Report of the 2023 ICCAT Atlantic Sailfish Data Preparatory and Stock Assessment Meeting

(Online, 5-10 June 2023)

1. Opening, adoption of agenda and meeting arrangements

The online meeting was held on 5-10 June 2023. The Atlantic billfishes Rapporteur, Dr. Fambaye Ngom Sow (Senegal) and meeting Chair, opened the meeting and welcomed participants. Mr. Camille Manel, ICCAT Executive Secretary, addressed the Group and welcomed the participants. The Group was informed that the in-person meeting in Dakar, Senegal was canceled due to unforeseen circumstances, proceeding only with the online meeting.

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

Sections	*Rapporteur*
Items 1 and 11	M. Ortiz and A. Kimoto
Item 2	D. Angueko, R. Coelho and A. Kimoto
Item 3	C. Mayor, C. Palma and J. García
Item 4	K. Ba, M. Narváez, G. Diaz and F. Forrestal
Item 5	M. Lauretta, B. Mourato, A. Kimoto, K. Geddes, M. Ortiz, F. Forrestal, C. Braham and A. Schueller
Item 6	M. Lauretta, B. Mourato, A. Kimoto, K. Geddes, F. Forrestal, C. Braham and A. Schueller
Item 7	M. Ortiz and A. Kimoto
Item 8	F. Sow and G. Diaz
Item 9	C. Brown
Item 10	F. Sow and M. Narváez

2. Biology

Document SCRS/2023/062 presented the report from the workshop on ageing and growth that took place earlier in the year for the billfishes, swordfish and small tunas. This workshop aimed to advance the biological programs of those Species Groups and was an opportunity to allow interactions and exchange experiences on the ageing and growth programs for the three Species Groups.

The Group acknowledged the effort that has been made within the Enhanced Program for Billfish Research (EPBR) to improve the biological sampling of billfishes, currently focusing more on the eastern Atlantic area. The Group noted that it is important to ensure that samples are collected from all areas of the distribution of the species. The presenter mentioned that the Program is ongoing and that all CPCs with fisheries that capture billfishes and have opportunities to collect and share samples are welcome to participate, and that a compensation scheme exists to compensate for such samples. It was noted that the collection of samples from many areas and fisheries has been difficult and that there are also issues with species identification in some cases.

The Group agreed that there is a need for a wider discussion, possibly within the SCRS strategic plan, on the need for CPCs to agree on a scheme to collect biological samples from their fisheries, assuring that all fleets and regions where species are captured can be covered in a more systematic, efficient and on-going basis.

There was some discussion on the preliminary growth values that were shown in the presentation. The presenter clarified that the current sampling is still very limited in terms of numbers, and there are missing size classes including juveniles and large adults, which affect these preliminary growth models. As such, the growth curves shown are preliminary, and should not be used for the stock assessment at this stage. With regards to the maximum observed age, it was noted that there is some more confidence in the estimations as the research project is using and comparing both otoliths and spines, but age readings are not yet validated at this stage.

Presentation SCRS/2023/P/077 summarized the results of two studies carried out recently using mitogenome and genome-wide genetics for sailfish. The results were consistent in both studies, showing measured genetic differences between the Atlantic and the Indo-Pacific areas but not within the Atlantic, suggesting there is a single panmictic sailfish genetic stock in the Atlantic.

The Group noted that current tagging data does not indicate mixing between the West and East Atlantic (see section 3 on tagging), but the genetic results do suggest genetic mixing between those areas. One possibility discussed was that the mixing could take place at the larval stage, even though it was noted that sailfish larvae grow very fast, so it is unlikely that they are subject to oceanic drift from currents for periods of time sufficiently long to disperse very long distances. Electronic tagging on adult sailfish in the Atlantic has shown a potential to cover large distances in a short time (Lam *et al*., 2016). The Group noted that there might be other explanations for this mixing, and there is a need to further investigate what is promoting the gene flow in the Atlantic.

Summary of the discussion and biological parameters used in the assessment

The Group acknowledged the effort and work that the modelers and specialists in biology have done previously to have preliminary parameters for the initial model runs for this meeting. As there was no data preparatory meeting, the Group did not have a chance to see this previously, and the time of the meeting was very limited and did not allow for major changes. As such, the Group discussed biology in a brief way and decided not to make any substantial changes at this point. This highlights some of the limitations and problems that occur when doing stock assessments without a separate data preparatory meeting.

One point discussed was the maximum age. For the east and west Just Another Bayesian Biomass Assessment (JABBA) models, and specifically for building the *r* priors for surplus production models, the previously used maximum age was 12 and that was maintained for this new assessment. It was noted that what should be used is the maximum theoretical age estimated from an unfished population and not the maximum ages observed in samples from a population that is already impacted by fisheries.

There was also some discussion on the M estimation, and if an age-varying M should be considered (e.g., Lorenzen equation). The Group noted that age-dependent M might not be too critical for billfishes as it is for tunas, as billfishes grow and reach L_{inf} very fast.

With regards to the growth models used in the assessments, it is noted that in the last assessment, the growth function used was a sex-combined curve from the Pacific, the Group considered an Atlantic sailfish growth model by sex (Ehrhardt and Delevaux, 2006), based on tagging data. Preliminary runs included this new growth model, but after a careful review of model results and diagnostics, and taking into consideration the limitations from the conventional sailfish tagging data (SCRS/2023/113, SCRS/2023/114) and the size distributions of sailfish catches from all gears (SCRS/2023/081), the Group decided not to adopt the Ehrhardt and Delevaux (2006) growth model for the Atlantic sailfish stocks. Thus, for both East and West sailfish stocks, the Group agreed to use the 2016 Sailfish Stock Assessment model growth assumptions (Anon., 2017) and strongly recommended prioritizing research studies on Atlantic sailfish growth before the next evaluation.

The following life history tables (**Tables 1 and 2**) summarize the parameters agreed upon and used in estimating r prior distribution for the current assessment.

Document SCRS/2023/114 presented a review of the maximum age that was considered by exploring the combined tagging data (the Cooperative Tagging Center, CTC and The Billfish Foundation, TBF) and considering the data records for the longest time at large. The data records were scrutinized for accuracy, and many were deemed to be unreliable due to missing recapture date, missing release information, or the tag number not matching a series deployed by the programs. After censoring data, the maximum time at large was 8.8 years. If that fish was tagged as a young fish (age 1), then the maximum age of sailfish based on the longest time at large would be at least 10 years.

The Group discussed these data and suggested using a broader view across multiple types of data to make decisions on maximum age, especially given the inherent bias in the conventional tagging data (e.g., reporting rate, tag shedding), the low recapture rate (2.2%), and the need to cover a broader spatial distribution including the tropical areas of the eastern and western Atlantic.

The Group agreed with the author's conclusions that special care should be taken when using conventional tagging data to infer the maximum age of sailfish. In particular, tagging data from non-scientific projects where information on tag release and recapture needs to be validated prior to accepting time at large as an indicator of maximum age.

3. Review of fishery statistics/indicators

The ICCAT Secretariat presented to the Group the most up-to-date fishery statistics and tagging information of sailfish (*Istiophorus albicans*, SAI) for the two stocks (SAI-E: East Atlantic; SAI-W: West Atlantic) available in the ICCAT database system (ICCAT-DB). The datasets reviewed include Task 1 nominal catches (T1NC), Task 2 catch and effort (T2CE), Task 2 size frequencies (T2SZ), and the most recent CATDIS estimations (T1NC catches of sailfish distributed by trimester and 5x5 squares, between 1950 and 2021). The existing sailfish conventional and electronic tagging information was also presented and reviewed by the Group.

Document SCRS/2023/081 analyses the information discussed below and details the work made to prepare the input files for the stock assessment models. It is further discussed in Section 5 of this report.

Task 1 catches and discards data and spatial distribution of catches

The updated sailfish T1NC statistics (landings plus dead discards) by stock and gear, are presented in **Table 3** and **Figure 1** (SAI-E) and **Figure 2** (SAI-W). The updated SCRS catalogues of sailfish stocks (SAI-N stock in **Table 4**; SAI-S stock in **Table 5**), showing both Task 1 (T1NC) and Task 2 (T2CE and T2SZ) paired series for the last 30 years (1993-2022) ranked by order of importance (i.e., % of landings by each CPC to the total landings in the last 30 years) were also presented to the Group. These SCRS catalogues allow the Group to identify potential data inconsistencies and gaps in both stocks. The T1NC dashboard with all billfish species for interactively querying T1NC information, was also made available to the Group.

The most recent update made to Catch 5x5 distribution (CATDIS) with sailfish estimates (derived T1NC information with catches distributed by trimester and in 5x5 squares, reflecting the existing catch and effort space-time distribution series provided to ICCAT) reproduces the T1NC information available until 31 January 2023. The corresponding sailfish maps with catches by decade (1990's to 2000's) and gear are presented in **Figure 3** (more details can be found in the ICCAT Statistical Bulletin Vol. 48 published on the ICCAT website). The CATDIS dataset was used as the basis for obtaining the overall catch matrices by fleet on each stock. These matrices account for the total removals used by the stock assessment models (see SCRS/2023/081 for details). The SAI-W catches (in dressed weight) of Venezuela's gillnet artisanal fleet (2015 to 2021) were also included in CATDIS. Overall, the updates made to T1NC since February 2023 were very minor and only in the last three years (2019-2021) of the catch series. No updates to T1NC were made to sailfish and other billfish species.

The Group considered that T1NC still lacks relevant catch quantities (details in **Table 4** and **Table 5**, missing catches indicated with "shaded light blue") and recommended a detailed analysis aimed to correct and complete the sailfish catch series as soon as feasible. Due to the lack of time, the Group adopted the updated CATDIS catch matrices as the best scientific estimates of the total removals, deferring the detailed revision and improvement of sailfish catch estimations (both T1NC and CATDIS) for a future sailfish data preparatory meeting session.

Task 2 catch/effort

The T2CE detailed catalogue, with important information (metadata and quantities) on SAI and other billfish species, was also prepared for the meeting. Its purpose is to serve as a tool for the ICCAT CPC scientists to revise their series in search for possible series incompleteness (provide missing datasets) or potential series improvement (provide updates for the existing datasets). The sailfish standard SCRS catalogues (**Tables 4** and **Table 5**) summarize the T2CE data (DSet="t2", character "a") using only the T2CE datasets that have sufficient time (by month) and area (5x5 squares or better for longline gears, and 1x1 squares or better for the surface gears). The ICCAT Secretariat noted that the CATDIS relies completely on the availability and the good quality of T2CE information and encouraged the ICCAT CPC scientists to use the SCRS catalogues to revise their T2CE statistics, as recommended by the SCRS. Very minor improvements were made to T2CE having sailfish and other billfish species on the T2CE species catch composition (many still have the billfish grouped, as BIL unclassified) since the last 2016 Sailfish Stock Assessment.

Task 2 size data

The T2SZ detailed catalogue, with important information (metadata and quantities) on sailfish and other billfish species, was also prepared for the meeting. As for T2SZ, its purpose is to serve as a tool for the ICCAT CPC scientists to revise their series in the search for possible series incompleteness (provide missing datasets) or potential series improvement (provide updates for the existing datasets). The sailfish standard SCRS catalogues summarize the availability of both T2SZ (character "b"). The ICCAT Secretariat noted the existence of some sailfish Task 2 catch-at-size datasets (T2CS) estimated/reported by CPCs to ICCAT in the past. This dataset type is not required for sailfish data provision to ICCAT and may be removed from the ICCAT-DB in the future. The SCRS catalogues do not include T2SZ datasets with poor quality (poor time-area detail, size/weight bins larger than 5 cm/kg) either.

Overall, T2SZ information on sailfish still has many missing datasets on both stocks. On the positive side, the ICCAT Secretariat informed the Group of a trend observed over the last decade on the majority of the ICCAT species, of reporting higher resolution datasets of T2SZ for sailfish.

In terms of T2SZ improvements of sailfish made in advance of the Sailfish Stock Assessment session, only one correction was made to T2SZ (replaced USA RR 2013), and a recovery of the size frequencies of the Venezuelan artisanal gillnet fishery for the period 2015 to 2021.

Tagging data

The ICCAT Secretariat provided a summary of Atlantic sailfish conventional tagging data. The number of releases and recoveries by year grouped by the number of years at liberty, is presented in **Table 6**. Three additional figures summarise geographically the sailfish conventional tagging available in ICCAT. The density of releases in 5x5 squares (**Figure 4**), the density of recoveries in 5x5 squares (**Figure 5**), and the sailfish apparent movement (arrows from release to recovery locations) are shown in **Figure 6**.

The ICCAT Secretariat also prepared two dashboards with sailfish tagging information available in ICCAT, aimed to dynamically and interactively explore the tagging data. The first one (snapshot in **Figure 7**) is for conventional tagging and presents the existing sailfish release and recovery data. The second one (snapshot in **Figure 8**) is for electronic tagging and summarising the information obtained from the meta database with electronic information of ICCAT. These two dashboards with conventional tagging data and metadata on electronics tagging for all species will be soon published on the ICCAT website. The ICCAT Secretariat thanked the support of scientists in the production of the dashboards presented.

The ICCAT Secretariat informed the Group on the difficulties of incorporating the conventional tagging data reported by the U.S. between 2009 and 2019 (all species including SAI) into the ICCAT conventional tagging ICCAT database. To solve these problems, preliminary contacts have begun between the ICCAT Secretariat and the U.S. tagging correspondents, to work on a complete cross-validation project of both conventional tagging databases, aiming to correct all the discrepancies and missing information across all species. The ICCAT Secretariat will update the ICCAT tagging databases as the revision proceeds.

These improvements to the conventional tagging (CTAG) data will continue and will run in parallel with the development of the new database on electronic tagging (ETAG). The ETAG project's main goal is to integrate into a centralized relational database all the information obtained from electronic tags and the corresponding metadata. Phase one has been completed including the inventory of data, the creation of the loading files, and the installation of the database. The second phase will work on the consolidation of the metadata and loading the electronic tagging data into the system.

The Group acknowledged the ICCAT Secretariat's work on tagging activities and encouraged its continuity, recalling the importance the tagging data can have on better understanding the sailfish stock structure. It was observed that the existing conventional tagging events (releases and recoveries) happened almost exclusively in the northwest Atlantic region, with a low number of releases occurring in both the eastern Atlantic and the southwest Atlantic regions. The apparent movement (**Figure 6**) does not show any Atlantic (east-west or north-south) migrations, but only relatively localized movements inside the northwest Atlantic region. This precludes any conclusions on the sailfish migratory patterns.

The Group also noted that conventional tag data release-recovery geographical locations (as the apparent movement shown in **Figure 6**) do not show the days at large. However, many billfish move fast and are characterized by cyclic movements (e.g., appearing in the same area around the same months year after year). This behaviour could explain why regional recreational fishing tournaments take place in specific months but not across all year.

So far, electronic tagging work on sailfish is scarce, and few published studies (e.g., Richardson *et al*., 2009, Lam *et al*., 2016, Mourato *et al*., 2014) have been conducted. Electronic tagging with detailed movements over time, can be used to better understand the geographical distribution of the conventional tagging releases and recaptures. An example of the advantages of combined tagging work can be found in Lam *et al*., (2016).

Document SCRS/2023/113 presented a review of the U.S. conventional tagging database for sailfish. The sailfish U.S. conventional tagging database consists of data from the National Oceanic and Atmospheric Administration (NOAA) Southeast Fisheries Science Center's CTC and TBF. A total of 112,979 tagged and released sailfish were reviewed with specific comments on regional and seasonal abundance. The 2,488 tag recaptures of sailfish show no trans-Atlantic or trans-equatorial movements. The authors discussed the importance of these findings that support the current stock structure used for the sailfish assessments of an East and West stock. It also suggested a potential for northern and southern divisions.

However, the Group discussed a need for additional tagging data in areas with low or non-releases, as well as the need for a higher recapture rate, to better understand the stock structure. While genetic studies suggest a single panmictic sailfish stock in the Atlantic (McDowell & Graves, 2002; Ferrette *et al*., 2021; 2023), there is no evidence of a single stock in the current conventional tagging data. The Group suggested a tag retention study to determine if tag loss could be impacting the recovery rate. In addition, this is one piece of information suggesting stock structure, and it needs to be considered in context with the other data available such as genetic evidence, electronic tagging, or analysis of the spatial-temporal distribution of catches of all fleets. The Group recommended that the deployment of new Pop-up Satellite Archival Tags (PSAT) throughout the range of Atlantic sailfish can provide data on movements and stock structure independent of fishery recaptures and reporting.

4. Relative indices of abundance

East Sailfish

Document SCRS/2023/079 updated the standardized catch rates of sailfish in the EU-Spain longline fleet during the period 2001-2019 in the East Atlantic stock. The standardized index of relative abundance showed an increasing trend for the Atlantic Ocean, reaching a peak in 2015, followed by a slightly decreasing trend in recent years, although the values remained higher than those at the beginning of the series.

The Group pointed out the need for more information about the deviance analysis. The author commented that that information is provided in García-Cortés *et al.,* 2017. However, the Group recommended that for all documents, even for updates, it is necessary to include all details and tables. In this regard, the author stated that these changes will be made in the final document. This index was included by the Group for use in the stock assessment models.

Document SCRS/2023/082 presented the updated catch, effort, and standardized Catch per unit effort (CPUEs) for the eastern Atlantic stock of Atlantic sailfish from the EU-Portugal pelagic longline fleet. The standardized CPUEs covered the years 1999-2019 and show a strong decrease in the initial years until 2010, followed by an increase until 2015, and then a more stable period in recent years with inter-annual oscillations.

The authors explained that the first years of the series were not included in the preliminary analyses because of the small CPUE values. The Group suggested trying additional runs by including 1997 and 1998 in the series to check if there would be some changes in the final standardized CPUE. Based on this suggestion, the authors provided an updated index including these two years, but without improvement. Therefore, the Group agreed to use the former index (1999-2019) and drop the first year of the series (i.e., 1999), which means that the series to be used for stock assessment will start from 2000 to 2019. In the future, the authors are encouraged to investigate the huge drop in the abundance index that occurred in 1999. The Group agreed to use this index for the stock assessment.

Document SCRS/2023/105 analyzed the catch and effort data of sailfish (*Istiophorus platypterus*) for the Chinese Taipei distant-water tuna longline fishery in the Atlantic Ocean. The nominal CPUE was standardized using generalized linear models (GLMs), with information on the operation type (i.e., number of hooks between floats) included as a potential effect in the models. Relative abundance indices of eastern Atlantic sailfish increased from 2009 to a higher level, but then dropped in 2014-2015 and increased again in the last two years.

The Group asked the authors the reason for the smaller spatial distribution in the CPUE in 2021 and they replied it was due to the restriction of the COVID-19 pandemic. The Group agreed to use this index for the stock assessment.

Document SCRS/2023/106 presented an updated standardized CPUE of Atlantic sailfish caught by the Senegalese artisanal fishery in the Eastern Atlantic stock. The artisanal nominal CPUE was standardized using a generalized linear mixed model (GLMM) to provide interannual variation in abundance. The standardized relative index, which ranged from 1981 to 2021, showed an increasing trend from 1981 to 2003, followed by a sharp and continuous decline from 2003 onwards, except in 2017, with a noticeable peak.

The Group discussed the possibility of splitting the CPUE by fishing gear to have a clear idea of the effort unit and the changes in the abundance index per gear, although the characteristics of the artisanal fishery make it difficult to have a continuous series for each gear. The authors agreed to try to do so in the future to have a standardized index for each main fishing gear (handline and gillnet). Finally, the Group agreed to use the Senegalese artisanal index in the stock assessment for the Eastern Atlantic stock.

Document SCRS/2023/109 showed an updated estimation of abundance indices of Eastern Atlantic sailfish caught by the Japanese tuna longline fishery using logbook data from 1994 to 2021. The nominal CPUEs were standardized using a spatio-temporal GLMM to provide annual changes in abundance. Overall, the estimated CPUEs of the Eastern stock revealed upward trends from 1994 to 2021 with extremely high CPUEs in 2013 and 2014, and the standard deviations after 2013 were wider than those in the 1990s and the 2000s due to a reduction in fishing effort.

The Group inquired whether the R package VAST, used by the authors for conducting various trials on probability distributions, could also handle Tweedie models. The authors confirmed that it was indeed possible and emphasized the package's benefits for future application of this CPUE standardization method for any other fleet catch and effort data. The Group agreed to incorporate this index into the stock assessment.

On a side point for the Eastern stock CPUE indexes, in preparation for the sailfish stock assessment, the Group contacted CPCs previously to the meeting to provide indices of abundance in advance of the meeting. Scientists from Côte d'Ivoire and Ghana contacted the ICCAT Secretariat for scientific support with the standardization of small-scale fisheries catch sailfish in the East Atlantic area. National scientists provided input data, and preliminary evaluations were done. Unfortunately, due to time limitations, some needed clarifications for the input data that were not resolved in time to produce a reliable index of abundance from these fleets. The Group strongly recommended that for the next assessment(s), a data preparatory meeting be scheduled to cover data inputs including indices of abundance of all sailfish eastern fisheries and fleets. The Group also recommended not to include in the current assessment the historical indices of Côte d'Ivoire and Ghana used in the 2016 Sailfish Stock Assessment.

West Sailfish

Document SCRS/2023/063 introduced a sailfish CPUE and size information for the artisanal drift gillnet fishery from Venezuela.

The Group noted that starting in 2015 the size data showed some very small sailfish. The authors agreed that the presence of such small fish in the size samples was odd, especially considering that fish of that size are usually kept by the fishers and not sold in the markets and, therefore, they are not regularly observed in the commercial length compositions. The authors noted that they have not been able to visit this artisanal fishing community in recent years and cannot corroborate these small sizes.

The Group also asked why the model did not include a spatial effect. It was explained that the CPUE is from an artisanal gillnet fishery that operates in a small area of fewer than two degrees square with no electronics capability for recording longitude and latitude positioning.

The document described the area of operation of this fishery as a sailfish 'hot spot'. The Group inquired if the conditions that make this area a sailfish 'hot spot' are known. It was explained that there is no oceanographic profile available for this area, but that marlins and sailfish gather in this area seasonally, most probably to forage, and in the case of sailfish it is also a spawning ground.

Finally, the Group requested clarification on Table 4 of the document which shows a consistent sample size of 12 every year. It was explained that the data was summarized by month and that is why there were 12 samples for each year.

After considering that this index only represents a small localized area, and that is considered to be a sailfish 'hot spot' that may cause hyper-stability on indices of abundance, the Group expressed concerns that the index might not represent the dynamics of the stock. Therefore, the Group decided not to include this index in the 2023 stock assessment.

It was noted, however, that this index is an important indicator of biological features of the west-sailfish stock such as reproductive activity, forage, and movement dynamics. Therefore, the Group agreed to continue monitoring and reporting catch and effort from this area.

Document SCRS/2023/064 presented a sailfish CPUE and size information from the Venezuelan pelagic longline fishery for the period 1987-2018.

The Group noticed that the LL CPUE is remarkably flat as was the CPUE for the gillnet fishery (SCRS/2023/063). It was noted that the apparent flat trend in the index was due to the scale used to plot the CPUE (1987 the first year in the time series had the highest CPUE value and about 4 times higher than the CPUE in 1988 and 1989).

The Group noted that the Venezuelan indices were the only documents that provided data on the sex ratio during this meeting. The absence of sex ratio data reported by other CPCs didn't allow the Group to evaluate if similar spatiotemporal sex patterns exist in other fisheries. More generally, spatiotemporal changes in sex ratio have been documented for sailfish (Arocha *et al*., 2016, Mourato *et al*., 2018), and appear to be a common phenomenon among swordfish and billfish species.

It was clarified that the presence of more males than females in the longline fishery samples only happens in the last three years and that in the rest of the series, the sex ratio is more balanced.

There was a general agreement that CPUEs from fisheries where biased sex ratios are present can still reflect the true dynamics of the stocks. It was discussed that the longline fishery captures the sailfish movements in the Caribbean and that, together with tagging data, this information should be taken into consideration when interpreting CPUE trends. The Group commented on the need to further discuss methodologies to integrate this information into the assessment models.

Finally, the Group recommended excluding the first year of the time series (1987) from the CPUE series but including the rest of the time series in the assessment models.

Document SCRS/2023/079 presented an updated standardized catch rate of sailfish for the Spanish longline fleet targeting SWO for the Western Atlantic, the Eastern Atlantic, and the entire Atlantic basin 2001-2019.

The document presented a straight update of the previous CPUE used in the 2016 Sailfish Stock Assessment. However, the Group noted that the document was missing some important information like deviance tables. The authors indicated that such information could be found in document García-Cortés *et al.*, 2017.

The Group inquired why the CPUE for the western stock was higher than for the eastern stock. The authors indicated that the sample size was about three times higher in the eastern Atlantic than in the western Atlantic and that might partially explain the differences. It was further explained that the EU-Spain longline fleet mainly targets swordfish and that there are no differences in target species between the eastern and western Atlantic.

As in the 2016 Sailfish Stock Assessment, the Group decided to include this index in the assessment model runs.

Document SCRS/2023/098 introduced an estimated sailfish CPUE for the U.S. recreational billfish tournaments for the period 1972-2021.

The Group inquired what was the reason to include 'Tournament' as a random factor in the model. It was explained that including 'Tournament' as a random effect improved model performance. In addition, this decision was supported by the fact that billfish tournaments have changed over time and not all of them cover the same periods. The best-performing model used "Tournament" as an explanatory factor rather than a random effect.

The Group also was interested in finding if other explanatory variables could be included in the model, particularly a spatial effect. The author argued that in the case of the sailfish tournaments, they occur in a relatively small area on the East coast of the state of Florida. The Group also asked for clarification on the definition of the fishing effort used in the analysis and it was explained that fishing effort was defined as 'fishing hours' (as reported by the tournament) times the 'number of boats' participating in each tournament.

The Group inquired about the decrease in the CPUE trend after 2010. While the authors did not provide a hypothesis that explains such a trend, it was noticed that the CPUE trend followed the trend of the commercial catches in the western Atlantic. Therefore, this might indicate that changes in the CPUE do not reflect only changes in local abundance.

The Group decided to include this index in the initial stock synthesis (SS) model runs together with the fishing power index discussed below. In the case of the JABBA models, the Group also decided to include this index together with 2 selectivity time blocks in the iniial runs (see discussion below and final decision in Section 5 of this report).

Document SCRS/2023/080 presented an index of fishing power for the U.S. billfish tournament fleet 1982-2021.

The Group asked why the 'issue of the magazine' was included as an explanatory variable in the model. It was explained that this variable is an indication of the timing (month) of the year the magazine was published but noting that month as a factor is also in the model, it could be dropped in future estimations of the index.

It was asked what the advantage was of using this approach of estimating changes in fishing power as a proxy of changes in catchability or if the use of a proxy like searching time could be used in the standardization of the U.S. Rod and reel directly. Unfortunately, the tournament data used to estimate the U.S. Rod and reel CPUE does not have search time information. In addition, the hypothesized increase in catchability over time cannot be incorporated into the CPUE standardization procedure.

It was also discussed that some recreational vessels might incorporate some of the electronic devices described in the document, but they might not participate in fishing tournaments. In addition, there might be a lag time between when a particular product was advertised in the magazines and the time it was incorporated into the recreational fleet.

The Group also inquired if a bio-economic analysis could be used to develop this power index. The authors indicated that the necessary data to conduct such an analysis is not available.

It was asked how the value scores for the electronic assistance were incorporated into the model. It was explained that it is a categorical variable. The number of ads for each piece of electronic equipment in the magazines was used to estimate a mean score that was used in the analysis as a categorical variable and that these mean scores are lower for the electronic devices used in the earlier part of the time series. A question was raised as to why each piece of equipment was not included as separate factor, and the authors noted that the mean score of several types of equipment gave a better indication of what the full suite of electronic assistance could be present on a single vessel.

The Group agreed that the clear improvement in fishing power associated with improvements in technology and/or vessel size resulted in an increased q and it discussed if this approach could also be used for other species. It was mentioned that while billfishes (BIL) are the main target species for many tournaments in the U.S., there are also fishing tournaments that include other target species.

The Group agreed that there is clear evidence that fishing power has increased over time which increased the catchability (q). While in the SS platform, this index can be used as a modifier for CPUEs varying q, the JABBA models need a different approach to incorporate this type of information.

The ICCAT Secretariat presented an approach showing how to externally adjust the U.S. recreational index (SCRS/2023/098) using the fishing power index. The Group noted that the resulting changes in the U.S. recreational index were much smaller than expected. The ICCAT Secretariat's analysis also helped to identify different periods with similar trends in fishing power.

The Group discussed if using time blocks for catchability was an acceptable approach. One potential approach that was discussed by the Group was to include a random walk-on q in the SS model and this could be used to validate the fishing power index. However, it was recognized that this approach requires assigning an input value for the Standard Deviation of the random walk and that would be an arbitrary value.

