REPORT OF THE 2019 ICCAT YELLOWFIN TUNA DATA PREPARATORY MEETING

(*Madrid, Spain, 22-26 April 2019*)

1. Opening, adoption of agenda and meeting arrangements

The meeting was held at the ICCAT Secretariat in Madrid, 22-26 April 2019. Dr. Shannon L. Cass-Calay (USA), the Yellowfin Tuna Species Group ("the Group") rapporteur and meeting Chair, opened the meeting and welcomed participants. Mr. Camille Jean Pierre Manel (ICCAT Executive Secretary) welcomed the participants and highlighted the importance of the work to be developed by the Group aiming at the preparation of the stock assessment for the management advice to the Commission. The Chair proceeded to review the Agenda, which was adopted without changes (**Appendix 1**).

The List of Participants is included in **Appendix 2**. The List of Documents presented at 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, A. Kimoto
Item 2	A. Pacicco, L. Ailloud
Items 3, 4	M. Ortiz, C. Palma
Item 5	C. Brown
Item 6	A. Rios, S. Hoyle, A. Kimoto
Item 7	J. Walter, K. Satoh, A. Kimoto
Item 8	A. Norelli, L. Ailloud, D. Beare
Item 9	D. Die, S. Cass-Calay
Item 10	S. Cass-Calay

2. Review of historical and new data on yellowfin biology

There were 3 documents and 3 presentations on yellowfin tuna biology. The Group was made aware of the recent publication relevant to stock structure (Pecoraro *et al.,* 2018). Further discussion on the importance of this information will occur at the stock assessment meeting in July 2019.

2.1 Age and growth

SCRS/P/2019/025 presented an age and growth analysis of yellowfin tuna caught in the US Gulf of Mexico and western Atlantic Ocean using annual increment counts. Results from a ^{14}C bomb radiocarbon validation study were also presented, showing validation of age estimates up to 18 years with strong support for the annual age reading criteria. The Group saw great value in including these data in the assessment but cautioned that these results will have important ramifications for the estimation of the natural mortality vector, which depends on both growth and maximum age (t_{max}) in the population.

The Group questioned why a 2-stanza growth model was not attempted as was done in previous studies for yellowfin growth. The author explained that samples of very small fish (<68cm CFL) were not available to inform the shape of the curve at the youngest ages. A question was then raised regarding the ability of the model to predict growth below than the minimum size observed in the sample. The Group agreed that the lack of samples at the youngest ages was problematic. It was proposed that age estimates obtained from reading daily increments, which are considered reliable for age 0 and 1 fish, be used to anchor the curve and that a growth curve be estimated inside the stock synthesis model. Daily rings age data are available from the Shuford *et al*. (2007) study, Brazil (unpublished data provided by Guelson da Silva) and the AOTTP reference collection. The peak selectivity of the FAD fishery of 50 cm means that having reliable estimates of growth and natural mortality for these smaller length groups is very important.

The Gulf of Mexico dataset is the first comprehensive and reliable set of direct ages that have been made available to the Group (n=3223) from 2004-2017 ranging in sizes from 68 to 191 cm CFL. The Group raised the concern that all the samples used in the growth analysis came largely from the same area and the maximum age of 18 years may not be representative of the whole population. It was pointed out that a separate study exists of annual ageing which has aged fish captured near Ascension Island to be up to 18 years old (Kate Downes, personal communication). Unfortunately, these data could not be made available in time for the data preparatory meeting. The Group raised concerns about the appropriateness of including these age estimates since they were not available for review. It was suggested to have experienced otolith age readers from the western area review the ageing protocol for these samples once these become available. The Group is requesting that these data be made available before the 31 May 2019 data submission deadline and that a working document describing the ageing protocol be submitted to the yellowfin stock assessment meeting.

Males and females both reach older ages (males=18; females=17) but females appear to reach a lower Linf than males. Observing equal numbers of males and females at age would suggest that males and females have equal survival, previous observations of unequal numbers of males and females at size could be explained by the differential Linf.

SCRS/2019/071 presented preliminary results of otolith increment deposition rate validation in AOTTP oxytetracycline (OTC) marked fish. Preliminary results suggest that age estimates based on daily increment counts may lead to underestimation of age, while annual increments appear to be deposited on an annual basis (**Figure 1**). The Group noted that these results were in agreement with the ^{14}C bomb radiocarbon validation results presented in SCRS/P/2019/025.

SCRS/2019/074 presented current work conducted using historical and recent (AOTTP) conventional and electronic tagging records of yellowfin tagged in St. Helena. Length frequencies and monthly modal progressions in the commercial landings was also presented. The Group was pleasantly surprised to see such clear modes in the fishery. It was remarked that the monthly modes of small fish (50-60 cm) did not appear to increase systematically as the year progressed. This could reflect the influx of smaller fish throughout the year, consistent with a protracted spawning period. A question was raised regarding the selectivity of the gears and potential impact it could have on the observed modes. In addition to the selectivity effect of the gear, it was pointed out that the fishermen discard smaller fish routinely and these are not present in the data. The author pointed out that there are no FADs in St. Helena and that most of the tagging data was from free schools, though a few are from sea mounts.

The Group inquired how the growth information from the tagging data compared to the currently accepted growth curve. The author presented additional plots of growth trajectories plotted against the Gascuel growth curve (Gascuel *et al*., 1992) (**Figure 2**). The records generally looked in agreement with the curve, though there were very few fish below 50cm CFL to help determine if the slowdown of the Gascuel curve was reflected in the tagging records. The Group suggested it would be helpful to plot these same trajectories onto other growth models being considered.

The Group suggested comparing like to like by comparing the growth information by location of capture (recapture), FAD vs free school, or using the grotag model to obtain estimates of growth rates by size from the tagging data. Plots of mean length (average length between release and recapture) vs. growth were presented to the Group which showed that the 2-stanza growth was apparent in the tagging data caught on FADs but much less apparent in the tagging data of fish caught in free schools (**Figure 3**). However, it was noted that the results were sensitive to the removal of the shortest times at liberty.

Additional analyses were run to explore the question of growth in the tagging data. However, due to the complexity of interpretation of the growth information, the preliminary analyses were not conclusive. We expect that additional tags collected through the AOTTP will shed light on growth. It also noted that tagging and the OTC may affect growth and the fishing mode at recapture (FAD vs free school) could have an effect on the interpretation of growth. It has also been suggested that there may be a slowdown in growth due to the association with FADs.

SCRS/2019/080 evaluated the estimability of growth inside the Stock Synthesis (SS) integrated modeling platform and found that; a) growth is estimable within the integrated models, b) externally fixed growth curves, including the currently ICCAT yellowfin curve result in model misspecification that produces the appearance of a regime shift at the initiation of the purse-seine FAD fishery, c) estimating growth in the models is a way to address this misspecification. Given the results of this analysis, the author favored estimating growth inside the SS model and underscored the fact that, in that way, SS could also be used for hypothesis testing (e.g. functional form of the growth curve).

The author also argued that the flattening of the growth curve at younger ages observed in the Gascuel growth model could be a result of assuming a common birth date of 15 January for all the cohorts, when in fact we know that yellowfin have a much more protracted spawning season in the Atlantic. It was noted that the Gascuel growth curve is in fact a piecewise function and that the younger ages were modelled to follow a linear growth pattern (following inspection of the tagging data which appeared to show slower growth rates at younger sizes) from a prior study by Bard (1984).

Given the complex patterns of gear selectivity of the fisheries for yellowfin tuna, it is important to consider the impact of size selection on observed growth rates.

A concern was raised that we are observing fish larger than the Linf estimated by SS and SCRS/P/2019/025. The author reminded the Group that the definition of Linf used in the age structured model is the mean asymptotic size in the population, not the absolute maximum size, and that, as such, it is natural to observe fish falling above and below the estimated Linf, according to the variability in size at age. A comment was also made on whether it was appropriate to merge the Lang *et al*. (2017) and SCRS/P/2019/025 datasets. The author confirmed that otolith age readers from each laboratory conducted calibration exercises and cross-checked age estimates using a reference collection and found little error between readers (+/-1 year).

The Group saw a benefit in estimating growth within SS to allow for hypothesis testing and account for potential biases (e.g. selectivity). Initial model runs using the Lang *et al*. (2017) otolith annual age readings found no evidence of a two-stanza growth pattern. The estimated Linf fell close to that estimated in SCRS/P/2019/025 but the *K* was higher. Since a minimum size limit (68.6 cm CFL) is present in the Gulf of Mexico recreational fishery, it was recommended to control for this in the integrated approach.

The recommendation for the stock assessment is to use two approaches for modelling the growth:

1. Estimate growth within SS using the annual age estimates from SCRS/P/2019/025 combined with daily age estimates of small fish (< 1 year old) from Shuford *et al*. (2007), the Brazilian collection (Guelson da Silva, unpublished data) and the AOTTP collection.

2. Include the Gascuel length frequency data, which will likely result in the 2-stanza shape but result in a Linf that is lower and therefore more commensurate with the length data.

2.2 Natural mortality

SCRS/P/2019/025 illustrated the impact that a higher t_{max} = 18 would have on the estimates of the natural mortality (M) vector by age.

Baseline natural mortality; the baseline natural mortality rate is the average mortality across the exploited ages. The Then *et al*. (2015) estimator, t_{max} based estimator, was used in the 2016 assessment to obtain the baseline M. The Group will be adopting a similar approach for the 2019 assessment.

The Group was reminded that the previously adopted t_{max} of 11 was based on the longest time at liberty observed in the ICCAT historical tagging dataset. While the Group does not dispute the new finding that the maximum age is 18, it was questioned whether that maximum age was an appropriate proxy for maximum age of fish found in the equatorial zone where the bulk of the catch is caught. It is possible that the maximum age is lower in the equatorial zone, which would entail a higher M. It was suggested to scale natural mortality in such a way that it would result in high M for the lower age classes targeted by the fishery, which would lead to a different shape because there is a concern of the estimation of M using a high t_{max} for the lower age classes.

The implied natural mortality based on the t_{max} of 18 is 0.35 yr^{-1}, which is lower than the 2016 assessment assumption of 0.54 yr^{-1} based on a t_{max} of 11 years. As there is variability in the relationship between t_{max} and natural mortality rates across species (Then *et al*., 2015), it was suggested to use the prediction standard deviation to obtain a range of baseline M: 0.18 - 0.65 yr^{-1}. This range of mortality estimates for a given age was obtained from the standard deviation of the residuals to the Then *et al*. (2015) regression. The range was obtained as 1.5 standard deviations above and below the estimate for a t_{max} of 18.

Scaling of M. The second component of natural mortality is the scaling according to the growth curves. This can be achieved internally with SS by specifying the baseline M and the age of full selection, and then allowing the internally estimated growth curve to scale M at age. This internal scaling achieves internal consistency between M and growth when growth is estimated. A figure was presented for demonstration purposes, showing the M vector scaled using dataset presented in SCRS/P/2019/025 assuming an age of full selection of 1 and a baseline M of 0.35 (**Figure 4**).

It is generally understood that large (>150 cm FL) yellowfin tuna in the Atlantic tend to be male. The Group has previously entertained two main alternative hypotheses that could account for this: 1) females experience higher M, or 2) there are sex-specific growth curves, with males growing to large sizes. The analyses presented in presentation SCRS/P/2019/025 demonstrate evidence supporting sex-specific growth curves, with males growing larger. Furthermore, baseline M estimates calculated using the maximum age in the samples as t_{max} (18 years for males, 17 years for females), adjusted accounting for the differing growth curves, indicate little difference in M estimates by sex.

While there may be differences in mortality and growth between the two sexes and the model might be able to capture improved biological realism by modeling separate sexes, the Group does not have enough information regarding the sex ratio in the catches to consider that such a model would result in improved advice at this time.

The recommendation for the stock assessment is to use a t_{max} of 18 and of 11 (continuity vector from 2016 assessment) for the Then *et al*., (2015) analysis as the baseline M to test two hypotheses about natural mortality in the stock assessment (see section 7).

2.3 Reproduction

SCRS/P/2019/027 presented a histological assessment of yellowfin tuna ovaries sampled in the US Gulf of Mexico and western Atlantic from 2010 to 2017 (n=410). Length at 50% maturity was estimated at 110cm CFL using a maturity threshold of advanced vitellogenesis (V3), with spawning capable females observed in 9 out of 11 months of capture, and batch fecundity estimated to increase with size and age with an observed maximum of 6.2 million eggs per batch. The data showed a sharp increase in gonad weight relative to size starting at around 115 cm CFL.

The author suggests using a length of maturity threshold at advanced vitellogenesis (V3; L_{50}=110 cm CFL) or at the onset of vitellogenesis (V1; 109 cm CFL). In 2016 the Group recommended the vitellogenic stage for the maturity threshold (L_{50} = 115.1 cm). Based on the similarity of the current study compared to Diaha *et al*. (2016), the Group did not see any strong reason to change the assumption placed on the maturity threshold but recommended that further collaborative work be conducted between the East and West Atlantic to agree on a maturity estimate that best represents the whole population.

This study supports our general understanding that the peak spawning months in the US Gulf of Mexico occur in May/June, differing from the spawning months observed in the Gulf of Guinea (September/October). The Group was reminded that in other closely related species, older females are known to enter the spawning grounds earlier in the year than younger females, and that this has an influence on the size frequency of spawning females observed. The Group suggested that it would be possible in future work to estimate the size/ages frequency of spawning to see if they differ by region. The Group noted that larger sample size would help with this estimation, and it was also suggested to continue improving estimates of batch fecundity by increasing the sample size.

Presentation SCRS/P/2019/033 described a macroscopic assessment of yellowfin tuna ovaries sampled in the Mexican EEZ of the Gulf of Mexico from 2000 to 2013. The Group acknowledged that the relatively long time series of sex ratio was valuable to improve stock assessment models and was impressed with the large number of samples presented (n=413,961). Regarding the methods, it was suggested to combine pre-spawning and spawning females into the calculation of sexual maturity oogive.

3. Review of fishery statistics

The Secretariat presented the most up-to-date information available in the ICCAT database system (ICCAT-DB) for yellowfin tuna (YFT) and to a less extent bigeye (BET) and skipjack (SKJ), namely the fishery statistics datasets (T1NC: Task I nominal catches; T2CE: Task II catch & effort; T2SZ: Task II size frequencies) and conventional tagging data. For 2018, only 11 CPCs provided fisheries statistics out of 39 that have reported catches of YFT in 2017.

3.1 Task I (catches) data

The Group revised entirely the T1NC dataset of YFT available and discussed the importance of including 2018 catches in the assessment given the recent increasing trends of catch that have overpassed the Commission current recommended YFT TACs. Therefore, the Group requested that CPCs provide T1NC estimates of YFT for 2018 YFT (including T2CE and T2SZ and T2CS) by 15 May 2019.

The T1NC revision for YFT (1950-2017) aimed to identify and estimate the YFT missing catches, and to improve the gear discrimination by flag across the entire catch series. This work, made whenever possible with the e ICCAT CPC scientists, included:

- The reclassification of unclassified gears (codes SURF, UNCL) of various flags: Argentina 1982-92 to TRAW; Brazil 1976-79 to BB and 1980-09 to LL-surf; Barbados 1974-96 to LL; Colombia 1991-97 to PS; Cuba 1991-97 to LL; EU-France Guadeloupe 2016 to LL-surf; EU-France small catches in the East Atlantic merged as TRAW; EU-Latvia 1991-97 to TRAW; Gabon 1995-1999 to TRAW; Ghana 1978-92 to PS; Grenada 1963-85 to LL; Senegal 1989-91 to HAND; São Tomé e Príncipe to PSS; UK-Bermuda 2014-17 to RR.

- The corrections of various CPC catches by gear (split/merge processes): USSR 1978-81 SURF split into LL (84%) and PS (16%) using 1982 catches; Angola 2007 HAND deletion and SURF 1950-55 split into BB (88%) and TRAP (2%) using 1956 catches; Cabo Verde 1981 SURF merged with BB; EU-Portugal (Mainland) 2009-11 SURF merged with LL-surf; Gabon 2000-01 merged with TRAW; Ghana 1977-92 SURF merged with PS; Guinea Rep. 2009 SURF merged with PS; Venezuela 1979-80 SURF split into PS (71%) and BB (29%) using 1982 catches.

- The estimation of missing catches (series gaps) using carry overs (in its majority the average of the two adjacent years): USSR 1977 PS; Canada PS (1972,1977) and LL (1989); Côte d'Ivoire 2009 GILL; Cabo Verde 2002 BB; Cuba 1972 (PS) and 1973 (LL); Namibia 2012 LL; Panama LL (2011-2015, 2017); Senegal 2017 GILL; São Tomé e Príncipe 2007 PSS; St. Vincent 2005 LL; Venezuela GILL (2015-2017); South Africa 1995-96 RR.

- The T1NC revision of Senegal (Ngom and Fonteneau, 2016) to the BB and PS tropical fisheries (1965-2014 for BET/YFT/SKJ) is now fully included in ICCAT-DB.

All the above changes made to T1NC (a total of about 500 records) were registered in the database system with a reference to this meeting.

The comparison of T1NC for YFT, before and after the revision, is presented in **Table 1**. Overall, the total catches by region (YFT-E and YFT-W) don't have big increases (less than 1% both regions). The major differences are related to the improvement of the gear discrimination (UNCL gear catches decreased from about 5% to less than 1% on both regions). As of today, this updated T1NC estimations for YFT (**Figure 5**) represent the best overall YFT catch estimates for the period 1950 to 2017 (2018 still very incomplete).

For the assessment input of Stock Synthesis, the annual catch of YFT will be disaggregated into a fleet-gear structure, similar as possible to the fleet structure used for the 2018 BET assessment (Anon. 2019). After reviewing the distribution of the size samples for the longline fleets, the modelling team may consider aggregated the longline fleet structure by the 3 regions specified within the joint longline CPUE analyses (see Section 7, **Figure 7** and **Table 7**).

3.2 Task II (catch-effort and size samples) data

The Secretariat presented the SCRS catalogues for YFT by region (YFT-E: eastern Atlantic; YFT-W: western Atlantic) for the period 1989-2018 (respectively, **Tables 2** and **3**). As observed, many T2CE datasets (crucial for estimating CATDIS, the YFT data source used as the quarterly catches by fishery in the stock synthesis models) are still missing in ICCAT. The Secretariat has informed that, several CPCs (Mexico, South Africa, EU-Cyprus, etc.) have an ongoing full revision of their corresponding T2CE datasets currently available in ICCAT, and invited all the CPC scientists to use the YFT catalogues to verify the completeness of their series.

SCRS/2019/064 document presented a summary of the YFT size data available in ICCAT-DB and the preliminary size frequency distributions by fishery ID, year and quarter as input for assessment models. The size data was quality control checked and standardized to straight fork length (SFL 2 cm bin size intervals), observations reported in weight units were excluded. From the size data, a size frequency samples were constructed when at least 75 fish measures were available by strata, and the frequency sample kurtosis and skewness were within their 95% percentile of the overall size frequency samples, respectively. The Group also requested excluding samples from other gears fishery ID that represented mix/unknown fishing gears and the respective catch is less than 5% of the annual YFT catch.

The Group enquired about the size distribution of the Chinese Taipei longline fleet, particularly in recent years, when the mean size of YFT catch has increased since 2005. The Group noted that in other tRFMOs (e.g. Indian Ocean) it was recommended no to use size sampling data from the Chinese Taipei fleets, until problems could be resolved. For bigeye in 2018, Chinese Taipei scientists corrected the catch size distribution data using the observer programme data. There were no scientists present at this meeting to answer questions from the Group. The Group recommended to exclude the size data from Chinese Taipei after 2004 and to seek advice from Chinese Taipei about whether to use size data before 2004.

3.3 Improvements to Ghana statistics (Task I and II, 2006-2018)

The Secretariat informed that it has recently received the data from Ghana tropical tuna fisheries statistics, though due to time restrictions, it was not able to provide estimates at the meeting. However, the proposed methodology for estimating total removals (T1NC) was presented to the Group, catch composition (CAS), catch & effort by fishing mode (T2CE) and size information (T2SZ). The estimation work will be done intersessional in collaboration with Ghana scientist, following the same procedure as done in 2018 for the bigeye assessment (Ortiz and Palma, 2019).

3.4 Improvements to "faux poissons" estimations (Task I)

No new estimates of "faux poissons" were presented at the meeting nor provided to the Secretariat. The Group requested to the scientist of the tropical tuna fisheries to update these estimates up to 2018 and to provide them before the deadline for data submission of 15 May 2019.

3.5 Other information (tagging)

The Secretariat provided a summary of the tagging information of the ICCAT database, including data from the AOTTP programme. See Section 8 for details and discussions on the tagging activities and results for yellowfin tuna.

4. Review and update of CAS/CAA

4.1 Preliminary estimations

No information on CAS was presented for YFT as most of the 2018 data fisheries statistics were not provided by the CPCs before this meeting. The Group agreed on an intersessional workplan (Section 7) and requested that CPCs provide 2018 fisheries statistics by 15 May 2019. It was noted that the develop of CAA is a low priority for the Group, as no VPA models are scheduled for the assessment. If required, the CAA can be extracted from the stock synthesis model outputs for each fishery and the overall population.

4.2 Improvements needed for a final CAS estimation

The Group discussed if it was necessary to develop CAS for YFT and noted that it is possible to extract population CAS from the Stock Synthesis model as a product of the model fitting. The Group determined that the model's estimates of mean weight and CAS obtained the Stock Synthesis model were consistent with the trends observed in the fishery.

5. Review of fishery indicators

Several presentations were made describing fisheries indicators, such as trends in fleet components and distribution, effort characterization and quantification, environmental conditions affecting catch rates, etc. Review of such fisheries indicators may assist in the treatment of stock assessment data inputs and interpretation of results, and in the formulation of management advice.

Fisheries Indicators from National Fleets

SCRS/2019/076 was presented, providing an update on the statistics for the EU-Spain tuna fisheries in the tropical Atlantic. During discussion, it was noted that a substantial increase in sets per day on FADs began in the early 2000s, around the time when sonar equipped FADs increased the efficiency of FAD fishing. However, there was no apparent increase during the 1990s, when it is generally understood that FAD sets began increasing (SCRS/2019/076, Figure 12). It was suggested that the figure showing the trends in FAD and free school sets/day across years be considered for inclusion in the report, potentially in the Executive Summary.

SCRS/2019/077 presented statistics on the EU and associated purse seine and baitboat fleets. The Group was informed that the current EU tropical tuna sampling programme has been modified beginning in 2019. Agreements are in place to ensure continued sampling of the EU fleet, but the situation is unclear currently in the case of the foreign flagged fleet. The Group considered the sampling conducted when purse seine catch is offloaded, as well as in the local markets of Abidjan and Dakar, to be very important because this is essential to characterizing the catch, species composition and size frequency of the PS fishery. The Group therefore recommended that sampling of the foreign flagged component (monitored by the EU sampling programme) continue at recent coverage levels into the future. The Group also recommends that the monitoring and sampling of other PS and BB tropical tuna fleets be carried out at similar levels.

The Group considered that it may be of value to examine potential differences among the fleets. It was suggested that this sampling data should be shared because it is anonymous. The rule is that each country is responsible for collecting its data, but not all data is shared globally.

The Group suggested that showing the number of sets per day by fishing mode (floating object vs free school sets) for the EU and associated fleets would be useful for understanding trends. It was indicated that this could be prepared, if requested, for future discussions.

