REPORT OF THE 2020 ICCAT ATLANTIC ALBACORE STOCK ASSESSMENT MEETING

(Online, 29 June - 8 July 2020)

"The results, conclusions and recommendations contained in this Report only reflect the view of the Albacore Species Group. Therefore, these should be considered preliminary until the SCRS adopts them at its annual Plenary meeting and the Commission revise them at its Annual meeting. Accordingly, ICCAT reserves the right to comment, object and endorse this Report, until it is finally adopted by the Commission."

1. Opening, adoption of agenda and meeting arrangements

The meeting was held online due to the outbreak of Coronavirus (COVID-19), particularly in Madrid, which obliged the ICCAT Secretariat to close. Therefore, it was decided to set an Online meeting from 29 June to 8 July 2020. Dr. Haritz Arrizabalaga (EU-Spain) and Dr. Josetxu Ortiz de Urbina (EU-Spain), the Atlantic and Mediterranean Albacore Species Group ("the Group") rapporteurs and meeting Chairmen, opened the meeting and welcomed participants. Dr. Miguel Neves dos Santos (ICCAT Assistant Executive Secretary) welcomed the participants and thanked the efforts made by all participants to remotely attend the meeting.

The Secretariat provided information on how to use the online platform for the meeting (Microsoft Teams). The Chair reviewed the annotated Agenda, which was adopted (**Appendix 1**).

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

Sections	Rapporteur
Items 1, 8	M. Ortiz
Item 2	C. Palma, V. Ortiz de Zárate, D. Parker
Item 3	G. Merino, H. Arrizabalaga, N. Duprey
Item 4	T. Matsumoto, B. Mourato, H. Winker, A. Kimoto, M. Ortiz
Item 5	H. Arrizabalaga, J. Ortiz de Urbina, A. Kimoto
Item 6	H. Arrizabalaga, J. Ortiz de Urbina, M. Ortiz
Item 7	H. Arrizabalaga, J. Ortiz de Urbina

2. Summary of available data for assessments

2.1 Biology

The biological parameters used for both stocks remain the same as in previous assessments (**Tables 1** and **2**).

Presentation SCRS/P/2020/044 provided a summary of new information on length, length-weight, and weight-weight relationships for albacore (*Thunnus alalunga*) caught in the Southwestern Atlantic Ocean. Weight and size data (over 78 thousand fish measurements) was collected by the Uruguay National Observer Program between 1998 and 2019. Size and weight measurements considered were curved fork (CFL) and pre-dorsal (PDL) length, and round (RW) and dressed (DW) weight, respectively. Conversion factors for CFL – PDL, RW – CFL, and RW - DW were presented. The relationships provided in this contribution covers most of the reported full-size (50 to 140 cm CFL) spectrum of the species and were compared with others adopted by ICCAT. The CFL is easier to measure on board than straight fork length (SFL) with minimal error, especially for larger individuals. The Group noted the need of a conversion factor from CFL to SFL for southern albacore. The Group did welcome this study and decided to further consider adopting these relationships in the future when a full peer review document is available.

The Group noted a small typo in the ICCAT manual for one of the parameters of the length weight relationship for the southern stock and asked the Secretariat to amend it. This refers to the *b* parameter of the length-weight relationship according to Penney (1994) for the S-ALB, where the correct value should be 3.0973.

The Group agreed that many of the critical biological parameters for Atlantic albacore are still poorly known (i.e. reproductive biology). This lack of knowledge undermines the advice of the SCRS since biological parameters are a critical input in the stock assessment models currently used by the Group. The albacore research program aims to increase biological knowledge to improve the quality of scientific advice and reduce the uncertainty associated with it.

2.2 Catch, effort, and size

Four documents on albacore (ALB) fisheries statistics with revised catch series and size information were presented during the meeting, covering the three ALB stocks (ALB-N: North Atlantic, ALB-S: South Atlantic, ALB-M Mediterranean Sea).

The document SCRS/P/2020/045 presented some of the main features that characterize the Spanish baitboat fishery targeting albacore in the Canary Islands (ALB-N stock). The total catches in weight (t) by year, and the seasonality expressed by the monthly distribution of catches (kg) within each year, was represented for the period 2000 to 2019. The annual mean weights (kg) of albacore estimated for the same period showed a decreasing trend.

The document SCRS/P/2020/080 presented, among other indicators, a revised catch series from the Spanish recreational fishery in the Balearic Sea (Western Mediterranean, ALB-M) for the period 2005-2018. The information used in this study was obtained from 23 fishing tournaments of the recreational fishery targeting mainly albacore in the months of June and July.

Chinese Taipei presented two documents (one for each ALB Atlantic stock) on size frequency samples obtained by the Chinese Taipei longline fleet between 1981 and 2018. The document SCRS/2020/107 presented a temporal-spatial analysis of ALB measured by fishing vessel, where the largest majority occurred mainly in the fishing ground between 15°N to 40°N of the North Atlantic Ocean (ALB-N stock). During the 1980s (ALB targeting period) the size of albacore caught in this fishery ranged from 80 to 120 cm SFL (strait fork length) with median values around 100 cm SFL. Few ALB size samples were collected in the early and mid-1990s since the vessels shifted to catch bigeye tuna. From 1999, vessels returned, and the size samples collected had a median around 90 and 110 cm SFL. The document SCRS/2020/108 presented a temporal-spatial analysis of ALB measured in the South Atlantic Ocean (ALB-S stock). A spatial structure of five fishing areas was used to analyse the annual variation in mean size over time. Overall, the ALB-S mean sizes seem to be relatively stable from 1981 to 2019, with annual variations in the mean size around 80 and 120 cm SFL. By area, small ALB individuals (SFL<100 cm) were observed in southern latitudes above 25ºS (both eastern and western areas) of the ALB-S stock, in contrast with the northern region (latitude < 25ºS) of ALB-S with low evidence of small fish and with a slightly higher mean size around 100 cm SFL.

The Secretariat briefly presented to the Group the most up-to-date albacore (ALB) fisheries information (T1NC: Task 1 nominal catches; T2CE: Task 2 catch & effort; T2SZ: Task 2 size samples; T2CS: Task 2 catch-at-size reported) available in ICCAT, for the three albacore stocks, covering the period 1950 to 2018. The ALB conventional tagging, and the CATDIS (1950 to 2017) estimations, were also made available to the Group but not discussed.

For a consolidated view of the available Task 1 and Task 2 statistics, the standard SCRS catalogues of the three ALB stocks covering the period 1990-2018, are presented in **Table 3** (ALB-N), **Table 4** (ALB-S), and **Table 5** (ALB-M). The corresponding ALB retrospective scores, quantifying the Task 1 and Task 2 data availability (one score per catalogue) over time are shown in **Figure 1**. All the three stocks show increasing trends in their scores (less accentuated in ALB-M) in the “30-year” time series, in particular during the last decade of each time series (periods 1980-2009 to 1989-2018), which indicate improvements in data completeness.

Task 1 catches (T1NC)

No major updates were made to T1NC for the three ALB stocks after the SCRS 2019 annual meeting. The total catches of ALB-N, ALB-S and ALB-M catches are presented in **Table 6.** The **Figure 2** show in each stock the accumulated catches by major gear between 1950 and 2018. The catches for 2019 were incomplete for the three stocks and therefore not considered.

The overall ALB-N catches show a decreasing trend since 2006 (~37,000 t) reaching a minimum of about 15,400 t in 2009. This decline in the catches, was mostly due to the decrease in the catches of the Spanish baitboat (~65% reduction in weight) and troll (~60% reduction) fisheries in the Cantabrian Sea. The catch of longline fisheries (mostly Chinese Taipei and Japan) have also shown a reduction of about 50% in weight. Since that minimum, the overall catches increased to a maximum of about 30,300 t in 2016, caused mostly by an increase in the catches of the European trawl and baitboat fisheries, as well as Japanese and Chinese Taipei. Preliminary total catches for 2017 and 2018 amount to 28,401 t and 29,691 t, respectively.

For ALB-S, the overall catches have oscillated around 24,000 t between 2006 and 2012, showing afterwards a large drop reaching about 13800 t (more than 40% reduction) in 2016. This decrease is linked to a catch reduction of the major fisheries (LL: Chinese Taipei, Japan, and Brazil; BB: South Africa, Namibia, and Brazil). Preliminary total catches for 2018 increased to about 17100 t.

For ALB-M, the overall catches of the last decades reached a peak of about 8,000 t in 2003, showing afterwards a decreasing trend to a minimum of 1,500 t (80% reduction) in 2013, and then a continuous increase to about 4300 t in 2016. Preliminary total catches for 2017 and 2018 are 2,780 t and 2,434 t, respectively. Despite the improvements in the catch as reported by CPCs in the recent years, the ALB-M stock still has some incomplete catch series. The recreational Spanish catch series (2005-2020) of the Western Mediterranean, presented in document SCRS/2020/080, was adopted by the Group and will be integrated into T1NC in the future. This integration will be made with the guidance of Spanish scientists to avoid double counting, since some catches could have been already reported under gear "UNCL".

Task 2 catch and effort (T2CE) and size (T2SZ)

The SCRS catalogues of ALB-N (**Table 3)**, ALB-S (**Table 4)** and ALB-M (**Table 5**) summarise the availability of T2CE, T2SZ, and T2CS datasets (respectively characters, "a", "b", "c" within each Task 2 row, i.e.: when field DSet="t2"). By default, the catalogues do not show datasets (which are available in the ICCAT-DB system) with poor resolution in time (by year), poor or no geographical detail (must have at least ALB sampling areas), and several other specific datasets usually not used by the SCRS (T2CE with no effort, non-standard frequencies in T2SZ, size/weight frequencies intervals in T2SZ larger than 5 cm/kg, etc.).

The ALB-N catalogue shows that, nearly 90% of the total yield is related to only seven fleets (Spanish BB and TR, Chinese Taipei LL, French TW and GN, Portuguese BB and, Irish TW). In the last decade, there are however some minor gaps in T2CE and T2SZ series (EU-France TW, EU-Portugal BB, and, EU-Ireland TW) that need to be recovered. The remainder 10% of the ALB-N fisheries still have important gaps in Task 2 data (both T2CE and T2SZ). The series with important gaps (at least two missing years of Task 2 data) are the surface LL fisheries of Vanuatu, Venezuela, EU-España, Panama, China PR, and Korea.

The ALB-S catalogue shows that, 90% of the total yield is linked to only five major fleets (Chinese Taipei LL, South Africa and Namibia BB, Brazil LL, and Japan LL). In terms of Task 2 (T2CE and T2SZ) availability, there are important gaps in South African, Namibian, and Brazilian series. The remainder 10% of the ALB-S fisheries still have important T2CE and T2SZ Task 2 gaps. The most important series with gaps are the Brazilian BB, and the most important LL fleets catching ALB as by-catch (Korea, Philippines, Vanuatu, EU-España and, China PR). The tropical BB and PS fisheries (Ghana, EU-France, EU-España, Guatemala, Curaçao, etc.) fishing ALB as by-catch have also incomplete Task 2 series.

The ALB-M catalogue shows that, 90% of the total yield is linked to eight major fleets (EU-Italy [LL, GN, PS], EU-Greece LL, EU-Cyprus LL, EU-España LL, Turkey LL). Despite a noted improvement in reporting ALB-M Task 1 and 2 datasets, many gaps still exist across some of the most important fleets, including the most recent years.

The Group recommended that, the Secretariat work together with the Statistical Correspondents of the CPCs having Task 2 gaps in the SCRS catalogues. For ICCAT CPCs with no scientific representation at the meeting, the Secretariat should request the corresponding missing datasets as soon as possible.

Catch-at-size

The overall catch-at-size (CAS) matrix was not updated (1975-2014) for this stock assessment. In consequence, the weighted mean weights by major gear and stock estimated using CAS were not updated.

2.3 Relative Indices of Abundance

2.3.1 North Atlantic

Document SCRS/2020/102 presented the standardized CPUEs of north Atlantic albacore caught by the Chinese Taipei longline fishery for period 1981 to 2018, using a GLM model with log-normal distribution of error modeled as in the last stock assessment conducted in 2016 (Anon., 2017). Effects of year, month, as well as latitude and longitude by 5 degrees squares were used. The variance explained by the model fit was $r^2 = 0.3$. The unit sample was set and catch in number of fish and fishing effort (1000 hooks) were recorded. The spatial distribution of fishery was stable compared with previous analysis. The analysis included 15 vessels that target albacore continuously, using the albacore catch ratio (Alb/all tuna spp) larger than 0.8 proportion. The overall standardized CPUEs trend showed a peak in 2014 and then a decreasing trend up to 2018.

The Group requested to provide the zero catch ratios to examine the trend. The authors responded that zero catch ratios are less than 1% for vessels targeting albacore. Other discussion held was on the need to provide CPUEs standardized in weight and present the results to compare with the CPUE series that was used in the last assessment (**Figure 3**). It was noted that both trends show very similar patterns. The Group also compared both CPUEs time series trends in number and in weight and evaluated possible effects in the surplus production model. It was decided to use the index provided in weight as input in the model.

Document SCRS/2020/91 presented the Japanese longline fishery characteristics including its albacore catch. Albacore was mainly caught as by-catch in both the North and South Atlantic Ocean except for a part of area and period. Recently the catch amount and the proportion of albacore in the catch are increasing in the south Atlantic.

Document SCRS/2020/92 presented the Japanese albacore longline standardized CPUEs analyzed by three periods, namely: the target (1959-1969, JPN-LL1), transition (1969-1975, JPN-LL2) and by-catch (1975-2018, JPN-LL3). Effects of year, quarter, subarea, fishing gear (number of hooks between floats) and some interaction were considered for analysis of CPUE using a GLM with negative binominal model. Recent trend (2015-2018) was slightly lower than the average of last decade (2009-2018).

The Group discussed the observed values of nominal CPUEs being higher than the standardized CPUEs after 2012, that will be further examined in future analysis to be presented.

The Group discussed the exclusion from the CPUE series of standardized index for the years 2013 and 2014 as done in the previous assessment in 2016. In this year, the Group agreed to exclude the standardized index observation for only 2013, which shows a strong spike, which represents an unusually high CPUE in the equatorial area.

Document SCRS/2020/089 presented the Venezuelan albacore longline standardized CPUEs (number of fish/1000hooks) analyzed for the period 1991 to 2018. The albacore by-catch represented 16% of all tuna species in the years analyzed and the presence of a minimum of one albacore in the overall longline set was present in 54.5% of the total sets observed during the time series analyzed. The GLM method with Delta log-nominal model distribution was applied.

Authors indicated that the low CPUE value in 2018 was caused by particularly low spatial and temporal sampling coverage in that year, therefore it was agreed by the Group to exclude this year from the input into the surplus production model. The Group agreed to use this index, with the exclusion of the 2018 value, as input in the production model.

Document SCRS/2020/086 presented the US albacore longline standardized CPUEs (number of fish/1000 hooks) analyzed for the period 1987 to 2018. A strict update of the standardized time series using the methods from the last assessment was completed. Data coverage included all U.S. pelagic longline sets north of latitude 20°-degree N, excluding the Gulf of Mexico, and areas where a fishery closure occurred. Year, season, area, and gear configuration (e.g. number of light-sticks) covariates were considered in the standardization GLMs. The U.S. longline index indicated a peak relative abundance during 2016. The CPUE in 2018 approach the lowest value observed during the period 2006 to 2009. As well, the 2018 catch presented the lowest observed level since 1988. The Group agreed to use this index as input in the production model.

Document SCRS/2020/098 presented the Spanish baitboat target albacore standardized CPUEs (number of fish/fishing days) analyzed for the period 1981 to 2018. Analyses were done using Generalized Linear Random Effects Model factors evaluated were year, month, zone and the interactions terms *year*month* and *year*zone*, which were treated as random effects in the final model. The model accounted for 45.4 % of the variability of the observed nominal CPUE. The GLMM model with random components *month* and *zone* variables captures better the variability observed in the baitboat nominal catch rates compared to the *quarter* and *zone* variables used in the standardization done for previous North Atlantic albacore assessment.

The temporal trend was quite stable. Short periods of increase and decrease alternate around the mean value. From 2012 to 2014 there was a decreasing period followed by an increase in 2015, then decreasing the annual CPUE value until 2017, followed by an increase in 2018, the highest CPUE value of the series. It was noted that in 2018 the Spanish albacore quota for this fleet was reached in the shortest period of time compared to prior years, causing a high nominal CPUE as effort is measure as fishing days.
The Group agreed to use this index as input in the production model.

2.3.2 South Atlantic

Document SCRS/2020/093 presented the standardized CPUEs of south Atlantic albacore caught by the Japanese longline fishery, split into three periods (1959-69, 1969-75 and 1975-2018), using a negative binominal model and same methods as in the last assessment. Effects of quarter, area, fishing gear (number of hooks between floats) and several interactions were tested, although the effect of fishing gear could be used only from 1975 onwards. The effect of area was greatest for all three periods. Standardized CPUE in the South Atlantic declined during the 1960s and early 1970s, after which the CPUE fluctuated with no clear trend.

The Group noted that this document provides an update in CPUE standardization from the previous assessments, and it was discussed that in the previous assessment the last three years of the time series (2012-2014) was excluded due to possible increased targeting. It was noted that the positive catch ratio has remained relatively constant (approx. 50%) across the recent years in this analysis, but in the analysis that only uses data from the main fishing ground for albacore (SCRS/2020/094), the ratio has increased (70-80%) since the early 2010s. The Group raised concern that the observed change in targeting may not have been fully captured in the CPUE standardization process, thus it was decided to use the same index (JPN-LL3) and period (1976-2011) applied in the 2016 assessment, and to apply the entire time series as well as the main fishing ground series (JPN-LL core) as a sensitivity analysis.

Document SCRS/2020/094 presented the standardization of CPUE for south Atlantic albacore (*T. alalunga*) caught by Japanese longline fishery during 1975-2018 conducted using a negative binominal model. The methodology was revised from the previous study, notably in that a “core area” or main fishing ground for albacore (southeast Atlantic) was determined and only data from this area was used standardization process. The effects of year, month, five-degree latitude and longitude blocks and fishing gear (number of hooks between floats) were incorporated. The effect of five-degree latitude and longitude blocks was greatest followed by the effect of month. The resultant standardized CPUE series showed large fluctuations for the period 1975-1987, with a period of low-level stability for 1988-1999, after which fluctuation increased again.

The Group noted the improvements made in the methodology from the previous study, namely the delineation of the core area, resulted in an increase in CPUE, with associated higher variability, in recent years when compared to the index across the entire South Atlantic. There was also an increase in the proportion of positive albacore catch per set, when compared to results from the entire Atlantic.

Document SCRS/2020/101 presented the standardised CPUE of albacore (*T. alalunga*) for the Chinese Taipei distant-water tuna longline fishery in the South Atlantic Ocean using a generalized linear model (GLM). Two periods of 1967-1995, and 1995-2018, as well as a continuous period from 1967 to 2018 were considered to address the issue of historical change in targeting. The standardized CPUE of albacore developed by period showed almost identical trends to those derived from the model of the entire period. An observed decrease in albacore CPUE since the 1970s was followed by a peak in the late 1990s and another subsequent decrease. From early 2000s the trend has steadily increased.

The Group noted that this document provides an update in CPUE standardization from the previous assessments; however, the unit of CPUE was calculated in number in this document whereas it was originally in weight in the last assessment. The author provided the CPUE in weight during the meeting, and the Group confirmed that the trend is consistent with the previous one as well as the CPUE in number, given that no strong patterns are observed in the mean weights. The Group agreed to use this weight index from 1967 to 2018.

Document SCRS/2020/83 presented standardised catch and effort data of albacore (*T. alalunga*) for the Brazilian tuna longline fleet, including both national and chartered vessels, in the equatorial and southwestern Atlantic Ocean, from 1998 to 2017. The standardization process was done with a GLM using a Delta Lognormal approach, and a stratified approach considering ICCAT albacore regions as a spatial proxy was applied. A comparison was made between results that integrated different regions. The explanatory variables included in the models were: year, quarter, vessels, clusters, hooks per floats, hooks and the lat-lon reference for each 5 by 5 spatial squares. The estimated delta-lognormal indices showed, in general, a very similar trend between the fitted models with two periods. However, the first period (1998-2010) was marked by a one-way down trend, while the second period (2011-2018) showed a more stable pattern. The Group noted the improvement in the Brazilian CPUE standardization methodology since previous applications and thanked the authors for their continued effort. It was noted that the Brazilian tuna longline fleet, including both national and chartered vessels, provides extensive catch data that are distributed in a wide area of the western Atlantic Ocean. However, the authors recommended to only use data from 2002 onwards, due to changes in the fishing strategy and targeting species.

Document SCRS/2020/83 presented standardised CPUE of albacore (*T. alalunga*) for the South African baitboat fishery for the period 2003-2018. Albacore is the main target species of the fishery which operates along the west and south west coast of South Africa and accounts for the second largest catch of albacore in the region. A Generalized Additive Mixed-Model (GAMM) with a Tweedie distributed error was implemented, with year, month, geographic position and targeting included as explanatory variables, and vessel as a random effect, in the final model. Standardized and nominal CPUE were broadly comparable, and despite inter-annual variability, the index remained stable since 2003.

The Group discussed the potential prevalence of juvenile fish in baitboat fisheries, and the implication when implementing a production model type assessment. It was acknowledged that a very low proportion of large fish (> 110 cm) are caught by the South African baitboat fishery, but that the majority of fish selected in this fishery are mature (>80 cm). The relatively small spatial extent in which this fishery operates was also highlighted. The Group noted that the South African baitboat index has been previously reviewed at the 2017 albacore Intersessional Meeting, where it was recommended to be used as input data for the next South Atlantic albacore assessment.

Finally, the Group was reminded that in the last assessment the Uruguayan LL index was included. This index is not updated due to lack of activity by the Uruguayan LL fleet, but remains useful for the assessment.

2.3.3 Mediterranean

Document SCRS/2020/080 presented a new standardized index of relative abundance for the Spanish recreational fishery in the Balearic Sea (Western Mediterranean), for the period 2005 2018. The index used trip-based information of catches and fishing effort collected by scientific observers.

Document SCRS/2020/081 presented an update of the standardized index for the Spanish surface longline (LL ALB) in the western Mediterranean Sea, for the period 2009-2017. The index used trip-based information of catches and fishing effort collected by scientific observers on board.

Both indices showed a relatively stable trend for the most recent period (2014-2018). It was noted that some of the current management regulations for other pelagic species in the Mediterranean (e.g. swordfish) may have affect the fishery operations for the albacore longline commercial fishery.

2.3.4 Summary of available CPUEs for North and South stocks

The Group reviewed and acknowledged the updated CPUE evaluation table using the format developed by WGSAM (**Table 7**).

For the North stock, **Table 8** and **Figure 4** summarizes the available indices of abundance for the updated assessment. The Group agreed to use the following indices of abundance: a) the weight index from the Chinese Taipei LL (1981-2018), b) the Japanese longline index (1976-2018) excluding the 2013 observation, c) the Venezuela longline index (1991-2017) excluding 2018 observation, d) the USA longline index (1987- 2018), and e) the Spanish baitboat index (1981-2018).

For the South stock, the Group noted that the ICCAT proposed work plan for South Atlantic albacore stock assessment is to "*at a minimum, update the surplus production models, up until 2018*". It was discussed that this assessment can be improved upon to provide more than just an update; time permitting. It was agreed that, at minimum, an update assessment should be provided using the same CPUE indices as in the 2016 assessment (**Table 9** and **Figure 5**): Japan longline in 1976-2011 (JPN-LL3), Chinese Taipei longline in 1967-2018 (CTP-LL), and Uruguay longline in 1983-2011 (URY-LL).

In addition, alternative indices that the Group considered adequate in their formulation, so as to warrant inclusion in the stock assessment, be considered as "*candidate"* indices that, at the very least, be included as a sensitivity runs in the 2020 albacore assessment. Such indices include JPN-LL1 (1959-1969), JPN-LL3 (1976-2018), JPN-LL core (1976-2018), Brazil longline (BRA-LL, 2002-2018) and South Africa baitboat (ZAF-BB, 2003-2018) (**Table 8**).

3. North Atlantic albacore Update Stock Status

3.1 Updated stock status

In 2016, North Atlantic albacore was assessed using the *biodyn* algorithm for a biomass dynamic (production) model based on ADMB, which is available in the *mpb* package of the FLR project (www.flr-project.org) repository. The *biodyn* algorithm was validated against ASPIC in Kell *et al*., 2017, by checking that it provided the same results using the 2013 assessment inputs and assumptions, and it is the algorithm that was used in the MSE framework (e.g. Merino *et al*., 2016, Merino *et al.,* 2017). For the 2016 assessment, the Group selected 5 CPUE series for use in the production model and the same updated indices were used in 2020. These indices showed an overall increasing trend since 2010 (**Figure 6**), which could be reflecting the increasing trend of the stock in the last decade, when the catch has been relatively low.

Following document SCRS/2020/113, the Group agreed to define the Reference Case including the 5 CPUE series, excluding the Japanese longline 2013 and the Venezuelan longline 2018 values. Some model convergence difficulties were initially encountered; in this respect, the Group examined convergence under alternative starting values of the intrinsic growth rate (r) and carrying capacity (k) parameters and ensured all results and conclusions were based on converged model runs. Model diagnostics examined include likelihood profiles (**Figures 7 and 8**), residuals of fit (**Figures 9 to 12**) and retrospective analyses (**Figure 13**). The latter were limited to the last 5 years of data. The retrospective pattern was minimal for the first 3 years of data, whereas removing 4 years yielded a similar result to the last assessment, conducted 4 years ago. Because changes in the trends of stock catches and CPUE indices occurred mostly in the last decade, it is not surprising that assessment results from the production model show some sensitivity to removing years of data from the recent period.

The results of the Reference Case assessment for North Atlantic albacore are shown in **Table 10** and **Figure 14.** Results indicate a decreasing biomass trend between the 1930s and the 1990s and an increasing trend since then. Relative to MSY benchmarks, the Reference Case scenario estimates that the stock has been above B_{MSY} continuously in the last decade and fishing mortality below F_{MSY} for a slightly longer period of years (**Figure 15** and **Table 12**). The Kobe phase plot shows a typical pattern of development, overexploitation, and recovery of the stock (**Figure 16**). Consistency with the 2016 stock assessment was evaluated by comparing the biomass trend of this year's Reference Case with the 2016 stock assessment Base Case (**Figure 17**). The Group noted that the current estimate of biomass is below that of the 2016 stock assessment base case. The current input data (catch and indices) indicates a shift of historical biomass to lower relative level. However, in the present stock assessment we estimate that the relative stock biomass has been increasing since 1990s. The differences between the estimated trends in 2016 and 2020 are consistent with the retrospective fits when the last 4 years of data were removed from the analysis (**Figure 13**).

The bootstrapped results are used to estimate uncertainty on parameters and reference points estimates (**Figure 18**). The probability of the stock currently being in the green area of the Kobe plot (not overfished and not undergoing overfishing, $F<F_{MSY}$ and $B>B_{MSY}$) is 98.4 %, while the probability of being in the bottom-left yellow area (overfished but not undergoing overfishing, $F<F_{MSY}$ and $B<B_{MSY}$) is 1.6 %. The probability of being in the red area (overfished and undergoing overfishing, $F>F_{MSY}$ and $B<B_{MSY}$) is 0% (**Figure 16**).

The Group conducted sensitivity analyses to estimate the potential impact of removing individual CPUE points (Japanese LL for 2013 and Venezuelan LL for 2018) and noted that the impact of these removals on the outcome of the assessment and the resulting TAC advice was minimal (**Figure 19** and **Table 11**).

In summary, the available information indicates that the stock has continued to improve, as reflected in the observed CPUE values. The increase in stock biomass was likely facilitated by the recent low catches, and the stock is now estimated to be in the green area of the Kobe plot with very high probability.

3.2 Updated TAC advice

Following Recommendation 17-04, the estimated median biomass and fishing mortality values were used to provide TAC advice for the period 2021-2023 according to the HCR specified in the Recommendation. As current stock biomass is estimated to be above B_{MSY}, equation 1 in paragraph 7(a) was applied:

$$TAC_{2021\text{-}2023} = F_{TAR} * B_{curr}$$
$$TAC_{2021\text{-}2023} = 0.8\ F_{MSY} * B_{curr} = 37{,}801 \text{ tons}$$

which corresponds to a 12.5% increase over the previous TAC calculated from the HCR for 2018-2020 (33,600 tons).

3.3 Harvest Control rules and Management procedures

The Group discussed the level of specification that would need to be included in a Recommendation, should the Commission decide to adopt a full Management Procedure for the north Atlantic Albacore stock, as was originally planned for 2020. The Group decided that, ideally, the MP specifications should include the following:

Indices:

Index	*First year*
Chinese Taipei LL late	1999
Japan bycatch LL	1988
Spanish baitboat	1981
US LL	1987
Venezuelan LL	1991

Software: *mpb*
Model: Fox (biomass dynamic), with the following specifications:
Catch time series start year: 1930
Catch and CPUE time series final year: t-1 preferably (t-2 otherwise). In any case, the Group will decide on which CPUE years to use when iterating an MP.
Biomass at the start of the time series = *K*
Variance treatment for the CPUE indices: model weighted

The Group felt that starting values and search spaces of the parameters (*r* and *K*) in the *mpb* algorithm did not need to be specified, and that these could be adjusted if the model showed convergence difficulties when using it in the periodical applications of the MP.

The Group also discussed the recent developments of the North Atlantic albacore MSE. Two advances were made in 2020: First, following the definitions of exceptional circumstances being developed for this stock, the impact of one or more indices not being updated for the 2020 stock assessment was evaluated. Second, new figures were generated to evaluate the fits of the indices available in 2013 in the Operating Models that were conditioned from the scenarios developed in the 2013 stock assessment.

For the first, the MSE was re-run including scenarios where one or more indices were not updated since 2014. The code of the MSE is exactly the same code used after the improvements made in 2019. **Table 13** shows the results of the new evaluations and the evaluation of the adopted HCR made in 2019 for comparison. Results suggested that the lack of update of one or more indices would not impede achieving the management objective of keeping the stock in the green zone of the Kobe plot with at least 60% probability. However, the results estimated a significantly lower performance (20-32%) in long term catch if only one index was updated. Also, with only one updated index, the probability of being in the green quadrant would be reduced by some amount between 7 and 15% (although still achieving values larger than 60% to be in the green Kobe quadrant). Overall, these results suggest that in the exceptional circumstance that one or more index was not available for stock assessments, the HCR would still achieve management objectives. However, the Group noted that these results are based on simulated indices which are proportional to stock abundance, with a CV of 0.2. To the extent that real world indices deviate from these assumptions (larger variability, autocorrelation, deviation from proportionality to abundance), the performance of the HCR could differ from what was evaluated. The Group plans to reflect the properties of real-world indices in a new MSE to be developed over the next several years (see the albacore work plan 2020).

For the second, two types of figures were produced: Histograms of residuals and time series of CPUE observations and model estimates. These figures were produced for each OM and for each of the 12 fisheries (Fleets) considered in the Multifan-CL OM scenarios developed in 2013. There are no differences in the fits of the OMs with regards to different natural mortality, steepness, or dynamic catchability but there are some differences between the original model scenarios developed in 2013. Specifically, it was stressed that adding size frequency data for Chinese Taipei worsens the fit of this CPUE, and the resulting residuals exceed the variability considered in the MSE (**Figure 20**). Also, in general, the Spanish baitboat data shows residuals with a wider variability than the values considered in the MSE (**Figure 21**). With regards to the Spanish baitboat residuals, the Group noted that it was a small number of extreme values that was widening the confidence interval of the residual values. It was suggested that, if those extreme values were removed, the variability in the residuals would be very similar to the variability used in the MSE.

3.4 Exceptional Circumstances

3.4.1 Evaluation

Several exceptional circumstances indicators were reviewed, and none were found to have values indicating that exceptional circumstances are occurring at present. The 5 CPUE indices used in the MP were all updated and generally fell within the range of values simulated for these indices in the MSE (**Figure 22**). The B/B_{MSY} and F/F_{MSY} estimates from this year's application of the production model in the MP were also seen to fall within the range of B/B_{MSY} and F/F_{MSY} values stemming from the MP's production model application across all OMs in the MSE (**Figures 23** and **24**).

3.4.2 Panel 2 advice and updating the Exceptional Circumstances indicators

Refining the N-ALB exceptional circumstances criteria was discussed at length and the Group updated the N-ALB exceptional circumstances table provided by the SCRS in 2019, taking into account the Panel 2 discussions and input provided by CPCs to the March 2020 Panel 2 meeting (see **Table 14**). The Group improved the descriptions in the table to reduce confusion about each indicator's purpose and the criteria used to judge if an exceptional circumstance is occurring. There was also some concern that the principle "Application of the HCR" did not have enough indicators to capture the intended concepts and the Group worked to improve this aspect.

The Group feels the revised table (**Table 14**) is a significant improvement over the original one. According to the revised table, the SCRS will review CPUE indices annually to compare to the values simulated across OMs in the MSE (**Figure 22**), to confirm that CPUE indices remain within the range tested in the MSE. At each new MP iteration (i.e. every 3 years), B/B_{MSY} and F/F_{MSY} results from the MP's production model will be compared to the range of values resulting from the MP's testing in the MSE (hence the addition of these figures to the consolidated report and presented in this report; **Figures 22** and **23**, respectively). While it was highlighted in the discussion that biological parameters (natural mortality, growth, and maturity) can be difficult to determine and to agree on the most suitable value, it was decided to keep these indicators in the table. It was re-iterated throughout the conversation that triggering an exceptional circumstance does not immediately result in TAC advice from the MP being rescinded, only that the albacore Working Group would need to examine the indicators and determine if a change in advice is warranted.

To help clarify the input parameters used in the MSE, and the resulting range of values from OMs and the MP's production model, the N-ALB consolidated report was referenced in **Table 14**. Also, several updates were identified for the consolidated report (**Appendix 6**), including adding:

- A figure of boxplots of all 132 OM B/B_{MSY} values by year (1952-2040)
- A figure of boxplots of all 132 OM F/F_{MSY} values by year (1952-2040)
- A figure of boxplots of all the simulated MP production model B/ B_{MSY} values by year (1952-2040)
- A figure of boxplots of all the simulated MP production model F/ F_{MSY} values by year (1952-2040)
- Figures for each of the 4 CPUE indices' annual values (until 2040) across all OMs
- A table listing the values used for natural mortality, maturity, and growth in the OMs

3.5 New MSE Roadmap discussion and future work

The Group reviewed the current MSE Roadmap (REF) and provided an update on expected work over the next 4 years. The Group recommends moving to a Stock Synthesis (SS) based new set of Operating Models for the MSE and notes that this work will take several years to accomplish; the Roadmap was adjusted accordingly. The first step would be to hold a Data Preparatory meeting in 2021. An important objective of this meeting would be getting the N-ALB data in the format needed for SS modelling. This 2021 meeting could be focused solely on the data formatting needed for SS modelling, should the SCRS be pressed for time (due to ongoing impact from the COVID pandemic), as this would allow the SS developers to continue moving the process along. Using the data preparatory meeting as a launch pad, work on the SS model would begin in 2021 and continue into 2022. In conjunction with the SS model development, axes of uncertainty for the MSE would be reconsidered and a new reference grid and robustness tests would be developed. The new benchmark assessment using the SS model as the reference case would have a target delivery date of 2023, and the adoption of the reference grid for the MSE would occur in the same year.

Other work to be incorporated into the MSE, would include improving the Observation Error Model component by incorporating statistical properties of historical CPUE residuals and testing management procedures against the new reference grid and robustness tests based on the SS benchmark model. Candidate management procedures could include the current one, as well as others, including one based on a JABBA assessment or other empirical management procedures.

3.6 Summary of management recommendations

In the 2020 assessment, the Committee noted that the relative abundance of North Atlantic albacore has continued to increase over the last decades and is estimated to be in the green area of the Kobe plot with 98.4% probability. In 2018, an external peer review was conducted confirming that overall, the MSE framework appears to be scientifically sound and robust to uncertainty. Thus, the interim HCR adopted by the Commission in 2017 had a robust scientific basis. On this basis and considering that no exceptional circumstances have been detected using the proposed indicators, the Group recommends applying the HCR to the current biomass estimates to set next TAC for the period 2021-2023. The recommended TAC is 37,801 t, which represents a 12.5% increase with respect to the previous one.

In view of adopting a long-term management procedure (paragraph 17 of Rec. 17-04), the Commission would need to select one HCR (either the interim one or one of the variants tested by the SCRS), plus the specifications of the stock assessment procedure. As for the latter, and while additional management procedures are tested in the future, the Committee recommends specifying the elements of the current stock assessment approach, as specified in section 3.3. Should the Commission consider adopting an Exceptional Circumstances protocol, the Group recommends using the indicators provided in **Table 14.**

4. South Atlantic albacore

4.1 Updated stock status

4.1.1 Preliminary results

ASPIC

Document SCRS/2020/095 presented preliminary assessment results from a non-equilibrium surplus-production model for the albacore stock in the southern Atlantic Ocean using the software package ASPIC v. 5.34. Fleet categorization (**Table 15**) was same as that used in the 2016 assessment. Catch for each fleet (**Table 16**) was calculated based on Task 1 data as of 2 June 2020. CPUE indices for the same fleet as those in the last assessment were used in the base case scenarios, which is based on the decisions made at the 2016 albacore stock assessment meeting. There are two CPUE indices for Japanese longline ("updated" and "core area" CPUE, 1976-2018), and the author examined five cases with different Japanese longline CPUE index and period. CPUE for Chinese Taipei longline (number base, 1968-2018) and Uruguay longline (1983-2011) were also used for base models. For each case, four scenarios with different weighting (equal weighting and catch weighting) and shape parameter (Schaefer and Fox model) were examined as with previous stock assessment (**Table 17**).

The results were similar among scenarios and estimated that currently the stock is neither overfished nor is overfishing occurring. The results were more optimistic than those in the previous 2016 ICCAT stock assessment. There were some concerns (unrealistic *r* estimates, too low B_{MSY} and poor CPUE fit) for the results of runs with Japanese longline core area CPUE.

Both equal and catch weighted models were proposed for ASPIC base cases to better account for the model uncertainty in fit to the indices of abundance.

Just Another Bayesian Biomass Assessment (JABBA)

The Group reviewed the preliminary stock assessment results applying the Bayesian state-space production model JABBA (SCRS/2020/104), which was applied to South Atlantic albacore stock in order to update the surplus production models up until 2018 following the procedures of the 2016 stock assessment. Extensive model diagnostics were provided to evaluate the model fits, retrospective patterns and prediction skill (*i.e.* hindcasting analysis), as well as the sensitivity of the reference scenario(s) to the inclusion of alternative and additional standardized CPUE indices that have been made available for this assessment, including longline (LL) and baitboat (BB) fisheries (**see Section 2.3**), as follows:

- Chinese-Taipei LL (CTP-LL) in 1968-2018 in numbers;
- Japan LL in 1959-1969 (JPN-LL1), and in 1976-2018 (JPN-LL3);
- Japan LL in core area in 1976-2018 (JPN-LL core);
- Brazil LL (BRA-LL) in 2002-2018;
- Uruguay LL (URY-LL) in 1983-2011;
- South Africa BB (ZAF-BB) in 2003-2018

The prior for the unfished equilibrium biomass *K* was computed based on the default settings of the JABBA R package corresponding to mean equal to the eight times the maximum catch and a large CV of 100%. Consistent with the 2016 ICCAT assessment, the initial depletion prior ($\varphi = B_{1956}/K$) was defined by a beta distribution with mean = 0.9 and CV of 10% All catchability parameters were formulated as uninformative uniform priors. The process error of log (B_y) in year y was estimated "freely" by the model using an uninformative inverse-gamma distribution with both scaling parameters set at 0.001.

