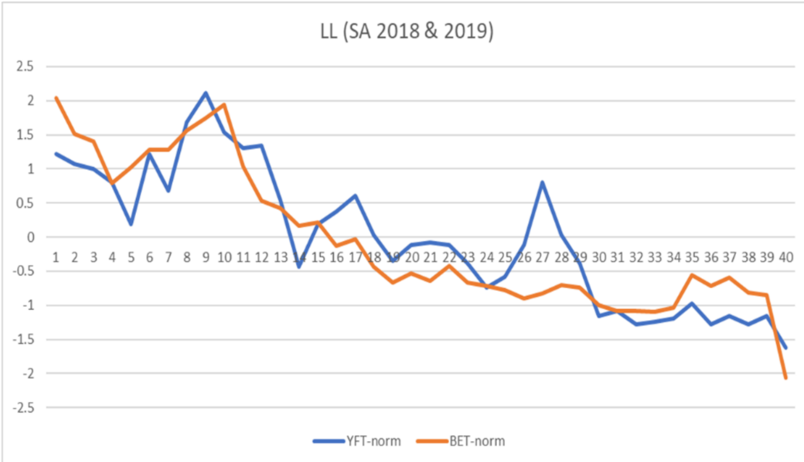

Figure 12. Estimated trends of the indices of abundance for BET (orange line) and YFT (blue line) from the Joint LL index estimated in 2018 BET and 2019 YFT Stock assessments.

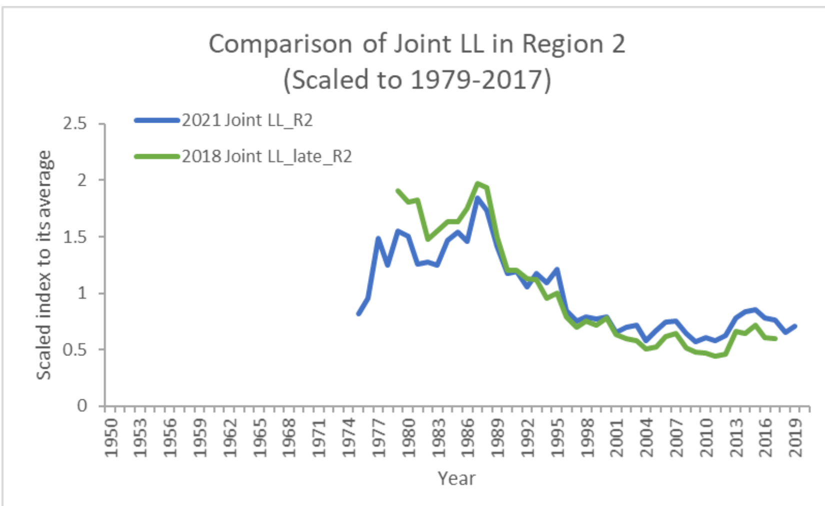

Figure 13. Comparison of Joint longline indices between one used in the 2018 Atlantic Bigeye tuna stock assessment (Hoyle *et al.*, 2018) and the newly revised one at this meeting (SCRS/2021/052) for region 2.