The Group indicated that in the SS platform, the fishing power index could be included as it is. However, in the case of the JABBA models the CPUEs should have to be externally adjusted or the models should use time blocks for catchability. The Group decided for JABBA to use two-time blocks: 1972-2005 and 2006-2021. The split year 2005/06 was based on a review of the estimated q trend U.S. Rod and reel index from the SS preliminary results.

Document SCRS/2023/092 introduced catch rates of sailfish from the Brazilian longline fisheries 1994-2021.

The Group noted that the Coefficient of Variance (CVs) of the estimated catch rates were very small, and it was indicated that this was probably due to the large amount of data used. The Group also inquired if the "influ" software package for R was used to develop the influence plots (Bently *et al*., 2011). The authors indicated that they intended to use the "CPUE.rfmo" software package, but they had to modify the package source code to be able to create some of the graph outputs as the packages had depreciated. The Group agreed on the need for these software packages to be updated.

After further consideration of this index, the Group decided to include it in the model assessment runs.

Document SCRS/2023/093 presented the estimated sailfish catch rates for the Brazilian billfish sport fishing tournaments for 2001-2020.

The Group asked the authors if they believe that the fishing power of the recreational fleet has changed over time. They indicated that it is very likely that it has and that in future iterations they might attempt to use an approach similar to what was done with the U.S. billfish tournaments and the increase of the fishing power of its recreational fleet.

The Group inquired why the 2007 data showed a zero proportion of zeros. It was explained that in 2007 fishing tournaments only targeted sailfish which resulted in that proportion.

The Group asked for clarification if this index was used in the 2016 Sailfish Stock Assessment. It was indicated that it was used in the preliminary runs, but it was excluded in the final runs due to the low-size sample in the year 2009. In addition, excluding this index improved model performance.

Finally, the Group asked for confirmation if the index was developed using both retained and released fish, which what the case for the index developed for this assessment.

The Group discussed that this index was not included in the final runs of the 2016 Sailfish Stock Assessment. due to issues related to small sample sizes for some years. Because this problem of small-size samples persists in the updated index, the Group decided not to include this index in the 2016 Sailfish Stock Assessment.

Document SCRS/2023/103 presented standardized indices of abundance of sailfish for the U.S. pelagic longline fleet estimated using observer data.

The Group asked why bait was not included as an explanatory variable in the model. It was explained that the proportion of positive sets was about 10% and when too many variables were included the models failed to converge. The authors indicated that in future iterations of the index, bait could be considered as a variable to be included in the model. The Group decided to include this index in the assessment models.

Document SCRS/2023/105 introduced standardized CPUE for sailfish caught by the Chinese Taipei tuna longline fishery in the Atlantic Ocean in 2009-2021.

The Group noted that the CPUE spatial distribution in 2021 was high in one particular area, but this was not the case for 2020 and 2019. It was explained that these differences were due to the effect of the COVID pandemic and that the particular area with the high CPUE in 2021 is not where the main fishing grounds of the fleet are. The Group decided to include this index in the assessment models.

Document SCRS/2023/110 presented a spatial-temporal model for the CPUE standardization of sailfish index of abundance for the Japanese tuna longline fleet operating in the western Atlantic for the period 1994-2021.

The Group noted that the index was developed assuming a lognormal probability distribution.

The Group also discussed the observed increase CPUE trend in the last part of the time series. The Group observed that while the total number of hooks decreased, the CPUE increased due to an increase in the proportion of positives. It was explained that as the number of vessels in the Japanese longline fleet decreased, the area of operation of the fleet was also reduced and concentrated in the Tropical region where sailfish abundance is higher.

It was discussed by the Group that the Japanese longline index used in the 2016 Sailfish Stock Assessment was split into 2 time periods to accommodate the change in areas of operation by the fleet. However, the updated index is a continuous time series. Therefore, the Group inquired why this new index was not estimated for 2 different periods. It was explained that the previous version of the model was estimated using a GLM that could not fully account for changes in fishing areas in the standardization procedure. The new index was estimated using a spatial-temporal model that can account for these changes in the fleet spatial distribution over time.

After discussing this index, the Group agreed to include it in the stock assessment models. However, it was discussed that the spike in CPUE in 2005 is biologically unrealistic. Therefore, it was recommended to check the model performance, and if issues related to the model performance due to the inclusion of the 2005 CPUE data point are identified, then use the index without that particular point.

Historical indices

VEN RR sport fishery historical index: The Group discussed if this historical index should be included in the 2023 assessment as it was included in the 2016 Sailfish Stock Assessment. While the index is from a relatively small fishing area, its importance was recognized due to the length of the time series since it starts in 1960. Therefore, the Group decided to include it in the assessment models.

JPN Longline historical index: The Group recalled that this index was estimated by the Group using Task 2 catch and effort data and a ratio to separate catches of roundscale spearfish and sailfish (Anon., 2010). Therefore, it was estimated using a very basic and limited standardization procedure. However, the Group also acknowledged the importance of this index given that it started in 1960 and covers a much larger geographical area than the VEN RR historical index. The Group agreed to include this index in the assessment model.

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

As it was decided to hold both data preparatory and stock assessments in the meeting, a modeling team was formed to initiate the assessment tasks. The Chair, assisted by the Group called for some informal preparation meetings and also set a deadline of 5 May 2023 for the input data to allow the modelers to start working on their preliminary runs. The preliminary assessment analyses by the team applied the catch and size provided by the ICCAT Secretariat and all indices provided by the CPC scientists before the deadline in two stock assessment modeling platforms. The Group also discussed parameter settings in the models and suggested updating some parameters if new and valid information were available since the 2016 Sailfish Stock Assessment (see Section 2). Due to the limited meeting time, it was suggested that the Group start discussions based on the proposed assessment model structures with the originally provided input data by the deadline, unless the Group found critical issues.

a. Production models

East Atlantic Sailfish

Document SCRS/2023/111 presented the preliminary stock assessment results for the East Atlantic sailfish stock applying the most updated version (v2.2.9) of JABBA, Winker *et al.*, 2018, https://github.com/jabbamodel/JABBA. The analyses used the total catch from 1957-2021 (**Figure 11**) and available indices of relative abundance. For the preliminary runs, the seven standardized CPUE series (see Section 4) were applied, and the Japan longline (1960-1993, and 1994-2021) and Ghana artisanal indices (1974-1987, and 1992-2014) split into two separate time blocks as agreed in the last stock assessment meeting in 2016 (Anon., 2017).

Initial trials considered six alternative specifications of the Pella-Tomlinson model type based on different sets of *r* priors and fixed input values of B_{MSY}/K. The input *r* priors for these six scenarios were estimated from age-structured model simulations (see details in Winker *et al.* 2020), based on two different maximum ages of 12 and 15 (Anon., 2017; Prince *et al.*, 1986) and the growth parameters agreed in the 2016 Sailfish Stock Assessment (Anon., 2017), and also other updated biological parameters (see Section 2). This allowed approximating the parameterizations of an age-structured model based on a range of stock-recruitment steepness values for the stock-recruitment relationship (h = 0.65, h = 0.75, and h = 0.85), and assuming reasonable uncertainty about the natural mortality M (CV of 20% with the central value mean value of 0.35). JABBA was implemented in R (R Development Core Team, https://www.r-project.org/) with JAGS interface (Plummer, 2003) to estimate the Bayesian posterior distributions of all quantities of interest utilizing a Markov Chains Monte Carlo (MCMC) simulation. Each model was run for 30,000 MCMC iterations sampled with a burn-in period of 5,000 for each chain.

Based on sensitivity analysis of these six initial runs, including the 'steepness-specific' *r* input priors (SCRS/2023/111 Figure A1), no major differences were found in the estimates of the main reference points (SCRS/2023/111 Figure A2). The authors proposed to select an *r* prior with the corresponding steepness of h = 0.75 and a maximum age of 15 for the subsequent analysis. This translates to an associated lognormal *r* prior: $\log(r) \sim N(\log(0.257),0.189)$ and a fixed input value of $B_{MSY}/K = 0.34$. Using these parameters, two runs applying different sets of CPUEs (all indices, or all indices excluding the Ghana index) were considered in the original document.

After the Group discussions on the biological parameters (Section 2), catch (Section 3), and abundance indices (Section 4), the Group recommended the following changes to the preliminary initial runs:

- Use the Senegal artisanal index, and the longline indices from Japan (historical and recent), Chinese Taipei, EU-Spain, and EU-Portugal.
- Exclude the Côte d'Ivoire and Ghana historical artisanal indices.
- Exclude 1999-year point from the EU-Portugal longline index.
- Use age 12 for a maximum age for estimating the *r* prior.

After the proposed changes the authors updated the original model with the new set of selected CPUEs and with the new *r* prior with corresponding steepness of h = 0.75 and a maximum age of 12, of: (log(r) ~ N(log(0.277),0.16)) and a fixed input value of B_{MSY}/K = 0.35 (scenario S1).

The evaluation model diagnostics following Carvalho *et al*. (2021) recommendations were provided: (1) model convergence (2) fit to the data, (3) model consistency (retrospective pattern), and (4) prediction skill through hindcast cross-validation (Kell *et al*., 2016; 2021). In addition, Jack-knife analyses were provided.

A set of diagnostics was provided to the Group for the S1 scenario (**Table 9**). The results of the MCMC convergence tests and the visual examination of trace plots show that this model has adequate convergence and a high level of model stability. Marginal posterior distributions along with prior densities were provided in **Figure 12**. The prior to posterior median ratio (PPMR) for *r* was close to 1, indicating that the posterior is heavily influenced by the prior. The small Prior-Posterior-Variance-Ratio (PPVRs) for *K* indicated that the input data was more informative about *K*. Estimated catch in JABBA with 1% of CV was almost the same as the observed catch (**Figure 13**). Estimated process error deviates show a negative trend between 2011 and 2015, followed by an increasing trend in the most recent years (**Figure 14**), which might indicate that the stock's productivity has been above average in recent years.

Four of the six CPUE indices passed the runs test (**Figure 15**) but with poor goodness-of-fit and a high Residual Mean Square Error (RMSE) estimate of 79.8% (**Figure 16**). This residual pattern suggests data-conflicts caused by CPUE indices' opposite trends, particularly in the last seven years (2015-2021), in which part of the indices shows an increasing trend (distant water longline fleets) while the artisanal fishery from Senegal shows a decreasing pattern in recent years.

A retrospective analysis for five years shows minimal retrospective deviations from the full model (**Figure 17**). The estimated Mohn's *rho* (**Table 10**) for B and B/B_{MSY} fell within the acceptable range of -0.15 and 0.20 (Hurtado-Ferro *et al*., 2014; Carvalho *et al*., 2017) and consequently indicated that the retrospective pattern was negligible. Hindcasting cross-validation results indicated that Senegal, Japan, and Chinese Taipei indices have good prediction skills (**Figure 18**). And the Jackknife analyses of CPUE indices indicated that the recent Japan longline index is highly influential with regards to stock status trajectories (**Figure 19**).

The Group recognized that the presented model is relatively reasonable for the East stock. It was observed that while Senegal index showed a decreasing trend in recent years and an opposite trend to the other indices. This could be in part due to the availability of the stock to coastal fisheries likely more impacted by environmental conditions. However, the conflicting trend of the Senegalese index did not substantially affect the estimates of stock abundance trajectories in the Jack-knife analysis (**Figure 19**).
The authors of the index from Senegal artisanal fishery further explained that their index reflects the abundance in more localized and coastal-oriented areas compared to the high seas, also the availability of sailfish is only from June to October, a period of warmer water temperatures associated with the rainy season and river run-off and likely associated with an increased productivity and prey availability (Binet *et al*., 1995). The Group highlighted the importance of continuing to monitor these artisanal fisheries.

It was questioned if alternative production functions (e.g., Schaefer vs Fox) were evaluated. Modelers indicated that preliminary runs suggested no significant differences in model results when assuming different production functions. The modelers tested a model with the Schaefer and Fox production functions, and those fits were very similar to the S1 scenario. It was also inquired about how the CV or standard error was used in the JABBA model settings. The modelers explained that the standard error (SE) by fleet was set to 0.2, and the additive variance component from the observation error in the JABBA model was used for internal model data weighting. The Group concluded that it was an appropriate approach as similar concepts have been applied in other ICCAT stock assessments.

The Group had no major concerns with the presented model (S1), however, the Group recognized that the 2023 Sailfish Stock Assessment showed relatively more optimistic results compared to the 2016 stock assessment. For a better understanding of the reasons behind the changes in stock status between assessments, the Group requested additional sensitivity runs (**Table 9**) to see the effects of (i) including the Côte d'Ivoire and Ghana small-scale indices of abundance from the 2016 runs (S2 scenario), (ii) replacing the *r* priors with those used in 2016 Sailfish Stock Assessment (S3 and S5 scenarios), and (iii) changing the terminal year of the model to 2014 (S4 and S5 scenarios).

The additional sensitivity runs (**Figure 20**) were provided during the meeting, the Group found that generally using different *r* priors and changing the terminal year from 2021 to 2014 provide similar results. The change of *r* prior provided a different magnitude of biomass at the beginning of the time series and slightly different shapes of the surplus production function, but the Maximum Sustainable Yield (MSY) levels were similar.

The modelers found that the addition of the two artisanal fishery indices from the 2016 Sailfish Stock Assessment in S2 scenario was influential to the stock trajectory and showed the lowest estimates among all scenarios (**Figure 20**). The Group reiterated their concerns about the estimated values of the CPUE in 2016, therefore the Group accepted JABBA S1 scenario as the final model for the 2023 East Atlantic sailfish stock assessment. The Group highlighted the importance of fully explaining the change in stock status compared to the 2016 Sailfish Stock Assessment.

West Atlantic Sailfish

Document SCRS/2023/112 presented the preliminary stock assessment results for the West Atlantic sailfish stock applying JABBA (v2.2.9). The analyses used the total catch from 1957-2021 (**Figure 11**) and available indices of relative abundance. For the preliminary runs, ten standardized CPUE series (see section 4) were applied, and the Japan longline (1960-1993, and 1994-2021) index split into two separate time blocks as agreed in the stock assessment meeting in 2016 (Anon., 2017).

Initial trials of the West Atlantic JABBA took a similar approach to estimate input priors as the East Atlantic stock. Based on sensitivity analysis of these six initial runs, including the 'steepness-specific' *r* input priors (SCRS/2023/112 Figure A1), no major differences were found in the estimates of the main reference points (SCRS/2023/112 Figure A2). The authors proposed to select an *r* prior with corresponding steepness of $h = 0.75$ and a maximum age of 15 for the subsequent analysis. This translates to an associated lognormal *r* prior = $\log(r) \sim N(\log(0.283),0.223)$. Using these parameters, two runs applying different sets of CPUEs (all indices, or all indices excluding the Brazil rod and reel index) were considered in the original document.

After the Group discussions and recommendations on the biological parameters (Section 2), catch (Section 3), and abundance indices (Section 4) the preliminary JABBA model runs were updated. The authors incorporated all changes during the meeting and provided full analyses to the Group for their review. The list of changes included;

- Use the rod and reel indices from the U.S. and Venezuela,
- Use the longline indices from Brazil, Japan (historical and recent), Chinese Taipei, EU-Spain, U.S., and Venezuela.
- Exclude the Brazil rod and reel and Venezuela gillnet indices.
- Exclude 1987-year point from Venezuela's longline index.
- Treat the recent Japan longline index as one index (not to split) and exclude the 2005-year point.
- Use the U.S. rod and reel index with a fishing power correction, and split it into two-time series (1970-2005, and 2006-2021).
- Use age 12 as sailfish maximum age for estimating input priors.

The authors proposed and the Group agreed to select an *r* prior with a corresponding steepness of $h = 0.75$ and a maximum age of 12 for all subsequent analyses. This translates to an associated lognormal *r* prior = $\log(r) \sim N(\log(0.297), 0.202)$ and a fixed input value of $B_{MSY}/K = 0.35$. Based on the Group's agreement, the modelers proposed two alternative scenarios (**Table 11**) for the US-RR index: S1) Include the U.S.-R&R index with an external fishing power correction as provided during the meeting by the ICCAT Secretariat, and S2) Include the U.S.-R&R index split into two-time series (1972-2005, and 2006-2021).

A full suite of diagnostics was provided to the Group for both scenarios. The results of the MCMC convergence tests and the visual examination of trace plots show that all models have adequate convergence and a relatively high level of model stability for both scenarios. The marginal posterior distributions along with prior densities were provided (**Figure 21**). The PPMR for *r* was close to 1 in both scenarios, indicating that the posterior is heavily influenced by the prior. The small PPVRs for carrying capacity (*K*) in both scenarios indicated that the input data was more informative about *K*. The estimated catch by the JABBA models with a 1% of CV was almost the same as the observed catch (**Figure 22**). Estimated process error deviates showed a similar trend between scenarios (**Figure 23**). The estimates fluctuated between -0.2 and 0.1 in the recent 10 years where the landings have increased with a positive trend of CPUE for most of the fleets.

Some CPUE indexes in both scenarios (**Figure 24**) were poorly fitted, with overall combined RMSE estimates of 57.2% and 52.3% for S1 and S2 scenarios, respectively (**Figure 25**). A retrospective analysis for five years peel-off showed minimal retrospective deviations from the full models in both scenarios (**Figure 26**). The estimated Mohn's *rho* (**Table 12**) values for *B* and B/B_{MSY} fell within the acceptable range of -0.15 and 0.20 (Hurtado-Ferro *et al.,* 2014; Carvalho *et al*., 2017) indicating that the retrospective pattern for both models was negligible. The hindcasting cross-validation results showed that the Median Absolute Standard Errors (MASE) scores for the U.S.-R&R and recent Japanese longline indices were around 2 in the S1 scenario, which might suggest these indices have poor prediction skills (**Figure 27a**), whereas, in the S2 scenario, the U.S.-R&R MASE score improved after splitting the index into two-time series (**Figure 27b**). The Jackknife analyses of CPUE indices for both scenarios indicated that the U.S.-R&R index is highly influential with regards to the stock status trajectories and the surplus production curves (**Figure 28**). Removing this index in the Jackknife analysis resulted in a much lower stock trajectory than the full model due to the significant increase since 2000 in scenario S1. Scenario S2 showed similar results to scenario S1 but was less influenced by removing the latter period of U.S.-R&R (2005-2021).

The Group reviewed the updated results from scenarios S1 and S2. The Group inquired about the hindcasting analysis and modelers indicated that for the Venezuela longline (1987-2018) and EU-Spain longline (2001-2019) indices, hindcast results were not provided because the diagnostic program code requires that the terminal year of the indices be the same as the terminal year of assessments. The Group also inquired about the effect of the input catch CV values on the model estimates of MSY and the potential utility of increasing this CV on the catch. The authors noted that higher CVs on the catch were investigated during the model development phase and found that the results were influenced by this input parameter. However, the Group acknowledges that currently there is not sufficient information to support applying higher CVs on the catch series without a thorough analysis of the catch series from all fleets and fisheries. The Group agreed to use a CV on the catch of 1% for all models.

It was commented that the results from the SS model would have some differences compared to the JABBA models largely due to the logistic selectivity used to inform the *r* prior in the JABBA model while the original SS model (Model 2, Section 5b) used dome-shaped selectivity. It was noted that selectivity in SS and JABBA are applied differently as JABBA only uses the selectivity parameters to estimate the *r*-prior as part of the Bayesian model.

The authors expressed their concern about the potential of underestimating fishing mortality in Scenario 1 by applying an external fishing power correction factor to the U.S.-R&R index given the recent catch levels compared to the MSY estimate. Discussion centered around whether the S1 or S2 models had better RMSE diagnostics given that S2 did have a lower RMSE, but it was still high and above 50%.

The Group had a long discussion about which modeling approach should be used to take into account the increase of catchability in the U.S.-R&R fishery, applying a gradual increase in catchability (S1), or using a time block on the index (S2). A concern was raised on the choice of 2005 as the breaking point for the time block because the estimated catchability in SS was continuously increasing after 2006 but JABBA assumes a constant catchability within the block. It was noted that in JABBA, the estimated *q* for the 2nd block was four times higher compared to *q* in the first block. The other concern was that there is no correlation between the catchability of the different blocks, creating an abrupt change in catchability.

The Group was reminded that the current JABBA model platform assumes a constant catchability for each fleet. Incorporating a continuous time-varying catchability would require changing the original coding, which is not feasible during the meeting. Therefore, time blocking has been commonly introduced as the closest approximation in other ICCAT species assessments.

The Group agreed that catchability in the U.S.-RR fishery has been changing but the index could not take that change into account directly with the CPUE standardization. The Group considered that the U.S.-RR index with a fishing power correction might not be sufficient to accommodate the assumed increased time-varying catchability. The Group then proposed removing the U.S.-RR index from the model given the lack of catchability information in the index standardization and the JABBA model diagnostics. It was suggested to focus on model diagnostics for the final decision.

Following the Group recommendations, scenario S3 was created based on S1 by removing the U.S.-RR index. During the meeting, a set of diagnostics for a new scenario S3 was provided. This model had substantially improved diagnostics as compared to S1 and S2 scenarios with a smaller RMSE (45.2%), and more indices passing the run tests (**Figure 29**).

During the discussion on the SS (Section 5b), the Group revisited the growth curve used in their proposed model, which is sex-specific growth parameters by Ehrhardt and Deleveaux (2006). Because this growth model was estimated from tagging data and was rejected by the Group in the 2016 stock assessment, the Group requested additional JABBA runs applying new *r* priors using the growth parameters of the model used in 2016 (Cerdenares-Ladrón *et al*., 2011).

Scenarios S4 and S5 were developed based on S2 (U.S.-RR index with time-block) and S3 (U.S.-RR index removed) and applied the new *r* prior ($\log(r) \sim N(\log(0.277), 0.16)$), and a fixed input value of B_{MSY}/K = 0.35, as outlined above. Generally, retrospective analysis (**Figure 30**), hindcasting (**Figure 31**), jack-knife analyses (**Figure 32**), and stock estimates (**Figure 33**) were almost identical between the models with the initial *r* prior (S2 and S3) and the ones with new *r* prior (S4 and S5), but with a slight improvement in terms of model diagnostics of the scenario S5. The Group found no concerns about moving forward with S4 and S5 scenarios for the W-SAI JABBA models.

The Group discussed the base model for the West JABBA assessment. The difference between scenarios S4 and S5 was due to the inclusion or exclusion of the U.S.-RR index with time-block, respectively. Also, it was noted that the removal of the U.S.-RR index substantially improved model diagnostics, and the Group expressed concerns about the choice of the split point for the time block.

For these reasons, it was agreed to use the JABBA model scenario S5 as the final model from JABBA to be included as part of the West-SAI management advice.

Stock Synthesis Methods

The Group reviewed the preliminary Stock Synthesis (version 3.30.18) model assumptions, data configuration, the model fits, and diagnostics presented in SCRS/P/2023/078. The preliminary Stock Synthesis model was a one area, two-sex, annual time-step model for the West Atlantic sailfish stock for the period 1950 to 2021. The catch series from 1950 to 1955 was set to 0, while the catch series provided was used as input after 1956. A total of four fleets (listed below and described in **Table 13**) and eight abundance indices (see Section 4, **Table 8, Figure 10**) were included. An overview summary of the different data series is presented in **Figure 34**. Major changes to the model structure recommended by the Group were included: a) changing the selectivity of fleets 1 to 3 (except for the recent period rod and reel) to dome-shaped using a double-normal function (parameters estimated freely) to improve fits of the length composition data, b) removing the U.S. rod and reel index, c) estimating L_∞ instead fixing it at 221 cm, d) steepness was freely estimated, and e) assuming a single-sex model (no sex ratio data were available).

The Group had a long discussion about the U.S. RR index, the uncertainty related to changes in fleet catchability, the conflict in trend compared to other indices, and the large influence on model results. The fit to the length compositions showed a considerable mismatch to the observations when logistic selectivity was assumed for all fleets. Allowing dome-shaped selectivity for the majority of fleets and allowing the model to estimate an L_∞ (versus a fixed value of 221 cm) drastically improved the model diagnostics and reduced conflict between data sources, improving the length-composition fits. The Group considered these modifications warranted, particularly due to the lack of reliable information on growth and the clear improvement to the model in terms of data fit. A brief description of the model inputs and recommended model structure, based on the Group's recommendations for a base model configuration, is provided below.

Fleet Structure: 4 fleets

- Gillnets
- Longlines
- Rod and reel
- Other gear

Indices of Abundance: 8 series

- Brazilian longline, 1994-2021
- Japan longline - late period, 1994-2021
- U.S. longline, 1993-2021
- Venezuela longline, 1988-2018
- Venezuela rod and reel, 1961-2001
- EU-Spain longline, 2001-2019
- Chinese Taipei longline, 2009-2021
- Japan longline - early period, 1960-1993

Growth and Natural Mortality

Growth was assumed to follow a von Bertalanffy growth model with k and t_0 being fixed parameters set to those published in Cerdenares-Ladrón *et al*., 2011, and L_∞ being estimated within the model (**Figure 35**). The natural mortality-at-age was assumed equal across all ages and fixed at 0.35 (Anon., 2017). The Stock Synthesis model was set to use 20 age bins, where the last bin (20+) is the plus group.

Catch, Length Compositions, and Fleet Length-based Selectivities

For the catch input, the SS3 settings assumed a CV of 1% across all fleets and all years. Annual length composition data were input by fleet aggregated into 5 cm length bins across a range from 50 to 250 cm LJFL (**Figure 37**). Length composition data were modelled assuming a multinomial distribution with the effective sample size equal to the natural logarithm of the numbers of measured fish.

Length-based selectivity was estimated directly for each of the four fleets, except Fleet 4 - Other gears, which assumed full selection across ages/sizes. The gillnets, longlines, and early-period rod and reel were modelled with a double-normal function, the current-period rod and reel was modelled as logistic selectivity. All fleet length selectivities were directly estimated in Stock Synthesis as free parameters. For the survey indices of abundance selectivity was mirrored to the corresponding gear type: gillnet, longline, or rod and reel.

No age data were included in the model, and age-based selectivity was derived from the length-based estimates and the growth model.

Initial F Assumptions

Initial Fs were assumed to be 0 in 1950.

Length-weight relationship

The length-weight relationship used in the model: $W = 1.1441E\text{-}06 * L^{3.2683}$ (**Table 2**)

Maturity

Maturity was assumed to be a logistic function of age with first age-at-maturity equal to age-1 (**Table 2**, **Figure 36**).

Stock-recruitment relationship

A Beverton-Holt stock-recruitment relationship was assumed with steepness estimated and sigmaR fixed at 0.6. *R0* was freely estimated. Recruitment deviations were assumed to follow a lognormal distribution estimated on a log scale as *N(0, sigmaR)* variates with a min and max of -5 and 5, respectively. Zero recruitment deviations were assumed until the start of length composition data beginning in 1970, and recruitment was not estimated for the terminal two years due to a lack of data to inform those estimates. The lognormal bias correction ($-0.5*\sigma^2$) for the mean of the stock recruitment relationship was applied following the method of Methot and Taylor (2011).

Data weighting method

Length compositions were weighted so that the standard deviation of the normalized residuals (SDNR) was near 1 (Francis, 2011). No weighting was applied to the indices of abundance to allow for objective weighting of the data components.

6. Stock Status results

a. Production models

East Atlantic sailfish

Based on the sensitivity analyses (**Table 9**), the Group concluded that the JABBA S1 scenario is appropriate as the final model for the 2023 East Atlantic sailfish stock assessment.

The results suggest that the final model is stable and provides a reasonably robust fit to the data as judged by the model diagnostic results. Summaries of the posterior quantiles for parameters and management quantities of interest are presented in **Table 14**. The MSY estimate is 2,337 t (2,003 t – 2,833 t) and the median marginal posterior for B_{MSY} was 8,052 t (6,098 t - 11,218 t). The F_{MSY} median estimate is 0.29 (0.22 - 0.38). It was noted that there is a difference in the estimated productivity of the stock from the 2016 assessment (MSY = 1,635 - 2,157 t) compared to the current one, which seems to be a more productive stock. However, the Group noted that in the 2016 Sailfish Stock Assessment (Anon., 2017), different model platforms were used with different methodologies, and those model performances were poor with a lack of convergence and were highly uncertain. The final JABBA model has a better fit, diagnostics, and performances compared to the 2016 assessment model results.
The estimated B/B_{MSY} trajectory (**Figure 38, Table 15**) showed a steep decline from about 2.8 to 1.0 in the period between the late 1960s and the mid-1970s, and continuously decreased to the historical lowest value in 1997. Since then, the estimated biomass increased, but biomass remained under the B_{MSY} until 2009. In the most recent 10 years, the stock has been recovering following the recent declining trend of catches, maintaining the stock above the B_{MSY} level (1.5-2.0 B_{MSY}).

The estimated F/F_{MSY} showed a slow increase until the mid-1970s, followed by a sudden increase reaching overfishing status, mainly driven by the large increase in catches. After this peak in the late 1970s, the F/F_{MSY} fluctuated between about 1.0 and 1.5 until the beginning of the 2000s. Afterward, fishing mortality gradually decreased to below 0.5 by the early 2010s and remained at around 0.5 t until 2021.