To provide continuity, initial JABBA runs included the same combination of standardized CPUE time series as applied in the previous assessments, that is: CTP-LL, JPN-LL3 (but removing years after 2011 due to changes in species targeting) and URY-LL. CPUE input data were characterized according to two alternative data weighting scenarios: 1) equal weighting (EqW), which correspond to a single observation variance estimate to all CPUE indices and; 2) Model-internal weighting (ModW), with index-specific variances being estimated internally by the model. For the shape of the production function, we considered two model-types: the Schaefer model ($B_{MSY}/K = 0.5$) and the Fox model ($B_{MSY}/K = 0.37$). All models assume a vaguely informative prior for $r \sim LN(\log(0.2),1)$, which broadly resembles the Bayesian Surplus Production (BSP) model r-prior developed in the 2016 assessment. Accordingly, we formulated the following four reference model scenarios for South Atlantic albacore:

- S1: Schaefer EqW
- S2: Fox EqW
- S3: Schaefer ModW
- S4: Fox ModW

JABBA is implemented in R (R Development Core Team, https://www.r-project.org/) with JAGS interface to estimate the Bayesian posterior distributions of all quantities of interest by means of a Markov Chains Monte Carlo (MCMC) simulation. Three MCMC chains were used and each model was run for 30,000 iterations, sampled with a burn-in period of 5,000 for each chain and thinning rate of five iterations.

All scenarios appeared to fit the CTP-LL and JPN-LL3 (1976-2011) CPUE data reasonably well, with exceptions of large, occasional deviations in the JPN-LL3 index (SCRS/2020/104, Figure 3). In contrast, CPUE from the URY-LL fleet indicated a fairly poor fit, in particular to the CPUE observations over the period 2000-2005, which showed a sudden systematic decrease over this period that was in conflict with the other indices (SCRS/2020/104, Figure 4). The results of the log-residuals runs test for each CPUE fit by year (SCRS/2020/104, Figure 4) indicated that CPUE time series from CTP-LL, JPN-LL3 and URY-LL failed the runs test diagnostic procedure, with the exception of scenario S4 fitted to JPN-LL3. The goodness-of-fit were comparable among all scenarios, ranging from 34.4% (S2) to 36.9% (S3) (**Figure 25**). Annual process error deviation on log biomass (**Figure 26**) indicated similar stochastic patterns, associated with relatively small process error estimates (< 0.05), which suggest no evidence of structural model misspecification.

The medians of the marginal posteriors for r ranged between 0.513 (S1) and 0.299 (S2) for the Schaefer models and 0.396 (S3) and 0.268 (S4) for the Fox models (SCRS/2020/104, Table 2 and **Figure 27**). The estimated median of marginal posterior for K was slightly lower for the Schaefer models (S1 = 218,999; S2 = 249,585 tons) than that for the Fox models (S3 = 285,454; S4 = 285,231 tons). The range of MSY median estimates was narrow among all four scenarios (S2 = 27,219; S3 =28,016 tons). All models showed similar trends for the medians of B/B_{MSY} and F/F_{MSY} over time, with scenarios S2 and S4 producing slightly more optimistic stock status estimates (**Figure 28**).

The Group agreed that the detailed model diagnostics for the preliminary JABBA assessment model runs presented in SCRS/2020/104 indicated reasonable fits to the data, no evidence of an undesirable retrospective pattern and a satisfying prediction skill to forecast into the future.

The Group discussed the alternative data weighting scenarios and the two model-types (Schaefer and Fox models) for selection of a base case model parameterization. It was agreed that the Fox model can better represent the population dynamics of albacore with the estimating additive variance terms for the CPUE indices. This approach was preferred, because it allows for inclusion of model process error which can help resolve conflicts between CPUE time series and also to avoid many of the problems with equal weighting, such as ignoring the model goodness of fit for the CPUE data and potentially further down-weighting. Also, the retrospectives and hindcasting analysis, and other model diagnostics indicated good predictive capability of the model internal weighting. Therefore, the Fox model with model internal weighting (S4) was selected as the base case for JABBA.

4.1.2 Additional model runs

In general, preliminary ASPIC and JABBA models showed similar results in terms of stock status and estimated *MSY*. The Group discussed the model specifications for the candidate base case models for ASPIC and JABBA, and agreed to use weight based Chinese Taipei longline CPUE index (1967-2018), the updated Japanese longline CPUE index (1976-2011) and the Uruguayan longline CPUE index (1983-2011) to keep consistency in the use abundance information with the 2016 stock assessment. More specifically, the Group noted that using the updated Japanese longline CPUE index instead of the newly developed core area CPUE index is preferably due to some concern identified above for the results of runs with core area CPUE and agreed that eliminating Japanese longline CPUE index after 2012 remains a sensible choice due to apparent change in albacore targeting. The Group agreed to conduct and present additional sensitive runs using (1) the full updated Japanese longline CPUE (1976-2018) and (2) the Japanese longline CPUE for the core area (1976-2018) instead of the updated Japanese CPUE (1976-2011) in the base-case model runs as well as adding either (3) the Brazilian longline CPUE (2002-2018) or (4) South African baitboat CPUE (2003-2018).

The three additional base case model runs for JABBA and ASPIC and sensitivity analyses were presented to the Group using the following specifications:

Base case models:

- ASPIC: Fox model-type with equal and catch data weighting (runs 06 and 08)
- JABBA: Fox model-type with model internal data weighting (S4)

Sensitivity runs on CPUE series:

- JPN2018: JPN-LL3 (1976-2018, entire series), URY-LL (1983-2011), and CTP-LL (1967-2018) in weight.
- JPNcore: JPN-LL in core area (1976-2018), URY-LL (1983-2011), and CTP-LL (1967-2018) in weight.
- BRALL: JPN-LL3 (1976-2011), BRA-LL (2002-2018), URY-LL (1983-2011), and CTP-LL (1967-2018) in weight.
- ZAFBB: JPN-LL3 (1976-2011), ZAF-BB (2003-2018), URY-LL (1983-2011), and CTP-LL (1967-2018) in weight.

The main change in the base case models compared to the preliminary runs was the treatment of CTP-LL CPUE. This CPUE index was initially provided calculated in number for the period 1968-2018, but to be consistent with the 2016 assessment, the analysists provided a revised CPUE index expressed in weight for the period 1967-2018. This change gave little effect on the updated runs for both ASPIC and JABBA, base case models, because the trend of the revised CPUE in weight is generally consistent with the trend in numbers, which is also corroborated by the absence of any systematic patterns in the mean weights.

ASPIC

Finally, two scenarios with Fox model were selected. Other specifications in the ASPIC model are the same as those at the last assessment.

Fit to CPUE seems comparatively well except for a part of period (**Figure 29**). The results based on the two base cases suggested that the exploitation level in recent years do not largely differ between cases (B_{2018}/B_{MSY} ranged from 1.495 to 1.702 and F_{2018}/F_{MSY} from 0.370 to 0. 443, **Figure 30** and **Table 18**). The models predicted that at some stage in the recent past the southern albacore stock had been undergoing overfishing and had been overfished. In recent years, the B-ratio is increasing, and the F-ratio is decreasing. It appears that the fishing pressure has declined in recent years which translated into a subsequent increase in stock biomass.

To generate confidence intervals, 1,000 bootstrap trials were conducted for each model. For both scenarios, current stock was estimated to be in the green quadrant (not overfished nor overfishing). MSY was estimated to range from 26,286 t to 27,418 t (**Table 18**) which was around 10,000 t higher than the total catch for 2018 (17,098 t).

Several sensitivity and retrospective analyses were conducted for two scenarios of ASPIC model (**Table 19**, **Figures 31** and **32**). In the scenarios with start year 1975, B1/K was assumed to the ratio of estimated biomass in 1975 to that in 1956 based on the base model. As a result of sensitivity analyses, B-ratio of initial period changed with different B1/K. The scenario with South African baitboat CPUE did not converge. For other scenarios, the results differed between Run 06 (equal weighting) and Run 08 (catch weighting), and basically the results are comparatively similar to that for the base case. Generally, Run 06 had more variability among scenarios. As for retrospective analyses, only slight difference was observed from base model. There was no clear retrospective pattern, and so the model indicated comparatively robust results.

JABBA

The JABBA base case model showed a reasonably good fit to the CTP-LL and JPN-LL3 (1976-2011) CPUE data, with exceptions of large, occasional deviations in the JPN-LL3 index (**Figure 33**). In contrast, CPUE from the URY-LL fleet indicated a fairly poor fit, in particular to the CPUE observations over the period 2000-2005, which showed a sudden systematic decrease over this period that was in conflict with the other indices (**Figure 33**). The results of the log-residuals runs test for each CPUE fit by year indicated that CPUE time series from CTP-LL and URY-LL failed the runs test diagnostic procedure, with the exception of JPN-

LL3 index (**Figure 33**). The eight year retrospective analysis show a negligible retrospective pattern (**Figure 34**) with the estimated Mohn's rho values for B (-0.0064) and B/B_{MSY} (-0.011) fell within the acceptable range of -0.15 and 0.20 and confirm the absence of an undesirable retrospective pattern. Hindcasting cross-validation results for the CTP-LL suggest that the JABBA base case model have good prediction skills as judged by the MASE scores of approximately 0.5 (**Figure 35**), which indicates that future projections are consistent with reality of model-based scientific advice.

The sensitivity runs confirmed that the inclusion of JPN-LL3 (1976-2018) had little effect on the trajectories of B/B_{MSY}, B/B_0 and F/F_{MSY}, or the overall stock status estimate, all of which remained similar to the JABBA base case model (**Figure 36**). On the other hand, the inclusion of the JPN-LL core CPUE was the most influential in that it resulted in notably more optimistic stock status trajectories as well as higher MSY estimates (**Figure 36**). The inclusion of BRA-LL and ZAF-BB CPUE time series resulted in a slightly more pessimistic stock status, but consistent with the *MSY* estimate of the JABBA base case model.

The medians of marginal posteriors for the model parameters and reference points for the JABBA base case model are depicted in the **Table 20**. The median for r was 0.22 (0.12-0.36, 95% CIs) and for K was 336,291 tones (215,120-603,726 t, 95% CIs). Estimate of *MSY* was 27,264 tones, with 95% CIs between 23,734 and 31,567 tones. The marginal posterior median for B_{2018}/B_{MSY} was 1.58 (1.14-2.05, 95% CIs), while F_{2018}/F_{MSY} was 0.40 with 95% CIs varying between 0.28 and 0.59 (**Table 20**). These results indicate that South Atlantic albacore is not overfished and no longer suffering overfishing.

The trajectory of B/B_{MSY} showed a long-term decrease between over the period from 1960 to the mid-2000s. The period between the late 1980s and 2000 had remained relatively stable at levels just above B_{MSY}. This was followed by a further decrease in biomass, which lead to an overfished stock status by 2005 (**Figure 37**). Coinciding with a notable reduction in total catches after 2005, biomass started to rebuild and attained levels at B_{MSY} during the late 2000s again. This is also reflected in the F/F_{MSY} trajectory, which gradually increased from the beginning of time series until late 1980s, followed by a relatively stable period at around the MSY level (**Figure 37**). In 2000, a substantial increase in fishing mortality was estimated when catches exceeded 30,000 tons. However, this overfishing period was relatively short lived and fishing mortality declined until dipping below F_{MSY} in the late-2000s where it has remained (F_{2018}/F_{MSY} < 1) (**Figure 37**). The continuous increase in biomass in recent years can be attributed to the fact that fishing mortality rate has remained below F_{MSY} since late-2000s and recent catches have been well below the estimated MSY of 27,264 tons (95% CIs: 23,734 -31,567).

4.2 Synthesis of stock assessments

The Group discussed the final stock assessment results for South Atlantic albacore. The work plan at the 2019 SCRS report was "*The intention is to, at a minimum, update the surplus production models, up until 2018, following the procedures of the 2016 stock assessment.*". After the investigations of two surplus production models (ASPIC and JABBA) and their base cases, the Group acknowledged that the stock assessment results among models were similar: trends of biomass and fishing mortality (**Figure 38**), and the median of MSY (26,286 t and 27,418 t for ASPIC, and 27,264 t for JABBA). Overall, both models provided similar historical trends of biomass, fishing mortality and current stock status. However, the level of uncertainty reflected in the results of each model were different. It was pointed out that ASPIC models showed narrower confidence intervals compared to JABBA, plus that the ASPIC program allows a maximum of 1000 bootstraps, while JABBA results showed wider credibility intervals, and were based on 15000 MCMC iterations. This can be explained as the estimation of uncertainty for each assessment model is different. In the case of ASPIC uncertainty on the parameter estimates are computed by bootstrapping of the residual fits to the indices of abundance inputs only (e.g. observation error). While with the Bayesian JABBA model uncertainty is estimated by MCMC that includes the model process error and the observation error. This is an important consideration in particular when future projections of stock status are considered for providing management advice.

Hence, the Group discussed whether the management advice should be based on either both model platforms or a single model, and for this it requested to the analysts to provide stock projection results for all models, with comparisons of Kobe plot and projection results among models. The Group evaluated the uncertainty estimates about the current stock status from both models (**Figure 39**), which clearly showed that the bootstrap samples of B/B_{MSY} and F/F_{MSY} from the two ASPIC model runs fell entirely within the JABBA marginal posterior distribution. Similarly, the uncertainty associated with future projections conducted with the two ASPIC models for the range of TAC scenarios captured a notably narrower of plausible future states than represented by the JABBA posteriors of relative biomass and fishing mortality, although the central tendency of the distributions (median estimates) were similar (**Figures 40** and **41**).

Finally, the Group concluded that JABBA and ASPIC results were consistent and similar in terms of central tendency, but that JABBA enables to capture more of the uncertainty by accounting for both observation and process error. The Group therefore recommended to provide the management advice based on the JABBA base case model results only, including the projections, and estimated Kobe probability matrices. The medians of marginal posteriors for the reference points for the JABBA base case model are presented in the **Table 21.**

It was noted, however that there is still a level of the real uncertainty that is not reflected in the model(s) results, and that the management advice provided should be taken with caution. The Group raised concerns about recent catches of southern albacore (2017-2018) having been below (~ 60%) the TAC advice provided (Rec. 16-07, 24,000 t). It is important to understand if this is related to capacity, catchability, or if is indicative of stock abundance levels inconsistent with stock assessment results.

It was recommended to explore an age-structured model assessment in the future to confirm the current results from the South Atlantic albacore that have been based on production model(s), even though all analyses have showed very robust results through base cases and sensitivity analysis.

4.3 Management advice and recommendations

The Group agreed to use the JABBA base-case model ('Fox ModW') to produce the Kobe phase plot and the projections results for the Kobe-2-Strategy Matrix (K2SM). Uncertainty is characterized in the form of Monte-Carlo Markov Chain (MCMC) posteriors of B/B_{MSY} and F/F_{MSY}. The joint marginal posterior distribution of the stock status in 2018 and stochastic future projections were constructed with 15,000 MCMC iterations. In accordance with the Group's recommendations, the projections were conducted for a range of Total Allowable Catch (TAC) scenarios, including a reference scenario of zero catch and then covering a range from 12,000 t to 34,000 t at specific intervals and for a period of 13 years (2021-2033). The catches for 2019 and 2020 were set to be 15,086 t, which corresponds to the average of total reported catch for 2016-2018.

The Kobe posterior of the JABBA base-case model (**Figure 42**) suggests a 99.4% probability that South Atlantic albacore stock is currently neither overfished ($B_{2018} > B_{MSY}$) nor subject to overfishing ($F_{2018} < F_{MSY}$). The point estimate of current biomass levels ($B_{2018}/ B_{MSY} = 1.581$) is higher than required to produce the median estimate of MSY = 27,264 tons (**Figure 43**), with the current fishing mortality rate being estimated as less than 50% of what would be sustainable ($F_{2018} / F_{MSY} = 0.398$).

The projections of biomass and fishing mortality (**Figures 44** and **45**) show that a total catch at approximate MSY levels of 27,000 tons, will maintain biomass levels above B_{MSY} and fishing mortality below F_{MSY} with a high probability of 90% over the projection horizon through 2033 (**Table 22**). None the less, due to the present level of the stock biomass, even catches exceeding MSY of up to 30,000 tons are still expected to maintain stock levels above B_{MSY} until 2033 with a probability of 61%. However, it is important to note that any catch levels exceeding MSY would require a reduction in TAC after 2033 to prevent overfishing (**Figure 43**).

5. Albacore Research Program North, South and Mediterranean stocks: current status and new proposals

The Group discussed the current status of research proposals for all three stocks of albacore tuna. While the North Atlantic albacore research program exists since 2010, research needs for the southern and Mediterranean stocks have rarely been discussed, while there seems to be some growing network and commitment among scientists of different CPCs. The discussion under this agenda item aimed to build the research proposal with prioritized budget. The Secretariat reminded the Group that this budget is allocated by species, not by stock, so it might be appropriate to prioritize research items as well as stocks. The objective of the research funds is to improve the scientific advice delivered by the SCRS by reducing bias and properly characterizing the different sources of uncertainty.

The Group reviewed a proposal of Mediterranean albacore research program that was similar to the one the Group reviewed in 2018. The proposal listed potential activities for data collection, modelling, biological studies, relative abundance indices and environmental issues affecting the Mediterranean stock. The Group welcomed the proposal but suggested to prioritize the studies and to focus on the activities that would improve the stock assessment. Age/Size composition is one of the key elements in the age-structured model assessments, and it was suggested to review task2sz information available to consider an additional sampling program. It was concluded that the Mediterranean research proposal is premature to adopt and requires substantially more discussion to clarify priorities, while efforts will need to be committed to the next stock assessment planned in 2021.

The Group reviewed a proposal of South Atlantic albacore research program that followed the structure of the North Atlantic research program and prioritized reproductive biology and migration (between southwest and southeast) studies. The proposal builds on the fact that biological and ecological knowledge of this stock is really scarce, and the life cycle of the stock is inferred mostly based on catch information of rather large individuals. The Group agreed on the strong need to conduct research for this stock. The Group mentioned that experience in the northern stock with e-tags could be useful for the southern stock. The Group also discussed other methodologies to improve the knowledge of stock structure. The authors clarified that the original proposal had several ideas such as genetic analysis, gene tagging, parasite bio-tags, and micro-chemistry analyses. The Group historically recognized that, like for some other tunas, some mixing with the Indian ocean might take place around South Africa. The Group was informed about a recent genetic study suggesting that the South Atlantic albacore stock is closer to the North Atlantic than to the Indian Ocean.

As part of the discussion on the North Atlantic albacore MSE, the Group reviewed the updated results of North Atlantic albacore pop-up tagging program (SCRS/P/2020/042). Although using PSATs in albacore tuna remains a challenge, the 5 tags implanted in 2019 in the Canary Islands have already provided more information than is available in the literature for this stock, including the longest time at liberty. These tracks cover one of the main migrations described in the life cycle of the stock, which is the feeding migration to productive waters of the NE Atlantic around summer. However, the authors suggested the need to increase sample size, to have multiyear tracks through internal archival tags, and to try to cover the second important migration described in the life cycle of this stock, the spawning migration. During 2020, 10 additional tags were implanted in the Canary Islands and there is no information about them yet, which could be linked to major problems in the batteries of WC Mini-PSATs. The Group questioned if any specific technique at tag deployment was made to recover the data in the entire set period, but the handling of fish and the conditions were similar among all tagged fish.

The North Atlantic Albacore research program has evolved since 2010, basically adapting as new knowledge was generated and new knowledge gaps were identified. This research program was appended to the albacore work plan during the last few years, and had three main items, namely Biology, Monitoring of stock status, and MSE, although is currently prioritizing electronic tagging and reproduction studies, as well as the MSE. The rapporteur presented the funds that had been assigned to different research items in 2020 and suggested to transfer €77,000 from other items, to e-tags. This was justified by the fact that under MSE €20,000 were saved, there was no need for a stock assessment expert (€5,000), and other fisheries related studies (€52,000) are not considered priority one (i.e. the environmental issues are listed as priority 2, and the current MP requires to use individual CPUEs). The Group endorsed this proposal and the Secretariat will look into ways to take this forward, considering the wider perspective of the changes required for other species. As for Reproductive Biology studies, the biological sampling was cancelled due to the pandemic, but the Secretariat informed that an amendment of the contract might allow to spend these funds up until the second quarter of 2021, so the Group preferred to keep these funds under the Reproductive Biology section instead of transferring them to e-tagging.

6. Recommendations on Research and Statistics

The Group recommends continued funding of the albacore research program for North and South Atlantic stocks. As for the Mediterranean stock, although there are still considerable gaps in knowledge on the species biology, fisheries and statistics, to date, the Group has not set research priorities; therefore, no funding is currently requested under the framework of the ICCAT Albacore Research Project. However, there is one recommendation, regarding larval studies, with financial implications for this stock.

Recommendations with financial implications

- The Group recommended that for the next four-years, the research on the North and South Albacore stocks will be focused on three main research areas: biology and ecology, monitoring of stock status, and management strategy evaluation (the latter is specific to the North Atlantic stock). For 2021 the Group recommended to continue electronic tagging activities in the North Atlantic, to start tagging in the southern Atlantic, to conduct reproductive biology studies in both stocks, and to progress on the North Atlantic albacore MSE. These are all considered to be high priority tasks, with an estimated cost of €120,000. More details of the proposed research and economic plan are provided in the Albacore 2021 work plan **(Appendix 5).**

- The Group supports the continuation of larval data collection in the Balearic Sea and other spawning areas (e.g. central and eastern Mediterranean), and recommends further research related to the use of larval indices to complement fisheries dependent data in stock assessments.

- During some of the recent scientific meetings of the Albacore Species Group, it was noted the absence of several CPCs with important albacore fisheries. This fact limited the ability of the Group to properly revise and interpret the basic fishery data and relative indices of abundance. This continues to result in unquantified uncertainties which negatively affects achieving the meeting objectives. To overcome this issue, the Group continues to recommend that CPCs make additional efforts to participate in the meetings. Moreover, whenever necessary developing CPCs may request financial assistance to the Secretariat through the ICCAT Meeting Participation Fund (MPF), to attend and contribute to Albacore Species Group meetings. This recommendation is pertinent for the 2021 Mediterranean albacore stock assessment.

- Following the ICCAT roadmap adopted by the Commission, which is currently under review by the SCRS, the Group recommends the Commission to provide the necessary financial means for the continuity of the work.

The table below provides information on the estimated costs of the above recommendations.

Species: ALB	*2021*	*2022*	*2023*
Tagging[1]	60000	40000	30000
Biological studies:			
Reproduction[1]	35000	35000	25000
Age and growth			
Genetic			
Other (Larval studies)	33000	33000	33000
MSE	20000	30000	30000
Other fisheries related studies (including data recovery)			
Sample collection and shipping	5000	5000	5000
Consumables			
Workshops/stock assessment expert/reviewer			
TOTAL	**153000**	**143000**	**123000**

[1] Funds to be evenly split between North/South stocks. In case of budget reduction, the southern stock has priority.

Recommendations without financial implications

The Committee recognized the lack of standardized CPUE data from the eastern Mediterranean as a potential source of uncertainty when assessing the Mediterranean albacore stock. The Group recommended the CPCs predominantly fishing in this area (EU-Greece, EU-Cyprus and Turkey) should make a concerted effort to generate, and submit, standardized CPUE data.

The Committee recommends conducting a review and collation of all the available data on age-length from the various studies that have estimated age from spines with the view to update the estimate of the growth curve for Mediterranean albacore. It is also recommended that methods of accounting for selectivity in the year 1 cohort in von Bertalanffy growth function (VBGF) be explored to ensure accurate parameter estimation.

The Group recommends that, the Secretariat work together with the Statistical Correspondents of ICCAT CPCs having gaps or incomplete Task 1 and Task 2 datasets identified in the three albacore SCRS catalogues (respectively stocks: ALB-N, ALB-S, ALB-M in **Tables 3, 4,** and **5**), to recover and report those missing datasets to ICCAT, foreseeing the 2021 ALB intersessional meeting.

7. Other matters

The Group also revised and updated the Atlantic and Mediterranean Albacore Executive Summary. However, the final version including figures, tables and minor additions related to the fisheries statistics of latest year(s) will be updated during the Species Group meeting in September. The Group also review and approved the Albacore work plan proposal for 2021 and successive years.

8. Adoption of the report and closure

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

References

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Table 1. Biological parameters and conversion factors for the North Atlantic albacore stock. The *K* value for the southern growth equation (marked with "*") was corrected from the previous report**.**

North Stock	***Parameters***	***Source***
Growth	$L\infty$ = 122.198cm; k = 0.21; t_0 = -1.338	Santiago and Arrizabalaga, 2005
	$L\infty$ = 124.74cm; k = 0.23; t_0 = -0.9892	Bard, 1981
Length-weight relationship	a=1.339x 10^{-5} b=3.1066	Santiago, 1993
Maturity	50% of mature fish at 90 cm (age 5)	Bard, 1981
Natural mortality	*M* = 0.3 per year	
M at age (1 to 15)	0.63; 0.46; 0.38; 0.34; 0.31; 0.29; 0.31; 0.34; 0.38; 0.44; 0.55; 0.55; 0.55; 0.55; 0.55	Anon., 2010

Table 2. Biological parameters and conversion factors for the South Atlantic albacore stock. ***** This corrects the detailed report (Anon., 2016) value for the *K* parameter in the Growth model.

South Stock	***Parameters***	***Source***
Growth	$L\infty$ = 147.5 cm; *K* = 0.126*; and t_0 = - 1.89	Lee and Yeh, 2007
Length-weight relationship	a=1.3718x 10^{-5} b=3.0973	Penney, 1994
Maturity	50% of mature fish at 90 cm (age 5)	Bard, 1981
Natural mortality	*M* = 0.3 per year	

Table 3 ALB-N standard SCRS catalogue on Task 1/2 data availability by major fishery (flag/gear combinations ranked by order of importance) and year (1989 to 2018). Only the most important fisheries (representing ~95% of Task 1 total catches) are shown. For each data series, Task 1 (DSet= "t1", in t) is visualized against its equivalent Task 2 availability (DSet= "t2") scheme. The Task 2 color scheme, has a concatenation of characters ("a"= T2CE exists; "b"= T2SZ exists; "c"= T2CS exists) that represents the Task 2 data availability in the ICCAT-DB system.

Species	Stock	Status	FlagName	GearGrp	DSet	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
				T1NC Total		32071	36881	27931	30851	38135	35163	38377	28803	29023	25746	34551	33124	26253	22741	25567
ALB	ATN	CP	EU.España	BB	t1	14918	15442	8267	10814	12277	11041	9953	9640	9401	7346	8448	10774	4929	4712	7325
ALB	ATN	CP	EU.España	BB	t2	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc
ALB	ATN	CP	EU.España	TR	t1	10479	10342	8955	7347	6094	5952	10225	6649	7864	5834	6829	5013	4245	3976	5193
ALB	ATN	CP	EU.España	TR	t2	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc
ALB	ATN	CP	EU.France	TW	t1	2240	1032	463	2459	1706	1967	2904	2570	2874	1178	4723	3466	4740	4275	3252
ALB	ATN	CP	EU.France	TW	t2	abc	abc	abc	ab	a	ab	ac	ac	ac	a	ac	ac	ac	ac	ab
ALB	ATN	NCC	Chinese Taipei	LL	t1	1294	1651	4318	2209	6300	6409	3977	3905	3330	3098	5785	5299	4399	4330	4557
ALB	ATN	NCC	Chinese Taipei	LL	t2	ab	ab	ab	ab	ab	ab	ab	ab	abc	abc	abc	ab	ab	ab	ab
ALB	ATN	CP	EU.Portugal	BB	t1	166	3182	700	1622	3369	926	6458	1622	393	76	281	255	1137	1913	516
ALB	ATN	CP	EU.Portugal	BB	t2	ab	abc	abc	abc	abc	abc	abc	abc	abc	ab	abc	abc	abc	ab	abc
ALB	ATN	CP	EU.France	GN	t1	1450	2268	3660	4465	4587	3967	2400	2048	1717	2393	1723	1864	1150	13	
ALB	ATN	CP	EU.France	GN	t2	abc	abc	abc	ab	ab	ab	ac	ac	ac	a	ac	ac	ac	a	
ALB	ATN	CP	EU.Ireland	TW	t1										57	319	80	634	1100	594
ALB	ATN	CP	EU.Ireland	TW	t2										-1	b	a	a	abc	abc
ALB	ATN	CP	EU.Ireland	GN	t1		40	60	451	1946	2534	918	874	1913	3639	4523	3374	1430		
ALB	ATN	CP	EU.Ireland	GN	t2		-1	-1	-1	ab	-1	-1	c	c	c	bc	ab	ab		
ALB	ATN	CP	Japan	LL	t1	764	737	691	466	485	505	386	466	414	446	425	688	1126	711	680
ALB	ATN	CP	Japan	LL	t2	ab	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc
ALB	ATN	CP	St. Vincent and Grenadines	LL	t1												703	1370	300	1555
ALB	ATN	CP	St. Vincent and Grenadines	LL	t2												-1	-1	a	a
ALB	ATN	CP	U.S.A.	RR	t1	133	175	251	103	224	324	23	309	335	601	90	251	122	323	334
ALB	ATN	CP	U.S.A.	RR	t2	a	ab	ab	ab	ab	ab	ab	b	ab	ab	ab	abc	abc	abc	abc
ALB	ATN	CP	U.S.A.	LL	t1	61	148	201	116	192	230	373	123	184	179	192	146	191	146	106
ALB	ATN	CP	U.S.A.	LL	t2	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	abc	abc	abc	abc
ALB	ATN	CP	Venezuela	LL	t1	29	93	75	51	18	0	0	52	49	16	36	106	35	67	135
ALB	ATN	CP	Venezuela	LL	t2	b	b	b	ab	ab	ab	ab	ab	b	ab	ab	ab	b	b	ab
ALB	ATN	CP	Venezuela	PS	t1	12	1	221	139	228	278	278	263	26	91	55	191	260	93	211
ALB	ATN	CP	Venezuela	PS	t2	ab	a	b	-1	ab	ab	ab	b	a	ab	a	ab	ab	ab	ab
ALB	ATN	CP	EU.España	LL	t1	27	8	11	13	8	5	19	35	30	105	86	214		264	12
ALB	ATN	CP	EU.España	LL	t2	ab	ab	ab	ab	ab	ab	ab	ab	-1	-1	-1	-1		-1	-1

Species	Stock	Status	FlagName	GearGrp	DSet	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Rank	%	%cum
				T1NC Total		25960	35318	36989	21991	20483	15375	19509	20039	25680	24633	26655	25551	30340	28401	29691			
ALB	ATN	CP	EU.España	BB	t1	7893	10067	14182	8375	7403	4940	5841	4676	7753	4473	4740	8353	13394	9687	10836	1	31.4%	31%
ALB	ATN	CP	EU.España	BB	t2	abc	abc	abc	abc	abc	abc	abc	abc	ac	ac	ac	ac	ac	ac	abc	1		
ALB	ATN	CP	EU.España	TR	t1	7477	10165	10277	6089	5233	4437	7009	3564	5833	5864	6651	5596	3559	4163	4806	2	23.0%	54%
ALB	ATN	CP	EU.España	TR	t2	abc	abc	abc	abc	abc	abc	abc	abc	ac	ac	ac	ac	ac	ac	ac	2		
ALB	ATN	CP	EU.France	TW	t1	2194	6743	5878	2842	2806	773	1216	3249	3126	4327	6699	3379	3961	4118	5718	3	11.4%	66%
ALB	ATN	CP	EU.France	TW	t2	abc	abc	abc	abc	abc	abc	abc	abc	ab	abc	abc	a	-1	a	b	3		
ALB	ATN	NCC	Chinese Taipei	LL	t1	4278	2540	2357	1297	1107	863	1587	1367	1180	2394	947	2857	3134	2385	2926	4	10.8%	77%
ALB	ATN	NCC	Chinese Taipei	LL	t2	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	abc	abc	abc	abc	4		
ALB	ATN	CP	EU.Portugal	BB	t1	224	391	21	80	517	54	179	855	1063	502	2601	912	1061	2509	494	5	4.0%	81%
ALB	ATN	CP	EU.Portugal	BB	t2	abc	abc	a	abc	abc	abc	ab	abc	abc	abc	abc	abc	abc	ab	ab	5		
ALB	ATN	CP	EU.France	GN	t1							2	1		21		7	3	0	0	6	4.0%	85%
ALB	ATN	CP	EU.France	GN	t2							-1	-1		-1		-1	-1	a	-1	6		
ALB	ATN	CP	EU.Ireland	TW	t1	172	258	505	586	1514	1997	785	3595	3551	2231	2485	2390	2337	2492	3102	7	3.6%	88%
ALB	ATN	CP	EU.Ireland	TW	t2	abc	ac	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ab	abc	bc	7		
ALB	ATN	CP	EU.Ireland	GN	t1																8	2.5%	91%
ALB	ATN	CP	EU.Ireland	GN	t2																8		
ALB	ATN	CP	Japan	LL	t1	893	1336	781	288	402	288	525	336	400	1745	267	276	297	366	196	9	2.0%	93%
ALB	ATN	CP	Japan	LL	t2	abc	abc	abc	abc	abc	abc	abc	abc	ab	ab	ab	ab	ab	ab	ab	9		
ALB	ATN	CP	St. Vincent and Grenadines	LL	t1	82	802	76	263	130	134	174	329	305	286	327	305	291	296	173	10	0.9%	94%
ALB	ATN	CP	St. Vincent and Grenadines	LL	t2	a	-1	a	a	a	a	a	ab	a	ab	a	ab	ab	ab	ab	10		
ALB	ATN	CP	U.S.A.	RR	t1	500	356	284	394	125	23	150	171	145	340	137	121	43	28	9	11	0.8%	94%
ALB	ATN	CP	U.S.A.	RR	t2	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	11		
ALB	ATN	CP	U.S.A.	LL	t1	120	108	103	127	127	158	160	240	261	255	309	229	203	209	93	12	0.6%	95%
ALB	ATN	CP	U.S.A.	LL	t2	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	12		
ALB	ATN	CP	Venezuela	LL	t1	116	111	155	146	138	290	242	247	292	274	437	560	587	601	326	13	0.6%	96%
ALB	ATN	CP	Venezuela	LL	t2	ab	ab	ab	ab	ab	ab	ab	ab	ab	a	a	a	a	a	-1	13		
ALB	ATN	CP	Venezuela	PS	t1	341	63	162	198	70	84	16		21		27			2		14	0.4%	96%
ALB	ATN	CP	Venezuela	PS	t2	ab	ab	ab	ab	ab	ab	ab		ab		ab			ab		14		
ALB	ATN	CP	EU.España	LL	t1	10	216	80	118	89	240	111	117	133	159	216	177	123	114	49	15	0.3%	96%
ALB	ATN	CP	EU.España	LL	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	b	b	-1	-1	-1	15		

Table 4 ALB-S standard SCRS catalogue on Task 1/2 data availability by major fishery (flag/gear combinations ranked by order of importance) and year (1989 to 2018). See details in Table 3

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
				T1NC Total		27212	28714	26016	36562	32813	35300	27552	28426	28022	30595	27656	31387	38796	31746	28005	22545	18916	24453	20283	18867	22265	19225	24129	25282	19457	13702	15199	14336	13825	17098			
ALB	ATS	NCC	Chinese Taipei	LL	t1	18386	20442	19883	23063	19400	22573	18351	18956	18165	16106	17377	17221	15833	17321	17351	13288	10730	12293	13146	9966	8678	10975	13032	12813	8519	6675	7157	8907	9090	9227	1	58.1%	58%
ALB	ATS	NCC	Chinese Taipei	LL	t2	ab	ab	ab	ab	ab	ab	ab	ab	abc	abc	abc	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	abc	abc	abc	abc	1		
ALB	ATS	CP	South Africa	BB	t1	6834	5220	3355	6306	6845	6842	5204	5425	6581	8401	5010	3463	6715	6057	3323	4153	2856	3365	2024	2334	2967	2446	2029	3466	3395	3620	3898	2001	1640	2353	2	17.1%	75%
ALB	ATS	CP	South Africa	BB	t2	ab	ab	ab	ab	ab	ab	ab	ab	ab	b	ab	abc	ab	abc	abc	abc	abc	ab	ab	ab	a	a	ab	ab	ab	ab	ab	ab	a	a	2		
ALB	ATS	CP	Namibia	BB	t1						915	950	982	1192	1422	1072	2240	2969	2858	2432	3079	2031	2426	1058	1856	4936	1263	3711	2275	838	1016	1008	893	205	874	3	5.9%	81%
ALB	ATS	CP	Namibia	BB	t2						abc	abc	-1	-1	-1	abc	c	ab	ac	-1	abc	abc	abc	abc	abc	abc	abc	abc	ab	abc	abc	ab	abc	abc	abc	3		
ALB	ATS	CP	Brazil	LL	t1	433	485	1095	2710	3600	835	723	807	589	3013	1478	3758	6240	2865	1844	285	359	267	222	233	150	207	920	824	778	326	431	494	383	311	4	4.9%	86%
ALB	ATS	CP	Brazil	LL	t2	a	a	a	ab	ab	ab	ab	a	ab	ab	ab	ab	a	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	a	a	a	a	a	ab	4		
ALB	ATS	CP	Japan	LL	t1	450	587	654	583	467	651	389	435	424	418	601	554	341	231	322	509	312	316	238	1370	921	973	1194	2903	3106	1131	1752	1096	1189	2985	5	3.6%	90%
ALB	ATS	CP	Japan	LL	t2	ab	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ac	abc	abc	abc	abc	abc	abc	ab	ab	ab	ab	ab	ab	ab	5		
ALB	ATS	CP	South Africa	RR	t1	56	60	55	54	36	89	10	209	127		73	58	377	323	82	201	288	324	1696	1028	1855	1529	1268								6	1.3%	91%
ALB	ATS	CP	South Africa	RR	t2	a	a	a	a	a	a	-1	a	a		-1	-1	-1	-1	-1	-1	a	a	a	a	a	a	-1								6		
ALB	ATS	CP	EU.España	LL	t1		0	1	127	135	149	202	180	190	20	871	282	573	829	183	81	261	358	758	908	997	266	250	235	369	256	354	195	259	301	7	1.3%	92%
ALB	ATS	CP	EU.España	LL	t2		ab	ab	ab	-1	ab	ab	ab	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	b	b	b	b	b	7		
ALB	ATS	CP	St. Vincent and Grenadines	LL	t1												2116	4292	44				65	160	71	51	31	94	92	97	110	100	107	101	98	8	1.0%	93%
ALB	ATS	CP	St. Vincent and Grenadines	LL	t2												-1	-1	a		a		a	a	a	a	a	a	-1	ab	a	ab	ab	ab	ab	8		
ALB	ATS	CP	Brazil	BB	t1	2	29	18		13	392	200	12	63	405	394	627	619	363	803	235	197	85	293	156	18	34	198	1190	979	129	60	55	0	1	9	1.0%	94%
ALB	ATS	CP	Brazil	BB	t2	a	a	a		a	-1	a	a	a	a	a	-1	a	a	a	a	a	a	ab	a	a	a	a	a	a	a	a	a	a	a	9		
ALB	ATS	CP	EU.Portugal	BB	t1	557	732	81	184	483	1185	655	494	256	124	232	486	40	433	415	9															10	0.9%	95%
ALB	ATS	CP	EU.Portugal	BB	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	a	a	a	a															10		
ALB	ATS	CP	Namibia	LL	t1						196			7	7	90	178	450	105	721	250	313	2674	138	102	0	57	80	145	10	41	54	101	8	14	11	0.8%	96%
ALB	ATS	CP	Namibia	LL	t2						a			-1	-1	a	-1	ab	ac	-1	ab	ab	ab	ab	a	ab	ab	abc	a	ab	a	a	a	a	abc	11		
ALB	ATS	CP	EU.España	PS	t1			279	1816	648	682	255	4	66	173	156	7		7	193		24	9		25	64	28	64	116		3	64		88	2	12	0.6%	97%
ALB	ATS	CP	EU.España	PS	t2	b	b	abc	abc	abc	abc	abc	abc	abc	abc	ac	abc	abc	abc	abc		abc	abc		abc	abc	abc	abc	abc	b	ac	ac		abc	a	12		

Table 5 ALB-M standard SCRS catalogue on Task 1/2 data availability by major fishery (flag/gear combinations ranked by order of importance) and year (1989 to 2018). See details in Table 3

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
				T1NC Total		4060	1896	2379	2202	2138	1349	1587	3150	2541	2698	4856	5577	4870	5608	7898	4874	3529	5965	6520	2970	4024	2124	4628	2047	1503	2400	3554	4319	2780	2434			
ALB	MED	CP	EU.Italy	LL	t1	165	624	523	436	402	347	81	366	172	172	307	2712	2445	3631	3786	1555	1189	1995	2721	2083	1497	1109	1634	1117	605	1342	1356	1480	1322	1029	1	35.9%	36%
ALB	MED	CP	EU.Italy	LL	t2	-1	-1	-1	-1	b	a	a	a	a	a	a	ab	ab	a	ab	b	b	ab	b	bc	abc	abc	abc	abc	abc	abc	abc	abc	abc	bc	1		
ALB	MED	CP	EU.Italy	GN	t1	110	565	668	1025	873	759	1027	1383	1222	1222	2254	916	379	397																	2	12.0%	48%
ALB	MED	CP	EU.Italy	GN	t2	-1	a	a	a	ab	a	-1	-1	-1	-1	-1	ab	b	-1	b		b														2		
ALB	MED	CP	EU.Italy	PS	t1															3079	2100	1046	2589	1249	15	1230		866		10	9	244	4	26	13	3	11.7%	60%
ALB	MED	CP	EU.Italy	PS	t2															-1	-1	-1	b	-1	-1	-1		-1		-1	-1	-1	-1	abc	-1	3		
ALB	MED	CP	EU.Greece	UN	t1	500	500	500	500	1	1		952	741	1152	1950	1735	1786	1304																	4	10.9%	71%
ALB	MED	CP	EU.Greece	UN	t2	-1	-1	-1	-1	-1	-1		-1	-1	-1	-1	-1	-1	-1																	4		
ALB	MED	CP	EU.Greece	LL	t1											35	33	40	36	445	427	323	242	257	191	116	125	126	126	165	287	541	1332	608	522	5	5.6%	76%
ALB	MED	CP	EU.Greece	LL	t2											-1	-1	-1	-1	a	a	ab	ab	-1	a	a	-1	-1	-1	b	b	a	-1	a	ab	5		
ALB	MED	CP	EU.Cyprus	LL	t1															17	243	337	451	695	204	220	206	247	321	357	385	505	558	568	624	6	5.6%	82%
ALB	MED	CP	EU.Cyprus	LL	t2															a	a	a	ab	abc	abc	abc	abc	abc	ab	a	abc	abc	abc	abc	abc	6		
ALB	MED	CP	EU.España	LL	t1			1	6	8	3	6	25	176	22	74	51	112	37	1	109	148	322	421	208	204	277	338	385	238	270	52	48	206	70	7	3.6%	85%
ALB	MED	CP	EU.España	LL	t2			ab	ab	ab	ab	ab	ab	ab	ac	ac	ab	ac	ac	-1	-1	a	a	a	abc	abc	abc	a	abc	ab	abc	abc	ab	abc	abc	7		
ALB	MED	CP	EU.Italy	UN	t1	3254					1	1									15	11			0					0						8	3.1%	88%
ALB	MED	CP	EU.Italy	UN	t2	-1					-1	-1								b	b	b	b		-1					-1						8		
ALB	MED	CP	Turkey	GN	t1																				208	631	402	1396								9	2.5%	91%
ALB	MED	CP	Turkey	GN	t2																				a	a	ab	ab								9		
ALB	MED	CP	EU.España	BB	t1		83	499	171	231	81	163	205		33	96	88	77	29			0		0												10	1.6%	93%
ALB	MED	CP	EU.España	BB	t2		ac	ac	ac	c	ac	ac	ac		ac	ac	a	-1	ac			-1		a												10		
ALB	MED	CP	Libya	LL	t1																											750	800		30	11	1.5%	94%
ALB	MED	CP	Libya	LL	t2																											-1	-1		-1	11		
ALB	MED	CP	EU.Greece	PS	t1															478	326	287	141	123												12	1.3%	95%
ALB	MED	CP	EU.Greece	PS	t2															-1	-1	-1	-1	-1												12		
ALB	MED	CP	EU.España	TR	t1			48	50	59	129	306	119	202	45	73			117										2							13	1.1%	96%
ALB	MED	CP	EU.España	TR	t2			abc	abc	abc	abc	abc	abc	abc	abc	abc			abc										a							13		

Table 6. Albacore total catches (T1NC, t) by stock, major gear, and year (period 1950-2018).