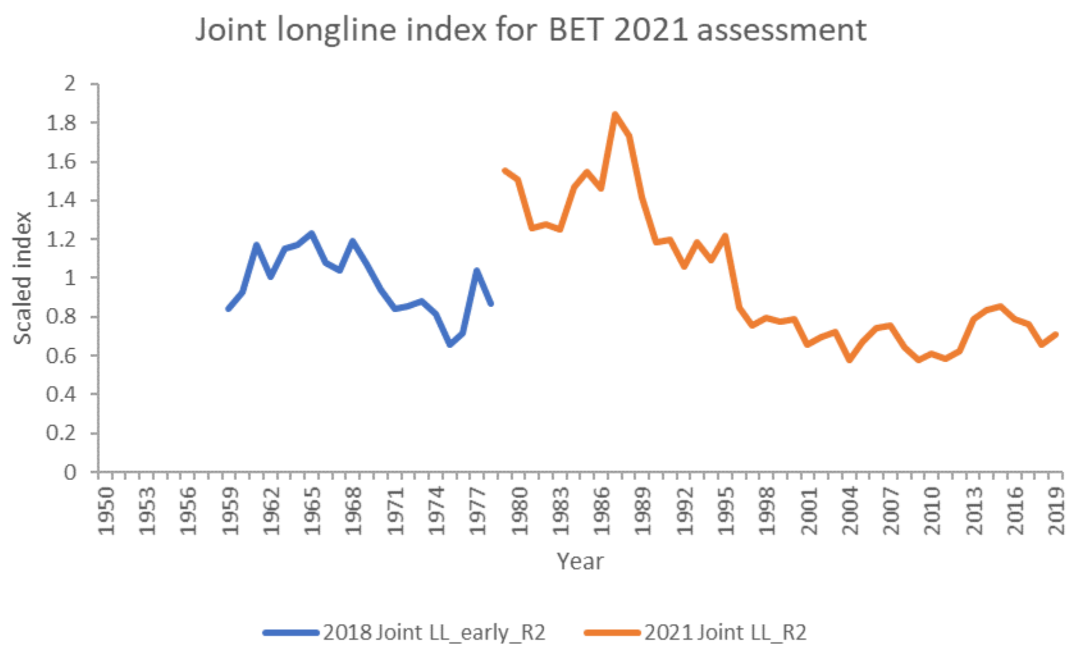

Figure 14. The Joint longline index to be used for the 2021 Atlantic bigeye tuna stock assessment.

Appendix 1

Annotated Agenda

1. Opening, adoption of Agenda and meeting arrangements
2. Review of the progress of AOTTP (excluding analysis of biological data)
3. Review of historical and new data on bigeye biology (including analysis of AOTTP data)
    - 3.1. Age and growth
    - 3.2. Natural mortality
    - 3.3. Reproduction and sex-ratio
    - 3.4. Length-weight relationship and its variability
    - 3.5. Movement and stock structure
4. Review of fishery statistics
    - *4.1.* Task 1 catch data
    - 4.2. Task 2 catch-effort and size samples data
    - 4.3. Tagging conventional data BET ICCAT
5. Fishery indicators
    - 5.1. Average weight by gear type
    - 5.2. Spatial distribution of catches
6. Estimation of Catch at size and catch at age
7. Indices of relative abundance
    - 7.1. For individual fleets
    - 7.2. Combined indices
8. Specifications of data inputs required for the different assessment models and advice framework
    - 8.1. Fleet structure for assessment models
9. Recommendations
    - 9.1. Recommendations with financial implications
    - 9.2. Recommendations without financial implications
10. Other maters
    - 10.1. Uncertainties MSE Tropical Tunas
11. Adoption of the report and closure