The Group considered that it would be useful to see the trends in number of vessels, active fishing days and carrying capacity for the total tropical tuna PS and BB fisheries. Information from some PS and BB vessels fishing for tropical tunas in the Atlantic are not covered within available information from the EU and associated fleets. However, all of this information is not currently submitted to the Secretariat because it is optional. Therefore, the Group recommends that the annual submission of number of vessels, active days fishing, and specific vessel characteristics (ST01FC) be mandatory for all CPCs with fisheries on PS and BB tropical tunas in the Atlantic. The Group recommends that the reporting of such data for other fleets also be considered.

SCRS/P/2019/030 provided descriptive statistics of the EU-France purse seiner fleet targeting tropical tunas in the Atlantic Ocean from 1991 to 2018, with the aim to present a global overview of tendencies. These fishery indicator statistics will be updated and made available for the Tropical tunas Species Group meeting in September 2019.

The indicators presented could be separated in four groups: (a) fleet characteristic indicators (number of vessels by volume of wells and carrying capacity over the years, (b) summarization of the activities (activity duration and number of sets by fishing modes), (c) distribution of catches (by fishing mode, mean weight of individuals and biomass by size class for the yellowfin tuna and spatial distribution of catches) and (d) at least nominal CPUE for each major tropical tuna by fishing modes (catches per searching day and catches per positive set).

The Group noted the importance of receiving the Task II information by the deadline established for this year's stock assessment.

SCRS/2019/029 presented an analysis of seasonal trajectories of tuna vessels off Mauritania from VMS data. On average, more than 50 foreign tuna vessels (EU, Japan, Senegal) have worked under free license during the last decade off the coast of Mauritania. This document presented an analysis of VMS data for 32 vessels in 2017, and 28 vessels in 2018. Models were applied to classify the observations by activity type (e.g. search time, set time). One future application planned would involve associating fishing time with catches in order to calculate a catch per unit of effort.

The Group noted that this analysis was conducted for was all gears together. It was suggested that this be done by main gear type, as the characteristics of the various components of fishing related activity are different between the major gears.

Effect of climate variability on catches

SCRS/P/2019/024 presented an analysis of the effect of climate variability on catches of yellowfin tuna in the southwestern Atlantic Ocean for the period 1982-2010. Results presented confirm that climatic variability caused by different atmospheric and oceanic processes affects the distribution and catches of yellowfin tuna in the southwestern Atlantic Ocean. No direct relationship between the increase in SST and the catches of this species were observed. The optimal SST range defined by the model (16° - 22.5°C) is below the preference ranges reported for the species. ENSO events appear to have a positive effect over CPUE in extreme events of El Niño and La Niña, while moderate events tend to be negative or low effect.

The Group noted that it would be a good input for the model to include a variable that addressed the change in target species of the fishery (which has been related over time to the differing composition of the fleet), as there was concern that could confound the associations with environmental variables that are being tested. For the analysis, targeting strategies for four different species were identified. The Group recommended removing from the analysis those targeting albacore and blue shark and keeping bigeye and swordfish. It was suggested that another way of dealing with target species could be splitting the time series as it has been previously done in the standardization of Uruguayan CPUE index. This approach might not be the best solution, as long temporal series are needed for climate effect analysis.

Also, the Group commented that the optimal SST range defined for the model might not mean that the preferences of the species are different from what is reported in the literature, and that the estimated optimal might be given by the lack of data with higher values of SST. It was clarified that the SST preference in the study reflects the strong association of the species with the thermal fronts occurring in the area. It was noted that electronic tagging data have shown that, despite an apparent preference for warmer waters, yellowfin tuna are somewhat tolerant of much cooler temperatures (e.g. 5-6 ^{o}C during deep dives extending over several hours), so the model estimated range of (16° - 22.5°C) did not seem unreasonable, given the conditions. The author noted that YFT were found in the study are at even lower temperature (below 16°), possibly associated with feeding on squid or anchovy, two very abundant prey species in the area. The author was asked if the effect of eddies was specifically examined; it was clarified that this complex topic was not addressed.

The Group noted that these data could be useful for developing an abundance index, although that was not part of the current study. The variable CV-DEPTH explained the highest percent of the deviance in the model. It was suggested that this might in part be explained by the aggregation by month, since cv-depth is constant for each cell (as it is defined by the variability of depth within the cell area, irrespective of where, when and under what environmental conditions the sets occurred), whereas the effect of other variables may be somewhat muted by the averaging.

There was concern that the model may not be able to distinguish annual climate effects from annual abundance changes (given that YEAR effects were included in the model, which can be a proxy for relative annual abundance), although there was discussion as to whether considering the climate effects on a monthly basis is addressing this. This is an important consideration when ultimately the effects of environmental factors are accounted for in abundance indices/stock assessments. There may be a confounding between the environmental factors and the year effect, particularly when using environmental indices compiled on a yearly basis, or when there are long-term environmental trends. The Group cautioned that climate-induced changes in catchability and/or availability that are not included in the development of indices of abundance can lead to false conclusions about population abundance trends.

There was interest in whether or not there will be AOTTP PSAT data from that area. At this time, there are some PSAT results for areas near South Africa and Brazil.

6. Review of available indices of relative abundances by fleet and estimation of combined indices

The Group was provided with standardized longline indices from several CPCs and a multi-national joint standardized index. After reviewing all provided information related to longline fisheries, the Group agreed to use the joint CPUE between Japan, USA, Brazil, Korea, and Chinese Taipei for the 2019 stock assessment. The Group was also provided with a novel abundance index of juvenile yellowfin tuna derived from echosounder buoys, and a refined method for the standardized CPUE of EU free school purse seine fleets. The Group made suggestions to improve and document diagnostics for echosounder and purse seine indices in order to consider them before and during the stock assessment meeting in July 2019. The abundance indices recommended for use in 2019 July assessment are available in **Table 4** and **Figure 6**, and all other available indices are found in **Table 5**. The Group also discussed and completed the CPUE evaluation tables (**Table 6**).

National longline indices

SCRS/2019/072 presented standardized Japanese longline CPUE for yellowfin tuna in the Atlantic Ocean up to 2018. The indices were updated using the same GLM model and area (40N-40S) as previously used. There was no discussion on this document.

SCRS/2019/079 presented the standardized catch rate for yellowfin tuna caught by the Brazilian pelagic longline fleet for the period 1978 to 2017. The Group asked why the index was less variable than the one presented in 2016 (Sant'Ana, 2017). The author emphasized that substantial improvements have been made for cleaning the data, resolving conflicting data, and updating the standardized method. Another important point was the inclusion of vessel ID in the model, this new factor in the model associated with targeting accounted well for the big variability observed in fleets from Brazil.

SCRS/2019/078 presented standardized indices, both in numbers and in weight, from the CPUE data of the US pelagic longline fishery up to 2018. The indices were updated using the same GLM model as previously used (Walter, 2017). It was noted that the fleet effort has declined due to fuel costs, regulations on bluefin tuna and other protected species, oil spills and recent hurricanes. The Group asked if the data had been explored to characterize fleet heterogeneity. It was noted that in this study, the presence and number of light sticks was used to differentiate targeting, and that other approaches that incorporate vessel ID (e.g. repeated measures) can also be useful to differentiate targeting.

SCRS/P/2019/032 provided the overview of Korean longline fishery for yellowfin tuna in the Atlantic Ocean. The Group recognized the increase in coverage since 2010 in the index and questioned the reasons. The author explained that Korea has introduced the electronic reporting system that improved the coverage of logbook significantly to 100% coverage. The Group was provided the final index in the region 2 that is the main fishing ground calculated by the same method used for the multi-national longline index (SCRS/2019/081).

SCRS/P/2019/031 presented the regional differences in size data that were used to define boundaries for utilization in CPUE standardization. Defining spatial boundaries is necessary in order to outline regions over which selectivity can be assumed constant in time and space. The information presented provided evidence of larger yellowfin tuna in the equatorial areas. The Group noted that the differences in size of yellowfin tuna that were observed across space could potentially reflect spatial structure in growth or movement across regions. It was also noted that CPUE may vary by season. The Group asked to see seasonal map for yellowfin. The author provided the requested information and it was noted that the distribution of fish sizes changed seasonally, with larger fish in warmer waters.

SCRS/P/2019/028 presented preliminary results of abundance indices by size categories of yellowfin tuna of the Japanese longline fishery in the Atlantic Ocean. It was noted that this work supports the regions defined in SCRS/P/2019/031. The Group noted that the spatial differences could be due to large fish moving to the tropical region or due to gear selectivities that are mainly associated with larger fish. There was a question about the figure showing direction of geometric anisotropy and the author clarified that the figure suggested that similarities in encounter probabilities and in the catch rates were present over a wider range of longitude than latitude.

Multi-national longline indices

SCRS/2019/060 presented the comparisons of yellowfin tuna CPUE and fish size from the Chinese-Taipei and Japanese longline fleets and provided a combined index with seven proposed areas. The conflict of CPUE trend between both fleets decreased compared with that in the 2016 stock assessment. After presenting the data, the authors suggested removing 4 temperate areas and retaining 3 tropical areas. The Group noted that the proposed spatial truncation was advantageous due to low catch and lack of targeting of yellowfin tuna in temperate regions but also disadvantageous because of the potential for hyperstability in a central region. The Group inquired about additional variables related to characterizing fishing configuration. The proxy that is currently used to define targeting is hooks per basket (HPB). Other potential variables briefly discussed were vessel and line setting speed, hook type, light sticks, and leader type. Howerver, these additional variables were deemed impracticable for use as they are historically not available in both fleets and a single model was intended to be used on both the Chinese Taipei and Japanese longline data.

SCRS/2019/081 provided the multi-national longline CPUE indices for Japan, USA, Brazil, Korea, and Chinese Taipei developed using the regional boundaries described in SCRS/P/2019/031. The presentation provided two alternatives for dividing the combined data into 3 or 6 spatial regions. The 6 region spatial configuration was similar to the 3 region configuration, with an additional division to define East and West Atlantic components. It was indicated that the joint indices developed using 6 regions provided very limited additional information compared to the indices with just 3 regions.

A spatio-temporal comparison of depletion in abundance within and across regions indicated declines in all regions with more pronounced declines evident in the Tropical region, which is the main central area for yellowfin tuna, compared to the North and South Temporal regions. This does suggest an overall decline in the population, rather than a contraction of habitat range. The author noted that the depletion analysis for region 1 (North temperate area) and region 3 (South temperate area) should be interpreted with caution, as the data in regions 1 and 3 were associated with much less observations than in region 2 (Tropical area).

The Group recommended using the joint index as an indicator of the abundance trend for yellowfin tuna based on the longline CPUE. The joint index is constructed for three regions (**Figure 7**). The Group recommended that the joint index using vessel effects for years 1979-2018 be used. Due to difficulties related to interpretation of the sharply declining trends in the early time period (1960-1978) that may be due to un-modeled changes in targeting, reporting or other unknown reasons the Group recommended that this early time period index not be used in the modeling.

The joint indices are available for the three regions defined as part of the joint CPUE evaluation process (**Figures 6** and **7**). The Group noted that indices for all three regions might be possible to use but as the Stock Synthesis model will not model movement, it may be necessary to consider some type of index weighting procedure to account for conflicting trends across the regions for indices that largely reflect the same population. This could be based on area or biomass weighting, however the Group felt that it would require substantial further work.

Therefore, the Group outlined a series of model runs (Section 7) that use the joint index in area 2 as the initial reference model, but also including a model run with all three region indices as a sensitivity run. The Group further notes that each of these index treatments will be screened before determining which ones will be used in the reference case and the treatment of the number of indices (1 or 3) will be determined through the modelling exercises outlined in Section 7.

Juvenile Indices

SCRS/2019/075 presented an index of abundance for juvenile yellowfin tuna calculated from echosounder buoys. This index is based on the echosound data collected from the buoys, the authors clarified that the window of time (between 20 to 35 days) within which data were used to estimate densities for each buoy was determined from the literature. This allows time for aggregations to form (at least 20 days) while avoiding exposure to fishing activity.

The Group noted that the species composition data used to estimate the index, Task II catch and effort data, is derived from large spatial area estimates which could imply that species composition proportions are kept constant which will affect the precision and accuracy of the CPUE (e.g. 3 tropical species-specific trends following parallel trends). The Group suggested developing and comparing the juvenile index across the three tuna species (bigeye and skipjack in addition to yellowfin tuna) to check whether the species composition from Task 2CE data affects the specific CPUE trends. It was also suggested that the species composition information should be based on data from fished sets with higher spatiotemporal relevance and that the uncertainty of species composition should be propagated into the final model. Thus, the Group requested the authors to use species composition and size frequencies at a more fine-scale (e.g. 1x1º and month) obtained from the EU Tropical sampling programme database.

The Group also suggested an alternative analysis whereby an abundance index from echosounder biomass for all species (skipjack, yellowfin tuna, bigeye tuna) is multiplied by estimates of species composition derived from another GLM model using the EU Tropical tuna sampling programme by the same strata (i.e. 1x1º and month).

The authors indicated that the early and current buoys used a single frequency signal echosounder, that was converted into species specific signals using specific target strength parameters. According to the literature there is also some differential vertical segregation among species that may be worth exploring.

Lastly, the Group commented on the potential effects of competing FADs to affect aggregations and the author noted that the FAD density is included in the standardization model.

Indices from Surface Fleets

SCRS/2019/066 introduced refined methods for standardizing CPUE of the EU purse seine fleet for free schools. The authors clarified the terms used to characterize the first component of the delta lognormal standardization method. The new response variable for this first component was defined as the number of detections, i.e. the total number of sets, thus becoming a Poisson component. Detection of free schools was modeled as a function of several variables, including searching time defined as the total vessel time, independently from the fishing mode, in a cell minus the time spent fishing in that cell. Fishing activity was counted for all sets, including null sets where fishermen failed to catch fish. The Group further discussed the Poisson response variable and how changes in this metric would be interpreted.

It was commented that the dependence of sets should be considered in the analysis, because there is little additional search time when a vessel sets repeatedly on the same school. It was suggested to consider a minimum time between consecutive sets. The Group also suggested that simulations could be used to support the aptness of the methodology for indexing density of free schools. The Group also noted that the method assumes similar composition between null and successful sets.

The Group discussed the types of gear used by the EU purse seine fleet in the eastern Atlantic, highlighting that the vessels use similar technology but that catch changes by vessel size. While the number of sets need to fill the wells of a vessel will vary, the author clarified that vessel age and storage capacity were incorporated in the model.

7. Identification of data inputs and specifications for the different assessment models and advice framework (SPM, SS3, Others)

7.1 General considerations

The Group agreed to conduct surplus production models and Stock Synthesis models, similar to the previous yellowfin tuna assessments, which would capture a range of model assumptions and complexity. The Group considered that the production models and different configurations of the integrated model would encompass a wide enough range of assumptions regarding data inputs and model structure such that several of the models previously applied to yellowfin (e.g. VPA and ASPM) would not be necessary to run. While this section outlines general recommendations and specifications, we maintain the prerogative of analysts to make necessary decisions to alter certain specifications according to the model performance and more detailed consideration of input data.

SCRS/2019/062 presented a hindcasting approach for the stock assessment for the Atlantic yellowfin tuna. The method is a retrospective cross-validation test, in which virtual prediction over several years ahead by intentionally removing data for such years is conducted and compared with actually observed data. This method is applied to test the prediction skill, which is crucial for management advice, and to compare the models across those with partially different data set. The method has been preliminary applied to several stock assessment exercises such as the Atlantic bigeye tunas, the Indian Ocean yellowfin tunas and the Pacific saury. It was demonstrated that, even when the retrospective patterns do not clearly differentiate performance between models, there can be contrast in prediction skill that help differentiate between models. While evaluation of the performance of the hindcasting method itself via simulation studies is ongoing, it remains valuable to apply the method in this assessment. The Group also noted that the hindcasting is useful not only for diagnostic screening of the sensitivity runs before constructing the grid but also for weighting considerations of the uncertainty grid. However, the method of hindcasting relies upon selectivity and catchability of the fleets used to model the index selectivity, and if selectivity varies over the recent time period the approach may have some limitations. In this case it may be most useful for screening and may not provide clear advice for weighting of the uncertainty grid. In this case equal weighting may be considered.

SCRS/2019/073 presented an outline for the upcoming ICCAT yellowfin tuna stock assessment in July 2019, of which most recommendations have been incorporated into reference model and sensitivity specifications outlined below.

Overall, for all modeling platforms, the time frame will be 1950-2018, assuming near virgin conditions in 1950. The modeling will be conducted by teams as the intention of the Group is to make the modeling process transparent (by routinely posting model input and data files to the Owncloud) and inclusive (any interested parties should contact model leads to participate). Leads, as of the data preparatory meeting, have been identified as follows: SPM (G. Merino), and JABBA (R. Sant Ana, A. Kimoto), SS (J. Walter, H. Yokoi, K. Satoh, T. Matsumoto, A. Urtizberea, T. Kitakado). The Group requests that leads post the reference case input files for each model to allow cross-checking of data files, control files, etc. At least one week prior to the assessment meeting (1 July 2019) all input, data files, code and executables for all model runs will be made available to the Group and each model should have an associated paper provided for the assessment workshop that describes the inputs, model and results as of that date so that the Group can fully evaluate each stock assessment platform.

All models to be considered for the development of management advice should have the full suite of diagnostics.

The Group notes that many essential modeling inputs are still in preparation and that all missing data inputs (primarily task I NC and size composition and several of the index inputs) be provided by 1 June 2019.

7.2 Deadlines

15 May 2019: Task I data through 2018 from CPCs
1 June 2019: Data deadline for Task I NC inputs to model
1 July 2019: Deadline for submission of reference model and sensitivity runs to Owncloud
8 July 2019: Start of meeting

7.3 Process for building the uncertainty grid starting from a reference case

SCRS/2019/073 presented an outline for the upcoming ICCAT yellowfin tuna stock assessment in July 2019. The process is composed of six steps; 1) developing the reference case, 2) conducting one-off sensitivity analyses based on the reference case, 3) conducting diagnostics for detecting the model mis-specification, understanding goodness-of-fit and model prediction performance, 4) assessing the impact of each parameter alternation, 5) constructing the uncertainty grid, and 6) assamble the results of multiple scenarios. The list of reference models and sensitivity runs are outlined below.

In all models, the reference case is merely the starting point for the subsequent analysis and is likely to change on the basis of diagnostic screening.

Phase 1. Develop the reference case. In recent year, diagnostic methodology for the integrated stock assessment model has been developed including the ASPM diagnostic (Minte-Vera *et al*., 2017) and R0 profile (Wang *et al*., 2014), which were applied for the tuna species stock assessment. The retrospective analysis and residual plots are useful tools for the diagnosis. Using these tools, an initial reference case should be screened for potential model mis-specification. Full diagnostics, including jitter analysis, retrospective analyses, likelihood profiling of R0, steepness; bootstrapping and simple projections will be conducted on the reference case model.

Phase 2. Define one-off sensitivities based as listed above.

Phase 3. Diagnostics on sensitivities. Screening of sensitivities runs based on diagnostics using these tools outlined above to identify model mis-specification. Some scenarios may be excluded from further analysis, if they do not pass diagnostic tests. Another screening diagnostic that will be applied is that each model considered for the grid analysis should have a positive definite Hessian matrix. Another criterion for model convergence is the maximum gradient component for which the standard criterion of 0.0001 may need to be relaxed. For the production models the approach of Kell and Merino (2016) serves as general screening of sensitivities to different indices.

Phase 4. Developing uncertainty grid. The impact of each parameter alternation will be assessed comparing the difference of the stock status indicators (F/F_{MSY} and B/B_{MSY}) between the reference case and the one-off sensitivity tests. The sensitivity runs with the largest differences have the greatest potential to influence the assessment results and are likely the most important to consider to encompass the range of uncertainty.
Phase 5. Grid analysis. After the selection of the previous process, the grid analysis will be conducted using these selected setting items. As an example, if three items (steepness, growth, mortality) are selected to form the sensitivity analysis, the total number of scenarios for the grid analysis are the products of the three items (12 = 3 x 2 x 2). Such grid would then be constructed for each model platform.

Phase 6. Ensemble the results of multiple scenarios. An ensemble of the uncertainty grid will likely be used for developing the management advice. The hindcasting methodology (Kell *et al*., 2016) to provide advice on how to weight candidate model constructions for the uncertainty grid may be considered. As management advice in ICCAT is based on future predictions using the Kobe 2 matrix, models that show good predictive performance are desirable. Therefore, a scenario, which shows good performance for future prediction, may be a better candidate for a larger weighting in the grid during the ensemble process.

Models to be included in the grid analyses will then be projected for development of management advice. Projection specifications will follow general advice by using likely carrying over preliminary 2018 TACs for 2019. A range of TACs ranging from 0, and 80-140 thousand t for development of Kobe 2 Strategic Matrix. For Stock Synthesis uncertainty will be quantified by use of the multivariate normal approximation similar to that used for bigeye tuna (Walter *et al*., 2019). For projection advice to be available by the end of the meeting the uncertainty grid must be finalized by the 3rd day of the meeting.

7.4 Stock synthesis specifications

Similar to the 2016 stock assessment, the integrated assessment modeling platform of Stock Synthesis will be used. Fleet structure (**Table 7**), model set ups and specifications will mostly remain the same as in 2016, though some restructuring of the fleets will be conducted to match the revised spatial structure identified in SCRS/2019/042. Fleet structure will, when possible, also be harmonized to match the structure of the bigeye assessment to facilitate structuring of Stock Synthesis models to inform operating models in the MSE. Specific changes are outlined below:

The reference case will have the following specifications:

1. Convert from SS 3.24 to 3.30
2. Address several parameter bounding issues and high CVs on some selectivity parameters
3. Check the plus group 10+ specifications to determine if a change is necessary
4. Annual indices will be used, though the model retains quarterly time step for length composition and recruitment partitioning. Though juvenile index may be retained as quarterly to reflect quarterly recruitment
5. Model will be one area, with fleets-as areas assigned according to revised 3 area definitions (**Figure 7**)
6. Movement will not be estimated
7. Recruitment estimated quarterly
8. Francis reweighting of composition data (Francis, 2011)
9. Lambda on size composition data =1
10. Reevaluate selectivities for baitboats and purse seine fleets, correcting for some bounded parameters.
11. Reevaluate seasonal selectivity/seasonal fleet structure to match seasonality of movement/availability for purse seine and longline indices.
12. The longline fleets will be initially 6 separate fleets as specified in the bigeye model and consideration of condensing them into three fleets will be based on inspection of the composition data. Selectivity for area two (central) will be estimated with an asymptotic function. Selectivity will be estimated as double normal for regions 1 and 3, based on larger average sizes from longline caught fish in region 2 (SCRS/2019/042).
13. A time block on selectivity for the longline fleet selectivity will be applied starting in 1979; similar time blocks as in the bigeye tuna stock assessment should be incorporated.
14. Growth estimated internally in the model with Richards using otolith data from SCRS/P/2019/025, and daily aged otoliths only up to age 1.
15. Baseline M=0.35 (as estimated from Then *et al*., 2015 using t_{max} of 18).
16. Attempt to estimate sigmaR (using the bias correction ramping of Methot and Taylor, 2016).
17. Initial size composition data sample size input as ln(N).
18. Brazil handline fleet landings assigned a new fleet, use size information from AOTTP tagging data.
19. Joint index for region 2 from 1979-2018 with vessel ID (one index).
20. Model will start in 1950 and go to 2018 (with preliminary catch used for 2018. This allows for the use of the 2018 index value; likely no composition data will be available for 2018 but it is not needed by the model). Stock status could be determined for 2017 in this case.
21. Beverton-Holt stock recruitment, steepness fixed at 0.8, but profiled as part of the diagnostic evaluation.
22. Joint index will be input with a common CV of 0.2 but with interannual variability to account for differential precision of the index.
23. Chinese Taipei (2005-2014) size composition; recommendation is to remove size composition after 2004 as the reported data may be uncertain and to confirm with National scientists whether the data prior to 2005 is reliable.
24. Evaluate whether the “others” (Oth) fleet can be moved or combined into another fleet.
25. Tagging data will be formatted for input to the data file, but probably not used in estimation.
26. Incorporate size limit and retention function for US RR fishery to account for size selection of samples at 69 cm.