The final model estimated median values of B_{2021}/B_{MSY} = 1.83 (95%CI: 1.14-2.88) and F_{2021}/F_{MSY} =0.36 (95%CI: 0.21-0.59), respectively. Considering that fishing mortality estimates for the last year of assessment models are usually uncertain, the Group suggested estimating the geometric mean of the last three years (2019-2021) with estimated values and 95% CI of $B_{2019-2021}/B_{MSY}$ = 1.63 (0.88-2.88) and $F_{2019-2021}/F_{MSY}$ = 0.41 (0.18-0.97), respectively.

The Kobe plot (**Figure 39**) of the production final model (JABBA) indicates that the stock is not overfished nor undergoing overfishing. There is less than a 1% probability that the stock is currently subject to overfishing (i.e., it falls within the yellow quadrant of the Kobe plot), and a 99% probability that the stock is not overfished (i.e., it falls within the green quadrant of the Kobe plot).

West Atlantic Sailfish

Of five JABBA model scenarios, the Group chose the S5 scenario (**Table 11**) as the selected JABBA model for the 2023 West Atlantic sailfish stock assessment.

The results suggest that the selected model is stable and provides a reasonably robust fit to the data, as judged by the model diagnostic results. Summaries of the posterior quantiles for parameters and management quantities of interest were presented to the Group (**Table 16**). The MSY estimate is 1,612 t (1,357 – 1,968 t) and the median marginal posterior for B_{MSY} was 5,421 t (4,005 - 7,951 t). The F_{MSY} median estimate is 0.30 (0.22 - 0.39).

The estimated B/B_{MSY} trajectory (**Table 17**) showed a steep increase at the beginning of the time series to the highest historical value in 1968 at approximately 3.5, mainly driven by the Japanese historical CPUE series, which indicated a substantial increase in this year. After 1968, the relative biomass continuously decreased for nearly three decades. The estimates remained below the B_{MSY} level in the 1990s and 2000s at about 0.7, followed by an increase in the relative biomass up to around the MSY level in the 2010s and remaining at this level until 2021.

The estimated F/F_{MSY} increased continuously and steadily until the mid-2000s, exceeding the F_{MSY} level in the early 1990s. After reaching the highest value in 2002, the relative fishing mortality declined to around 0.5 in 2013. From 2014 on, the F/F_{MSY} quickly increased over the next 5 years and remained close to the MSY level, but in the most recent year (2021), the value dropped again, following recent catch trends.

The final model estimated median values of B_{2021}/B_{MSY} = 0.96 (95% CRI: 0.59-1.49) and F_{2021}/F_{MSY} = 0.58 (95% CI: 0.36-0.95), respectively. Considering that fishing mortality estimates for the last year of assessment models are usually more uncertain, the Group suggested estimating the geometric mean of the last three years (2019-2021) with estimated values and 95% CI of $B_{2019-2021}/B_{MSY}$ = 0.95 (95% CI: 0.58-1.52) and $F_{2019-2021}/F_{MSY}$ = 0.86 (95% CI: 0.36-1.64), respectively.

b. Catch integrated model Stock Synthesis

West Atlantic Sailfish

Model diagnostics

The Stock Synthesis base model showed relatively good convergence (final gradient = 8.9912e-05), with a positive definite Hessian matrix. Those estimates included one growth model parameter, two stock-recruitment curve parameters, fifty recruitment deviations, eight catchability parameters (one for each index), and fleet-based F values, and the remaining parameters were fleet length-based selectivity parameters. Parameter estimates and asymptotic standard errors are provided in **Table 14**.

A jitter analysis was conducted to evaluate whether the model converged to a global solution by applying a random deviation to starting values of 10%. The jitter runs generally indicated good convergence of the model runs (**Figure 40**).

Plots of the observed versus fit data and residual plots were examined to evaluate model fits to the indices (**Figures 41** and **42**) and length composition data (**Figure 43**). Overall, the model demonstrated a relatively good fit to some indices of abundance, including U.S. longlines, Chinese Taipei longlines, Brazilian longlines, and Venezuelan longlines. Runs tests were applied to the residual series of each index and length composition to quantitatively evaluate the randomness of the overall fits to the different series. There was evidence ($p \geq 0.05$) to reject the hypothesis of randomly distributed residuals for some of the indices, including Venezuela rod and reel, Japanese longlines - early and late period, and Spanish longline. Seventeen data points across the indices fell outside the sigma limits for the indices (**Figure 44** and **Figure 45**). In general, there was a good fit to several fleet length compositions (**Figure 43**).

A likelihood profile was examined for the estimated parameter of steepness across a range of 0.45 to 1.0 (**Figure 46**), where the parameter was estimated to be 0.75. The profile of steepness by data component showed a consistent minimum for the index data, while the recruitment deviations and length data contained opposing information on the overall best estimate. There was a less defined profile for the other data source with no clear minimum. The likelihood profiles demonstrate a well-defined estimate of steepness.

The retrospective analysis (**Figure 47**) indicated that spawning stock biomass was consistently estimated, with Mohn's rho estimates of 0.15. However, there was one run for the terminal year 2019 that was observably different. Specifically, the retrospective run with the terminal year of 2019 estimated a higher long-term spawning biomass, but the estimate was still contained within the confidence bounds. Overall, the retrospective analysis did not provide concerning results with runs being contained within the confidence bounds and small Mohn's rho values.

Hindcasts tests were run for each of the indices of abundance. The MASE were below 1.0 for the Brazilian and U.S. longlines. The additional six indices had MASE values greater than 1.0 with a range of 1.41 to 3.2.

Model estimates

Asymptotic growth, L_∞, was estimated at 198.7 cm within the model. This estimate is smaller than the literature value in Cerdenares-Ladrón *et al.*, (2011). This estimate of L_∞ contributed to a better fit to the length composition and index data.

The time series of relative spawning stock biomass (SSB), fishing mortality, and recruitment estimates are listed in **Table 18** and plotted in **Figures 48, 49,** and **50,** respectively. SSB showed a sharp decline between 1960 and 2000 in response to increased harvest, after which the SSB remained at a lower and relatively stable level for the duration of the time series.

The model estimated variable recruitments with no observable patterns over time. Notably strong recruitments were estimated for the years 1996 and 2017, while the model estimated notably lower than average recruitment (e.g., negative recruitment deviations) from 2009 to 2013.

In general, F estimates were low at the beginning of the time series and increased during the 1960s to a peak fishing mortality in the early 2000s, decreased until the early 2010s, and increased again until the end of the time series.

Stock Status Estimates

The terminal year fishing mortality rate is less than the fishing mortality rate at MSY (F_{2021}/F_{MSY} = 0.65 and 95% CI 0.40, 1.04), while the spawning biomass is less than the spawning biomass at MSY (B_{2021}/B_{MSY} = 0.95 and 95% CI 0.63, 1.42). Thus, the stock is not undergoing overfishing but is overfished. The uncertainty results indicated that for 58% of runs, the stock was overfished but not subject to overfishing (i.e., in the yellow Kobe plot quadrant), 39% of the runs indicated that the stock was overfished and overfishing was occurring (i.e., in the red Kobe plot quadrant), and 3% of the runs indicated that the stock was not overfished and no overfishing is occurring (i.e., in the green Kobe plot quadrant).

c. Synthesis of assessment results

East Atlantic Sailfish

For the E-SAI stock, a single assessment platform was used for the stock assessment: JABBA, a Bayesian surplus production-based model. The Group selected a single model (E-SAI S1) to represent the stock status at the terminal year of the assessment, 2021.

E-SAI 2023 assessment results indicated that the stock is not overfished nor undergoing overfishing. There is less than a 1% probability that the stock is currently subject to overfishing (i.e., it falls within the yellow quadrant of the Kobe plot), and a 99% probability that the stock is not overfished (i.e., it falls within the green quadrant of the Kobe plot). Details of estimated management parameters are provided in **Table 14**.

The Group discussed the changes in the stock status in 2023 compared to the 2016 Sailfish Stock Assessment (Anon., 2017) and concluded that the most influential factor was the absence of indices of abundance for some of the small-scale fisheries from the West Africa region. It was further noted that the stock status determination was more uncertain in the 2016 assessment than in the current assessment.

The Group concluded that the scientific advice and management recommendations for the E-SAI stock can be provided from the final model and proceeded to carry out stock projections assuming constant catch from 2024 onwards (details provided in Section 7 a). However, the Group acknowledged the uncertainty in the assessment model associated with the limited information from artisanal fisheries as they account for a significant proportion of the total removals of E-SAI stock. These removals cannot be accounted for in the model due to a lack of data, thus the results must be interpreted with caution. The Group recommends closer monitoring of catches, indices of abundance, and stock trends in the following years.

West Atlantic Sailfish

The Group reviewed both JABBA (S5) and Stock Synthesis (Model 6) results and discussed how to produce scientific advice for the West Atlantic sailfish stock. The Group compared the model outputs between the models (**Figure 51**). The trajectories were similar until the early 1990s, but since that time the magnitudes were different while the trend looked similar.

It was noted that the Group should focus on the diagnostics specific to each model scenario presented and not the comparison of stock status between each modeling platform. The conclusions reached thus far are that removing the U.S. rod and reel index substantially improved performance for the two platforms and that differences exist between the two final scenarios from each model platform.

A proposal was made to conduct a comparison of the results obtained in the 2016 Sailfish Stock Assessment (Anon., 2017) and, given the expected differences in stock status, clearly identify and explain the changes that have led to the different stock status (i.e., additional years of data, updated standardized CPUE series, model assumptions, etc.).

The Group did not detect any more concerns with the results of either modeling platform. The Group noted that SS Model 6 estimated the growth parameters without age-length input data, while the Center for the Advancement of Population Assessment Methodology (CAPAM) recommended using additional supportive information when a growth curve is estimated internally in SS.

The Group noted that SS will have larger variations in the derived time series results due to the estimated recruitment deviations within the model. These deviations track age classes and will follow the age classes through the model. JABBA does estimate process error; however, this error does not get carried throughout the model time series. Due to the differences between age-structured models and surplus production models, the models' estimated stock status trends should not be expected to perfectly match.

After further discussions, the Group agreed that scientific advice and management recommendations for the W-SAI stock assessment will be based on the combined results from SS Model 6 and the JABBA selected model S5, with equal weighting. It was agreed also that W-SAI stock projections will be performed for each platform assuming constant catch scenarios from 2024 forward and combined thereafter to produce the Kobe matrices.

It was noted that the terminal year of 2021 in the assessment could contain potential underestimations of catch, which will have a large influence on the estimation of the terminal year stock status. To account for this, a proposal was made to consider estimating the final stock status based on the geometric mean of the relative biomass and fishing mortality of the last three years (2019-2021), instead of using just the values from 2021. The Group will discuss this at the Species Group meeting in September 2023 when drafting the Executive Summary.

A joint Kobe plot (**Figure 52**) of both the production final model (JABBA) and the SS final model indicates that the stock is overfished (B_{2021}/B_{MSY} = 0.78, with 95% confidence interval: 0.43-1.39), but no undergoing overfishing (F_{2021}/F_{MSY} = 0.76, with 95% confidence interval: 0.39-1.32). Based on the uncertainty results from both models, there is a 57% probability that the stock currently falls within the yellow quadrant of the Kobe plot, a 23% probability that the stock falls within the green quadrant, and a 20% probability that it is in the red quadrant.

7. Stock Projections

East Atlantic Sailfish

Based on the JABBA S1 scenario, the final model, the Group decided to conduct stochastic stock projections for the E-SAI stock with eleven constant catch scenarios (0; 1,000 – 3,000 t with 250 t interval; MSY level). The annual medians of relative B/B_{MSY} and F/F_{MSY} are provided in **Figure 53**. The initial catches for 2022-2023 were set to 1,586 t, which corresponds to the average catch of the most recent three years (2019-2021) available in Task 1, the different constant catch scenarios started in 2024 and stock projections were run until 2033. The projections sample the posteriors of all parameters including *r* and *K* (10,000 iterations), the observation error parameters, and the process errors to propagate the uncertainty in these quantities to the future stock status. The Kobe 2 Strategic Matrices (**Table 19**) were estimated and show the probability that overfishing is not occurring ($F<=F_{MSY}$), the stock is not overfished ($B>=B_{MSY}$), and the joint probability of being in the green quadrant of the Kobe plot (i.e., $F<= F_{MSY}$ and $B>= B_{MSY}$). Equilibrium MSY was estimated to be 2,336 t. Given the stock status in 2021, constant future catches (2024 onwards) of 2,750 t or less will result in at least a 55% chance that B/B_{MSY} will be equal to or greater than 1 by 2033.

As the official reported sailfish catch for 2022 was not yet available at the meeting, the Group suggested reviewing the official catch reports at the Species Group meeting in September 2023 to evaluate whether the assumptions for the E-SAI stock projections need further refinement. The ICCAT Secretariat will coordinate with the Chair in early September 2023 for this revision.

The Group discussed that the stock status in 2021 is relatively more optimistic and less uncertain than the 2016 assessment results (Anon., 2017). The sensitivity analysis conducted during the meeting indicated that the change in status was strongly influenced by the absence of indices of abundance from the small-scale fisheries of Ghana and Cote d'Ivoire in the 2023 assessment. Although small-scale fisheries in West Africa operate in relatively close coastal areas, their removals account for a significant proportion of total E-SAI catches (about 40% in the last ten years). Therefore, the Group recommends precaution and close monitoring of catches and stock indicators in the upcoming years. It was further recommended that CPCs improve their monitoring and estimates of total removals, as well as provide standardized indices of abundance from these small-scale fisheries, taking advantage of the upcoming workshop on artisanal fisheries.

The Group also noted that purse-seine tropical fisheries are also important in terms of E-SAI catch and recommended that the CPCs of these fleets provide indices of abundance for future evaluations.

West Atlantic Sailfish

The Group decided to conduct projections based on both selected JABBA (S5) and SS (Model 6) given equal weighting. The following settings were used:

- Apply JABBA S5 base model and SS Model 6 base model.
- Set the 2022 and 2023 catch at 1,313 t (geometric mean of 2019-2021 catches in Task 1).
- Project 10 years (2024-2033).
- 11 future constant catch scenarios: 0; 1,000 – 3,000 t with 250 t interval; joint MSY level (1,566 t).
- 10,000 iterations in both models (combine 20,000 iterations for the results).
- For SS, use a 5-year average (2017-2021) for future catch by fleet and selectivity.
- For SS, apply the multivariate lognormal (MVLN) approach for the projection.
- For SS, future recruitment values (beyond 2019) were taken directly from the stock-recruitment relation estimated within the model.
- For JABBA, sample the posteriors for all parameters including the leading parameters (*r* and *K*), the observation error parameters, and the process error.

The Group received the JABBA stochastic projection results (**Figure 54**) during the meeting. Due to time constraints, the Group reviewed only deterministic projection by SS (**Figure 55**). The MVLN projection by SS will be conducted intersessionally and the joint projection results will be provided to the Group prior to the September 2023 Species Group meeting with B/B_{MSY} and F/F_{MSY} trajectories, Kobe 2 matrix, and a probability matrix of biomass being below 20% of B_{MSY}. It was agreed that these results and figures will be included in this report as an addendum after the review by the Billfish Group during the September 2023 meeting.

8. Recommendations

The Group noted that the sailfish CPUE estimates spatially distributed along the equator on both sides of the Atlantic may indicate the possibility of exchange between the two stocks. Therefore, considering that genetic studies identify Atlantic sailfish as a single panmictic genetic stock, the Group recommends that the ICCAT Enhanced Program for Billfish Research (EPBR) find mechanisms to increase sailfish tagging efforts for both sides of the Atlantic in the equatorial regions.

The Group recommends deploying pop-up satellite archival tags throughout the range of Atlantic sailfish distribution, with special attention to tropical areas to collect data on movements and stock structures independent of fishery recaptures and reporting.

The Group noted that the Venezuelan longline observer programme has been suspended since 2019. Considering the broad importance of observer data to carrying out the work of the SCRS, the Group strongly recommends that the Venezuelan longline observer programme be promptly reinstated, and the data collected be reported to the ICCAT Secretariat following the guidelines adopted by the Commission and, if possible, with financial assistance from ICCAT.

The Group was made aware of potentially important sailfish landings from the Venezuelan artisanal offshore (VAOS) longline fleet that have not been reported to ICCAT since 2014. The Group recommends that efforts be made by Venezuelan national scientists to recover and report this fleet's landing statistics.

Important recreational fisheries have been developed in the West Africa region and, particularly in Senegal, the Group recommends that CPCs increase efforts to report current and historical recreational catches, fishing effort, and tagging data.

The Group recommends that national scientists continue to update all indices of abundance as they are important fishery indicators even if they are not included in a particular stock assessment.

The Group recommends that CPCs continue with their efforts to improve and report their fishery indicators and fishery statistics including estimates of dead discards and live releases.

The Group recommends that all SCRS documents that present updates to CPUE series used in previous assessments include all the required elements (e.g., diagnostics, deviance tables, tables, and graphs) to allow for their full review, following the recommendations from the Working Group on Stock Assessment Methods (WGSAM) for CPUE evaluation (Anon., 2023).

The Group recommended that stock assessment preliminary runs be provided as an SCRS document(s).

Noting the limitations and problems that resulted from conducting a combined data preparatory and stock assessment meeting, the Group strongly recommends that future data preparatory meetings be conducted in advance and separately from the stock assessment meeting.

The Group was informed of emerging views from other SCRS meetings that the review by meeting participants of the initial entries for an index in the Indices Evaluation Table takes place immediately after the presentation of that index while the information is fresh in mind and the presenter is available to respond to questions. The Group recommends that this practice be followed in future data preparatory meetings.

9. Responses to the Commission

The Group reviewed two requests from the Commission. Any responses will require approval firstly by the BILSG during its September 2023 meeting and later by the SCRS Plenary meeting, and the draft responses could be modified during either meeting. Given this, in addition to the fact that some information needed for the responses is not expected to be available until after this meeting, draft responses are not included in this detailed report. Instead, the Group agreed that the focus during this meeting would be on developing the work plan to develop the responses. Draft responses would be developed in advance of the BILSG meeting in September 2023 by an ad hoc Responses Sub-group.

The SCRS shall review these data and determine the feasibility of estimating fishing mortality by commercial fisheries, Rec. 16-11 para 2

Background: *CPCs shall enhance their efforts to collect data on catches of sailfish, including live and dead discards, and report these data annually as part of their Task 1 and 2 data submission to support the stock assessment process. The SCRS shall review these data and determine the feasibility of estimating fishing mortality by commercial fisheries (including longline, gillnets and purse seine), recreational fisheries and artisanal fisheries.*

Through the stock assessments carried out at this meeting, the feasibility of estimating fishing mortality by commercial fisheries (including longline, gillnets and purse seine), recreational fisheries and artisanal fisheries have been evaluated. Furthermore, the Group intends to include in the response estimates for West and East Atlantic sailfish fishing mortality by gear and potentially by fleet based on the assessment results. For the SS model, these fishing mortality values are an output. In the case of the JABBA model, these fishing mortality estimates can be derived by dividing the total fishing mortality estimate by the proportion of landings made by each gear or fleet.

Revise the statistical methodology used to estimate dead and live discards and provide feedback to CPCs, Rec. 19-05 para 16

Background: *No later than 2020, CPCs shall present to the SCRS the statistical methodology used to estimate dead and live discards. CPCs with artisanal and small-scale fisheries shall also provide information about their data collection programmes.*

The SCRS shall review these methodologies and, if it determines that a methodology is not scientifically sound, the SCRS shall provide relevant feedback to the CPCs in question to improve the methodologies.

The SCRS shall also determine if one or more capacity building workshops are warranted to help CPCs to comply with the requirement to report total live and dead discards. If so, the ICCAT Secretariat in coordination with the SCRS should begin organizing the SCRS-recommended workshop(s) in 2021 with a view to convening them as soon as practicable.

The Group noted that the SCRS had provided a response to this request in ICCAT (2023). Nevertheless, the Group agreed that that response should be updated to incorporate the following information:

1. Add relevant commentary regarding the SCRS work regarding minimum standards for Electronic Monitoring Systems, for dead and live discards in both LL and PS.

The SCRS has a Technical Sub-group that has been working on developing minimum standards for Electronic Monitoring (EM) systems in ICCAT fisheries. Part of the work has been to compare what can be collected by human observers versus EM Systems, and this includes observations on dead discard and live releases. With regards to longline fisheries, the Technical Sub-group on EM (Electronic Monitoring) has noted that the collection of such data could be possible with some adaptations, as the EM Systems would need cameras in specific positions to determine specimen condition at release, and would need video recording, rather than only still images, to determine the degree of the specimen's movement upon release. Those details are presented in the Report of the Sub-group on Electronic Monitoring Systems: Proposal of draft ICCAT minimum technical standards for EMS in pelagic longliners (Anon., 2022). With regards to purse seine fisheries, work is ongoing during 2023 and the final findings will be presented by the Technical Sub-group on EM (Electronic Monitoring) to SC-STATS in September 2023.

2. Add relevant commentary on the outcomes from the upcoming (12-16 June) ICCAT Workshop in West Africa for the improvement of statistical data collection and reporting on small-scale (artisanal) fisheries.

3. Add note on the bycatch estimation tool being evaluated by the WGSAM, considering any relevant outcomes from the upcoming (25-27 June) Workshop on the Bycatch Estimation Tool

4. Note in the response any new information provided to the SCRS by CPCs on their data collection programmes and statistical methodologies for estimating bycatch and discards in their ICCAT fisheries.

   The ICCAT Secretariat will provide an updated list of any SCRS documents provided by CPCs on their data collection programmes and statistical methodologies for estimating bycatch and discards in their ICCAT fisheries.

5. Recommend that Atlantic sailfish be included in the list of species covered by paragraphs 14 to 16 of Rec. 19-05.

10. Other matters

The Group proposed an intersessional workplan for updating the Executive Summary for sailfish stocks. It was agreed that a small *ad hoc* "friends of the Chair" Group would provide an updated version in advance of the SCRS Species Group meeting in September 2023. It was agreed that this work will be done by correspondence and proposed a deadline of 25 July 2023 for the initial draft and a second deadline on 10 September 2023 for a draft that is ready for the Group in advance of the SCRS meeting in September 2023.

The Group also discussed the development and update of the Billfish Research Plan including research recommendations with financial implications. The SCRS Chair requested that this research plan be a 2-year budgeted plan in the context of a long-term research plan extending to 6 years. This research plan is to be integrated into the SCRS strategic plan and accommodated within the Commission's regular budget discussions. The Group agreed to move forward through correspondence.

11. Adoption of the report and closure

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

References

Anonymous. 2010. Report of the 2009 Sailfish Stock Assessment (Recife, Brazil, June 1-5, 2009). Collect. Vol. Sci. Pap. ICCAT, 65(5): 1507-1632.

Anonymous. 2017. Report of the 2016 Sailfish Stock Assessment (Miami, USA 30 May to 3 June, 2016). Collect. Vol. Sci. Pap. ICCAT, 73(5): 1579-1684.

Anonymous. 2022. Report of the Sub-group on Electronic Monitoring Systems: Proposal of draft ICCAT minimum technical standards for EMS in pelagic longliners. Collect. Vol. Sci. Pap. ICCAT, 79(5): 367-382.

Anonymous. 2023. Report of the 2023 Intersessional Meeting of the Working Group on Stock Assessment Methods (Madrid, hybrid, 15-18 May 2023). Collect. Vol. Sci. Pap. ICCAT, 80(7): 1-50.

Arocha F., Narvaez M., Laurent C., Silva J., Marcano L.A. 2016. Spatial and temporal distribution patterns of sailfish (*Istiophorus albicans*) in the Caribbean Sea and adjacent waters of the western central Atlantic from observer data of the Venezuelan fisheries. Collect. Vol. Sci. Pap. ICCAT, 72(8): 2102-2116.

Bentley N., Kendrick T.H., Starr P.J., Breen P.A. 2011. Influence plots and metrics: tools for better understanding fisheries catch-per-unit-effort standardisations. ICES Journal of Marine Science, 69: 84-88. doi:10.1093/icesjms/fsr174] (http://icesjms.oxfordjournals.org/cgi/reprint/fsr174).

Binet D., Le Reste L., Diouf P.S. 1995. The influence of runoff and fluvial outflow on the ecosystems and living resources of West African coastal waters. FAO Fisheries Technical Paper 349. FAO Fisheries Department, Rome 1995. 133 p.

Carvalho F., Winker H., Courtney D., Kapur M., Kell L., Cardinale M., Schirripa M., Kitakado T., Yemane D., Piner K.R., Maunder M.N., Taylor I., Wetzel C.R., Doering K., Johnson K.F., and Methot R.D. 2021. A cookbook for using model diagnostics in integrated stock assessments. Fisheries Research, 240: 105959.

Cerdenares-Ladrón De Guevara, G., Morales-Bojórquez, E., and Rodríguez-Sánchez, R. 2011. Age and growth of the sailfish *Istiophorus platypterus* (Istiophoridae) in the Gulf of Tehuantepec, Mexico, Marine Biology Research, 7:5, 488-499.

Ehrhard N. M., Deleveaux V.K. 2006. Interpretation of tagging data to study growth of the Atlantic sailfish (*Istiophorus platypterus*). Bull. of Mar. Sci. 79(3):719-726.

Ferrette B.L., Coimbra R.T., Winter S., De Jong M.J., Williams S.M., Coelho R., Rosa D., Rotundo M.M., Arocha F., Mourato B.L., Mendonça F.F. 2023. Seascape Genomics and Phylogeography of the Sailfish (*Istiophorus platypterus*). Genome biology and evolution. 2023 Apr;15(4):evad042.

Ferrette B.L., Mourato B., Hazin F.H., Arocha F., Williams S.M., Rodrigues Junior C.E., Porto-Foresti F., de Amorim A.F., Rotundo M.M., Coelho R., Hoolihan J.P. Global phylogeography of sailfish: deep evolutionary lineages with implications for fisheries management. Hydrobiologia. 2021 Oct;848(17):3883-904.

Francis R.C. 2011. Data weighting in statistical fisheries stock assessment models. Can. J. Fish. Aquat.Sci. 68:1124-1138.

García-Cortés B., Ramos-Cartelle A., Fernández-Costa J., and Mejuto J. 2017. Standardized catch rates of sailfish (*Istiophorus albicans*) caught as bycatch of the Spanish surface longline fishery targeting swordfish (*Xiphias gladius*) in the Atlantic Ocean. Collect. Vol. Sci. Pap. ICCAT, 73(5): 1685-1696.

Gelman, A., Rubin, D.B. 1992. Inference from Iterative Simulation Using Multiple Sequences. Stat. Sci. 7, 457–472. https://doi.org/10.2307/2246093.

Geweke J. 1992. Evaluating the accuracy of sampling-based approaches to the calculation of posterior moments., in: Berger, J.O., Bernardo, J.M., Dawid, A.P., Smith, A.F.M. (Eds.), Bayesian Statistics 4: Proceedings of the Fourth Valencia International Meeting. Clarendon Press, Oxford, pp. 169–193.

Heidelberger P., Welch P.D. 1992. Simulation run length control in the presence of an initial transient. Oper. Res. 31, 1109–1144. https://doi.org/10.1287/opre.31.6.1109.

Hoenig, J.M. 1983. Empirical use of longevity data to estimate mortality rates. Fish. Bull., 82: 898–903.

Hurtado-Ferro F., Szuwalski C.S., Valero J.L., Anderson S.C., Cunningham C.J., Johnson K.F., Licandeo R., McGilliard C.R., Monnahan C.C., Muradian M.L., Ono K., Vert-Pre K.A., Whitten A.R., Punt A.E. 2015. Looking in the rear-view mirror: Bias and retrospective patterns in integrated, age-structured stock assessment models, in: ICES Journal of Marine Science. pp. 99–110. https://doi.org/10.1093/icesjms/fsu198.

Kell L.T., Kimoto A., Kitakado T. 2016. Evaluation of the prediction skill of stock assessment using hindcasting. Fisheries Research, 183:119–127.

Lam C.H. *et al*. 2016. Sailfish migrations connect productive coastal areas in the West Atlantic Ocean. Sci. Rep. 6, 38163; doi: 10.1038/srep38163.

McDowell J.R., Graves J.E. 2002. A genetic perspective on Atlantic sailfish stock structure. Collect. Vol. Sci. Pap. ICCAT, 54 (3): 805-810.

Methot R., Taylor I.G. 2011. Adjusting for bias due to variability of estimated recruitments in fishery assessment models. Canadian Journal of Fisheries and Aquatic Sciences 68(10):1744-1760.

Mohn R. 1999. The retrospective problem in sequential population analysis: An investigation using cod fishery and simulated data. ICES J. Mar. Sci. 56, 473–488. https://doi.org/10.1006/jmsc.1999.0481.

Mourato B.L, Narvaez M., de Amorim A.F., Hazin H., Carvalho F., Hazin F., Arocha F. 2018. Reproductive biology and space–time modelling of spawning for sailfish *Istiophorus platypterus* in the western Atlantic Ocean, Marine Biology Research, 14:3, 269-286, DOI: 10.1080/17451000.2017.1407873.