Appendix 2

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Appendix 3

List of SCRS Papers and Presentations

Reference	Title	Authors
SCRS/2021/051	Review of Fishing Operation and Bigeye Tuna Catch by Japanese Longline Fishery in The Atlantic Ocean	Matsumoto T.
SCRS/2021/052	Update of Trilateral Collaborative Study Among Japan, Korea And Chinese-Taipei For Producing Joint Abundance Indices for The Atlantic Bigeye Tunas Using Longline Fisheries Data Up To 2019	Kitakado T., K. Satoh, Sl Lee, NJ Su, T Matsumoto, H Yokoi, K Okamoto, MK Lee, JH Lim, Y Kwon, SP Wang, WP Tsai, ST Chang, and FC Chang
SCRS/2021/053	Update of information on Korean longline fishery focusing on Bigeye tuna in the Atlantic Ocean	Lee SL, MK Lee, J. Lim, and Y. Kwon
SCRS/2021/054	Standardization of Bigeye Tuna CPUE In the Atlantic Ocean by The Japanese Longline Fishery Which Includes Cluster Analysis	Matsumoto T., H. Yokoi, and K. Satoh
SCRS/2021/055	Progress on Characterization of Structural Uncertainty In Tropical Tuna Stocks' Dynamics With Summary Of Discussions Held During The Tropical Tuna Mse Meeting (29-31St March 2021)	Merino G., D. Die, A. Urtizberea, and A. Laborda
SCRS/2021/057	Sex-Ratio Du Thon Obèse *Thunnus obesus* (Lowé, 1839) Capture Dans L'Ocean Atlantique Et Debarque Au Port De Peche D'Abidjan	Doffou Y.C., N. C. Diaha, M.J. Amandè, M. Guillou, M. Lesage, and P. Coquille
SCRS/2021/058	Index of Abundance Of Juvenile Bigeye Tuna In The Atlantic Ocean Derived From Echosounder Buoys	Santiago J., and et al.
SCRS/2021/059	Catch and effort standardization for bigeye tuna (*Thunnus obesus*) caught in the Taiwanese distant-water longline fishery in the Atlantic Ocean	Su N.J., W.R. Lin, and W.H. Huang
SCRS/2021/060	Developing abundance index of bigeye tuna (*Thunnus obesus*) for the Taiwanese longline fishery in the Atlantic Ocean using boosted regression trees	Lin W.R., N.J. Su, and W.H. Huang
SCRS/2021/061	Size composition of bigeye tuna (*Thunnus obesus*) caught in the Taiwanese distant-water longline fishery in the Atlantic Ocean	Su N.J., W.H. Huang, and W.R. Lin
SCRS/2021/062	Catch-Per-Unit-Effort Standardization for Bigeye (*Thunnus obesus*) based on Brazilian longline fishery data (1998-2020)	Sant'Ana R., B. Mourato, F. Hazin, and P. Travassos
SCRS/2021/063	Pesquería de Bigeye Tuna (*Thunnus obesus*, Lowe 1839) en las Islas Canarias, período 1926 A 2019	Pascual-Alayón P.J., S. Déniz, and F.J. Abascal
SCRS/2021/064	Introduction to the ICCAT tuna factory sales data flow and database	Bodin N., F. Fiorellato, C. Palma, and C. Mayor

Number	Title	Authors
SCRS/P/2021/010	Northwest BET Annual Age Estimation	Austin R., and W. Golet
SCRS/P/2021/011	Update on AOTTP tagging activities	ICCAT Secretariat
SCRS/P/2021/012	Update on AOTTP Atlantic Bigeye tuna age and growth work with implications for stock assessment	Ailloud L.

SCRS/P/2021/013	Updating the parameters estimates of tag-shedding rate, tag-reporting rate, tagging failure and efficiency of the dFAD moratorium from AOTTP data	Gaertner D., L. Guéry, S. Akia, and I. Perez.
SCRS/P/2021/015	Movement Patterns of Bigeye Tunas in The Tropical Atlantic, Described Through Tag Attrition Models Based on Historical and Recent Tag And Recapture Data	Goñi N., I. Arregui, T. Dindart, and M. Chifflet
SCRS/P/2021/016	European purse seine CPUE standardization: methodology and framework for the BET stock assessment	Guéry L., D. Kaplan, M. Grande, P. Pascual, and D. Gaertner
SCRS/P/2021/017	On going development of VAST models for ATL BET using LL data	Satoh K.

Appendix 4

SCRS Documents and Presentation Abstracts as provided by the authors

SCRS/2021/051. Status of effort, bigeye tuna catch and CPUE was summarized for Japanese longline fishery operating in the Atlantic Ocean including recent trends. Bigeye tuna was the main component of the catch after the mid-1970s. Bigeye tuna catch in number peaked in 1989 (861 thousand fish) and it decreased after that. Historical change in the geographical distribution of fishing effort is observed. There was an increasing trend in the hooks between floats before the mid-1990s, after that, it showed a stable trend. Size sampling of bigeye tuna is conducted for the longline catch. The fish mainly ranged between 80 and 180cm FL. There was some difference in fish size by area, but the difference was not clear by decade and quarter.