One-off sensitivity analyses

Based on the reference case, a list of the model specifications for the sensitivity analysis is included below:

1. Baseline M=0.55 (Continuity M from 2016)
2. High M = 0.65
3. Low M=0.18
4. Growth estimated internally in the model Richards fit to Gascuel *et al*. (1992) data
5. Joint index for regions 1, 2, 3 1979-2018 with vessel ID (3 indices)

6. Steepness 0.7
7. Steepness 0.9
8. Reduce size composition data weights (0.5) with respect to reference case
9. Reference case + purse seine free school index (CV 0.3, scaled according to interannual variability in precision)
10. Reference case + juvenile acoustic index (CV 0.3, scaled as above)
11. Reference case + purse seine free school and juvenile acoustic index (CV 0.3, scaled as above)
12. Incorporate Dirichlet multinomial distribution
13. Best-fit M value, on the basis of profiling M in the reference case, above

These sensitivity analyses should get the full diagnostic evaluation.

7.5 Surplus production model

The SPM/JABBA model requires total landings and at least one index of abundance. One of the key assumptions with a surplus production model is that all fish are fully selected. In previous ASPIC models single indices were used in isolation and full diagnostics similar to Kell and Merino (2016) will be applied to screen models in a process similar to that outlined above. These include evaluating the correlation of indices to determine if there are similarities, profiling of *r*, *K* and the shape parameter, retrospective analyses of estimates of *r*, *K*, and stock status and evaluation of sensitivity to starting conditions and starting values.

Runs for production models will consist first of a reference case which will use the joint longline index for region 2 (1979-2018 with vessel ID) and then model runs with the other index specifications outlined for Stock Synthesis.

After screening of models, a base case or an uncertainty grid will be developed for projections, the production models are chosen for projections.

For JABBA, three approaches will be taken to consider prior distributions for *r*, *K* and shape parameter for the model:

i) the first, will be aimed at informative priors, based on the same priors used in the past for yellowfin tuna Bayesian SPM models (Anon, 2009).

ii) the second, as informative priors too, will be based on trying to derive the priors from the life history information.

iii) the third, as non-informative priors, will be aimed to use flat priors for these parameters.

To facilitate the process of comparison and explore behaviour/sensitivity of the models to distinct index information input, analyses will be conducted using distinct indices into the models one at a time and a posterior analysis will be conducted to evaluate and infer from the answer that these distinctions will provide.

8. Review of the progress of AOTTP

There were six documents and one presentation on the progress of the AOTTP.

SCRS/2019/065 provided a progress update of the AOTTP and described the data availability for the yellowfin stock assessment. The Group noted the fish movement in January and March and suggested an improved figure to clarify which direction the fish were moving. Additionally, the Group noted the lack of recoveries in the western Atlantic on the southern coast of Brazil. The author explained that relatively few fish were released in that area and that recovery rates have been low for Brazil.

The Group asked for additional details on the AOTTP hard part collection and analyses. The authors clarified that the hard parts were read using daily rings and were found to be between the ages of 0 and 4. Suggestions included to; have multiple labs analyze the AOTTP otolith references to confirm ages, utilize annual rings instead of daily rings, and encourage longline fishers or canneries to contribute larger fish or fish heads. The Group acknowledged the benefits of otolith references but were concerned about the lack of older fish hard parts.

The AOTTP received a no-cost extension to November 2020, but recoveries will need to continue after that point to ensure as many tag recoveries as possible. A clear recommendation for the Commission is needed, including a budget estimation for continuing recoveries for 2 or 5 years.

SCRS/2019/068 provided estimates of tag shedding from the AOTTP, estimating rates for the various types of tag loss. The Group concluded that future work should focus on explaining why the larger fish are shedding tags at a higher rate. Typically, younger fish have weaker bodies, so the larger fish were expected to lose less tags.

SCRS/P/2019/026 presented preliminary analyses of the AOTTP tagging data to estimate annual total survival rate and year specific tag recovery rate parameters using a traditional Brownie dead recoveries model. These exploratory analyses indicated that the fact that newly tagged fish do not immediately mix in the population is likely to cause problems in the estimation of mortality from tagging data.

The Group proposed that the tagging data could be incorporated into the SS model, however the fact that not all fish are fully mixed into the population must be accounted for. The Group suggested that the level of mixing be further explored using analyses such as those described in Kolody and Hoyle (2015). The Group also suggested that these Brownie type analyses be further explored for the July assessment as they provide a helpful check on estimates resulting from the integrated assessment model analysis.

It was also suggested that post release mortality be explored by comparing return rates from different taggers. This was found to be non-negligible in the Indian Ocean tagging programme (20%+).

SCRS/2019/069 presented a GLM examining factors that affect reporting rate, including four tagger types, three species, three years, and six unloading locations. It was observed that all variables were significant predictors of tag recovery rates and questioned whether this could be a result of overdispersion. The author explained that it was difficult to conduct robust statistical analyses on these data since they were not evenly spread in nature (i.e. species, gear), space and time.

A comment was made regarding the fact that one of the objectives of tag seeding should also be to give us an idea of where along the production line we are most likely to recover a tag. Since the tag seeding takes place at different levels of the production line (on vessel, at unloading, during transshipment, etc.) this can allow for the estimation of the probability of recovering a tag at every stage. Another objective could be to uncover the rate of misreporting of fish location, date, species and vessel/gear. This could in turn help inform uncertainty in estimates of movement and growth obtained from the tagging data.

The author pointed to very low reporting rate in Brazil and Cabo Verde. AOTTP clarified that the tag seeding data from Brazil has since then been invalidated. And, that the data from Cabo Verde had originally contained an error that has since then been corrected, all 10 tags seeded were in fact recovered.

The Group was informed that the protocol for tag seeding experiments was modified six months into the project. Originally, one tag was seeded per seeding event, today five tags are seeded. This should be considered when analyzing the data.

The Group noted the lack of tag seeding effort done on longlines. AOTTP reminded the Group of the difficulty of seeding on longliners. The Group encouraged National scientists to make sure that their longliners know about the programme and declare tags. The Group reiterated the importance and benefit of having tag seeding data for the mark recapture data to be informative. It was noted that these tag seeding exercises ought to be extended in time for the duration of the recovery activities, beyond the life of the AOTTP programme.

SCRS/2019/070 assessed if the data discrepancies in the recapture data of the AOTTP were random across time, space, and fleet. The analyses of recaptures included all tropical species, but only for the purse seine fishery. Concerns over apparent data discrepancies near Mauritania were raised but the author noted that the high number of data discrepancies corresponds with an area of high recaptures and the significance of it depends on the spatial scale used to assess it.

The Group recommended to run this analysis again with updated data since several quality control checks have now been put in place to reduce gaps in data. This type of analysis could allow one to look at randomness of the recovery locations based on release location to identify levels of mixing.

SCRS/2019/067 examined the effectiveness of the FAD moratorium utilizing data from fish tagged inside or outside the moratorium. Fish were 18 times more at risk of being caught when released outside the moratorium area. The Group inquired whether AOTTP tagging data could be used to estimate the appropiate size/time duration of the moratorium based on the mixing rates and movement of tagged fish. The author acknowledged that this could be possible in the future. The Group also suggested that the author try and exclude short times at liberty or look at the recapture rates as a function of distance from the moratorium.

SCRS/2019/074 summarized St. Helena's yellowfin tuna fishery. St. Helena hosts an impressive tagging programme including ~3,000 conventional tags, 30 satellite tags, and 123 internal tags. Electronic tagging data show yellowfin tuna diving to maximum depths between 150 and 400 meters and migrating as far as the Ivory Coast. A Principle Component Analysis revealed five distinct behavioral patterns that vary by month and may have implications for catchability.

Younger yellowfin tuna were seen in St. Helena inshore area with length frequencies demonstrating the formation of yellowfin tuna cohorts that moved offshore (to Bonaparte or Cardno seamounts) as they grow. Concerns about gear selectivity affecting the distribution of fish size from inshore to offshore were raised, but the fish appear to move as cohorts.

9. Recommendations

9.1 Biology

It has been shown that ageing of otoliths can provide accurate and precise estimates of aging, both for the first year of growth (with daily annuli) and for older fish (with annual rings). Current ageing data is overwhelmingly coming from NW Atlantic samples. It is recommended that otoliths from the eastern and southern parts of the distribution of the stock be collected and aged. Such collection and analysis should be coordinated to follow the standardized protocol successfully developed by NW Atlantic scientists. The Group also recommends that the sex of the fish be recorded to allow estimation of sex-specific growth.

The Group noted the value of the information on maturity and fecundity that was presented from the northern Gulf of Mexico, and the extensive collection of information on sex ratio, spawning season and spawning condition that was also available in the southern Gulf of Mexico. Thus, it recommends that National scientists from Mexico and the United States collaborate to continue to improve and expand these valuable programmes.

The Group recommends enhancing the collection of biological samples from tropical tunas throughout the Atlantic but especially in the East and South. The Group recommends that national observer programmes should be considered as a platform for these collections. Biological collections should include samples of ovaries, otoliths and muscle tissue for studies of reproduction, ageing, growth and stock structure. The Group also recommends that National scientists explore options for obtaining biological samples from their fisheries. The Group requests that at least 1,000 otoliths be collected from each of the major gears, using a representative sampling scheme.

9.2 Statistics

Improvements of historical catch and effort data series continue to happen under the leadership of the Secretariat and with the collaboration of some CPCs. There is still a need for CPCs to continue to review historical data series to improve the quality of the reports, especially for data sets which contain gaps that have been temporarily replaced with "carry-overs".

The Group noted that size frequency from the longline fishery of Chinese Taipei suggests substantial changes in gear selectivity, availability or retention of small yellowfin tuna in the early 2000s. As no scientist from Chinese Taipei attended the data preparatory meeting, it was not possible to obtain answers to the questions raised. The Group recommended that the Secretariat reach out to data correspondents of Chinese Taipei to determine the appropriate use of size frequency data in the yellowfin tuna stock assessment.

The Group was informed that the current EU tropical tuna sampling programme has been modified beginning in 2019. Agreements are in place to ensure continued sampling of the EU fleet, but the situation is unclear currently in the case of the foreign flagged fleet. The Group considered the sampling conducted when purse seine catch is offloaded, as well as in the local markets of Abidjan and Dakar, to be very important because this is essential to characterizing the catch, species composition and size frequency of the purse seine fishery.

The Group therefore recommended that sampling of the foreign flagged component (monitored by the EU sampling programme) continue at recent coverage levels into the future. The Group also recommends that the monitoring and sampling of other purse seine and baitboat tropical tuna fleets be carried out at similar levels.

The Group noted the importance of information on fishing effort from the tropical tuna surface fleets. The Group recommends that the Sub-Committee on statistics considers requesting all CPCs with surface fleet fisheries targeting tropical tuna fleets to provide information on the number of vessels, active fishing days and specific vessel characteristics (STF01FC).

9.3 Fishery indicators and indices of abundance

The estimates of a biomass index obtained from acoustic data from buoys deployed with FADs show a lot of promise. It is recommended that this work continues and is extended to other species of tropical tunas (see Section 6).

The development of a joint index from set by set data from longline fleets was successful in showing the usefulness of joining data sets from different fleets. This analysis provided not only an index more representative of the abundance of yellowfin throughout the entire distribution of the stock, but also a better understanding of the spatial sub-structure of the stock. It is recommended that such joint indices continue to be developed for other ICCAT stocks and that data from other longline fleets, not yet incorporated to the joint index, are added to the data set.

The Group noted the increased contribution of the Brazilian handline fleet to the overall landings of yellowfin tuna. The Group recommends the development of indices of abundance from CPUE data and that additional statistics be reported from that fleet, including fish size and fishing effort data.

9.4 Assessment models

The Group noted the need to follow the timelines specified in Section 7 of this report.

9.5 AOTTP

The success of the AOTTP in improving the capacity of coastal scientists to participate and contribute to the work of the SCRS is obvious from the number of SCRS papers and presentations provided during the meeting. It is recommended that ICCAT continues to support such type of activities in the future to capitalize on the investment success of the AOTTP project.

Most AOTTP-tagged fish were released small and it takes several years for such fish to grow to the large sizes which are more informative for the study of growth and mortality from gears other than surface gears. As a result, dedicated tag recovery activities need to continue for 3-5 years at a minimum to ensure that tagged fish caught in subsequent years are reported. Such activities should partially shift their focus from surface gears to longline gear.
AOTTP has successfully invested in the improvement of data reports for tagged fish. Despite this, there are some records with missing information required for analysis. It is recommended that the analysis of data gaps is used to further improve the quality of reports.

Analysis of tag seeding experiments conducted by the AOTTP has shown that there is still room for improvement of reporting rates for all fleets, and particularly longline fleets. The variability in estimated reporting rates highlights the need to continue such tag seeding experiments in the future, so as to be able to use future tag-returns for stock assessments. It is recommended that awareness programmes are increased or maintained and estimates of reporting rates continue to be obtained into the future.

The Group noted the estimates of tag shedding obtained by analysis of the AOTTP data. Studies from other tRFMOs have shown that tag-release mortality is significant and can be as high as 30%. It is recommended that tag shedding rates, tag-release mortality and the level of mixing of recently tagged fish be considered in the analysis of AOTTP tag returns.

The Group noted the success of the releases of internal tagged fish in St. Helena, where the percentage of tag returns of such fish is at the same level or greater than those from fish released with conventional-tags. The Group recommends that ICCAT scientists releasing fish with satellite tags or internal tags contact the St Helena scientists for advice on the best procedures to be used for handling fish during tagging experiments.

There is some evidence from tag returns that growth of yellowfin tuna may be halted or depressed right after fish are released. It is recommended that further analyses are conducted of the short-term growth of tagged fish, including a review of studies conducted elsewhere.

The Group noted the usefulness of the preliminary work on the movement of fish tagged within the FAD moratorium area and during the moratoria. The Group recommends that such work continues and is expanded to help the SCRS to respond to the Commission request of the effects of the moratoria. Ideally updated results of the expanded work should be presented at both the 2019 yellowfin assessment meeting in July and the 2019 September SCRS species Group meeting.

10. Other matters

The Group was made aware that the final report of work conducted during phase 1 of the tropical tuna management strategy evaluation (MSE) is available (SCRS/2019/033), as well as a description of the observation error model (SCRS/2019/015). The Group asked that a brief plan and budget for the completion of phase 2 activities be presented to the yellowfin tuna assessment meeting in July 2019.

The Group was also made aware that the United States has recently improved their recreational statistical sampling programme, which may result in revised estimates of recreational catch for yellowfin tuna and other ICCAT species. Any revisions to US statistics would be presented and reviewed through typical ICCAT protocols. The potential changes are not expected to be of the magnitude that they would impact the stock assessment results.

11. Adoption of the report and closure

The Chair acknowledged that the successful outcome of the data preparatory meeting was made possible by the substantial efforts of the Secretariat and National scientists to prepare the needed data inputs, to participate in the review of those products, and to make modeling recommendations. The Chair also thanked the rapporteurs who volunteered to prepare the report of this meeting. The Group adopted the report at this meeting and the meeting was adjourned.

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Table 1. Final YFT Task I nominal catch (T1NC, t) by region, major gear, and year (left table). The comparison (differences) against the previous T1NC for YFT is also shown on the right table.

T1NC final

Year	YFT-E BB	GN	HL	HS	LL	PS	RR	TP	TR	TW	UN	TOTAL	YFT-W BB	GN	HL	HP	HS	LL	PS	RR	TL	TP	TR	TW	UN	TOTAL
1950	1176							24				1200														
1951	1176							24				1200			158											158
1952	2548							52				2600			187											187
1953	3528							72				3600														
1954	3332							68				3400												7		7
1955	4218							82				4300														
1956	5723							111				5834						612						151		763
1957	9187				10347			323				19857						3539						302		3841
1958	10304				13987			45				24336						15962						283		16245
1959	5775				32761			112				38648						19121								19121
1960	11247				40606			125				51978						16515								16515
1961	9839				40940			202				50981						7822								7822
1962	10557				17492			274				28323						29200								29200
1963	17785				23263	1300		60				42408						21991	199							22190
1964	21116				19027	7225		34				47402						21400	126							21526
1965	18486				27663	8279		13				54441						13281								13281
1966	15050				12931	15658		12				43651						15085								15085
1967	16761				17741	18722		1				53225						6782	218							7000
1968	22135				22711	29745						74591						9618	114							9732
1969	15645				21358	44362		5				81370						13221								13221
1970	9787				16572	33525	100	15				59999			48			14522							151	14721
1971	10701				15099	32374	100	21				58295			48			16235	17						151	16451
1972	13304				18506	50219	100	10				82139			48			12314	810						151	13323
1973	14747				20629	46665	106	3				82150	26		51			12984	573						151	13785
1974	19699				19535	53520	97	6				92857	1278		51			12895							151	14375
1975	9633				15575	83222	59					108489	408		54			14263	1137	10					154	16026
1976	12814				12837	85237	114					111002			69			13002	634	11					224	13940
1977	10949				15662	90685	125	202				117623			67			12170	1313	10					152	13712
1978	9970		41		11375	98351	150	312				120199	32		67			9862	3662	12					183	13818
1979	14096	5	479	43	6970	92651	240	111				114595	736		28			9666	2329	26					188	12973
1980	7763	30	4	65	12756	97159	74	20				117871	1648		31	1		7373	3614	35			5		191	12898
1981	10018	2	4404	98	8185	115341	68	211				138327	1917	0	59			11425	2822	1296			6	0	179	17704
1982	13211	3	2691	110	10456	112303	130	5			92	139001	2970		40			10036	12112	934			19	0	179	26290
1983	11507	5	3392	44	6143	103742	177				92	125102	3603	0	56			8454	25749	2206			44	1	204	40318
1984	14757	9	1958	56	8146	51598	92	2			40	76658	3698		82	0		10184	23203	415			77	0	173	37833
1985	16186		1154	60	9520	86970	108	11			3	114011	5478	941	305			11281	20994	3436			45	5	330	42815
1986	15223	1	2004	18	5779	85879	84				5	108993	2421	10	339	0		19743	9822	4880			256	1	361	37834
1987	16713		1768	3	6629	88506	96				1	113716	5468	1	399			14638	6665	3977			415	0	418	31982
1988	16034		1997	2	8956	74323	105	1			63	101481	5822	3	258	0		19863	6034	1923		70	245	0	376	34594
1989	12216		1986	7	7566	103655	113		1		0	125544	4834	14	144	0	9	17853	11647	1953	7		153	1	306	36921
1990	19625		1724	1	10253	129144	102		0		4	160853	4718	27	80		0	19749	6800	561			370	1	425	32731
1991	17693		1324	1	9740	100470	108	1	1	470	817	130626	5359	9	139		1	14967	14414	1438	1		281	34	254	36897
1992	15095		1239	1	7171	102273	172		3	54	50	126058	6276	11	149	0	13	18442	11359	1003			136	45	278	37712
1993	18467	12	1350	1	9079	95757	4	3		16	13	124702	6383	2	156		1	13675	16081	1956		0	190	44	257	38745
1994	15646	88	1560	1	14876	93335	13				5	125524	7094	4	287	0		12626	23030	4567		0	247	45	315	48215
1995	13570		1362	1	13935	90241	16	1		273	5	119404	5297	22	253			11560	13510	4097	4		334	48	149	35274
1996	11401		1309	1	14493	88550	18	1		356	3	116132	4560	21	261			12605	10784	4099	1		330	2	393	33056
1997	12639	2	1299	3	10740	79828	14	2		448	2	104978	4275	6	357			11896	11710	3624	0	0	273	2	197	32341
1998	14261		1145	1	13872	83890	21	9		392	3	113594	5511	13	341			12426	9157	2980	0	0	225	1	265	30919
1999	16558		1185	1	13561	73860	28			250	1	105444	5364	8	342			13923	6523	4027	1	1	38	4	478	30710
2000	9965	673	1388	1	11588	72838	40	1		198		96692	6753	10	417			16163	7870	3893	0	1	33	2	482	35623
2001	14018	215	1374		7576	89577	18			344	0	113123	5572	14	445			15696	13942	4222	0	0	24	3	399	40317
2002	11488	99	918		5869	86129	10			597		105110	6009	34	244	0		11921	7966	2936	0	1	107	0	441	29660
2003	10099	302	1617		9183	76008	12			378	0	97598	3764	8	504			10166	4607	5375	0	0	164	2	391	24982
2004	14773	565	1520		11537	59332	236			340		88303	4868	21	278	0		18165	3217	3842	1	0	252	328	283	31255
2005	9770	175	985		7206	56483	614			336		75569	3867	4	210			18171	2634	3719		0	291	327	276	29498
2006	12836	482	1218		7234	54899	565			378		77613	2695	7	280			15468	4442	4940	0	0	163	1	276	28272
2007	12914	216	1048		13437	47961	687					76264	2304	11	257			16104	2341	2997	0		144	2	7	24167
2008	9553	626	658		8562	74131	206			1	8	93745	886	4	195			13779	2067	1050		0	140	0	2	18123
2009	8851	483	1248		7443	81098			9	0		99131	1331	9	183	0		14659	1370	1052		0	169	1	2	18777
2010	9370	340	1126		5161	80970			2	207	12	97189	1436	5	262	0		14890	2722	1269		0	259	1	9	20855
2011	12382	136	807		6298	74896			12	143	3	94678	2311	8	614			11972	2256	1498			255	1	4	18921
2012	9196	675	1194		5338	77532				20	2	93957	1299	23	1825	0		14940	3292	1728			164	0	13	23285
2013	6808	1804	1174		5657	69457				2		84901	1602	5	5410			11867	3635	687			232		2	23440
2014	9424	312	1238		4742	77133				0		92850	513	8	10546	0		8942	2581	1089			180	0	55	23914
2015	9452	236	1210		4340	89700				150		105088	743	6	12257	0		8806	2332	951			271		25	25392
2016	10070	376	2093		4860	100032				1		117432	1216	8	13765	0		11458	5334	1921			260		25	33986
2017	8323	1044	1280		4589	87038		2		3		102279	866	6	17027	1		10412	4121	1858	0		402		52	34745
2018	6676				1379	47533						55587						2139	31							2170