	ALB-N															ALB-S									ALB-M												
Year	BB	GN	HL	HP	HS	LL	PS	RR	TL	TN	TP	TR	TW	UN	Total	BB	GN	HL	LL	PS	RR	TW	UN	Total	BB	GN	HL	LL	PS	RR	SP	TN	TP	TR	TW	UN	Total
1950												39623			39623																						
1951												34149			34149																						
1952												32397			32397																						
1953	3875											26242			30117																						
1954	7250											32729			39979																						
1955	3125											28299			31424																						
1956	5500					2						35398			40900				21					21													
1957	11959					135						30028			42122				725					725												1700	1700
1958	17558					945						33945			52448				1047					1047												2900	2900
1959	18517					599						30796			49912				4715					4715												2900	2900
1960	18139					1658						33072			52869				10475					10475												1300	1300
1961	21120					703						20907			42730				10365				400	10765												1400	1400
1962	21469					6375						30943			58787				17171				1800	18971												1200	1200
1963	20739					14976						24625			60340				17385					17385												1600	1600
1964	20428					16148						28058			64634	22			25977					25999												1600	1600
1965	20112					15002						25544			60658				29845					29845												2200	2200
1966	16757					7815						22791			47363				27296					27296												3000	3000
1967	18349					10124						30669			59142				15883					15883												2300	2300
1968	13936					7291						23993			45220	38			25650					25688												2600	2600
1969	14569					14238						17923			46730				28493					28493					200							3200	3400
1970	14388					15801						15706			45895				23653					23653												500	500
1971	15677					17115						24029			56821				24885					24885												500	500
1972	8196					14068						26517			48781				33079	10	100			33189				1								700	701
1973	8833					18155						18712			45700	1			28134	3	96			28234												500	500
1974	13986					14662						20958			49606	97			19553	13	53			19716												500	500
1975	19687					12710						9491			41888	46			17456	1	104			17607												500	500
1976	20227					23090						13918			57235				19178	47	150			19375				41								520	561
1977	15559					21081						17391			54031	66			20982	114	150		143	21455				130								483	613
1978	11958					14163	68					23931		1	50121	43			22800	51	162		39	23095				150								440	590
1979	15764		3			12214						23332		59	51372	53			21855	188	410		134	22640												833	833
1980	16177	1	0			9453					0	13059	0	0	38691	1346			20671	480	264		185	22946												500	500
1981	13412	2					9819		398			63	10778	1	58	34531	1721			20426	1804	69		20	24040	900											600	1500
1982	15857	4	7			13206	84	667			0	12831	0	16	42673	2575			25255	1349	467		26	29672	539									33		700	1272
1983	21108	0	5	1		16896	364	322			3	12788	0	3	51490	1794			11941	699	429		55	14918	535											700	1235
1984	8313	1	4			19709	555	2176			0	11029	0	13	41800	4166			9834	365	20		214	14599	1331	191	37	226	141							1525	3451
1985	12589	3	2			17413	59	75			3	10654	2	25	40826	7909	0		22672	182	181		153	31097	243	385		375	274					264		2588	4129
1986	15202	3	10			21232	60	190			0	10847		10	47554	6829			29815	244	38		362	37288		100		324	10	10				310		2958	3712
1987	18756	90	21			7296	1	230			0	11457	262	2	38115	8181			30964	948	60		477	40630		107		164	50	10						3665	3996
1988	15933	758	9			3013	97	214			0	11329	1693	13	33059	7696			21894	185	45		353	30173		110		168	16	15						3754	4063
1989	15374	1481	12	0	0	2239	12	133	22			10554	2240	3	32071	7393			19407		57		354	27212		110		165	16	15						3754	4060
1990	18624	3682	5			2683	1	175				10675	1033	3	36881	5982	927		21590	4	60		151	28714	83	565		624	91	30			3			500	1896
1991	8968	3732	6		2	5315	222	251			2	8959	469	6	27931	3459			22025	416	55		60	26016	499	668		524	110	30				48		500	2379
1992	12436	4984	4		54	3152	139	103			8	7348	2603	20	30851	6518			27167	2517	54		306	36562	171	1025		442	6	5			3	50		500	2202
1993	15646	7034	2			7093	229	224			0	6109	1779	19	38135	7379			23950	1448	36			32813	231	873		410	559	5				59		1	2138
1994	11967	7122	8			7309	292	324			1	5959	2131	50	35163	9339			24806	1064	89		2	35300	81	759		350	23	5				129		2	1349
1995	16411	3518	1			4859	278	23	1			10226	3049	12	38377	7091			20040	412	10			27552	163	1027		87	0	3				306		1	1587
1996	11338	3002	2			4641	263	309	10		3	6652	2571	11	28803	6960			21000	257	209	0		28426	205	1383	80	391			20			119		952	3150
1997	9821	3706	5			4051	26	337	3		1	7870	2877	325	29023	8110			19547	117	127	120		28022		1222	2	348		5	20			202		742	2541
1998	7562	6108	0			4035	91	601	3		1	5894	1318	133	25746	10353			19799	434		9		30595	33	1222	24	194		5	20		2	45		1153	2698
1999	8780	6315	18			6710	56	94	10		0	6845	5343	379	34551	6709			20640	183	73	52		27656	96	2254	61	416					0	73		1956	4856
2000	11072	5254	77			7321	191	258	12		0	5023	3547	370	33124	6873			24398	58	58	0		31387	88	916	23	2796		6	2		8			1739	5577
2001	6103	2585	86	0		7372	264	126	5		0	4312	5374	24	26253	10355			28039	25	377			38796	77	379	26	2597	0		2					1790	4870
2002	6638	17	9			6235	118	335	2		1	4009	5376	1	22741	9712			21671	39	323	0		31746	29	397	38	3704	1	12	4			117		1306	5608
2003	7840	1	55			7826	211	352	6		1	5373	3846	55	25567	6976		0	20626	309	82	12		28005		0	27	4248	3557	13	1				48	5	7898
2004	8128	5	46	0		7037	348	501	3		6	7501	2369	16	25960	7477		96	14735	16	201	18	2	22545			49	2335	2452	6	1	7				25	4874
2005	10458	12	225	0		6911	99	367	1		2	10224	7001	17	35318	5119			12977	534	288	0	0	18916	0		53	1997	1362	30	2	58				26	3529
2006	14273	6	309	0		5223	188	297	2		1	10296	6385	10	36989	5938			17740	442	324		9	24453		0	78	3026	2803					1		56	5965
2007	8496	6	114	0		3237	198	399	0		0	6105	3429	6	21991	3421			15087	58	1696		21	20283	0		163	4101	2237	2				0		17	6520
2008	7931	10	123	3		2647	70	130	1		0	5239	4321	6	20483	4443			13218	81	1028		98	18867		208	31	2694	24			1		1	5	5	2970
2009	4994	30	30	1		2619	84	24	0		0	4440	2811	342	15375	8007		96	12113	160	1855		34	22265		631	0	2160	1230					0	0	3	4024
2010	6026	27	133	0		3913	74	150	0	0	0	7146	2026	14	19509	3750		89	13471	355	1529		30	19225		402	2	1719				0		1			2124
2011	5530	1	48	1		3666		176	0	26	0	3578	6852	160	20039	6058	41	104	16445	208	1268		5	24129		1396	10	2352	869						0	2	4628
2012	8816	6	17	1		3759	167	152	0			5909	6678	177	25680	6933		64	17847	437			0	25282		0	5	1965	68					6		3	2047
2013	4975	21	5	1		6607	7	342	0	0		5891	6558	226	24633	5213		264	13888	91				19457		0	11	1399	86						0	6	1503
2014	7341	4	6	1		3272	35	142	2		0	6660	9184	8	26655	4765		7	8888	42				13702		0	15	2351	14				5	3	5	8	2400
2015	9265	8	4	0		4667	115	122	0			5597	5771	1	25551	4965		0	10104	129				15199		0	4	3245	247			0	0	0	4	54	3554
2016	14455	19	26	1		5694	45	44	0	2		3753	6299	3	30340	2949			11243	36			108	14336		0	3	4274	7			0		0	9	26	4319
2017	12196	90	17	0		5253	38	29	0	1		4165	6611	0	28401	1846			11674	191			114	13825		0	2	2706	26			0		2	0	44	2780
2018	11330	4	47	0		4633	39	10		0		4807	8820	1	29691	3228		84	13767	19				17098		0	2	2378	14			0		1	2	38	2434

Table 7. Evaluation of the CPUE series on North and South Atlantic albacore stocks presented to the Group. The evaluation was made using the protocol established by the WGSAM.

North Atlantic stock

Use in stock assessment?	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate
SCRS Doc No.	SCRS/2020/092	SCRS/2020/086	SCRS/2020/098	SCRS/2020/102	SCRS/2020/089	SCRS/2016/087
Index Name:	JPNLL North Update	US pelagic LL	Spain BB	Taiwan LL North	Venezuela LL	JPNLL North Core area
Data Source (state if based on logbooks, observer data etc)	logbooks	logbooks	trip enquires	logbook, e-logbook and task2	Observers	logbooks
Do the authors indicate the percentage of total effort of the fleet the CPUE data represents?	No	Yes	No	Yes	YES	No
If the answer to 1 is yes, what is the percentage?		91-100%		91-100%	5-11%	
Are sufficient diagnostics provided to assess model performance??	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient
How does the model perform relative to the diagnostics ?	Well	Well	Well	Well	Well	Well
Documented data exclusions and classifications?	Yes	Yes	Yes	Yes	Yes	Yes
Data exclusions appropriate?	Yes	Yes	Yes	Yes	no exclusions	Yes
Data classifications appropriate?	Yes	Yes	Yes	Yes	Yes	Yes
Geographical Area	Atl N	Atl NW	Atl NE	Atl N	ATL NW	Atl NW
Data resolution level	OTH	Set	trip	Set	Set	Set
Ranking of Catch of fleet in TINC database (use data catalogue)	6-10	11 or more	1-5	1-5	11 or more	6-10
Length of Time Series	longer than 20 years	longer than 20 years	longer than 20 years	longer than 20 years	longer than 20 years	longer than 20 years
Are other indices available for the same time period?	Few	Few	Few	Few	Few	Few
Are other indices available for the same geographic range?	Few	Few	None	Few	Few	Few
Does the index standardization account for Known factors that influence catchability/selectivity? (eg. Type of hook, bait type, depth etc.)	Yes	Yes	No	Yes	Yes	Yes
Estimated annual CV of the CPUE series	Variable	Low	Low	Low	Medium	Variable
Annual variation in the estimated CPUE exceeds biological plausibility	Possible	Possible	Unlikely	Unlikely	Unlikely	Possible
Is data adequate for standardization purposes	Yes	Yes	Not fully, partially	Yes	Yes	Yes
Is this standardised CPUE time series continuous?	Yes	Yes	Yes	Yes	Yes	Yes
For fisheries independent surveys: what is the survey type?					n/a	
For 19: Is the survey design clearly described?					n/a	
Other Comments					Exclude 2018, see SCRS/2020/089	

Table 7. Continued.

South Atlantic stock

Use in stock assessment?	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate
SCRS Doc No.	SCRS/2020/093	SCRS/2013/043	SCRS/2020/083	SCRS/2020/101	SCRS/2020/085	SCRS/2020/094
Index Name:	JPNLL South Update	Uruguay LL	Brazil LL	Taiwan LL South	South Africa baitboat	JPNLL South core area
Data Source (state if based on logbooks, observer data etc)	logbooks	logbooks	logbooks	logbook, e-logbook and task2	logbook	logbooks
Do the authors indicate the percentage of total effort of the fleet the CPUE data represents?	No	No	No	Yes	Yes	No
If the answer to 1 is yes, what is the percentage?				91-100%	71-80%	
Are sufficient diagnostics provided to assess model performance??	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient
How does the model perform relative to the diagnostics ?	Well	Well	Well	Well	Well	Well
Documented data exclusions and classifications?	Yes	Yes	Yes	Yes	Yes	Yes
Data exclusions appropriate?	Yes	Yes	Yes	Yes	Yes	Yes
Data classifications appropriate?	Yes	Yes	Yes	Yes	Yes	Yes
Geographical Area	Atl S	Atl SW	Atl SW	Atl S	Atl SE	Atl SE
Data resolution level	OTH	Set	Set	Set	OTH	Set
Ranking of Catch of fleet in TINC database (use data catalogue)	1-5	11 or more	1-5	1-5	1-5	1-5
Length of Time Series	longer than 20 years	longer than 20 years	longer than 20 years	longer than 20 years	11-20 years	longer than 20 years
Are other indices available for the same time period?	Few	Many	Many	Few	Many	Few
Are other indices available for the same geographic range?	Few	Few	Few	Few	Few	Few
Does the index standardization account for Known factors that influence catchability/selectivity? (eg. Type of hook, bait type, depth etc.)	Yes	Yes	No	Yes	Yes	Yes
Estimated annual CV of the CPUE series	Variable	Variable	Low	Low	Medium	Low
Annual variation in the estimated CPUE exceeds biological plausibility	Possible	Possible	Unlikely	Unlikely	Possible	Possible
Is data adequate for standardization purposes	Yes	Yes	Yes	Yes	Yes	Yes
Is this standardised CPUE time series continuous?	Yes	Yes	Yes	Yes	Yes	Yes
For fisheries independent surveys: what is the survey type?						
For 19: Is the survey design clearly described?						
Other Comments			BRA-R02, BRA-R03, BRA-ALL		covers limited spatial area	

Table 8. Available CPUEs for the 2020 stock assessment of the North Atlantic albacore.

	US pelagic LL		Venezuela LL		Japan LL North		Chinese-Taipei LL North		Spain BB	
	US-LL		Ven-LL		JPN-LL Bycatch		CTP-LL		SPN-BB	
SCRS Doc No.	SCRS/2020/086		SCRS/2020/089		SCRS/2020/092		SCRS/2020/102		SCRS/2020/098	
Age range	3-8		5-8+		3-8+		2-8+		1-4	
Catch Units	Number		Number		Number		Weight		Number	
Effort Units	1000 hooks		1000 hooks		1000 hooks		1000 hooks		Fishing days	
Methods	Delta log-normal		Delta log-normal		Negative binominal		Log-Normal		Log-Normal	
Used 2020 assessment for Base case	Yes		Yes (1991-2017)		Yes (1988-2018 except 2013)		Yes(1999-2018)		Yes(1981-2018)	
Used 2020 assessment for sensitivity analysis	-		Yes (1991-2018)		Yes (1988-2018)		-		-	
Year	Index	CV	Index	CV	Index	CV	Index	CV	Index	CV
1981									0.56	0.09
1982									0.61	0.08
1983									0.77	0.06
1984									0.45	0.10
1985									0.75	0.06
1986									0.62	0.06
1987	0.47	0.10							0.94	0.06
1988	0.55	0.09			0.78	0.12			0.91	0.06
1989	0.67	0.10			0.74	0.08			0.65	0.06
1990	1.00	0.09			0.58	0.10			1.11	0.06
1991	1.01	0.10	0.35	0.61	0.68	0.10			0.82	0.06
1992	0.73	0.10	0.41	0.63	0.54	0.10			0.74	0.07
1993	1.15	0.09	0.34	0.63	0.52	0.10			0.88	0.07
1994	1.28	0.09	0.68	0.51	0.68	0.08			1.11	0.06
1995	1.29	0.09	0.80	0.51	0.41	0.08			0.95	0.06
1996	0.81	0.11	0.79	0.45	0.39	0.07			0.99	0.06
1997	1.04	0.10	0.86	0.52	0.49	0.07			0.85	0.06
1998	1.03	0.11	1.07	0.42	0.85	0.07			1.22	0.06
1999	1.24	0.10	1.05	0.51	0.48	0.08	294.53	0.05	0.67	0.07
2000	1.11	0.09	1.15	0.43	0.82	0.07	252.17	0.05	0.97	0.06
2001	1.28	0.10	0.67	0.44	1.23	0.07	213.09	0.05	0.42	0.08
2002	1.04	0.11	0.84	0.53	1.17	0.10	205.54	0.05	0.35	0.08
2003	0.81	0.12	1.03	0.42	0.90	0.09	253.43	0.05	0.86	0.06
2004	0.82	0.12	1.08	0.45	0.63	0.08	230.68	0.05	0.70	0.06
2005	0.85	0.11	1.15	0.44	0.80	0.07	261.86	0.05	0.65	0.06
2006	0.70	0.12	1.19	0.4	0.77	0.10	317.60	0.05	1.40	0.05
2007	0.73	0.12	1.96	0.42	0.44	0.11	319.41	0.05	1.08	0.06
2008	0.59	0.13	2.01	0.5	0.42	0.10	256.97	0.05	0.77	0.07
2009	0.77	0.12	1.08	0.5	0.64	0.10	333.45	0.05	0.93	0.06
2010	0.97	0.12	0.88	0.54	0.92	0.10	501.16	0.05	0.83	0.06
2011	1.26	0.10	0.51	0.61	0.66	0.12	459.88	0.05	1.57	0.05
2012	1.06	0.11	0.78	0.52	0.77	0.12	423.61	0.05	1.66	0.05
2013	1.33	0.10	1.36	0.56	8.52	0.12	625.02	0.05	1.07	0.06
2014	1.71	0.09	1.86	0.56	1.52	0.13	927.56	0.06	0.73	0.07
2015	1.34	0.10	1.32	0.59	1.09	0.15	560.80	0.05	2.18	0.05
2016	1.31	0.10	0.79	0.56	1.73	0.13	551.76	0.05	1.78	0.05
2017	1.28	0.10	1.48	0.59	1.57	0.14	415.95	0.05	1.05	0.06
2018	0.81	0.12	0.53	0.73	0.88	0.13	383.75	0.05	3.40	0.06

Table 9. Available CPUE for the 2020 stock assessment of the South Atlantic albacore.

	Uruguay LL		Japan LL South				Japan LL South Core		Chinese-Taipei LL North		Brazil LL		South Africa baitboat	
	UGY-LL		JPN-LL1		JPN-LL3		JPN-LL core		CTP-LL		BRA-LL		ZAF-BB	
SCRS Doc No.	SCRS/2013/043		SCRS/2020/093				SCRS/2020/094		SCRS/2020/101		SCRS/2020/083		SCRS/2020/085	
Age range	3-8+		3-8+				3-8+		3-8+		3-8+		2-3	
Catch Units	Weight		Number				Number		Weight		Number		Weight	
Effort Units	1000 hooks		1000 hooks				1000 hooks		1000 hooks		1000 hooks		Fishing days	
Methods	Delta log-normal		Negative binominal				Negative binominal		Log-normal		Delta log-normal		Log-normal	
Used 2020 assessment for Base case	Yes (1983-2011)		No		Yes (1976-2011)		No		Yes (1967-2018)		No		No	
Used 2020 assessment for sensitivity analysis	-		Yes (1959-1969)		Yes (1976-2018)		Yes (1976-2018)		-		Yes (2002-2018)		Yes (2003-2018)	
Year	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV (log.se)
1959			40.39	0.14										
1960			38.09	0.14										
1961			30.60	0.08										
1962			21.93	0.08										
1963			21.23	0.08										
1964			21.31	0.08										
1965			14.36	0.06										
1966			13.05	0.07										
1967			13.87	0.09					843.61	0.28				
1968			12.80	0.08					655.32	0.08				
1969			7.75	0.08					622.04	0.06				
1970									519.43	0.05				
1971									581.92	0.06				
1972									384.73	0.05				
1973									327.22	0.06				
1974									338.79	0.05				
1975									394.43	0.06				
1976					1.18	0.27	6.96	0.11	350.02	0.05				
1977					0.75	0.22	2.87	0.10	408.51	0.05				
1978					1.40	0.21	3.96	0.09	371.76	0.05				
1979					0.56	0.18	5.58	0.07	370.44	0.05				
1980					0.84	0.13	2.49	0.06	379.73	0.05				
1981					1.79	0.14	7.95	0.06	336.79	0.05				
1982					1.39	0.12	9.59	0.05	328.99	0.05				
1983	1.69	0.45			1.13	0.18	4.58	0.09	315.16	0.05				
1984	1.46	0.44			1.13	0.13	3.15	0.06	362.56	0.06				
1985	1.53	0.45			1.96	0.11	9.66	0.07	330.78	0.05				
1986	1.51	0.48			2.42	0.13	6.45	0.06	328.99	0.05				
1987	1.41	0.46			0.95	0.15	1.82	0.09	274.91	0.05				
1988	1.47	0.47			0.66	0.11	1.53	0.06	221.65	0.06				
1989	1.75	0.5			0.83	0.10	2.46	0.05	192.71	0.06				
1990	1.15	0.47			1.13	0.09	1.39	0.05	195.76	0.06				
1991	1.33	0.5			1.30	0.10	1.50	0.05	211.52	0.05				
1992	0.88	0.53			0.70	0.11	1.33	0.05	243.20	0.06				
1993	1.55	0.58			0.60	0.10	1.90	0.04	257.05	0.05				
1994	0.69	0.55			0.82	0.08	1.27	0.03	291.24	0.05				
1995	1.10	0.55			0.54	0.09	0.96	0.04	304.25	0.05				
1996	1.51	0.52			0.60	0.09	1.73	0.04	264.19	0.05				
1997	1.11	0.54			0.76	0.10	2.16	0.04	352.75	0.05				
1998	1.53	0.53			0.70	0.11	2.46	0.04	302.42	0.05				
1999	1.22	0.53			0.81	0.11	3.03	0.04	246.89	0.05				
2000	0.97	0.61			1.19	0.10	5.49	0.04	214.84	0.04				
2001	0.56	0.62			1.32	0.12	5.15	0.05	245.83	0.05				
2002	0.46	0.7			0.82	0.13	2.18	0.06	182.67	0.05	1.06	0.05		
2003	0.32	0.73			0.87	0.11	0.99	0.04	165.57	0.06	1.02	0.05	1132	0.15
2004	0.23	0.72			0.96	0.11	3.42	0.04	284.51	0.05	0.90	0.06	917	0.14
2005	0.15	0.74			0.70	0.13	4.30	0.06	273.00	0.05	0.94	0.05	1057	0.14
2006	0.56	0.56			0.40	0.12	4.01	0.05	220.88	0.05	1.03	0.05	1263	0.14
2007	0.71	0.5			0.34	0.13	5.61	0.06	278.35	0.05	0.69	0.05	1506	0.14
2008	0.53	0.5			0.60	0.11	10.74	0.04	301.57	0.05	1.27	0.07	1240	0.14
2009	0.67	0.56			0.79	0.11	3.88	0.06	331.52	0.05	1.03	0.06	1642	0.14
2010	0.59	0.55			1.02	0.11	3.67	0.05	343.98	0.05	0.81	0.06	1299	0.14
2011	0.37	0.59			0.80	0.11	9.66	0.05	298.39	0.05	0.79	0.05	999	0.14
2012					2.07	0.12	13.62	0.04	324.04	0.05	0.66	0.06	773	0.14
2013					3.23	0.12	15.88	0.04	298.69	0.05	0.83	0.06	1163	0.14
2014					0.73	0.13	12.22	0.04	239.31	0.05	1.02	0.05	1464	0.14
2015					0.59	0.13	11.46	0.04	317.51	0.05	0.85	0.06	1216	0.14
2016					0.76	0.14	7.60	0.05	382.08	0.05	0.68	0.06	715	0.14
2017					0.73	0.13	6.50	0.04	344.04	0.05	0.75	0.08	715	0.14
2018					1.72	0.13	13.47	0.04	429.40	0.05	0.85	0.04	860	0.14

Table 10 Estimated reference points and parameters of the stock assessment model using the agreed Reference Case.

Scenario	Fit	Bcurr (t)**	MSY (t)	F_{MSY} (yr-1)	B_{MSY} (t)	r (yr-1)	K (t)
RefCase_ 2020	MLE	464,796	36,737	0.100	367,719	0.100	999,064
	Bootstrapped*	508,074 (425,273-602,157)	36,816 (35,761-38,039)	0.093 (0.091-0.108)	392,556 (349,403-405,097)	0.093 (0.091-0.108)	1,066,546 (943,300-1,100,619)

* Median and 80% CI
** Biomass in 2019

Table 11: Estimated reference points and parameters of the stock assessment model using the agreed Reference Case and sensitivity analysis evaluating the impact of individual CPUE points' removal.

Scenario	MSY	F_{MSY}	B_{MSY}	r	K	TAC (t)
BC_2020: -JP13 -Ven18	36738	0.100	367719	0.100	999064	100.00%
Sens 1: All data in	37131	0.103	359068	0.104	975561	104.94%
Sens 2: -13JP only	37140	0.103	359291	0.103	976166	105.24%
Sens 3: -13JP & -14JP only	37183	0.104	357559	0.104	971461	105.44%
Sens 4: -Ven 2018 only	37131	0.103	359068	0.104	975561	104.94%

Table 12. Estimates of biomass, fishing mortality, biomass relative to BMSY, and fishing mortality relative to FMSY between 1930 and 2018 of *mpb* Reference Case model for North Atlantic albacore with 80% credibility intervals.

	Biomass			Fishing mortality			B/BMSY			F/FMSY		
Year	Median	10%LCI	90%UCI	Median	10%LCI	90%UCI	Median	10%LCI	90%UCI	Median	10%LCI	90%UCI
1930	1066546	949300	1100618	0.011	0.010	0.012	2.717	2.717	2.717	0.113	0.109	0.116
1931	1055246	938000	1089318	0.015	0.014	0.017	2.688	2.685	2.689	0.158	0.153	0.162
1932	1040677	923607	1074773	0.012	0.012	0.014	2.651	2.643	2.653	0.132	0.128	0.136
1933	1030122	913471	1064267	0.011	0.011	0.013	2.624	2.614	2.627	0.119	0.115	0.123
1934	1021907	905806	1056119	0.018	0.018	0.021	2.603	2.592	2.607	0.197	0.191	0.203
1935	1007016	891542	1041306	0.021	0.020	0.023	2.565	2.551	2.570	0.220	0.214	0.227
1936	991524	876849	1025915	0.017	0.016	0.019	2.526	2.509	2.532	0.181	0.175	0.186
1937	981388	867463	1015728	0.014	0.013	0.016	2.500	2.482	2.507	0.147	0.142	0.151
1938	975384	862505	1009678	0.015	0.014	0.017	2.485	2.467	2.493	0.160	0.155	0.164
1939	968796	857027	1003242	0.018	0.017	0.020	2.468	2.451	2.476	0.188	0.182	0.194
1940	960258	849534	994857	0.012	0.012	0.014	2.446	2.429	2.456	0.128	0.124	0.131
1941	958026	848330	992785	0.014	0.013	0.016	2.441	2.426	2.450	0.147	0.142	0.151
1942	954278	845577	989189	0.018	0.017	0.020	2.431	2.418	2.441	0.188	0.182	0.193
1943	947225	839491	982269	0.018	0.017	0.020	2.413	2.400	2.424	0.189	0.183	0.195
1944	940739	833994	975890	0.018	0.017	0.020	2.397	2.383	2.408	0.193	0.186	0.198
1945	934576	828825	969835	0.030	0.028	0.033	2.381	2.368	2.393	0.315	0.304	0.324
1946	918354	813488	953675	0.025	0.024	0.029	2.340	2.324	2.353	0.271	0.261	0.278
1947	907699	803978	943085	0.022	0.022	0.025	2.313	2.296	2.327	0.239	0.230	0.246
1948	900858	798276	936111	0.027	0.026	0.030	2.296	2.280	2.310	0.285	0.275	0.294
1949	890743	789134	926183	0.031	0.030	0.035	2.270	2.253	2.286	0.334	0.322	0.344
1950	877595	776935	913233	0.045	0.043	0.051	2.236	2.219	2.253	0.482	0.465	0.496
1951	853706	754036	889410	0.040	0.038	0.045	2.175	2.154	2.195	0.427	0.411	0.439
1952	837004	738503	872436	0.039	0.037	0.044	2.133	2.109	2.154	0.414	0.398	0.425
1953	823184	726033	858804	0.037	0.035	0.041	2.098	2.074	2.120	0.391	0.375	0.402
1954	812609	716861	848454	0.049	0.047	0.056	2.072	2.047	2.095	0.525	0.504	0.540
1955	792898	698469	829035	0.040	0.038	0.045	2.022	1.995	2.047	0.423	0.406	0.435
1956	782997	689998	819492	0.052	0.050	0.059	1.997	1.971	2.023	0.558	0.534	0.574
1957	764251	672667	801109	0.055	0.053	0.063	1.950	1.921	1.977	0.588	0.563	0.606
1958	745417	655337	782693	0.070	0.067	0.080	1.902	1.872	1.931	0.751	0.718	0.774
1959	717388	628626	754621	0.070	0.066	0.079	1.831	1.797	1.863	0.744	0.709	0.765
1960	693484	606102	731236	0.076	0.072	0.087	1.770	1.733	1.805	0.815	0.775	0.839
1961	667900	582084	705736	0.064	0.061	0.073	1.705	1.665	1.743	0.684	0.649	0.704
1962	653659	569590	692127	0.090	0.085	0.103	1.670	1.630	1.709	0.962	0.911	0.990
1963	624182	541718	663196	0.097	0.091	0.111	1.595	1.551	1.637	1.034	0.977	1.065
1964	594468	513668	634047	0.109	0.102	0.126	1.520	1.472	1.565	1.163	1.095	1.201
1965	561665	482537	601860	0.108	0.101	0.126	1.437	1.383	1.486	1.155	1.083	1.197
1966	534195	456646	574824	0.089	0.082	0.104	1.366	1.310	1.419	0.949	0.885	0.986
1967	520905	444957	562212	0.114	0.105	0.133	1.333	1.276	1.388	1.215	1.130	1.265
1968	495922	422583	538228	0.091	0.084	0.107	1.270	1.210	1.328	0.975	0.903	1.019
1969	485952	413861	528511	0.096	0.088	0.113	1.244	1.185	1.304	1.028	0.950	1.076
1970	474443	403754	517774	0.097	0.089	0.114	1.216	1.157	1.278	1.034	0.952	1.084
1971	464327	394795	508173	0.122	0.112	0.144	1.190	1.130	1.254	1.308	1.201	1.374
1972	443116	375646	487856	0.110	0.100	0.130	1.136	1.074	1.204	1.176	1.074	1.241
1973	430378	364693	475880	0.106	0.096	0.125	1.104	1.040	1.174	1.134	1.032	1.201
1974	420596	357195	467106	0.118	0.106	0.139	1.079	1.014	1.152	1.259	1.141	1.336
1975	406980	345350	454490	0.103	0.092	0.121	1.046	0.979	1.121	1.098	0.989	1.169
1976	401148	340819	449980	0.143	0.127	0.168	1.032	0.965	1.110	1.520	1.364	1.622
1977	379966	320818	430169	0.142	0.126	0.168	0.978	0.908	1.061	1.514	1.348	1.627
1978	362356	303214	413560	0.138	0.121	0.165	0.933	0.859	1.020	1.472	1.301	1.596
1979	348637	289905	401119	0.147	0.128	0.177	0.898	0.821	0.989	1.567	1.376	1.710
1980	333633	275491	387330	0.116	0.100	0.140	0.859	0.779	0.956	1.234	1.074	1.359
1981	331066	273208	386197	0.104	0.089	0.126	0.852	0.771	0.954	1.109	0.960	1.225
1982	332313	273916	389219	0.128	0.110	0.156	0.857	0.775	0.961	1.365	1.175	1.512
1983	325856	267678	384112	0.158	0.134	0.192	0.840	0.756	0.949	1.681	1.434	1.873
1984	310466	252566	369632	0.135	0.113	0.166	0.800	0.712	0.914	1.431	1.209	1.612
1985	303866	246435	364872	0.134	0.112	0.166	0.785	0.693	0.904	1.426	1.193	1.618
1986	298954	240546	361115	0.159	0.132	0.198	0.771	0.676	0.896	1.690	1.402	1.933
1987	287432	227850	350511	0.133	0.109	0.167	0.739	0.640	0.871	1.411	1.156	1.637
1988	284819	224355	349798	0.116	0.095	0.147	0.732	0.629	0.869	1.237	1.005	1.447
1989	287060	224175	354065	0.112	0.091	0.143	0.739	0.630	0.879	1.192	0.965	1.403
1990	289423	226658	359376	0.127	0.103	0.163	0.747	0.634	0.892	1.355	1.093	1.607
1991	287728	223521	359886	0.097	0.078	0.125	0.742	0.625	0.894	1.032	0.826	1.236
1992	295455	229838	369452	0.104	0.084	0.134	0.760	0.638	0.920	1.111	0.889	1.326
1993	299834	233370	375364	0.127	0.102	0.163	0.772	0.648	0.939	1.355	1.078	1.619
1994	296909	229871	374795	0.118	0.094	0.153	0.765	0.636	0.938	1.259	0.995	1.521
1995	297185	229255	377193	0.129	0.102	0.167	0.766	0.630	0.944	1.371	1.079	1.674
1996	293929	225227	376393	0.098	0.077	0.128	0.757	0.617	0.941	1.038	0.810	1.284
1997	300591	230006	385163	0.097	0.075	0.126	0.775	0.630	0.962	1.021	0.797	1.268
1998	307431	234832	394141	0.084	0.065	0.110	0.791	0.640	0.983	0.886	0.692	1.106
1999	317621	243865	406539	0.109	0.085	0.142	0.819	0.665	1.015	1.153	0.899	1.434
2000	318729	243144	409654	0.104	0.081	0.136	0.822	0.663	1.023	1.100	0.854	1.378
2001	321088	244515	414187	0.082	0.063	0.107	0.830	0.666	1.035	0.866	0.669	1.089
2002	330532	252252	425582	0.069	0.053	0.090	0.856	0.686	1.064	0.728	0.563	0.916
2003	344297	264117	440596	0.074	0.058	0.097	0.892	0.717	1.101	0.785	0.612	0.986
2004	355592	272709	452473	0.073	0.057	0.095	0.919	0.741	1.134	0.773	0.605	0.969
2005	366170	280781	463847	0.096	0.076	0.126	0.945	0.765	1.163	1.021	0.803	1.277
2006	367721	282709	465777	0.101	0.079	0.131	0.948	0.765	1.168	1.066	0.837	1.339
2007	366978	280307	466018	0.060	0.047	0.078	0.946	0.760	1.170	0.634	0.496	0.801
2008	381172	292911	481254	0.054	0.043	0.070	0.986	0.794	1.208	0.568	0.447	0.713
2009	396946	308152	497767	0.039	0.031	0.050	1.028	0.834	1.249	0.409	0.325	0.509
2010	417850	329040	519087	0.047	0.038	0.059	1.082	0.888	1.305	0.492	0.395	0.606
2011	434771	345276	535808	0.046	0.037	0.058	1.126	0.932	1.347	0.486	0.393	0.595
2012	451056	360745	551577	0.057	0.047	0.071	1.169	0.976	1.387	0.600	0.490	0.732
2013	461437	372072	561262	0.053	0.044	0.066	1.196	1.007	1.411	0.562	0.462	0.684
2014	472578	384124	571701	0.056	0.047	0.069	1.226	1.037	1.437	0.594	0.490	0.719
2015	481381	394576	579785	0.053	0.044	0.065	1.250	1.059	1.457	0.559	0.462	0.672
2016	491136	405053	588504	0.062	0.052	0.075	1.276	1.086	1.478	0.649	0.539	0.776
2017	496028	410677	592350	0.057	0.048	0.069	1.288	1.100	1.488	0.601	0.502	0.714
2018	502766	418789	598000	0.059	0.050	0.071	1.306	1.118	1.502	0.619	0.520	0.735
2019	508074	425273	602157	NA	NA	NA	1.320	1.133	1.513	NA	NA	NA

Table 13: Evaluation test of the HCRs performance when one or more indices of abundance are not available or updated since 2014. The first column indicates the scenarios of missing indices. In the "*Adopted*" HCR all indices are available.