SCRS/2021/052. Three distant-water tuna longline countries, Japan, Korea, and Chinese Taipei, have started a collaborative study since December 2019 for producing the joint abundance indices using integrated fishery data of these fleets to contribute to the upcoming stock assessments of bigeye tuna in the Atlantic Ocean. The intention is to produce reliable indices by increasing the spatial and temporal coverage of fishery data. In this paper, some preliminary results using data up to 2019 fisheries were provided to update the SCRS on the progress of this activity. As an underlying analysis, a clustering approach was utilized to account for the inter-annual changes of the target in each fishery in each region. Due to the high dimensionality of fishery data with species composition, a two-step procedure was employed. A "K-means clustering" method with a pre-specified enough large number of initial clusters was firstly applied to fine scale fishery data in order to reduce the dimension of data, and then the aggregated data based on the first step were used in the subsequent "hierarchical clustering". The whole process was repeated through a certain number of iterations with different random initial clusters to seek a set of the smallest sum of within-cluster variation. The outputs of the finalized cluster were then used to assign the cluster label on fishery target to each catch-effort data. For standardizing the catch-per-unit-effort data, the conventional linear models and delta-lognormal linear models were employed for data of monthly and 1° grid resolution in each region. In addition to the implicit target species through the clustering, geographical and temporal covariates were used in the regression structures. The models were diagnosed by the standard residual plots and influence analysis. Although the results shown in this paper were still preliminary because of delayed and difficulty in data-sharing process, a final set of results based on the updated data including 2020 fishery outcomes will be submitted before the upcoming bigeye stock assessment meeting scheduled in July 2021 for use as inputs for the update of its stock assessment. In addition, analyses can be further updated if some extra data are available from other longline countries. Besides these conventional regression methods, analyses using an advanced spatio-temporal model, vector-autoregressive spatio-temporal model (VAST), were attempted for developing abundance indices with additional consideration of spatio-temporal correlations and targets as well as the life stage of bigeye tuna. In the VAST analysis, the convergence was not achieved enough when aggregating the three fisheries data yet, but the codes were developed well and ready to use for the finalization of results. As with other future works, the regional scaling will be applied for the conventional regression models so that a constant catchability can be assumed across the regions in the stock assessment models. The regional trends in the standardized CPUE are then compared to those from the VAST analysis, where catchability is constant by default and the regional scaling is not required.

SCRS/2021/053. Korean tuna longline fishery in the Atlantic Ocean commenced operating with one vessel in 1964. In the 1970s, the total catches and number of vessels related to the Korean longline fleets had sharply increased, and the catch hit the highest about 40 thousand t in 1977. After then they have decreased with fluctuations, and the average catch was about 2.8 thousand t for the recent 5 years (2015-2019). In the beginning period, albacore was a predominant species, however, its catch largely dropped due to shifting target species to tropical tunas (bigeye and yellowfin) from the late-1960s. Bigeye tuna catch started to increase from the beginning of 1970s and recorded the highest of 12 thousand t in 1981. In the late-1980s the catch of bigeye tuna sharply decreased, and since then it has been at a low level. Fishing efforts have concentrated on the tropical area across the whole period, however, it has appeared some different patterns depending on fishing capacity, target species, etc. In this study, bigeye CPUEs were standardized from the lognormal constant model and delta lognormal model, adding cluster factor as a categorical variable for addressing target changes through time.

SCRS/2021/055. The MSE for the Atlantic tropical tuna stocks started in 2018 by developing a proposal on how to conduct this MSE in a series of phases. The present document corresponds to the second phase of the tropical tuna MSE by attempting to define the axes of uncertainty to be considered in the Operating Models of the tropical tuna MSE. This work follows document SCRS/2021/016 where the main sources of uncertainty characterized for tropical tunas in ICCAT and other RFMOs were reviewed. In this document, we expand the description of potential axes of uncertainty by reviewing the uncertainty of other tuna stocks and by summarizing the points of discussion and agreements reached in ICCAT's Tropical Tuna MSE meeting (29-31st March 2021). We also propose the steps to start the conditioning of Operating Models.

SCRS/2021/054. Standardization of bigeye tuna CPUE by Japanese longline in the Atlantic Ocean was conducted using generalized linear models (GLM) with log-normal errors. The models incorporated fishing power based on vessel ID and used cluster analysis to account for targeting. The variables year, quarter, vessel ID, latlon5 (five-degree latitude-longitude block), cluster, and year-quarter interaction were used in the standardization. The numbers of clusters were 3-5perregion. Dominant species differed among clusters. The trend of CPUE was similar among regions with some differences. CPUE usually shows decreasing until around 2010 and is increasing after that in regions 2 (central) and 3(south). The CPUE trends were similar to those in the previous study.