Differences against T1NC as of 2019-04-20

Year	YFT-E BB	GN	HL	HS	LL	PS	RR	TP	TR	TW	UN	TOTAL	YFT-W BB	GN	HL	HP	HS	LL	PS	RR	TL	TP	TR	TW	UN	TOTAL
1950	1176	0	0	0	0	0	0	24	0	0	-1200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1951	1176	0	0	0	0	0	0	24	0	0	-1200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1952	2548	0	0	0	0	0	0	52	0	0	-2600	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1953	3528	0	0	0	0	0	0	72	0	0	-3600	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1954	3332	0	0	0	0	0	0	68	0	0	-3400	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1955	4018	0	0	0	0	0	0	82	0	0	-4100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1956	0	0	0	0	0	0	0	19	0	0	-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1957	0	0	0	0	0	0	0	260	0	0	-260	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1958	0	0	0	0	0	0	0	22	0	0	-22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1959	0	0	0	0	0	0	0	108	0	0	-108	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	0	0	0	0	0	82	0	0	-82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1961	0	0	0	0	0	0	0	125	0	0	-125	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1962	0	0	0	0	0	0	0	260	0	0	-260	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1963	0	0	0	0	0	0	0	55	0	0	-55	0	0	0	0	0	0	100	0	0	0	0	0	0	-100	0
1964	0	0	0	0	0	0	0	1	0	0	-1	0	0	0	0	0	0	100	0	0	0	0	0	0	-100	0
1965	0	0	0	0	0	0	0	13	0	0	-13	0	0	0	0	0	0	100	0	0	0	0	0	0	-100	0
1966	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	-100	0
1967	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	-100	0
1968	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	-100	0
1969	-28	0	0	0	0	48	0	0	0	0	0	20	0	0	0	0	0	100	0	0	0	0	0	0	-100	0
1970	127	0	0	0	0	138	0	15	0	0	-15	265	0	0	48	0	0	100	0	0	0	0	0	0	-148	0
1971	125	0	0	0	0	156	0	1	0	0	-1	281	0	0	48	0	0	100	0	0	0	0	0	0	-148	0
1972	163	0	0	0	0	671	0	8	0	0	-8	834	0	0	48	0	0	100	0	0	0	0	0	0	-148	0
1973	1	0	0	0	0	434	0	0	0	0	0	435	0	0	51	0	0	467	0	0	0	0	0	0	-151	367
1974	3	0	0	0	0	88	0	6	0	0	-6	91	0	0	51	0	0	148	0	0	0	0	0	0	-199	0
1975	-25	0	0	0	0	-231	0	0	0	0	-25	-281	0	0	54	0	0	179	0	0	0	0	0	0	-233	0
1976	20	0	0	0	0	-23	0	0	0	0	-15	-18	0	0	69	0	0	228	0	0	0	0	0	0	-297	0
1977	6	0	0	0	0	133	0	202	0	0	-259	82	0	0	67	0	0	796	240	0	0	0	0	0	-863	240
1978	10	0	0	0	85	253	0	311	0	0	-686	-27	0	0	67	0	0	290	0	0	0	0	0	0	-357	0
1979	-5	0	0	0	193	360	0	110	0	0	-607	51	517	0	28	0	0	389	1294	0	0	0	0	0	-2228	0
1980	26	0	0	0	248	102	0	20	0	0	-370	26	1256	0	27	0	0	622	-1256	0	0	0	0	0	-649	0
1981	229	0	0	0	199	-68	0	211	0	0	-678	-107	0	0	25	0	0	102	0	0	0	0	0	0	-127	0
1982	0	0	0	0	0	48	0	0	0	0	0	48	0	0	26	0	0	110	0	0	0	0	0	0	-136	0
1983	0	0	0	0	0	-192	0	0	0	0	0	-192	0	0	23	0	0	222	0	0	0	0	0	0	-245	0
1984	63	0	0	0	0	445	0	0	0	0	-73	435	0	0	56	0	0	270	0	0	0	0	0	0	-326	0
1985	66	0	0	0	0	144	0	0	0	0	0	210	0	0	79	0	0	526	0	0	0	0	0	0	-605	0
1986	-78	0	0	0	0	301	0	0	0	0	-4	219	0	0	125	0	0	89	0	0	0	0	0	0	-214	0
1987	-37	0	0	0	6	1264	0	0	0	0	-886	347	0	0	76	0	0	128	0	0	0	0	0	0	-204	0
1988	14	0	0	0	0	5	0	0	0	0	-180	-161	0	0	97	0	0	319	0	0	0	0	0	0	-416	0
1989	48	0	0	0	0	187	0	0	0	0	-180	55	0	0	70	0	0	145	0	0	0	0	0	0	-196	19
1990	-23	0	0	0	0	183	0	0	0	0	-180	-20	0	0	58	0	0	256	0	0	0	0	0	0	-314	0
1991	0	0	0	0	658	180	0	0	0	255	-1093	0	0	0	49	0	0	247	0	0	0	0	0	0	-296	0
1992	0	0	0	0	653	108	0	0	0	54	-815	0	0	0	58	0	0	511	0	0	0	0	0	0	-569	0
1993	-4	0	0	-1	542	0	0	0	0	16	-557	-4	0	0	92	0	0	688	0	0	0	0	0	0	-780	0
1994	-5	0	0	0	238	0	0	0	0	0	-238	-5	0	0	130	0	0	451	3418	0	0	0	0	0	-3999	0
1995	74	0	0	0	212	0	16	0	0	273	-485	90	0	0	144	0	0	375	7172	0	0	0	0	0	-7691	0
1996	36	0	0	0	257	0	0	0	0	151	-408	36	0	0	110	0	0	200	0	0	0	0	0	0	-310	0
1997	-56	0	0	0	257	0	0	0	0	448	-705	-56	0	0	110	0	0	40	0	0	0	0	0	0	-150	0
1998	-3	0	0	0	0	0	21	0	0	295	-295	18	0	0	110	0	0	271	0	0	0	0	0	0	-381	0
1999	-171	0	0	0	0	0	0	0	0	225	-225	-171	0	0	123	0	0	0	0	0	0	0	0	0	-123	0
2000	-58	0	0	0	219	0	0	0	0	160	-160	161	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	-16	0	0	0	0	0	0	0	0	11	-11	-16	257	0	0	0	0	71	834	0	0	0	0	0	-1161	0
2002	262	0	0	0	0	0	0	0	0	0	0	262	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	-26	0	0	0	0	0	0	0	0	0	0	-26	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	-92	0	13	0	0	0	0	0	0	0	-14	-92	0	18	0	0	0	2147	0	0	0	0	0	0	-2147	18
2005	-195	0	0	0	0	0	0	0	0	0	0	-195	0	0	0	0	0	3722	0	0	0	0	0	0	-292	3430
2006	85	0	0	0	0	0	0	0	0	0	0	85	0	0	0	0	0	1213	0	0	0	0	0	0	-1213	0
2007	252	0	-382	0	0	144	0	0	0	0	0	14	0	0	0	0	0	2541	0	0	0	0	0	0	-2541	0
2008	132	0	0	0	0	0	0	0	0	0	0	132	0	0	0	0	0	581	0	0	0	0	0	0	-581	0
2009	-133	483	-892	0	758	892	0	0	0	0	-758	350	0	0	0	0	0	1868	0	0	0	0	0	0	-1868	0
2010	-273	0	0	0	138	0	0	0	0	0	-138	-273	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	185	49	0	0	181	0	0	0	0	0	-231	185	0	0	0	0	0	1126	0	0	0	0	0	0	0	1126
2012	192	71	0	0	19	0	0	0	0	5	-71	216	0	0	0	0	0	1630	0	0	0	0	0	0	0	1630
2013	-166	89	0	0	-2	0	0	0	0	2	-89	-166	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	-9	101	0	0	0	0	0	0	-1	0	-100	-9	0	0	0	0	0	0	0	12	0	0	0	0	-12	0
2015	0	88	0	0	0	0	0	0	0	0	-88	0	0	5	0	0	0	1370	0	10	0	0	0	0	-10	1375
2016	0	57	0	0	0	0	0	0	0	0	-57	0	0	6	0	0	0	371	0	9	0	0	0	0	-380	6
2017	0	31	-2	0	0	0	0	2	0	0	0	31	0	5	0	0	0	1604	0	25	0	0	0	0	-25	1609
2018	290	0	0	0	0	4726	0	0	0	0	0	5016	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2. SCRS catalogue for YFT-E (1989-2018).

Species	Stock	Status	FlagName	GearGrp	DSet	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Rank	%	%cum
				T1 Total		125544	160853	130626	126058	124702	125524	119404	116132	104978	113594	105444	96692	113123	105110	97598	88303	75569	77613	76264	93745	99131	97189	94678	93957	84901	92850	105088	117432	102279	55587			
YFT	ATE	CP	EU.España	PS	t1	60746	66565	51762	48952	40044	39734	37707	31866	23901	28282	19332	24764	30433	30343	23665	20454	11121	10607	12833	23557	32140	24191	18238	17898	11336	13463	19918	17802	10817		1	25.7%	26%
YFT	ATE	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	abc	abc		1		
YFT	ATE	CP	EU.France	PS	t1	28827	42431	31199	31894	35031	34396	28877	32633	29737	31123	31010	30287	31871	31600	32344	23961	22319	18480	10934	15981	18748	20093	21772	18590	20390	20878	19239	25766	25611	24409	2	25.3%	51%
YFT	ATE	CP	EU.France	PS	t2	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	a	2		
YFT	ATE	CP	Ghana	BB	t1	6855	11808	9074	9223	13283	9984	9268	5640	9459	9139	11810	7451	11605	7426	6711	9943	6655	9173	10174	7325	6257	6301	6771	5791	4526	6023	6488	6765	5919	5680	3	7.8%	59%
YFT	ATE	CP	Ghana	BB	t2	abc	ac	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	-1	3		
YFT	ATE	CP	Ghana	PS	t1	180	180	180	108				2542	5628	4710	9640	5222	12240	11120	9127	5502	6364	4865	5396	9197	9602	13951	11730	12984	11448	16819	16079	16827	16703	18362	4	7.6%	66%
YFT	ATE	CP	Ghana	PS	t2	-1	-1	-1	-1				abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ab	abc	abc	abc	abc	abc	abc	abc	ab	ab	ab	-1	4		
YFT	ATE	CP	Panama	PS	t1	3131	7207	6623	7041	7781	8548	10854	5759	3137	1753	775	1087	574	1022		1887	6325	8682	9539	6289	5911	5102	4459	5058	4062	4646	3202	4305	5090		5	4.5%	71%
YFT	ATE	CP	Panama	PS	t2	b	b	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		5		
YFT	ATE	CP	Curaçao	PS	t1								3183	6082	6110	3962	5441	4793	4035	6185	4161	15	1964	1390	7367	6469	5397	4501	6906	3813	5230	6140	7905	6535		6	3.4%	74%
YFT	ATE	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		6		
YFT	ATE	CP	Japan	LL	t1	3792	4185	3020	2124	2627	4194	4770	4246	2733	4092	2101	2286	1550	1534	1999	5066	3088	4206	8496	5266	3563	3041	3348	3637	3843	3358	2855	2914	2715		7	3.2%	78%
YFT	ATE	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	ab	ab	ab		7		
YFT	ATE	CP	Cape Verde	PS	t1											0	6	12	884	246	356	5110	4443	3556	7295	3620	4954	5260	3469	6424	3591	6651	4933	1491		8	2.0%	80%
YFT	ATE	CP	Cape Verde	PS	t2					a						a	a	a	a	a	ab	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	ab	ab			8		
YFT	ATE	NCC	Chinese Taipei	LL	t1	96	2244	2163	1554	1301	3851	2681	3985	2993	3643	3389	4014	2787	3363	4946	4145	2327	860	1707	807	1180	537	1463	819	1023	902	927	761	563	578	9	2.0%	82%
YFT	ATE	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	ab	ab	abc	abc	abc	abc	9		
YFT	ATE	CP	Guatemala	PS	t1															2207	1588	2963	5300	3478	3768	2612	3158	2811	2961	4036	3773	5200	2703	3647		10	1.6%	83%
YFT	ATE	CP	Guatemala	PS	t2															ab	ab	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc		10		
YFT	ATE	CP	Belize	PS	t1										963		321	406								377	1820	3154	5888	5295	7070	7125	3497	5782		11	1.3%	84%
YFT	ATE	CP	Belize	PS	t2										a		ab	ab		b						abc	ab	ab	ab	ab	ab	ab	ab	abc		11		
YFT	ATE	CP	Maroc	PS	t1	2305	5306	1799	2653	2396	3017	2290	3430	1947	2276	2307	2441	3000	2032	1567	719	1757	127					9	8	21	17	11	35	27	35	12	1.3%	86%
YFT	ATE	CP	Maroc	PS	t2	b	b	ab	a	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab					-1	-1	-1	-1	-1	-1	-1	-1	12		
YFT	ATE	CP	EU.España	BB	t1	1182	2384	2623	1758	1498	1767	1101	3069	996	3509	1311	601	504	917	1379	1292	798	928	769	1055	874	1561	3010	973	593	1043	1068	1393	1416	95	13	1.3%	87%
YFT	ATE	CP	EU.España	BB	t2	abc	abc	ac	ac	ac	ac	ac	ac	ac	ac	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ac	abc	abc	a	13		
YFT	ATE	CP	Cape Verde	HL	t1	1985	1634	1272	1202	1344	1560	1362	1289	1299	1145	1185	1388	1374	918	1617	1501	985	1218	1048	648	1121	1054	800	1164	1167	1167	1167	2057	1265		14	1.2%	88%
YFT	ATE	CP	Cape Verde	HL	t2	b	b	b	b	ab	ab	ab	ab	ab	ab	ab	ab	ab	a	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	-1	a	-1		14		
YFT	ATE	NCO	NEI (Flag related)	LL	t1	280	1115	2310	1315	1157	2524	2975	3588	3368	5464	5182	3072	2019	43	466																15	1.1%	89%
YFT	ATE	NCO	NEI (Flag related)	LL	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1																15		
YFT	ATE	CP	EU.France	BB	t1	2197	3671	4571	3103	2587	2533	1764	1658	887	319	1068	416	684	1444	757	585	596	588	430	186	378	360	609	258	29	322	340	432	283	171	16	1.1%	91%
YFT	ATE	CP	EU.France	BB	t2	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	a	16		
YFT	ATE	CP	St. Vincent and Grenadines	PS	t1			510	4936	5391	2476	2142	2969	3017	3327	1916	1987	3640								1										17	1.0%	92%
YFT	ATE	CP	St. Vincent and Grenadines	PS	t2			ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	b	b						-1										17		
YFT	ATE	CP	Russian Federation	PS	t1			3200	1862	2160	1503	2936	2696	4275	4931	4359	737						42	211	42	33										18	0.9%	92%
YFT	ATE	CP	Russian Federation	PS	t2			-1	b	-1	b	b	-1	b	b	-1	-1						-1	abc	-1	a										18		
YFT	ATE	CP	Panama	LL	t1	901	1498	1270	1297	3134	3422	2588	1954	1156	358	385	219	52	90							169										19	0.6%	93%
YFT	ATE	CP	Panama	LL	t2	-1	-1	-1	a	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1				a	a	a	a					a					19		
YFT	ATE	CP	El Salvador	PS	t1													933														2750	8252	6227		20	0.6%	94%
YFT	ATE	CP	El Salvador	PS	t2													ab														abc	abc	abc		20		
YFT	ATE	NCO	Mixed flags (EU tropical)	PS	t1	259	230	998	571	744	688	876	254	452	291	216	423	42	13	298	570	292	251	416	464	467	857	1601				1855	1691	1155		21	0.5%	94%
YFT	ATE	NCO	Mixed flags (EU tropical)	PS	t2	-1	-1	-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		21		
YFT	ATE	CP	Senegal	BB	t1	191	89	52		9	1	94	77	152	248	663	194	279	558	253	576	1106	1347	1068	682	1024	895	1199	1839	1052	491	583	692	241	290	22	0.5%	95%
YFT	ATE	CP	Senegal	BB	t2	ab	ab	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	-1	22		
YFT	ATE	CP	Senegal	PS	t1	69	3																									1230	6017	3685	4726	23	0.5%	95%
YFT	ATE	CP	Senegal	PS	t2	a	a																									abc	abc	ac	-1	23		

Table 3. SCRS catalogue for YFT-W (1989-2018).

Species	Stock	Status	FlagName	GearGrp	DSet	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Rank	%	%cum
				T1 Total		36921	32731	36897	37712	38745	48215	35274	33056	32341	30919	30710	35623	40317	29660	24982	31255	29498	28272	24167	18123	18777	20855	18921	23285	23440	23914	25392	33986	34745	2170			
YFT	ATW	CP	Venezuela	PS	t1	11612	6533	11967	9693	12659	19587	6338	10777	11653	9157	6523	7572	13934	7961	4607	3185	2634	4439	2341	2067	1363	2722	2253	3291	3635	2581	1920	2367	3373		1	21.4%	21.4%
YFT	ATW	CP	Venezuela	PS	t2	ab	a	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab		1		
YFT	ATW	CP	U.S.A.	LL	t1	6247	4474	4141	5337	3886	3246	3645	3320	3773	2449	3541	2901	2200	2573	2164	2492	1746	2010	2395	1394	1686	1218	1462	2270	1544	1446	1041	1300	1431		2	8.8%	30.2%
YFT	ATW	CP	U.S.A.	LL	t2	ab	ab	ab	a	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		2		
YFT	ATW	CP	U.S.A.	RR	t1	1930	545	1418	957	1898	4523	4053	4032	3569	2927	3967	3862	4185	2887	5328	3759	3657	4908	2966	1033	1011	1231	1498	1727	687	1067	936	1911	1832		3	8.4%	38.6%
YFT	ATW	CP	U.S.A.	RR	t2	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	abc	ab	abc	ab	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc		3		
YFT	ATW	CP	Venezuela	BB	t1	3458	3765	4190	3616	3296	4350	2684	2604	2632	4267	4152	3660	4296	3166	2475	2030	1631	1481	951	489	929	809	1068	788	673	395	428	771	500		4	7.4%	46.1%
YFT	ATW	CP	Venezuela	BB	t2	ab	a	a	a	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab		4		
YFT	ATW	CP	Brazil	LL	t1	1157	805	669	1568	2044	1365	1378	734	849	1285	2930	2754	4954	3323	1941	4115	4987	2543	4093	2326	2906	2989	1954	2558	1141	1112	1206	2579	1118		5	7.2%	53.3%
YFT	ATW	CP	Brazil	LL	t2	a	a	ab	ab	a	ab	a	a	a	a	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	a	a	a	a	ab		5		
YFT	ATW	CP	Brazil	HL	t1						60	18	69	156						272			30	22	25	2	61	415	1570	5208	10415	12123	13658	16878		6	6.9%	60.2%
YFT	ATW	CP	Brazil	HL	t2						b	−1	−1	−1						−1			−1	−1	−1	−1	a	−1	−1	−1	a	−1	−1	ab		6		
YFT	ATW	CP	Brazil	BB	t1	1376	953	1169	2660	3087	2744	2613	1956	1643	1229	1197	3093	1276	2843	1289	2838	2236	1214	1353	397	402	627	1243	511	928	118	315	445	366		7	4.8%	65.0%
YFT	ATW	CP	Brazil	BB	t2	ab	ab	ab	ab	ab	ab	a	a	a	a	a	−1	a	a	a	a	a	a	ab	a	a	a	a	a	a	a	a	a	ab		7		
YFT	ATW	NCC	Chinese Taipei	LL	t1	762	5221	2009	2974	2895	2809	2017	2668	1473	1685	1022	1647	2018	1296	1540	1679	1269	400	240	315	211	287	305	252	236	139	293	181	213	414	8	4.4%	69.3%
YFT	ATW	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	ab	ab	abc	abc	abc	abc	8		
YFT	ATW	CP	Japan	LL	t1	3178	1734	1698	1591	469	589	457	1004	806	1081	1304	1775	1141	571	755	1194	1159	437	541	986	1431	1539	1106	1024	734	465	613	462	416		9	3.4%	72.8%
YFT	ATW	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	ab	ab	ab		9		
YFT	ATW	CP	Mexico	LL	t1	345	112	433	742	855	1093	1126	771	826	788	1283	1390	1084	1133	1313	1208	1050	943	896	961	1220	924	1183	1421	1006	1048	971	1282	1244		10	3.3%	76.0%
YFT	ATW	CP	Mexico	LL	t2	−1	−1	−1	−1	ab	abc	ab	ab	ab	ab	a	ab	bc	b	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	abc		10		
YFT	ATW	CP	St. Vincent and Grenadines	LL	t1											152	1956	1341	1147	543	4227	3430	2633	2972	2532	2230	819	927	551	325	481	124	434	642		11	3.1%	79.2%
YFT	ATW	CP	St. Vincent and Grenadines	LL	t2											−1	−1	−1	a	a	a	−1	a	a	a	a	a	a	a	a	a	a	a	ab		11		
YFT	ATW	NCO	NEI (Flag related)	LL	t1	2500	2985	2008	2521	1514	1880	1227	2374	2732	2875	1578	2197	765	14	112																12	3.1%	82.3%
YFT	ATW	NCO	NEI (Flag related)	LL	t2	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1																12		
YFT	ATW	CP	Panama	LL	t1	1595	2651	2249	2297							5		20	28				2804	227	153	119	2134	1126	1630	1995	902	1370	1837	1604		13	2.8%	85.1%
YFT	ATW	CP	Panama	LL	t2	−1	−1	−1	−1							−1	a	−1	−1				a	a	a	a	−1	−1	−1	a	a	−1	−1	−1		13		
YFT	ATW	CP	Venezuela	LL	t1	497	258	338	459	707	850	687	383	381	560	504	421	451	266	323	559	828	593	613	712	898	1249	1090	736	738	790	773	1060	1181		14	2.1%	87.2%
YFT	ATW	CP	Venezuela	LL	t2	b	b	−1	a	a	a	a	a	ab	ab	ab	a	−1	−1	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a		14		
YFT	ATW	CP	Trinidad and Tobago	LL	t1	10	303	540		4	120	79	183	223	213	163	112	122	125	186	224	295	459	615	520	629	788	798	930	1128	1141	1179	1057	889	1214	15	1.6%	88.8%
YFT	ATW	CP	Trinidad and Tobago	LL	t2	−1	−1	−1		−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	a	a	a	a	a	a	a	a	a	a	a	a	ab	ab	ab	ab	15		
YFT	ATW	NCO	Colombia	PS	t1					2404	3418	7172																								16	1.5%	90.3%
YFT	ATW	NCO	Colombia	PS	t2					−1	−1	−1																								16		
YFT	ATW	CP	Grenada	LL	t1	235	530	620	595	858	385	409	523	302	484	430	403	759	593	749	460	492	502	633	756	630	673									17	1.4%	91.7%
YFT	ATW	CP	Grenada	LL	t2	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	a	a	a	a	a	a	−1	−1									17		
YFT	ATW	CP	Vanuatu	LL	t1																681	689	661	555	873	816	720	330	207	124	17					18	0.6%	92.3%
YFT	ATW	CP	Vanuatu	LL	t2																a	a	a	−1	−1	−1	a	ab	ab	a	a					18		
YFT	ATW	CP	Barbados	LL	t1	62	89	108	179	161	156	255	160	149	150	155	155	142	115	146	181	243	160	133	135	60	86	103	145	175	194	258	316	217		19	0.5%	92.8%
YFT	ATW	CP	Barbados	LL	t2	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	b	−1	−1	−1	−1	−1	−1	−1	−1	abc	ab	ab	ab	ab	ab	ab	ab	ab		19		
YFT	ATW	CP	China PR	LL	t1										628	655	22	470	435	17	275	74	29	124	284	248	258	126	94	81	73	91	182	232		20	0.5%	93.3%
YFT	ATW	CP	China PR	LL	t2										a	a	a	a	a	a	a	a	ab	a	ab	ab	ab	ab	ab	ab	abc	ab	abc	abc		20		
YFT	ATW	CP	Belize	LL	t1																		143	1164	1160	940	264	42	41	38	33		39	359		21	0.5%	93.8%
YFT	ATW	CP	Belize	LL	t2																		a	a	a	ab	ab	ab	ab	ab	ab	ab	a	ab		21		
YFT	ATW	CP	Korea Rep.	LL	t1	1055	484	1	45	11			84	156								580	279	270	10	52	56	470	472	115	39	11	12	3	6	22	0.5%	94.3%
YFT	ATW	CP	Korea Rep.	LL	t2	ab	ab	ab	ab	a	a	a	a	a								a	a	a	a	a	ab	a	abc	abc	abc	abc	abc	abc	−1	22		
YFT	ATW	CP	EU.España	PS	t1			1451	1290	810																							281	265		23	0.5%	94.8%
YFT	ATW	CP	EU.España	PS	t2			a	abc	a	a	a	ac	ac	a	ac	a	a	ac	a	a	ac	a	a	abc	abc	abc	abc	abc	ac	abc	ac	a	ac		23		
YFT	ATW	CP	EU.France	LL	t1																					122	456	712	412	358	647	632	371	242		24	0.4%	95.2%
YFT	ATW	CP	EU.France	LL	t2																					−1	−1	−1	−1	−1	−1	−1	−1	−1		24		