		Stock Status				Safety			Catch				Stability			
HCR	Bmin	Bmean	Fmean	pG(%)	pR(%)	pBlim(%)	pBin(%)	Yshort	Ymid	Ylong	MAP	sd	var	pshut	p(δTAC+10%)	p(δTAC-10%)
Adopted	0.35	1.47	0.57	78.34	5.56	99.9	13.08	29.14	23.21	29.65	8.43	7.64	58.42	0.84	13.27	10.91
Except Spain BB	0.31	1.43	0.56	76.26	6.78	99.82	13.88	29.75	23.60	29.99	8.65	7.58	57.51	1.02	12.83	10.73
Except Japan LL	0.34	1.46	0.58	75.32	6.06	99.88	13.16	29.50	23.70	29.21	8.30	7.71	59.44	1.14	12.98	10.79
Except Taiwan LL	0.40	1.53	0.55	80.48	4.82	99.96	12.68	27.99	22.64	28.81	8.40	7.67	58.83	1.32	12.98	10.96
Except Other LL	0.38	1.49	0.55	80.14	5.3	99.96	12.54	28.62	22.30	28.47	8.71	7.89	62.28	0.96	13.38	11.03
Spain BB- Jp LL	0.44	1.57	0.53	82.14	4.54	100	12.3	26.67	21.66	28.47	8.44	7.61	57.96	1.2	13.63	10.36
Spain BB- Chi Tai LL	0.43	1.55	0.55	81.46	4.98	100	13.64	27.94	21.02	27.98	8.57	7.80	60.77	1.68	13.83	10.83
Spain BB- US-Ven LL	0.43	1.52	0.51	79.46	4.96	100	13.68	27.80	21.54	28.84	8.44	7.70	59.31	1.68	13.04	11.08
Jp LL - Chi Tai LL	0.31	1.45	0.58	78.04	6.16	99.74	12.72	30.37	23.41	28.39	8.28	7.40	54.82	0.96	12.85	11.02
Jp LL - US-Ven LL	0.31	1.43	0.55	76.46	7.26	99.82	13.68	28.70	22.95	29.24	8.68	7.84	61.49	1.56	13.00	11.13
Chi Tai LL - US-Ven LL	0.28	1.40	0.60	73.9	7.74	99.66	14.2	30.27	25.57	29.52	8.60	7.60	57.80	1.56	12.67	11.08
Only Spain BB	0.30	1.38	0.52	72.72	6.8	99.44	17.96	27.45	19.31	23.61	9.70	8.18	66.85	3.24	12.67	10.71
Only Japan LL	0.27	1.38	0.46	68.06	9.72	99.24	19.74	30.60	23.01	22.79	10.11	8.31	69.10	2.94	12.46	12.29
Only Taiwan LL	0.22	1.33	0.43	71	9.02	98.72	19.34	28.06	19.57	21.47	10.33	8.64	74.72	4.32	12.80	12.90
Only Ven-US LL	0.24	1.37	0.45	67.04	8.92	99.48	18.44	26.35	21.58	20.08	9.96	8.55	73.17	4.5	12.46	12.90

Table 14. Revised list of indicators to detect exceptional circumstances for north Atlantic albacore.

<table>
<tr><th>Principle</th><th>Indicator</th><th>Criterion</th><th>Frequency of evaluation of Exceptional Circumstances</th></tr>
<tr><td rowspan="6">1) Stock dynamics</td><td>Relative stock biomass (B/B_{MSY})</td><td rowspan="2">Falls outside the full range of values in each year from the OMs used in the MSE when the accepted MP was tested*</td><td rowspan="2">Each full/benchmark stock assessment (every 6-7 years)</td></tr>
<tr><td>Relative Fishing mortality (F/F_{MSY})</td></tr>
<tr><td>Growth</td><td rowspan="3">Are substantially different from the values from the OMs used in the MSE when the accepted MP was tested*</td><td rowspan="3">After completion, presentation, and acceptance by SCRS of a study as the new reference</td></tr>
<tr><td>Maturity</td></tr>
<tr><td>Natural mortality</td></tr>
<tr><td>CPUE</td><td>Falls outside the full range of values in each year from the OMs used in the MSE when the accepted MP was tested*</td><td>Annually</td></tr>
<tr><td rowspan="4">2) Application of the HCR</td><td>CPUE</td><td>If one or more series have not been updated
If one or more series are determined to no longer reflect abundance</td><td>Each MP iteration (every 3 years)</td></tr>
<tr><td>Catch</td><td>Total catch is above the TAC set using the MP plus the allowed carry overs</td><td>Annually</td></tr>
<tr><td>Relative stock biomass (B/B_{MSY})</td><td rowspan="2">Values from the production model in an iteration of the MP fall outside the full range of values in each year produced by the accepted MP's production model during MSE testing*</td><td rowspan="2">Each MP iteration (every 3 years)</td></tr>
<tr><td>Relative Fishing mortality (F/F_{MSY})</td></tr>
</table>

* As reflected in the ALB MSE Consolidated report

Table 15. Fleet descriptions used in the ASPIC models for South Atlantic albacore.

Fleet	Fleet 1	Fleet 2 (1956 – 1969) Fleet 3 (1970 – 1975) Fleet 4 (1976 – 2018)	Fleet 5	Fleet 6 (1956 – 1998) Fleet 7 (1999 – 2018)	Fleet 8
CPUE*	Chinese Taipei (LL) (1967-2018)	Japan (LL) None (1956-1975)	Brazil (LL) (2002-2018)	South Africa (BB) (2003-2018) None (1956 –1998)	Uruguay (LL) (1983-2011)
Catch	Chinese Taipei (LL) Korea (LL)	China LL E. C. Spain (LL) E. C. Portugal (LL) Japan (LL) Philippines (LL) St Vincent and Grenadier (LL) USA (LL) Vanuatu (LL) Honduras (LL) Nei (LL) Côte D'Ivoire (LL) EU.United Kingdom (LL) Seychelles (LL) UK.Sta Helena (LL) Angola (LL) Senegal (LL) Trinidad and Tobago (LL)	Brazil (LL, SU) Panama (LL) South Africa (LL, UN) Argentina (LL, TW, UN) Belize (LL) Cambodia (LL) Cuba (LL, UN) Namibia (LL)	Brazil (BB, GN, HL, PS, TW, UN) E. C. Spain (PS) E. C. France (BB, PS) E. C. Portugal (BB, PS) Japan (BB, PS) Namibia (BB) Korea (BB) Maroc (PS) Panama (PS) South Africa (BB, HL, PS, RR, SP) USA (PS) USSR (SU, UN) UK St Helena (BB, RR) Chinese Taipei (GN) Nei (BB, PS) Argentina (PS) Belize (PS) Cape Verde (PS) Curaçao (PS) Guatemala (PS) Côte D'Ivoire (PS) Ghana (BB, PS) Guinea Ecuatorial (UN, HL) Guinée Rep. (PS) St. Vincent and Grenadines (PS) Guinea Ecuatorial (HL)	Uruguay (LL)

* includes those used also for sensitivity analyses

Table 16. Catches (t) for each fleet for ASPIC for south Atlantic albacore as listed in previous table.

Year	Fleet 1	Fleet 2	Fleet	Fleet 4	Fleet 5	Fleet 6	Fleet 7	Fleet 8	Total
1956		21							21
1957		725							725
1958		1.047							1.047
1959		3.015			1.700				4.715
1960		8.673			1.802				10.475
1961		8.893			1.872				10.765
1962		16.422			2.549				18.971
1963		15.104			2.281				17.385
1964	115	23.738			2.124	22			25.999
1965	346	28.309			1.190	0			29.845
1966	5.275	21.023			998	0			27.296
1967	7.412	7.719			752	0			15.883
1968	12.489	11.857			1.304	38			25.688
1969	21.732	6.331			430	0			28.493
1970	17.255		5.898		500	0			23.653
1971	21.323		3.218		344	0			24.885
1972	30.640		2.087		352	110			33.189
1973	25.888		277		1.969	100			28.234
1974	19.079		109		365	163			19.716
1975	16.614		306		536	151			17.607
1976	17.976			73	1.129	197			19.375
1977	19.858			105	1.019	473			21.455
1978	21.837			135	828	295			23.095
1979	21.218			105	532	785			22.640
1980	19.400			333	938	2.275			22.946
1981	18.869			558	976	3.614		23	24.040
1982	23.363			569	1.095	4.410		235	29.672
1983	10.101			162	1.360	2.922		373	14.918
1984	8.237			224	1.056	4.556		526	14.599
1985	20.154			623	517	8.272		1.531	31.097
1986	27.913			739	1.257	7.117		262	37.288
1987	29.173			357	1.725	9.197		178	40.630
1988	20.926			405	807	7.935		100	30.173
1989	18.440			450	788	7.450		83	27.212
1990	20.461			587	638	6.973		55	28.714
1991	19.914			804	1.333	3.930		34	26.016
1992	23.068			1.001	3.374	9.089		31	36.562
1993	19.420			748	3.753	8.863		28	32.813
1994	22.576			923	1.292	10.492		16	35.300
1995	18.354			695	941	7.513		49	27.552
1996	18.974			785	1.165	7.426		75	28.426
1997	18.169			673	769	8.354		56	28.022
1998	16.113			487	3.098	10.787		110	30.595
1999	17.391			1.560	1.651		6.965	90	27.656
2000	17.239			3.041	4.027		6.989	90	31.387
2001	15.834			5.235	6.834		10.757	135	38.796
2002	17.321			1.142	3.097		10.074	111	31.746
2003	17.356			534	2.641		7.367	108	28.005
2004	13.325			703	605		7.792	120	22.545
2005	10.772			1.446	726		5.940	32	18.916
2006	12.359			2.247	3.041		6.713	93	24.453
2007	13.202			1.313	538		5.195	34	20.283
2008	10.054			2.633	478		5.650	53	18.867
2009	9.052			2.470	493		10.152	97	22.265
2010	11.105			1.693	649		5.754	24	19.225
2011	13.103			1.888	1.417		7.684	37	24.129
2012	12.902			3.708	1.226		7.434	12	25.282
2013	8.552			4.136	991		5.569	209	19.457
2014	6.677			1.647	564		4.814		13.702
2015	7.161			2.327	617		5.095		15.199
2016	8.955			1.502	786		3.093		14.336
2017	9.176			1.743	755		2.150		13.825
2018	9.394			3.518	856		3.331		17.098

Table 17. Details of model runs in the ASPIC for South Atlantic albacore.

Run	Scenario name	Weight	B1/K (fixed)	Model
2*	Run02_Eq_Sh	Equal for all fleets	0.9	Logistic
6	Run06_Eq_Fox	Equal for all fleets	0.9	Fox
7*	Run07_CW_Sh	Weighted by catch	0.9	Logistic
8	Run08_CW_Fox	Weighted by catch	0.9	Fox

* Scenarios only in the Document (preliminary runs).

Table 18. Results of the ASPIC base case runs for South Atlantic albacore.

Model run	Model and CPUE Weight	MSY (t)	F_{MSY}	B_{MSY} (t)	B_{2018}/B_{MSY}	F_{2018}/F_{MSY}	K (t)	r
Run6	Fox: Equal for all fleets	26,286	0.221	118,694	1.495	0.443	322,644	0.22
Run8	Fox: Weighted by catch	27,418	0.201	136,087	1.702	0.370	369,922	0.20

Table 19. Scenarios of sensitivity analyses for the ASPIC model runs for South Atlantic albacore.

Scenario	*Abbreviation in the graph*
B1/K fix at 0.8	B1/K 0.8
B1/K fix at 1.0	B1/K 1.0
Only with Chinese Taipei LL index	only TWLL
Only with index of Japan LL3 (1976-2018)	only JPLL3
Without Uruguay LL index	no URG LL
Additional South Africa BB index (2003-2018)	Add BB_L
Additional Brazil LL index (2002-2018)	Add BZLL
Start year 1975	Start1975

Table 20. Summary of posterior quantiles presented in the form of marginal posterior medians and associated the 95% credibility intervals of parameters for the JABBA base case model for South Atlantic albacore.

	Base case model (Fox ModW)		
Estimates	Median	2.50%	97.50%
K	336291	215120	603726
r	0.222	0.118	0.36
ψ *(psi)*	0.929	0.684	0.997
σ_{proc}	0.067	0.032	0.118
F_{MSY}	0.219	0.116	0.356
B_{MSY}	124453	79611	223424
MSY	27264	23734	31567
B_{1956}/K	0.919	0.669	1.097
B_{2018}/K	0.585	0.422	0.758
$B_{2018}/B_{\mathrm{MSY}}$	1.581	1.141	2.047
$F_{2018}/F_{\mathrm{MSY}}$	0.398	0.282	0.587

Table 21. Estimates of biomass, fishing mortality, biomass relative to BMSY, and fishing mortality relative to FMSY between 1956 and 2018 of JABBA base case model for South Atlantic albacore with 95% credibility intervals.

	Biomass			Fishing mortality			B/B_{MSY}			F/F_{MSY}		
Year	Median	95%LCI	95%UCI	Median	95%LCI	95%UCI	Median	95%LCI	95%UCI	Median	95%LCI	95%UCI
1956	305684	178251	571123	0.000	0.000	0.000	2.483	1.807	2.964	0.000	0.000	0.000
1957	312622	187919	581534	0.002	0.001	0.004	2.528	1.905	3.091	0.011	0.008	0.014
1958	319071	194033	588705	0.003	0.002	0.005	2.569	1.973	3.171	0.015	0.012	0.020
1959	323636	198470	593762	0.015	0.008	0.024	2.606	2.035	3.227	0.066	0.051	0.088
1960	324268	198399	596570	0.032	0.018	0.053	2.611	2.054	3.245	0.147	0.113	0.195
1961	321263	194307	589404	0.034	0.018	0.055	2.577	2.036	3.207	0.153	0.117	0.201
1962	319131	191024	592243	0.059	0.032	0.099	2.561	2.029	3.210	0.272	0.206	0.356
1963	311086	184453	583878	0.056	0.030	0.094	2.488	1.969	3.129	0.256	0.194	0.336
1964	307044	181036	577953	0.085	0.045	0.144	2.459	1.947	3.131	0.388	0.291	0.510
1965	297227	174007	566734	0.100	0.053	0.172	2.377	1.885	3.069	0.462	0.340	0.603
1966	286145	166509	551889	0.095	0.049	0.164	2.286	1.805	2.976	0.439	0.316	0.577
1967	281725	165510	541387	0.056	0.029	0.096	2.252	1.788	2.958	0.260	0.184	0.340
1968	277988	169883	524588	0.092	0.049	0.151	2.234	1.774	2.904	0.423	0.300	0.556
1969	262302	160564	494203	0.109	0.058	0.177	2.110	1.661	2.725	0.497	0.354	0.660
1970	242993	148206	459351	0.097	0.051	0.160	1.955	1.521	2.518	0.445	0.319	0.600
1971	230095	141146	429689	0.108	0.058	0.176	1.853	1.423	2.367	0.494	0.357	0.673
1972	211334	129788	398392	0.157	0.083	0.256	1.714	1.285	2.165	0.713	0.522	0.992
1973	190312	114063	364494	0.148	0.077	0.248	1.542	1.133	1.972	0.673	0.490	0.954
1974	180606	107829	349531	0.109	0.056	0.183	1.462	1.068	1.884	0.496	0.357	0.709
1975	181857	110408	345949	0.097	0.051	0.159	1.477	1.074	1.894	0.439	0.315	0.629
1976	183126	113431	340880	0.106	0.057	0.171	1.490	1.085	1.902	0.478	0.344	0.688
1977	183738	114002	338331	0.117	0.063	0.188	1.493	1.085	1.897	0.529	0.382	0.756
1978	182244	113990	334815	0.127	0.069	0.203	1.485	1.087	1.891	0.573	0.412	0.820
1979	177465	110676	327687	0.128	0.069	0.205	1.446	1.045	1.837	0.577	0.416	0.836
1980	178026	111459	327746	0.129	0.070	0.206	1.449	1.054	1.847	0.583	0.420	0.837
1981	179060	112796	327690	0.134	0.073	0.213	1.456	1.068	1.855	0.609	0.437	0.865
1982	176983	111587	323766	0.168	0.092	0.266	1.440	1.060	1.826	0.759	0.546	1.074
1983	169952	105538	311529	0.088	0.048	0.141	1.383	1.010	1.761	0.398	0.286	0.567
1984	178766	114866	320719	0.082	0.046	0.127	1.453	1.073	1.837	0.370	0.267	0.525
1985	186218	122731	323725	0.167	0.096	0.253	1.514	1.118	1.910	0.756	0.548	1.077
1986	174908	113607	309657	0.213	0.120	0.328	1.421	1.052	1.794	0.966	0.703	1.368
1987	154462	96797	278781	0.263	0.146	0.420	1.252	0.916	1.580	1.197	0.872	1.699
1988	133794	80655	250871	0.226	0.120	0.374	1.086	0.784	1.399	1.024	0.739	1.472
1989	128487	77355	239953	0.212	0.113	0.352	1.044	0.743	1.347	0.961	0.689	1.390
1990	129294	78760	239769	0.222	0.120	0.365	1.052	0.751	1.354	1.007	0.724	1.458
1991	130359	80464	240285	0.200	0.108	0.323	1.061	0.771	1.351	0.904	0.654	1.294
1992	134168	84478	243180	0.273	0.150	0.433	1.093	0.798	1.379	1.231	0.903	1.753
1993	130327	81321	238536	0.252	0.138	0.403	1.060	0.784	1.350	1.142	0.828	1.621
1994	130480	81902	241425	0.271	0.146	0.431	1.059	0.792	1.354	1.229	0.885	1.708
1995	126847	78943	236057	0.217	0.117	0.349	1.031	0.773	1.329	0.987	0.699	1.369
1996	130443	81574	239752	0.218	0.119	0.348	1.056	0.798	1.365	0.993	0.704	1.373
1997	133676	84345	243045	0.210	0.115	0.332	1.080	0.822	1.395	0.956	0.678	1.317
1998	133118	84582	243691	0.230	0.126	0.362	1.075	0.818	1.390	1.049	0.739	1.439
1999	127999	80959	234761	0.216	0.118	0.342	1.033	0.781	1.332	0.988	0.702	1.358
2000	126151	80167	230550	0.249	0.136	0.392	1.019	0.768	1.309	1.137	0.810	1.568
2001	120783	77166	222312	0.321	0.175	0.503	0.978	0.735	1.251	1.464	1.054	2.018
2002	105951	64947	203780	0.300	0.156	0.489	0.860	0.639	1.113	1.361	0.972	1.887
2003	100979	61077	196039	0.277	0.143	0.459	0.818	0.604	1.072	1.264	0.888	1.760
2004	102247	61334	198328	0.220	0.114	0.368	0.827	0.609	1.093	1.005	0.697	1.406
2005	104806	63639	202474	0.180	0.093	0.297	0.849	0.626	1.120	0.823	0.570	1.158
2006	110401	68033	207674	0.221	0.118	0.359	0.895	0.649	1.165	1.007	0.704	1.436
2007	114054	69627	215578	0.178	0.094	0.291	0.923	0.673	1.210	0.811	0.561	1.158
2008	123196	76098	229862	0.153	0.082	0.248	0.996	0.734	1.309	0.700	0.484	0.994
2009	133472	84332	244041	0.167	0.091	0.264	1.080	0.798	1.416	0.761	0.527	1.077
2010	138054	86984	253269	0.139	0.076	0.221	1.117	0.830	1.470	0.634	0.439	0.894
2011	142318	89813	260342	0.170	0.093	0.269	1.157	0.853	1.505	0.769	0.540	1.094
2012	143835	90397	264886	0.176	0.095	0.280	1.168	0.854	1.523	0.796	0.556	1.136
2013	142590	87886	263945	0.136	0.074	0.221	1.157	0.836	1.517	0.619	0.429	0.892
2014	146538	90151	270983	0.094	0.051	0.152	1.189	0.847	1.557	0.425	0.296	0.622
2015	159840	101590	288573	0.095	0.053	0.150	1.299	0.941	1.685	0.430	0.302	0.627
2016	171655	110738	305582	0.084	0.047	0.129	1.399	1.014	1.805	0.378	0.267	0.552
2017	182000	118700	321824	0.076	0.043	0.116	1.483	1.065	1.911	0.343	0.243	0.506
2018	194583	127908	339293	0.088	0.050	0.134	1.581	1.141	2.047	0.398	0.282	0.587

Table 22. Estimated probabilities of the South Atlantic Albacore (a) stock being below F_{MSY} (overfishing not occurring), (b) stock being above B_{MSY} (not overfished), and (c) stock being above B_{MSY} and below F_{MSY} (green Kobe plot quadrant) shown for a range of total allowable catches (TACs) scenarios of 0 – 34,000 metric tons over the fixed catch projection horizon 2021-2033 based on joint projection MCMC posteriors of JABBA base-case model run ('Fox ModW').

(a) F<FMSY

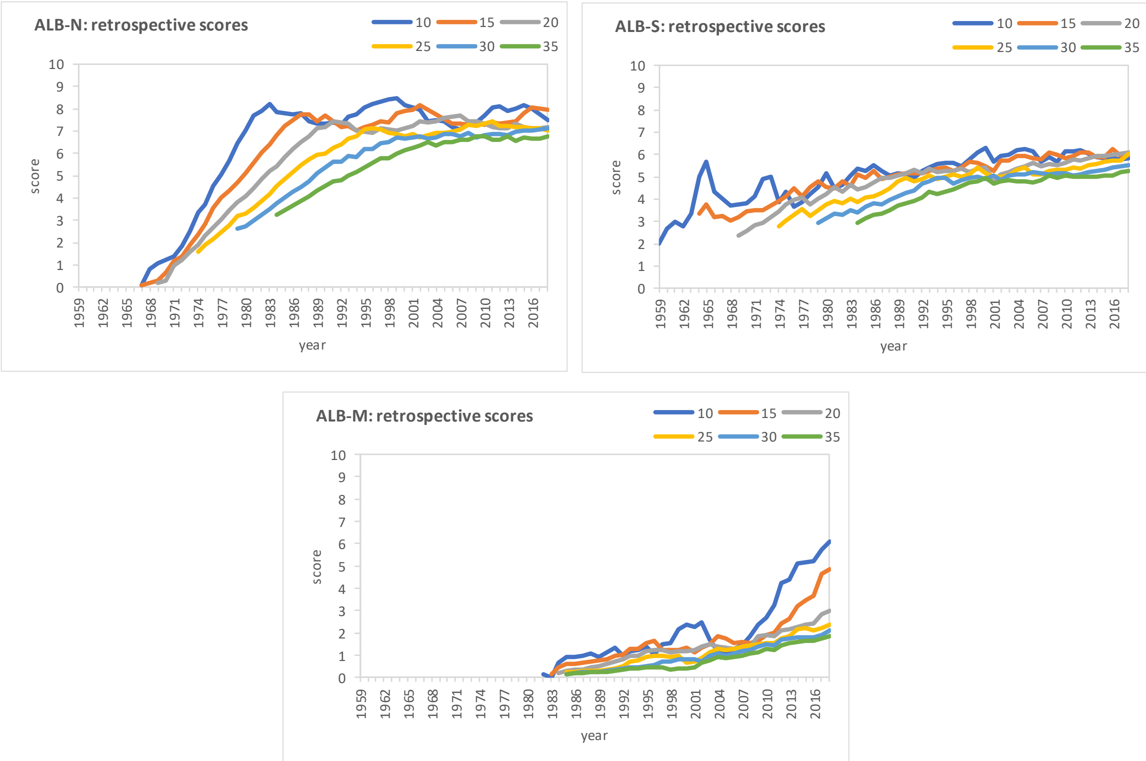
TAC | Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0	100	100	100	100	100	100	100	100	100	100	100	100	100
12000	100	100	100	100	100	100	100	100	100	100	100	100	100
14000	100	100	100	100	100	100	100	100	100	100	100	100	100
16000	100	100	100	100	100	100	100	100	100	100	100	100	100
18000	100	100	100	100	100	100	100	100	100	100	100	100	100
20000	100	100	100	100	100	100	100	100	100	100	100	100	100
21000	100	100	100	100	100	100	100	100	100	100	100	100	100
22000	100	100	100	100	100	100	100	100	100	100	99	99	99
23000	100	100	100	100	100	100	99	99	99	99	99	99	99
24000	100	100	100	99	99	99	99	99	99	99	99	98	98
25000	100	100	99	99	99	99	98	98	98	98	98	97	97
26000	99	99	99	99	98	98	98	97	97	96	95	95	94
27000	99	99	98	98	97	97	96	95	94	93	92	91	90
28000	99	98	98	97	96	95	93	92	91	89	87	86	84
29000	99	98	97	96	94	93	90	88	85	82	80	77	74
30000	98	97	96	94	91	89	85	81	78	73	70	65	62
32000	97	95	92	88	82	76	69	62	56	49	44	39	35
34000	95	91	85	77	67	57	48	40	32	27	22	19	16

(b) B>BMSY

TAC | Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0	100	100	100	100	100	100	100	100	100	100	100	100	100
12000	100	100	100	100	100	100	100	100	100	100	100	100	100
14000	100	100	100	100	100	100	100	100	100	100	100	100	100
16000	100	100	100	100	100	100	100	100	100	100	100	100	100
18000	100	100	100	100	100	100	100	100	100	100	100	100	100
20000	100	100	100	100	100	100	100	100	100	100	100	100	100
21000	100	100	100	99	99	99	99	99	99	99	99	99	99
22000	100	100	100	99	99	99	99	99	99	99	99	99	99
23000	100	100	100	99	99	99	99	99	99	99	99	99	98
24000	100	99	99	99	99	99	99	99	98	98	98	98	98
25000	100	100	99	99	99	99	98	98	98	98	97	97	97
26000	100	99	99	99	99	99	98	98	97	97	96	95	95
27000	100	99	99	99	98	98	97	97	96	95	94	93	92
28000	100	99	99	99	98	97	96	95	94	93	91	90	88
29000	100	99	99	98	98	97	96	94	92	90	88	85	83
30000	100	99	99	98	97	96	94	92	89	86	83	79	76
32000	100	99	99	98	96	93	89	85	80	74	68	62	56
34000	100	99	98	96	93	89	82	75	66	58	49	42	36

(c) F<FMSY and B>BMSY

TAC | Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0	100	100	100	100	100	100	100	100	100	100	100	100	100
12000	100	100	100	100	100	100	100	100	100	100	100	100	100
14000	100	100	100	100	100	100	100	100	100	100	100	100	100
16000	100	100	100	100	100	100	100	100	100	100	100	100	100
18000	100	100	100	100	100	100	100	100	100	100	100	100	100
20000	100	100	100	100	100	100	100	100	100	100	100	100	100
21000	100	100	100	99	99	99	99	99	99	99	99	99	99
22000	100	100	100	99	99	99	99	99	99	99	99	99	99
23000	100	100	99	99	99	99	99	99	99	99	99	98	98
24000	100	99	99	99	99	99	99	98	98	98	98	98	98
25000	100	99	99	99	99	98	98	98	98	97	97	97	96
26000	99	99	99	98	98	98	97	97	96	96	95	94	94
27000	99	99	98	98	97	97	96	95	94	93	92	91	90
28000	99	98	98	97	96	95	93	92	90	89	87	85	83
29000	99	98	97	96	94	93	90	88	85	82	79	77	74
30000	98	97	96	94	91	89	85	81	78	73	69	65	61
32000	97	95	92	88	82	76	69	62	56	49	44	39	35
34000	95	91	85	77	67	57	48	40	32	27	22	19	16



SCORECARD on Task I/II availability for the main ICCAT fisheries (final year: 2018)

FisheryID	Spc. Group	Species	Species/stock	SCORES (by time series) 10 years (2009-18)	20 years (1999-18)	30 years (1989-18)	N. flag fisheries ranked 10 years (2009-18)	20 years (1999-18)	30 years (1989-18)	Change (%) agains't 1988-17 (30 yrs)
1	Temperate	ALB	ALB-N stock	7.48	7.18	7.14	12	14	12	1%
2			ALB-S stock	5.84	6.10	5.54	10	9	10	1%
3			ALB-M stock	6.10	3.00	2.10	6	9	12	11%

Figure 1. Retrospective scores for ALB in the three stocks (top-left: ALB-N; top-right: ALB-S; bottom: ALB-M), obtained for different time series (10 to 35 years, being the 30 years period the corresponding standard SCRS catalogue) between 1950 and 2018. The bottom panel shows the ALB scores of the SCRS scorecard for the terminal year 2018 (last point of the retrospective scores). The last column shows the relative change against the previous 30 year's period (1988-2017), i.e. a slight improvement of 1% in the Atlantic stocks and a reasonable improvement of 11% in the Mediterranean stock.

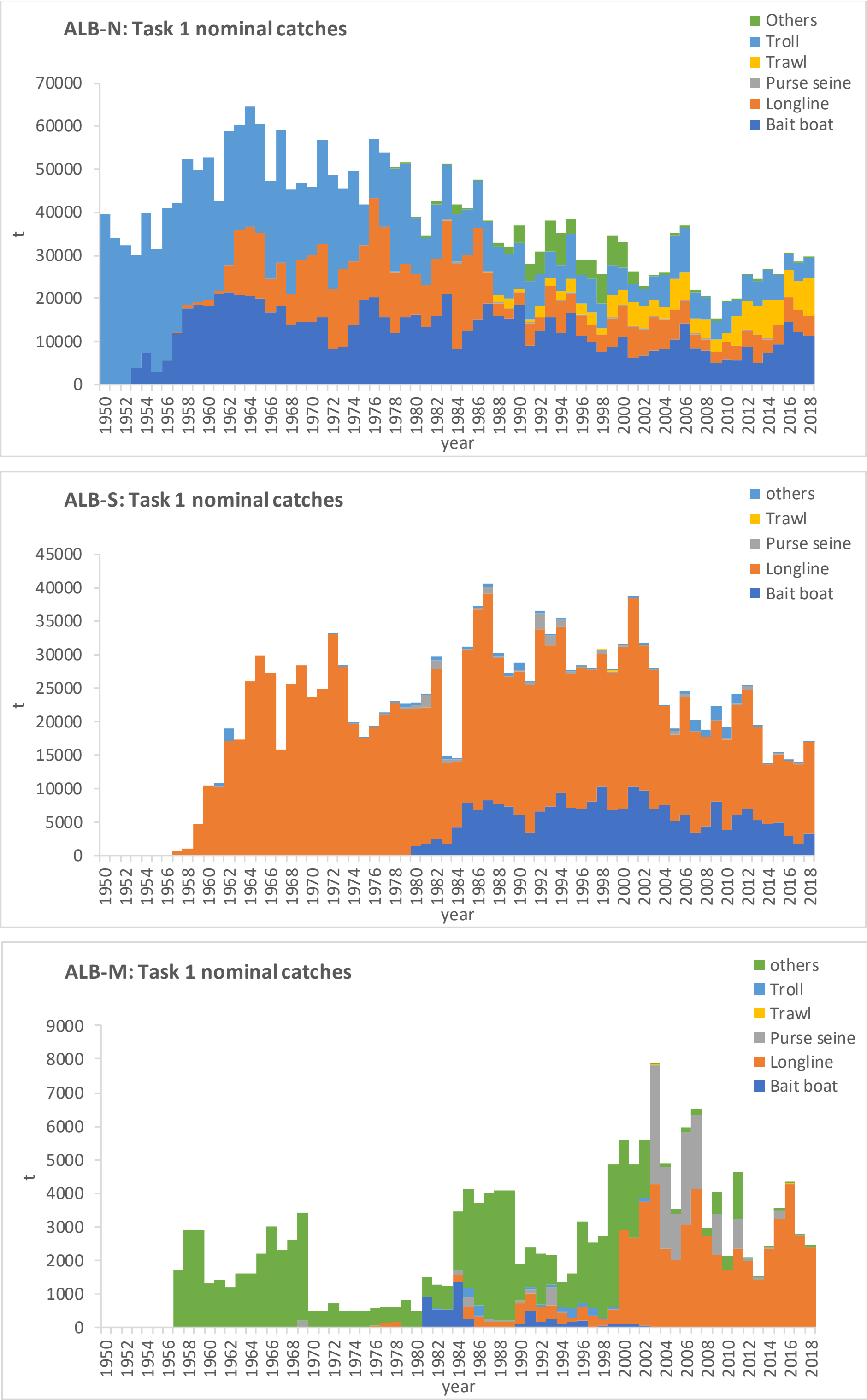


Figure 2. ALB total nominal catches (T1NC, t) by stock (ALB-N: top; ALB-S: centre; ALB-M: bottom) stacked by gear, between 1950 and 2018.

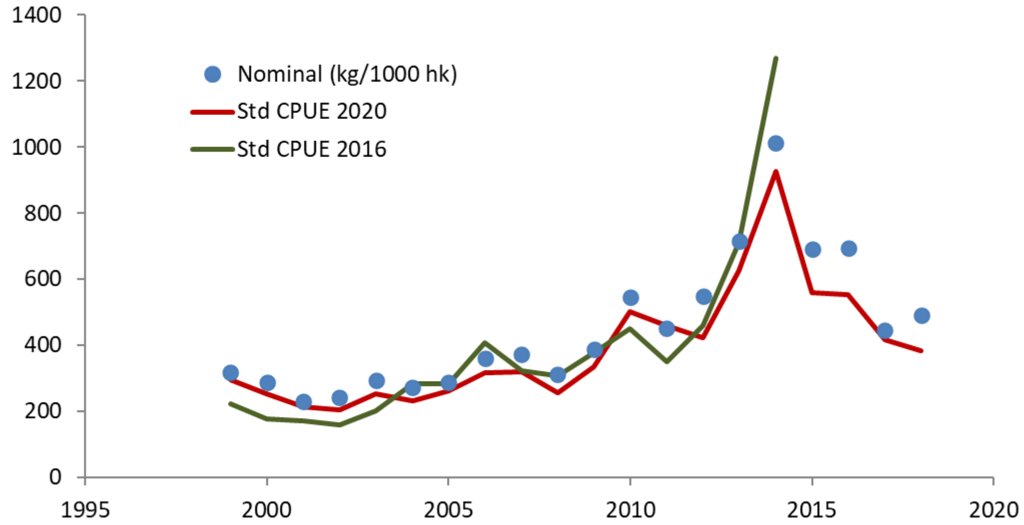


Figure 3. Comparison of Chinese-Taipei CPUE series: the nominal CPUE (blue points), the standardized CPUE used in the 2016 stock assessment (green), and the standardized CPUE in weight provided during the meeting (red).

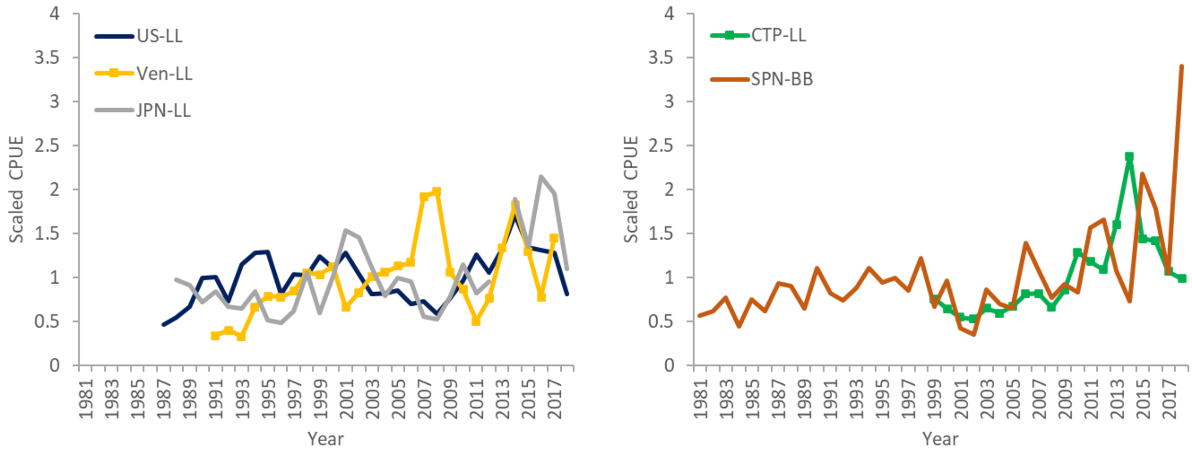


Figure 4. CPUEs used for the base case of the 2020 stock assessment for the North Atlantic albacore.

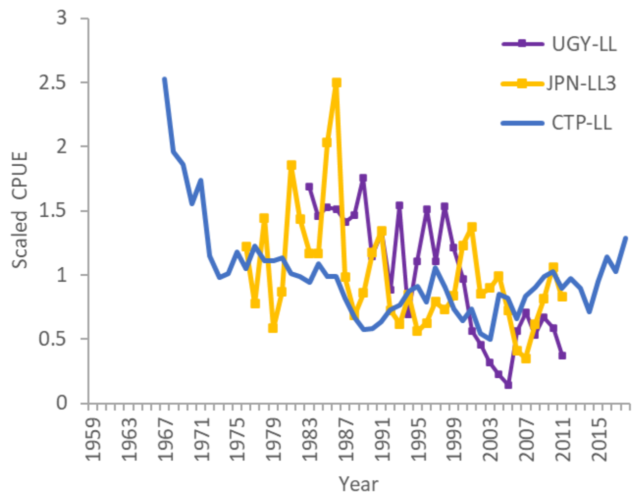


Figure 5. CPUEs used for the base case of the 2020 stock assessment for the South Atlantic albacore.

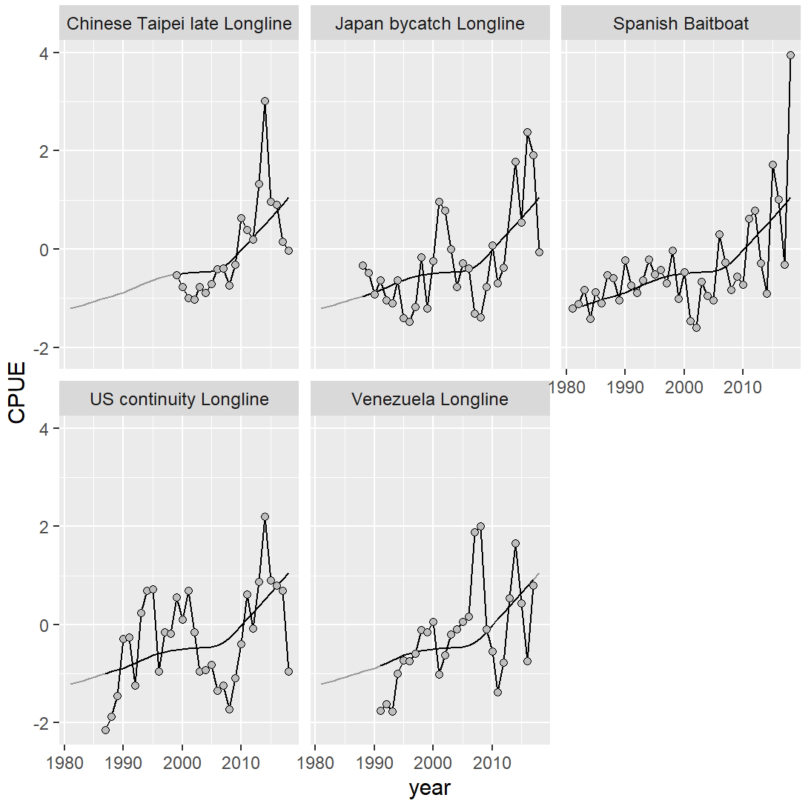


Figure 6. CPUEs (in logarithmic scale) used in the 2020 stock assessment. The Japanese 2013 and Venezuelan 2018 values are not shown, as the group decided not to use them.