SCRS/2021/057. Cet article présente les résultats du sex-ratio correspondant au patudo (Thunnus obesus, Lowé, 1839) obtenus avec le programme Data Collection Multi-Annual Programm (DCMAP). La collecte des données a été réalisée de janvier 2018 à décembre 2019 en fonction de la disponibilité de la ressource à partir des débarquements de thoniers senneurs au port de pêche d'Abidjan (situé en bordure de la lagune Ebrié). La taille des patudos a varié de 40,8 cm à 173,7 cm. L'analyse du chi carré a été utilisée pour déterminer le sex-ratio. Ainsi, le sex-ratio global calculé sur 737 poissons est de l'ordre de 1 : 1,21 en faveur des femelles. Cependant, le sex-ratio global comparé au sex-ratio théorique (1 :1 ; c'est-à-dire un mâle pour une femelle) est significativement différent au seuil de 5% (χ^2 = 6,83 ; p = 0,007 < 0,05). Par ailleurs, plus de la moitié des captures sont réalisées sous DCP. Aussi, les femelles sont abondantes dans les tailles inférieures et prédominent les tailles intermédiaires tandis que les mâles dominent les grandes tailles de l'échantillon. Paradoxalement, les plus grandes tailles sont capturées sous bancs libres et les plus petites et moyennes sous Dispositif de concentration de poissons.

SCRS/2021/058. The collaboration with the Spanish vessel-owners associations and the buoy-providers companies has made it possible the recovery of the information recorded by the satellite linked GPS tracking echosounder buoys used by the Spanish tropical tuna purse seiners and associated fleet in the Atlantic since 2010. These instrumental buoys inform fishers remotely in real-time about the accurate geolocation of the FAD and the presence and abundance of fish aggregations underneath them. Echosounder buoys have the potential of being a privileged observation platform to evaluate abundances of tunas and accompanying species using catch-independent data. Current echosounder buoys provide a single acoustic value without discriminating the species or size composition of the fish underneath the FAD. Therefore, it has been necessary to combine the echosounder buoys data with fishery data, species composition and average size, to obtain a specific indicator. This paper presents a novel index of abundance of juvenile bigeye tuna in the Atlantic Ocean derived from echosounder buoys for the period 2010-2020.

SCRS/2021/059. Tropical tunas, including bigeye tuna (*Thunnus obesus*) and yellowfin tuna (*Thunnus albacares*), are major target species for the Taiwanese distant-water tuna longline fishery, with the main fishing ground occurring in tropical waters of the Atlantic Ocean. Regional abundance indices of bigeye tuna were developed for this fishery using generalized linear models (GLMs). Data from 1995 to 2019 with targeting effect derived from a cluster analysis based on catch composition were used in the GLM analysis. Standardized CPUE (Catch Per Unit of Effort) of bigeye tuna showed diverse trends among the regions and the whole region. For the main fishing ground of bigeye tuna in the tropical area (Region 2), the trend was increased from the late 1990 and decreased from 2005, but showed a slightly decreasing trend in recent years.

SCRS/2021/060. The abundance index of bigeye tuna (*Thunnus obesus*) was developed in this study using traditional generalized linear models (GLMs) and boosted regression trees (BRTs). The ANOVA table from the GLM analysis showed that all explanatory variables were significant, among which the targeting effect explained a large proportion of deviance. Overall, the R^2 values were 0.549 for the GLM model. The most important in the BRT model was also the targeting effect, with relative importance (RI) to evaluate the main and interaction terms, which showed that the interaction term be included in the BRT model. The performance of GLM and BRT were similar, as assessed using RMSE and MAE values. The standardized CPUE of bigeye tuna showed similar trends for the region 2 (tropical areas), for which the trend was increased from the late 1990 and decreased from 2005, but showed a slightly decreasing trend in recent years.

SCRS/2021/061. Tropical tunas, including bigeye tuna (*Thunnus obesus*) and yellowfin tuna (*Thunnus albacares*), are major target species for the Taiwanese distant-water tuna longline fishery, with main fishing ground in tropical waters of the Atlantic Ocean. The bigeye tuna caught by the Taiwanese tuna longline fleet were sampled and measured in the main fishing ground between 15°N to 15°S in the Atlantic Ocean; the fish were collected from logbooks and recorded by observers. The size compositions become stable after 2007 when the sample sizes increased more than 100,000 and 10,000 for the data that were collected from logbooks and observers, respectively. Meanwhile, the proportions for size classes larger than 145 cm fork length by year increased from 2002 and become relatively stable after 2007 until recent years in 2019 for both data observed from logbooks and observers. Similar patterns were found for both data collection system by captains and observers, particularly for the period from 2002 to 2019.