Table 4. Recommended abundance indices for reference set in 2019 Atlantic yellowfin tuna stock assessment.

series	Joint LL- Region1		Joint LL- Region2		Joint LL- Region3		PS	
units	Number		Number		Number			
area	North Temprate		Tropical		South Temprate		Tropical	
method	Delta lognormal		Delta lognormal		Delta lognormal			
source	SCRS/2019/081		SCRS/2019/081		SCRS/2019/081		SCRS/2019/066	
Year	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV
1979	1.12	0.10	1.29	0.08	1.35	0.20		
1980	0.89	0.10	1.25	0.06	0.62	0.14		
1981	0.81	0.08	1.23	0.05	0.72	0.12		
1982	0.74	0.09	1.18	0.04	0.90	0.10		
1983	1.01	0.09	1.02	0.06	0.85	0.11		
1984	1.12	0.09	1.29	0.05	1.07	0.12		
1985	0.86	0.09	1.15	0.04	0.86	0.10		
1986	1.06	0.08	1.41	0.05	0.99	0.10		
1987	1.06	0.07	1.52	0.04	0.91	0.11		
1988	1.19	0.07	1.37	0.04	1.35	0.10		
1989	1.16	0.06	1.31	0.04	1.00	0.10		
1990	1.36	0.07	1.32	0.04	1.00	0.09		
1991	1.23	0.06	1.11	0.04	1.03	0.07		
1992	1.25	0.06	0.86	0.04	1.07	0.09		
1993	0.96	0.07	1.02	0.04	0.88	0.09		
1994	1.22	0.07	1.07	0.04	1.06	0.07		
1995	1.26	0.06	1.13	0.04	1.22	0.07		
1996	1.01	0.06	0.98	0.04	1.09	0.08		
1997	1.04	0.06	0.88	0.04	0.98	0.08		
1998	1.08	0.06	0.94	0.04	1.15	0.06		
1999	1.10	0.06	0.95	0.04	1.05	0.07		
2000	1.07	0.05	0.94	0.04	1.08	0.06		
2001	1.00	0.05	0.87	0.04	1.11	0.07		
2002	0.86	0.05	0.78	0.04	1.18	0.08		
2003	0.93	0.05	0.82	0.04	1.16	0.07		
2004	1.04	0.05	0.94	0.04	1.13	0.08		
2005	1.34	0.05	1.18	0.03	1.29	0.06		
2006	1.14	0.06	0.98	0.03	1.07	0.05		
2007	0.90	0.06	0.87	0.04	1.02	0.05		
2008	0.69	0.07	0.67	0.04	0.85	0.06		
2009	0.77	0.07	0.69	0.03	0.81	0.06		
2010	0.72	0.07	0.64	0.03	0.90	0.06		
2011	0.79	0.07	0.65	0.03	1.02	0.06		
2012	0.84	0.06	0.66	0.03	1.21	0.06		
2013	0.87	0.06	0.72	0.04	1.24	0.05		
2014	0.80	0.08	0.64	0.04	0.89	0.06		
2015	0.78	0.07	0.67	0.04	0.99	0.06		
2016	0.86	0.07	0.64	0.04	0.98	0.06		
2017	0.92	0.07	0.67	0.04	1.04	0.06		
2018	0.86	0.09	0.55	0.05	0.91	0.09		

series		Buoy-derived Abundance Index	
units			
area		Tropical	
method		Delta lognormal	
source		SCRS/2019/075	
Year	Quarter	Std. CPUE	CV
2010	**1**	0.44	0.15
2010	**2**	0.44	0.15
2010	**3**	0.41	0.16
2010	**4**	0.63	0.16
2011	**1**	0.45	0.16
2011	**2**	0.51	0.15
2011	**3**	0.37	0.16
2011	**4**	0.33	0.16
2012	**1**	0.23	0.15
2012	**2**	0.34	0.15
2012	**3**	0.22	0.16
2012	**4**	0.17	0.15
2013	**1**	0.12	0.14
2013	**2**	0.17	0.14
2013	**3**	0.17	0.13
2013	**4**	0.22	0.13
2014	**1**	0.17	0.13
2014	**2**	0.18	0.13
2014	**3**	0.22	0.12
2014	**4**	0.22	0.12
2015	**1**	0.15	0.12
2015	**2**	0.17	0.12
2015	**3**	0.22	0.09
2015	**4**	0.22	0.10
2016	**1**	0.14	0.11
2016	**2**	0.19	0.12
2016	**3**	0.22	0.12
2016	**4**	0.21	0.11
2017	**1**	0.17	0.12
2017	**2**	0.24	0.11
2017	**3**	0.34	0.11
2017	**4**	0.46	0.11

Table 5. Other available abundance indices for 2019 Atlantic yellowfin tuna stock assessment.

series	Joint LL- Region1		Joint LL- Region2		Joint LL- Region3		Joint LL- Region1		Joint LL- Region2		Joint LL- Region3		Joint LL- Region1		Joint LL- Region2		Joint LL- Region3	
units	Number						Number						Number					
area	North Temprate		Tropical		South Temprate		North Temprate		Tropical		South Temprate		North Temprate		Tropical		South Temprate	
method	Delta lognormal						Delta lognormal						Delta lognormal					
source	SCRS/2019/081						SCRS/2019/081						SCRS/2019/081					
note	without vessel ID before 1979 with 3 areas						with vessel ID after 1979 with 3 areas						without ID for the entire period with 3 areas					
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
1959	5.11	0.19	3.52	0.05	6.58	0.19							5.81	0.20	6.60	0.05	8.17	0.20
1960	1.85	0.15	2.82	0.04	4.89	0.15							2.94	0.16	4.99	0.05	7.90	0.16
1961	1.93	0.27	1.89	0.03	2.85	0.09							3.07	0.27	3.47	0.04	4.32	0.10
1962	2.16	0.08	1.58	0.04	1.79	0.08							3.07	0.08	3.07	0.04	2.10	0.09
1963	1.63	0.06	1.17	0.03	1.24	0.06							2.46	0.07	2.14	0.04	1.49	0.07
1964	1.12	0.05	0.89	0.03	0.86	0.06							1.65	0.06	1.59	0.04	0.90	0.06
1965	0.32	0.04	0.82	0.03	0.75	0.05							0.60	0.05	1.42	0.03	0.86	0.06
1966	0.53	0.06	0.72	0.04	0.52	0.07							0.81	0.06	1.31	0.04	0.54	0.07
1967	1.14	0.06	0.84	0.04	0.52	0.08							1.58	0.06	1.55	0.04	0.61	0.09
1968	0.47	0.06	0.90	0.04	0.68	0.06							0.91	0.07	1.82	0.05	0.76	0.07
1969	1.05	0.06	0.75	0.04	0.63	0.07							1.49	0.07	1.42	0.05	0.89	0.07
1970	0.41	0.05	0.51	0.04	0.44	0.07							0.81	0.05	0.96	0.05	0.56	0.08
1971	0.40	0.04	0.51	0.04	0.44	0.08							0.83	0.05	0.95	0.05	0.50	0.08
1972	0.51	0.07	0.55	0.05	0.60	0.07							0.88	0.07	0.97	0.06	0.80	0.08
1973	0.44	0.07	0.55	0.07	0.71	0.09							0.78	0.08	0.85	0.08	0.81	0.09
1974	0.45	0.08	0.79	0.10	0.54	0.10							0.74	0.08	1.23	0.11	0.58	0.11
1975	0.28	0.07	0.40	0.06	0.40	0.11							0.56	0.07	0.68	0.07	0.44	0.12
1976	0.31	0.06	0.50	0.07	0.49	0.26							0.62	0.07	0.71	0.08	0.55	0.28
1977	0.49	0.08	0.55	0.08	0.58	0.14							0.89	0.08	0.87	0.09	0.55	0.14
1978	0.59	0.08	0.55	0.09	0.58	0.12							1.02	0.07	0.84	0.10	0.60	0.13
1979	0.43	0.07			0.54	0.17	1.12	0.10	1.29	0.08	1.35	0.20	0.77	0.07	0.87	0.07	0.59	0.14
1980							0.89	0.10	1.25	0.06	0.62	0.14	0.60	0.07	0.89	0.05	0.48	0.10
1981							0.81	0.08	1.23	0.05	0.72	0.12	0.59	0.06	0.85	0.04	0.57	0.09
1982							0.74	0.09	1.18	0.04	0.90	0.10	0.64	0.08	0.80	0.04	0.69	0.08
1983							1.01	0.09	1.02	0.06	0.85	0.11	0.74	0.08	0.70	0.05	0.63	0.09
1984							1.12	0.09	1.29	0.05	1.07	0.12	0.88	0.08	0.83	0.04	0.80	0.10
1985							0.86	0.09	1.15	0.04	0.86	0.10	0.69	0.08	0.77	0.04	0.79	0.08
1986							1.06	0.08	1.41	0.05	0.99	0.10	0.83	0.07	0.92	0.04	0.83	0.08
1987							1.06	0.07	1.52	0.04	0.91	0.11	0.83	0.06	0.97	0.04	0.78	0.09
1988							1.19	0.07	1.37	0.04	1.35	0.10	1.00	0.06	0.93	0.04	1.08	0.08
1989							1.16	0.06	1.31	0.04	1.00	0.10	1.05	0.06	0.85	0.03	0.80	0.09
1990							1.36	0.07	1.32	0.04	1.00	0.09	1.17	0.06	0.84	0.04	0.84	0.08
1991							1.23	0.06	1.11	0.04	1.03	0.07	1.07	0.06	0.71	0.04	0.89	0.06
1992							1.25	0.06	0.86	0.04	1.07	0.09	1.00	0.06	0.57	0.04	1.01	0.08
1993							0.96	0.07	1.02	0.04	0.88	0.09	0.74	0.07	0.65	0.04	0.67	0.08
1994							1.22	0.07	1.07	0.04	1.06	0.07	0.98	0.06	0.65	0.04	0.83	0.06
1995							1.26	0.06	1.13	0.04	1.22	0.07	0.95	0.06	0.71	0.04	0.96	0.06
1996							1.01	0.06	0.98	0.04	1.09	0.08	0.78	0.05	0.65	0.04	0.93	0.07
1997							1.04	0.06	0.88	0.04	0.98	0.08	0.72	0.06	0.58	0.03	0.81	0.07
1998							1.08	0.06	0.94	0.04	1.15	0.06	0.80	0.06	0.63	0.04	0.86	0.06
1999							1.10	0.06	0.95	0.04	1.05	0.07	0.87	0.06	0.61	0.04	0.93	0.06
2000							1.07	0.05	0.94	0.04	1.08	0.06	0.89	0.05	0.63	0.04	1.11	0.06
2001							1.00	0.05	0.87	0.04	1.11	0.07	0.81	0.05	0.59	0.04	1.03	0.07
2002							0.86	0.05	0.78	0.04	1.18	0.08	0.59	0.05	0.54	0.04	1.12	0.08
2003							0.93	0.05	0.82	0.04	1.16	0.07	0.64	0.05	0.51	0.04	0.94	0.07
2004							1.04	0.05	0.94	0.04	1.13	0.08	0.78	0.05	0.56	0.03	0.87	0.07
2005							1.34	0.05	1.18	0.03	1.29	0.06	0.92	0.05	0.70	0.03	1.07	0.06
2006							1.14	0.06	0.98	0.03	1.07	0.05	0.95	0.06	0.57	0.03	0.89	0.05
2007							0.90	0.06	0.87	0.04	1.02	0.05	0.70	0.06	0.53	0.04	0.82	0.05
2008							0.69	0.07	0.67	0.04	0.85	0.06	0.49	0.06	0.44	0.03	0.70	0.06
2009							0.77	0.07	0.69	0.03	0.81	0.06	0.56	0.06	0.46	0.03	0.72	0.06
2010							0.72	0.07	0.64	0.03	0.90	0.06	0.50	0.06	0.42	0.03	0.82	0.06
2011							0.79	0.07	0.65	0.03	1.02	0.06	0.55	0.06	0.47	0.03	0.96	0.05
2012							0.84	0.06	0.66	0.03	1.21	0.06	0.64	0.06	0.43	0.03	1.17	0.06
2013							0.87	0.06	0.72	0.04	1.24	0.05	0.67	0.06	0.47	0.04	1.15	0.05
2014							0.80	0.08	0.64	0.04	0.89	0.06	0.63	0.08	0.43	0.04	0.82	0.06
2015							0.78	0.07	0.67	0.04	0.99	0.06	0.63	0.07	0.46	0.04	0.89	0.06
2016							0.86	0.07	0.64	0.04	0.98	0.06	0.70	0.07	0.43	0.04	0.93	0.06
2017							0.92	0.07	0.67	0.04	1.04	0.06	0.76	0.07	0.45	0.04	0.87	0.06
2018							0.86	0.09	0.55	0.05	0.91	0.09	0.72	0.09	0.39	0.05	0.92	0.09

series	Joint LL- Region1		Joint LL- Region2		Joint LL- Region3		Joint LL- Region4		Joint LL- Region5		Joint LL- Region6	
units	Number											
area	NW Temprate		West Tropical		SW Temprate		SE Temprate		East Tropical		NE Temprate	
method	Delta lognormal											
source	SCRS/2019/081											
note	without vessel ID before 1979 with 6 areas											
Year	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV
1959	5.56	0.12	3.05	0.03	5.36	3.82	7.41	0.17	4.12	0.07		
1960	1.22	0.10	2.50	0.03			5.55	0.10	3.06	0.06		
1961	1.60	0.17	1.38	0.03	4.39	0.10	3.25	0.06	1.93	0.05		
1962	1.97	0.05	1.53	0.03	2.39	0.09	1.49	0.07	1.43	0.05		
1963	1.51	0.04	1.08	0.03	2.23	0.07	1.06	0.04	1.12	0.04	2.59	0.15
1964	0.77	0.04	0.84	0.02	2.13	0.04	0.71	0.05	0.84	0.04	1.45	0.06
1965	0.16	0.03	0.90	0.02	2.03	0.05	0.68	0.04	0.65	0.03	0.65	0.05
1966	0.53	0.04	0.87	0.03	1.88	0.05	0.40	0.05	0.54	0.04	0.66	0.07
1967	0.99	0.05	0.79	0.03	1.96	0.05	0.35	0.06	0.78	0.04	1.92	0.07
1968	0.31	0.05	0.95	0.03	1.82	0.07	0.54	0.05	0.72	0.05	0.84	0.08
1969	1.08	0.05	0.77	0.03	1.72	0.06	0.41	0.06	0.64	0.05	1.17	0.09
1970	0.34	0.04	0.55	0.03	1.63	0.06	0.26	0.06	0.42	0.07	0.64	0.06
1971	0.34	0.03	0.42	0.03	1.50	0.08	0.26	0.05	0.39	0.07	0.54	0.06
1972	0.54	0.05	0.37	0.04	1.73	0.07	0.36	0.06	0.47	0.07	0.51	0.10
1973	0.38	0.06	0.38	0.07	5.57	0.11	0.34	0.06	0.47	0.09	0.56	0.08
1974	0.40	0.06	0.45	0.04			0.27	0.07	0.79	0.10	0.67	0.09
1975	0.13	0.05	0.29	0.05			0.17	0.07	0.37	0.08	0.62	0.07
1976	0.20	0.05	0.38	0.04			0.28	0.12	0.43	0.09	0.58	0.09
1977	0.29	0.06	0.84	0.05			0.26	0.09	0.41	0.09	0.63	0.11
1978	0.40	0.05	0.61	0.07			0.41	0.09	0.44	0.11	0.76	0.09
1979	0.30	0.05			1.86	0.09	0.28	0.11			0.75	0.18
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2018												

series	Joint LL- Region1		Joint LL- Region2		Joint LL- Region3		Joint LL- Region4		Joint LL- Region5		Joint LL- Region6	
units	Number											
area	NW Temprate		West Tropical		SW Temprate		SE Temprate		East Tropical		NE Temprate	
method	Delta lognormal											
source	SCRS/2019/081											
note	with vessel ID after 1979 with 6 areas											
Year	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV
1959												
1960												
1961												
1962												
1963												
1964												
1965												
1966												
1967												
1968												
1969												
1970												
1971												
1972												
1973												
1974												
1975												
1976												
1977												
1978												
1979	1.16	0.10	1.47	0.10			1.53	0.19	0.92	0.10	1.31	0.30
1980	0.75	0.10	2.18	0.10	0.16	0.51	0.55	0.15	1.12	0.08	1.56	0.35
1981	0.88	0.09	1.57	0.08	0.15	0.44	0.77	0.13	1.07	0.05	1.19	0.26
1982	0.83	0.11	1.17	0.08	0.30	0.40	0.93	0.12	1.12	0.05	0.79	0.26
1983	1.03	0.11	1.56	0.12	0.46	0.40	0.53	0.12	1.09	0.07	1.12	0.17
1984	1.34	0.09	1.54	0.12	0.42	0.39	0.99	0.15	1.24	0.06	0.95	0.19
1985	0.74	0.10	1.05	0.08	0.83	0.37	0.59	0.11	1.17	0.05	1.16	0.22
1986	1.07	0.09	1.57	0.13	0.71	0.37	0.82	0.11	1.34	0.05	1.05	0.18
1987	1.08	0.08	1.29	0.13	0.76	0.37	0.69	0.12	1.63	0.05	2.25	0.15
1988	1.29	0.07	1.33	0.09	0.75	0.37	1.39	0.12	1.53	0.04	1.31	0.19
1989	1.50	0.08	1.25	0.08	0.65	0.37	0.89	0.11	1.29	0.04	1.48	0.14
1990	1.33	0.08	1.34	0.09	0.36	0.39	1.05	0.09	1.33	0.04	1.51	0.13
1991	1.41	0.08	1.20	0.08	0.46	0.39	1.30	0.07	1.10	0.04	1.61	0.15
1992	1.53	0.07	0.98	0.11	0.90	0.42	0.90	0.09	0.89	0.05	1.07	0.13
1993	0.94	0.07	0.87	0.10			1.07	0.09	1.10	0.04	1.18	0.14
1994	1.34	0.07	0.92	0.10	0.79	0.34	1.01	0.07	1.15	0.04	1.40	0.17
1995	1.36	0.07	1.09	0.11	2.55	0.32	1.27	0.07	1.19	0.04	1.50	0.11
1996	1.05	0.07	0.95	0.09			1.22	0.08	1.00	0.04	0.98	0.11
1997	1.11	0.07	0.75	0.08			0.90	0.08	0.80	0.04	1.13	0.11
1998	1.11	0.06	0.92	0.08	1.54	0.20	1.00	0.08	0.88	0.05	0.99	0.12
1999	1.27	0.07	0.85	0.07	1.43	0.21	0.95	0.09	0.94	0.04	0.90	0.13
2000	1.13	0.06	0.54	0.08	1.38	0.20	1.04	0.08	0.93	0.04	0.95	0.09
2001	1.01	0.07	0.65	0.07	1.34	0.21	0.98	0.10	0.97	0.05	1.10	0.08
2002	0.85	0.06	0.55	0.08	1.23	0.21	1.43	0.13	0.90	0.05	1.12	0.10
2003	0.92	0.06	0.70	0.10	1.19	0.21	1.31	0.09	0.92	0.04	1.10	0.13
2004	1.08	0.06	0.62	0.07	1.01	0.22	1.27	0.09	1.01	0.04	1.17	0.09
2005	1.29	0.06	0.82	0.07	1.14	0.20	1.52	0.08	1.23	0.04	1.31	0.09
2006	1.26	0.08	0.61	0.07	1.08	0.20	1.21	0.06	0.97	0.04	1.33	0.11
2007	0.97	0.07	0.51	0.07	0.98	0.20	1.23	0.07	0.96	0.04	0.91	0.14
2008	0.73	0.07	0.40	0.07	0.85	0.21	0.87	0.07	0.69	0.04	0.80	0.19
2009	0.81	0.07	0.47	0.07	0.75	0.21	0.82	0.07	0.74	0.04	0.80	0.14
2010	0.80	0.07	0.37	0.07	1.07	0.20	0.90	0.07	0.66	0.04	0.75	0.15
2011	0.78	0.07	0.48	0.06	0.93	0.20	1.07	0.07	0.69	0.04	0.82	0.11
2012	0.83	0.06	0.48	0.06	0.83	0.22	1.25	0.06	0.65	0.04	1.11	0.14
2013	0.85	0.07	0.40	0.08	0.85	0.21	1.43	0.06	0.80	0.04	0.93	0.14
2014	0.81	0.07	0.34	0.09	0.84	0.21	0.93	0.07	0.70	0.05	0.81	0.21
2015	0.85	0.07	0.45	0.09	0.74	0.21	1.12	0.07	0.68	0.05	0.78	0.17
2016	0.94	0.07	0.46	0.09	1.07	0.21	1.15	0.08	0.69	0.05	0.66	0.18
2017	0.92	0.07	0.47	0.08	1.10	0.21	0.91	0.08	0.69	0.04	0.84	0.18
2018	0.87	0.09	0.39	0.12			0.99	0.09	0.62	0.05	1.07	0.26