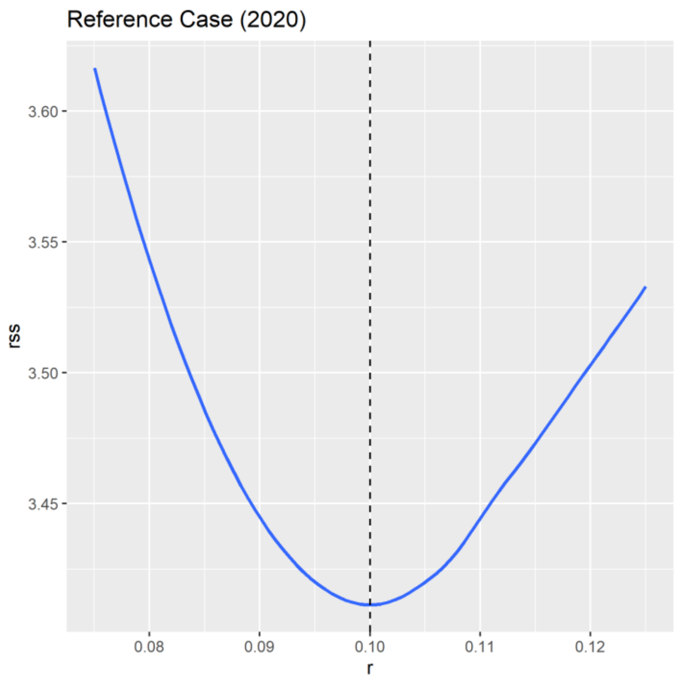


Figure 7. Likelihood profile for intrinsic growth rate (r).

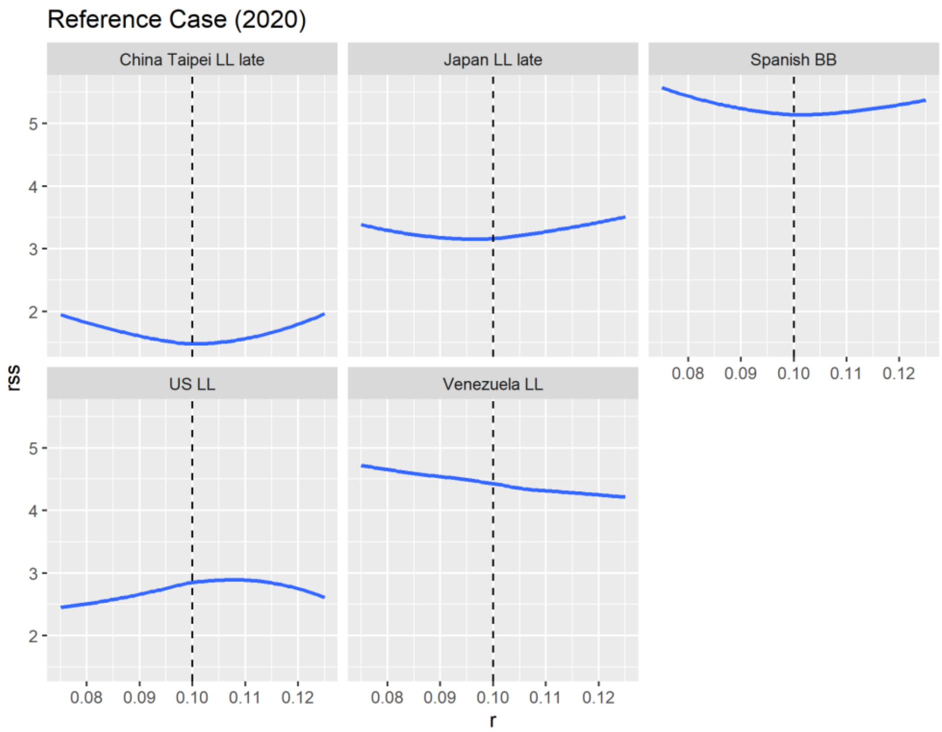


Figure 8. Partial likelihood profiles for intrinsic growth rate (r) for each of the CPUE series used in the stock assessment.

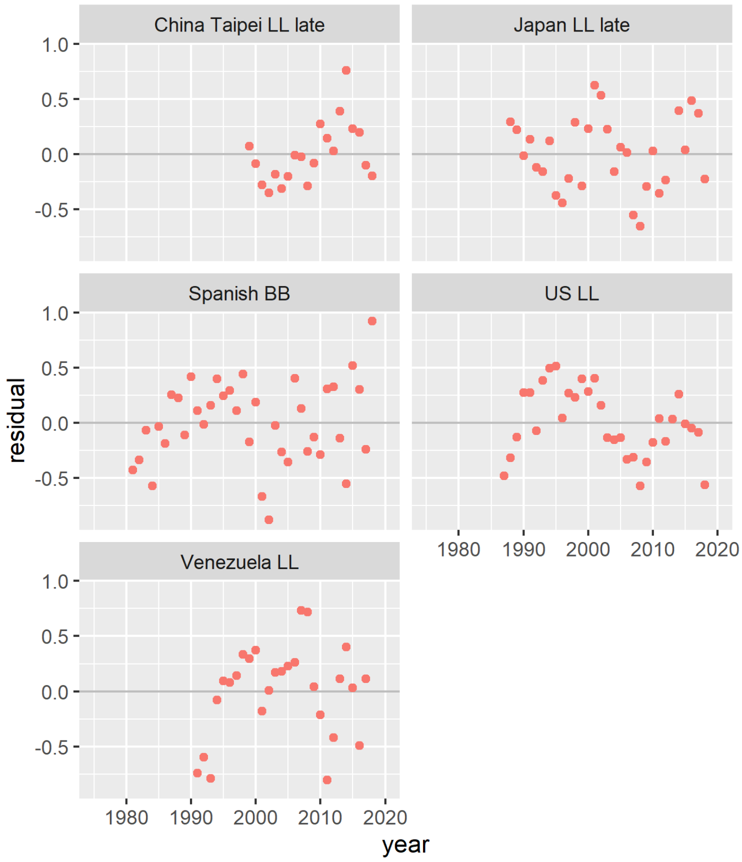


Figure 9. Residuals for the Reference Case stock assessment fit to the CPUE indices.

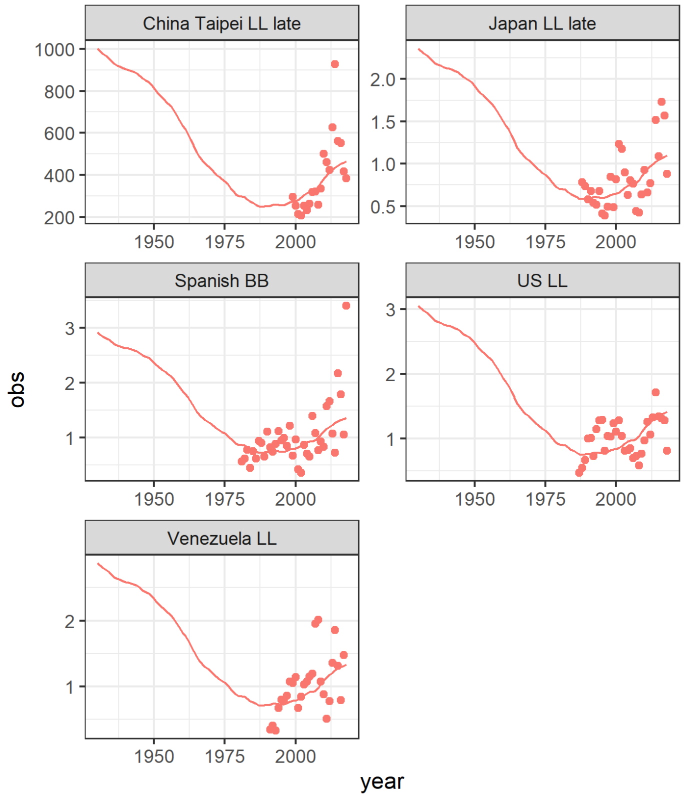


Figure 10. Estimated stock biomass (scaled according to the estimated CPUE catchability) and CPUE observations.

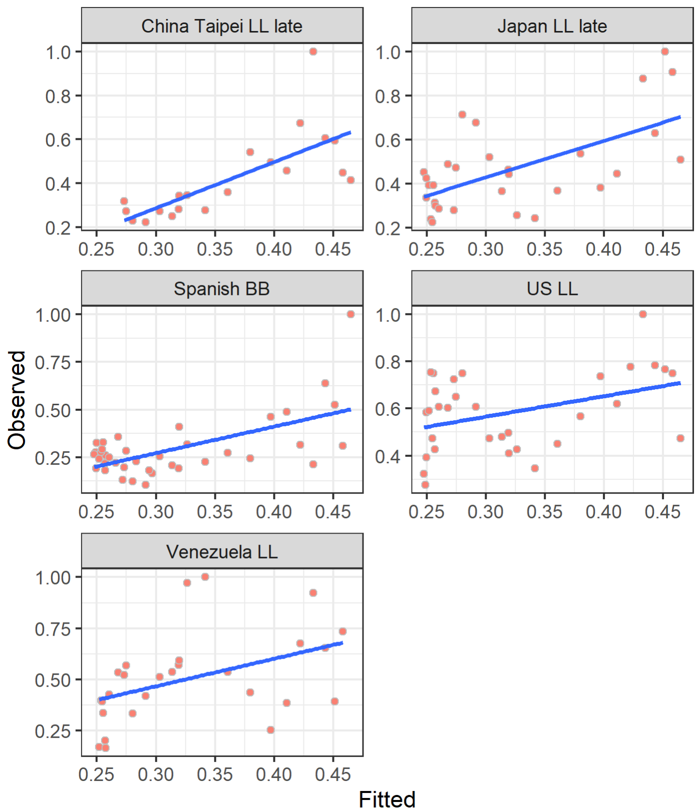


Figure 11. Estimated versus observed CPUE indices.

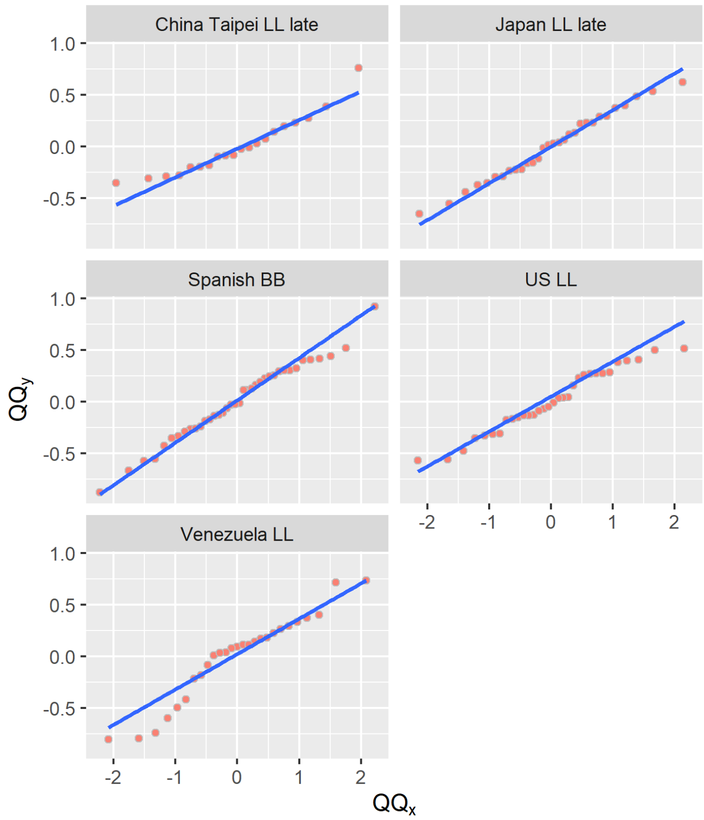


Figure 12. Quantile-quantile plots to compare CPUE residual distributions with the normal distribution.

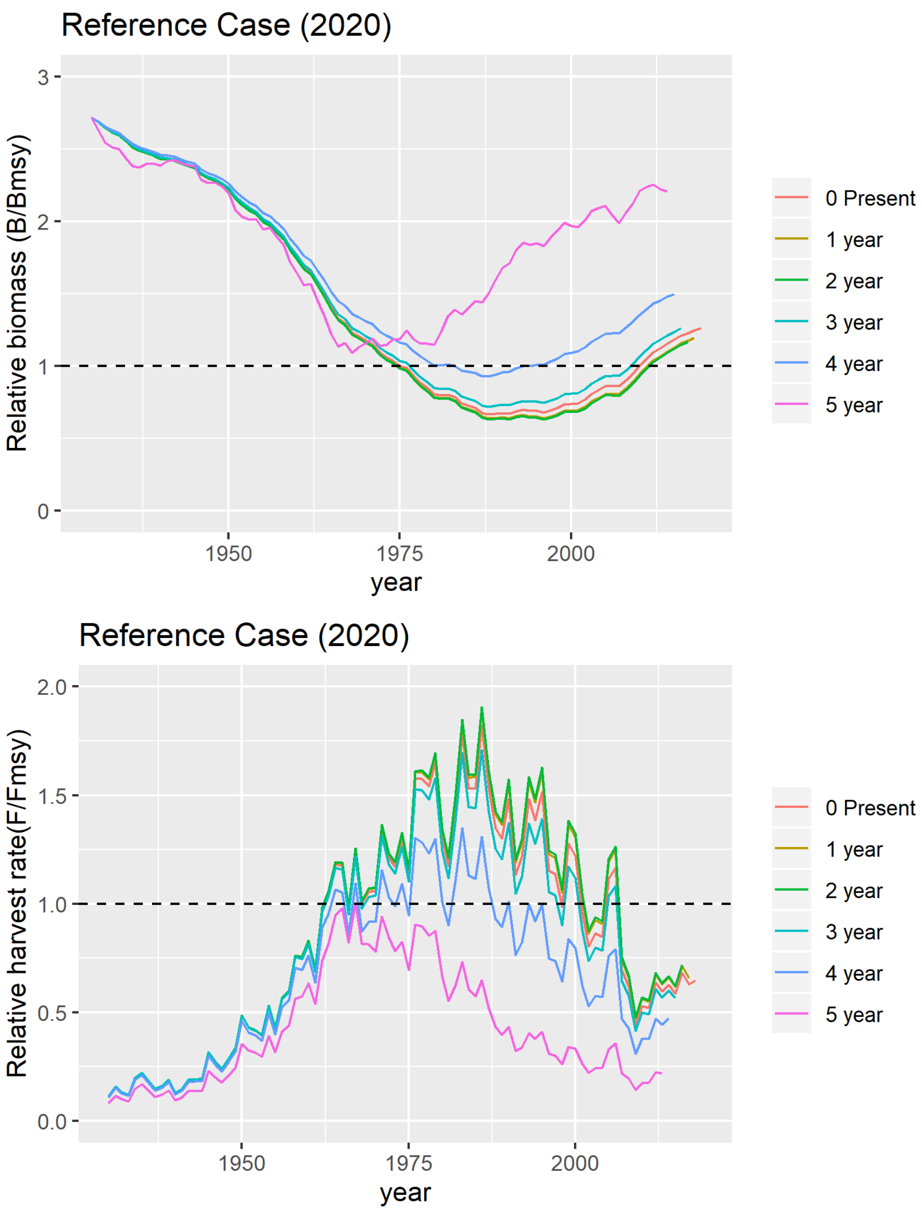


Figure 13. Retrospective fits with the Reference Case of the 2020 stock assessment.

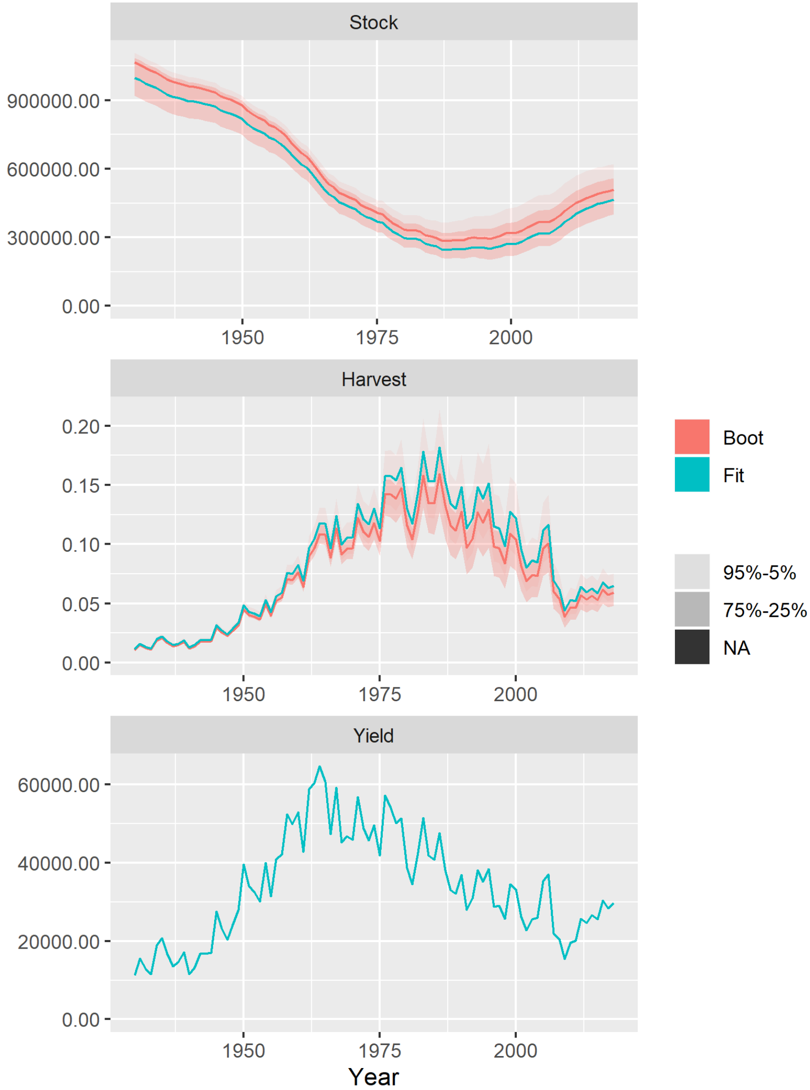


Figure 14. Bootstrap results: biomass and fishing mortality trajectories estimated for the Reference Case and observed yield. The red line is the median of the bootstrap values.

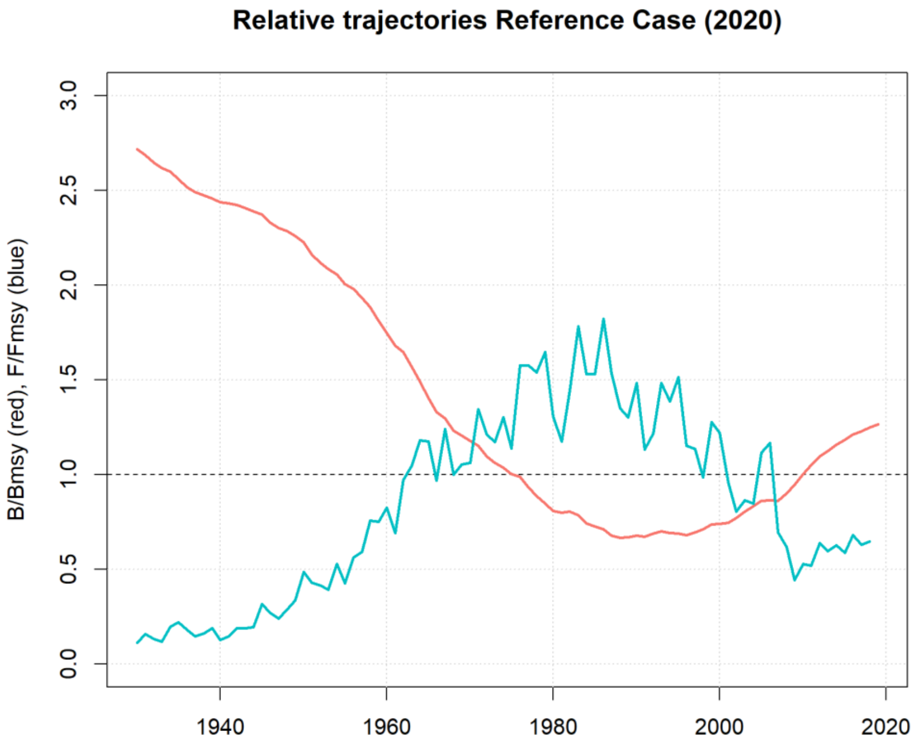


Figure 15. Relative biomass (red) and fishing mortality (blue) as estimated by the Reference Case.

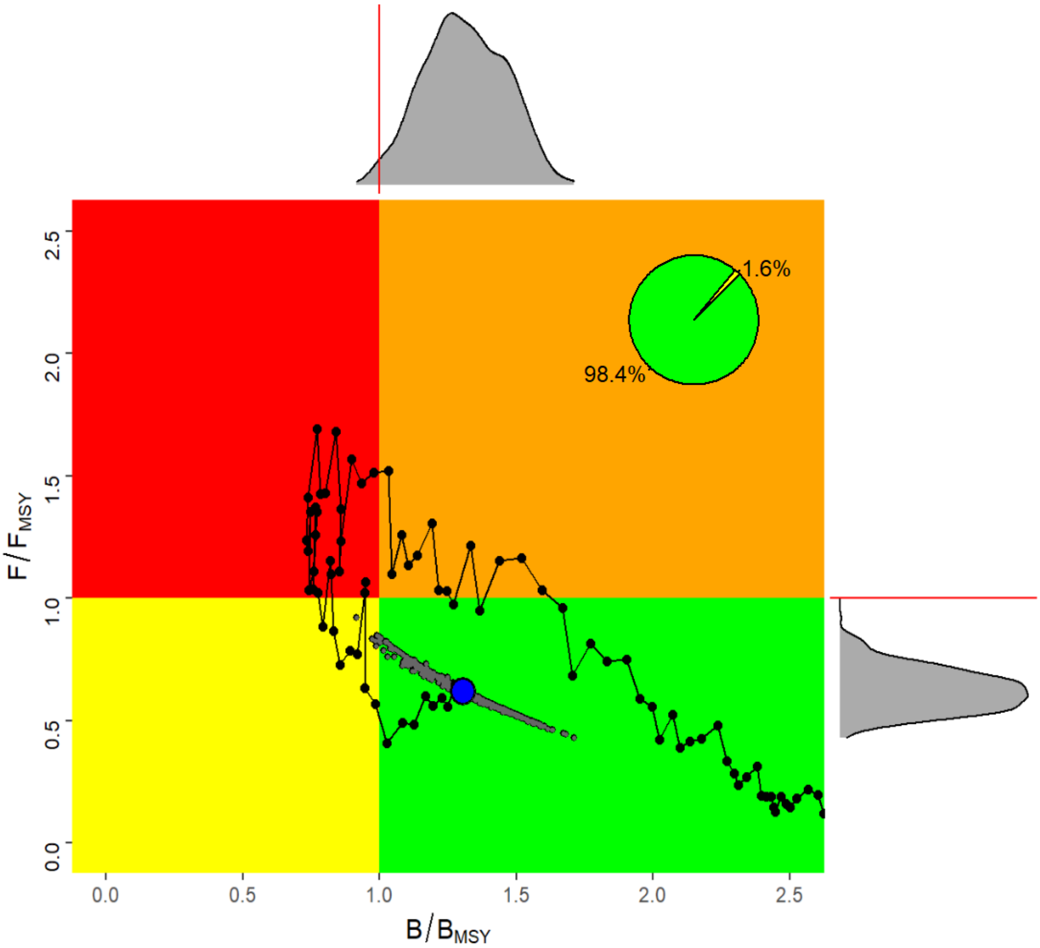


Figure 16. Estimated trajectories of B/BMSY and F/FMSY with the Reference Case North Atlantic albacore stock assessment. Dots represent the bootstrapped 2018 B/BMSY and F/FMSY coordinates (median in blue).

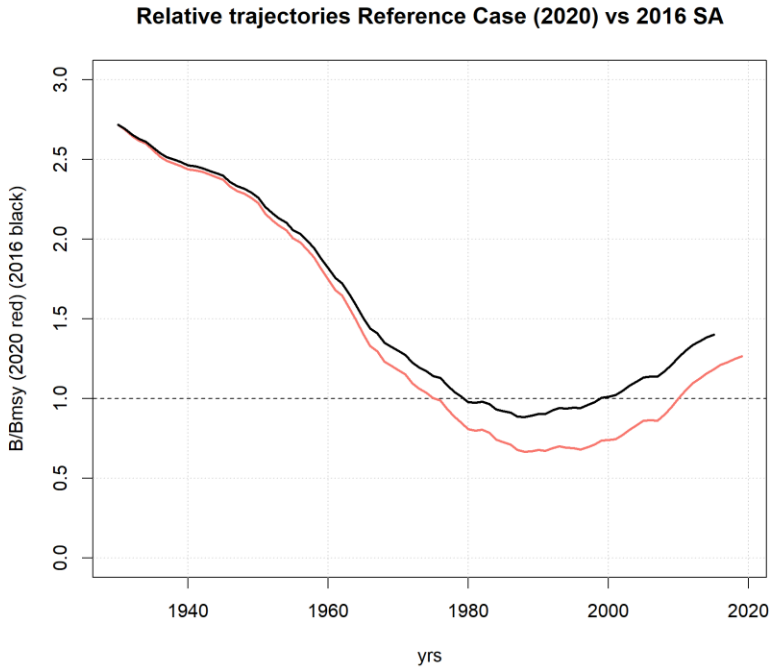


Figure 17. Relative biomass trajectory estimated in the Reference Case of 2020 (red) and the Base Case from 2016 (black).

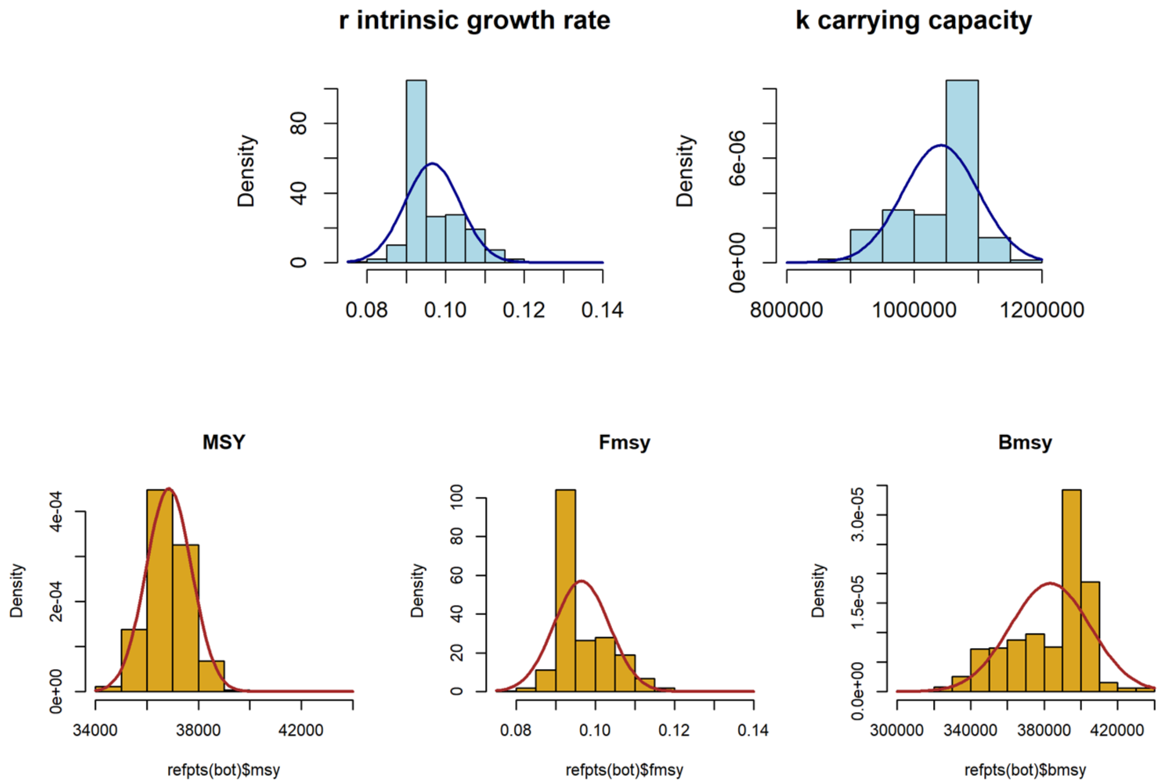


Figure 18. Histograms and density distribution of the parameters and Reference Points estimated by the Reference Case. Histograms are built using mean and sd values from model output.

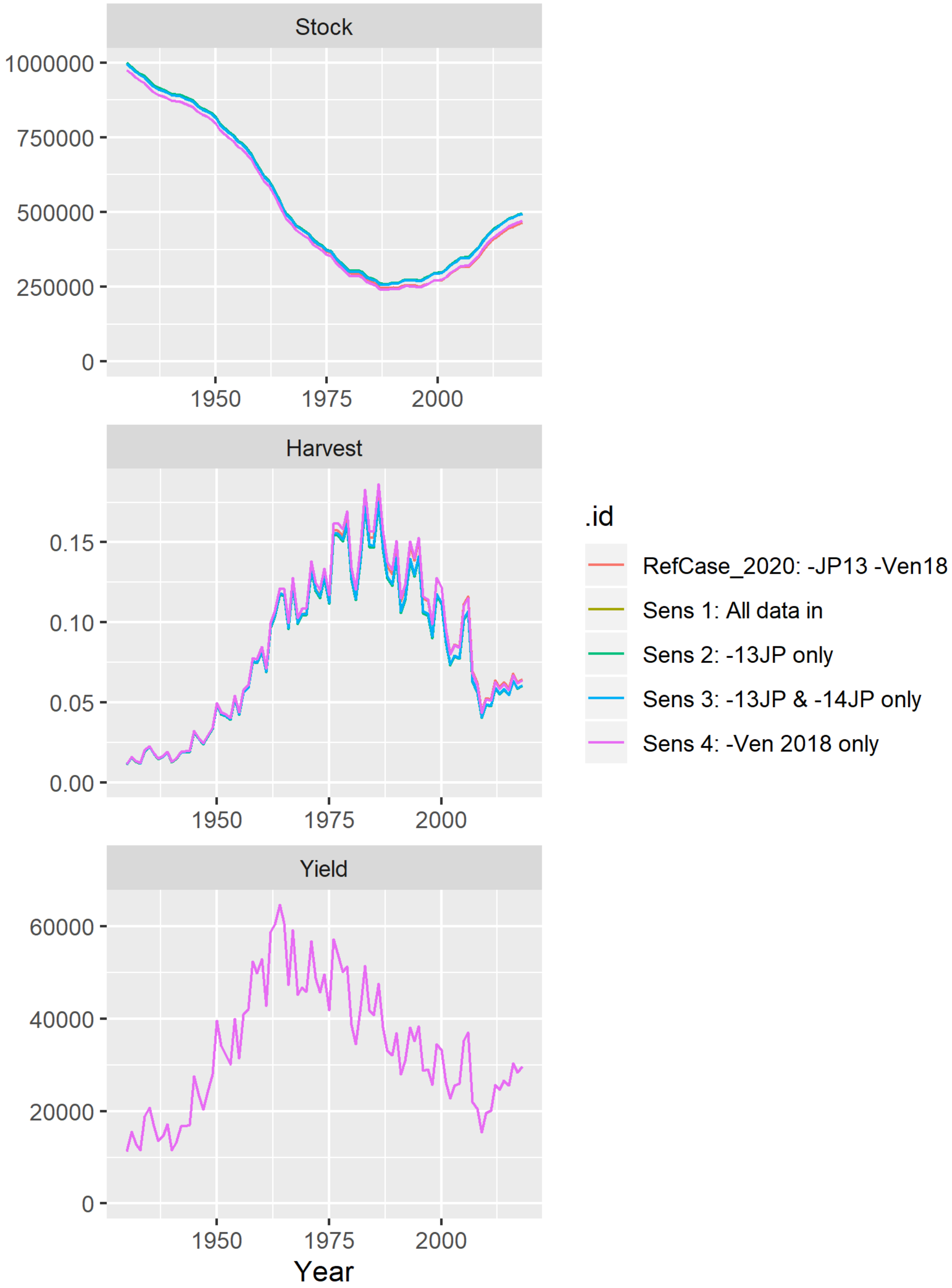
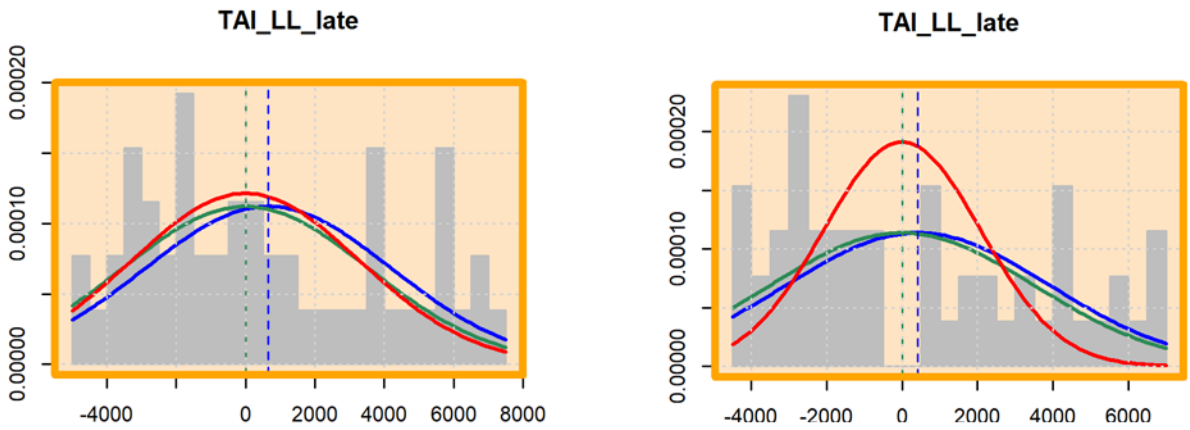


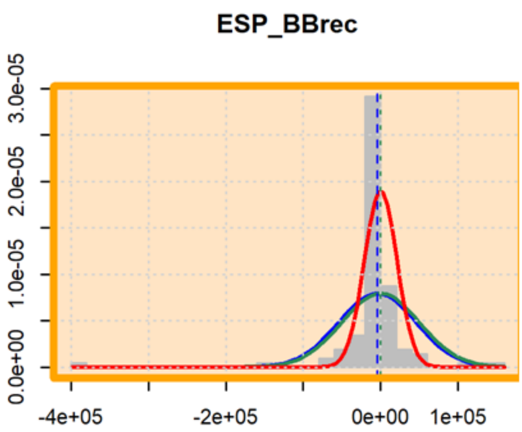
Figure 19. Estimated trajectories for the scenarios developed to evaluate the impact of individual data point removals.



Base_h6_M03_q0:
Downweighted SF for China Taipei

Alt7_h6_M03_q0:
Includes equal weights for Japan and Chinese Taipei longline size frequency data and catch per unit of effort data

Figure 20. Histogram of the residuals of fit between the observed CPUE for Chinese Taipei in the late period in the 2013 base case OM scenario (Base) and the scenario where the OM includes equal weights for Japan and Chinese Taipei longline size frequency data. The blue line is the normal distribution generating the mean and sd of the residuals, the green line is generated using mean=0 and the sd of the residuals, and the red line represents the variability (CV=20%) considered in the Observation Error Model of the MSE.



Base_and others:
Residuals larger than considered in the MSE, in general.

Figure 21. Histogram of residuals for Spanish baitboat CPUE. The blue line is the normal distribution generating the mean and sd of the residuals, the green line is generated using mean=0 and the sd of the residuals, and the red line represents the variability (CV=20%) considered in the Observation Error Model of the MSE.

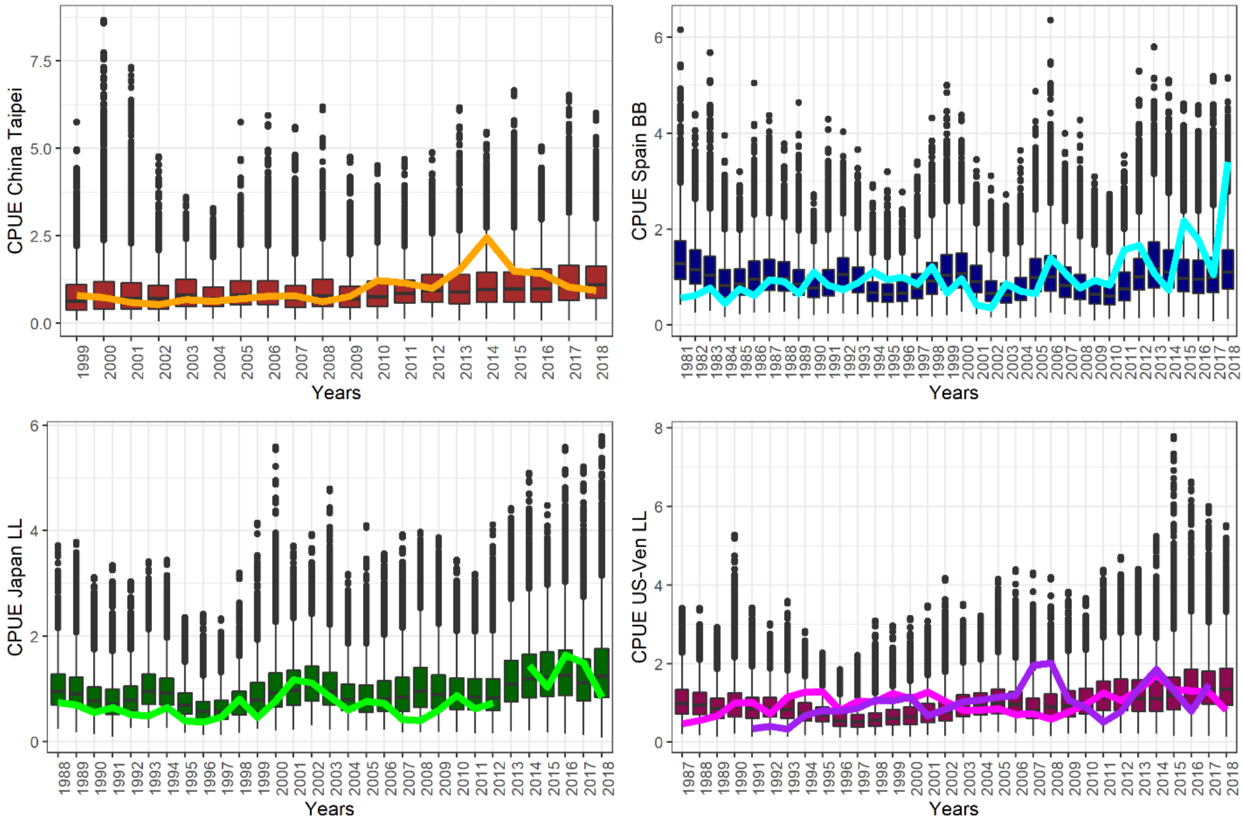


Figure 22. Evaluation of exceptional circumstances according to CPUE indicators. Boxplots represent the range of values in each year simulated from the OMs used in the MSE when the accepted MP was tested. Colored time series indicate updated CPUE values used in this year's MP iteration. In the bottom right panel, the pink line is the US-LL series and the purple one is the Venezuelan LL index.

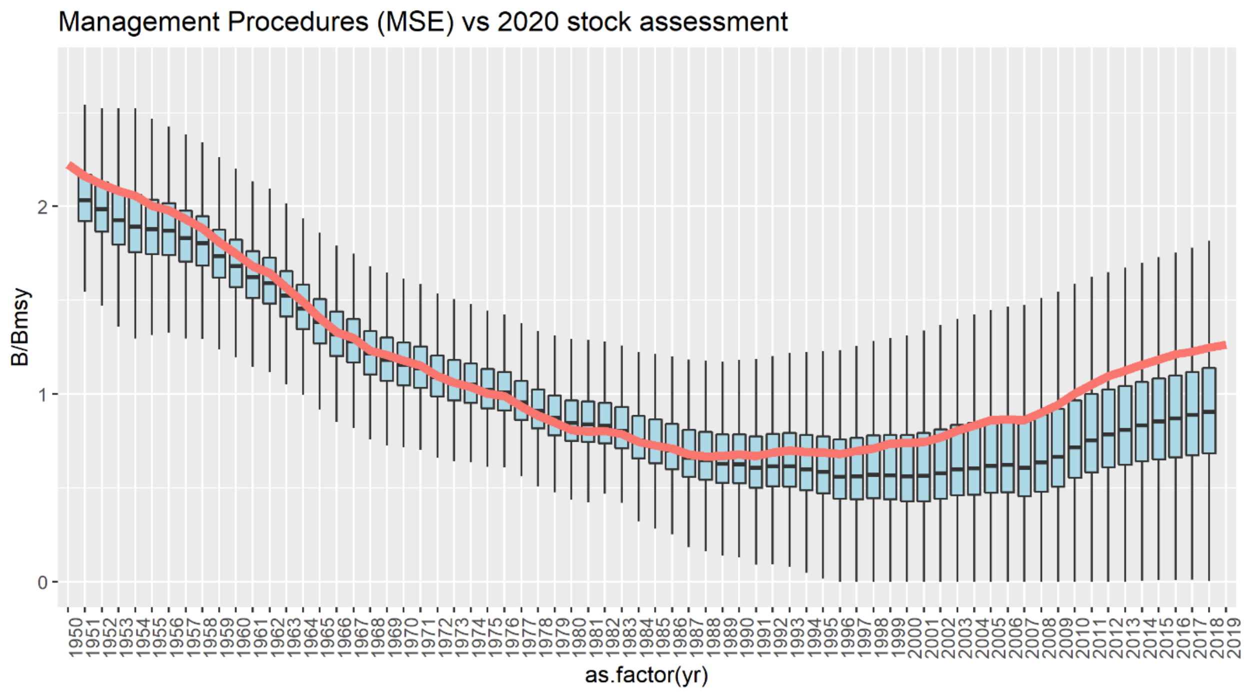


Figure 23. Evaluation of exceptional circumstances according to B/Bmsy indicators from the production model applied in the MP. Boxplots represent the range of values (across OMs) produced by the production model during MSE testing of the accepted MP. The orange line indicates the estimated B/Bmsy trajectory from the production model applied in this year's MP iteration.