SCRS/2021/062. Catch and effort data from Brazilian tuna longline fishery, in the north and south Atlantic Ocean, from 1998 to 2020, were analyzed. The effort was distributed in a wide area of the western Atlantic Ocean. The CPUE of the bigeye tuna was standardized by a GLM, using a Delta Lognormal approach. The factors used in the models were: year, quarter, vessels, clusters, hooks per floats, hooks, and the lat-long reference for each 5 by 5 degrees squares. The estimated delta-lognormal index showed three distinct periods. The first one, between 1998 and 2005, was marked by a steep one-way downward trend. The second one, from 2006 to 2013, showed a more unstable pattern in relative abundance, but, in general, with a small increase in the index during this period. The third period, from 2014 to 2020, shows a small decrease again in the beginning of the period, with a slight upward trend in late years.

SCRS/2021/063. En este documento se presenta un estudio detallado de la pesquería de patudo (*Thunnus obesus*) en las islas Canarias durante el período de 1926 a 2019. Existen evidencias claras de la existencia de esta pesquería desde principios del pasado siglo XIX en la isla de La Gomera. Se analiza el esfuerzo pesquero para los diferentes segmentos de flota para el período de 1973 a 2019. Se observa una disminución casi continua del número de barcos y TRB a lo largo de todo este período histórico, pasando de más de 400 barcos a unos 235, mucho más grandes y modernos en la actualidad. El TRB total anual también ha ido en descenso desde algo más de 5000 toneladas hasta alrededor de unas 3000 toneladas. Las capturas totales de patudo a lo largo de todo el período de estudio han oscilado en forma de dientes de sierra, con años buenos y años malos. En los años 70 y años 90 se produjeron los máximos históricos totales con 6991 t y 9325 t respectivamente. La proporción o porcentaje de patudo con respecto a las otras especies de túnidos capturados en Canarias ha sufrido pocos cambios, representando en muchos años más del 50% de las capturas totales en las islas. La estacionalidad de las capturas de la especie ha cambiado desde el primer y segundo trimestre en las primeras décadas hacia el tercer y cuarto trimestre en los años más recientes. Las zonas de pesca de esta especie han ido en aumento y se ha producido una gran extensión de la actividad pesquera de estos barcos de cebo vivo. En los años 80 y 90 los principales caladeros se encontraban en las islas y en la cercana costa africana. En cambio en los años 2000 las principales zonas de pesca son al sur, al oeste y al norte de las islas, llegando hasta Madeira y Azores.

SCRS/2021/064. Tuna factory sales constitute a complementary source of independent information in support of ICCAT tuna fisheries analyses. This novel data source is aimed to be used by SCRS routinely for future assessment and for reducing uncertainties in the currently available statistical data. A total of 34 companies have been submitting tuna sales quarterly reports to ICCAT secretariat since 2010. Here, we present the ICCAT tuna factory sales data flow and database, including the different steps of data harmonization, compilation and preliminary curation undertaken on the quarterly reports to improve the overall data quality and traceability to the original information source. Between 2015 and 2020, 53% of the total number of sales records came from the Atlantic Ocean, and the rest from the Indian and Pacific Oceans. The Atlantic Ocean 2015-2020 reports revealed that purse-seine and pole-and-line represented the majority of the tuna factory sales (45% and 50%, respectively), and were dominated by skipjack (49%), followed by yellowfin (24%), bigeye (14%), and albacore (8%) tunas. Moreover, around 75% of the Atlantic sales data were harmonized into four species-specific commercial weight categories for the four major tuna species. Next project steps aim to finalize data compilation and curation for the entire 2010-2020 period, and conduct analyses including comparisons of the tuna sales against the ICCAT fisheries statistics by species and gear.