series	Joint LL- Region1		Joint LL- Region2		Joint LL- Region3		Joint LL- Region4		Joint LL- Region5		Joint LL- Region6	
units	Number											
area	NW Temprate		West Tropical		SW Temprate		SE Temprate		East Tropical		NE Temprate	
method	Delta lognormal											
source	SCRS/2019/081											
note	without ID for the entire period with 6 areas											
Year	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV
1959	8.27	0.19	5.82	0.07	5.13	0.30	10.25	0.28	9.90	0.08		
1960	2.49	0.16	4.59	0.06			8.87	0.16	6.88	0.06		
1961	2.61	0.26	2.38	0.07	4.63	0.18	5.05	0.11	4.29	0.05		
1962	2.93	0.09	2.81	0.06	2.00	0.17	2.01	0.11	3.12	0.05		
1963	2.42	0.06	1.91	0.06	1.43	0.13	1.47	0.08	2.39	0.05	3.89	0.23
1964	1.46	0.06	1.37	0.05	1.26	0.08	0.83	0.09	1.81	0.05	2.00	0.09
1965	0.47	0.05	1.56	0.05	0.95	0.10	0.85	0.07	1.27	0.04	1.07	0.09
1966	0.95	0.07	1.54	0.06	0.73	0.10	0.45	0.08	1.06	0.05	1.02	0.12
1967	1.66	0.08	1.41	0.07	0.93	0.11	0.49	0.11	1.67	0.05	2.30	0.12
1968	0.81	0.07	1.63	0.07	1.37	0.13	0.63	0.09	1.74	0.06	1.31	0.13
1969	1.78	0.08	1.38	0.06	1.26	0.12	0.53	0.11	1.29	0.06	1.79	0.15
1970	0.88	0.07	1.03	0.07	0.90	0.12	0.35	0.10	0.93	0.08	1.06	0.09
1971	0.85	0.05	0.83	0.07	0.84	0.16	0.33	0.10	0.81	0.08	0.89	0.10
1972	1.10	0.08	0.84	0.09	1.31	0.13	0.51	0.11	0.77	0.08	0.82	0.19
1973	0.89	0.09	0.97	0.14	5.55	0.21	0.48	0.10	0.72	0.10	0.99	0.12
1974	0.96	0.09	1.30	0.09			0.38	0.11	1.03	0.11	0.82	0.17
1975	0.54	0.08	0.65	0.10			0.24	0.12	0.66	0.08	0.84	0.12
1976	0.61	0.07	0.88	0.09			0.44	0.28	0.58	0.10	0.93	0.14
1977	0.82	0.10	1.61	0.11			0.34	0.15	0.55	0.10	0.97	0.17
1978	1.01	0.08	0.94	0.14	0.67	0.17	0.52	0.14	0.58	0.12	0.90	0.16
1979	0.76	0.07	1.05	0.07			0.68	0.14	0.56	0.08	1.97	0.18
1980	0.47	0.07	1.45	0.08	0.54	0.26	0.34	0.12	0.61	0.06	1.16	0.20
1981	0.49	0.07	1.02	0.06	0.63	0.21	0.43	0.10	0.65	0.05	1.03	0.15
1982	0.46	0.10	0.81	0.06	0.74	0.15	0.58	0.09	0.63	0.04	0.97	0.14
1983	0.56	0.10	1.16	0.09	0.99	0.17	0.30	0.09	0.61	0.06	1.00	0.11
1984	0.86	0.08	1.03	0.09	0.90	0.17	0.62	0.12	0.67	0.05	0.97	0.11
1985	0.41	0.10	0.82	0.06	1.14	0.16	0.51	0.09	0.65	0.04	1.26	0.15
1986	0.67	0.09	1.18	0.11	1.01	0.14	0.66	0.09	0.72	0.05	0.95	0.17
1987	0.69	0.07	1.02	0.12	1.14	0.17	0.39	0.11	0.81	0.05	1.60	0.11
1988	0.91	0.07	1.00	0.08	1.20	0.17	0.82	0.09	0.79	0.04	1.40	0.12
1989	1.09	0.07	0.88	0.07	1.19	0.17	0.56	0.09	0.71	0.04	1.29	0.10
1990	1.02	0.07	0.84	0.08	1.02	0.18	0.69	0.08	0.70	0.04	1.47	0.12
1991	1.06	0.07	0.72	0.07	1.12	0.16	0.89	0.07	0.58	0.04	1.06	0.12
1992	1.07	0.07	0.56	0.10	1.57	0.18	0.75	0.09	0.48	0.04	1.09	0.11
1993	0.66	0.07	0.47	0.09			0.65	0.08	0.58	0.04	1.14	0.12
1994	0.95	0.07	0.44	0.09	1.09	0.15	0.67	0.07	0.58	0.04	1.53	0.17
1995	0.83	0.07	0.61	0.10	1.80	0.18	0.90	0.07	0.64	0.04	1.48	0.09
1996	0.69	0.07	0.50	0.08			0.75	0.07	0.54	0.04	1.10	0.09
1997	0.60	0.07	0.42	0.07			0.66	0.07	0.45	0.04	1.07	0.10
1998	0.75	0.06	0.48	0.07	1.00	0.11	0.69	0.08	0.49	0.05	0.97	0.09
1999	0.85	0.07	0.48	0.07	1.33	0.10	0.69	0.08	0.50	0.04	0.91	0.12
2000	0.86	0.06	0.38	0.07	1.69	0.10	0.82	0.08	0.49	0.04	0.90	0.08
2001	0.75	0.06	0.42	0.06	1.42	0.10	0.76	0.10	0.53	0.04	1.09	0.07
2002	0.57	0.06	0.51	0.07	1.40	0.11	0.94	0.13	0.47	0.05	0.91	0.09
2003	0.63	0.06	0.29	0.08	1.25	0.11	0.85	0.09	0.43	0.04	0.96	0.11
2004	0.71	0.06	0.33	0.06	0.95	0.16	0.88	0.08	0.46	0.04	1.01	0.08
2005	0.91	0.06	0.49	0.06	1.19	0.09	1.24	0.07	0.58	0.04	1.00	0.08
2006	0.90	0.08	0.36	0.06	1.14	0.09	0.95	0.06	0.48	0.04	1.14	0.09
2007	0.59	0.07	0.32	0.06	1.11	0.08	0.90	0.07	0.47	0.04	0.89	0.13
2008	0.53	0.07	0.29	0.06	1.04	0.11	0.68	0.07	0.37	0.04	0.75	0.15
2009	0.47	0.07	0.31	0.06	0.84	0.12	0.70	0.07	0.39	0.04	0.90	0.13
2010	0.48	0.07	0.24	0.06	1.16	0.11	0.92	0.07	0.37	0.04	0.82	0.13
2011	0.50	0.07	0.37	0.05	1.01	0.10	0.96	0.07	0.38	0.04	0.86	0.11
2012	0.60	0.06	0.34	0.06	0.85	0.14	1.12	0.06	0.36	0.04	1.25	0.13
2013	0.65	0.07	0.33	0.07	0.95	0.11	1.29	0.06	0.42	0.04	0.90	0.13
2014	0.59	0.08	0.28	0.08	1.00	0.11	0.80	0.07	0.38	0.05	0.98	0.20
2015	0.58	0.07	0.35	0.08	1.06	0.13	1.04	0.07	0.38	0.05	0.90	0.12
2016	0.66	0.07	0.37	0.08	1.01	0.11	1.11	0.08	0.37	0.05	0.85	0.15
2017	0.69	0.07	0.33	0.07	1.05	0.11	0.79	0.08	0.39	0.04	0.96	0.16
2018	0.62	0.09	0.30	0.11			0.91	0.09	0.36	0.05	1.00	0.24

Table 5. Continued. Other available abundance indices for 2019 Atlantic yellowfin tuna stock assessment.

series	JPN LL-index2		JPN LL-index5		JPN LL-index8		JPN LL-index1		JPN LL-index4		JPN LL-index7		USA LL		USA LL		BRA LL (Region 2)		BRA LL (Region 3)		BRA LL (regions2&3)		KOR LL (Region 2)	
units	Number		Number		Number		Weight		Weight		Weight		Number		Weight		Number		Number		Number		Number	
area	Atlantic		Atlantic		Atlantic		Atlantic		Atlantic		Atlantic		North Atlantic		North Atlantic		Tropical		South Temprate		TRO and South Temp		Tropical	
method	Delta lognormal		Delta lognormal		Delta lognormal		Delta lognormal		Delta lognormal		Delta lognormal		Delta lognormal		Delta lognormal		Delta lognormal		Delta lognormal		Delta lognormal		Delta lognormal	
source	SCRS/2019/072		SCRS/2019/072		SCRS/2019/072		SCRS/2019/072		SCRS/2019/072		SCRS/2019/072		SCRS/2019/078		SCRS/2019/078		SCRS/2019/079		SCRS/2019/079		SCRS/2019/079		SCRS/P/2019/032	
note																								
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	Std. CPUE	CV
1959																								
1960																								
1961																								
1962																								
1963																								
1964																								
1965	2.69	0.03	2.88	0.03																				
1966	2.15	0.06	2.21	0.06																				
1967	4.48	0.08	4.59	0.07																				
1968	3.59	0.07	3.78	0.07																				
1969	3.05	0.08	3.18	0.08																				
1970	2.06	0.07	2.15	0.07																				
1971	1.96	0.06	2.01	0.06			94.28	0.06	96.78	0.06														
1972	1.66	0.07	1.73	0.06			82.81	0.07	86.77	0.07														
1973	1.42	0.09	1.45	0.09			62.02	0.09	63.27	0.09														
1974	2.13	0.12	2.23	0.12			108.93	0.13	115.12	0.13														
1975	1.16	0.06	1.21	0.06			53.52	0.06	56.10	0.06														
1976	1.56	0.08	1.61	0.09	1.37	0.11	66.38	0.09	68.93	0.10	54.77	0.11												
1977	0.82	0.09	0.86	0.09	0.78	0.13	35.30	0.10	37.06	0.10	32.05	0.13												
1978	1.43	0.09	1.48	0.09	1.40	0.12	57.72	0.10	60.00	0.10	54.87	0.12												
1979	1.90	0.08	1.88	0.08	1.78	0.10	68.65	0.08	67.92	0.08	54.99	0.10											1.56	1.51
1980	1.22	0.07	1.22	0.06	1.64	0.09	42.31	0.07	42.42	0.07	55.52	0.08											1.81	0.08
1981	1.19	0.05	1.20	0.05	1.59	0.06	42.64	0.05	43.13	0.05	57.35	0.06											1.80	0.05
1982	1.07	0.06	1.08	0.06	1.18	0.07	39.00	0.07	39.56	0.07	46.69	0.07											1.35	0.06
1983	1.20	0.08	1.20	0.08	1.33	0.09	40.30	0.08	40.13	0.08	47.72	0.09											1.11	0.09
1984	1.57	0.09	1.56	0.09	1.87	0.10	52.43	0.09	52.37	0.09	66.10	0.09											2.06	0.08
1985	0.79	0.06	0.80	0.06	0.75	0.07	28.89	0.07	29.29	0.07	30.58	0.07											1.08	0.05
1986	1.57	0.09	1.56	0.09	1.50	0.10	52.75	0.09	52.44	0.09	52.82	0.10												
1987	1.53	0.07	1.53	0.07	1.28	0.08	53.25	0.07	53.46	0.07	47.64	0.07	11.79	0.10	454.98	0.11							1.30	0.06
1988	1.41	0.06	1.40	0.06	1.12	0.07	48.28	0.07	48.32	0.07	42.29	0.07	12.36	0.09	467.19	0.11							1.75	0.05
1989	1.06	0.05	1.07	0.05	0.89	0.05	36.47	0.05	37.00	0.05	33.63	0.05	11.89	0.09	449.18	0.10							1.42	0.05
1990	2.03	0.07	2.01	0.07	1.52	0.07	67.01	0.07	66.46	0.07	53.94	0.07	9.97	0.09	376.51	0.11								
1991	1.41	0.08	1.39	0.08	1.09	0.09	46.85	0.08	46.61	0.08	40.09	0.08	8.09	0.10	309.26	0.11							0.92	0.08
1992	1.22	0.09	1.20	0.09	0.99	0.10	39.70	0.09	39.36	0.09	36.62	0.09	9.28	0.09	356.89	0.11							0.44	0.13
1993	0.65	0.07	0.65	0.07	0.52	0.08	20.24	0.07	20.48	0.07	18.82	0.08	6.70	0.10	226.22	0.11							0.76	0.12
1994	0.96	0.10	0.96	0.10	0.81	0.11	29.22	0.10	29.25	0.10	26.23	0.10	7.08	0.10	207.93	0.11								
1995	0.64	0.05	0.65	0.05	0.51	0.06	20.02	0.06	20.36	0.06	18.95	0.06	8.04	0.09	290.98	0.11							0.86	0.09
1996	0.64	0.04	0.64	0.04	0.53	0.05	20.55	0.05	20.69	0.05	19.84	0.05	5.64	0.09	256.31	0.11							0.95	0.11
1997	0.56	0.05	0.56	0.05	0.43	0.05	16.95	0.05	16.98	0.05	15.65	0.05	6.24	0.09	245.21	0.11							1.09	0.12
1998	0.64	0.04	0.63	0.04	0.47	0.05	18.73	0.05	18.54	0.05	16.70	0.05	4.88	0.10	170.66	0.11							1.31	0.21
1999	0.80	0.05	0.80	0.05	0.61	0.06	23.13	0.06	23.35	0.05	20.62	0.06	6.22	0.10	251.47	0.11	1.58	0.09	1.55	0.10	1.40	0.06		
2000	0.80	0.05	0.79	0.05	0.60	0.05	21.47	0.05	21.33	0.05	19.18	0.05	6.64	0.10	240.21	0.11	1.44	0.08	1.47	0.10	1.28	0.06		
2001	0.73	0.05	0.72	0.05	0.48	0.05	19.71	0.05	19.55	0.05	15.62	0.05	6.08	0.10	243.94	0.12	0.79	0.08	1.24	0.09	0.97	0.05		
2002	0.66	0.05	0.65	0.05	0.42	0.06	17.96	0.06	17.65	0.05	14.28	0.06	5.77	0.10	192.17	0.11	1.09	0.08	1.32	0.11	1.26	0.06		
2003	0.78	0.05	0.77	0.05	0.63	0.05	21.39	0.05	21.10	0.05	20.01	0.05	5.45	0.11	162.64	0.12	0.99	0.09	1.18	0.11	1.01	0.07		
2004	0.99	0.04	0.98	0.04	0.74	0.05	27.54	0.05	27.40	0.05	23.63	0.05	8.38	0.11	302.70	0.12	0.88	0.07	1.09	0.15	0.95	0.07		
2005	0.78	0.05	0.77	0.05	0.54	0.05	22.57	0.05	22.31	0.05	18.78	0.05	7.47	0.10	267.56	0.11	1.04	0.07	1.20	0.18	1.24	0.07	0.82	0.13
2006	0.87	0.05	0.86	0.05	0.70	0.06	24.22	0.05	24.26	0.05	23.29	0.05	7.59	0.10	289.03	0.12	0.99	0.06	1.21	0.13	1.23	0.06	1.04	0.10
2007	0.87	0.09	0.88	0.09	0.62	0.09	25.02	0.09	25.32	0.09	21.57	0.08	8.30	0.10	342.81	0.12	1.10	0.06	1.15	0.13	1.29	0.05	0.88	0.06
2008	0.77	0.07	0.77	0.07	0.48	0.07	24.36	0.08	24.36	0.08	18.45	0.07	4.39	0.11	189.66	0.12	1.42	0.07	1.54	0.27	1.44	0.07	0.53	0.06
2009	0.69	0.07	0.69	0.07	0.48	0.08	20.75	0.08	20.80	0.08	17.50	0.08	4.75	0.11	160.83	0.12	0.90	0.06	0.79	0.25	1.03	0.06	0.68	0.07
2010	0.65	0.06	0.64	0.06	0.44	0.07	18.16	0.07	17.92	0.07	14.32	0.07	5.92	0.10	218.97	0.12	0.69	0.06	0.55	0.22	0.91	0.07	0.61	0.05
2011	1.10	0.09	1.07	0.09	0.65	0.09	30.73	0.10	30.22	0.10	21.67	0.09	5.83	0.11	206.02	0.12	0.55	0.06	1.52	0.18	0.77	0.06	0.53	0.05
2012	1.24	0.09	1.21	0.09	0.83	0.10	30.44	0.10	29.86	0.10	25.07	0.09	7.09	0.10	260.97	0.12	0.48	0.06	0.74	0.19	0.71	0.06	0.74	0.06
2013	1.64	0.14	1.61	0.09	1.16	0.15	43.59	0.14	43.04	0.14	36.45	0.14	6.68	0.10	261.97	0.11	0.58	0.11	0.54	0.22	0.64	0.10	0.57	0.06
2014	1.18	0.13	1.16	0.09	0.72	0.13	38.47	0.14	37.97	0.14	28.06	0.13	5.74	0.10	221.88	0.12	0.64	0.08	0.71	0.22	0.74	0.07	0.38	0.07
2015	1.19	0.12	1.18	0.09	0.84	0.12	34.80	0.12	34.64	0.12	30.56	0.12	5.77	0.10	223.62	0.12	0.65	0.10	0.82	0.21	0.75	0.08	0.19	0.10
2016	0.94	0.10	0.94	0.09	0.67	0.11	30.04	0.10	30.11	0.10	24.84	0.10	6.02	0.10	209.30	0.12	0.70	0.08	0.76	0.21	0.80	0.08	1.03	0.09
2017	0.83	0.10	0.83	0.09	0.66	0.12	26.03	0.11	26.00	0.10	24.22	0.11	7.16	0.10	251.44	0.11	0.74	0.09	0.75	0.20	0.92	0.09	0.68	0.08
2018	1.40	0.19	1.39	0.09	1.04	0.20	48.22	0.20	47.91	0.20	40.66	0.19	6.03	0.11	250.48	0.12							0.76	0.09

Table 6. CPUE evaluation table for abundance indices presented during the meeting.

SCRS Doc No.	SCRS/2019/072	SCRS/2019/075	SCRS/2019/078	SCRS/2019/079	SCRS/2019/081
Index Name:	Japan longline	Buoy-derived Abundance Index	USA longline	Brazil longline	Combined longline
Data Source (state if based on logbooks, observer data etc)	logbooks	acoustic data from echosunders buoys, TaskII	logbooks	logbooks	logbooks
Do the authors indicate the percentage of total effort of the fleet the CPUE data represents?	No	NA	No	Yes	Yes
If the answer to 1 is yes, what is the percentage?				71-80%	91-100%
Are sufficient diagnostics provided to assess model performance??	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient
How does the model perform relative to the diagnostics ?	Well	Well	Well	Well	Well
Documented data exclusions and classifications?	Yes	Yes	Yes	Yes	Yes
Data exclusions appropriate?	Yes	Yes	Yes	Yes	Yes
Data classifications appropriate?	Yes	Yes	Yes	Yes	Yes
Geographical Area	Atlantic	Tropical	Atl NW	Atl S	Atlantic
Data resolution level	Set	OTH	Set	Set	Set
Ranking of Catch of fleet in TINC database (use data catalogue)	6-10		11 or more	11 or more	6-10
Length of Time Series	longer than 20 years	6-10 years	longer than 20 years	11-20 years	longer than 20 years
Are other indices available for the same time period?	Few	Few	Few	Few	Few
Are other indices available for the same geographic range?	Few	Few	Few	Few	None
Does the index standardization account for Known factors that influence catchability/selectivity? (eg. Type of hook, bait type, depth etc.)	Yes	Yes	Yes	No	No
Estimated annual CV of the CPUE series	Low	Low	Low	Variable	Variable
Annual variation in the estimated CPUE exceeds biological plausibility	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely
Is data adequate for standardization purposes	Yes	Yes	Yes	Yes	Yes
Is this standardised CPUE time series continuous?	Yes	Yes	Yes	Yes	Yes
For fisheries independent surveys: what is the survey type?		Acoustic			
For 19: Is the survey design clearly described?		Yes			
Other Comments		need to revise the catch composition of the 1x1 and month cell using more detailed information; the same with the size data.	The data used for this index are also utiled in the combined index.		multi-national joint longline index from Japan, USA, Brazil, Korea, and Chinese-Taipei

Table 7. Proposed Fleet structure for Stock Synthesis model.

Model	Fishery	Region	Name	Gear	Yr start	Yr end
YFT_2019	1	2	Early PS	PS	1965	1985
YFT_2019	2	2	Transition PS	PS	1986	1990
YFT_2019	3	2	Late PS Free Schools	PS	1991	2018
YFT_2019	4	2	Late PS FAD	PS	1991	2018
YFT_2019	5	2	Ghana BB+PS	PS / BB	1965	2018
YFT_2019	6	2	TRO BB south Dakar	BB	1962	2018
YFT_2019	7	2	TRO BB north Dakar Early	BB	1965	1979
YFT_2019	8	2	TRO BB north Dakar Late	BB	1980	2018
YFT_2019	9	1	North BB Azores	BB	1965	2017
YFT_2019	10	1	JLL North	LL	1950	2018
YFT_2019	11	2	JLL Tropical	LL	1950	2018
YFT_2019	12	3	JLL South	LL	1950	2018
YFT_2019	13	1	Other LL North	LL	1950	2018
YFT_2019	14	2	Other LL Tropical	LL	1950	2018
YFT_2019	15	3	Other LL South	LL	1950	2018
YFT_2019	16	1	RR USA	RR	1980	2018
YFT_2019	17	2	HL Brazil north	HL	2014	2018

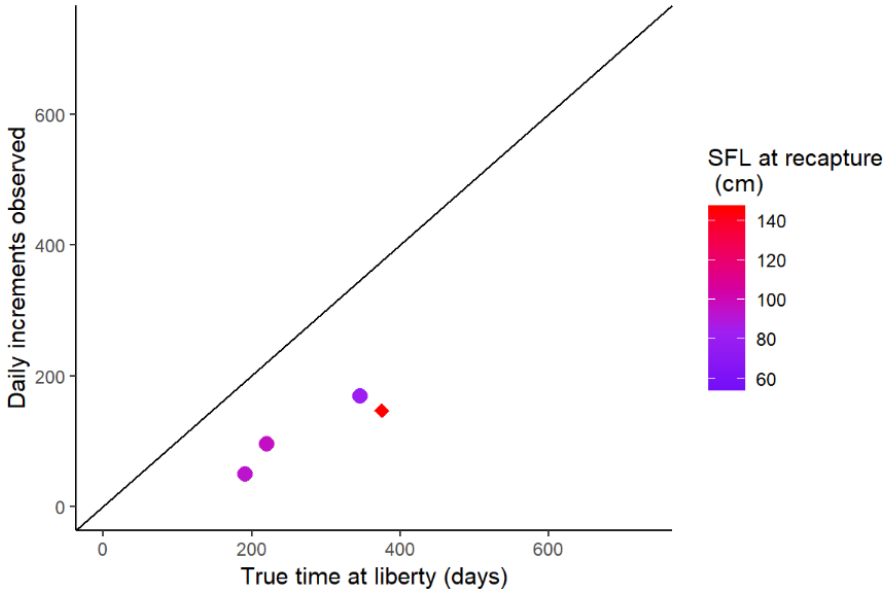

Figure 1. Comparison of daily increment counts with true time at liberty. A one-to-one line is drawn in solid black. Points falling below the line indicate that the number of increments counted underestimates the true time at liberty. Different symbols reflect the different age read experts. The colors of the symbols indicate the fish size at recapture. SFL = straight fork length.

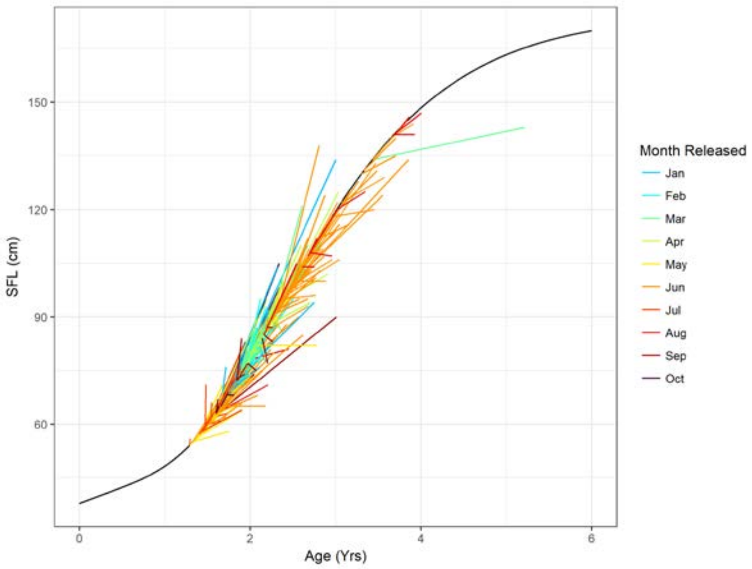

Figure 2. YFT size increments from tagged and recapture fish off St Helena. The age at release is plotted assuming the Gascuel *et al.* (1992) YFT growth model, colors indicate the month of release.