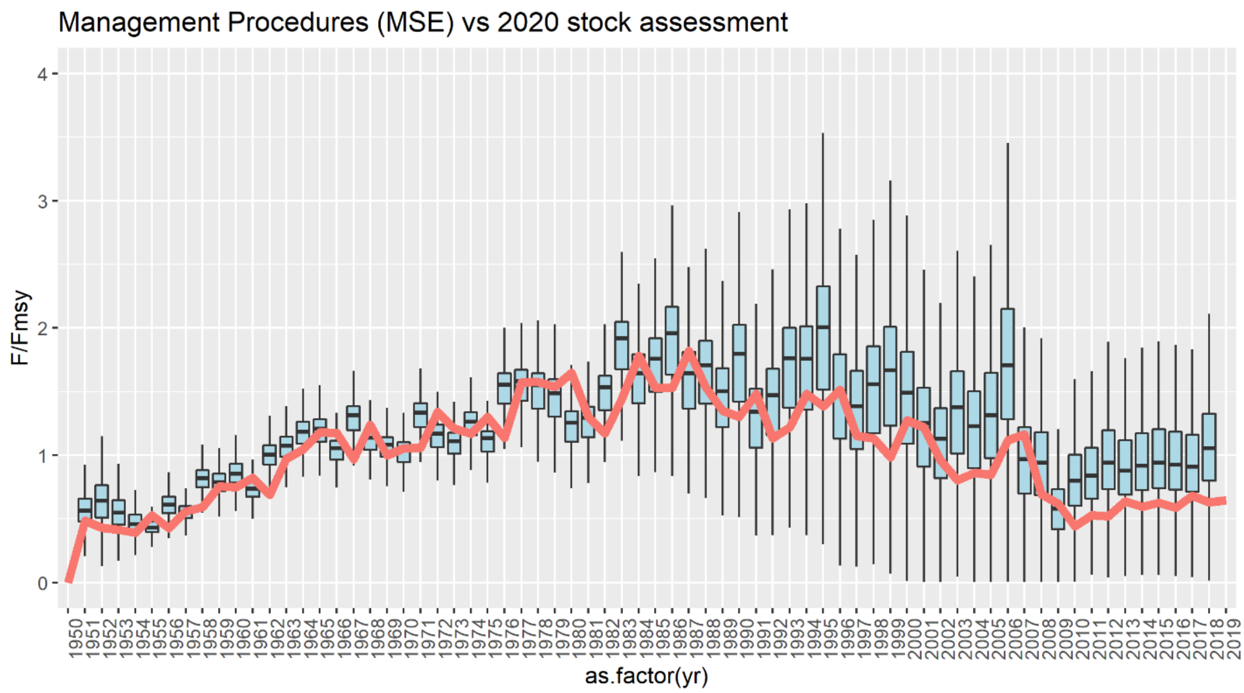


Figure 24. Evaluation of exceptional circumstances according to F/Fmsy indicators from the production model applied in the MP. Boxplots represent the range of values (across OMs) produced by the production model during MSE testing of the accepted MP. The orange line indicates the estimated F/Fmsy trajectory from the production model applied in this year's MP iteration.

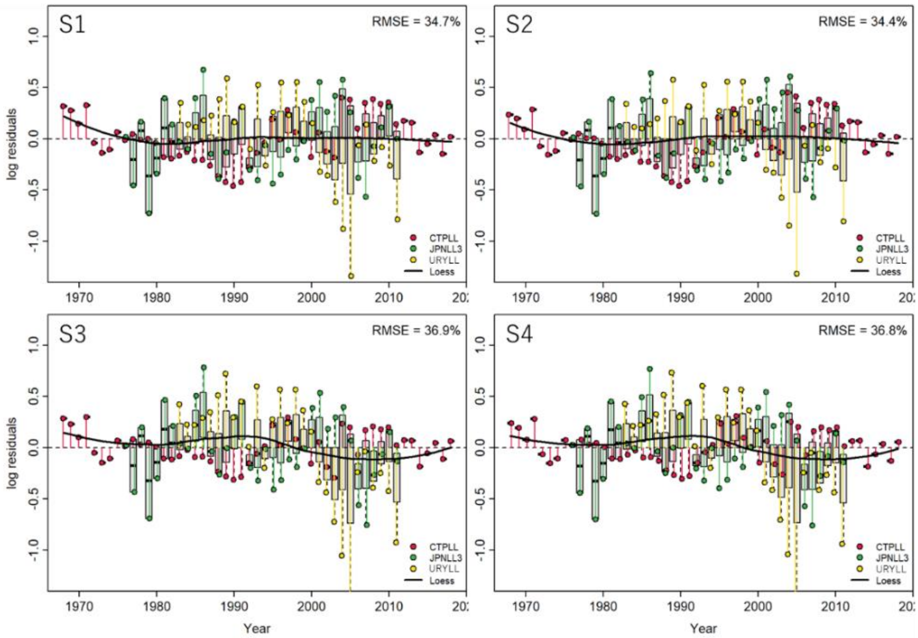


Figure 25. JABBA residual diagnostic plots for alternative sets of CPUE indices examined for each reference scenario (S1) SchaeferEqW; (S2) FoxEqW; (S3) SchaeferModW; (S4) FoxModW for the South Atlantic albacore. Boxplots indicate the median and quantiles of all residuals available for any given year, and solid black lines indicate a loess smoother through all residuals.

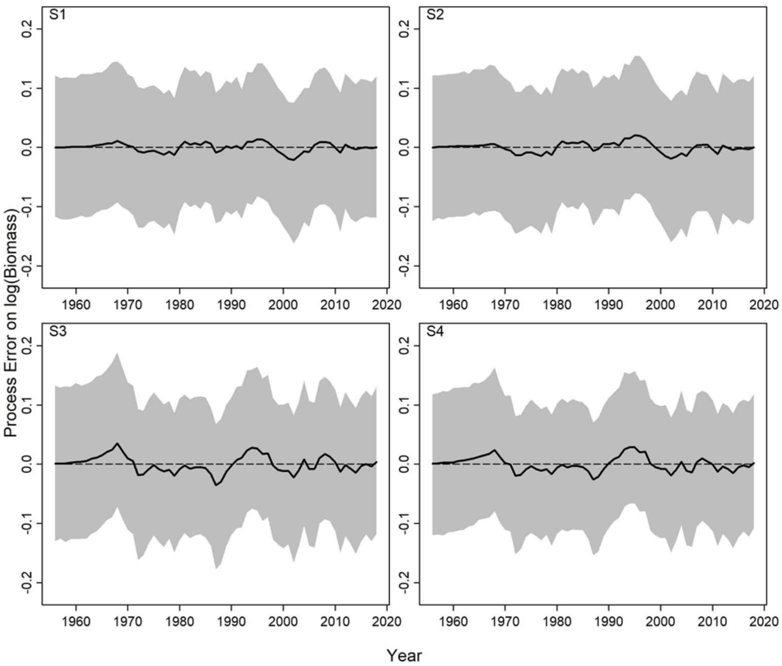
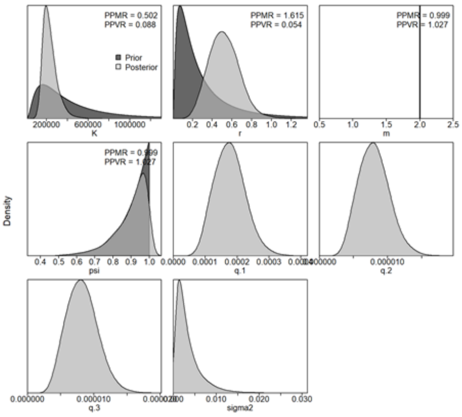
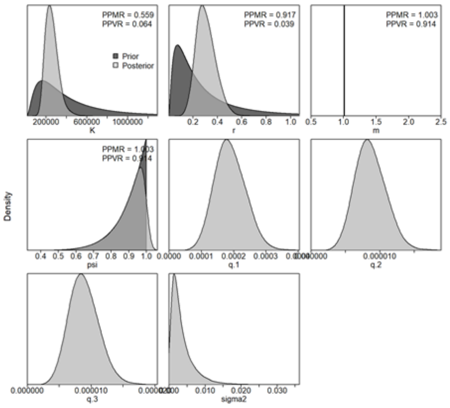


Figure 26. JABBA residual diagnostic plots for alternative sets of CPUE indices examined for each reference scenario (S1) SchaeferEqW; (S2) FoxEqW; (S3) SchaeferModW; (S4) FoxModW for the South Atlantic albacore. Process error deviates (median: solid line) with shaded grey area indicating 95% credibility intervals.

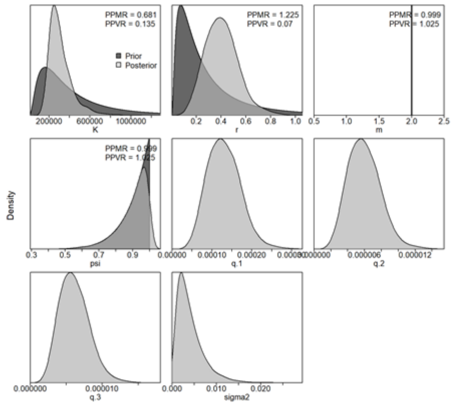
S1



S2



S3



S4

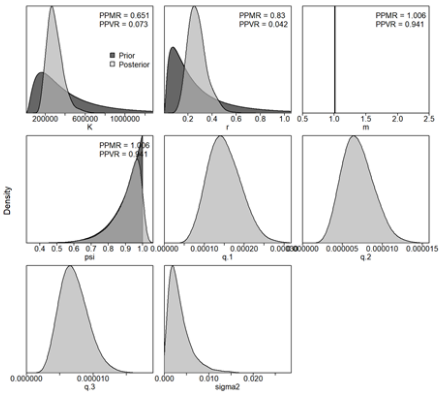


Figure 27. Prior and posterior distributions of various model and management parameters for the Bayesian state-space surplus production models (S1) SchaeferEqW; (S2) FoxEqW; (S3) SchaeferModW; (S4) FoxModW) for South Atlantic albacore. PPRM: Posterior to Prior Ratio of Medians; PPRV: Posterior to Prior Ratio of Variances.

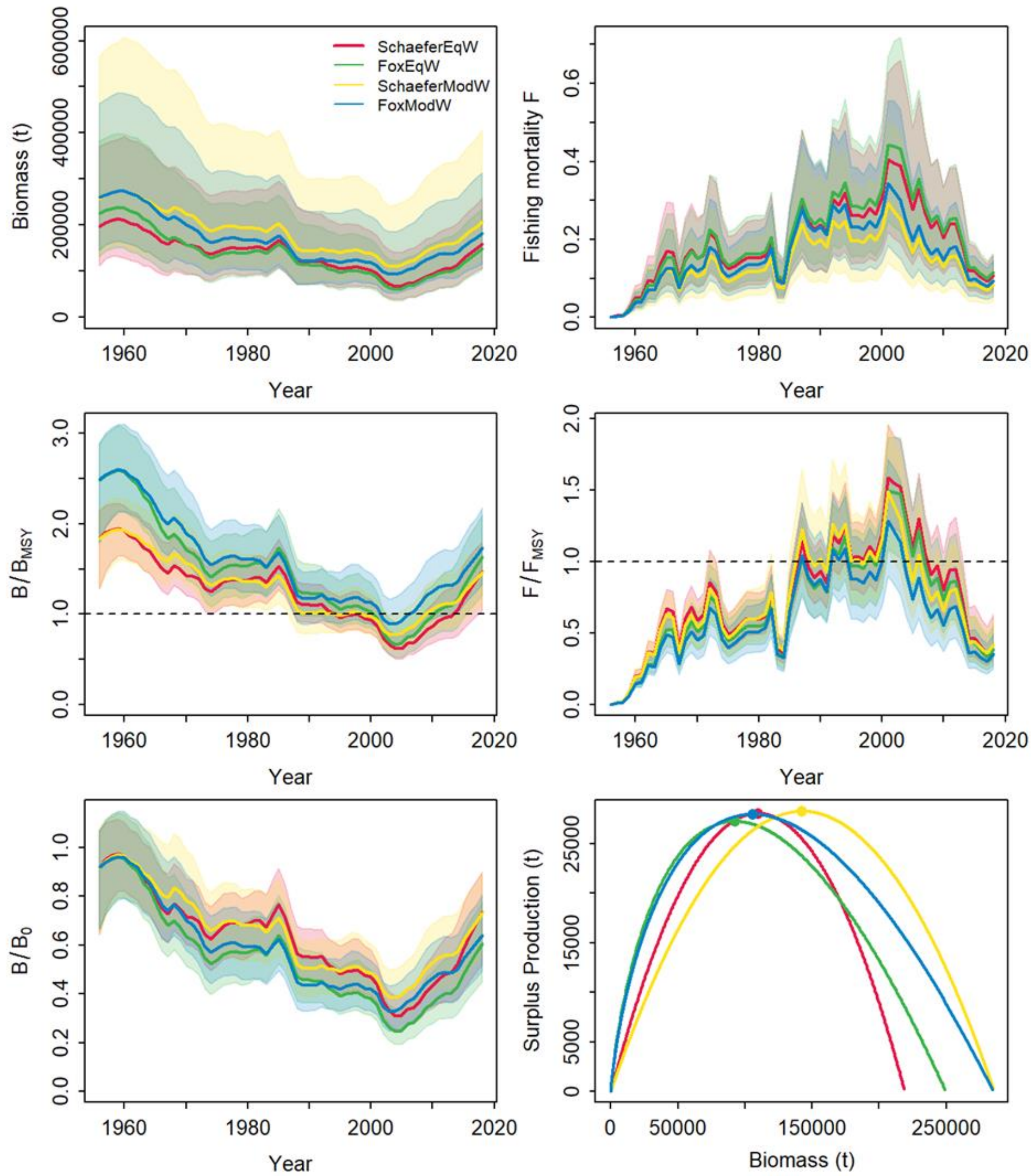


Figure 28. Trends in biomass and fishing mortality (upper panels), biomass relative to B_{MSY}(B/B_{MSY}) and fishing mortality relative to F_{MSY} (F/F_{MSY}) (middle panels) and biomass relative to K (B/K) and surplus production curve (bottom panels) for each reference scenario (S1: SchaeferEqW, S2: FoxEqW, S3: SchaeferModW, S4: FoxModW) from the Bayesian state-space surplus production JABBA model fits to South Atlantic albacore.

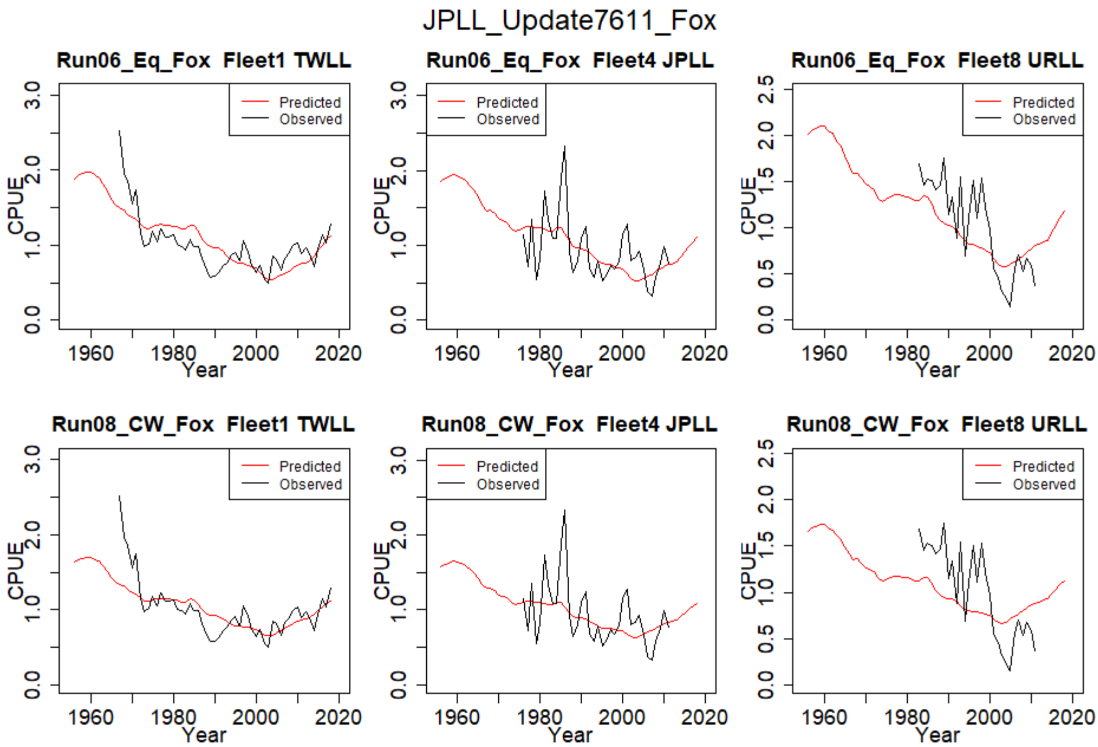


Figure 29. Fit to CPUE for South Atlantic albacore based on ASPIC analysis (ASPIC base models).

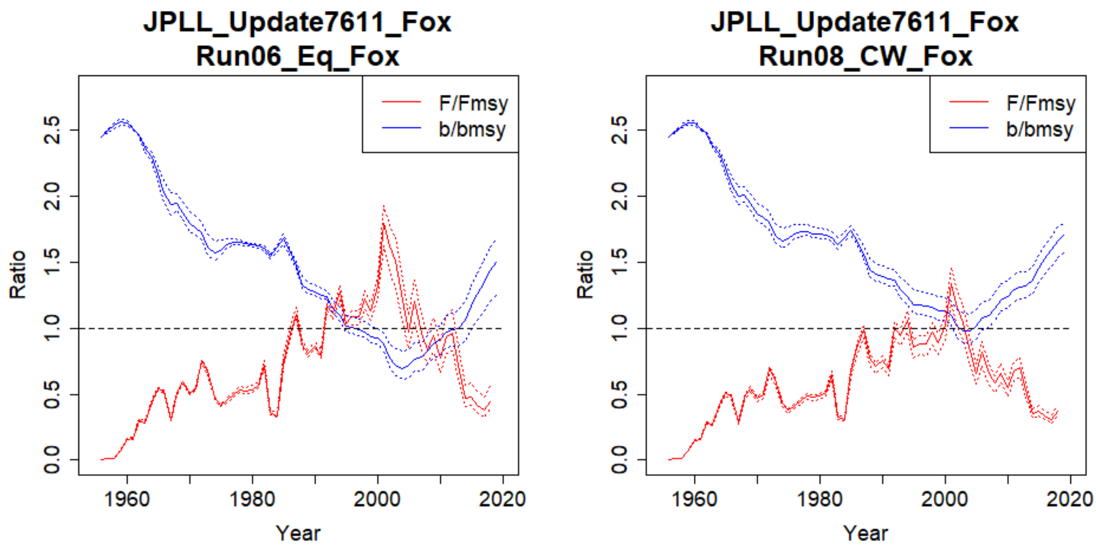


Figure 30. Biomass and fishing mortality/harvest rate trajectories for South Atlantic albacore based on ASPIC base models.

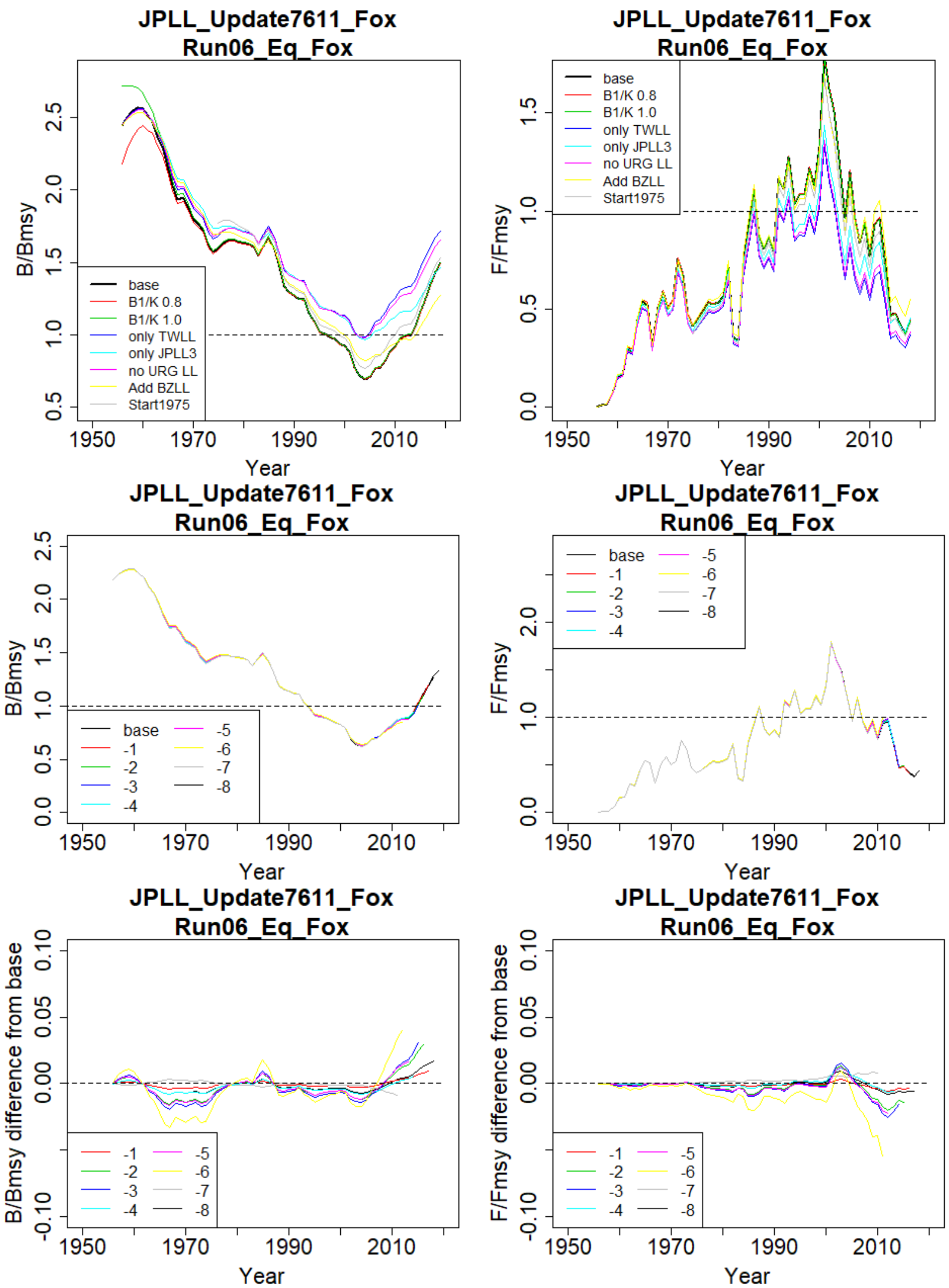


Figure 31. Results of sensitivity (top row, **Table 19**) and retrospective (middle row) analyses for ASPIC analysis (Run06_Eq_Fox) for South Atlantic albacore. Bottom graphs show the difference between base case and retrospective analysis.

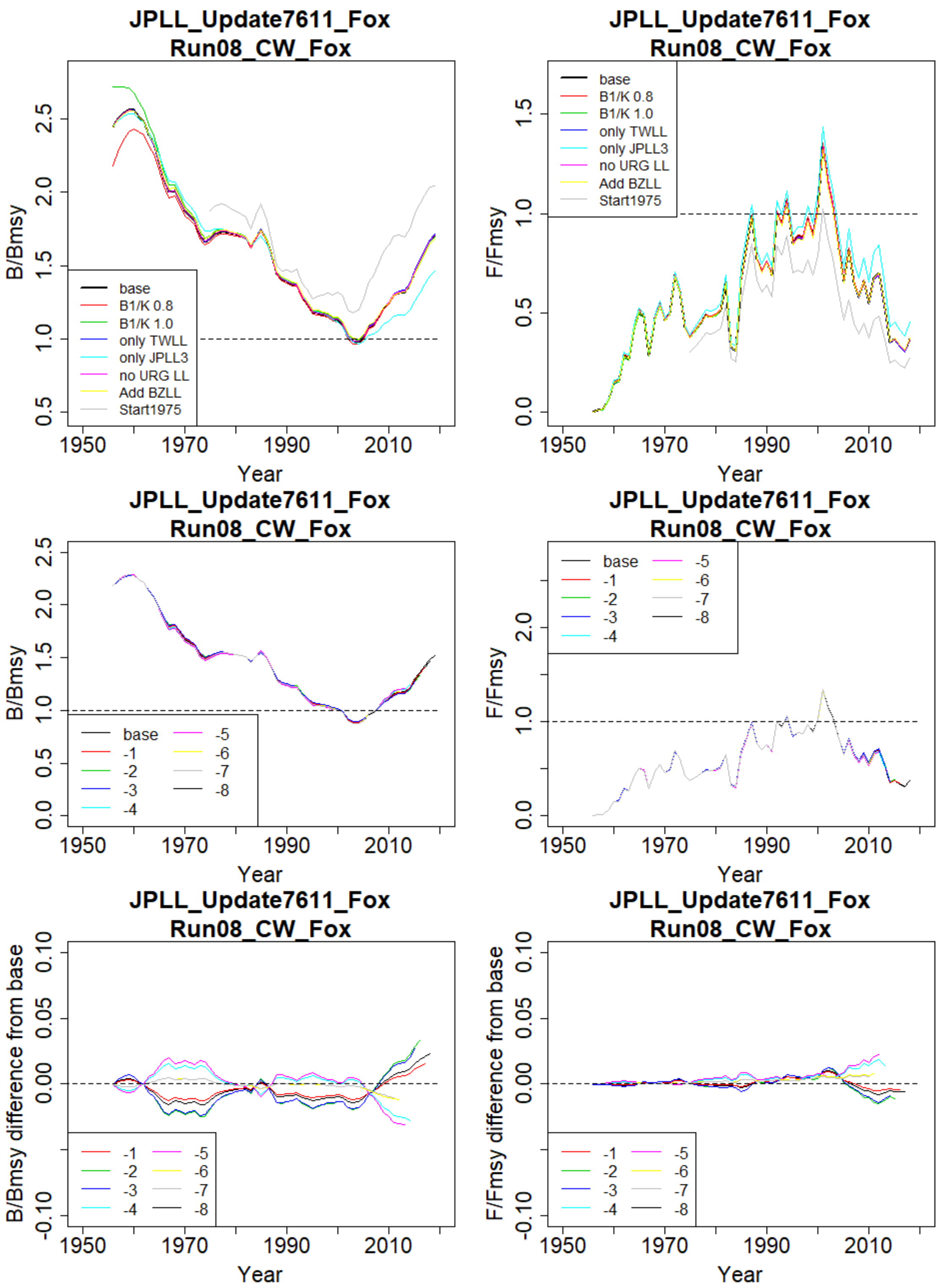


Figure 32. Results of sensitivity (top row, **Table 19**) and retrospective (middle row) analyses for ASPIC analysis (Run08_CW_Fox) for South Atlantic albacore. Bottom graphs show the difference between base case and retrospective analysis.

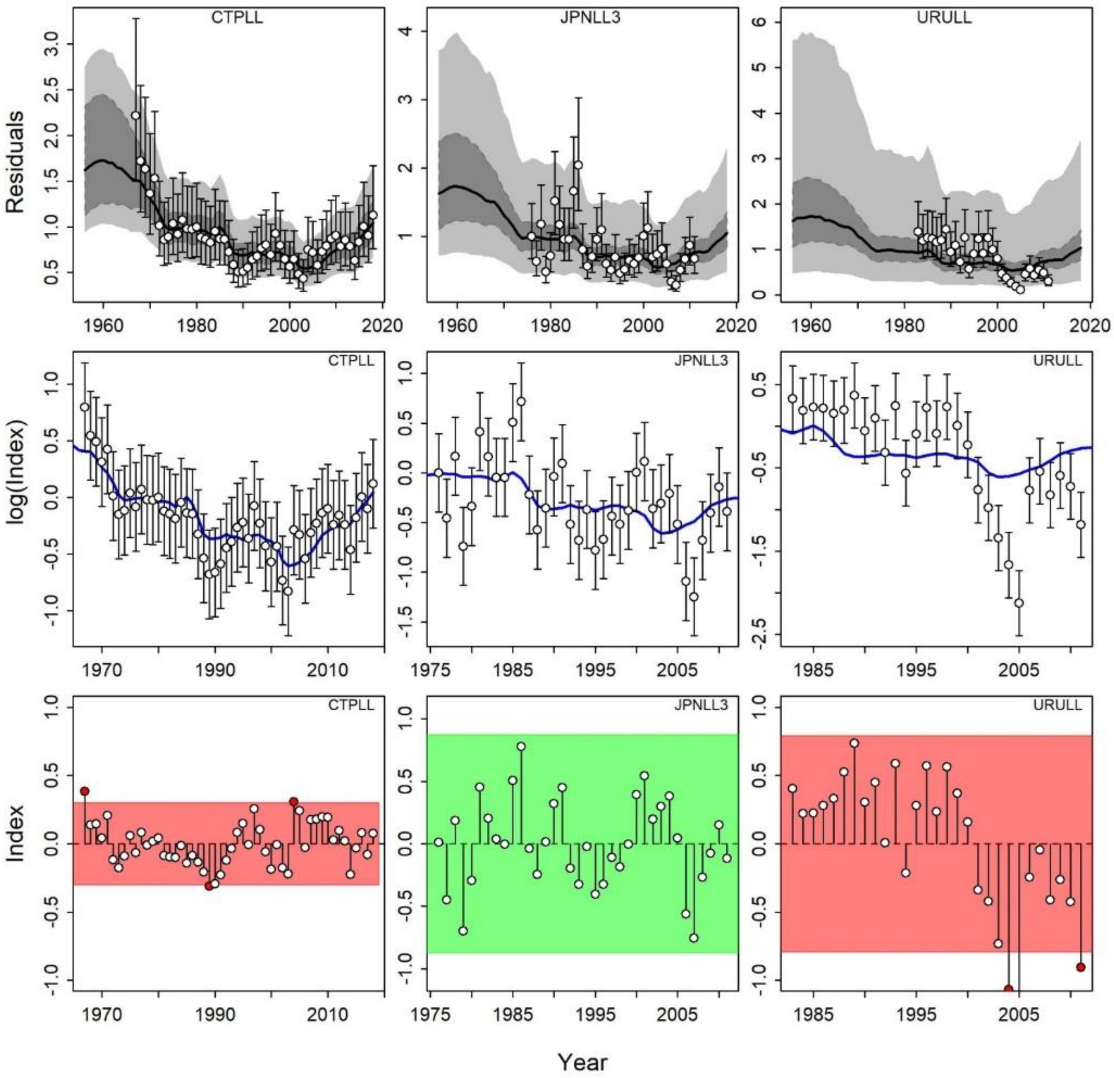


Figure 33. Results of the JABBA base case model for the South Atlantic albacore stock. Upper panels: Time-series of observed (circle) with error 95% CIs (error bars) and predicted (solid line) CPUEs. Middle panels: Time-series of log observed (circle) with error 95% CIs (error bars) and log predicted (blue line) CPUEs. Bottom panels: Runs tests to quantitatively evaluate the randomness of the time series of CPUE residuals by fleet. Green panels indicate no evidence of lack of randomness of time-series residuals (p>0.05) while red panels indicate the opposite. The inner shaded area shows three standard errors from the overall mean and red circles identify a specific year with residuals greater than this threshold value (3x sigma rule).

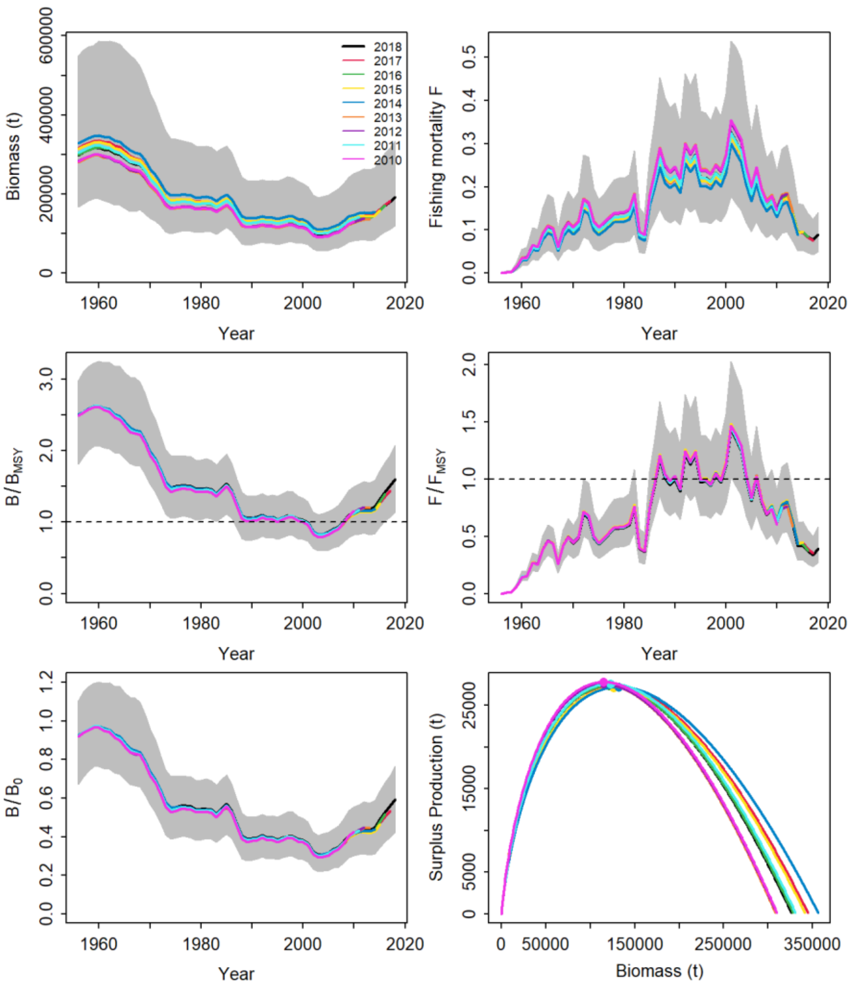


Figure 34 Results of the JABBA base case model for the South Atlantic albacore stock. First upper panels shows the retrospective analysis, by removing one year at a time sequentially (n=8) and predicting the trends in biomass and fishing mortality, biomass relative to B_{MSY} (B/B_{MSY}) and fishing mortality relative to F_{MSY} (F/F_{MSY}) and biomass relative to K (B/K) and surplus production curve.

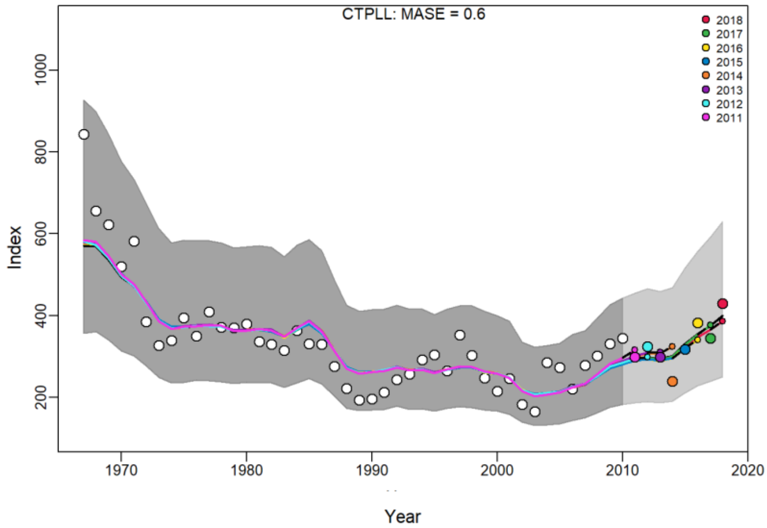


Figure 35. Results of the JABBA base case model for the South Atlantic albacore stock. Hindcasting cross-validation results (HCxval) performed with eight hindcast model runs relative to the expected CTP-LL CPUE. The CPUE observations, used for cross-validation, are highlighted as color-coded solid circles with associated light-grey shaded 95% confidence interval. The model reference year refers to the end points of each one-year-ahead forecast and the corresponding observation (i.e. year of peel + 1).

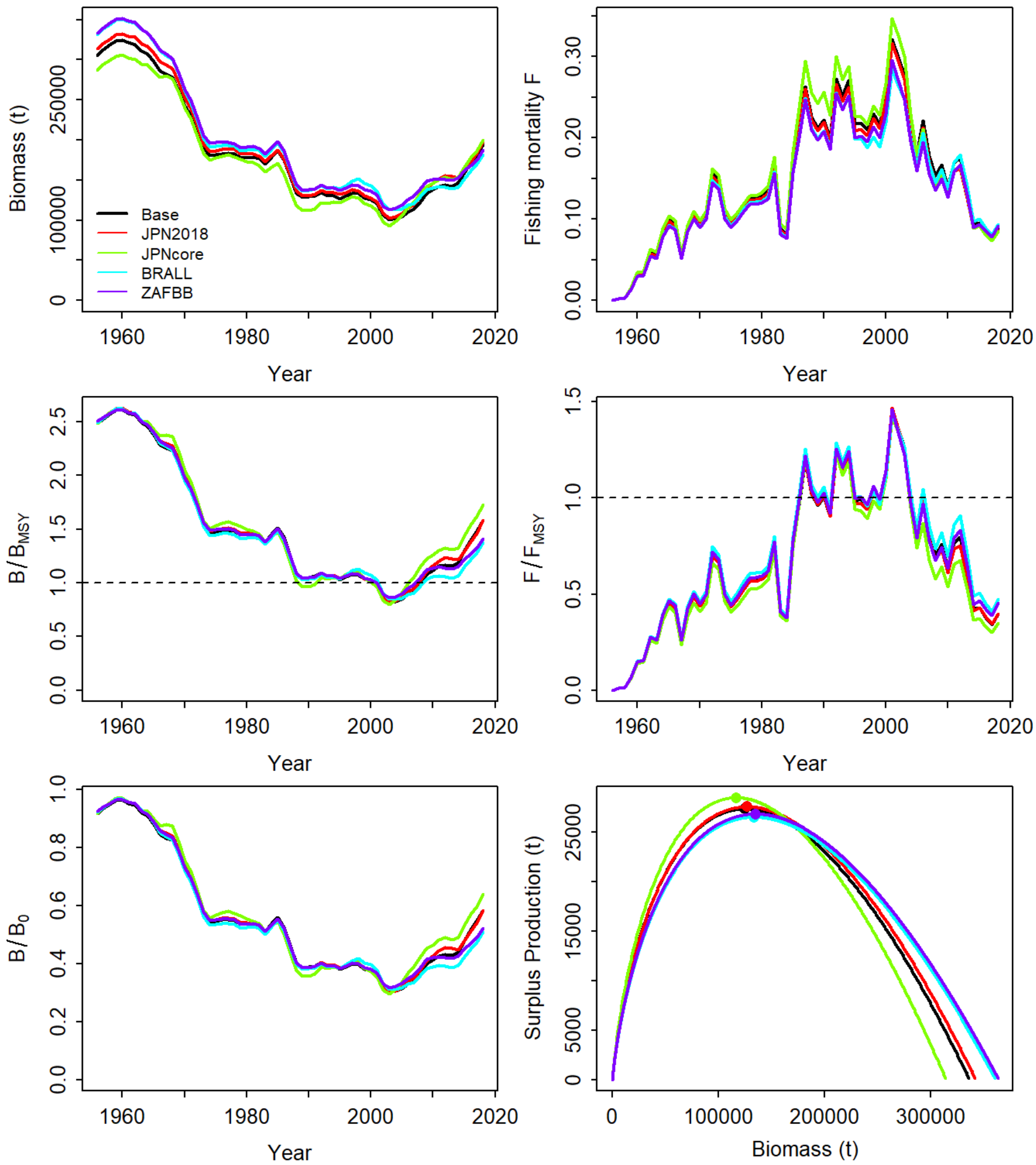


Figure 36. Sensitivity analysis performed to alternative sets of CPUE series for the JABBA assessment of South Atlantic albacore showing the trends in biomass and fishing mortality (upper panels), biomass relative to B_{MSY} (B/B_{MSY}) and fishing mortality relative to F_{MSY} (F/F_{MSY}) (middle panels) and biomass relative to K (B/K) and surplus production curve (bottom panels).