SCRS/P/2021/010. Otoliths from 234 bigeye tuna captured in recreational surface and commercial pelagic longline fisheries were collected from May to December during the years of 2018-2020. Straight fork lengths ranged from 70- 175 cm with a mean of 122.2 cm. Whole otoliths were weighed and imaged, then one otolith from each individual was embedded in Epothin 2 epoxy resin. Four transverse sections, including one containing the origin, were cut using a 1000 Isomet saw with Buhler diamond edge blades. Sections were polished to widths of approximately 0.4 mm or width that opaque bands could be clearly viewed. The first two sections closest to the origin were aged by counting fully formed opaque macro-increments. Otoliths that could not be read clearly were discarded. The index of average percent error (IAPE) was 5.86% and 5.19% for the two sections respectively after two reads blind of length. Edge types were also assigned based on marginal increment ratios (MIR) to calculate fractional ages. The MIR was defined as the length of the translucent zone after the final fully formed opaque zone to the terminal edge of the ventral arm divided by the length of the previous translucent zone that occurred before the final opaque zone. Annual ages ranged from 1-17 years with Von Bertalanffy parameter estimates of L_∞ =173.1, k=0.213, and t0=-2.413. Fractional age length relationships were explored using birth dates of July 1st and January 1st. Preliminary sex-specific Von Bertalanffy parameters were also presented.

SCRS/P/2021/011 Provides an update on the progress of the AOTTP activities until the close of the programme on 28/02/2021, with a particular focus on the tagging related activities throughout the Atlantic Ocean (i.e. conventional and electronic tagging, tag recoveries, time at liberty and movements). A total of 119429 specimens were tagged during the programme, corresponding 20.6%, 33.8%, 39.3% to Bigeye (BET), Yellowfin (YFT) and Skipjack (SKJ), respectively. Among these, a total of 17.162 were recovered (mean recovery rate of 14.4 %), including 4.941 for BET (20.5%), 8.094 for YFT (20.1%), and 3.540 for SKJ (7.5%), respectively. A total of 21,417 specimens were double tagged with conventional tags (18% of the total), among which 3.166 were recovered (14.8%). The mean and maximum days at liberty by species were: 131 and 1.620 for BET, 96 and 1.437 YFT and, 68 and 1.112 for SKJ. The mean and maximum distance traveled between release and recovery locations were 218 and 2.144 nm for BET, 139 and 3.651 nm for YFT and, 192 and 2.669 nm for SKJ, respectively. A total of 599 electronic tags were deployed (430 internal tags, 169 PSAT tags), of which 234 on BET, 356 on YFT, and 9 on SKJ. Among the electronic tags deployed, 159 were recovered and data downloaded (26.5%), 122 of which corresponded to pop-up tags (72% transmitted information). The recovery rate of internal tags was 13%, whereas only 9% was possible to download the archived data. As regards tags seeding experiments, a total of 1.052 specimens were tagged and 781 were recovered (corresponding to 74% for both purse-seines and bait-boats). In addition, the presentation provides an overview of the ongoing activities on maintenance and development of the tagging database by the Secretariat, aiming for the dissemination of available data collected within AOTTP. Finally, information is also provided on the post-AOTTP ongoing works (i.e. awareness campaigns, tag recovery, and tag seeding experiments).

SCRS/P/2021/012 This presentation provides an overview of the work carried out during the AOTTP as it relates to age and growth of tropical tunas. More specifically, the document shows the results of the AOTTP reference collection (daily ageing) and the AOTTP age validation work, with special emphasis on Atlantic bigeye tuna. The AOTTP provided a unique opportunity to directly validate the otolith increment deposition rates for two important species of tropical tuna. Here we present results on the analysis of a number of bigeye tuna (Thunnus obesus) and yellowfin tuna (Thunnus albacares) otoliths recovered from samples previously marked with oxytetracycline during a large-scale tag-recapture program run by the AOTTP. Total age and time at liberty were estimated using conventional methods for counting larger macro-increments (presumed annual) and micro-increments (presumed daily) in transverse sections. The counts of annual increments resulted in greater estimates of age than the counts of micro-increments for samples greater than about 55 cm straight fork length at recovery. When compared to known time at liberty, the results indicated that age estimates based on presumed daily increments lead to underestimation of age, while annual increments appeared deposited on an annual basis. Ageing fish accurately is particularly important in the context of tropical tuna stock assessments where data on age and growth play an increasingly important role in informing the population dynamics of the stock. The AOTTP age and growth work is ongoing and expected to yield additional valuable information on Atlantic bigeye and yellowfin tuna in the near future.