Plummer M. 2003. JAGS: A Program for Analysis of Bayesian Graphical Models using Gibbs Sampling, 3rd International Workshop on Distributed Statistical Computing (DSC 2003); Vienna, Austria.

Plummer M., Best N., Cowles, K., Vines, K., 2006. CODA: Convergence Diagnosis and Output Analysis for MCMC. R News 6, 7–11.

Prince E.D., Lee D.W., Wilson C.A., Dean J.M. 1986. Longevity and age validation of a tag-recapture Atlantic Sailfish, *Istiophorus platypterus*, using dorsal spines and otoliths. Fish. Bull. 84(3):493-502.

Richardson D.E. *et al.* 2009 Sailfish (*Istiophorus platypterus*) spawning and larval environment in a Florida Current frontal eddy. Prog. Oceanogr. 82, 252-264, doi:0.1016/j.pocean.2009.07.003.

Winker H., Carvalho F., Kapur M. 2018. JABBA: Just Another Bayesian Biomass Assessment. Fish. Res. 204, 275–288. https://doi.org/http://doi.org/10.1016/j.fishres.2018.03.01.

Winker H., Carvalho F., Kerwath S., 2020. Age-structured biomass dynamics of north Atlantic shortfin mako with implications for the interpretation of surplus production models. Collect. Vol. Sci. Pap. ICCAT, 76, 316–336.

Table 1. Summary of the biological parameters used in the East Atlantic models.

Parameter	***Values in 2023 SA***	***CV***	***Reference***	***Values in 2016 SA***
Natural Mortality	0.35	0.2	Anon. (2017), Hoenig (1983)	0.35
Growth (sex combined)				
$L\infty$ (cm)	206.83	0.1	Cerdenares-Ladrón *et al.* (2011) from eastern Pacific, sex combined	206.83
k	0.36	0.1	Cerdenares-Ladrón *et al.* (2011) from eastern Pacific, sex combined	0.36
t_o	-0.24	0.2	Cerdenares-Ladrón *et al.* (2011) from eastern Pacific, sex combined	-0.24
Weight at length (RWT-LJFL)			Anon. (2017)	
a	1.14E-06	-		1.14E-06
b	3.26	-		3.26
Maturity-logistic-length $L_{50\%}$ (cm)	146.12	0.2	Mourato *et al.* (2018)	
Logistic maturity ogive (D)	L_{50} x0.05	0.2		
Longevity (t_{max})	12	0.2	Anon. (2017)	12
Length at 50% selectivity	119	fixed	25%tile of the entire size distribution (LJFL)	
Steepness (h)	0.65, 0.75, and 0.85	fixed		

Table 2. Summary of the biological parameters used in the West Atlantic models (* for Stock Synthesis, ** for JABBA).

Parameter	*Values in 2023*	*CV*	*Reference*	*Values in 2016*
Natural Mortality	0.35	0.2	Anon. (2017), Hoenig (1983)	0.35
Growth (sex combined)				
Size-at-age 1 (cm) *	74.0			
$L\infty$ (cm)	206.8	0.1	Cerdenares-Ladrón *et al.* (2011) from eastern Pacific, sex combined	206.83
k	0.36	0.1	Cerdenares-Ladrón *et al.* (2011) from eastern Pacific, sex combined	0.36
t_0	-0.24	0.2	Cerdenares-Ladrón *et al.* (2011) from eastern Pacific, sex combined	-0.24
Weight at length (RW, kg – LJFL cm)			Anon. (2017)	
a	1.14E-06	-		1.14E-06
b	3.26	-		3.26
Number of age classes*	20		Anon. (2017)	20
Longevity (t_{max})**	12	0.2	Anon. (2017)	12
Maturity-logistic-length $L_{50\%}$ (cm)	146.12	0.2	Mourato *et al*. (2018)	
Logistic maturity ogive (*D*)	L_{50} x0.05	0.2		
Length at 50% selectivity	119	fixed	25%tile of the entire size distribution (LJFL)	
Steepness (*h*)**	0.65, 0.75, and 0.85	fixed		

Table 3. Task 1 nominal catches (t) of SAI by stock, major gear and year (1955-2021).

	SAI-E												SAI-W								
	Longline	Other surf.								Sport (HL+RR)		TOTAL	Longline	Other surf.					Sport (HL+RR)		TOTAL
YearC	LL	BB	GN	HS	PS	TP	TR	TW	UN	HL	RR		LL	BB	GN	PS	TR	UN	HL	RR	
1955																				0	0
1956	0											0	1							0	1
1957	71											71	24							0	24
1958	32											32	66							0	66
1959	4											4	5							0	5
1960	50											50	65							111	176
1961	173											173	217							133	350
1962	218											218	217							147	364
1963	228				2							230	195							159	354
1964	260				4							264	356							177	533
1965	793				4							797	788							191	979
1966	529				11							540	444							205	649
1967	754				18					76		848	482							211	693
1968	808				36					76		920	653					0		218	871
1969	835				46					81		962	516					0		236	752
1970	474				67					87		628	998					28		232	1258
1971	711				93					112		916	976					28		239	1243
1972	605				143					122		870	533					28		243	804
1973	376		2		148					144		670	376					28		245	649
1974	191		3040		235					107		3573	460					38		255	753
1975	174		4726		256					122		5278	436					38		258	732
1976	351	14	4517		327					189		5398	476					110		266	852
1977	133		764		400					160		1457	394					167		339	900
1978	96		1885		405					143		2529	300					141		338	779
1979	57		2691		375		0			107		3230	382					135		350	867
1980	121		1191		432		0			325		2069	325					148		368	841
1981	153		926	2	504					497		2082	356					51		561	968
1982	229		1475	3	521					568		2796	422					146		475	1042
1983	238		2463		499					506		3706	347					104		735	1186
1984	177		1750	3	354					161		2445	508					107		536	1151
1985	89		1576		364					240		2269	581		0			110		313	1004
1986	99		990		403		1			571		2065	671		24			60		496	1252
1987	99		1467		394		9			584		2553	619					83		491	1193
1988	93		948		408		123			537		2109	577					94		472	1143
1989	112		536		432		185			445		1710	629					71		352	1052
1990	109		504		595		150			957		2315	717					251		267	1235
1991	229		531		174		112			429		1474	762		41			52		371	1226
1992	300		401		150		218		14	692		1776	955		25			150		333	1463
1993	332		758		182		92		2	448		1814	1021		60			100		233	1414
1994	234		529		160		178		4	67		1171	679		65			160		217	1121
1995	261		585		128		121		2	135		1231	610		41			215		348	1214
1996	729		722		97		148		2	182		1880	523		98			292		230	1143
1997	216		324		115		198		7	488		1347	698		114			95		350	1257
1998	275		553		141		165		1	228		1363	1061		182			105		267	1615
1999	273		549		135		185		14	186		1342	1173		140			104		163	1580
2000	198		509		357		350		15	551		1980	1757		71			92		76	1996
2001	568		773		400		292		5	767		2805	1671		64	0	2		3	58	1798
2002	756		866		365		259		6	98		2351	1643		88			223	3	103	2060
2003	497		931		413		473		43	282		2639	1166		93		0	238	0	0	1498
2004	335		841		336		859	4	17	219		2612	1278	0	122	0	1	326		0	1727
2005	319		829		264		641	1	22	143		2220	1708		131			1		0	1839
2006	580		540		274		470		5	46		1916	1743		135		1	58	2	0	1939
2007	590		690		205		896		7	189		2577	1308		186		3	60	1	5	1562
2008	628		970		251		272			108		2229	1416		113		4	193	4	4	1734
2009	622		467		308		137	0	19	575	0	2129	1164		96		1	361	1	3	1626
2010	514		486		265		121	0	28	439		1853	1136		89		2	2	2	0	1230
2011	547		445		275		124		26	136		1553	1225		93	1	2	7	10	0	1337
2012	548		477		275	0	231		2	58		1591	1104	0	139	0	3	12	12	7	1278
2013	457		321		275	0	156	0	0	128		1339	893		79		2	6	4	3	986
2014	423		317		275		134	4	0	10		1163	746		118		3	6	9	2	884
2015	441		158		275		312	3	0	56		1246	924		73		2	0	3	2	1005
2016	339		650		7		425	0	0			1422	1337		58		3	6	12	3	1419
2017	359		812		21		339	5	0	94		1631	1255		156	0	6	6	10	3	1436
2018	500		177		11		246	2		1		936	1520		153	0	4	6	3	3	1688
2019	968		742		34		264	7	0	2		2017	1356		108		1	6	3	3	1476
2020	322	1	752		10			26		50		1161	1698		33	0	3	6	1	1	1743
2021	223		747		3			1	0	537		1510	748		119		0	0	3	5	876

Table 4. SCRS standard catalogue for SAI-E

Score: 3.050
Score: 3.05

Species	Stock	Status	FlagName	GearGrp	DSet	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Rank	%	%cum
				T1 Total		1814	1171	1231	1880	1347	1363	1342	1980	2805	2351	2639	2612	2220	1916	2577	2229	2129	1853	1553	1591	1339	1163	1246	1422	1631	936	2017	1161	1510	19			
SAI	ATE	CP	Ghana	GN	t1	693	450	353	303	196	351	305	275	568	592	566	521	542	282	420	342	358	417	299	201	220	191	99	238	267	82	78	68			1	18.2%	18%
SAI	ATE	CP	Ghana	GN	t2	-1	a	-1	-1	b	ab	b	ab	ab	ab	ab	ab	ab	ab	ab	a	ab	a	a	a	a	a	a	a	a	a	-1	-1			1		
SAI	ATE	CP	Senegal	HL	t1	448	67	135	182	488	228	186	551	767	98	282	219	143	46	189	108	575	439	136	58	117	9	53		94			0	475		2	11.9%	30%
SAI	ATE	CP	Senegal	HL	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	ab	ab	ab	ab	ab	a	a	a	ab	ab	a	a	a		-1			-1	-1		2		
SAI	ATE	NCO	Mixed flags (FR+ES)	PS	t1	182	160	128	97	110	138	131	353	400	365	413	336	264	274	205	251	308	265	275	275	275	275	275								3	11.3%	41%
SAI	ATE	NCO	Mixed flags (FR+ES)	PS	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1								3		
SAI	ATE	CP	EU-España	LL	t1	42	8	13	42	48	15	20	8	195	245	197	169	202	214	227	239	318	206	197	257	229	302	333	225	233	277	324	86	84		4	9.7%	51%
SAI	ATE	CP	EU-España	LL	t2	b	b	b	b	b	b	b	b	b	b	b	b	b	b	-1	b	b	b	b	-1	-1	b	b	b	b	b	b	b	b		4		
SAI	ATE	CP	S Tomé e Príncipe	TR	t1	81	88	92	96	139	141	141	136	136	136	136	515	346	292	384	114	119	121	124	127	131	134	312	212	219						5	8.8%	60%
SAI	ATE	CP	S Tomé e Príncipe	TR	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1						5		
SAI	ATE	CP	Senegal	TR	t1	11	90	29	52	59	24	44	213	155	123	337	343	296	177	512	158	18			104	25			213	120	246	264				6	7.1%	67%
SAI	ATE	CP	Senegal	TR	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	ab	-1			b	b	a	b	b	b	-1	b				6		
SAI	ATE	CP	Côte d'Ivoire	GN	t1	40	54	66	91	65	35	80	45	47	65	121	73	93	78	52	448	74	24	108	192	80	99	52	38	400	17	482	298	246		7	7.0%	74%
SAI	ATE	CP	Côte d'Ivoire	GN	t2	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	-1	-1	a	-1	-1	-1	a	a	a	ab	a	a	ab	-1	a	-1	-1		7		
SAI	ATE	CP	Senegal	GN	t1	2	3	3	6	3	5	0	8	28	19	15	1	22	27	28	180	35	45	38	85	21	26	7	373	87	67	132	339	497		8	4.1%	78%
SAI	ATE	CP	Senegal	GN	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	a	-1	-1	b	b	b	a	ab	b	-1	-1	-1	-1	-1		8		
SAI	ATE	CP	Japan	LL	t1	27	45	52	47	19	58	16	26	6	20	22	70	50	62	144	199	94	115	143	157	71	59	36	52	45	47	64	51	31	13	9	3.6%	82%
SAI	ATE	CP	Japan	LL	t2	-1	a	ab	a	a	ab	ab	ab	ab	ab	ab	ab	ab	ab	a	ab	ab	ab	ab	ab	ab	ab	a	a	a	a	a	a	a	-1	9		
SAI	ATE	CP	Liberia	GN	t1			33	85	43	136	122	154	56	133	127	106	122	118	115										59	11	50	47	3		10	3.0%	85%
SAI	ATE	CP	Liberia	GN	t2			-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1										-1	-1	b	b	b		10		
SAI	ATE	NCC	Chinese Taipei	LL	t1	157	38	58	24	56	44	66	45	50	62	49	15	25	36	109	121	80	21	52	59	42	17	27	24	30	23	20	19	8	6	11	2.7%	87%
SAI	ATE	NCC	Chinese Taipei	LL	t2	-1	-1	-1	-1	-1	-1	-1	a	a	a	a	a	a	-1	-1	a	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	11		
SAI	ATE	CP	EU-Portugal	LL	t1						27	42	9	1	5	10	6	11	137	43	49	112	142	96	70	108	33	41	30	27	123	65	51	13		12	2.4%	90%
SAI	ATE	CP	EU-Portugal	LL	t2						-1	a	a	a	a	a	a	a	a	a	ab	a	a	ab	ab	ab	ab	a	ab	ab	ab	ab	a	ab		12		
SAI	ATE	NCO	NEI (BIL)	LL	t1								28	269	408	213	55	1	105	43	20	11		44												13	2.3%	92%
SAI	ATE	NCO	NEI (BIL)	LL	t2								-1	-1	-1	-1	-1	-1	-1	-1	-1	-1		-1												13		
SAI	ATE	NCO	Cuba	LL	t1	77	83	72	533																											14	1.5%	94%
SAI	ATE	NCO	Cuba	LL	t2	-1	-1	-1	-1																											14		
SAI	ATE	NCO	NEI (ETRO)	LL	t1	27	51	57	69	86	127	120	77	43	3	2	16	7	8	10																15	1.4%	95%
SAI	ATE	NCO	NEI (ETRO)	LL	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1																15		
SAI	ATE	CP	Côte d'Ivoire	LL	t1																								0	5	19	477	60	32		16	1.2%	96%
SAI	ATE	CP	Côte d'Ivoire	LL	t2																								a	b	-1	a	a	a		16		

Table 5. SCRS standard catalogue for SAI-W.

Score: 3.564

Species	Stock	Status	FlagName	GearGrp	DSet	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
					T1 Total	1414	1121	1214	1143	1257	1615	1580	1996	1798	2060	1498	1727	1839	1939	1562
SAI	ATW	CP	Venezuela	LL	t1	271	148	139	167	165	333	227	190	186	188	233	387	476	907	363
SAI	ATW	CP	Venezuela	LL	t2	ab	ab	ab	ab	ab	ab	ab	ab	b	b	ab	ab	ab	ab	ab
SAI	ATW	CP	EU-España	LL	t1	13	19	36	5	20	42	7	14	309	414	183	160	89	134	214
SAI	ATW	CP	EU-España	LL	t2	b	b	-1	b	b	-1	b	b	b	b	b	-1	b	b	-1
SAI	ATW	CP	Grenada	LL	t1	246	151	119	56	83	151	148	164	187	151	171	112	147	159	174
SAI	ATW	CP	Grenada	LL	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	a	a	a	a	a
SAI	ATW	CP	Brazil	LL	t1	201	60	97	76	69	106	278	531	412	325	347	208	415	82	59
SAI	ATW	CP	Brazil	LL	t2	a	a	a	a	a	a	ab	ab	ab	a	a	a	ab	ab	ab
SAI	ATW	CP	Venezuela	GN	t1	60	65	41	88	114	182	140	71	64	88	93	122	131	135	186
SAI	ATW	CP	Venezuela	GN	t2	ab	ab	ab	ab	ab	ab	ab	ab	ab	b	b	b	b	b	b
SAI	ATW	CP	Panama	LL	t1															
SAI	ATW	CP	Panama	LL	t2															
SAI	ATW	CP	Brazil	UN	t1	21	41	143	224	67	78	78	67		222	238	326	0	58	60
SAI	ATW	CP	Brazil	UN	t2	-1	-1	-1	-1	-1	-1	-1	-1		-1	-1	-1	-1	-1	-1
SAI	ATW	CP	USA	RR	t1	201	179	342	230	349	267	163	76	58	103		0	0	0	0
SAI	ATW	CP	USA	RR	t2	ab	ab	b	ab	b	ab	b	b	-1	b	b	b	b	b	b
SAI	ATW	NCO	Dominican Republic	LL	t1					101	89	27	67	81	260	91	144	165	133	147
SAI	ATW	NCO	Dominican Republic	LL	t2					-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
SAI	ATW	CP	Mexico	LL	t1	2	19	19	10	9	65	40	118	36	34	45	51	55	42	47
SAI	ATW	CP	Mexico	LL	t2	a	a	a	a	a	a	a	a	a	a	a	a	a	a	abc
SAI	ATW	CP	Barbados	LL	t1	50	46	74	25	71	58	44	44	42	26	27	26	42	58	42
SAI	ATW	CP	Barbados	LL	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
SAI	ATW	NCO	NEI (BIL)	LL	t1								297	268					68	81
SAI	ATW	NCO	NEI (BIL)	LL	t2								-1	-1					-1	-1
SAI	ATW	NCO	Cuba	LL	t1	42	46	37	37	40	28	196	208	68	32	18	50	72	47	56
SAI	ATW	NCO	Cuba	LL	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
SAI	ATW	CP	Trinidad and Tobago	LL	t1	1	2	1	4	10	25	37	3	7	6	7	10	9	17	13
SAI	ATW	CP	Trinidad and Tobago	LL	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	a	a	a	a	a
SAI	ATW	NCC	Chinese Taipei	LL	t1	112	117	19	19	2	65	17	11	33	31	13	8	21	5	14
SAI	ATW	NCC	Chinese Taipei	LL	t2	-1	-1	-1	-1	-1	-1	-1	a	a	a	a	a	a	-1	-1
SAI	ATW	CP	St Vincent and Grenadines	LL	t1									2	164	3	86	73	59	18
SAI	ATW	CP	St Vincent and Grenadines	LL	t2									-1	a	a	a	-1	a	a
SAI	ATW	CP	USA	LL	t1	65	29	30	69	57	27	72	45	11	7	5	7	3	5	7
SAI	ATW	CP	USA	LL	t2	a	a	a	a	a	a	ab	a	a	ac	a	a	a	a	a
SAI	ATW	CP	EU-Portugal	LL	t1								4			12	12	110	18	53
SAI	ATW	CP	EU-Portugal	LL	t2							a	a			a	a	a	a	a
SAI	ATW	NCO	NEI (ETRO)	LL	t1	15	27	30	36	46	67	64	41	23	1	1	9	4	4	6
SAI	ATW	NCO	NEI (ETRO)	LL	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
SAI	ATW	CP	Japan	LL	t1	1	8	2	4	17	3	10	12	3	3	10	5	22	4	1
SAI	ATW	CP	Japan	LL	t2	-1	a	a	a	a	ab	ab	ab	a	ab	a	ab	a	ab	ab

Species	Stock	Status	FlagName	GearGrp	DSet	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Rank	%	%cum
					T1 Total	1734	1626	1230	1337	1278	986	884	1005	1419	1436	1688	1476	1743	876	101			
SAI	ATW	CP	Venezuela	LL	t1	269	320	409	498	404	262	112	152	246	387	381	373	363	290		1	20.8%	21%
SAI	ATW	CP	Venezuela	LL	t2	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	a	a	a		1		
SAI	ATW	CP	EU-España	LL	t1	361	412	275	190	184	203	244	311	207	454	256	228	57	67		2	12.0%	33%
SAI	ATW	CP	EU-España	LL	t2	b	b	b	-1	-1	-1	-1	b	b	b	b	b	-1	b		2		
SAI	ATW	CP	Grenada	LL	t1	216	183	191	191	191	191	191	210	137	164	149	110	96	61		3	10.6%	43%
SAI	ATW	CP	Grenada	LL	t2	a	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1		3		
SAI	ATW	CP	Brazil	LL	t1	75	73	70	135	106	76	57	72	59	39	43	17	28	24		4	9.7%	53%
SAI	ATW	CP	Brazil	LL	t2	ab	ab	ab	ab	ab	a	a	a	a	a	a	ab	ab	a		4		
SAI	ATW	CP	Venezuela	GN	t1	113	96	89	92	139	79	118	73	58	156	153	108	33	119	90	5	7.3%	60%
SAI	ATW	CP	Venezuela	GN	t2	b	b	ab	ab	ab	ab	a	b	b	b	b	b	b	b	b	5		
SAI	ATW	CP	Panama	LL	t1									415		461	378	839	198		6	5.4%	66%
SAI	ATW	CP	Panama	LL	t2									-1		-1	a	a	a		6		
SAI	ATW	CP	Brazil	UN	t1	193	360	1	0	0						0					7	5.1%	71%
SAI	ATW	CP	Brazil	UN	t2	-1	-1	-1	-1	-1						-1					7		
SAI	ATW	CP	USA	RR	t1	3	3	0	0	7	3	2	2	3	3	3	3	1	1		8	4.7%	76%
SAI	ATW	CP	USA	RR	t2	b	ab	b	b	b	b	b	b	b	b	b	b	b	b		8		
SAI	ATW	NCO	Dominican Republic	LL	t1																9	3.1%	79%
SAI	ATW	NCO	Dominican Republic	LL	t2																9		
SAI	ATW	CP	Mexico	LL	t1	45	48	34	32	51	63	42	35	47	51	24	27	20	24		10	2.7%	81%
SAI	ATW	CP	Mexico	LL	t2	a	a	a	a	a	a	a	ab	ab	ab	ab	ab	ab	ab		10		
SAI	ATW	CP	Barbados	LL	t1			16	29	25	35	37	53	45	34	19	12	14	18		11	2.4%	84%
SAI	ATW	CP	Barbados	LL	t2			-1	a	a	a	a	a	a	a	a	a	a	a		11		
SAI	ATW	NCO	NEI (BIL)	LL	t1	252	17		21												12	2.4%	86%
SAI	ATW	NCO	NEI (BIL)	LL	t2	-1	-1		-1												12		
SAI	ATW	NCO	Cuba	LL	t1																13	2.3%	88%
SAI	ATW	NCO	Cuba	LL	t2																13		
SAI	ATW	CP	Trinidad and Tobago	LL	t1	32	16	16	32	60	28	23	51	48	58	46	51	42	43		14	1.6%	90%
SAI	ATW	CP	Trinidad and Tobago	LL	t2	a	a	a	a	a	a	a	a	a	a	a	a	-1	a		14		
SAI	ATW	NCC	Chinese Taipei	LL	t1	10	11	6	8	27	6	3	6	5	5	6	5	7	2	1	15	1.4%	91%
SAI	ATW	NCC	Chinese Taipei	LL	t2	a	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	15		
SAI	ATW	CP	St Vincent and Grenadines	LL	t1	13	8	7	4	4	3	4	1	85	8	10	5	17	0		16	1.4%	93%
SAI	ATW	CP	St Vincent and Grenadines	LL	t2	a	a	a	a	a	a	a	a	a	a	a	a	a	a		16		
SAI	ATW	CP	USA	LL	t1	9	10	4	10	18	11	11	6	7	6	6	5	3	2		17	1.3%	94%
SAI	ATW	CP	USA	LL	t2	a	a	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab		17		
SAI	ATW	CP	EU-Portugal	LL	t1	101	20	19	9	2					1	37	9	3	0		18	1.0%	95%
SAI	ATW	CP	EU-Portugal	LL	t2	ab	a	a	ab	ab	ab	ab		a	a	a	a	a	a		18		
SAI	ATW	NCO	NEI (ETRO)	LL	t1																19	0.9%	96%
SAI	ATW	NCO	NEI (ETRO)	LL	t2																19		
SAI	ATW	CP	Japan	LL	t1	33	43	36	12	16	7	11	12	13	7	3	18	3	7	9	20	0.8%	97%
SAI	ATW	CP	Japan	LL	t2	ab	ab	ab	a	a	a	a	a	a	a	a	a	a	a	-1	20		

Table 6. Summary of Atlantic Sailfish (*Istiophorus albicans*) conventional tagging data: number of recoveries grouped by the number of years at liberty in each release year. The last column shows the recovery rate (%) in each release year.

Number of tag Atlantic Sailfish (Istiophorus albicans)													
			Years at liberty										
Year	Releases	Recaptures	< 1	1 - 2	2 - 3	3 - 4	4 - 5	5 - 10	10+	15+	Unk	ERROR	% recapt*
1950	2	1		1									50.0%
1951	1	1	1										100.0%
1952	2	2	2										100.0%
1953	1	1			1								100.0%
1955	3	2		2									66.7%
1956	2	1			1								50.0%
1957	25	2	1	1									8.0%
1958	24	2	1	1									8.3%
1959	117	1		1									0.9%
1960	806	5	3	2									0.6%
1961	1119	7	5	2									0.6%
1962	1253	10	7	3									0.8%
1963	1147	8	8										0.7%
1964	1065	6	6										0.6%
1965	1091	9	8	1									0.8%
1966	1143	17	13	2	1		1						1.5%
1967	809	13	12	1									1.6%
1968	752	10	8	2									1.3%
1969	747	7	5	1		1							0.9%
1970	598	2	1		1								0.3%
1971	1031	4	2	1	1								0.4%
1972	912	6	3	3									0.7%
1973	898	17	7	8		1			1				1.9%
1974	864	10	4	4	2								1.2%
1975	979	17	14	3									1.7%
1976	1440	22	15	7									1.5%
1977	1374	32	24	4	1	2		1					2.3%
1978	1535	32	18	11	2				1				2.1%
1979	1838	37	23	4	5	2	1			2			2.0%
1980	2048	38	24	9	2	1	1		1				1.9%
1981	1783	43	34	4	4	1							2.4%
1982	1589	32	20	7	2	2	1						2.0%
1983	1790	13	8	4	1								0.7%
1984	2176	32	16	7	4	2	1	2					1.5%
1985	1894	41	26	8	3		2	2					2.2%
1986	2215	43	31	8	4								1.9%
1987	1987	46	24	10	6	3		3					2.3%
1988	2436	50	30	7	4	4	2	3					2.1%
1989	2075	48	23	17	7		1						2.3%
1990	3353	85	48	23	6	6	1	1					2.5%
1991	3745	114	51	41	15	2	3	2					3.0%
1992	4891	131	73	41	11	2	1	3					2.7%
1993	4639	119	77	28	10		1	3					2.6%
1994	3994	83	50	14	9	6	1	3					2.1%
1995	3462	86	48	23	7	6	1	1					2.5%
1996	3434	112	60	30	15	2	3	2					3.3%
1997	3267	95	49	26	12	5	2	1					2.9%
1998	2900	94	46	28	11	4	1	1				3	3.2%
1999	2761	99	62	23	11	2		1					3.6%
2000	1925	33	19	7	7								1.7%
2001	1905	31	17	8	2	2	2						1.6%
2002	1569	23	17	4	1	1							1.5%
2003	882	14	9	4	1								1.6%
2004	439	18	9	7	1							1	4.1%
2005	437	23	17	6									5.3%
2006	8	8	8										100.0%
2011	5	1	1										20.0%
2017	3	2	2										66.7%
2018	2	2	1		1								100.0%
2019	1148	25	22	2	1								2.2%
2020	1037	16	14	2									1.5%
2021	366	21	18	1								2	5.7%
(blank)	140	105									105		75.0%
Grand Total	87883	2010	1145	464	173	57	26	29	3	2	105	6	2.3%

Table 7. Criteria table for available abundance indices for the (a) East and (b) West Atlantic sailfish stocks in 2023.

(a) East stock

Use in stock assessment?	YES	YES	YES	YES	YES	YES
SCRS Doc No.	SCRS/2023/106	SCRS/2023/109	ICCAT 2016	SCRS/2023/079	SCRS/2023/105	SCRS/2023/082
Index Name:	Senegal Artisanal	Japan Longline	Japan Longline historical	Spain Longline	CTP LL Update	Portugal Longline
Data Source (state if based on logbooks, observer data etc)	Artisanal fleet	logbooks	Task2	voluntary scientific reporting fleet, observer data	logbooks	Observers, self-sampling and port sampling
Do the authors indicate the percentage of total effort of the fleet the CPUE data represents?	No	No	No	Yes	Yes	Yes
If the answer to 1 is yes, what is the percentage?				71-80%	91-100%	0-10%
Are sufficient diagnostics provided to assess model performance??	Sufficient	Sufficient	Incomplete	Sufficient	Sufficient	Sufficient
How does the model perform relative to the diagnostics ?	Well	Well	Mixed	Well	Well	Well
Documented data exclusions and classifications?	Yes	Yes	Yes	NA	Yes	Yes
Data exclusions appropriate?	Yes	Yes	Yes	NA	Yes	Yes
Data classifications appropriate?		Yes	Yes	Yes	Yes	Yes
Geographical Area	Atl NE	Atlantic	Atlantic	Atlantic	Atlantic	Atl NE
Data resolution level		OTH	OTH	trip	Set	OTH
Ranking of Catch of fleet in TINC database (use data catalogue)	6-10	6-10	6-10	1-5	6-10	6-10
Length of Time Series	longer than 20 years	longer than 20 years	longer than 20 years	11-20 years	11-20 years	11-20 years
Are other indices available for the same time period?	None	None	Few	Many	Many	Many
Are other indices available for the same geographic range?	None	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	Yes	Yes	Yes	Yes
Estimated annual CV of the CPUE series	Variable	Variable	Variable	Medium	Medium	High
Annual variation in the estimated CPUE exceeds biological plausibility		Likely	Likely	Unlikely	Unlikely	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		100 knot is used as station				

Table 7. Continued.