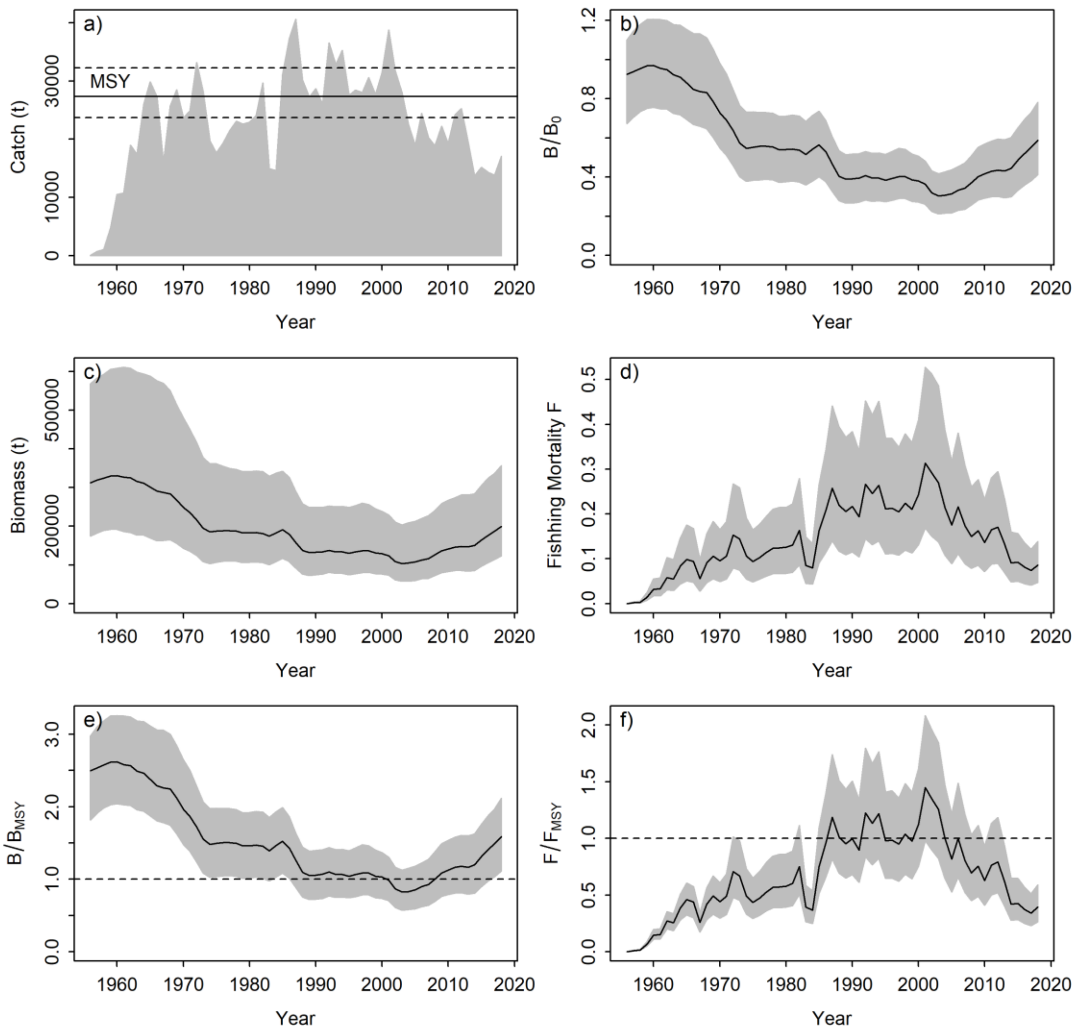


Figure 37. JABBA assessment base case model results for the South Atlantic albacore. (a) Catch time series depicting the *MSY* estimate with associated 95% credibility interval (dashed line); (b) biomass relative to *B0* (*B/B0*) (upper panels); (c) trends in biomass and (d) fishing mortality; (e) trends of biomass relative to *BMSY* (*B*/*BMSY*); and (f) fishing mortality relative to *FMSY* (*F/F*MSY).

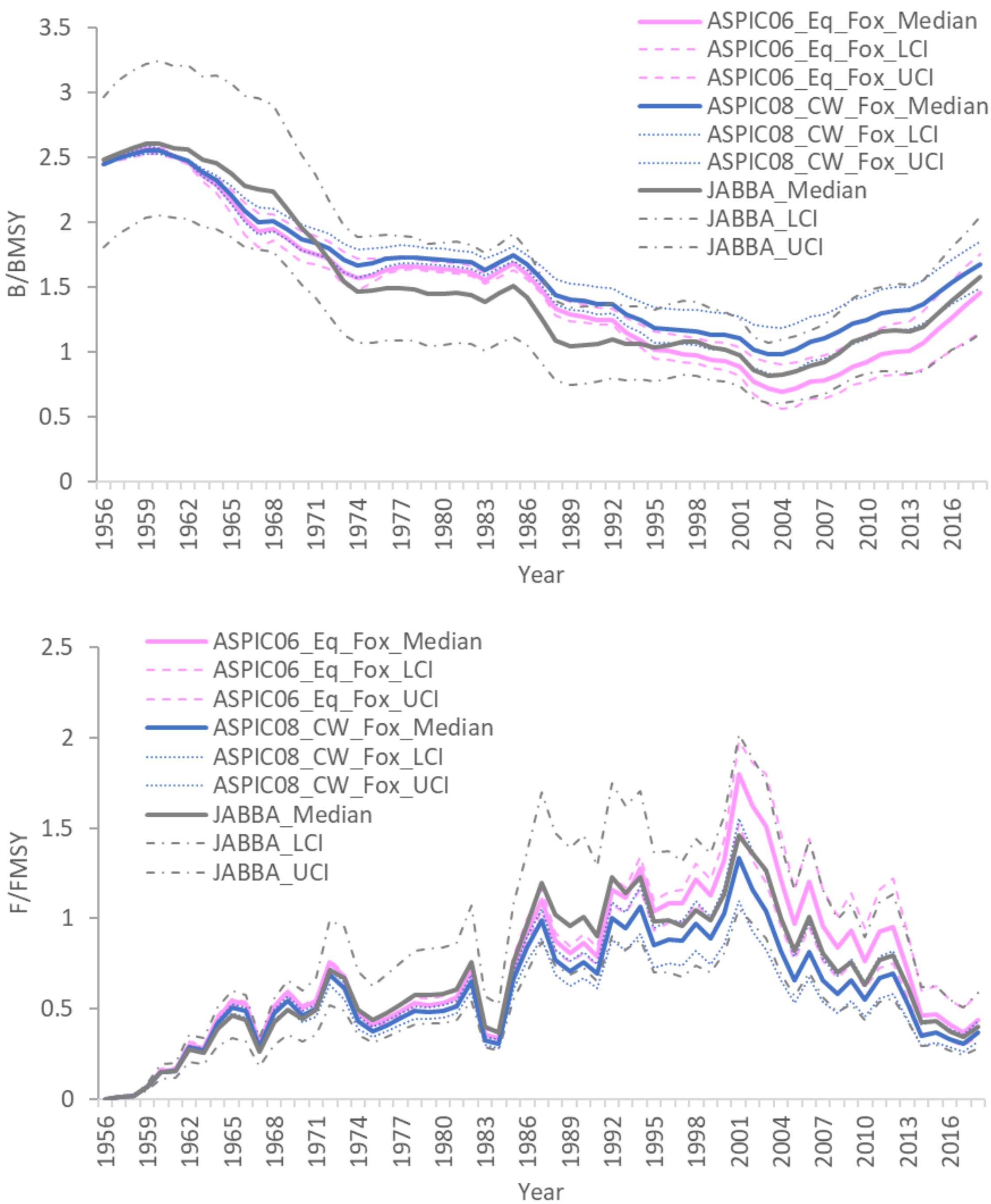


Figure 38. Comparisons of B/B_{MSY} and F/F_{MSY} between two ASPIC and one JABBA base cases.

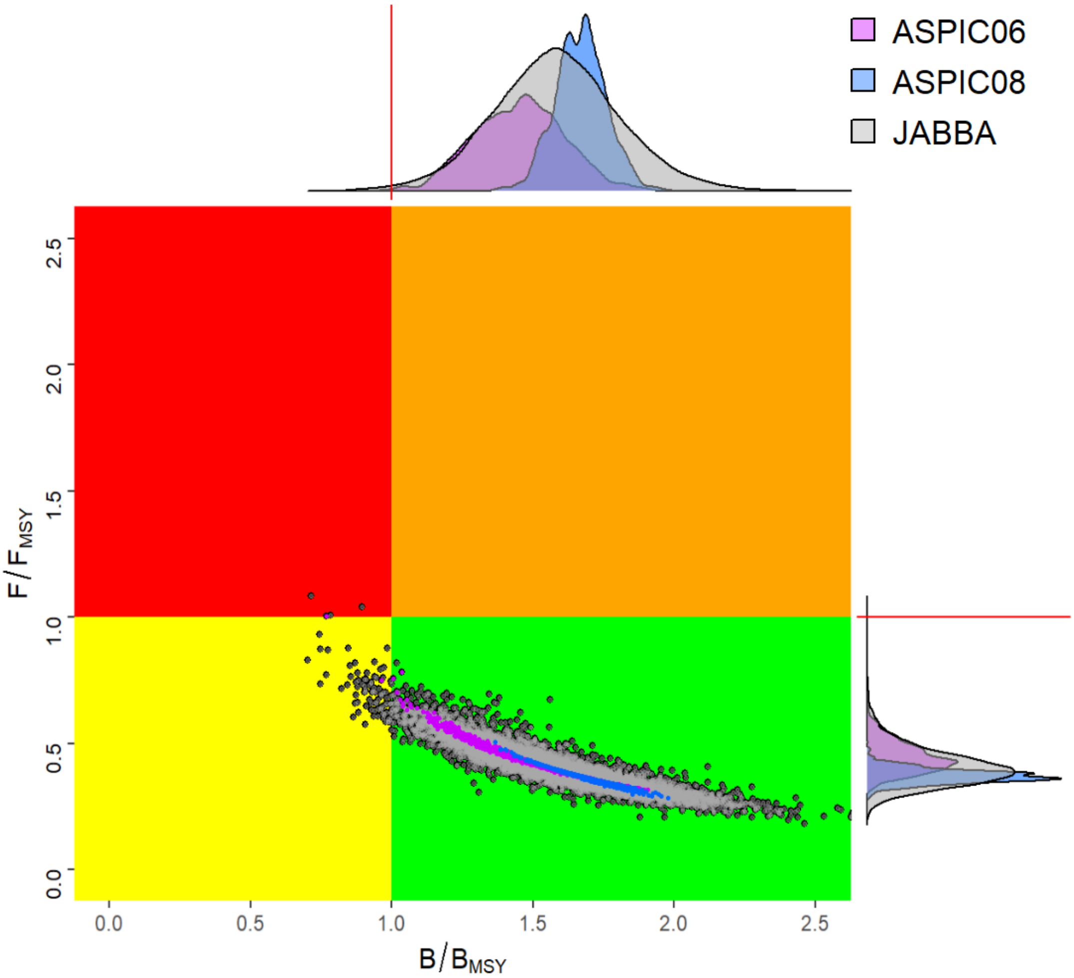


Figure 39. Comparisons of stock status (Kobe plot) between two ASPIC (25% weighting on each case) and one JABBA (50% weighting) base cases.

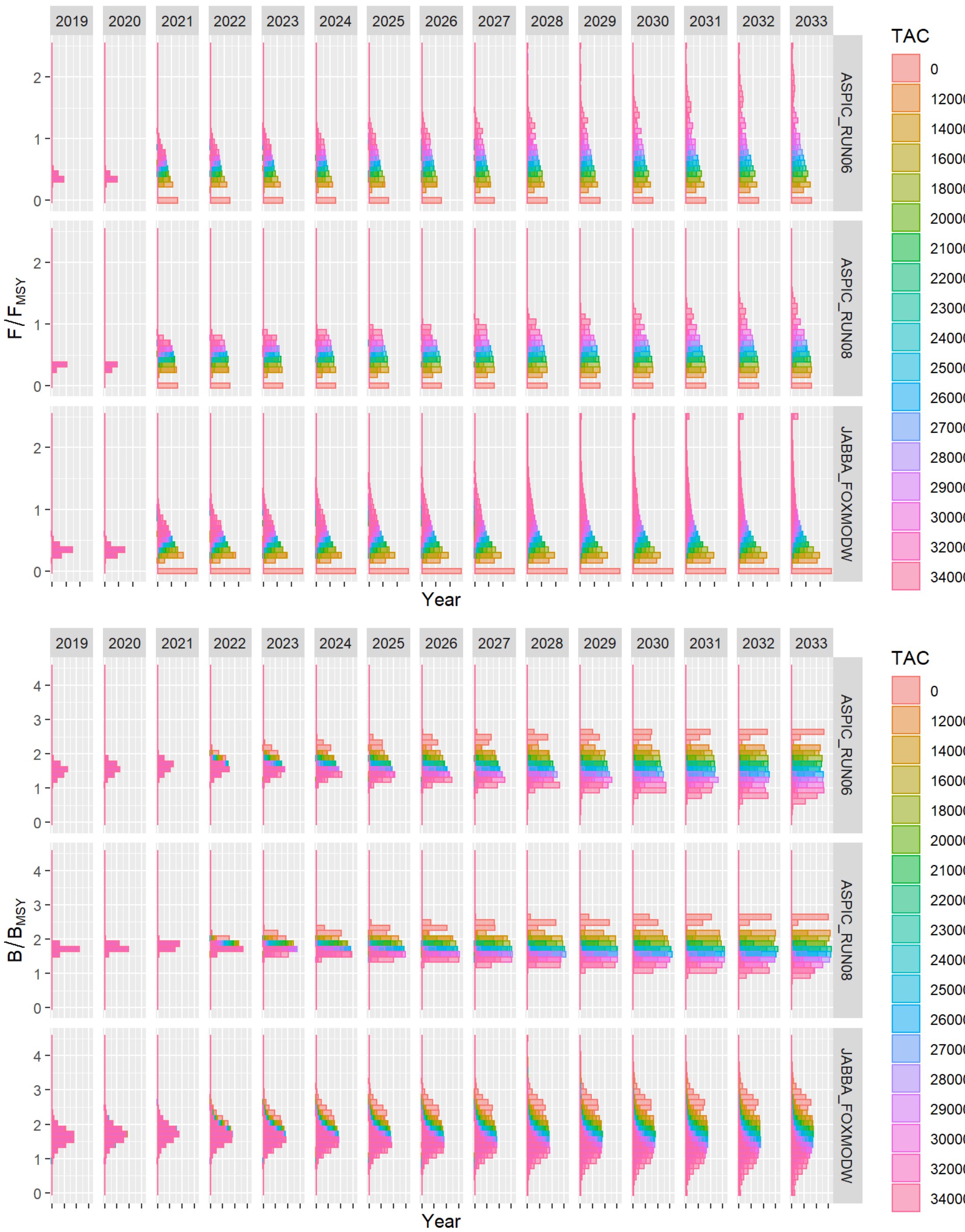


Figure 40. Posterior distribution of projected relative stock biomass (upper panel, B/B_{MSY}) and fishing mortality (bottom panel, F/F_{MSY}) of the South Atlantic albacore tuna stock under different total allowable catch (TAC) scenarios of 0 – 34,000 tons, based upon the projections of two ASPIC and JABBA base-case models.

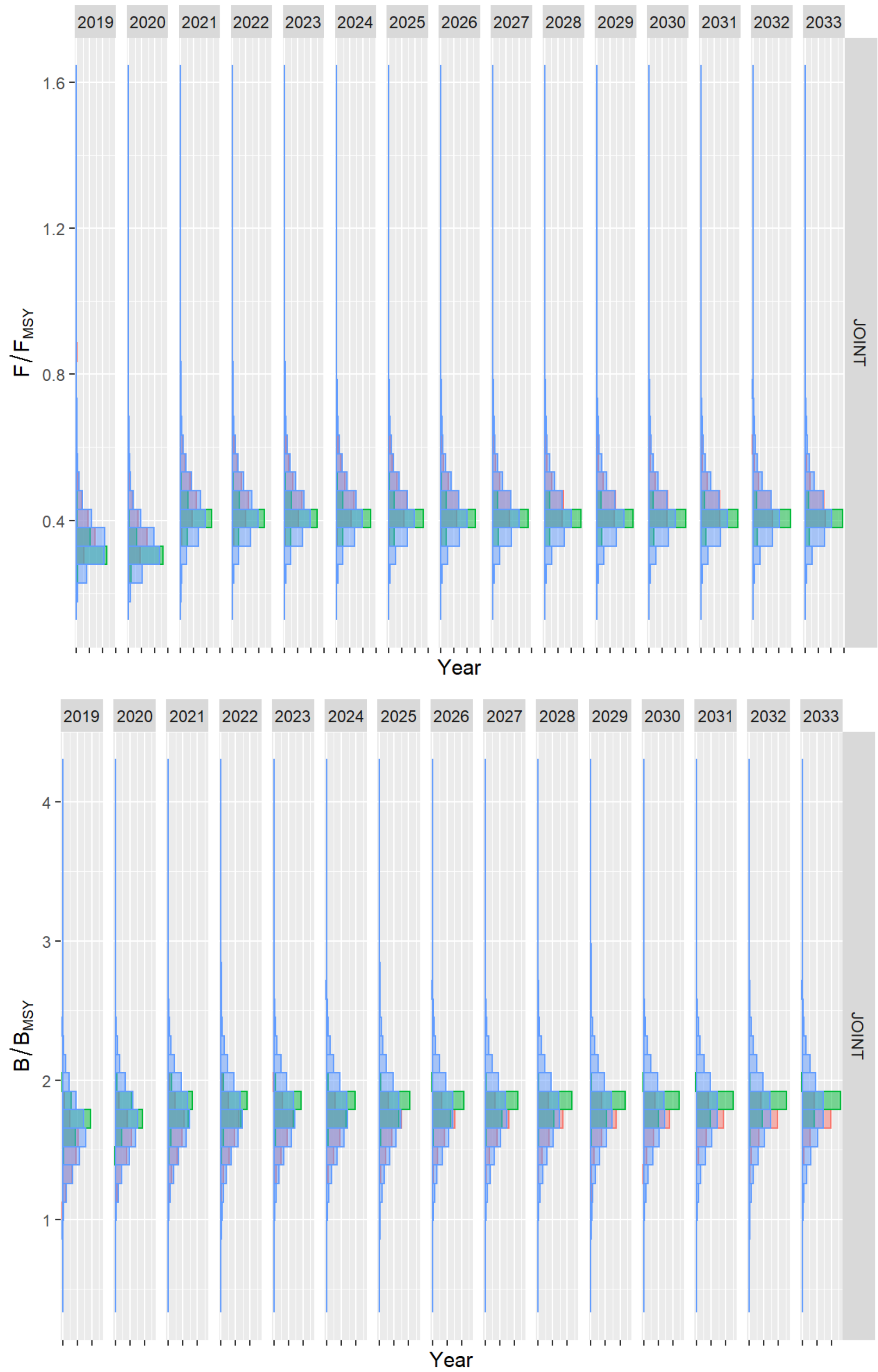


Figure 41. Posterior distribution of projected relative stock biomass (upper panel, B/B_{MSY}) and fishing mortality (bottom panel, F/F_{MSY}) of the South Atlantic albacore tuna stock under 20,000 t total allowable catch (TAC) scenario, based upon the projections of two ASPIC (pink: Run06_Eq_Fox, green: Run_08_CW_Fox) and JABBA (blue) base-case models.

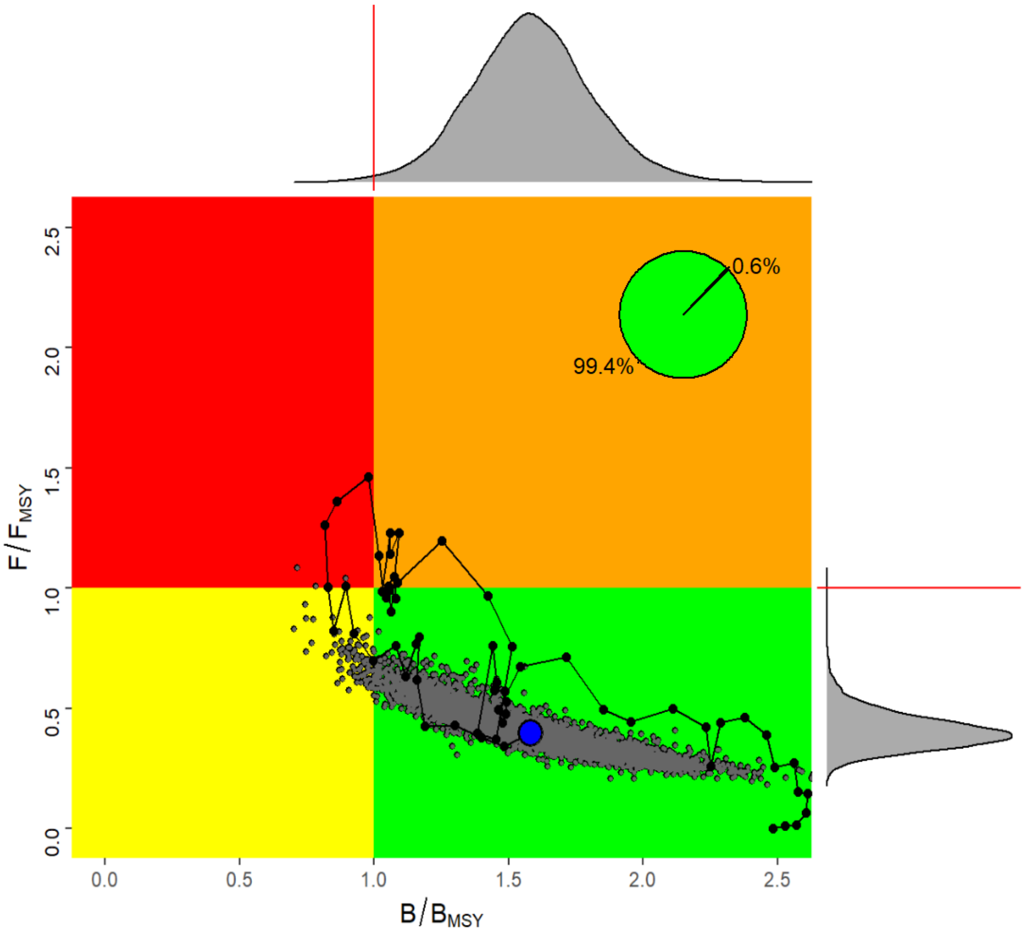


Figure 42. Kobe phase plot showing the combined posteriors of B_{2018}/B_{MSY} and F_{2018}/F_{MSY} presented in the form of joint MCMC posteriors of the JABBA base-case model ('Fox ModW') for the South Atlantic albacore tuna stock. The probability of posterior points falling within each quadrant is depicted in the pie chart.

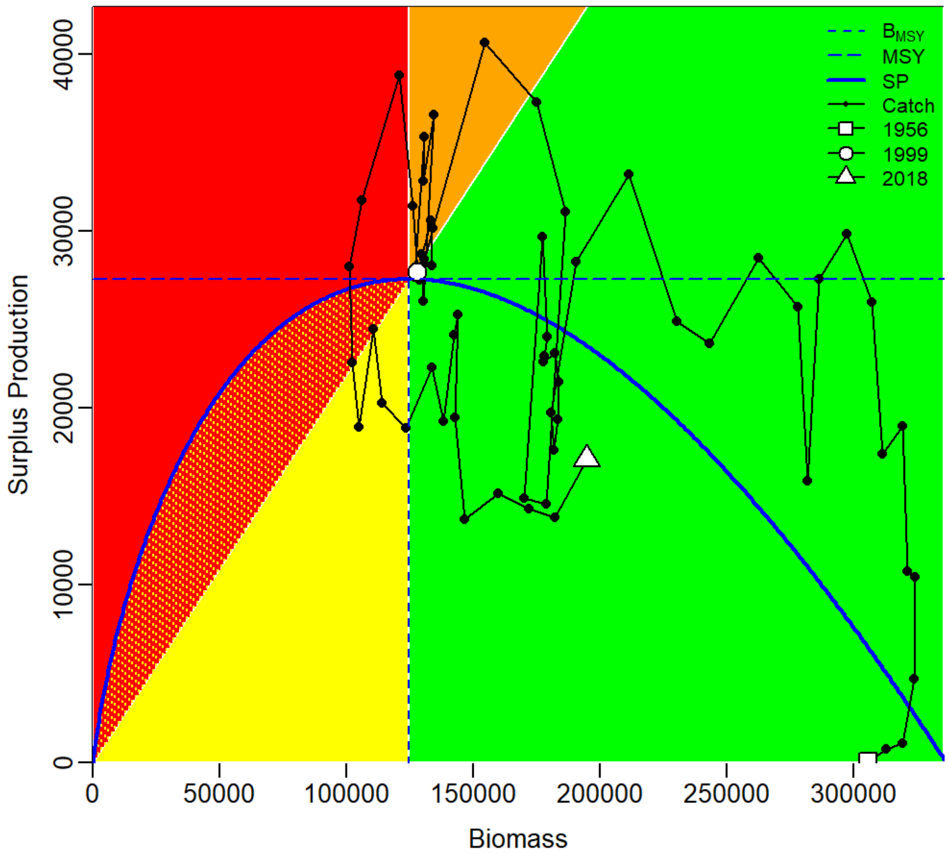


Figure 43. Surplus Production phase plot for South Atlantic albacore tuna stock showing the surplus production (SP) curve along with the catch trajectory (y-axis) over the biomass range between 0 and K (x-axis) based on the JABBA base-case model ('Fox ModW'). Conceptually, if current catch falls in the area below the SP curve, biomass is predicted to increase given that SP is larger than the Catch. The point where the SP curve attains a maximum is equivalent to MSY, which corresponds to B_{MSY} on the x-axis. The color-coded plot regions are consistent with Kobe phase plot quadrants to facilitate interpretation. Superimposed on this is the portion of the red region with yellow shading, where biomass can recover under a constant quota while still in the red overfished state ($B < B_{MSY}$, $F > F_{MSY}$), but catch is below SP. Conversably, a constant quota will lead to overfishing under a constant catch above MSY despite the stock currently being in the green 'sustainable' kobe quadrant ($F < F_{MSY}$, $B > B_{MSY}$, but MSY < Catch).

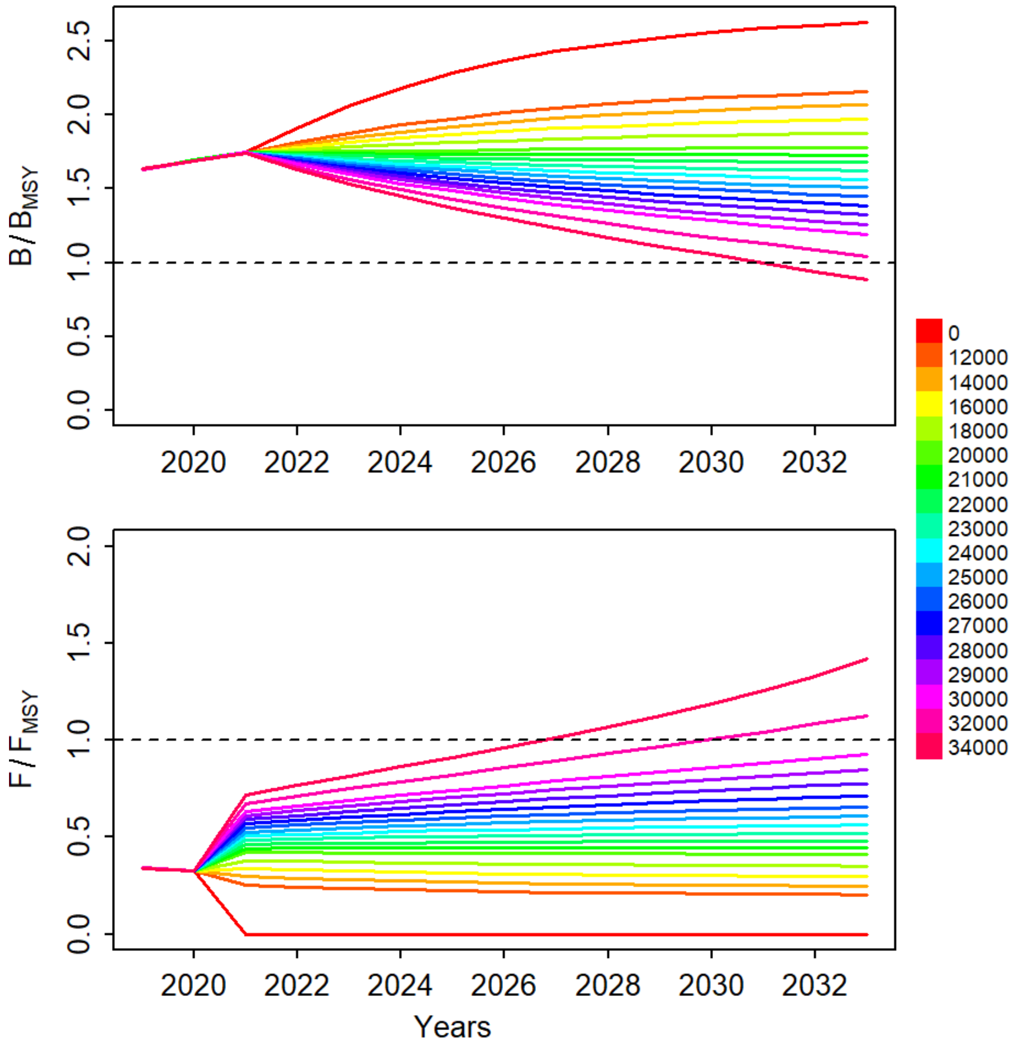


Figure 44. Trends of projected relative stock biomass (upper panel, B/B_{MSY}) and fishing mortality (bottom panel, F/F_{MSY}) of the South Atlantic albacore tuna stock under different total allowable catch (TAC) scenarios of 0 – 34,000 tons, based upon the projections of JABBA base-case model ('Fox MosW'). Each line represents the median of 15,000 MCMC iterations by projected year.

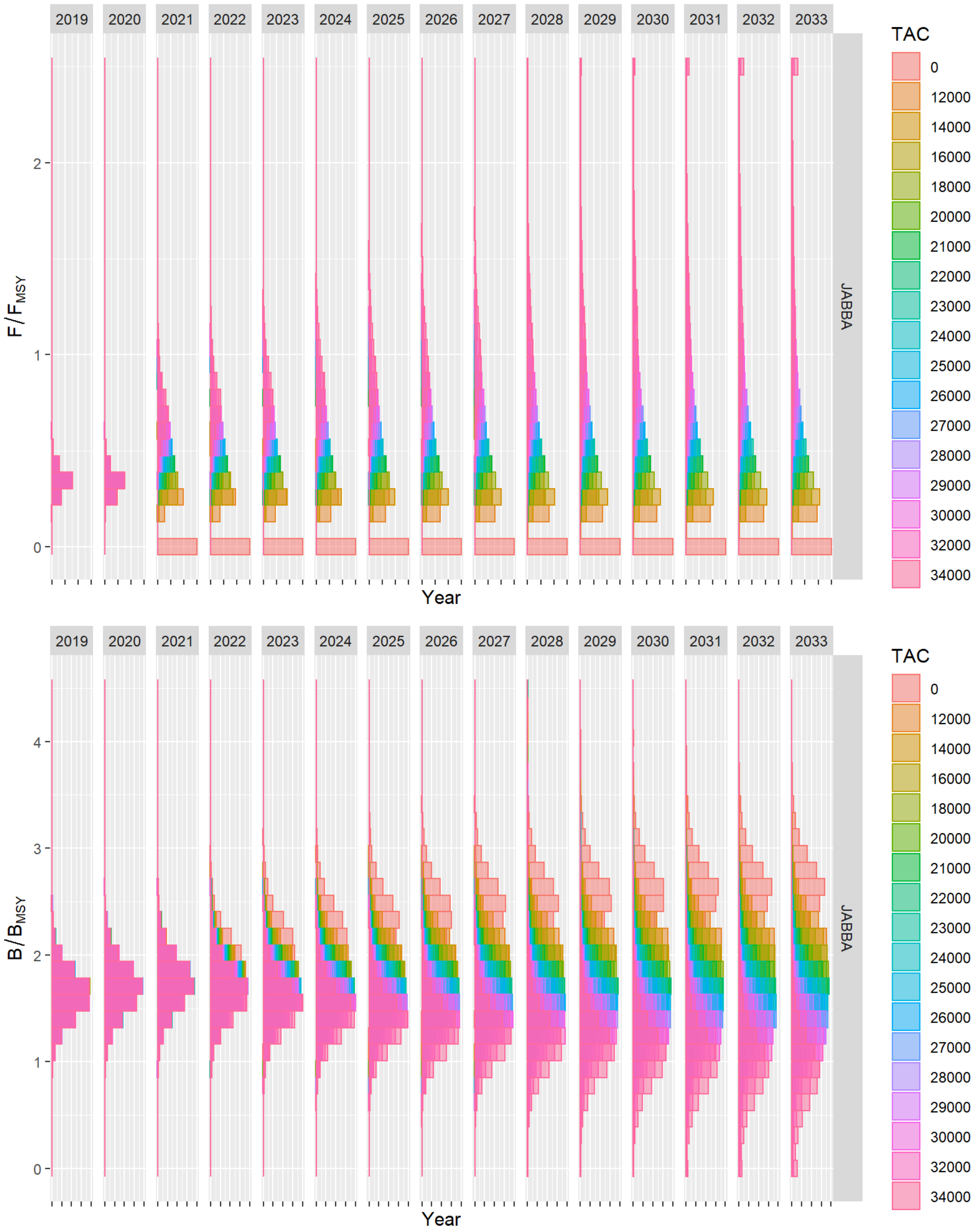


Figure 45. Posterior distribution of projected relative stock biomass (right panel, B/B_{MSY}) and fishing mortality (left panel, F/F_{MSY}) of the South Atlantic albacore tuna stock under different total allowable catch (TAC) scenarios of 0 – 34,000 tons, based upon the projections of JABBA base-case model ('Fox MosW'). Each line represents the median of 15,000 MCMC iterations by projected year.

Appendix 1

Tentative annotated Agenda
29 June - 8 July 2020 (working hours 12:00 - 16:30 CET)

DAY 1

1. Opening, adoption of the Agenda and meeting arrangements
2. Summary of available data for assessments
   2.1 Biology
   2.2 Catch, effort and size (North, South)
   2.3 Relative abundance indices
   2.3.1. North
   2.3.2. South
   2.3.3. Mediterranean

DAY 2 and **DAY 4**

3. North Atlantic albacore:
   3.1 Updated stock status
   3.2 Updated TAC advice
   3.3 Harvest Control rules and Management procedures
   3.4 Exceptional Circumstances:
      3.4.1 Evaluation
      3.4.2 Panel 2 advice
   3.5 New MSE roadmap and future work
   3.6 Summary of management recommendations

DAY 3 and DAY 5

4. South Atlantic albacore:
   4.1 Updated stock status
   4.2 Projections
      **JABBA and ASPIC projections*
   4.3 Summary of Management recommendations

DAY 6

5. Albacore research for north, south and Mediterranean stocks: current status and new proposals.
6. Recommendations on research and statistics
7. Other matters
- Executive Summary
  Workplan

DAY 7 and 8

8. Adoption of the report and closure
   First Revision of Report sections
   Adoption of the report

Appendix 2

List of Participants

Atlantic Albacore Stock Assessment meeting (Online, 29 June to 8 July 2020)

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Appendix 3

List of Papers and Presentations

Number	Title	Authors
SCRS/2020/009	Report of the Atlantic Albacore stock assessment meeting	Anonymous
SCRS/2020/059	Additions to the Italian annotated bibliography on albacore (*Thunnus alalunga*, Bonnaterre, 1788) and comprehensive overview	Di Natale A.
SCRS/2020/080	Standardized catch rates of albacore (*Thunnus alalunga* Bonnaterre, 1788) in the Spanish recreational fishery in the western Mediterranean in the period 2005-2018	Saber S., Macías D., García S., Meléndez M.J., Gómez-Vives M.J., Rioja P., Godoy D., Puerto M.A., and Ortiz de Urbina J.
SCRS/2020/081	Standardized catch rates of albacore (*Thunnus alalunga* Bonnaterre, 1788) in the Spanish surface longline fishery in the western Mediterranean in the period 2009-2017	García S., Saber S., Macías D., Gómez-Vives M.J., Rioja P., and Ortiz de Urbina J.
SCRS/2020/083	Albacore (*Thunnus alalunga*) Catch-per-unit-effort standardization: An update based on Brazilian longline fishery fleet data (1998-2018)	Sant'Ana R., Mourato B., Hazin F., and Travassos P.
SCRS/2020/085	Standardization of the catch per unit effort of albacore (*Thunnus alalunga*) for the South African tuna pole-line (baitboat) fleet for the time series 2003-2018	Parker D., Winker H., and Kerwath S.E.
SCRS/2020/086	Standardized indices of albacore, *Thunnus alalunga*, from the United Stated pelagic longline fishery	Lauretta M.
SCRS/2020/089	Updated standardized catch rates for northern albacore (*Thunnus alalunga*) from the Venezuelan pelagic longline fishery off the Caribbean Sea and adjacent areas of the Western Central Atlantic	Arocha F., Ortiz M., and Marcano J.H.
SCRS/2020/091	Review of operation and albacore catch by Japanese Longline Fishery including recent status in the Atlantic	Matsumoto T.
SCRS/2020/092	Standardization of CPUE for North Atlantic Albacore by the Japanese Longline Fishery from 1959 to 2018	Matsubara N., Aoki Y., Kiyofuji H., and Matsumoto T.
SCRS/2020/093	Updating of standardized CPUE for South Atlantic Albacore by the Japanese Longline Fishery	Matsumoto T., and Matsubara N.
SCRS/2020/094	Standardization of albacore CPUE for South Atlantic core area by the Japanese Longline Fishery	Matsumoto T.
SCRS/2020/095	Stock assessment for South Atlantic albacore using a non-equilibrium production model	Matsumoto T.
SCRS/2020/098	Standardized catch per unit of effort of albacore (*Thunnus alalunga*) from the Spanish bait boat fleet in North East Atlantic from 1981 to 2018	Ortiz de Zárate V., and Ortiz M.
SCRS/2020/101	CPUE standardization of albacore tuna (*Thunnus alalunga*) for the Chinese Taipei longline fishery in the South Atlantic Ocean.	Su N.J., Cheng C.Y, and Lin W. R.
SCRS/2020/102	CPUE standardization of albacore tuna (*Thunnus alalunga*) for the Chinese Taipei longline fishery in the North Atlantic Ocean.	Su N.J., and Liu K. M.
SCRS/2020/103	Assessment of North Atlantic Albacore (*Thunnus alalunga*) using a biomass dynamic model	Merino. G., Arrizabalaga H., and Santiago J.
SCRS/2020/104	Preliminary stock assessment of South Atlantic albacore tuna (*Thunnus alalunga*) using the Bayesian state-space surplus production model JABBA.	Winker H., Mourato B., Parker D., Sant'Ana R., Kimoto A., and Ortiz M.
SCRS/2020/106	Assessing the applicability of environmental indicators for improving the fisheries assessment of the albacore (*Thunnus alalunga*) under the A4A approach	Alvarez-Berastegui D., Ortiz de Urbina J., Saber S., and Tugores M.P.