SCRS/P/2021/013 Provides an update on several studies that were presented at the AOTTP symposium, including on parameters estimates of tag-shedding rate, tag-reporting rate, tagging failure, and an analysis of the efficiency of the dFAD moratorium from AOTTP data, and exploratory analysis on potential miscodification on seamounts at release or recapture in the tagging database. From double tagging experiments the shedding rate was estimated to reach 50% of tags after 8 years at sea for yellowfin and after 9 years at sea for bigeye tuna. The reporting rate for the European purse seiner was estimated from tag seeding experiments at 85% and then used to estimate the reporting rates for other 12 surface fleets (purse seiners and baitboats) with coincidental catches and tag returns for the same spatio-temporal strata. The reporting rates ranged from 85% (PS_RF_ESP) to 7.5% (PS_GTM). A tagging failure rate was calculated by considering the difference in the recapture rate between tagging performed under optimal conditions and those performed under less optimal conditions. The average value of the tagging failure rate estimates for the AOTTP is 11.12% disaggregated into 17.77% for skipjack, 5.68% for yellowfin, and 7% for bigeye. To avoid biases in the evaluation of the efficiency of the moratorias on dFADs, a matching procedure was applied to the tagging data in order to balance the tagging sampling plan between fish released inside and outside the spatio-temporal strata under regulation. This allowed concluding on the efficiency of Rec. [98-01] and Rec. [15-01] for protecting juveniles of yellowfin and for skipjack. However, by removing all bigeye tagged inside the moratorium it was not possible to use the relative risk statistic for assessing the effect of these moratorias on bigeye. In addition, due to the impact of some school types at release (anchored FADS, seamounts) on the displacement rate of tunas, potential miscodification of seamounts coded as free-school was explored.

SCRS/P/2021/016. Purse seine CPUE standardization is thought on a combination of fishing mode and commercial size categories of species basis, i.e., large fish in free schools (FSC) sets on one side and small fish under floating objects associated sets on the other side. However, while FSC sets are randomly encountered, FOB sets can either be randomly encountered, e.g., foreign drifting fish aggregating devices (dFADs) or natural log not instrumented, or not randomly encountered, i.e., vessels have access to buoys and/or echosounder data equipping the dFAD. The non-randomness of encounters leads to different statistical approaches and different impacts on effort creep. On one hand, the standardization approach using an extension of the Delta-lognormal GLMM to three components, i.e., the product of the number of schools detected (summing positive and null sets) (number of schools) by spatio-temporal strata, the proportion of positive sets with the species/category of interest and the catch per positive set with it (school size), is appropriate to randomly encountered schools. We propose to apply this methodology to FSC sets as well as to FOB sets randomly encountered. On the other hand, for FOB sets not randomly encountered, we propose to use, as a classical approach, the product of the third component, i.e., school size, by a fishing efficiency rate per set calculated with a methodology quantifying the increase in fishing efficiency due to the use of FOB equipped with echo sounders (Wain et al. 2020). This framework would allow to homogenized standardization of CPUE based on fisheries-dependant data and provide several time series, i.e., on randomly encountered FSC and FOB sets separately and on not randomly encountered FOB sets, here of EU purse seine fleet catches per unit effort (CPUE) of bigeye tuna (BET) from the Atlantic Ocean.

SCRS/P/2021/017. It provided a complementary analysis results of vector-autoregressive spatiotemporal model (VAST) related to the joint index (SCRS/2021/052). Two types of indices, an age aggregated index and an age-specific index (age 2, 3 , 4 and 5+), were developed using only Japanese longline data. This work was originally a part of joint index but the developing of the VAST model had faced a convergence problem for the size aggregated index, thus the results of VAST were not include in the paper of the joint index. There were three models tested for each age aggregated model and the age specific model, considering combination of a catchability covariates and a vessel effect. Three age aggregated models were likely not converged, while three age specific models were converged but one model showed huge standard error of index. The time series of size (age)-specific indices showed reasonable one year lug between adjacent age index for some peaks, but other peaks can not be traced. Size segregation was observed in geographic distribution of mean predicted log density, by fish size category from 1975 to 2019.