(b) West stock

West Atlantic stock

Use in stock assessment?	To be used in SA	To be used in SA	To be used in SA	Not to be used in SA	To be used in SA	To be used in SA	Not to be used in SA	To be used in SA	To be used in SA	To be used in SA	To be used in SA
Notes		index include a FP correct and Split for Q in year 2005 (Jabba only)			Exclude first year of data			NOT SPLIT of JPN INDEX / exclude 2005 yr point			
SCRS Doc No.	SCRS/2020/	SCRS/2020/098	SCRS/2014/065	SCRS/2023/063	SCRS/2023/064	SCRS/2023/092	SCRS/2023/093	SCRS/2023/110	ICCAT 2016	SCRS/2023/079	SCRS/2023/105
Index Name:	USA LL	**U.S. Rod&Reel**	**Venezuela Rod&Reel**	**Venezuela Gillnet**	**Venezuela Longline**	**Brazil Longline**	**Brazil Sports**	Japan Longline	Japan Longline historical	Spain Longline	CTP LL Update
Data Source (state if based on logbooks, observer data etc)	observers	tournament logbooks	Port master	Port sampler	Observer data	logbooks	fishing tournaments	logbooks	Task2	voluntary scientific reporting fleet, observer data	logbooks
Do the authors indicate the percentage of total effort of the fleet the CPUE data represents?	Yes	No	Yes	Yes	Yes	No	No	No	No	Yes	Yes
If the answer to 1 is yes, what is the percentage?	0-10%		91-100%	91-100%	0-10%					71-80%	91-100%
Are sufficient diagnostics provided to assess model performance??	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient	Incomplete	Sufficient	Sufficient
How does the model perform relative to the diagnostics ?	Well	Well	Well	Well	Mixed	Well	Well	Well	Mixed	Well	Well
Documented data exclusions and classifications?	Yes	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	NA	Yes
Data exclusions appropriate?	Yes	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	NA	Yes
Data classifications appropriate?	Yes	Yes	NA		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geographical Area	Atl NW	Atl NW	Localised (< 10 x 10 degrees)	Localised (< 10 x 10 degrees)	Tropical	Atl SW	Atl SW	Atlantic	Atlantic	Atlantic	Atlantic
Data resolution level	Set	OTH	trip	Set	Set	Set	OTH	OTH	OTH	trip	Set
Ranking of Catch of fleet in TINC database (use data catalogue)	11 or more	1-5	11 or more	1-5	1-5	1-5	11 or more	6-10	6-10	1-5	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	longer than 20 years	longer than 20 years	longer than 20 years	11-20 years	11-20 years
Are other indices available for the same time period?	Few	Few	Few	Many	Many	None	None	None	Few	Many	Many
Are other indices available for the same geographic range?	Few	Few	Few	Few	Few	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	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Estimated annual CV of the CPUE series	Medium	Variable	Variable	Medium	High	Variable	Medium	Variable	Variable	Medium	Medium
Annual variation in the estimated CPUE exceeds biological plausibility	Possible	Possible	Possible	Possible	Possible	Possible	Possible	Likely	Possible	Unlikely	Unlikely
Is data adequate for standardization purposes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Is this standardised CPUE time series continuous?	Yes	Yes	No	Yes	Yes	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			Tournament data. standard error and mean.					100 knot is used as station			

Table 8. Available abundance indices for the (a) East and (b) West Atlantic sailfish stock assessments in 2023.

(a) East stock

Name	Côte d'Ivoire Artisanal		Senegal Artisanal		Ghana Artisanal		Japan Longline		Japan Longline historical		Spain Longline		Chinese-Taipei Longline		Portugal Longline	
	CIV-AR 2016		SEN-AR		GHA-AR 2016		JPN-LL		JPN-LL hist		SPN-LL		CTP-LL		PRT-LL	
SCRS Doc No.	Konan et al. 2010		SCRS/2023/106		SCRS/P/2016/027		SCRS/2023/109		2009 assessment		SCRS/2023/079		SCRS/2023/105		SCRS/2023/089	
Catch Units	Number		Number		Number		Number		Weight		Weight		Number		Weight	
Effort Units							1000 hooks		1000 hooks		1000 hooks		1000 hooks		1000 hooks	
Year	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV
1960									0.736							
1961									5.036							
1962									1.08							
1963									0.778							
1964									2.405							
1965									2.028							
1966									1.951							
1967									0.66							
1968									1.80							
1969									2.85							
1970									4.27							
1971									1.09							
1972									1.01							
1973									0.58							
1974					0.21				0.47							
1975					0.86				0.45							
1976					0.96				0.61							
1977					0.11				0.38							
1978					0.16				0.69							
1979					0.21				0.26							
1980					0.18				0.53							
1981			0.18	0.11	0.09				0.33							
1982			0.27	0.08	0.94				1.08							
1983			0.14	0.15					0.42							
1984			0.09	0.23	0.20				1.15							
1985			0.12	0.17	0.18				0.64							
1986			0.19	0.12	0.51				0.67							
1987			0.42	0.05	0.26				0.49							
1988	0.61		0.30	0.07	4.67				0.48							
1989	0.30		0.39	0.06	0.03				0.40							
1990	0.35		0.43	0.05	1.53				0.25							
1991	0.40		0.37	0.06	3.31				0.20							
1992	0.18		0.32	0.06	1.93				0.21							
1993	0.18		0.15	0.16	1.86				0.38							
1994	0.24		0.14	0.15	1.63		0.41	0.14								
1995	0.12		0.16	0.13	0.78		0.56	0.15								
1996	0.11		0.40	0.05	2.39		0.38	0.15								
1997	0.19		0.35	0.06	1.29		0.26	0.18								
1998	0.16		0.44	0.05	0.82		0.46	0.15								
1999	0.25		0.29	0.07	0.56		0.44	0.18							5.77	0.22
2000	0.11		0.53	0.04	0.37		0.58	0.17							2.08	0.31
2001	0.18		0.68	0.03	0.94		0.50	0.27			0.23	0.46			1.85	0.36
2002	0.20		0.52	0.04	1.76		0.98	0.18			1.24	0.40			2.26	0.32
2003	0.10		0.76	0.03	2.22		0.65	0.16			0.81	0.42			0.90	0.48
2004	0.20		0.25	0.08	0.82		1.03	0.15			0.79	0.43			1.65	0.43
2005	0.20		0.29	0.07	1.33		0.89	0.13			0.99	0.44			1.12	0.28
2006	0.20		0.10	0.20	0.70		0.72	0.14			1.17	0.41			0.36	0.31
2007	0.25		0.15	0.13	0.65		0.56	0.11			1.40	0.41			0.41	0.32
2008			0.22	0.09	0.61		0.88	0.09			1.84	0.39			0.18	0.43
2009			0.15	0.13	1.53		0.60	0.10			1.99	0.38	0.07	0.18	0.34	0.33
2010			0.14	0.14			0.97	0.11			1.59	0.38	0.06	0.18	0.09	0.67
2011			0.11	0.18	0.50		1.34	0.10			1.34	0.38	0.07	0.18	0.83	0.29
2012			0.11	0.17	0.71		2.05	0.11			2.49	0.38	0.09	0.17	0.71	0.28
2013			0.05	0.40	0.20		2.45	0.14			4.22	0.37	0.10	0.19	0.57	0.31
2014			0.02	1.25			1.33	0.19			4.62	0.36	0.07	0.19	1.17	0.24
2015			0.04	0.58			1.26	0.28			6.10	0.36	0.07	0.19	1.35	0.24
2016			0.11	0.19			1.41	0.24			2.83	0.38	0.09	0.19	1.22	0.38
2017			0.33	0.06			0.76	0.21			3.10	0.37	0.06	0.19	2.04	0.26
2018			0.13	0.17			1.43	0.21			2.42	0.39	0.05	0.20	0.65	0.38
2019			0.06	0.35			1.62	0.23			2.42	0.38	0.05	0.22	1.51	0.27
2020			0.01	1.77			1.74	0.22					0.09	0.21		
2021			0.04	0.67			1.75	0.20					0.11	0.23		

Table 8. Continued.

(b) West stock

Name	U.S. Pelagic Longline		U.S. Rod&Reel		Venezuela Rod&Reel		Venezuela Gillnet		Venezuela Longline		Brazil Longline		Brazil Sports		Japan Longline		Japan Longline historical		Spain Longline		Chinese-Taipei Longline	
	US-LL		US-RR		VEN-RR		VEN-GN		VEN-LL		BRA-LL		BRA-SP		JPN-LL		JPN-LL hist		SPN-LL		CTP-LL	
SCRS Doc No.	SCRS/2023/103		SCRS/2023/098		SCRS/2014/065		SCRS/2023/063		SCRS/2023/064		SCRS/2023/092		SCRS/2023/093		SCRS/2023/110		2009 assessment		SCRS/2023/079		SCRS/2023/105	
Catch Units	Number		Number		Number		Weight		Number		Number		Number		Number		Weight		Weight		Number	
Effort Units															1000 hooks		1000 hooks		1000 hooks		1000 hooks	
Year	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV	CPUE	CV
1960																	0.80					
1961					0.33												1.10					
1962					0.27												1.40					
1963					0.12												1.36					
1964					0.16												1.53					
1965					0.18												1.87					
1966					0.38												1.97					
1967					0.22												2.22					
1968					0.3												3.31					
1969					0.3												2.27					
1970					0.25												2.16					
1971					0.37												1.44					
1972			1.43	0.11	0.31												1.18					
1973			2.42	0.15	0.26												1.40					
1974			1.26	0.08	0.25												1.38					
1975			2.70	0.14	0.15												0.75					
1976			2.50	0.14	0.2												0.75					
1977			2.66	0.15	0.09												1.67					
1978			2.80	0.15	0.06												1.25					
1979			2.29	0.13	0.06												1.15					
1980			2.58	0.14	0.09												0.93					
1981			1.90	0.15	0.08												1.29					
1982			0.89	0.09	0.04												1.31					
1983			0.70	0.05	0.12												1.35					
1984			0.81	0.03	0.21												1.00					
1985			0.80	0.03	0.17												0.75					
1986			1.99	0.08	0.10												0.84					
1987			1.08	0.04	0.17				4.68	0.83							0.93					
1988			1.18	0.04	0.09				1.26	1.08							0.69					
1989			0.83	0.03	0.12				1.24	0.90							0.51					
1990			1.29	0.05					0.71	1.00							0.38					
1991			1.09	0.04	0.04		28.72	0.67	0.96	0.74							0.61					
1992			1.33	0.05	0.07		11.51	0.55	0.78	0.81							0.52					
1993	1.63	0.17	2.13	0.10			22.29	0.74	0.27	1.05							0.47					
1994	0.67	0.22	2.21	0.10	0.08		24.95	0.53	0.57	0.86	1.12	0.14			0.62	0.55						
1995	0.74	0.19	1.71	0.07	0.05		31.91	0.52	0.53	0.86	1.21	0.11			0.25	1.07						
1996	1.36	0.21	2.19	0.09	0.02		24.67	0.52	0.55	0.81	0.43	0.15			0.18	0.83						
1997	1.34	0.21	2.16	0.09	0.01		31.71	0.47	0.44	0.92	0.79	0.06			0.25	0.63						
1998	0.33	0.27	3.99	0.24	0.02		36.30	0.52	0.54	0.75	0.79	0.07			0.41	0.60						
1999	1.80	0.19	3.37	0.14	0.01		40.24	0.51	1.53	0.63	1.06	0.05			0.91	0.48						
2000	1.88	0.19	3.96	0.15	0.06		26.25	0.53	0.73	0.73	0.96	0.05			0.82	0.54						
2001	0.48	0.22	4.55	0.17	0.06		20.83	0.52	0.36	0.93	1.25	0.05	1.35	0.50	0.76	0.42			4.42	0.38		
2002	0.43	0.23	5.23	0.18			16.17	0.57	0.46	0.99	1.25	0.06	1.48	0.21	0.47	0.55			5.71	0.31		
2003	0.30	0.22	5.12	0.17			26.62	0.53	0.42	0.88	1.50	0.06	2.14	0.13	0.35	0.23			4.80	0.36		
2004	0.50	0.18	5.93	0.19			37.57	0.51	0.47	0.85	0.96	0.06	1.29	0.22	0.40	0.25			2.68	0.40		
2005	1.45	0.15	7.07	0.23			32.51	0.52	0.50	0.81	0.85	0.05	1.42	0.23	3.05	0.26			5.07	0.39		
2006	0.86	0.19	8.69	0.27			25.90	0.52	0.88	0.68	1.11	0.06	1.86	0.16	1.08	0.50			4.50	0.36		
2007	0.80	0.16	6.21	0.19			34.77	0.51	2.71	0.57	0.83	0.05	1.16	0.26	0.20	0.63			5.93	0.36		
2008	1.14	0.14	9.34	0.29			20.99	0.52	0.88	0.75	0.89	0.06	1.61	0.22	0.88	0.30			8.55	0.30		
2009	1.17	0.14	9.95	0.33			18.31	0.52	0.67	0.92	1.28	0.05	0.56	0.68	0.76	0.29			9.77	0.29	0.08	0.23
2010	0.97	0.15	13.80	0.47			20.32	0.52	0.78	0.92	1.06	0.06	0.35	0.22	0.65	0.28			9.70	0.28	0.12	0.24
2011	1.11	0.15	11.06	0.39			16.85	0.52	0.91	0.87	1.02	0.05	0.24	0.38	1.44	0.14			8.75	0.30	0.11	0.21
2012	1.51	0.14	11.31	0.40			30.05	0.52	1.39	0.82	0.89	0.07	0.21	0.54	0.80	0.21			8.63	0.32	0.12	0.21
2013	0.85	0.14	8.92	0.34			20.36	0.52	1.25	0.78	1.45	0.16	1.12	0.16	0.83	0.40			13.77	0.31	0.10	0.23
2014	1.00	0.14	9.08	0.35			20.33	0.53	0.68	0.97	0.81	0.11	0.45	0.27	1.35	0.36			8.59	0.34	0.05	0.24
2015	0.79	0.16	7.56	0.34			16.10	0.51	0.79	0.98	0.63	0.13	0.83	0.26	1.14	0.40			10.97	0.31	0.07	0.21
2016	1.48	0.13	5.73	0.25			12.60	0.51	1.81	0.71	0.61	0.10	1.09	0.17	1.84	0.56			8.05	0.31	0.05	0.20
2017	0.82	0.17	9.04	0.36			23.00	0.52	1.13	0.95	0.67	0.14	0.74	0.25	1.48	0.57			9.66	0.31	0.05	0.22
2018	1.44	0.15	10.91	0.44			20.32	0.55	1.14	0.97	0.63	0.08	1.53	0.12	2.28	0.54			9.93	0.29	0.05	0.21
2019	0.50	0.22	7.20	0.28			17.55	0.54			0.94	0.09	0.20	0.48	1.89	0.61			7.39	0.30	0.03	0.24
2020	1.43	0.22	8.06	0.34			14.34	0.53			1.15	0.08	0.38	0.28	1.32	0.58					0.08	0.22
2021	0.59	0.27	4.43	0.19			25.77	0.54			0.89	0.12			1.60	0.64					0.07	0.27
2022	0.64	0.22					23.61	0.51			0.82	0.10										

Table 9. E-SAI. A list of JABBA scenarios considered by the Group for East Atlantic sailfish. The S1 scenario in bold is the selected model by the Group.

Scenarios	*JABBA model descriptions*
S1	All CPUE excluding the Côte d'Ivoire and Ghana artisanal indices and r-prior based on Cerdenares-Ladronetal (2011).
S2	S1 scenario with the Côte d'Ivoire and Ghana (2 blocks defined in the 2016 stock assessment) artisanal indices
S3	S1 scenario with replacing r prior and B/B_{MSY}=1 (very close) used in 2016 stock assessment (Schaefer production model, BSP model).
S4	S1 but data up to 2014 which is the terminal year of the 2016 stock assessment (retrospective analysis with minus 7 years).
S5	S3 but data up to 2014 which is the terminal year of the 2016 stock assessment (retrospective analysis with minus 7 years).

Table 10. E-SAI. Summary of Mohn's rho models of the considered JABBA scenarios for East Atlantic sailfish. The S1 scenario in bold is the selected model by the Group.

Model	*B*	*F*	*B/B_{MSY}*	*F/F_{MSY}*	*MSY*
S1	0.043	-0.040	0.060	-0.051	-0.004
S2	-0.011	0.013	0.005	0.002	-0.005
S3	0.004	-0.003	0.052	-0.037	-0.015
S4	0.011	0.004	0.027	0.012	-0.028
S5	-0.021	0.029	-0.070	0.130	-0.044

Table 11. W-SAI. A list of JABBA scenarios considered by the Group for the West Atlantic sailfish. The S5 scenario in bold is the selected model by the Group.

Scenarios	*JABBA model descriptions*
S1	All CPUEs with fishing power catchability correction for the US-RR index, and *r*-prior based on growth-Ehrhardt and Deleveaus (2006)
S2	All CPUEs with time-block (1972-2005 and 2006-2021) for the US-RR index, and *r*-prior based on growth-Ehrhardt and Deleveaus (2006)
S3	S1 scenario without the US-RR index
S4	S2 scenario with replacing new r prior: *r*-prior based on growth Cerdenares-Ladronetal (2011) used in the 2016 stock assessment.
S5	S3 scenario with replacing new r prior: *r*-prior based on growth Cerdenares-Ladronetal (2011) used in the 2016 stock assessment.

Table 12. W-SAI. Summary of Mohn's rho statistic models computed for a retrospective evaluation period of five years for the West Atlantic sailfish. S5 scenario in bold is the selected model by the Group.

Model	*B*	*F*	*B/B_{MSY}*	*F/F_{MSY}*	*MSY*
S1	-0.062	0.067	-0.054	0.063	-0.014
S2	-0.010	0.014	-0.037	0.031	-0.007
S3	0.006	-0.005	0.012	-0.008	0.004
S4	-0.016	0.021	-0.031	0.031	-0.007
S5	0.011	-0.009	0.002	-0.009	0.001

Table 13. W-SAI. West Atlantic sailfish fleet structure in Stock Synthesis.

Fleet ID	**Label**	**Time Period**	**Description**
1	Gillnet	1986-2021	All gillnets in West Atlantic
2	Longline	1956-2021	All longlines in West Atlantic
3	Rod_Reel	1960-2021	All rod and reel in West Atlantic
4	Other	1970-2020	All other gears in West Atlantic

Table 14. W-SAI. Stock Synthesis Model 6 parameter estimates for West Atlantic sailfish.

Label	Value	Phase	Parm_StDev	Gradient	Pr_type	Prior	Pr_SD
NatM_uniform_Fem_GP_1	0.35	-2	_	_	Normal	0.2	0.04
L_at_Amin_Fem_GP_1	74	-3	_	_	No_prior		
L_at_Amax_Fem_GP_1	198.171	-1	_	_	No_prior		
VonBert_K_Fem_GP_1	0.36	-3	_	_	No_prior		
SD_young_Fem_GP_1	10	-3	_	_	No_prior		
SD_old_Fem_GP_1	20	-3	_	_	No_prior		
Wtlen_1_Fem_GP_1	1.14E-06	-2	_	_	Normal	1.14E-06	0.8
Wtlen_2_Fem_GP_1	3.2683	-2	_	_	Normal	3.2683	0.8
Mat50%_Fem_GP_1	146.12	-3	_	_	No_prior		
Mat_slope_Fem_GP_1	-0.10491	-3	_	_	No_prior		
Eggs/kg_inter_Fem_GP_1	1	-3	_	_	No_prior		
Eggs/kg_slope_wt_Fem_GP_1	0	-3	_	_	No_prior		
CohortGrowDev	1	-1	_	_	Normal	1	1
FracFemale_GP_1	0.5	-99	_	_	No_prior		
SR_LN(R0)	6.17624	-1	_	_	No_prior		
SR_BH_steep	0.731843	-1	_	_	Full_Beta	0.7	0.07
SR_sigmaR	0.6	-4	_	_	No_prior		
SR_regime	0	-4	_	_	No_prior		
SR_autocorr	0	-99	_	_	No_prior		
Main_RecrDev_1970	0.055273	_	_	_	dev		
Main_RecrDev_1971	-0.12975	_	_	_	dev		
Main_RecrDev_1972	-0.39802	_	_	_	dev		
Main_RecrDev_1973	-0.13967	_	_	_	dev		
Main_RecrDev_1974	-0.1079	_	_	_	dev		
Main_RecrDev_1975	-0.24729	_	_	_	dev		
Main_RecrDev_1976	-0.28347	_	_	_	dev		
Main_RecrDev_1977	0.240001	_	_	_	dev		
Main_RecrDev_2010	-0.10055	_	_	_	dev		
Main_RecrDev_2011	-0.61425	_	_	_	dev		
Main_RecrDev_2012	-0.4207	_	_	_	dev		
Main_RecrDev_2013	-0.05025	_	_	_	dev		
Main_RecrDev_2014	0.316639	_	_	_	dev		
Main_RecrDev_2015	0.057988	_	_	_	dev		
Main_RecrDev_2016	-0.19501	_	_	_	dev		
Main_RecrDev_2017	0.677319	_	_	_	dev		
Main_RecrDev_2018	-0.40705	_	_	_	dev		
Main_RecrDev_2019	0.03751	_	_	_	dev		
Late_RecrDev_2020	-0.08002	_	_	_	dev		
Late_RecrDev_2021	0	_	_	_	dev		
Size_DblN_peak_Gillnet_1(1)	163.78	-2	_	_	No_prior		
Size_DblN_top_logit_Gillnet_1(1)	-15	-3	_	_	Normal	-15	0.3
Size_DblN_ascend_se_Gillnet_1(1)	0.00884	-2	_	_	No_prior		
Size_DblN_descend_se_Gillnet_1(1)	0.009536	-4	_	_	No_prior		
Size_DblN_start_logit_Gillnet_1(1)	-7.98304	-1	_	_	No_prior		
Size_DblN_end_logit_Gillnet_1(1)	0.999924	-6	_	_	No_prior		
Size_DblN_peak_Longline_2(2)	168.607	-2	_	_	No_prior		
Size_DblN_top_logit_Longline_2(2)	-15	-3	_	_	Normal	-15	0.3
Size_DblN_ascend_se_Longline_2(2)	6.50731	-2	_	_	No_prior		
Size_DblN_descend_se_Longline_2(2)	5.00928	-4	_	_	No_prior		
Size_DblN_start_logit_Longline_2(2)	-15	-1	_	_	No_prior		
Size_DblN_end_logit_Longline_2(2)	-3.59107	-6	_	_	No_prior		
Size_DblN_peak_Rod_Reel_3(3)	170.692	-4	_	_	No_prior		
Size_DblN_top_logit_Rod_Reel_3(3)	14	-3	_	_	No_prior		
Size_DblN_ascend_se_Rod_Reel_3(3)	6.81975	-4	_	_	No_prior		
Size_DblN_descend_se_Rod_Reel_3(3)	4	-4	_	_	No_prior		
Size_DblN_start_logit_Rod_Reel_3(3)	-15	-1	_	_	No_prior		
Size_DblN_end_logit_Rod_Reel_3(3)	9	-6	_	_	No_prior		
minage@sel=1_Gillnet_1(1)	1	-99	_	_	No_prior		
maxage@sel=1_Gillnet_1(1)	20	-99	_	_	No_prior		
Size_DblN_peak_Gillnet_1(1)_BLK4repl_1950	171.745	-1	_	_	No_prior		
Size_DblN_peak_Gillnet_1(1)_BLK4repl_2011	156.927	-1	_	_	No_prior		
Size_DblN_top_logit_Gillnet_1(1)_BLK4repl_1950	-15	-1	_	_	Normal	-15	0.45
Size_DblN_top_logit_Gillnet_1(1)_BLK4repl_2011	-15	-1	_	_	Normal	-15	0.45
Size_DblN_ascend_se_Gillnet_1(1)_BLK4repl_1950	4.90132	-1	_	_	No_prior		
Size_DblN_ascend_se_Gillnet_1(1)_BLK4repl_2011	3.24373	-1	_	_	No_prior		
Size_DblN_descend_se_Gillnet_1(1)_BLK4repl_1950	4.61473	-1	_	_	No_prior		
Size_DblN_descend_se_Gillnet_1(1)_BLK4repl_2011	5.61911	-1	_	_	No_prior		
Size_DblN_start_logit_Gillnet_1(1)_BLK4repl_1950	-8.30375	-1	_	_	No_prior		
Size_DblN_start_logit_Gillnet_1(1)_BLK4repl_2011	-8.82104	-1	_	_	No_prior		
Size_DblN_end_logit_Gillnet_1(1)_BLK4repl_1950	-2.73003	-1	_	_	No_prior		
Size_DblN_end_logit_Gillnet_1(1)_BLK4repl_2011	-5.49271	-1	_	_	No_prior		
Size_DblN_peak_Longline_2(2)_BLK2repl_1950	158.806	-1	_	_	No_prior		
Size_DblN_peak_Longline_2(2)_BLK2repl_1991	172.79	-1	_	_	No_prior		
Size_DblN_top_logit_Longline_2(2)_BLK2repl_1950	-12.9218	-1	_	_	Normal	-12.9218	2.6
Size_DblN_top_logit_Longline_2(2)_BLK2repl_1991	-15	-1	_	_	Normal	-15	0.45
Size_DblN_ascend_se_Longline_2(2)_BLK2repl_1950	5.38689	-1	_	_	No_prior		
Size_DblN_ascend_se_Longline_2(2)_BLK2repl_1991	6.32218	-1	_	_	No_prior		
Size_DblN_descend_se_Longline_2(2)_BLK2repl_1950	5.71779	-1	_	_	No_prior		
Size_DblN_descend_se_Longline_2(2)_BLK2repl_1991	3.92617	-1	_	_	No_prior		
Size_DblN_start_logit_Longline_2(2)_BLK2repl_1950	-5.63723	-1	_	_	No_prior		
Size_DblN_start_logit_Longline_2(2)_BLK2repl_1991	-5.72281	-1	_	_	No_prior		
Size_DblN_end_logit_Longline_2(2)_BLK2repl_1950	-2.53207	-1	_	_	No_prior		
Size_DblN_end_logit_Longline_2(2)_BLK2repl_1991	-0.17912	-1	_	_	No_prior		
Size_DblN_peak_Rod_Reel_3(3)_BLK3repl_1950	164.811	-1	_	_	No_prior		
Size_DblN_peak_Rod_Reel_3(3)_BLK3repl_1988	166.435	-1	_	_	No_prior		
Size_DblN_peak_Rod_Reel_3(3)_BLK3repl_1999	157.762	-1	_	_	No_prior		
Size_DblN_top_logit_Rod_Reel_3(3)_BLK3repl_1950	-15	-1	_	_	Normal	-15	0.36
Size_DblN_top_logit_Rod_Reel_3(3)_BLK3repl_1988	-15	-1	_	_	Normal	-15	0.3
Size_DblN_top_logit_Rod_Reel_3(3)_BLK3repl_1999	15	-3	_	_	No_prior		
Size_DblN_ascend_se_Rod_Reel_3(3)_BLK3repl_1950	5.54966	-1	_	_	No_prior		
Size_DblN_ascend_se_Rod_Reel_3(3)_BLK3repl_1988	5.22914	-1	_	_	No_prior		
Size_DblN_ascend_se_Rod_Reel_3(3)_BLK3repl_1999	-5	-1	_	_	Normal	-5	0.2
Size_DblN_descend_se_Rod_Reel_3(3)_BLK3repl_1950	4.81669	-1	_	_	No_prior		
Size_DblN_descend_se_Rod_Reel_3(3)_BLK3repl_1988	4.46651	-1	_	_	No_prior		
Size_DblN_descend_se_Rod_Reel_3(3)_BLK3repl_1999	4.81975	-4	_	_	No_prior		
Size_DblN_start_logit_Rod_Reel_3(3)_BLK3repl_1950	-4.67217	-1	_	_	No_prior		
Size_DblN_start_logit_Rod_Reel_3(3)_BLK3repl_1988	-6.32513	-1	_	_	No_prior		
Size_DblN_start_logit_Rod_Reel_3(3)_BLK3repl_1999	-5.72373	-1	_	_	No_prior		
Size_DblN_end_logit_Rod_Reel_3(3)_BLK3repl_1950	-2.72861	-1	_	_	No_prior		
Size_DblN_end_logit_Rod_Reel_3(3)_BLK3repl_1988	-0.82233	-1	_	_	No_prior		
Size_DblN_end_logit_Rod_Reel_3(3)_BLK3repl_1999	9.43741	-6	_	_	No_prior		

Table 15. E-SAI. Summary of posterior quantiles presented in the form of marginal posterior medians and associated with the 95% credibility intervals (5% LCI and 95% UCI) of parameters for the final JABBA model (S1) for the East Atlantic sailfish stock.