SCRS/2020/107	Length composition of albacore tuna collected from the Chinese Taipei longline fishery in the North Atlantic Ocean.	Su N.J., Liu K.M, and Lin W.R
SCRS/2020/108	Mean sizes and catch-at-size patterns of albacore tuna based on size samples collected from the Chinese Taipei tuna longline fishery in the South Atlantic Ocean	Su N.J., Lin W.R., Sung Y.F, and Cheng C.Y.
SCRS/2020/109	North Atlantic albacore tuna reproductive biology study: Final Report	Arocha F.
SCRS/P/2020/041	Evaluation of exceptional circumstances in 2020	Merino G.
SCRS/P/2020/042	Updated North Atlantic albacore pop-up tagging in the Canary Islands.	Oñandia I., Lezama N., Arregui I., Ortiz de Zarate V., Delgado de Molina R., Santiago J., and Arrizabalaga H.
SCRS/P/2020/043	North Atlantic albacore: New MSE roadmap and future work	Fernandez C. and Merino G.
SCRS/P/2020/044	Length-length, length-weight and weight-weight relationships of albacore, thunnus alalunga, caught by longliners in the Southwestern Atlantic Ocean.	Forselledo R., Mas F., Ortiz M., and Domingo A.
SCRS/P/2020/045	Spanish albacore (*Thunnus alalunga*) baitboat fishery in Canary Islands.	Delgado de Molina R.
SCRS/P/2020/046	JABBA Base-Case Model Run for South Atlantic Albacore: Stock Status and Projections	Winker H., Mourato B., Parker D., Sant'Ana R., Kimoto A., and Ortiz M.
SCRS/P/2020/047	Comparisons of stock status and projections between ASPIC and JABBA for South Atlantic Albacore	Kimoto A., Winker H., Matsumoto T., Mourato B., Parker D., Sant'Ana R., and Ortiz M.

Appendix 4

SCRS Documents and Presentations Abstracts as provided by the authors

SCRS/2020/080. Catch and effort data from the Spanish recreational fishery in the Balearic Sea (Western Mediterranean) were analysed to estimate an index of relative abundance for albacore for the years 2005-2018. Standardized catch per unit effort (CPUE) in number were estimated through a General Linear Mixed Modeling (GLMM) approach under a negative binomial (NB) error distribution assumption. Nominal catch rates and a standardized abundance index are presented along with estimates of 95% confidence limits of the predicted means. These indices show an upward trend from the start of the series 2005 peaking in 2013; followed by a decrease until 2015. For the latest three-year period (2016-2018), the index shows a relatively stable trend fluctuating around a level two times lower than the maximum abundance recorded in the time series.

SCRS/2020/081. Standardized relative abundance indices of albacore (*Thunnus alalonga,* Bonnaterre, 1788) caught by the Spanish surface longline (LLALB) in the western Mediterranean Sea were estimated for the period 2009-2017. Yearly standardized CPUE were estimated through Generalized Linear Mixed Effects Models (GLMM) under a negative binomial error distribution assumption. The main factors in the standardization analysis were year and season (quarter). The index shows an increasing trend from the beginning of the series (2009) to a maximum in 2011; following a decrease up to 2013, and a relatively stable trend fluctuating around a level three and a half times lower compared to the maximum abundance for the period 2013-2017.

SCRS/2020/083. Catch and effort data done by the Brazilian tuna longline fleet, including both national and chartered vessels, in the equatorial and southwestern Atlantic Ocean, from 1998 to 2017, were analyzed. The effort was distributed in a wide area of the western Atlantic Ocean. The CPUE of the albacore tuna was standardized by a GLM using a Delta Lognormal approach. The standardization was implemented in a stratified way considering ICCAT albacore tuna regions as a proxy. A comparison using both regions integrated was also implemented. The factors used in the models were: year, quarter, vessels, clusters, hooks per floats, hooks and the lat-long reference for each 5 by 5 spatial squares. The estimated delta-lognormal indices showed, in general, a very similar trend between the fitted models with two periods, the first one between 1998 and 2010 was marked by a one-way down trend, while the second one, from 2011 to 2018, showed a more stable pattern.

SCRS/2020/085. Albacore, Thunnus alalunga, is the main target of the South African tuna pole-line (baitboat) fleet operating along the west and south west coast of South Africa. The South African catch is the second largest in the region with annual landings of around 4000 t. A standardization of the CPUE of the South African baitboat fleet for the time series 2003-2018 was carried out with a Generalized Additive Mixed-Model (GAMM) with a Tweedie distributed error. Explanatory variables in the final model included year, month, geographic position and targeting, which was included in form of clustered PCA loadings of the root-root transformed, normalized catch composition. Vessel was included as a random effect. Standardized CPUE and nominal CPUE are broadly comparable, and there is no obvious trend for the period 2003-2018. The analyses indicate that the CPUE for the South African baitboat fishery for albacore has been fluctuating, but there is no obvious trend over the last 15 years.

SCRS/2020/086. Catch and effort data from the United States pelagic longline fishery operating in the Atlantic Ocean were analyzed to estimate an index of albacore relative abundance. The standardized index was updated for the period 1987 to 2018, with no change in methods from the previous assessment. The updated time series and model diagnostics are presented.

SCRS/2020/089. A standardized index of relative abundance for northern albacore (Thunnus alalunga) was updated by the combination of two data sources; the ICCAT/EPBR sponsored Venezuelan Pelagic Longline Observer Program (1991-2011), and the National Observer Program (2012-2018). The index was estimated using Generalized Linear Mixed Models under a delta lognormal model approach due to the by-catch nature of T. alalunga in the Venezuelan pelagic longline fishery. The standardization analysis procedure included year, vessel, area, season, bait, and fishing depth as categorical variables. Diagnostic plots were used as indicators of overall model fitting.

SCRS/2020/091. Status of effort, albacore catch and CPUE was summarized for Japanese longline fishery operating in the Atlantic Ocean including recent trends. Japanese longline vessels targeted albacore around 1960s, albacore became non-target after that, but the proportion of albacore is increasing in recent years, and is one of the target species. Historical change in geographical distribution of fishing effort is observed. Albacore CPUE was high during the early period (until around 1970), sharply decreased around early 1970s, kept comparatively constant in a low level until early or mid-2000s, and increased after that especially in the south Atlantic. Basically there is increasing trend for the number of hooks per basket, although the trend differed among areas.

SCRS/2020/092. Standardized CPUE of north Atlantic albacore (Thunnus alalunga) caught by Japanese longline fishery was summarized in this document. Standardized CPUE was calculated based on same methods from the previous studies. Considering the availability of logbook database, CPUE were analyzed by three periods (1959-1969, 1969-1975, 1975-2018). Effects of year, quarter, subarea, fishing gear (number of hooks between floats) and some interaction were considered for analysis of CPUE. Recent trends (2015-2018) of updated north Atlantic albacore CPUE of Japanese longline were slightly lower than the average of last ten decade (2009-2018).

SCRS/2020/093. CPUEs of south Atlantic albacore (Thunnus alalunga) caught by Japanese longline fishery were separately standardized into three periods (1959-69, 1969-75 and 1975-2018) using negative binominal model, as with previous studies. Effects of quarter, area, fishing gear (number of hooks between floats) and several interactions were incorporated, although effect of gear can be used only from 1975. The effect of area was greatest for all three period. Standardized CPUE declined during the 1960s and early 1970s, after that the CPUE fluctuated and showed no clear trend.

SCRS/2020/094. Standardization of CPUE for south Atlantic albacore (*Thunnus alalunga*) caught by Japanese longline fishery during 1975-2018 was conducted using negative binominal model, based on revised methods from the previous study. Core area (main fishing ground for albacore) was selected and used. Effects of year, month, five degree latitude and longitude blocks and fishing gear (number of hooks between floats) were incorporated. The effect of five degree latitude and longitude blocks was greatest followed by the effect of month. Standardized CPUE showed large fluctuation during 1975-1987, kept in a low level during 1988-1999, and increased with fluctuation after that.

SCRS/2020/095. A Stock-Production Model Incorporating Covariates (ASPIC), a non-equilibrium surplus-production model, was attempted for the stock assessment for the southern Atlantic Ocean albacore, using the software package ASPIC ver. 5.34. Various cases exist with different index and/or period of Japanese longline CPUE. For each case, four models by different weighting and shape parameter, which were selected for final models at 2013 and 2016 assessment, were examined. Several models predicted that at some stage in the recent past, the southern Albacore stock had been overfishing and overfished. The fishing pressure appears to have eased in recent years, with a subsequent recovery in biomass. The scenarios with Japanese longline core area CPUE were more optimistic, but CPUE fit was worse. Based on the results of future projection, stock status will be in green zone with >60% probability if future catch is up to 28,000 to 30,000t (depends on the cases and scenarios).

SCRS/2020/098. Nominal catch of number of fish per unit of effort (CPUE´s) of the North Atlantic albacore (*Thunnus alalunga*) caught by the Spanish bait boat fleet in the North Eastern Atlantic were collected by trip for the period 1981-2018. Standardized index was estimated using Generalized Linear Random Effects Model (GLMM) with log-normal error distribution. The year*month interaction term and year*zone interaction term were included in the model as random effects to derive the annual standardized catch rates as relative index of abundance for 1981 - 2018.

SCRS/2020/101. Catch and effort data of albacore tuna (Thunnus alalunga) were standardized for the Chinese Taipei distant-water tuna longline fishery in the South Atlantic Ocean using a generalized linear model (GLM). Two periods of 1967-1995, and 1995-2018 (with the information on operation type, i.e., number of hooks per basket, HPB available from 1995) and a whole period from 1967 to 2018 were considered in the standardization of albacore CPUE (catch per unit effort) to address the issue of historical change in targeting in this fishery. Standardized CPUE of albacore developed by period showed almost identical trends to those derived from the model of entire period. Results were insensitive to the inclusion of gear configuration (HPB) in the model as an explanatory variable; however, we suggest the use of this index given the improvement of the model and the index for 1967-1994 as well. Abundance indices of South

Atlantic albacore started to decrease in the 1970s, but showed a relative peak in the late 1990s and then decreased. The trend remained increasing slightly from the early 2000s until recent years to 2018.
SCRS/2020/102. Catch and effort data of albacore tuna (*Thunnus alalunga*) were standardized for the Chinese Taipei distant-water tuna longline fishery in the North Atlantic Ocean using a generalized linear model (GLM). A whole period from 1981to 2018 was considered in the standardization of albacore CPUE (catch per unit effort), which potentially takes the issue of historical change in targeting in this fishery into account. Standardized CPUE of albacore developed by period showed almost identical trends to those derived from the model of entire period. We suggest the use of this index for 1981-2018 given the improvement of the model. In general, the standardized CPUE of albacore in the North Atlantic Ocean started to decrease slightly in the early 1980s, but showed a relative peak in 1997 and then decreased again. The trend remained increasing from the late 1990s until 2014, and then slightly decreased during recent 5 years from 2014 to 2018.

SCRS/2020/103. The status of North Atlantic albacore was estimated in 2016 as not overfished and not subject to overfishing. The latest stock assessment was carried out using a biomass dynamic model (Kell, 2016) and both the model and its configuration in 2016 were evaluated as an implicit Management Procedure using MSE in combination with candidate HCRs (Merino *et al*., 2017) to provide the scientific basis to adopt a HCR for this stock (ICCAT, 2017). Here, we provide a new stock assessment with the total catch and the same five indices used in 2016, updated until 2018. We provide two options for the assessment, one with the five indices used in the 2016 stock assessment updated until 2018 and the other excluding the values of the Japanese longline index for the years 2013 and 2014, as done in 2016. Overall, the results with both scenarios are consistent with the reference points and trends of the 2016 stock assessment, certify the recovery of the stock to levels well above the B_{MSY}, and suggest that the stock has been exploited at levels below the estimated MSY in the recent years. Also, both model configurations show similar residuals' patterns and relatively poor retrospective diagnostics, similarly to the 2016 stock assessment model. Should the SCRS endorse these results, the output of the stock assessment can be used to estimate catch limits for the period 2021-2023 for North Atlantic albacore.

SCRS/2020/104. Bayesian State-Space Surplus Production Models were fitted to South Atlantic albacore (*Thunnus alalunga*) catch and CPUE data using the 'JABBA' R package. In accordance with the 2019 SCRS work plan (update of the 2016 assessment), this document presents four preliminary scenarios that explore two production functions (Schaefer or Fox) as well as two CPUE data weighting scenarios (equal or model-internal weighting). Model diagnostics indicated reasonable fits to the data, no evidence of an undesirable retrospective pattern and a satisfying prediction skill to forecast into the future. Notable differences were the change in scale of absolute biomass between Schaefer and Fox models and a slightly more pessimistic stock depletion during in the late 1990s when applying equal CPUE weighting. The current stock status estimates were found to be insensitive model weighting and the production function, indicating a 98.4% - 100% probability that stock is not overfished nor subject to overfishing. The consistency in current status estimates and model diagnostic results provide a degree of confidence in the updated assessment of the stock status of South Atlantic albacore for scientific advice.

SCRS/2020/106. In this study we explore the potential for improving the stock assessment of the Mediterranean Albacore by integrating environmental indicators. For this purpose, we developed a catch at age model within the A4A stock assessment approach. The input data was similar to that used in the official SCRS stock assessment in 2017 but with an updated larval index. The environmental indicator provides information on the interannual variability of the sea surface temperature in the Balearic Sea during the spawning season, and it is included in the "Environmental pressure" component of the Ecosystem Report Card. The indicator is included in the assessment model in different ways, as index of the class age 0, as vector for the Stock/recruitment model, and as productivity value in other stock recruitment models (Ricker, Beverton-Holt). The results showed that incorporating the environmental variability indicators provide a better stock assessment fits (AIC, BIC), and also show the need for more advance techniques to test stock assessment performance when testing the inclusion of environmental variability.

SCRS/2020/107. The albacore tuna sampled and measured by the Chinese Taipei tuna longline fleet occurred mainly in the fishing ground between 15°N to 40°N in the North Atlantic Ocean. In total 16 Chinese Taipei tuna longline vessels were selected for analysis because of their targeting on albacore. During the 1980sand 1990s, the size of albacore caught in this fishery ranged from 80 to 120 cm FL with median values around 100 cm in fork length (FL). After 2000, size samples collected from these vessels centered around 90-110 cm FL. The sizes of albacore caught seemed to increase during 2000s for two vessels. However, for the other vessel that targets on albacore, the sizes of albacore catch increased to around 110 cm FL from 2008 and remained relatively stable during the next 10 years to 2017 except for 2014.

SCRS/2020/108. The size data in fork length (FL) of albacore tuna were collected from the Chinese Taipei tuna longline fleet in the South Atlantic Ocean, with annual sizes increased to more than 100,000 from 2004 until 2019. Most of size samples were collected from temperate waters of the south-eastern Atlantic Ocean. Based on the catch-at-size (size samples) distribution of albacore tuna for the Chinese Taipei tuna longline fishery, five fishing areas were considered for analyzing the annual variation in mean size by spatial structure. In general, the mean sizes of albacore tuna seem to be stable relatively from 1981 to 2019, with small amount of annual variation in the mean size. Albacore tuna in small size (<100 cm FL) were collected in the south part of the South Atlantic Ocean (SW and SE areas). In contrast, the albacore tuna measured in other areas of the fishing grounds (NW, CW and NE areas) were slightly large than 100 cm FL.

SCRS/2020/109. The fishing area of operations of the Venezuelan LL fleet is within the northern albacore (ALB) spawning grounds, and no sampling for reproductive studies has ever been undertaken in the area. A short-term contract was awarded by ICCAT to collect biological samples and conduct analyses in order to improve the knowledge about ALB spawning grounds (area and season), maturity at age, and fecundity in the Guyanas-Amazon (GUY-AMZ) area and the southeastern Caribbean Sea. The results presented in this document correspond to the findings to date. These include: A) The logistics of data collection and sampling of ALB reproductive organs, B) The sampling and analyses of the ALB reproductive organs, and C) The analyses of the data and reproductive characteristics of ALB to define the state of reproduction of ALB during the sampling period in the study area.

The logistics for ALB sampling included port sampling activities and at-sea sampling conducted by scientific observers on board Venezuelan LL during regular fishing operations. Port sampling activities were conducted by an experienced port sampler (former scientific observer) on a monthly basis, starting mid-June and ending in October. Reproductive organs of all ALB were extracted to identify sex, and the sex organs collected for laboratory analyses. Reproductive samples were saved in plastic bags and stored frozen for later analyses at the laboratory. The number of ALB port samples collected for the study was 607 individuals, of the estimated 500; however, due to the by-catch nature of the species sampled and the spacing of the landing sites, the monthly collection resulted in an unbalanced monthly sampling. The at-sea sampling resulted in 138 days at-sea, 66 LL sets observed, and the total number of samples collected at-sea through November totaled 75 ALB specimens.

All samples were stored frozen until their arrival to the laboratory for further processing and analyses, with the exception of 8 samples preserved in biopsy vials on board during the last observer trip. At the laboratory, the samples were thawed, catalogued, sex identification confirmed, complete gonads were re-weighted (±0.1 g), and macroscopic maturity staging was initiated. Maturity phases were based on the developmental stage of fresh whole oocytes and the size frequency distributions of fresh whole oocyte diameters. Each ovary was staged according to the macroscopic and microscopic characteristics and the most advanced group of oocytes (MAGO). The gonadosomatic index (GSI) and the hepatosomatic index (HSI) were estimated for all females with complete gonads. Sex ratio was evaluated with Chi2 test for 5cm intervals of size, and differences among sizes (FL) with ANOVA.

Female ALB ranged in size from 88 to 116 cm FL, and males from 84 to 116 cm FL. The prevailing ALB size class (FL) from port sampling and at-sea sampling was 100-104 cm. There were significant differences in size between sex, and months ($F=70.62$, $p<0.005$; $F=10.05$, $p<0.005$). Spatially, most of the samples were collected in the Guyanas-Amazon area, with some samples in the southeastern Caribbean Sea. The proportion of males was significantly lower than females (Chi2=64.45; $p<0.05$), with 56.6% females and 43.4 % males. Spatially, the proportion was different according to the area; in most of the Atlantic quadrants males prevailed; while in the Caribbean Sea was a mixture. The size frequency distributions of fresh whole oocyte diameter for females included all stages of oocyte development except for the spawning stage. From July through November, an important number of ALB females were in Spawning Capable stages, but none of them were in spawning condition (Spawning Capable 2 stage). During the study period, the GSI showed a decreasing trend from July through November, and similar to the GSI, the HSI highest value was observed in July. Although both indices may be reflecting the reproductive behavior of the species in the area sampled during the period of sampling activity, it is still too early to provide any conclusion on what these trends mean.

Two recommendations were provided, one suggests the need to complete the current sampling and study through August 2019, and the other suggest that funds need to be increased if the sampling were to continue in order to obtain a balanced sample size. The recommendations are needed in order to have a better understanding of reproductive characteristics and biology of northern albacore in the sampling area of the present study, which would require the completion of full annual cycle with a complete and adequate sample size

SCRS/P/2020/044. This study reports length-length, length-weight, and weight-weight relationships for albacore (Thunnus alalunga) caught in the Southwestern Atlantic Ocean. Data used was gathered by the Uruguay National Observer Program on board the Uruguayan pelagic longline fleet between 1998 and 2012, on board Japanese longline fishing vessels operating in Uruguayan jurisdictional waters in the period 2009-2011 and 2013, and on-board Uruguay´s R/V during 2009-2019. Size and weight measurements considered were curved fork (CFL) and pre-dorsal (PDL) length, and Round (RW) and Dressed weight (DW), respectively. Conversion factors for CFL – PDL (n=75,103), RW – CFL (n=5,001), and RW - DW (n=158) are presented for sexes combined for each case, and also for each sex separately for the case of CFL – PDL. Relationships were fitted using linear and nonlinear regression models, applying robust methods to reduce the influence of possible outliers. Also, split linear regression methods were used for the CFL – PDL. The relationships provided in this contribution covers most of the reported full-size spectrum of the species and were compared with others adopted by ICCAT. Authors mentioned that for onboard sampling, CFL is easier to measure with minimal error than straight fork length (SFL), especially for larger individuals. However, it is recognized the need of a conversion factor from CFL to SFL.

SCRS/P/2020/046. The additional JABBA model (base case) and its sensitivity runs were provided during the meeting, using Chinese Taipei longline index in weight. The base case model showed very similar results to the preliminary run. The results showed that stock status in 2018 for the South Atlantic albacore is not overfished and no longer suffering overfishing. The inclusion of BRA-LL and ZAF-BB CPUE time series resulted in a slightly more pessimistic stock status, but consistent with the MSY estimate of the JABBA base case model.

SCRS/P/2020/047. The presentation provides the comparisons of stock status and projections between ASPIC and JABBA for South Atlantic Albacore. The uncertainty estimates about the current stock status and projections from both models clearly show that the bootstrap samples of B/BMSY and F/FMSY from the two ASPIC model runs fell entirely within the JABBA marginal posterior distribution. The comparison graphs showed JABBA and ASPIC results were consistent and similar in terms of central tendency, but that JABBA enables to capture more of the uncertainty by accounting for both observation and process error.

Appendix 4

Albacore Work Plan

The Mediterranean, Southern and Northern albacore stocks were assessed in 2017, 2020 and 2020, respectively. Between 2018 and 2020 advice was provided for the adoption of a long-term Management Procedure for North Atlantic albacore.

In 2021, the Albacore Species Group plans to assess the Mediterranean stock and prioritize future research activities for this stock. As for the Northern stock, the Group will start preparing data for a future Stock Synthesis reference case and will evaluate exceptional circumstances. The Group will also continue the research activities for the Atlantic stocks. One intersessional meeting is envisaged (6 days in late June or early July) for both the Mediterranean and Northern stocks.

North Atlantic Stock Proposed Work Plan

a) Exceptional Circumstances:

- Prepare T1 dataset including 2019. Responsibility: Secretariat. Deadline: one month before the meeting.

- Update (till 2019) the following yearly standardized CPUEs, in weight (if possible). Deadline: one month before the meeting. Deliverable: SCRS documents, following the standards provided by the WGSAM. Responsibility: CPCs.

    - Japanese longline
    - Chinese-Taipei longline
    - US longline
    - Venezuela longline
    - Spanish baitboat
    -

- Determine whether exceptional circumstances occur, according to the indicators developed. Responsibility: EU-Spain. Deadline: one week before the Intersessional meeting. Deliverable: SCRS document.

b) Stock Synthesis reference case:

- A webinar meeting will be held by a subgroup to consider options for the structure of the model (building upon earlier models), including main relevant aspects of the stock and fleet dynamics, and the available data. Likely issues to be discussed at the webinar meeting include: time step (whether annual or quarterly), spatial structure (whether one or more regions), fleet structure, data available (catch, effort, size composition, age composition, tagging and other data that could be available).

Possible date for the webinar meeting: between November 2020 and February 2021.

- Update (till 2019) the following quarterly and yearly standardized CPUEs. Deadline: one month before the meeting. Deliverable: SCRS documents, following the standards provided by the WGSAM. Responsibility: CPCs.

    - Japanese longline (whole period)
    - Chinese-Taipei longline (whole period)
    - US longline
    - Venezuela longline
    - Spanish baitboat
    - Spanish troll
    - Irish mid-water trawl
    - French mid-water trawl

- Following from the indications of the webinar meeting, the Secretariat will prepare catch, effort, size, age and tagging data available, to be screened during the intersessional ALB meeting. The intersessional meeting will examine the data and evaluate their ability to inform on stock and fishery dynamics. No SS work will be presented in this meeting, which will be solely focus on data examination. The meeting will identify main hypotheses to be considered in the subsequent work.

- After the intersessional meeting, first attempts by the subgroup to fit SS models to the data. Model structure could be reconsidered based on the findings on the intersessional meeting and the results from the initial SS runs. The subgroup will work by correspondence, including webinar meetings, as needed.

c) Research:

The Group reiterates the need for a comprehensive Albacore Research Programme (see **Addendum 1** to albacore work plan). For 2021, it is prioritized to complete the reproductive biology and the electronic tagging studies, and to start working on a Stock Synthesis model as part of the MSE activities. Deadline: one week before the Species Group meeting. Deliverable: SCRS documents. Responsibility: V. Ortiz de Zarate (reproductive study) and H. Arrizabalaga (e-tagging study).

South Atlantic Stock Proposed Work Plan

The Group stressed the need to start incorporating research activities for this stock on the Albacore Research Programme (see **Addendum 2** to albacore work plan). Consistent with the north Atlantic albacore workplan, it is prioritized to start activities on reproductive biology and electronic tagging. Deadline: one week before the Species Group meeting. Deliverable: SCRS documents. Responsibility: Brazil / South Africa.

Mediterranean Albacore Stock Proposed Work Plan

An intersessional assessment meeting should be held. This meeting is high priority and all CPCs involved in Mediterranean albacore fisheries need to be involved. The meeting should cover the following topics:

– Review of available data with emphasis in historical series.

– Updated standardized CPUE indices for the most important fisheries. All data needs to be ready at least one month before the meeting, to allow for bringing a preliminary assessment ready by the start of the meeting.

– Updated information on species biology

– Identification of appropriate stock assessment approaches, including data poor methods, to increase confidence in the Jabba assessment.

– Exploration of the potential of using alternative indicators and reference points (Lopt, measures based on reproductive potential, etc.).

– Identifying research priorities (with a view to incorporate these in the ICCAT Albacore Research Program).

Addendum 1 to the Albacore Work Plan

North Atlantic Albacore tuna Research Programme

The Albacore Species Group proposes to pursue a coordinated, comprehensive four-year research programme on North Atlantic albacore to advance knowledge of this stock and be able to provide more accurate scientific advice to the Commission. This plan is based on the plan presented in 2010, which was based on document by Ortiz de Zárate (2011) that has been revised according to new knowledge, reconsidering the new priorities and reducing the total cost.

The research plan will be focused on three main research areas: biology and ecology, monitoring stock status and management strategy evaluation, during a four-year period (2021-2024).

Biology and Ecology

The estimation of comprehensive biological parameters is considered a priority as part of the process of evaluating northern albacore stock capacity for rebounding from limit reference points. Additional biological knowledge would help to establish priors for the intrinsic rate of increase of the population as well as the steepness of the stock recruitment relationship, which would facilitate the assessment. Among the key biological parameters are ones related to the reproductive capacity of the northern albacore stock, which include sex-specific maturity schedules (L50) and egg production (size/age related fecundity). In order to estimate comprehensive biological parameters related to the reproductive capacity of the northern albacore stock, an enhanced collection of sex-specific gonad samples need to be implemented throughout the fishing area where known and potential spawning areas have been generally identified. The collection of samples needs to be pursued by national scientists from those fleets known to fish in the identified areas and willing to collaborate in the collection of samples for the analysis. Potential CPCs that could collaborate with the sampling program may include (but not limited to): Chinese-Taipei, Japan, the USA and Venezuela. Expected results will include a comprehensive definition of sex-specific maturity development for albacore, spatial and temporal spawning grounds for northern albacore, estimate of L50 and size/age related fecundity.

The Group also recommended further studies on the effect of environmental variables on CPUE trends of surface fisheries. The understanding of the relationship between albacore horizontal and vertical distribution with the environment will help disentangle abundance signals from anomalies in the availability of albacore to surface fleets in the North East Atlantic.

It is also proposed to conduct an electronic tagging experiment to investigate the spatial and vertical distribution of albacore throughout the year. Given the typically high cost of these experiments, and the difficulties to tag albacore with electronic tags, it is proposed to deploy 50 small size pop up tags in different parts of the Atlantic where albacore is available to surface fisheries (to guarantee good condition and improve survival), namely the Sargasso Sea and off Guyanas, off USA/Canada, Azores-Madeira-Canarias, and the Northeast Atlantic. Internal archival tags will also be considered for multiyear tracks.

Finally, the existence of potential subpopulations in the North Atlantic has been largely discussed in the literature. While recent genetic studies suggest genetic homogeneity (Laconcha *et al.* 2015), otolith chemistry analyses (Fraile *et al.* 2016) suggested the potential existence of different contingents, which could also have important management implications. Thus, in order to clarify the existence of potential contingents, the Group propose to expand the studied area in Fraile *et al.* (2016) to the entire North Atlantic, as well as to address inter-annual variability through multiyear sampling and analysis of otolith chemistry.

Monitoring of stock status

The Group recommended the joint analysis of operational catch and effort data from multiple fleets be undertaken, following the example of other SCRS Species Groups. This would provide a more consistent view of population trends, compared to partial views offered by different fleets operating in different areas. The analysis is suggested for both longline fleets operating in the central and western Atlantic, and surface fleets operating in the northeast Atlantic. However, this task has lower priority since the iteration of the Management Procedure requests using individual indices.

Finally, given the limitations of the available fishery dependent indicators, the Group mentioned the need to investigate fishery independent abundance indices. Although the Group is aware that, in the case of albacore, there are not many options to develop such fishery independent indices of abundance, it is proposed to conduct a feasibility test using acoustics during baitboat fishery operations to improve the currently available indices. A fine scale analysis for surface fisheries catch of albacore recruits (Age 1) is suggested to analyze the feasibility of designing some transect based approach for a recruitment index.

Management Strategy Evaluation

The Albacore Species Group recommends that further elaboration of the MSE framework be developed for albacore, considering the recommendations by the 2018 external review, the Methods and the Albacore tuna Species Groups, as well as the guidance of the Commission and the Joint t-RFMO MSE Group initiative. Now that an HCR is in place and advice for adopting a long term MP has been provided, the Group realizes that the OMs were conditioned with data up until 2011, so it is time to start working towards reconditioning them using more recent data. The Group decided to start working towards a Stock Synthesis based reference case and use this as a basis to recondition the OMs after reconsidering the axes of uncertainty. The process to adopt a new grid of OMs and reference tests will take several years. Once this is achieved, it is important to improve observation error models (e.g. by considering the statistical properties of CPUE residuals in future projections) and to test alternative management procedures (e.g. empirical harvest control rules, alternative stock assessment models such as Jabba or Delay Difference models).

The total requested funds to develop this research Programme have been estimated at €842,000, with €600,000 to cover priority 1 tasks. The research Programme will be an opportunity to join efforts from an international multidisciplinary group of scientists currently involved in specific topics and fisheries.

Budget

Research aim	***Priority***	*Approximate 4-year cost (€)*
Biology and Ecology		
Reproductive biology (spawning area, season, maturity, fecundity)	1	100,000
Environmental influence on NE Atlantic surface CPUE	2	20,000
Distribution throughout the Atlantic (e-tags)	1	350,000
Population structure: contingents	3	100,000
Monitoring stock status		
Joint Atlantic longline CPUE	3	30,000
Joint NE Atlantic surface CPUE	3	12,000
Feasibility of fisheries independent survey	3	180,000
Management Strategy Evaluation		
Development of MSE framework	1	150,000
	Total	**842,000**

Timeline

Research aim	*2021*	*2022*	*2023*	*2024*
Biology and Ecology				
Reproductive biology (spawning area, season, maturity, fecundity)	x	x	X	
Environmental influence on NE Atlantic surface CPUE	x	x		
Distribution throughout the Atlantic (e-tags)	x	x	X	x
Population structure: contingents	x	x	X	x
Monitoring stock status				
Joint Atlantic longline CPUE	x	x		

Joint NE Atlantic surface CPUE	x	x		
Feasibility of fisheries independent survey		x	X	x
Management Strategy Evaluation				
Operating models:				
- Stock Synthesis based reference set	x	x	x	
- New OM reference grid and robustness tests		x	x	X
Observation error:				
- Project CPUEs with error structures			x	
Management Procedures:				
- Jabba, Delay difference, empirical			X	X
Communication:				
- Determine additional minimum standards for performance metrics (currently only prob(Green)>0.6)	x	x	X	x

Addendum 2 to the Albacore Work Plan

SOUTH ATLANTIC ALBACORE TUNA RESEARCH PROGRAMME

Background information

Despite the Southern Atlantic albacore being an important resource to fleets from several countries, it is perhaps one of the tuna stocks within ICCAT that has the least information available on its bio-ecology parameters and more data deficiencies for monitoring stock status, even if this information is essential for management measures. Thus, this proposal's main objective is to improve the current knowledge on the bio-ecology and fisheries for the South Atlantic albacore, providing important information and more accurate scientific advice to the Commission.

The project proposal follows that already underway for the North Atlantic stock, so as to avoid discrepancies in scientific information between the South and North Atlantic. The research plan will be focused on two main research areas: biology and ecology, and monitoring stock status, during a four-year period (2021-2024).

Biology/Ecology and Stock Structure

Important gaps on basic biological parameters such as size of first sexual maturation, fecundity, age-growth, among others, still persist for this stock, bringing considerable uncertainty to stock assessments as well as to the implementation of fisheries management and species conservation measures. Therefore, to estimate these different biological parameters, broad biological sampling should be implemented in different areas of the South Atlantic (east and west sides and high and low latitudes), taking into account the knowledge of potential breeding and feeding areas.

Sampling would be carried out by national scientists from the countries that actively fish the species in the southern Atlantic in the different areas. Potential CPCs that could collaborate in this sampling effort would be (but not limited to): Brazil, Uruguay, Namibia, South Africa, Chinese Taipei and Japan.

Similar knowledge gaps exist with regards to the ecology of the species, particularly the effects of oceanographic conditions on the space-time distribution, migration, definition of areas and periods of reproduction and feeding, as well as the vertical habitat of the albacore. This is also very relevant information to better understand the availability of the species for surface (baitboat) and sub-surface (longline) fisheries and the trends in its abundance indexes.

In this case, information from fisheries (gear, catch and effort) and environment (temperature, chlorophyll, currents, climate indices and others) would be used in the analyses to assess possible effects of climate variability on the distribution and fishing conditions of albacore in the Southern Atlantic Ocean.

It is intend to implement electronic tagging experiments (pop-up archival tag/miniPAT) to evaluate and better understand the migration processes undertaken by the species between breeding (West) and feeding (East) areas (**Figure 1**), and also to determine the vertical movements, behavior, and habitat use in light of environmental conditions. Due to the difficulty of tagging albacore tuna and the costs of such a study, miniPAT tags will be used (n=50) in two areas where bait-boat fishery can guarantee fish in good conditions for tagging. One in Brazil (Rio de Janeiro), where the target species of this fishery is the skipjack (SKJ), but it also catches a certain amount of albacore, and another in South Africa, where historically the species is caught by this fishing method.

As a complement to this tagging experiments, a preliminary investigation into the West-East connectivity of the South Atlantic Albacore stock will be implemented based on analysis of parasitic communities and parasite genetics from fish sampled offshore Brazil and South Africa. Fish that undertake lengthy migrations within their life, such as tuna species, expose themselves to areas with various parasites which ultimately increases their chances of parasite transmission (Lester and MacKenzie, 2009). Parasites can be used as biological tags. The idea is that fish can only become infected with a particular parasite if the fish moves into the endemic area of that parasite (Lester and MacKenzie, 2009). Thus, parasites can be used to distinguish between stocks through behavioral differences such as migration. Parasites have been considered as biotags for bigeye tuna (*Thunnus obesus*) and yellowfin tuna (*Thunnus albacares*) in Indonesian waters (Lestari *et al*., 2017).

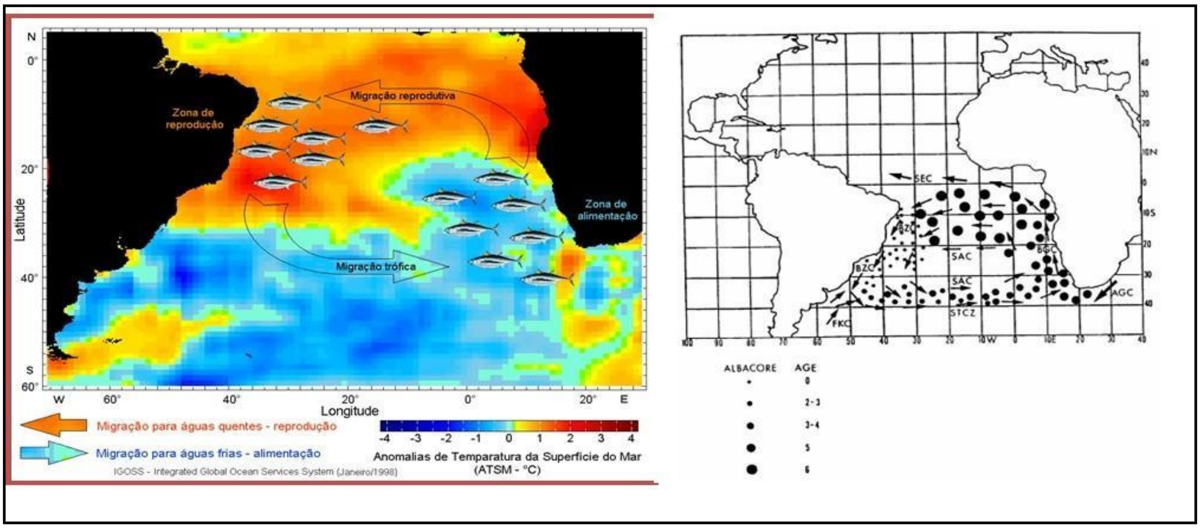

Figure 1. Representative scheme of albacore West-East connectivity in the Southern Atlantic Ocean through migratory processes (Travassos, 1999a, 1999b) and the spatial distribution of catches by age (Coimbra, 1999).

Monitoring of stock status

To improve methods of evaluating status of the southern Atlantic albacore stock, we intend to perform joint analysis of catch and effort of different fleets, generating joint standardized series of abundance indexes according to work already done on other species groups. This analysis should be considered both for longline fleets operating in different regions in the South Atlantic (e.g. Brazil, Uruguay, Chinese Taipei, Japan), and for surface fleets (bait-boat) operating in the Southeast Atlantic (e.g. Namibia, South Africa).

Budget

The total requested funds to develop this research plan have been estimated at €605,000, with €450,000 to cover priority 1 tasks. The research programme will be an opportunity for international collaboration between CPC scientists with multidisciplinary expertise and experience in specific topics and fisheries.

Research aim	**Priority Tasks**	**Approximate 4-year cost (€)**
Biology / Ecology and Stock Structure		
Reproductive biology (spawning area, season, maturity, fecundity)	1	100,000
Age-growth	3	50,000
Environmental influence on CPUE	4	30,000
Migration / vertical movements (e-tags)	1	350,000

Analysis of parasitic communities (biotag) and parasite genetics	3	30,000
Monitoring stock status		
Joint South-Atlantic longline CPUE [to be confirmed]	2	30,000
Joint South Atlantic surface CPUE	2	15,000
	Total	**605,000**

Timeline

Research aim	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Biology / Ecology and Stock Structure				
Reproductive biology (spawning area, season, maturity, fecundity)	X	X	X	
Age-growth	X	X		
Environmental influence on CPUE	X	X		
Migration / vertical movements (e-tags)	X	X	X	
Analysis of parasitic communities (biotag) and parasite genetics	X	X	X	

Timeline (continued)

Research aim	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Monitoring stock status				
Joint South Atlantic longline CPUE	X	X		
Joint South Atlantic surface CPUE	X	X		
Availability of information and results			**X**	**X**

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Appendix 6

Consolidated Report for North Atlantic Albacore Management Strategy Evaluation

N-ALB Consolidated Report MSE trial specifications