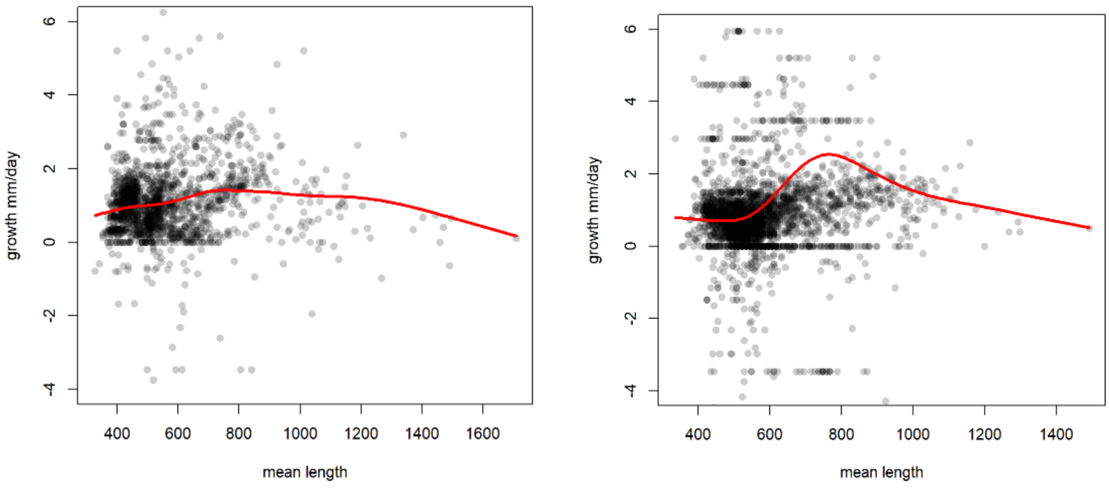

Figure 3. Growth information from AOTTP tagging records of fish recaptures on free schools (left panel) and FAD/Seamounts (right panel). A smoothing spline with a tuning parameter = 0.9 was fitted to the data (red solid line) to show the trend in growth rates. The 2-stanza growth pattern is clearly apparent in the FAD caught fish and much less striking in the free school fish. Note: the y-axis was cropped at -4 and +6 to ease visualization, some data exist beyond these bounds.

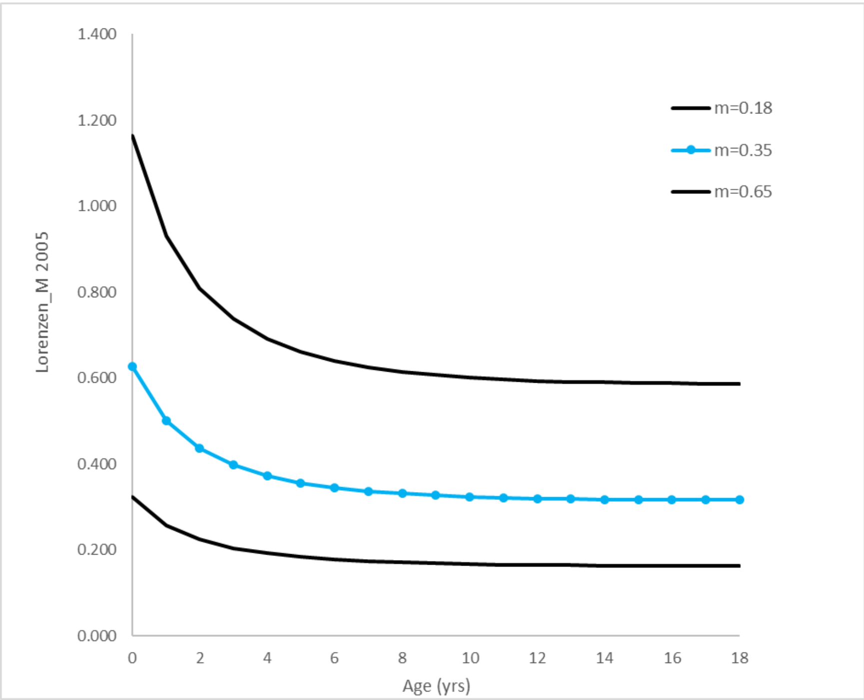

Figure 4. Reference mortality vector (blue) from the Then *et al*. (2015) model using a t_{max} of 18, and alternative mortality vectors (black) obtained from the prediction standard error of the Then *et al*. (2015) model at age 18 (0.15).

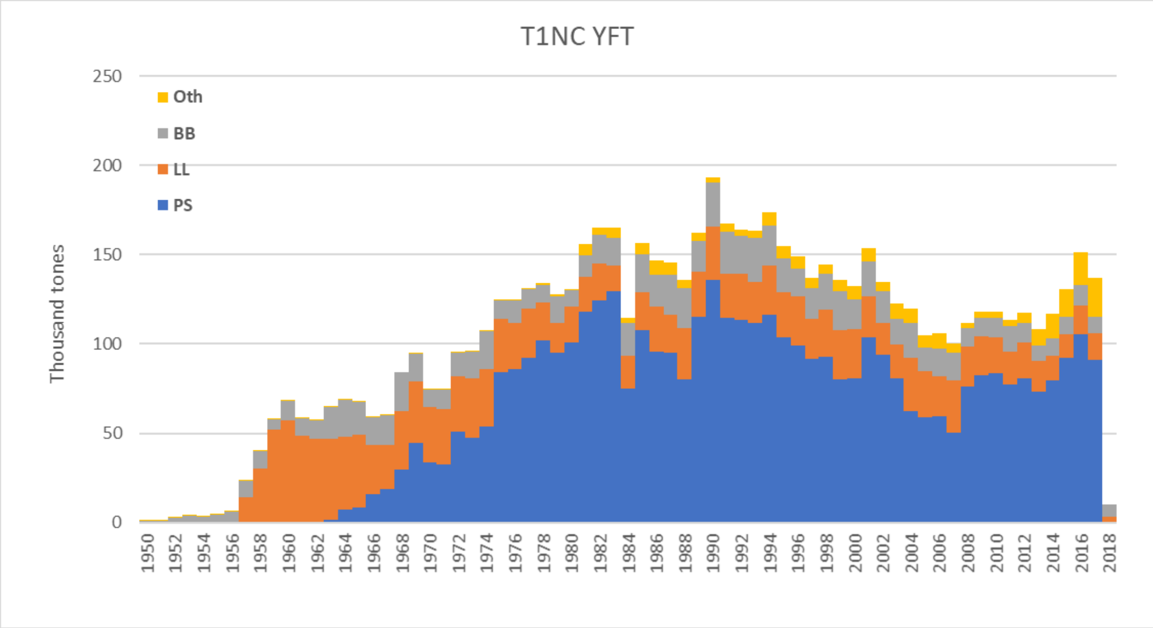

Figure 5. Task I nominal catches of YFT accumulated by main gear type.

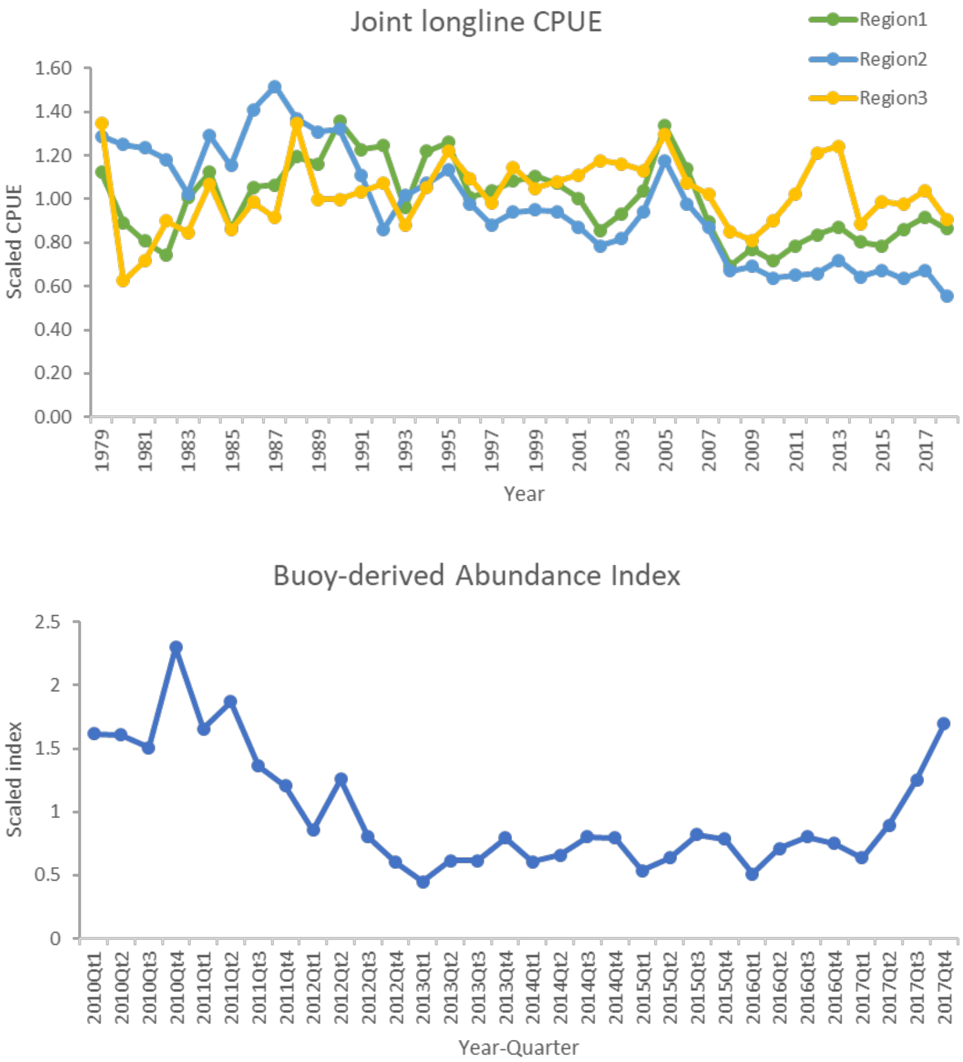

Figure 6. Recommended abundance indices for reference set in 2019 Atlantic yellowfin tuna stock assessment.

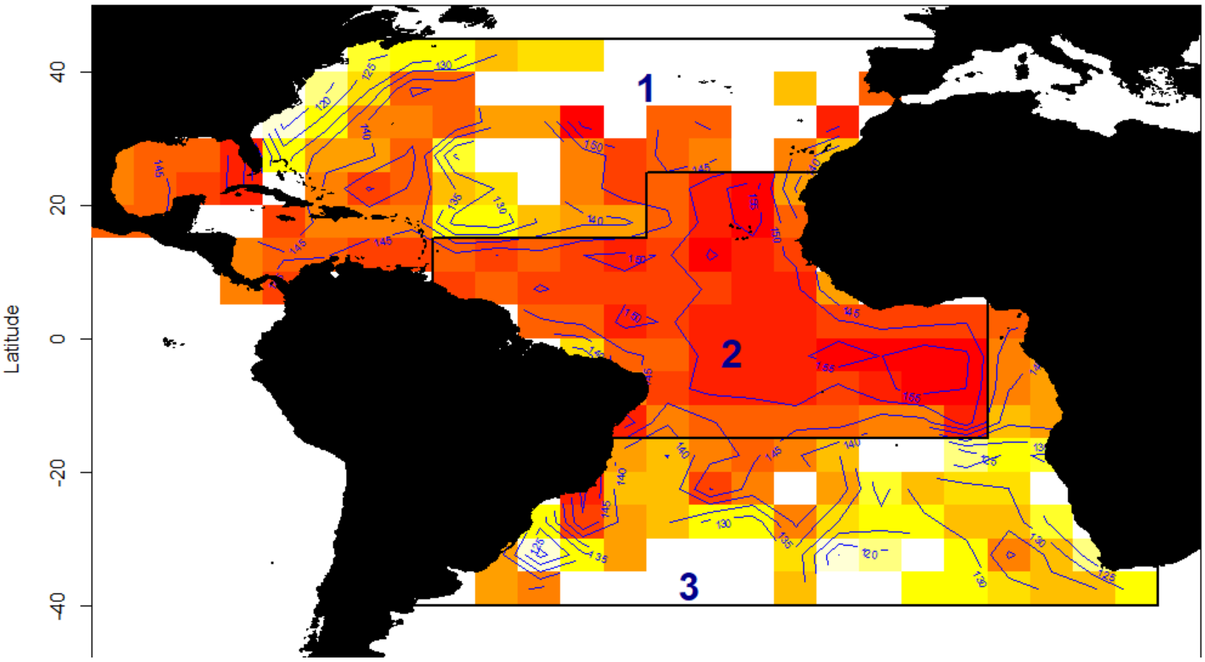

Figure 7. Proposed spatial partitioning for assessment model fleet structure.

Appendix 1

Agenda

1. Opening, adoption of agenda and meeting arrangements

2. Review of historical and new data on yellowfin biology

   2.1 Age and growth

   2.2 Natural mortality

   2.3 Reproduction

3. Review of fishery statistics

   3.1 Task I (catches) data

   3.2 Task II (catch-effort and size samples) data

   3.3 Improvements to Ghana statistics (Task I and II, 2006-2018)

   3.4 Improvements to "faux poissons" estimations (Task I)

   3.5 Other information (tagging)

4. Review and update of CAS/CAA

   4.1 Preliminary estimations

   4.2 Improvements needed for a final CAS estimation

5. Review of fishery indicators

6. Review of available indices of relative abundances by fleet and estimation of combined indices

7. Identification of data inputs and specifications for the different assessment models and advice framework (ASPIC, VPA2-Box, BSP, SS3, Others)

   7.1 General considerations

   7.2 Deadlines

   7.3 Process for building the uncertainty grid starting from a reference case

   7.4 Stock synthesis specifications

   7.5 Surplus production model

8. Review of the progress of AOTTP

9. Recommendations

   9.1 Biology

   9.2 Statistics

   9.3 Fishery indicators and indices of abundance

   9.4 Assessment models

   9.5 AOTTP

10. Other matters

11. Adoption of the report and closure

Appendix 2

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Appendix 3

List of Papers and Presentations

Number	Title	Authors
SCRS/2019/060	Comparison of yellowfin tuna CPUE and length composition between the Taiwanese and Japanese longline fisheries in the Atlantic Ocean	Matsumoto T., Satoh K., Kitakado T., Wang S., Su N., and Yeh Y.
SCRS/2019/062	Proposal of use of the hindcasting approach for evaluating prediction skill of the stock assessment models	Kitakado T., Satoh K., Matsumoto T., and Yokoi H.
SCRS/2019/064	Review and preliminary analyses of size samples of Atlantic yellowfin tuna (*Thunnus albacares*)	Ortiz M., and Palma C.
SCRS/2019/065	AOTTP yellowfin tuna Tag-recapture data by numbers - an update	Beare D., Ailloud L., Garcia J., and Seynabou N.
SCRS/2019/066	Accounting for fishing days without set in the CPUE standardisation of yellowfin tuna in free schools for the EU purse seine fleet operating in the Eastern Atlantic Ocean during the 1991-2018 period	Guéry L., Deslias C., Kaplan D., Marsac F., Abascal F., Pascual P., and Gaertner D.
SCRS/2019/067	Assessing the effectiveness of the current moratorium on dFADs using conventional tagging data from the AOTTP	Deledda-Tramoni G., and Gaertner D.
SCRS/2019/068	First estimate of tag-shedding for yellowfin tuna in the Atlantic Ocean from AOTTP data	Gaertner D. , Goni N. , Amande J., Pascual Alayon P., N'Gom F., Addi E., Conceicao I., da Silva G. B., Alves Bezerra N., Ferreira Muniz R., Niella Y., Wright S., Beare D., and Ailloud L.
SCRS/2019/069	First estimates of the reporting rate for recaptures of yellowfin, bigeye and skipjack tunas from tag-seeding experiments conducted during the AOTTP program	Akia S., Amande M., and Gaertner D.
SCRS/2019/070	Assessing the randomness of unreported recapture data for the Atlantic Ocean tropical tuna purse seine fishery	Norelli A. P.
SCRS/2019/071	Preliminary results on AOTTP validation of otolith increment deposition rates in yellowfin tuna in the Atlantic	Ailloud L., Beare D., Farley J.H., and Krusic-Golub K.
SCRS/2019/072	Japanese longline CPUE for yellowfin tuna (*Thunnus albacares*) in the Atlantic Ocean standardized using GLM up to 2018	Yokoi H., Matsumoto T., and Satoh K.
SCRS/2019/073	Propose of stock assessment model specification of yellowfin tuna in the Atlantic Ocean	Yokoi H., and Satoh K.
SCRS/2019/074	Review of St. Helena yellowfin tuna (*Thunnus albacares*) tagging data.	Wright S., Riley A., Stamford T., Beard A., Clingham E., Henry L., Thomas W., Caswell D., Madigan D., Schallert R., Castelton M., Righton D., Block B., and Collins M.

SCRS/2019/075	A novel index of abundance of juvenile yellowfin tuna in the Atlantic Ocean derived from echosounder buoys	Santiago J., Uranga J., Quincoces I., Orue B., Grande M., Murua H., Merino G., and Boyra G.
SCRS/2019/076	Estadística de las pesquerías Españolas atuneras, en el océano Atlántico tropical, período 1990 a 2018	Pascual-Alayón P., Rojo V., Amatcha H., Sow F.N, Ramos M.L., and Abascal F.J.
SCRS/2019/077	Statistics Of The European And Associated Purse Seine And Baitboat Fleets, In The Atlantic Ocean (1991-2018)	Pascual-Alayón P., Floch L., Gom F.N., Dewals P., Irié D, Amatcha A.H., and Amandè M-J.
SCRS/2019/078	Standardized catch rate in number and weight of yellowfin tuna (*Thunnus albacares*) from the United States Pelagic Longline Fishery 1987-2018	Rios A.
SCRS/2019/079	Catch Rate Standardization For Yellowfin Tuna Caught By The Brazilian Pelagic Longline Fleet (1978-2016)	Sant´Ana R., Travassos P., and Hazin F.
SCRS/2019/080	Integrated modeling of growth for Atlantic yellowfin tuna	Walter J., Lang E., Falterman B., Pacicco A., Schirripa M., Brown C., Shuford R., Cass-Calay S., Sharma R., and Allman R.
SCRS/2019/081	Collaborative study of yellowfin tuna CPUE from multiple Atlantic Ocean longline fleets in 2019	Hoyle S.D., Lauretta M., Lee M.K., Matsumoto T., Sant'Ana R., and Yokoi H.

SCRS/P/2019/024	Effect of climate variability on catches of yellowfin tuna (Thunnus albacares) in the southwestern Atlantic Ocean	Forselledo R., Ortega L., Jiménez S., and Domingo A.
SCRS/P/2019/025	Age validation, growth, and mortality of yellowfin tuna (Thunnus albacares) from the U.S Gulf of Mexico and Atlantic	Pacicco A., Allman R., Andrews A., Lang E., Falterman B., Golet W., and Murie D.
SCRS/P/2019/026	Preliminary estimates of tag shedding and mortality from the AOTTP mark recapture data	Ailloud L., and Beare D.
SCRS/P/2019/027	A histological assessment of yellowfin tuna ovaries sampled in the U.S Gulf of Mexico and Atlantic from 2010-2017	Pacicco A., Allman R., and Murie D.
SCRS/P/2019/028	Preliminary results of abundance indices by size category of yellowfin tuna of Japanese longline fishery in the Atlantic Ocean	Satoh K., Kitakado T., and Matsumoto T.
SCRS/P/2019/029	Spatio-seasonal trajectory of tuna vessels in the West African area: case of Mauritania	Braham C.B., and Bamba D.A.
SCRS/P/2019/030	Descriptive statistics of the French purse seiner fleet targeting tropical tunas in the Atlantic Ocean (1991-2018)	Depetris M., Duparc A., Lebranchu J., and Floc'h L.
SCRS/P/2019/031	Regional boundaries for Atlantic yellowfin tuna CPUE	Hoyle S.
SCRS/P/2019/032	Overview of the yellowfin information by Korean tuna longline fishery in the Atlantic Ocean	Lee M.K.
SCRS/P/2019/033	Analysis of sexual maturity yellowfin tuna *Thunnus albacares* in the Gulf of Mexico	López R.K., and Wakida-Kusunoki A.T.

Appendix 4

SCRS Document and Presentations Abstracts as provided by the authors

SCRS/2019/060 - Comparison of CPUE and fish size of yellowfin tuna for several areas in the Atlantic Ocean was conducted between Taiwanese and Japanese longline fisheries from the concern of conflict of CPUE trend among fleets at the previous stock assessment. The trend of standardized CPUE based on the same method was similar between fleets except for a part of period, and differed depending on the area. Mean length of the catch by area has some similarity between Taiwanese and Japanese longline, although some difference was also observed. These results indicate that area stratification and using the method for standardization is one solution of conflict of CPUE, and that it is possible to create joint yellowfin CPUE for Japanese and Taiwanese longline fishery. This kind of collaborative study is desired to be continued and expanded.

SCRS/2019/062 - A hindcasting approach is proposed for the stock assessment for the Atlantic yellowfin tuna. The method is a kind of retrospective cross-validation test, in which virtual prediction over several years ahead by intentionally removing data for such years is conducted and compared with actually observed data. This method is applied to test the prediction skill, which is crucial for management advice, and to compare the models even across those with partially different data set. The method has been preliminary applied to several stock assessment exercises such as the Atlantic bigeye tunas, the Indian Ocean yellowfin tunas and the Pacific saury by the leading author of this paper. It was demonstrated that, even when the retrospective pattern tends to be ignorable, prediction is so hard even a short period. However, there is a contrast that some models have some prediction skill in light of medium term prediction. Even the evaluation of hindcasting method itself via simulation studies is on-going by a group consisting of Kitakado, Sharma and Kell, it is worth conducting application of hindcasting method to some models used in stock assessment for the Atlantic yellow tunas.

SCRS/2019/064 - Size sampling data of Atlantic yellowfin tuna was reviewed, and preliminary analyses performed for its use within the stock evaluation models. Size data is normally submitted to the Secretariat by CPCs under the Task II requirements; for the major fisheries CPCs have also to submit Catch at Size for the major fisheries. The size samples data was revised, standardized and aggregated to size frequencies samples by main fishery/gear type, year and quarter. Preliminary analyses indicated a minimum number of 75 fish measured per size frequency sample, with size information since 1970 for the purse seine, baitboat and longline fishing gears. For Atlantic yellowfin tuna, the size sampling proportion among the major fishing gears is consistent with the proportion of the catch.