	Median	***LCI***	***UCI***
K	23,000	17,418	32,043
r	0.263541	0.199789	0.342175
psi	0.992906	0.962329	0.999711
sigma.proc	0.169	0.107	0.206
m	0.907	0.907	0.907
Fmsy	0.291	0.22	0.377
B_{MSY}	8,051.83	6,097.88	11,217.83
MSY	2,336.67	2,002.52	2,833.38
B_{MSY}/K	0.35	0.35	0.35
B_{1957}/K	0.967	0.702	1.266
B_{2021}/K	0.641	0.398	1.007
B_{2021}/Bmsy	1.831	1.138	2.878
F_{2021}/Fmsy	0.362	0.212	0.585

Table 16. E-SAI. Biomass, B/B_{MSY} and F/F_{MSY} estimated for the East Atlantic sailfish stock in the final JABBA model (S1).

Year	Biomass			B/Bmsy			F/Fmsy		
	JABBA			JABBA			JABBA		
	Median	95%LCI	95%UCI	Median	95%LCI	95%UCI	Median	95%LCI	95%UCI
1957	22226	14600	33866	2.762	2.005	3.616	0.011	0.008	0.016
1958	21847	13637	33959	2.715	1.831	3.655	0.005	0.004	0.008
1959	21579	13284	33706	2.676	1.773	3.658	0.001	0.000	0.001
1960	21400	13189	33415	2.662	1.782	3.621	0.008	0.006	0.012
1961	23019	14545	35134	2.862	1.932	3.748	0.026	0.019	0.039
1962	21642	13414	33688	2.694	1.792	3.627	0.035	0.024	0.052
1963	21171	13059	32855	2.635	1.736	3.607	0.037	0.026	0.057
1964	22452	13987	34271	2.786	1.878	3.709	0.040	0.029	0.061
1965	22534	14103	34334	2.806	1.878	3.719	0.121	0.087	0.184
1966	21722	13497	33597	2.699	1.803	3.668	0.085	0.060	0.130
1967	20861	12867	32342	2.586	1.703	3.565	0.140	0.097	0.215
1968	21758	13443	33557	2.700	1.782	3.654	0.146	0.102	0.224
1969	22328	13832	34765	2.782	1.844	3.717	0.148	0.104	0.225
1970	21840	13584	34115	2.723	1.789	3.688	0.099	0.068	0.152
1971	19545	12235	31083	2.425	1.602	3.469	0.161	0.109	0.247
1972	17515	10995	27952	2.176	1.405	3.207	0.171	0.113	0.263
1973	16013	9985	25456	1.995	1.260	2.971	0.144	0.094	0.224
1974	15587	10115	24390	1.938	1.246	2.889	0.788	0.523	1.203
1975	13331	9060	20779	1.663	1.098	2.459	1.358	0.910	1.992
1976	10212	6776	16880	1.277	0.841	1.940	1.812	1.167	2.663
1977	7163	3982	13276	0.888	0.528	1.502	0.703	0.404	1.168
1978	8259	5006	14556	1.029	0.641	1.672	1.054	0.633	1.638
1979	8087	5040	14241	1.005	0.642	1.631	1.379	0.823	2.119
1980	7553	4458	13579	0.936	0.572	1.554	0.946	0.556	1.519
1981	8168	4947	14363	1.016	0.630	1.634	0.878	0.530	1.392
1982	9190	5710	15925	1.144	0.733	1.798	1.050	0.638	1.608
1983	8856	5579	15472	1.107	0.718	1.752	1.438	0.868	2.168
1984	7858	4527	14539	0.979	0.595	1.617	1.075	0.615	1.727
1985	7659	4335	14046	0.948	0.573	1.572	1.025	0.587	1.695
1986	7513	4269	13826	0.934	0.555	1.555	0.949	0.535	1.576
1987	7323	4265	13372	0.911	0.552	1.518	1.208	0.683	1.956
1988	6520	3635	12344	0.809	0.484	1.385	1.120	0.615	1.866
1989	5988	3328	11358	0.740	0.442	1.280	0.992	0.538	1.642
1990	5633	3245	10523	0.697	0.424	1.197	1.428	0.780	2.307
1991	4838	2650	9339	0.599	0.352	1.071	1.055	0.563	1.776
1992	4802	2792	9281	0.595	0.364	1.039	1.279	0.685	2.067
1993	4593	2660	8920	0.571	0.344	0.997	1.371	0.731	2.227
1994	4238	2426	8235	0.526	0.311	0.943	0.962	0.507	1.588
1995	4563	2634	8696	0.567	0.341	0.985	0.936	0.501	1.540
1996	4417	2582	8465	0.549	0.328	0.964	1.475	0.781	2.432
1997	3947	2191	7985	0.491	0.276	0.920	1.178	0.599	2.052
1998	4597	2575	8890	0.573	0.329	1.022	1.025	0.541	1.739
1999	5160	2959	9730	0.641	0.373	1.115	0.900	0.490	1.509
2000	6112	3712	10962	0.762	0.465	1.255	1.119	0.645	1.793
2001	6350	3988	11226	0.790	0.494	1.285	1.534	0.893	2.362
2002	6885	4234	12325	0.857	0.537	1.388	1.181	0.682	1.860
2003	6861	4239	12267	0.856	0.533	1.373	1.326	0.766	2.079
2004	7163	4356	12824	0.890	0.551	1.458	1.261	0.716	2.002
2005	7117	4228	12934	0.890	0.540	1.462	1.078	0.608	1.744
2006	7063	4173	12943	0.879	0.531	1.443	0.940	0.531	1.529
2007	7383	4447	13241	0.921	0.560	1.482	1.205	0.692	1.943
2008	7783	4585	14335	0.968	0.585	1.605	0.993	0.560	1.612
2009	8342	4929	15026	1.038	0.628	1.676	0.886	0.505	1.433
2010	9083	5374	16230	1.132	0.687	1.806	0.705	0.410	1.144
2011	11028	6586	19682	1.374	0.841	2.188	0.487	0.281	0.787
2012	14058	8459	25000	1.756	1.078	2.821	0.390	0.225	0.637
2013	15148	9047	27338	1.884	1.155	3.053	0.305	0.174	0.500
2014	13024	7818	23356	1.623	0.983	2.606	0.308	0.176	0.502
2015	12507	7470	22231	1.560	0.950	2.486	0.343	0.201	0.560
2016	12388	7472	21955	1.547	0.945	2.454	0.401	0.234	0.649
2017	10955	6488	19470	1.365	0.813	2.181	0.515	0.299	0.843
2018	10553	6217	19007	1.315	0.783	2.120	0.311	0.178	0.514
2019	11621	6953	20595	1.451	0.880	2.297	0.598	0.349	0.973
2020	12970	7777	23242	1.624	0.987	2.588	0.318	0.185	0.518
2021	14690	8905	25820	1.831	1.138	2.878	0.362	0.212	0.585

Table 17. W-SAI. Summary of posterior quantiles presented in the form of marginal posterior medians and associated with the 95% credibility intervals (5% LCI and 95% UCI) of parameters for the final JABBA model (S5) for West Atlantic sailfish stock.

	Median	**LCI**	**UCI**
K	15484.13	11439.93	22711.83
r	0.268507	0.197131	0.354176
psi	0.992695	0.962536	0.999751
sigma.proc	0.181	0.135	0.208
m	0.907	0.907	0.907
F_{MSY}	0.296	0.217	0.39
B_{MSY}	5420.648	4004.864	7950.905
MSY	1612.323	1357.427	1967.759
B_{MSY}/K	0.35	0.35	0.35
B_{1957}/K	0.908	0.638	1.246
B_{2021}/K	0.334	0.206	0.522
B_{2021}/B_{MSY}	0.955	0.588	1.491
F_{2021}/F_{MSY}	0.585	0.364	0.952

Table 18. W-SAI. B/B$_{MSY}$ and F/F$_{MSY}$ estimated for the West Atlantic sailfish stock in the final JABBA model (S5) and Stock Synthesis model (Model 6) and the joint stochastic results.

Contents	B/Bmsy or SSB/SSBmsy									F/Fmsy								
Method	JABBA			Stock Synthesis			joint results			JABBA			Stock Synthesis			joint results		
Year	median	95%LCI	95%UCI	median	95%LCI	95%UCI	median	95%LCI	95%UCI	median	95%LCI	95%UCI	median	95%LCI	95%UCI	median	95%LCI	95%UCI
1957	2.59	1.82	3.56							0.01	0.00	0.01						
1958	2.39	1.56	3.44	4.32	3.20	5.85	3.31	1.67	5.60	0.02	0.01	0.03	0.01	0.01	0.02	0.02	0.01	0.02
1959	2.15	1.40	3.15	4.32	3.20	5.85	3.18	1.50	5.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1960	1.90	1.33	2.67	4.26	3.16	5.77	2.92	1.41	5.52	0.06	0.04	0.08	0.04	0.03	0.05	0.04	0.03	0.08
1961	2.12	1.51	2.91	4.15	3.09	5.60	3.00	1.59	5.36	0.10	0.07	0.15	0.08	0.07	0.10	0.09	0.07	0.14
1962	2.32	1.67	3.16	4.05	3.02	5.45	3.09	1.76	5.23	0.10	0.07	0.14	0.08	0.07	0.10	0.09	0.07	0.13
1963	2.37	1.71	3.22	3.98	2.97	5.34	3.09	1.81	5.12	0.09	0.07	0.13	0.08	0.07	0.10	0.09	0.07	0.12
1964	2.60	1.90	3.47	3.85	2.89	5.16	3.17	2.00	4.95	0.13	0.09	0.18	0.13	0.11	0.15	0.13	0.10	0.17
1965	2.92	2.15	3.71	3.60	2.72	4.79	3.23	2.26	4.60	0.21	0.15	0.29	0.24	0.20	0.29	0.23	0.16	0.29
1966	3.11	2.33	3.79	3.50	2.65	4.63	3.29	2.42	4.46	0.13	0.10	0.18	0.17	0.14	0.20	0.15	0.10	0.20
1967	3.28	2.53	3.84	3.41	2.59	4.51	3.34	2.56	4.34	0.13	0.10	0.18	0.18	0.16	0.22	0.16	0.11	0.21
1968	3.53	2.82	3.91	3.28	2.51	4.32	3.43	2.59	4.16	0.15	0.12	0.20	0.24	0.20	0.28	0.20	0.13	0.27
1969	3.32	2.55	3.85	3.22	2.46	4.23	3.27	2.49	4.07	0.14	0.11	0.19	0.21	0.18	0.24	0.18	0.11	0.24
1970	3.11	2.32	3.78	2.99	2.30	3.91	3.05	2.31	3.83	0.25	0.19	0.35	0.36	0.31	0.41	0.32	0.20	0.40
1971	2.65	1.94	3.50	2.81	2.17	3.64	2.73	2.02	3.59	0.29	0.21	0.41	0.37	0.33	0.43	0.35	0.22	0.42
1972	2.32	1.69	3.19	2.79	2.15	3.63	2.56	1.77	3.52	0.21	0.15	0.31	0.26	0.23	0.29	0.24	0.16	0.29
1973	2.28	1.65	3.10	2.78	2.09	3.72	2.53	1.74	3.57	0.18	0.12	0.25	0.21	0.19	0.24	0.20	0.13	0.25
1974	2.12	1.52	2.92	2.64	1.94	3.59	2.36	1.60	3.43	0.22	0.15	0.32	0.26	0.22	0.30	0.24	0.16	0.31
1975	1.72	1.22	2.39	2.44	1.78	3.35	2.06	1.28	3.19	0.26	0.18	0.38	0.27	0.22	0.32	0.26	0.19	0.36
1976	1.72	1.21	2.37	2.25	1.63	3.12	1.97	1.29	2.97	0.31	0.21	0.44	0.32	0.27	0.39	0.32	0.23	0.42
1977	2.00	1.43	2.74	2.10	1.51	2.92	2.05	1.47	2.85	0.28	0.19	0.40	0.37	0.30	0.44	0.33	0.21	0.43
1978	1.89	1.35	2.59	1.98	1.42	2.75	1.93	1.38	2.68	0.26	0.18	0.36	0.34	0.28	0.41	0.31	0.19	0.40
1979	1.80	1.29	2.46	1.90	1.38	2.63	1.85	1.32	2.56	0.30	0.21	0.43	0.38	0.31	0.45	0.35	0.22	0.45
1980	1.74	1.24	2.41	1.97	1.44	2.71	1.85	1.30	2.61	0.30	0.21	0.43	0.36	0.30	0.44	0.34	0.22	0.44
1981	1.88	1.34	2.58	1.98	1.45	2.71	1.93	1.39	2.66	0.32	0.22	0.46	0.41	0.34	0.50	0.38	0.24	0.49
1982	1.90	1.36	2.59	1.95	1.43	2.67	1.92	1.39	2.64	0.34	0.24	0.49	0.44	0.36	0.53	0.40	0.25	0.52
1983	1.92	1.38	2.62	1.84	1.33	2.55	1.88	1.35	2.59	0.38	0.27	0.55	0.53	0.44	0.64	0.47	0.28	0.62
1984	1.73	1.24	2.38	1.62	1.17	2.26	1.68	1.20	2.32	0.41	0.29	0.59	0.56	0.46	0.68	0.50	0.30	0.66
1985	1.51	1.08	2.08	1.53	1.12	2.11	1.52	1.10	2.10	0.41	0.28	0.59	0.51	0.42	0.62	0.48	0.30	0.62
1986	1.46	1.04	2.00	1.45	1.06	1.99	1.45	1.05	2.00	0.53	0.37	0.76	0.65	0.54	0.79	0.61	0.39	0.78
1987	1.40	1.00	1.94	1.34	0.97	1.85	1.37	0.98	1.90	0.53	0.36	0.75	0.68	0.56	0.83	0.63	0.39	0.81
1988	1.19	0.86	1.64	1.14	0.83	1.58	1.17	0.84	1.61	0.59	0.42	0.84	0.75	0.61	0.91	0.69	0.44	0.89
1989	1.01	0.72	1.39	0.93	0.67	1.29	0.97	0.69	1.35	0.65	0.45	0.93	0.80	0.65	0.98	0.74	0.48	0.96
1990	0.86	0.61	1.20	0.78	0.58	1.07	0.82	0.59	1.15	0.89	0.62	1.27	0.97	0.79	1.20	0.94	0.66	1.24
1991	0.89	0.64	1.21	0.82	0.61	1.12	0.85	0.62	1.17	0.86	0.60	1.20	0.97	0.77	1.22	0.92	0.64	1.21
1992	0.84	0.61	1.15	0.82	0.60	1.14	0.83	0.61	1.14	1.07	0.76	1.50	1.15	0.91	1.45	1.12	0.80	1.48
1993	0.74	0.53	1.03	0.72	0.51	1.01	0.73	0.52	1.02	1.18	0.82	1.66	1.23	0.96	1.56	1.21	0.87	1.62
1994	0.70	0.48	1.00	0.65	0.45	0.93	0.67	0.46	0.97	1.00	0.68	1.44	1.11	0.86	1.43	1.06	0.72	1.43
1995	0.65	0.43	0.95	0.55	0.37	0.81	0.59	0.39	0.90	1.17	0.78	1.71	1.29	0.98	1.69	1.24	0.83	1.70
1996	0.57	0.38	0.85	0.52	0.36	0.77	0.55	0.36	0.82	1.24	0.83	1.83	1.24	0.94	1.63	1.24	0.87	1.75
1997	0.59	0.39	0.88	0.53	0.36	0.79	0.56	0.37	0.85	1.32	0.88	1.92	1.32	0.99	1.75	1.32	0.92	1.84
1998	0.65	0.43	0.96	0.57	0.39	0.84	0.61	0.41	0.92	1.54	1.04	2.21	1.41	1.06	1.88	1.47	1.05	2.10
1999	0.78	0.52	1.15	0.77	0.53	1.11	0.77	0.53	1.13	1.26	0.84	1.81	1.30	0.97	1.72	1.28	0.89	1.76
2000	0.81	0.55	1.18	0.66	0.45	0.96	0.73	0.48	1.12	1.53	1.04	2.17	1.60	1.20	2.11	1.57	1.10	2.14
2001	0.68	0.47	0.97	0.55	0.38	0.81	0.61	0.40	0.93	1.64	1.14	2.30	1.61	1.21	2.13	1.63	1.17	2.22
2002	0.66	0.45	0.95	0.43	0.30	0.63	0.53	0.31	0.90	1.93	1.34	2.69	2.03	1.52	2.69	1.98	1.41	2.70
2003	0.58	0.39	0.85	0.42	0.29	0.62	0.49	0.31	0.80	1.62	1.09	2.30	1.66	1.24	2.22	1.64	1.15	2.26
2004	0.58	0.39	0.84	0.48	0.33	0.70	0.53	0.35	0.80	1.85	1.28	2.61	1.69	1.26	2.24	1.76	1.27	2.48
2005	0.68	0.46	0.98	0.58	0.40	0.84	0.63	0.42	0.94	1.69	1.16	2.36	1.62	1.22	2.15	1.65	1.18	2.27
2006	0.75	0.51	1.09	0.59	0.41	0.87	0.67	0.43	1.03	1.60	1.09	2.25	1.71	1.27	2.27	1.66	1.16	2.26
2007	0.81	0.54	1.19	0.60	0.41	0.88	0.70	0.44	1.12	1.20	0.80	1.72	1.39	1.03	1.86	1.31	0.86	1.81
2008	0.94	0.63	1.37	0.64	0.44	0.94	0.77	0.47	1.30	1.15	0.77	1.66	1.49	1.11	1.99	1.33	0.82	1.91
2009	1.02	0.68	1.49	0.65	0.45	0.96	0.81	0.48	1.39	1.00	0.66	1.45	1.40	1.04	1.87	1.21	0.71	1.79
2010	1.05	0.69	1.54	0.74	0.51	1.07	0.88	0.54	1.45	0.73	0.49	1.07	1.08	0.80	1.45	0.91	0.52	1.39
2011	1.11	0.73	1.62	0.75	0.52	1.10	0.91	0.55	1.53	0.75	0.50	1.10	1.15	0.85	1.54	0.95	0.54	1.47
2012	1.15	0.76	1.68	0.70	0.48	1.03	0.89	0.51	1.58	0.69	0.46	1.03	1.16	0.86	1.55	0.93	0.49	1.48
2013	1.18	0.77	1.71	0.67	0.46	0.99	0.88	0.49	1.62	0.52	0.35	0.78	1.01	0.75	1.35	0.76	0.37	1.28
2014	1.00	0.65	1.48	0.62	0.42	0.91	0.78	0.45	1.39	0.54	0.36	0.80	0.94	0.70	1.26	0.74	0.38	1.20
2015	1.02	0.66	1.50	0.57	0.39	0.83	0.75	0.41	1.42	0.61	0.40	0.92	1.06	0.79	1.41	0.84	0.43	1.35
2016	1.03	0.66	1.53	0.55	0.38	0.80	0.74	0.40	1.44	0.84	0.55	1.28	1.36	1.01	1.81	1.11	0.59	1.73
2017	0.99	0.64	1.47	0.61	0.42	0.89	0.77	0.45	1.39	0.88	0.58	1.34	1.35	1.01	1.81	1.14	0.62	1.72
2018	1.00	0.64	1.48	0.52	0.36	0.77	0.71	0.38	1.39	1.03	0.68	1.56	1.61	1.20	2.14	1.34	0.73	2.05
2019	0.89	0.58	1.34	0.53	0.36	0.78	0.68	0.38	1.26	1.02	0.66	1.54	1.40	1.04	1.88	1.23	0.71	1.80
2020	1.00	0.65	1.52	0.57	0.38	0.85	0.75	0.41	1.42	1.07	0.69	1.64	1.66	1.22	2.24	1.38	0.74	2.13
2021	0.96	0.59	1.49	0.64	0.40	1.04	0.78	0.43	1.39	0.58	0.36	0.95	0.95	0.63	1.42	0.76	0.39	1.32

Table 19. E-SAI. Kobe 2 Strategic Matrices for the eastern sailfish stock from the JABBA final model. Top: the probability that overfishing is not occurring (F<=F_{MSY}); middle: the probability that the stock is not overfished (B>=B_{MSY}); and bottom: the joint probability of being in the green quadrant of the Kobe plot (i.e., F<= F_{MSY} and B>= B_{MSY}). The first column shows the constant catch scenario "CXXX" values.

(a) Probability F<=F_{MSY}

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
C0	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
C1000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
C1250	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
C1500	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
C1750	100%	100%	100%	99%	99%	99%	99%	99%	99%	99%
C2000	99%	99%	98%	98%	97%	97%	96%	95%	94%	94%
C2250	98%	97%	95%	94%	92%	90%	88%	86%	84%	83%
C2336	98%	96%	94%	91%	89%	87%	84%	82%	79%	77%
C2500	97%	94%	90%	86%	83%	79%	75%	71%	68%	65%
C2750	94%	88%	82%	75%	69%	64%	58%	52%	48%	44%
C3000	90%	81%	72%	62%	54%	46%	40%	35%	30%	27%

(b) Probability B>=B_{MSY}

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
C0	98%	99%	100%	100%	100%	100%	100%	100%	100%	100%
C1000	98%	99%	99%	99%	99%	99%	99%	100%	100%	100%
C1250	98%	99%	99%	99%	99%	99%	99%	99%	99%	99%
C1500	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
C1750	98%	98%	97%	97%	97%	97%	96%	96%	95%	96%
C2000	98%	97%	97%	96%	95%	94%	93%	92%	91%	91%
C2250	98%	97%	95%	93%	92%	90%	88%	86%	84%	82%
C2336	98%	97%	95%	92%	90%	88%	85%	83%	81%	78%
C2500	98%	96%	94%	91%	87%	84%	80%	77%	73%	70%
C2750	98%	96%	92%	87%	82%	76%	71%	65%	60%	55%
C3000	98%	95%	89%	83%	75%	67%	60%	52%	46%	40%

(c) Probability F<=F_{MSY} and B>=B_{MSY}

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
C0	98%	99%	100%	100%	100%	100%	100%	100%	100%	100%
C1000	98%	99%	99%	99%	99%	99%	99%	100%	100%	100%
C1250	98%	99%	99%	99%	99%	99%	99%	99%	99%	99%
C1500	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%
C1750	98%	98%	97%	97%	97%	97%	96%	96%	95%	96%
C2000	98%	97%	96%	96%	95%	94%	93%	92%	91%	91%
C2250	98%	96%	94%	93%	91%	89%	87%	85%	82%	81%
C2336	98%	96%	93%	91%	88%	86%	83%	81%	78%	76%
C2500	97%	93%	90%	86%	82%	78%	74%	71%	67%	64%
C2750	94%	88%	82%	75%	69%	63%	58%	52%	48%	44%
C3000	90%	81%	72%	62%	54%	46%	40%	35%	30%	27%

Table 20. W-SAI. Kobe 2 Strategic Matrices for the western sailfish stock from the joint projections of the JABBA and Stock Synthesis final models. Top: the probability that overfishing is not occurring ($F<=F_{MSY}$); middle: the probability that the stock is not overfished ($B>=B_{MSY}$); and bottom: the joint probability of being in the green quadrant of the Kobe plot (i.e., $F<= F_{MSY}$ and $B>= B_{MSY}$).

(a) Probability $F<=F_{MSY}$

Catch (t)	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
1000	75%	81%	85%	89%	91%	94%	96%	97%	99%	99%
1250	60%	63%	65%	68%	70%	72%	74%	76%	78%	80%
1500	46%	47%	47%	47%	48%	49%	48%	36%	45%	48%
1566	43%	43%	43%	43%	44%	47%	31%	31%	30%	30%

(b) Probability $B>=B_{MSY}$

Catch (t)	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0	58%	84%	95%	99%	100%	100%	100%	100%	100%	100%
1000	47%	55%	62%	68%	74%	78%	83%	87%	91%	94%
1250	45%	49%	52%	54%	57%	60%	63%	66%	68%	71%
1500	43%	43%	43%	44%	45%	44%	45%	40%	43%	46%
1566	43%	42%	41%	42%	41%	44%	37%	33%	33%	33%

(c) Probability $F<=F_{MSY}$ and $B>=B_{MSY}$

Catch (t)	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0	58%	84%	95%	99%	100%	100%	100%	100%	100%	100%
1000	47%	55%	62%	68%	74%	78%	83%	87%	91%	94%
1250	45%	48%	50%	53%	56%	59%	62%	64%	67%	70%
1500	41%	40%	40%	41%	41%	44%	38%	33%	41%	40%
1566	40%	38%	37%	37%	40%	36%	29%	29%	29%	28%

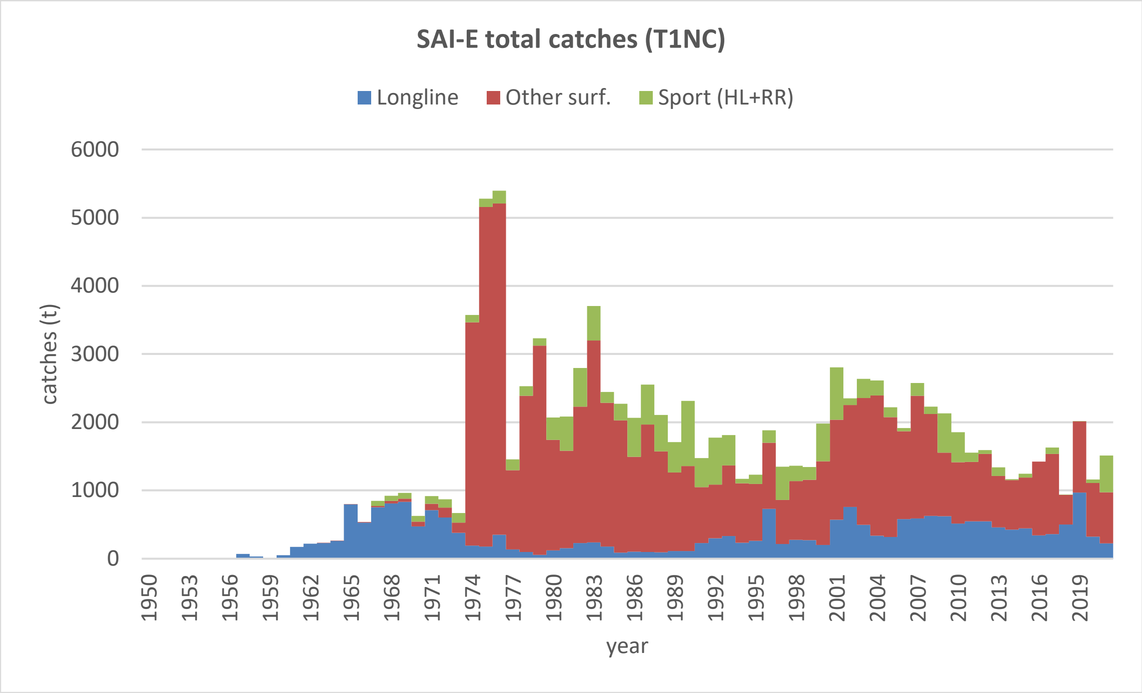


Figure 1. SAI-E catches (t) in Task 1.

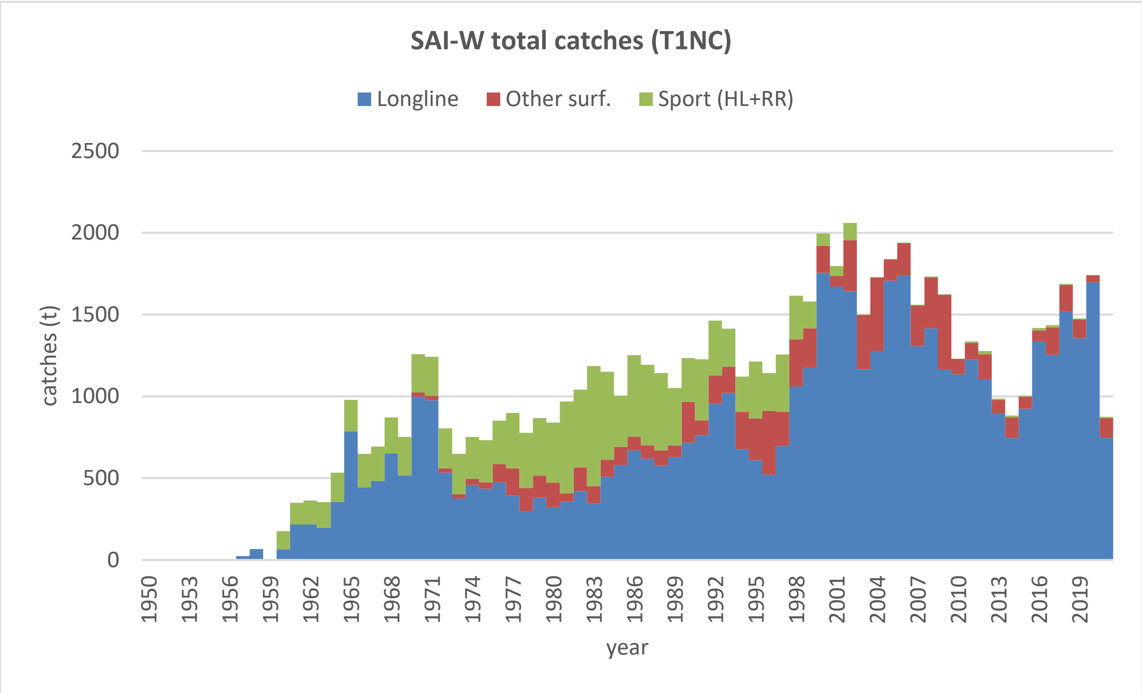


Figure 2. SAI-W catches (t) in Task 1.

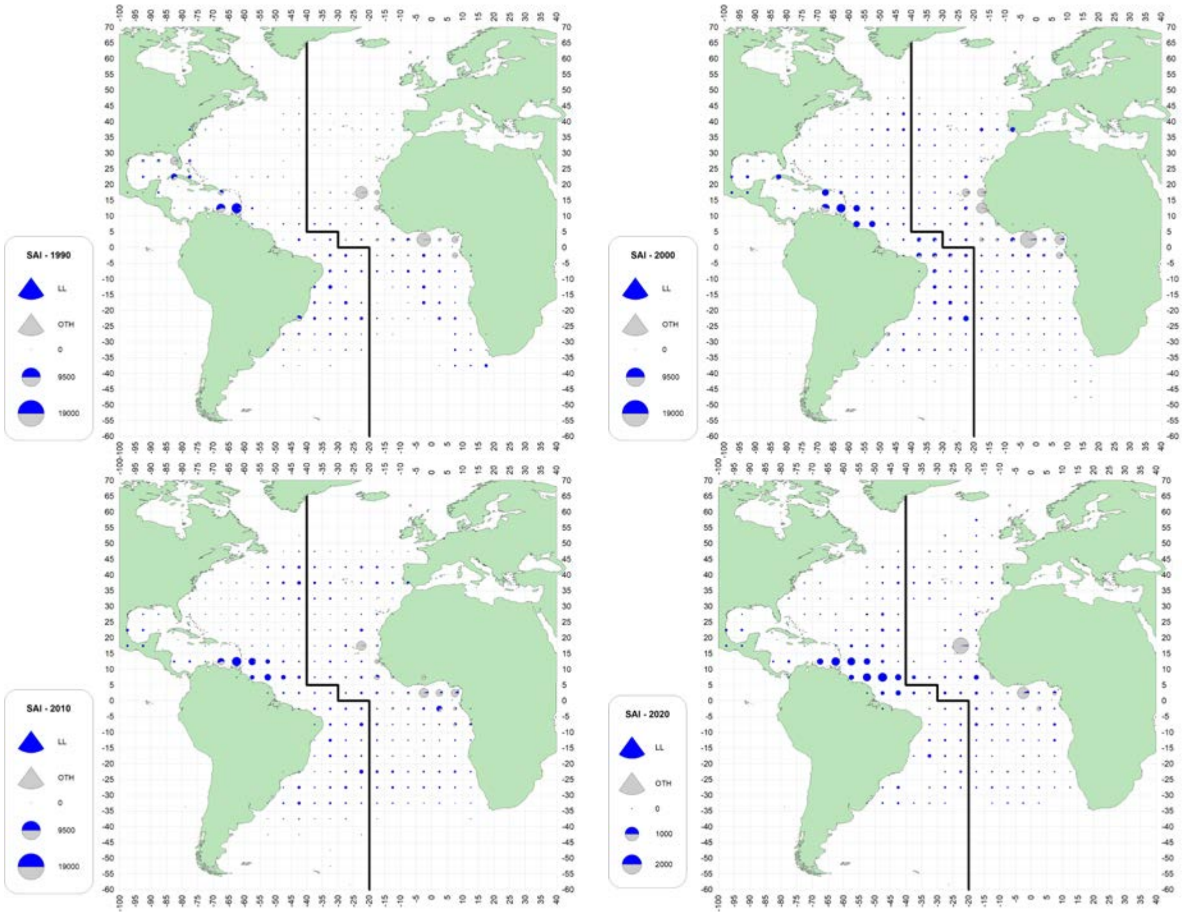


Figure 3. SAI geographical distribution of catches (t) by decade and gear (source: CATDIS). The last decade includes only 2020 and 2021.

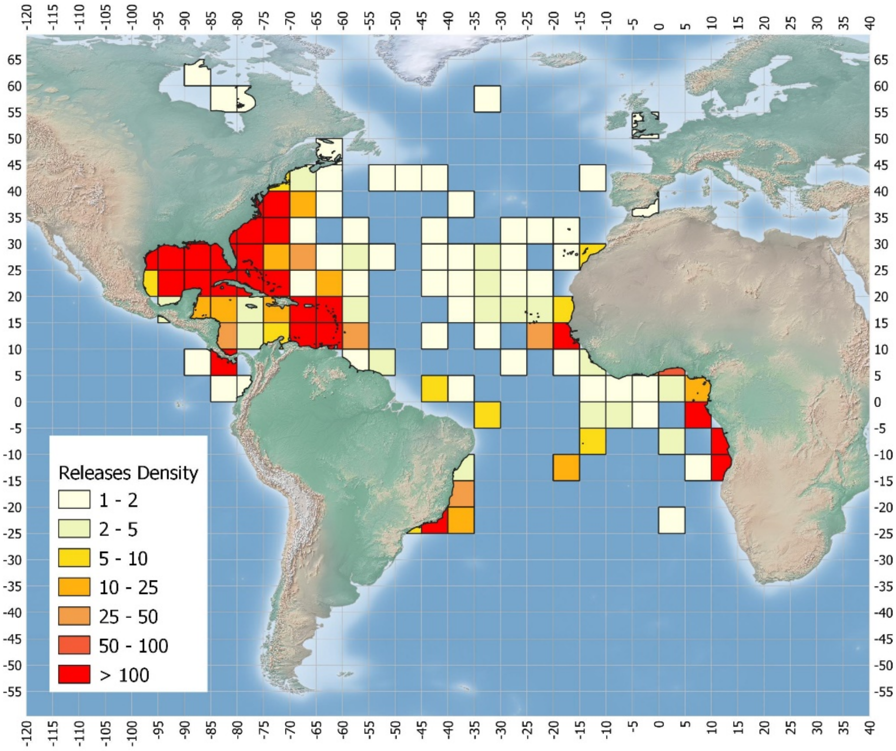


Figure 4. Density of SAI conventional tags released in a 5x5 square grid, in the ICCAT Convention area.

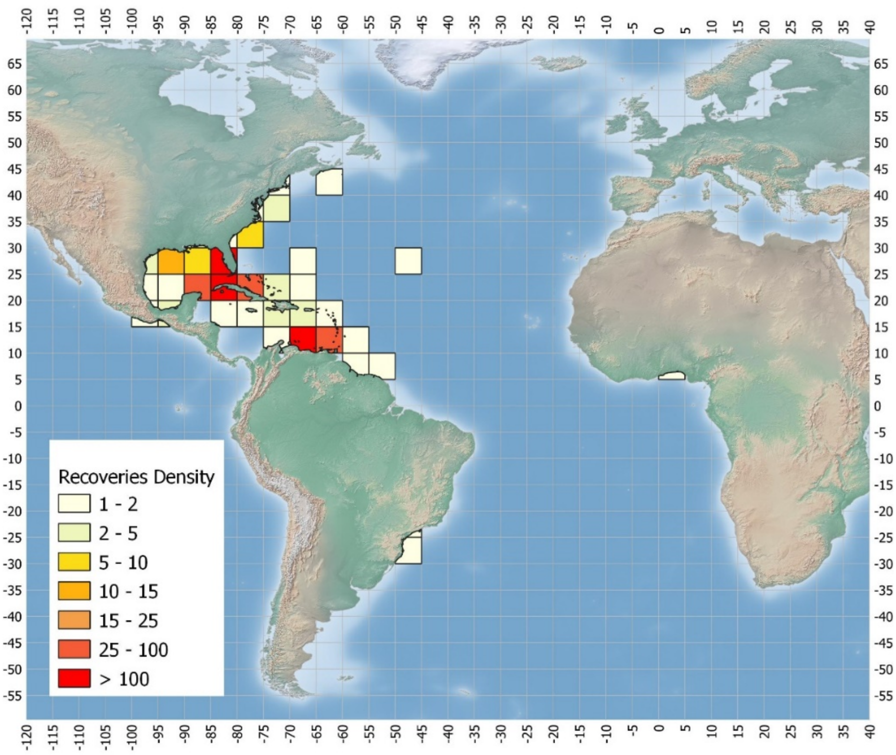


Figure 5. Density of SAI conventional tags recovered in a 5x5 square grid, in the ICCAT Convention area.

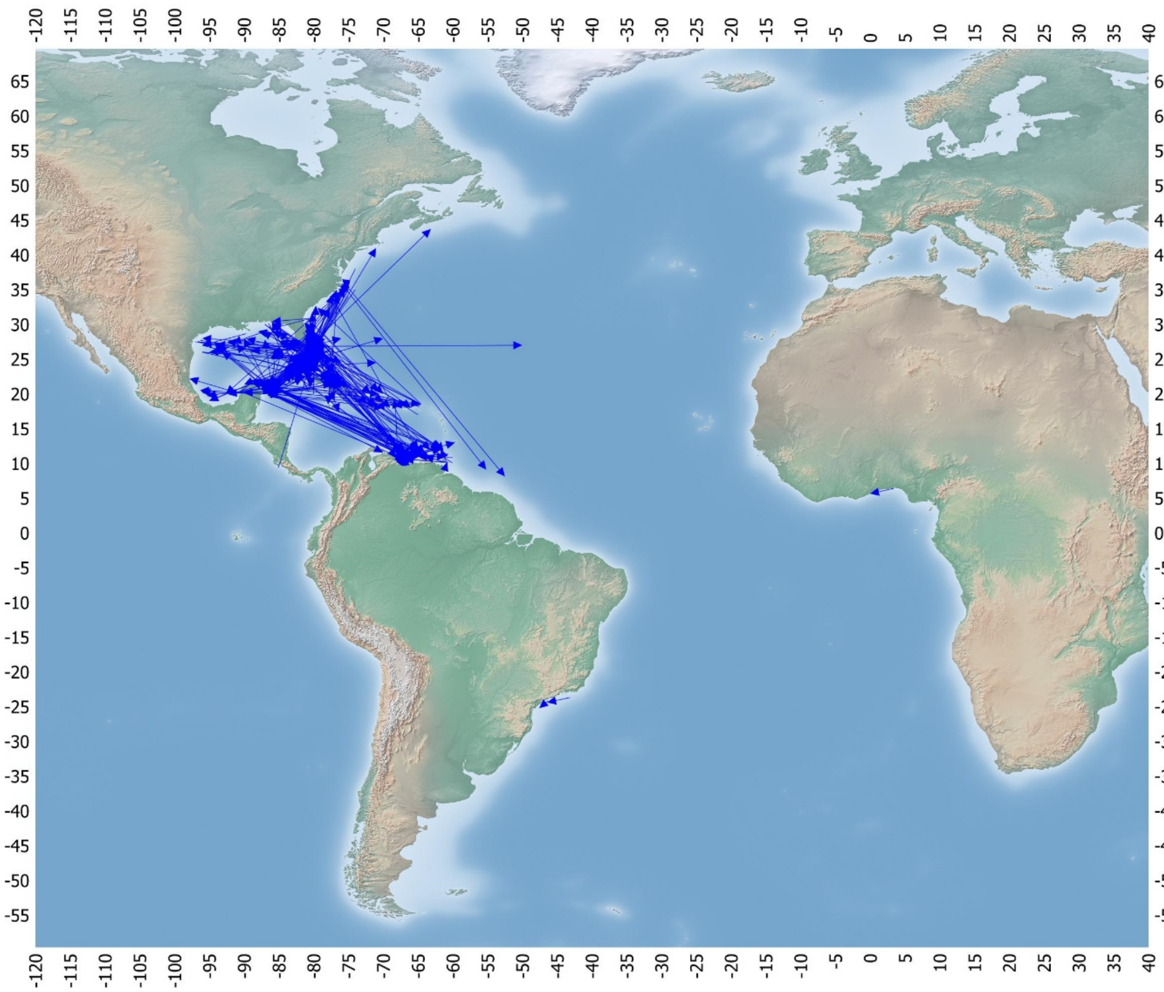


Figure 6. Apparent movement (arrows: release to recovery location) of the SAI conventional tagging.

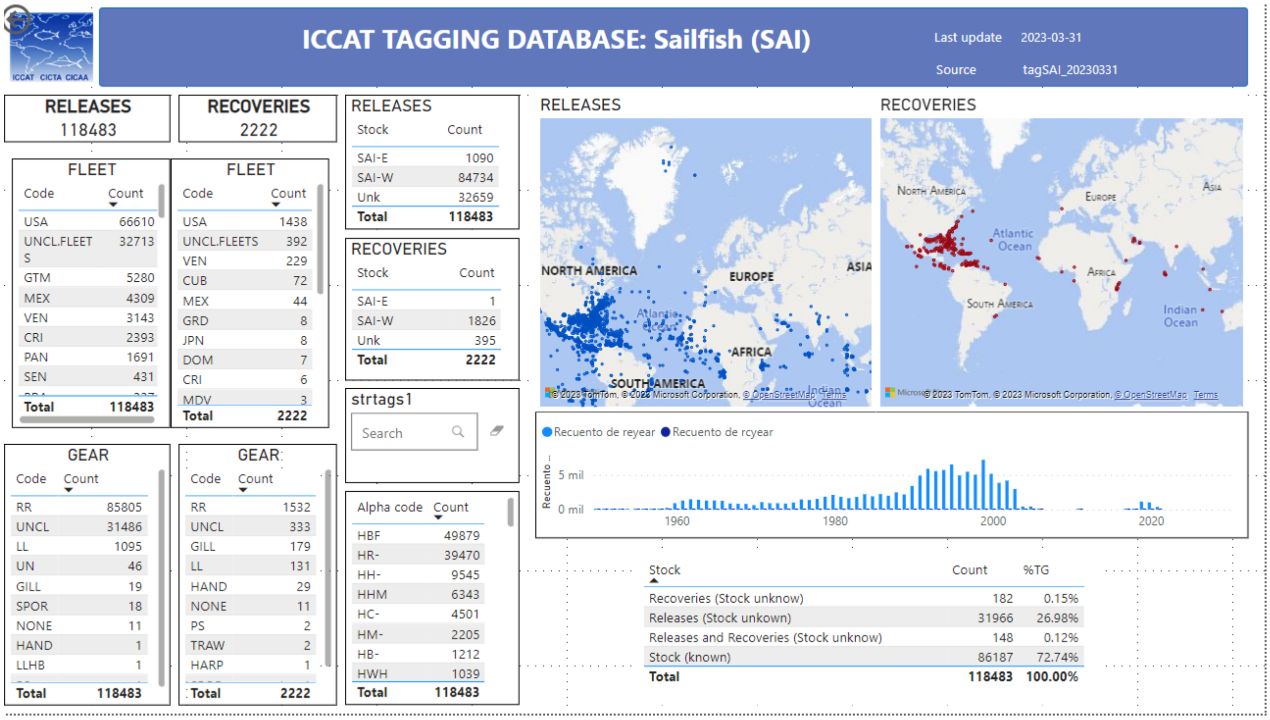


Figure 7. Snapshot of the conventional tagging dashboard (SAI).

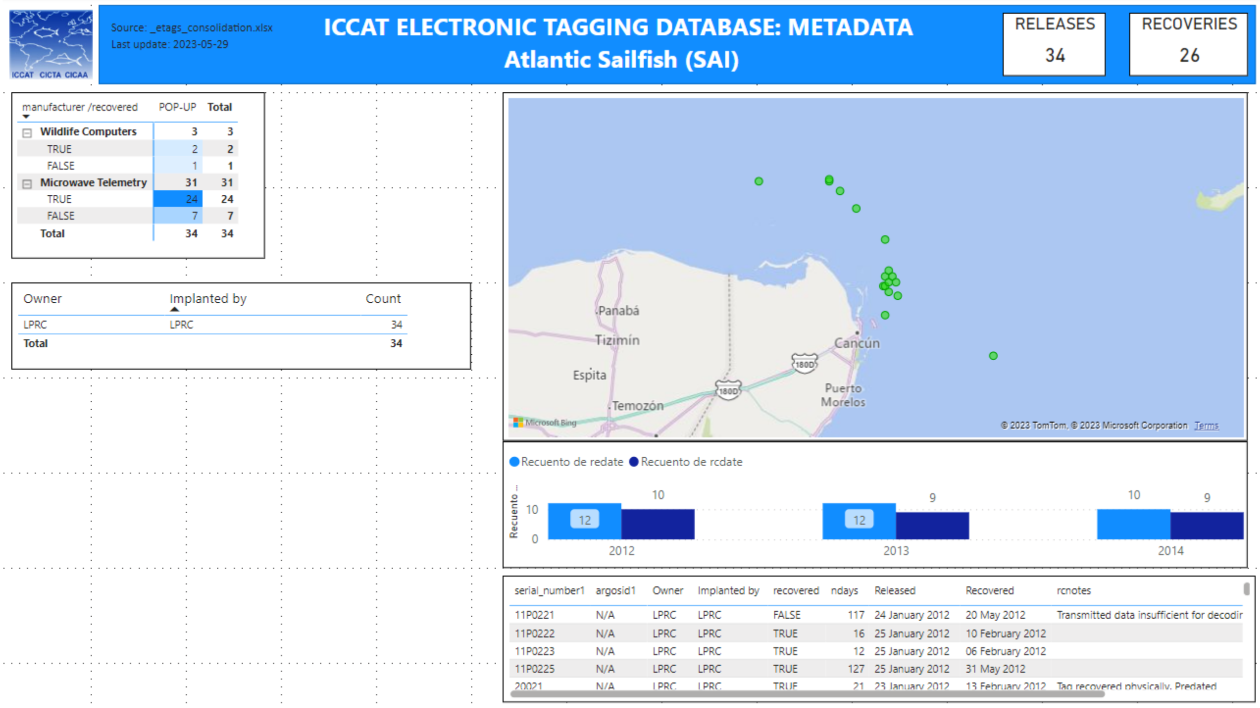


Figure 8. Snapshot of the electronic tagging dashboard (SAI).

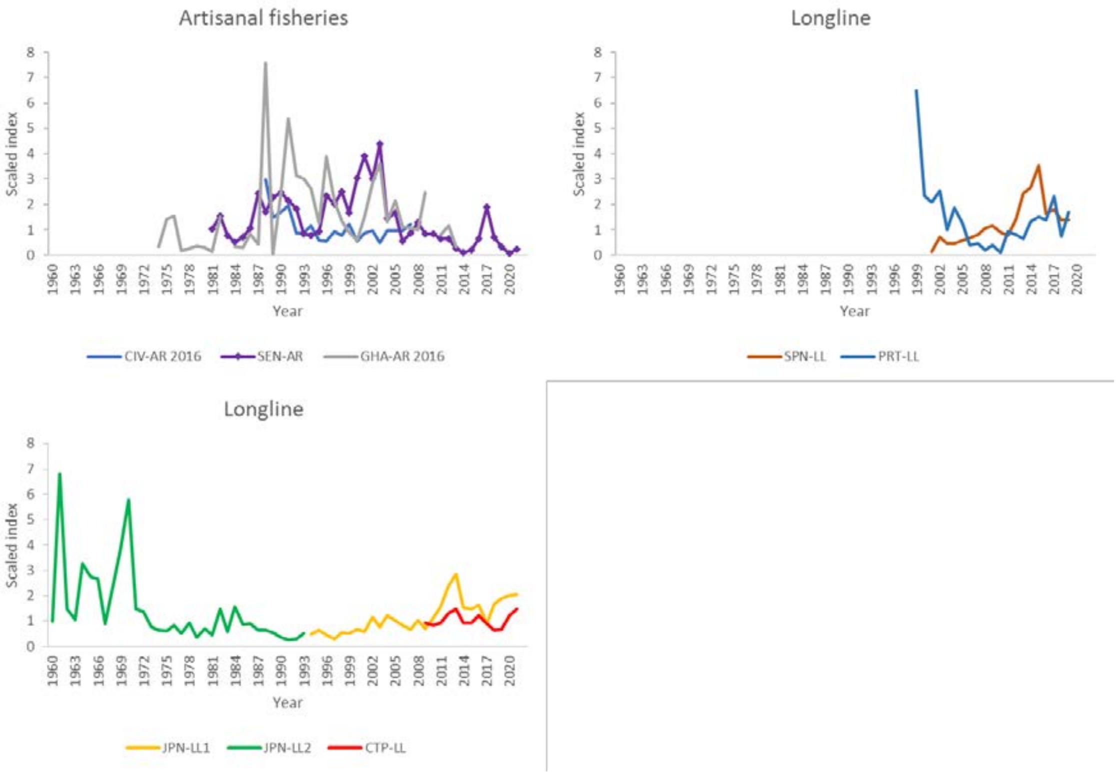


Figure 9. Available abundance indices for the East Atlantic sailfish stock. Côte d'Ivoire and Ghana artisanal indices from the 2016 stock assessment were excluded from the 2023 stock assessment. The 1999-year point of Portugal longline (PRT-LL) was not used in the stock assessment.

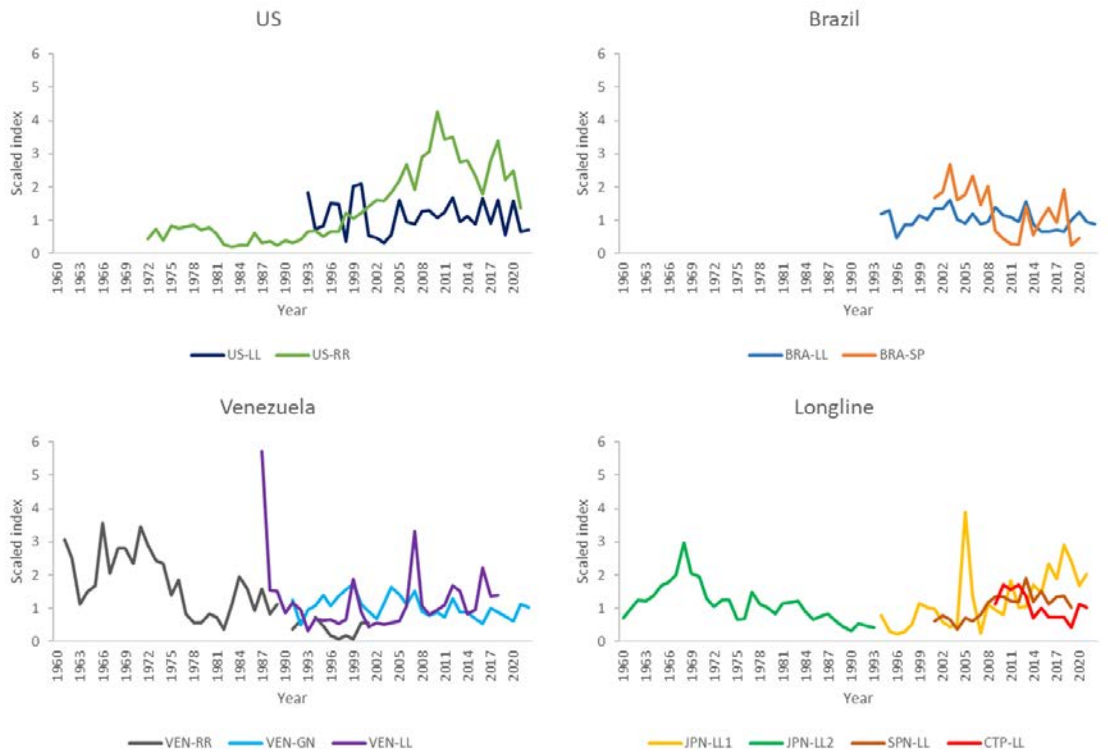


Figure 10. Available abundance indices for the West Atlantic sailfish stock. Brazil sport rod and reel (BRA-SP), Venezuela gillnet (VEN-GN), 1987-year point of Venezuela longline (VEN-LL), and 2005-year point of Japan longline (JPN-LL1) were not used in the stock assessment.

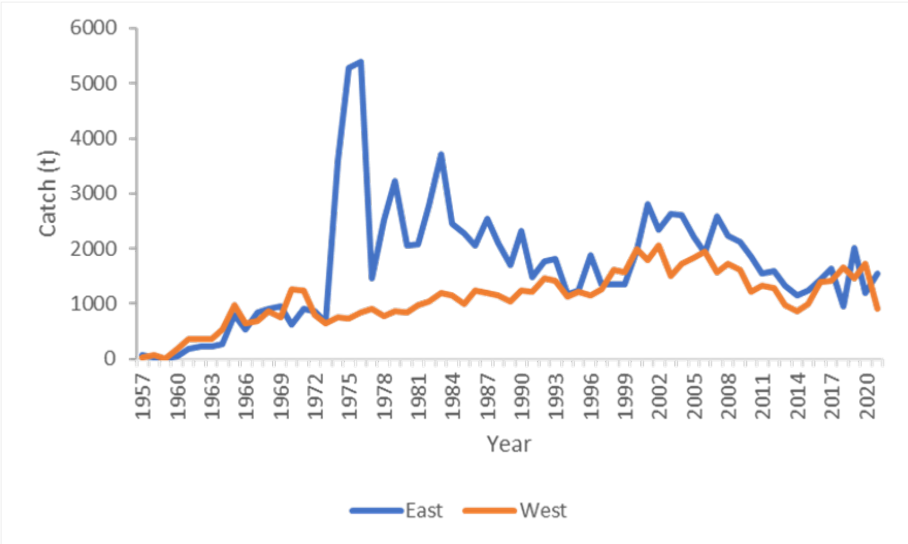


Figure 11. Total catch in tons from 1957-2021 used in JABBA models for the East (blue) and West (orange) Atlantic sailfish stock assessments.

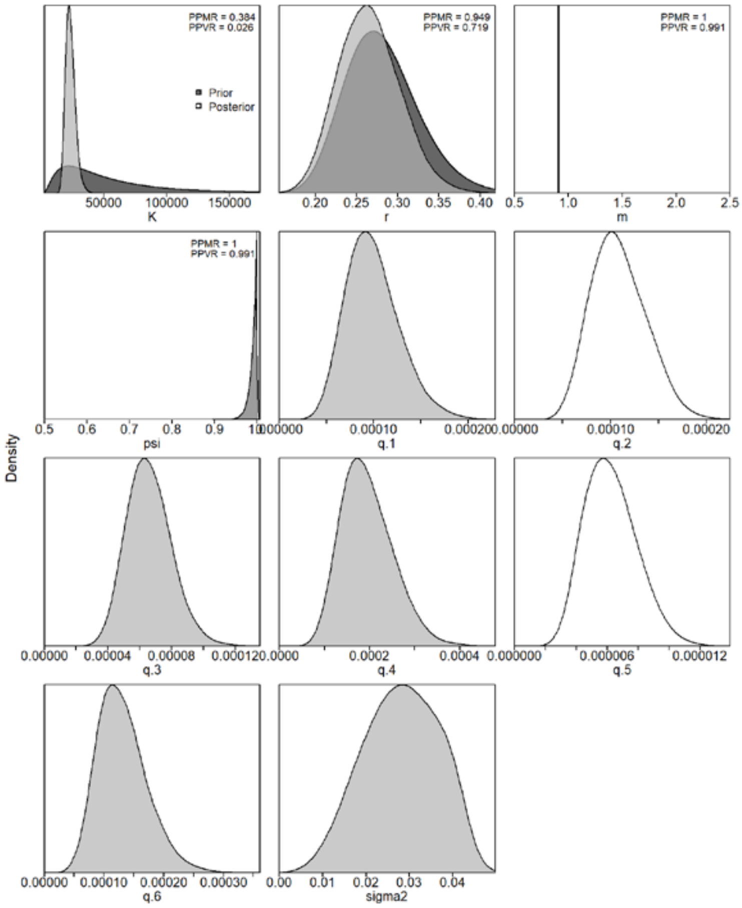


Figure 12. E-SAI. Prior and posterior distributions of the JABBA S1 scenario for the East Atlantic sailfish stock. PPRM: Posterior to Prior Ratio of Means; PPRV: Posterior to Prior Ratio of Variances.