SCRS/2019/065 - The purpose of this working document is to summarise the tagging effort on yellowfin tuna by the AOTTP project. It provides a general overview of the data available to date. AOTTP has been tagging the three main species (bigeye, skipjack, yellowfin) of tropical tuna throughout the Atlantic since June 2016 using a range of different tags and approaches (e.g. conventional tagging, double-tagging, electronic and chemical tagging). Nearly 35,000 yellowfin have been tagged & released (R-1) in the EEZs of 21 different countries, although most have been in the High Seas. Nearly 300 electronic tags (pop-ups and internals) have been deployed on yellowfin which will provide new information on migrations and habitat preferences. Over 6,500 tagged yellowfin have been recovered with conventional tags (yellowfin recovery rate is ca 19%). Tag-seeding experiments are ongoing, and the reporting rate for yellowfin in the purse-seine fleet is ca 70%. Over 4,500 yellowfin have been double-tagged allowing tag-shedding rates to be estimated, and ca 2,600 chemically tagged which improves our ability to age recaptured fish. AOTTP partners from Brazil and Senegal are creating a pan-Atlantic Otolith Reference Set to standardise age-determination, workshops have been held on hard-part procedures, protocols and validation, and two trainees (one in Dakar and one in Abidjan) have been employed to undertake routine ageing of tropical tuna, including yellowfin, into the future.

SCRS/2019/066 - The time series of EU purse seine fleet catches per unit effort (CPUE) of yellowfin tuna (*Thunnus albacares*) from the Atlantic Ocean were standardized using a new development of the Delta-lognormal generalised linear mixed model. The aim was to depict the trend in abundance for adults yellowfin tuna, i.e. only in free school (FSC). The originality of this work relied on the inclusion of i) null sets, considered as presence of yellowfin tuna FSC, ii) fishing days without set, considered as absence of FSC, iii) EU fishing agreement in the exclusive economic zones driving the EU purse seine fleet presence in these areas, and iv) environmental variables known to affect catchability. CPUE for FSC was thus defined as the catch per sets (positive and null) of large yellowfin tuna (> 10 kg). To detect and include cells with fishing days but without set, all activities recorded in the captain logbooks were used for the period 1991-2018. In addition, we also investigated the use of vessels monitoring system (VMS) data to detect these fishing days when they were available for the French fleet, i.e. period 2000-2018. This new standardization approach of yellowfin tunas CPUE therefore, represents a significant advance over previous efforts. Nevertheless, several avenues for future progress are noted in the discussion.

SCRS/2019/067 - The objective of this study is to assess the effectiveness of the current dFAD fishing moratorium using tagging data from the AOTTP (2016-2018). Capture - recapture data can be used to assess the efficiency of time-area closure regulation in terms of protection of juvenile tropical tunas. In this study, the effectiveness of the current moratorium Rec [15-01] was assessed for both yellowfin and bigeye juveniles (Fork length <70 cm) by (1) computing the relative risk of recapture which depends on tagged tunas recapture rates inside and outside the moratorium area. Secondly, for both species, (2) shortest distance in kilometers at sea, cardinal directions and time at sea were computed for individuals tagged inside the moratorium area in 2017. The results showed that (1) the recapture rates when juvenile yellowfin tunas were tagged outside the moratorium area is equal to 17 times the recapture rate of tunas which were tagged inside the moratorium area (2017 and 2018 confounded) and that (2) directions patterns can be evidenced with circular diagrams. Finally, this paper proposes several perspectives to better assess the effectiveness of the moratorium in future analyses.

SCRS/2019/068 - A key objective of the Atlantic Ocean Regional Tuna Tagging Project (AOTTP) was to estimate tag-shedding rates, Type-I (immediate tag shedding) and Type-II (long-term tag shedding) for yellowfin tuna. To assess this, a series of double-tagging experiments (4,518 double tags released with 1,061 recoveries) were conducted as part of the broader tagging program. We used a constant-rate model for characterizing tag-shedding rates of yellowfin, as follows: $Q(t) = \alpha^* e - (L^* t)$. While the observed percentage in tag loss shows minor differences between the insertion point of the tag according to the body side of the fish, introducing a tag-location effect in Type-1 (i.e., 1- α) and in Type-II tag-shedding did not improve significantly the fit. The estimates of the Type-I (0.026) and Type-II tag shedding (L (per year) = 0.031) are very close to the values obtained from the Indian Ocean Tuna Tagging Program (0.028 and 0.040, respectively). On the basis of these results, the Atlantic yellowfin shedding rate is about 6% the first year at sea and reaches 17% after 5 years at sea. Preliminary results indicate that tag loss could differ according to the size at release but additional factors must be taken into account before drawing a definitive conclusion. This study suggests however that tag shedding rate should be taken into account with other sources of uncertainty such as the reporting rate in order to estimate exploitation and mortality rates derived from tagging data.

SCRS/2019/069 - The purpose of this article is to analyses the reported rate of BET, SKJ and YFT using the AOTTP's tag seeding experiment. To achieve this objective, we have adopted the methodology developed by Hillary (Hillary 2008). It consists of using a binomial GLM to identify possible factors that impact the tag reported rate and use them as level of disaggregation to estimate reported rate by stratum in a Bayesian approach. The disaggregation variables analysed are the species, the unloading location, the interaction between year and quarter (time) and the tagger type. However, only the year, the unloading location and the specie were used to estimate reported rate by strata. Some levels of disaggregation such as the tagger type and the quarterly interaction factor were dropped in favour of the three first due to the limited number of the data. The overall results showed that reported rate range from 8% to 93% and is highly dependent on defined strata.

SCRS/2019/070 - This project aimed to identify data discrepancies in the AOTTP dataset and determine if the data discrepancies were randomly distributed across time space and fleet. Non-random data can cause error in spatially and temporally explicit parameter analysis. Utilizing chi-square tests for independence, the discrepancy-free data was compared to the data with discrepancies. Tests were conducted on time scales of years and months, and location scales of ~650km. Ultimately, the data discrepancies were not randomly distributed across time, space, or fleet. However, the significance of the results rely heavily on the scale at which the data is sorted so there is a chance that the locational and spatial data is actually random. These tests should be conducted again on the full AOTTP dataset at different spatial scales and the same time scales to confirm the results.

SCRS/2019/071 - The Atlantic Ocean Tropical Tuna Programme (AOTTP) has tagged a total of 3,104 yellowfin tuna with oxytetracycline and has now begun to analyse the hard parts from recaptured fish. To date, a total of 16 OTC marked otoliths have been prepared and analysed for annual increment counts, and four sister otoliths were prepared and analysed for daily micro-increment counts. Increment counts were compared to known times at liberty to validate the deposition rate of ("daily") micro-increments and larger ("annual") increments. Preliminary results suggest that age estimates based on daily increment counts may lead to underestimation of age, while annual increments appear to be deposited on an annual basis. In previous studies, maximum age observed in Atlantic yellowfin tuna based on readings of annual increments in otoliths is 18 years, much higher than the maximum age of 11 years currently used in the assessment. So, although our preliminary results are limited in scope (small sample size, short times at liberty, < 2 years), they should be taken into consideration as they could have implications for the Atlantic yellowfin stock assessment.

SCRS/2019/072 - Japanese longline CPUE in number for yellowfin tuna caught the Atlantic Ocean was standardized in quarter and annual base using GLM (General Linear Model) for the period from 1965 to 2018 in order to provide indicator of the stock. Annual CPUE in weight was also estimated from 1970 to 2018. Catch and effort data from the Japanese longline fishery operating in the Atlantic Ocean from 1965 to 2018 were used to standardize the abundance index of yellowfin tuna (*Thunnus albacares*). Three new indices were presented as 1) annual index from 1971 to 2018 in weight, 2) annual index from 1965 to 2018 in number and 3) quarterly index from 1965 to 2018 in number. As factors in the models, the standardization procedure evaluated year, season (quarter), sub-area, number of hooks between floats, materials of main line, materials of branch line, sea surface temperature and sea floor depth. Model selection was performed according to the reduction in explained deviance, with factors being retained if they result in greater than a 5% reduction in explained deviance.

SCRS/2019/073 - The upcoming stock assessment for yellowfin tuna in the Atlantic Ocean is scheduled at July 2018. The uncertainty of the model specification is always accompanied with assessment results. The ensemble results can be readily changed according to the weighting. Thus, the weighting methodology to ensemble multiple scenario results preferably should be determined in advance.

SCRS/2019/074 - Yellowfin tuna (YFT; *Thunnus albacares*) are commercially the most important species in the waters around St Helena. Since November 2015, YFT have been tagged with conventional and satellite tags around St Helena Island, with the goal of better understanding their movement patterns. Conventional tags have been deployed on 1010 YFT (size range 24-134 cm Fork Length, FL), and electronic tags have been deployed on 12 YFT (size range 95-138 cm FL). Most conventionally tagged YFT (90%) were recaptured close to the release location (within 50 km), though four showed larger-scale movements, providing connections between inshore regions and seamounts and further afield (outside St Helena's EEZ). One tuna (60 cm) was caught in excess of 2000 km 14 days after release close to St Helena Island. All satellite tagged YFT remained within the St Helena EEZ up to 277 days after release. While the results suggest that YFT may spend a large proportion of their time within the STH EEZ, more work is required to disentangle the factors that may affect migratory behaviour, such as size, spawning behaviour, and environmental conditions.

SCRS/2019/075 - 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. Apart from its unquestionable impact in the conception of a reliable CPUE index from the tropical purse seine tuna fisheries fishing on FADs, echosounder buoys have also 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 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 yellowfin tuna in the Atlantic Ocean derived from echosounder buoys for the period 2010-2017.

SCRS/2019/076 - En este documento se presentan datos de la flota española, estrategias de pesca, zonas de pesca, capturas de las especies objetivo, esfuerzos, rendimientos (CPUEs), coberturas de muestreos y distribuciones de talla de las especies objetivos y accesorias de la flota atunera de cerco y de la flota de cañeros de cebo vivo que faena en el Océano Atlántico Tropical. El número de barcos de cerco que operó durante este último año se mantuvo en los mismos términos que durante 2017 y la captura total disminuyó un 15% con respecto al año anterior durante 2018. En éste último año, se realizaron igualmente más lances a objeto que a banco libre. En términos de porcentaje más del 70 % correspondió a Objetos y algo más del 20 % a Banco Libre. Los pesos medios de los ejemplares capturados para el rabil y patudo han aumentado ligeramente con respecto al año anterior, siendo: para rabil 6,7 kg (2,9 kg objeto y 40 kg banco libre); para el listado 1,6 kg (1,62 kg objeto y 1,83 kg banco libre) y para patudo 3,5 kg (3,24kg objeto y 31,7 kg banco libre). El rabil (YFT) presentó una talla modal de captura 42 cm a Objeto (OB) y tres tallas modales de 44 cm, 52 cm, 150 cm para las capturas a Banco libre (FS) en 2018. El listado (SKJ) una talla modal de captura, 44 cm para Objeto (OB) y una talla modal de 48 cm para Banco libre (FS) en 2018. El patudo (BET) una única talla modal de captura 40 cm para Objeto (OB) y dos tallas modales de 44 cm y 146 cm para Banco libre (FS) en 2018.

SCRS/2019/077 - The document presents an overall summary of the fishing activities of the European and assimilated purse seine and bait boat fleets operating in the eastern Atlantic Ocean over the period 1991-2018. We describe the annual changes in fleet technical characteristics (carrying capacity, size), fishing effort (fishing and searching days), extent of fishing grounds, catches and nominal Catch per Unit Effort by species, as well as the average individual weight by species. Maps are also presented indicating the fishing effort distribution in the Atlantic, as well as the spatio-temporal distribution of European and assimilated purse seine catches in 2018.

SCRS/2019/078 - Two indices of abundance of yellowfin tuna from the United States pelagic longline fishery are presented for 1987-2018. These are: 1: Entire Atlantic (ATL) and Gulf of Mexico (GOM) CPUE in number; 2: Entire ATL and GOM CPUE in weight. Both indices were updated using the same standardization procedure that was developed previously for the United States pelagic longline indices utilized in 2016 ICCAT Yellowfin Tuna Stock Assessment. The updated indices show identical trends to the indices presented in 2016. The indices have declined since 1987 and were some of lowest on record for 2008-2010 but show some slight increasing trends in the most recent years.

SCRS/2019/079 - In the present paper, catch and effort data from 99,376 sets done by the Brazilian tuna longline fleet, including both national and chartered vessels, in the equatorial and southwestern Atlantic Ocean, from 1978 to 2017, were analyzed. The fished area was distributed along a wide area of the equatorial and South Atlantic Ocean, ranging from 20ºW to 52ºW of longitude, and from 011ºN to 50ºS of latitude. The CPUE of the yellowfin tuna was standardized by a Generalized Linear Model (GLM) using a Delta Lognormal approach. The standardization was implemented in a stratified way concerning the Yellowfin tuna regions as a proxy (Reg 02; Reg03). A comparative standardization using both regions integrated was also implemented. The factors used in the models were: year, quarter, vessels, strategy, hooks per floats, hooks and the lat-long reference for each 5 by 5 spatial squares. Due to some assumptions of the model, principally the structure of the covariates and the presence of vessels that never caught the target species of this analysis, the final index was estimated only for the period between 1999 and 2017. In general, the behaviour of the three indices estimate here, over the Brazilian LL fleet, shows a quite similar pattern with two stables periods, first between 1999 and 2008 and the second among 2012 and 2017. In the period between 2008 and 2012 presents a soft decreasing in the Yellowfin tuna index.

SCRS/2019/080 - We evaluate the estimability of growth inside of the Stock Synthesis integrated modeling platform. We employ a factorial combination of three different empirical datasets including otolith annual increments (Lang et al., 2016, daily ages (Shuford et al (2007) and modal progression (Gascuel et al., 1992) and evaluate a von Bertalanffy and a Richards model that mimics the current two-stanza growth model used by ICCAT. The integrated modeling approach highlighted that a) growth is estimable within the integrated models b) externally fixed growth curves, including the currently ICCAT curve result in model misspecification that produces the appearance of a regime shift at the initiation of the Purse-seine FAD fishery, c) estimating growth in the models is a possible means to address this misspecification. When estimated, Linf across all datasets and growth models was ~ 155 cm CFL indicating that many externally derived growth models may have substantially overestimated Linf. Further, Linf had substantial impact on estimated management quantities which highlights the importance of correctly specifying this aspect of growth. While this study cannot conclusively exclude it, the modeling and data showed little support for a slow-down in growth at young ages. The appearance of this in the current ICCAT growth model may have been partially an artifact of the assumed birthdate of all cohorts in the modal progression. The approach illustrates the value of an integrated modeling approach for addressing key uncertainties regarding tuna growth.

SCRS/2019/081 - In April 2019 a collaborative study was conducted between national scientists with expertise in Brazilian, Japanese, Korean, Chinese-Taipei, and USA longline fleets, and an independent scientist. The meetings addressed Terms of Reference covering several important issues related to yellowfin tuna CPUE indices in the Atlantic Ocean. The study was funded by the International Commission for the Conservation of Atlantic Tunas (ICCAT) and the International Seafood Sustainability Foundation (ISSF). The meeting developed joint CPUE indices based on analysis of combined data from the Japanese, Korean, Chinese-Taipei, Brazilian, and US fleets.

SCRS/P/2019/024 - This study presented an analysis of the effect of climatic variability on the Yellowfin tuna captures over the Southwestern Atlantic Ocean for the period 1982-2010. The study area is characterized by a very complex hydrography, with multiple contrasting water masses. Changes in the trend of SST and wind anomalies is demonstrated. YFT CPUE was modeled using GAM with climatic and environmental variables such as SST, Wind Anomaly, Depth and ENSO events. The results presented confirm that climatic variability caused by different atmospheric and oceanic processes affects the distribution and catches of yellowfin tuna in the Southwestern Atlantic Ocean. No direct relationship between the increase in SST and the catches of this species were observed. The optimal SST range defined by the model (16° - 22.5° C) is below the preference ranges reported for the species. The analysis of the

CPUE and the environmental variables indicate a clear association of the species with the thermal fronts that characterize the continental slope area, most likely due to trophic migration as the fronts are characterized by a great abundance of possible preys (squid and anchovy). ENSO events appear to have a positive effect over CPUE in extreme events of El Niño and La Niña, while moderate events tend to be negative or low effect.

SCRS/P/2019/025 - During 2004-2017, a total of 3,223 yellowfin tuna sagittal otoliths were collected form the US Gulf of Mexico (n=3,055) and Atlantic coast (n=168). Ages ranged from 1 to 18 years old with 91% of estimates less than 5 years old. Bomb-radio carbon (14C) results validated the maximum age of 18 years. The growth model with the most parsimonious fit to the age data for pooled sex based on the lowest ΔAIC score was the Gompertz (L∞=1,606, Gi =0.4, tinfl =-0.11), followed by the logistic, (L∞ =1,580, Gi =0.5, tinfl =0.7) (ΔAIC = 3.95) and von Bertalanffy (VB) (L∞ 1,647, k=0.29 t0 =-1.44) (ΔAIC=10.64). Likelihood ratio tests revealed significant differences in sex-specific growth for all three candidate models (p<0.001), with males consistently obtaining a greater size than females. Natural mortality was investigated using two different point estimates (Hoenigfsh; Then et al. 2015) using a tmax of 18 and scaled across ages using the Lorenzen type function (Lorenzen 2005) with the estimated VB growth parameters.

SCRS/P/2019/026 - We conducted preliminary analyses of the AOTTP tagging data to estimate annual total survival rate and year specific tag recovery rate parameters using a traditional Brownie dead recoveries model. The first step was to estimate type I (immediate) and type II (chronic) shedding rates from double tagged fish. Results indicated a 3% immediate tag loss rate and a 4% annual chronic tag loss rate, similar to what has been estimated in yellowfin from the Indian Ocean tagging program. Tag returns were then adjusted for tag shedding in each year and, using the annual tag reporting rate estimates obtained from SCRS/2019/069, we were able to separate the estimated tag recovery rates from exploitation rates. Including all data, regardless of the time spent at liberty, resulted in unrealistic estimates of F and M. This is likely caused by the fact that newly tagged fish do not immediately mix in the population, violating one of the main assumptions of the Brownie model. The issue of mixing must be explored further to be able to properly include tagging data in the assessment.

SCRS/P/2019/027 - Histological assignment of female reproductive phase (n=410) followed the standardized terminology of Brown-Peterson et al. (2011) with specifications made for yellowfin tuna (Schaefer 1996;1998). Length at 50% maturity (L50) was estimated for all capture months using three different maturity thresholds; cortical alveolar (L50=1,040 mm CFL), primary vitellogenesis (V1) (L50=1,090 mm), and late-stage vitellogenesis (V3) (L50=1,100 mm). In the Gulf of Mexico, ovaries were observed in the spawning capable phase March-December with peak spawning occurring May-August. Females began actively spawning as early as age 2, but were observed more frequently by age 3. Batch fecundity estimates ranged from 1.3-6.2 million eggs per female and increased with yellowfin tuna size and age.

SCRS/P/2019/028 - Spatiotemporal delta-generalized linear mixed model of catch rate data are used to produce size specific standardized indices of relative abundance for yellowfin tuna (*Thunnus albacares*) caught by Japanese longline fisheries from 1986 to 2017 in the Atlantic Ocean. The nine size groups, from smaller than 90 cm to larger than 160 cm by 10 cm interval, were modeled. Results show that the density of yellowfin tuna had both pronounced spatial variation across the Atlantic Ocean and annual spatiotemporal variation. Spatial segregation in size was observed. According to the preliminarily analysis, smaller fish, less than 130 cm mainly distributed in the coastal area, and the larger fish, larger than 130 cm distributed in the equatorial area. There were differences in annual CPUE trend by the size category.

SCRS/P/2019/029 - The work presented constitutes the development of a statistical approach to study the trajectory and cartography of the fishing effort of the tuna vessel working in the West African area. Tuna (large pelagic) are highly migratory species that move in very wide areas and over very large areas. The Vessel Monitoring System (VMS) data are retrieved for the period 2012 to 2018. This work is based on the comparison of tuna fishing activity mapping based on the trawl speed classification and the choice of a semi-Markov approach with an estimation by EM (Expectation-maximization) algorithms using nonparametric residence laws. The ultimate goal is the quantification and refined calculation of fishing effort to obtain standardized CPUEs and unbiased indices of abundance by joining these data with catch data per year. It also allows to know the zones of frequentation of the predators (vessels), to map a proxy of abundance of the preys (targeted species). The first result of this work show a high mobility of vessel in 2018 compared to 2017. The fishing activity is concentrated at the beginning of the year (January-March) in southern Senegal. From April to October, the fishing activity seems to concentrate in the Mauritanian zone. This work did not take into account the distinction between the different nationalities nor the fishing under FADs where a free bank. In the perspective of this work, we plan to:

- Complete the analyses for every month
- Correct the fishing effort of the boats working in the Mauritanian zone

- Use the observer data to validate the model
- Joins catch data by boat with the effort to calculate a catch per unit of effort

SCRS/P/2019/030 - aims to provide a first batch of several indicators for descriptive statistics of the French purse seiner fleet targeting tropical tunas in the Atlantic Ocean from 1991 to 2018. The idea was to have an overview and global tendencies. A second batch of newer indicators will be available for the next species working groups on tropical tunas in September. For now, indicators presented could be separated in 4 groups: (a) fleet characteristic indicators (number of vessels by volume of wells and carrying capacity over the years), (b) summarize of the activities (activity duration and number of sets by fishing modes), (c) distribution of catches (by fishing mode, mean weight of individuals and biomass by size class for the YFT and spatial distribution of catches) and (d) at least nominal CPUE for each major tropical tuna by fishing modes (catches per searching day and catches per positive set).

SCRS/P/2019/031 - An analysis of ICCAT and US observer size data was presented that showed spatial patterns in yellowfin tuna size distribution. Fish were larger in equatorial areas and smaller at higher latitudes and closer to coastlines. These spatial patterns were used to propose 2 alternative sets of regional boundaries for CPUE analyses.

SCRS/P/2019/032 - It was presented the fishing characteristics of Korean tuna longline fishery, with a focus on catch and fishing effort information for yellowfin tuna in the Atlantic Ocean. In the 1970's catches of yellowfin were over 10 thousand mt over that period, especially it recorded the highest about 18 thousand mt in 1975, and sharply declined from 17.6 thousand mt in 1977 to 180 mt in 1993. The average catch from the 1990's to the present is about 355 mt. Most of yellowfin caught in the central part (20°~40°W) of the tropical area (20°N~20°S), however, the areas shown higher yellowfin CPUE were quite different from those of catch. For the joint longline CPUE standardization analysis, fishing data with operational level were used from 1979 to 2018. And data fields consist of vessel id, operation date and location(lat/long), no. of hooks, no. of floats, catch in number of 12 species categories.

SCRS/P/2019/033 - The objective of this work was to analyze the sexual maturity of yellowfin tuna *Thunnus albacares* through data from the on-board observer program on longline vessels in the Gulf of Mexico. For this purpose, information was analyzed for the period 2000-2013, in which 413 961 individuals with a sexual composition of 224 564 males (54.25%), 166 835 females (40.30%) and 22 562 undetermined (5.49%) were studied. The sex ratio presented a range of 1.20: 1 to 1.57: 1 male: female, the male predominance occurs in an average proportion of 1.35:1. Of the gonadal stages of the females, 32.5% corresponded to Stage IV (pre-spawning and spawning), which presented the largest number of individuals with 53,637 total females with an average of 3 831 females / year. The months of presence of females in Stage IV were May, June, July and August with higher values in June. The furcal length (Lf) of the females in Stage IV registered a range of 80 to 195 cm Lf with mode of 140 cm. The average length of maturity (L50) in females in Stage IV was 142 cm Lf.