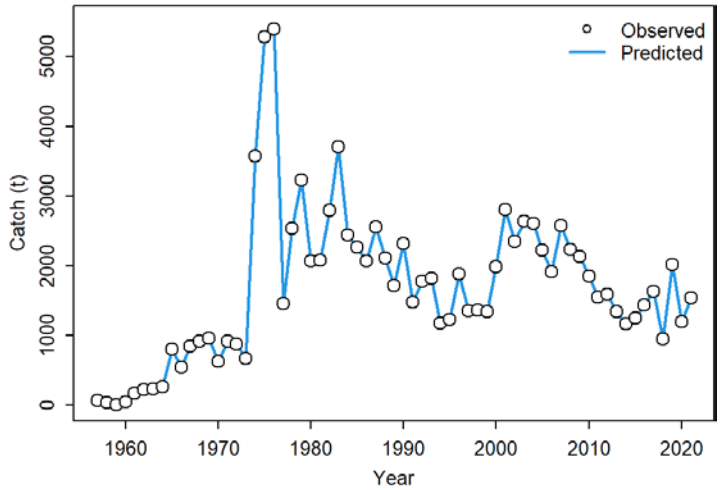


Figure 13. E-SAI. Comparison of catch time series between input data (observed) and predicted catch from the JABBA S1 scenario for the East Atlantic sailfish stock.

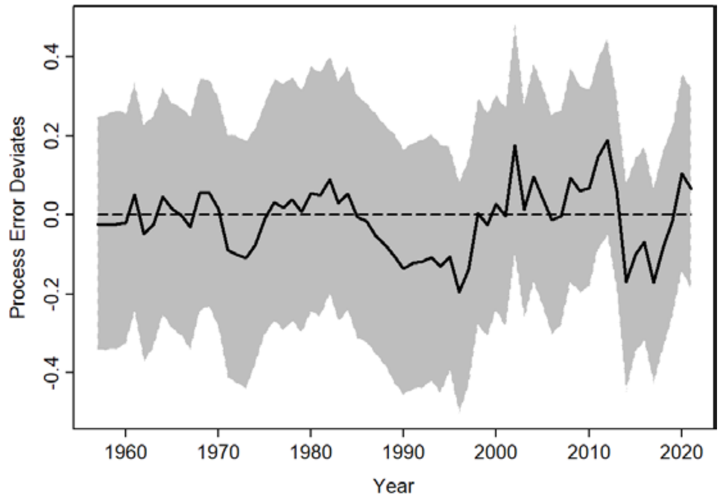


Figure 14. E-SAI. Process error deviates (median: solid line) for the East Atlantic sailfish JABBA S1 scenario. The shaded grey area indicates 95% credibility intervals.

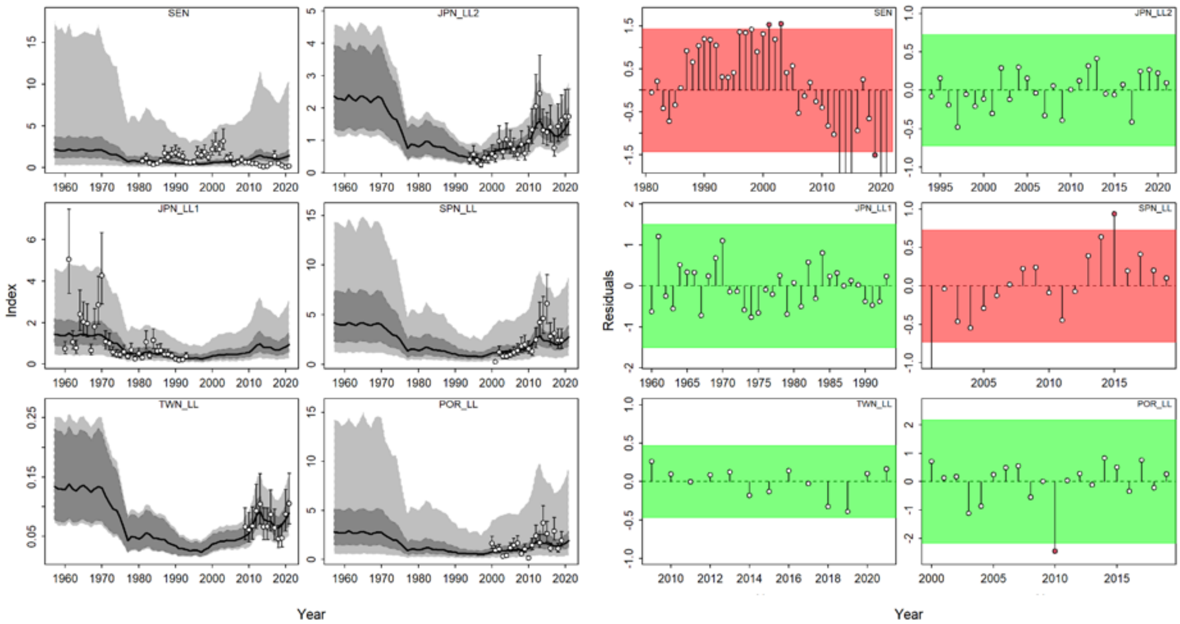


Figure 15. E-SAI. Left panel: Time series of observed (circle, input data) and predicted (solid line) CPUE of the East Atlantic sailfish JABBA S1 scenario. The dark-grey shaded areas show 95% credibility intervals of the expected mean CPUE, and the light-grey shaded areas denote the 95% posterior predictive distribution intervals. Right panel: Runs tests to evaluate the randomness of the time series of CPUE residuals by fleet for the JABBA S1 scenario. Green panels indicate no evidence of lack of randomness of time-series residuals (*p*>0.05), while red panels indicate possible autocorrelation. 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).

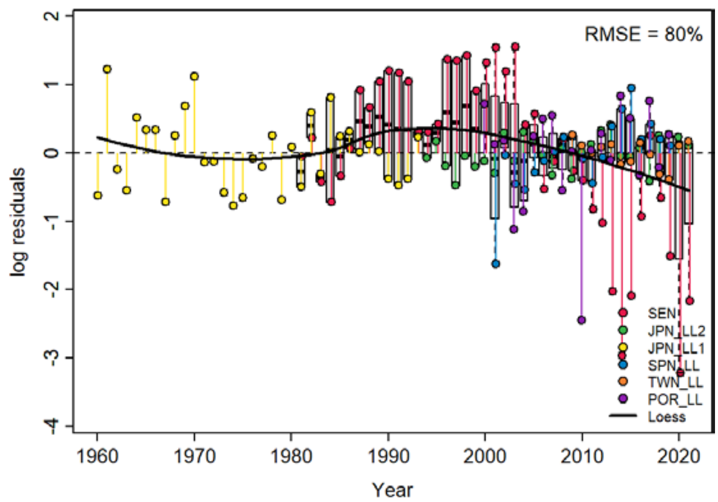


Figure 16. E-SAI. Residual diagnostic plots of CPUE indices for the East Atlantic sailfish JABBA S1 scenario. Boxplots indicate the median and quantiles of all residuals available for any given year, and solid black lines indicate a loess smoother through all residuals.

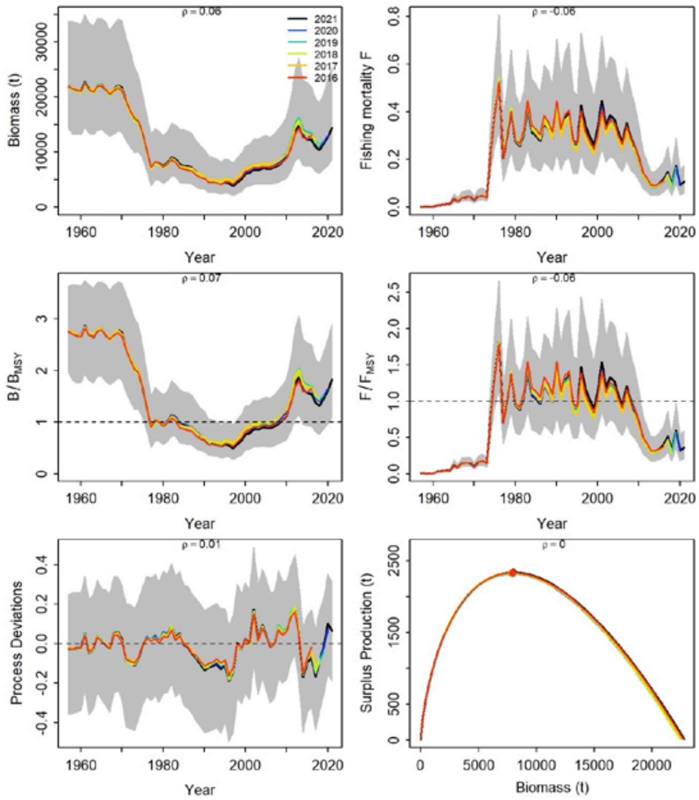


Figure 17. E-SAI. Retrospective analysis of the JABBA S1 scenario for East Atlantic sailfish, by removing one year at a time sequentially (n=5) and predicting the trends in biomass and fishing mortality (upper panels), biomass relative to B_{MSY} (B/B_{MSY}) and fishing mortality relative to F_{MSY} (F/F_{MSY}) (middle panels) and biomass relative to K (B/K) and surplus production curve (bottom panels).

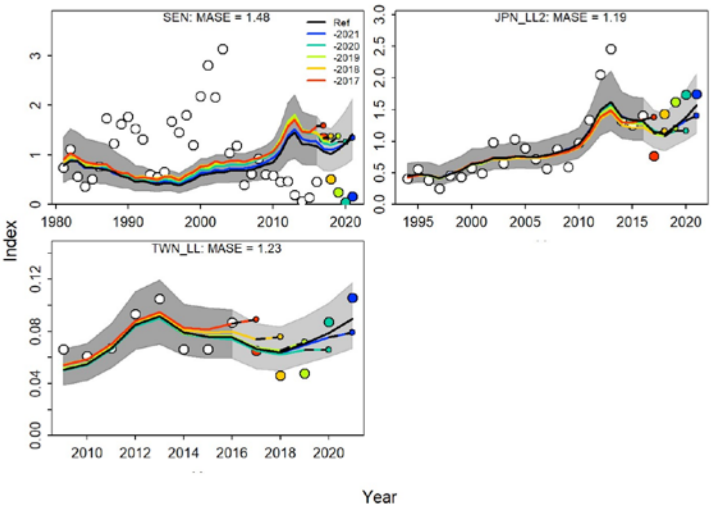


Figure 18. E-SAI. Hindcasting cross-validation results for the JABBA S1 scenario for East Atlantic sailfish, showing one-year-ahead forecasts of CPUE values (2017-2021), performed with five hindcast model runs relative to the expected CPUE. The CPUE observations used for cross-validation are highlighted as color-coded solid circles with the 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).

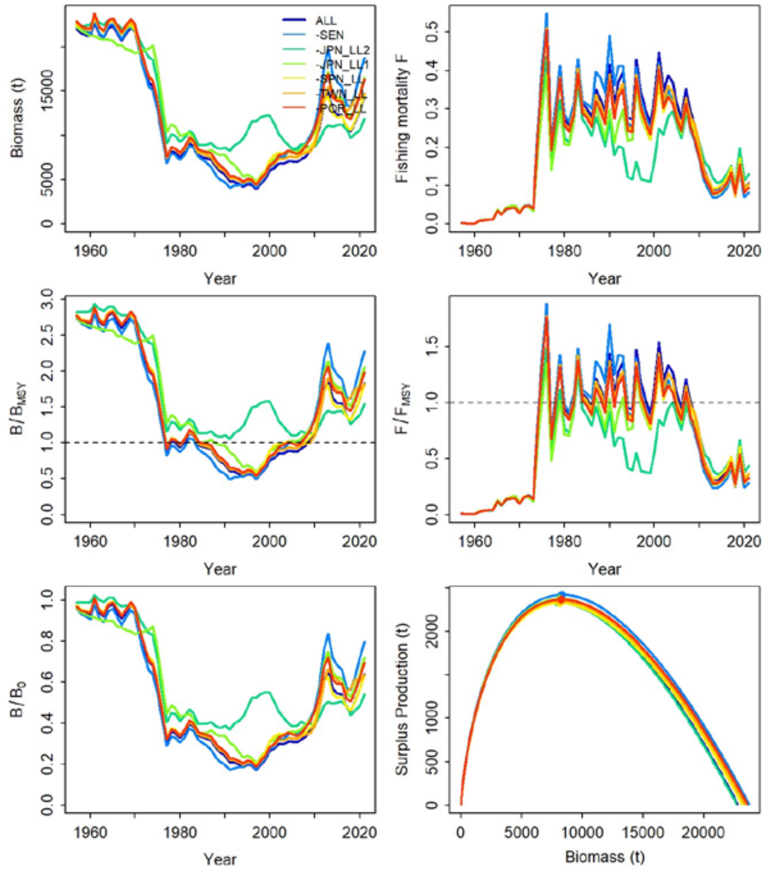


Figure 19. E-SAI. Jackknife index analysis of the East Atlantic sailfish JABBA S1 scenario, by removing one CPUE fleet at a time and predicting the trends in biomass and fishing mortality (upper panels), biomass relative to B_{MSY} (B/B_{MSY}) and fishing mortality relative to F_{MSY} (F/F_{MSY}) (middle panels) and biomass relative to K (B/K) and surplus production curve (bottom panels).

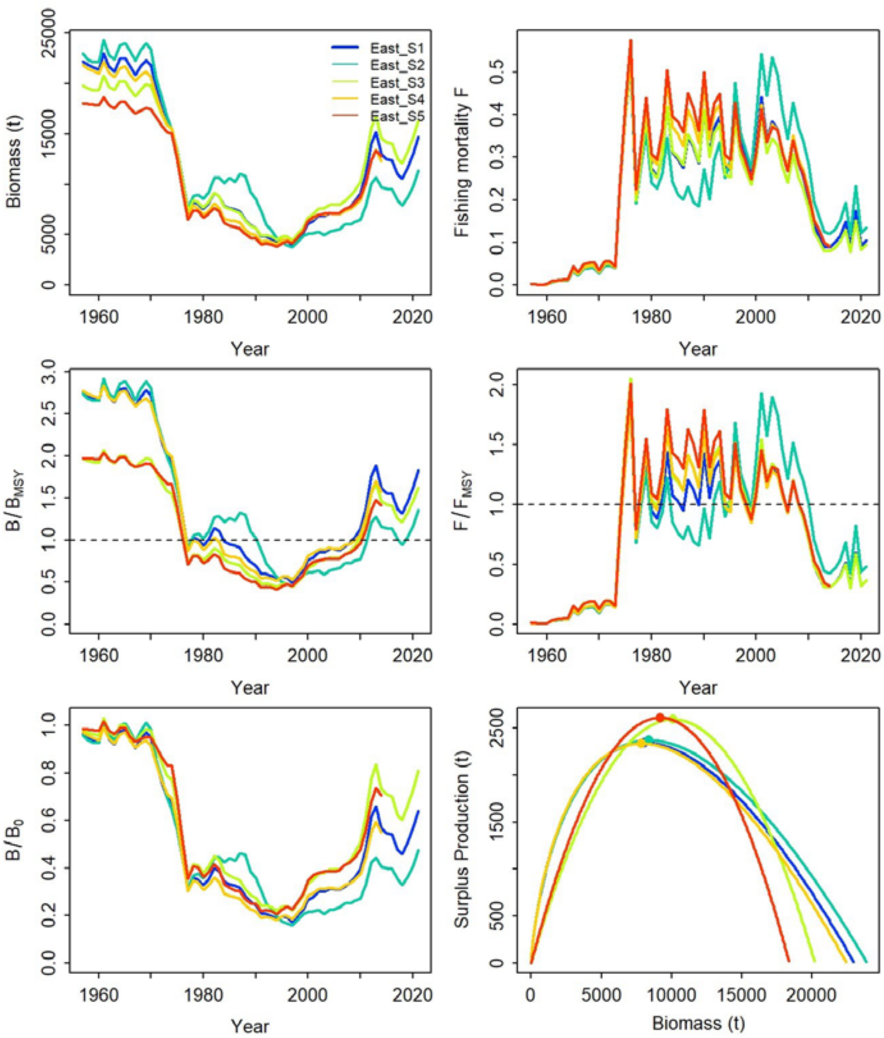


Figure 20. E-SAI. Sensitivity analysis of the East Atlantic sailfish JABBA S1-S5 scenarios. Comparisons of outputs between scenarios one at a time and predicting the trends in biomass and fishing mortality (upper panels), biomass relative to B_{MSY} (B/B_{MSY}) and fishing mortality relative to F_{MSY} (F/F_{MSY}) (middle panels) and biomass relative to K (B/K) and surplus production curve (bottom panels).

(a) S1 (b) S2

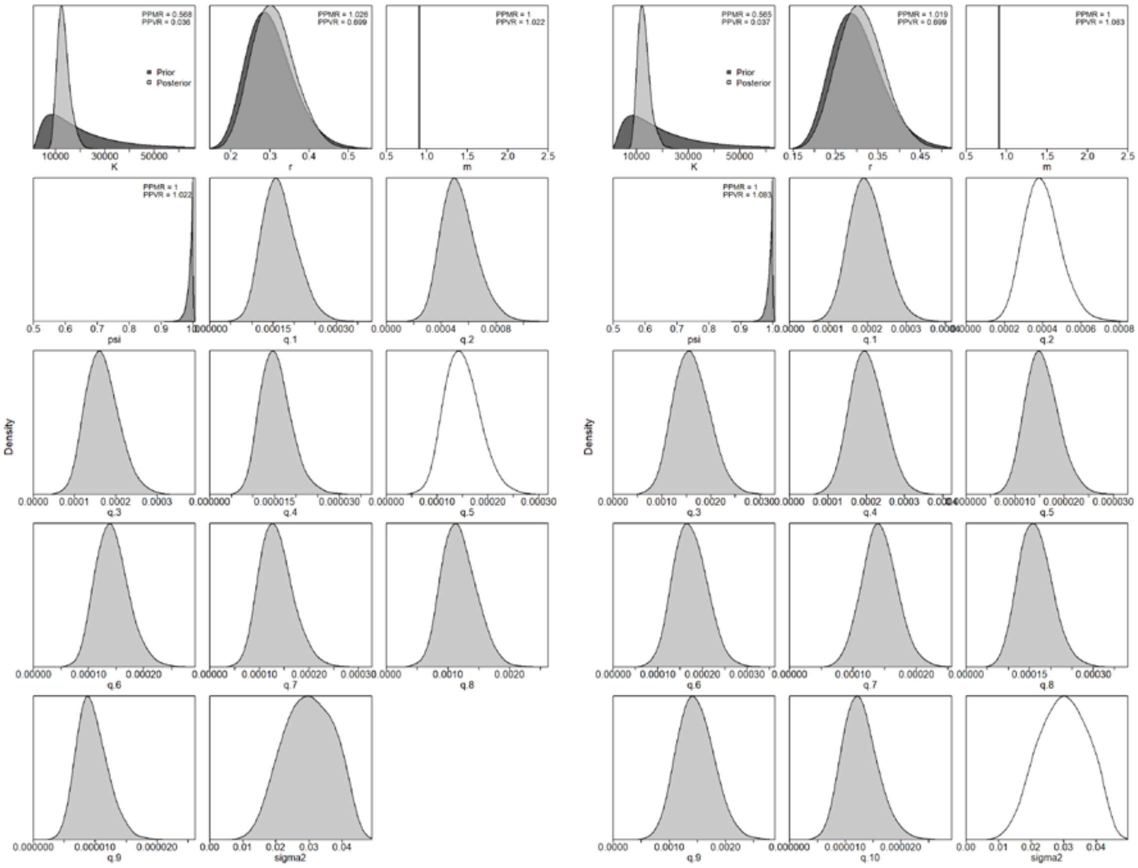


Figure 21. W-SAI. Prior and posterior distributions of the JABBA S1 (a: left panel) and S2 (b: right panel) scenarios for the West Atlantic sailfish stock. PPRM: Posterior to Prior Ratio of Means; PPRV: Posterior to Prior Ratio of Variances.

(a) S1 (b) S2

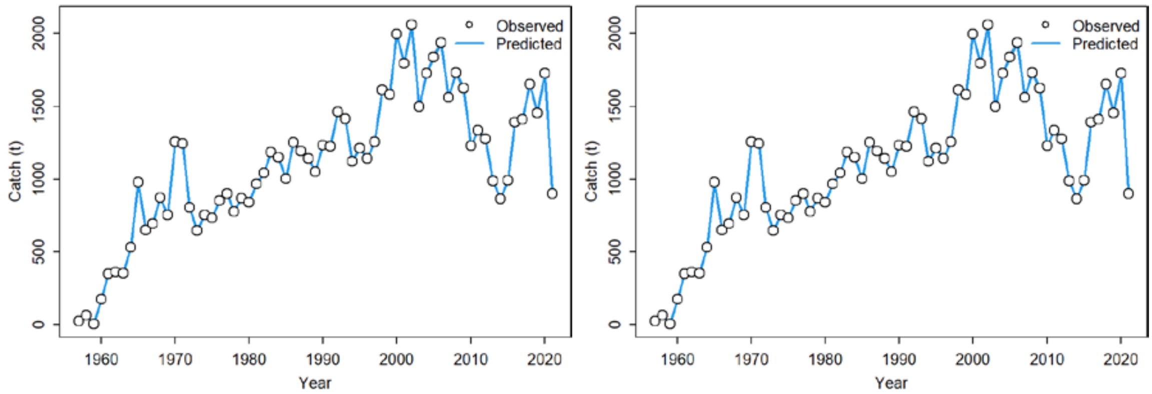


Figure 22. W-SAI. Comparison of catch time series between input data (observed) and predicted catch from the JABBA S1 (a: left panel) and S2 (b: right panel) scenarios for the West Atlantic sailfish stock.

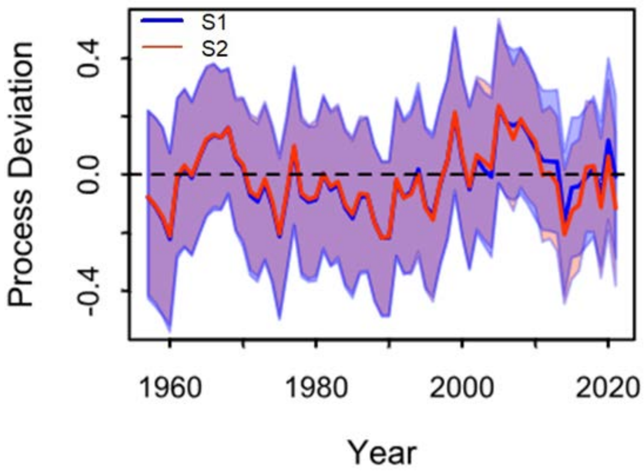


Figure 23. W-SAI. Process error deviates (median: solid line) for the West Atlantic sailfish JABBA S1 (blue line) and S2 (red line) scenarios. The shaded purple area indicates 95% credibility intervals.

(a) S1

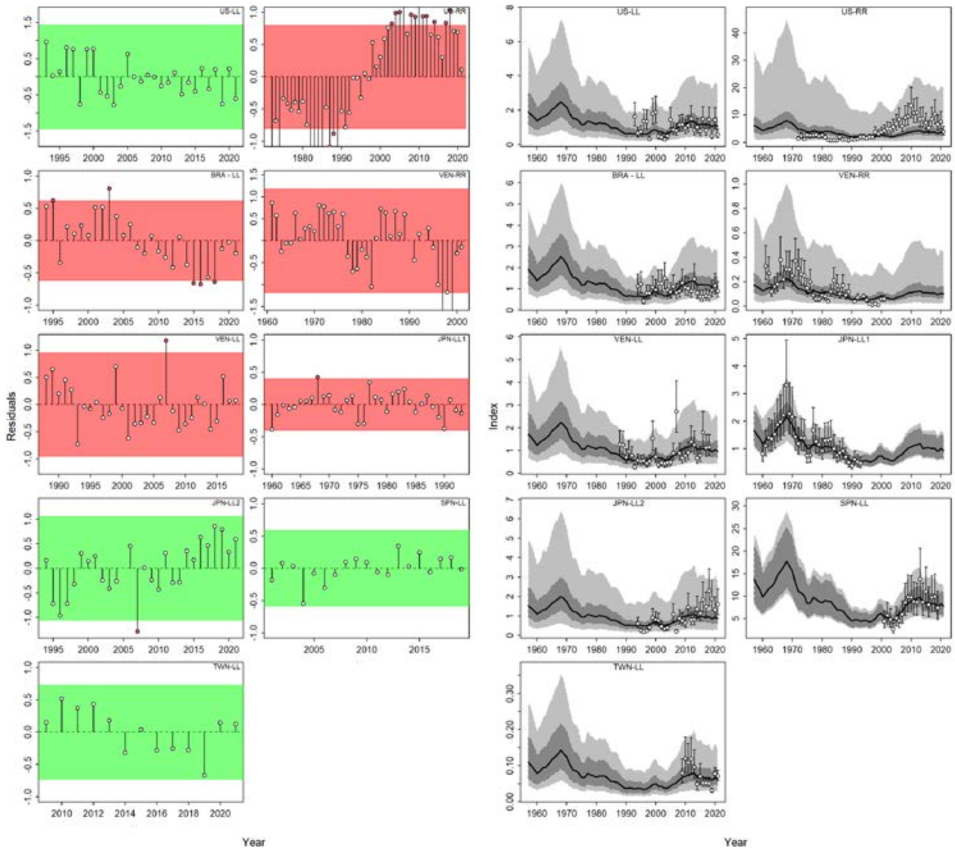


Figure 24. W-SAI. Left panel: Time series of observed (circle, input data) and predicted (solid line) CPUE of the West Atlantic sailfish JABBA S1 (a: upper panels) and S2 (b: bottom panels) scenarios. The dark-grey shaded areas show 95% credibility intervals of the expected mean CPUE, and the light-grey shaded areas denote the 95% posterior predictive distribution intervals. Right panel: Runs tests to evaluate the randomness of the time series of CPUE residuals by fleet for the JABBA S1(upper panel) and S2 (bottom panel) scenarios. Green panels indicate no evidence of lack of randomness of time-series residuals (*p*>0.05), while red panels indicate possible autocorrelation. 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).

(b) S2

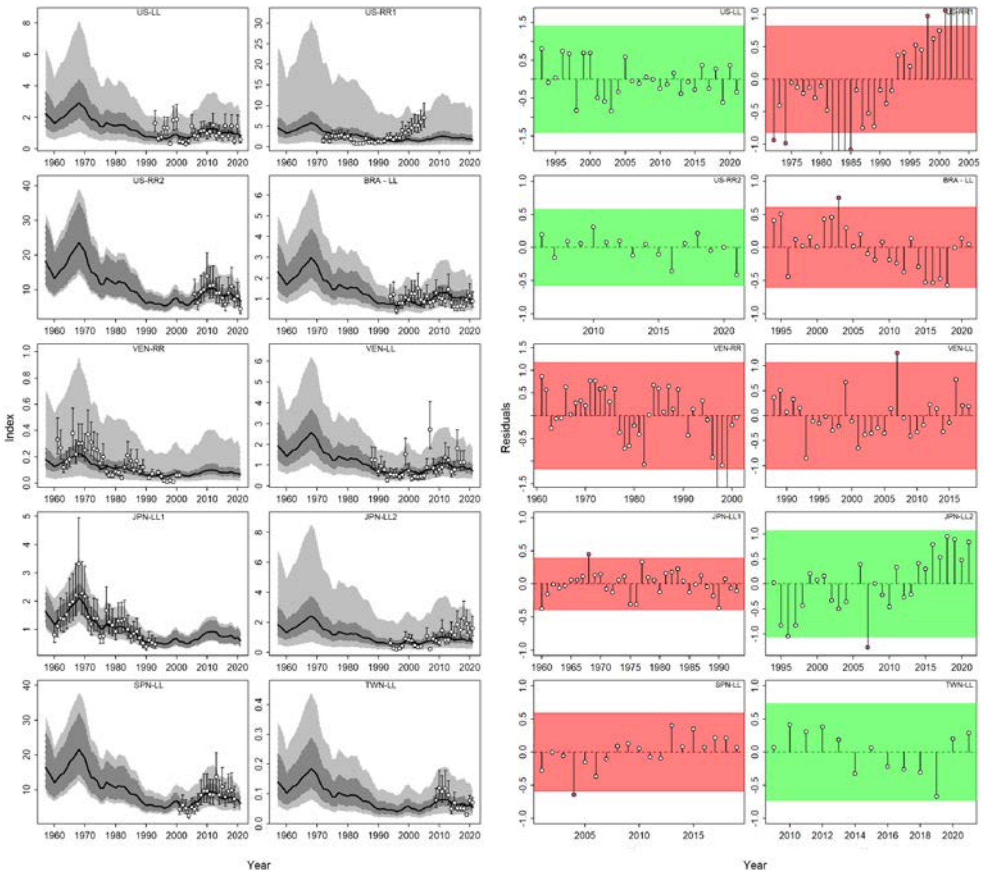


Figure 24. W-SAI. Continued.

(a) S1 (b) S2

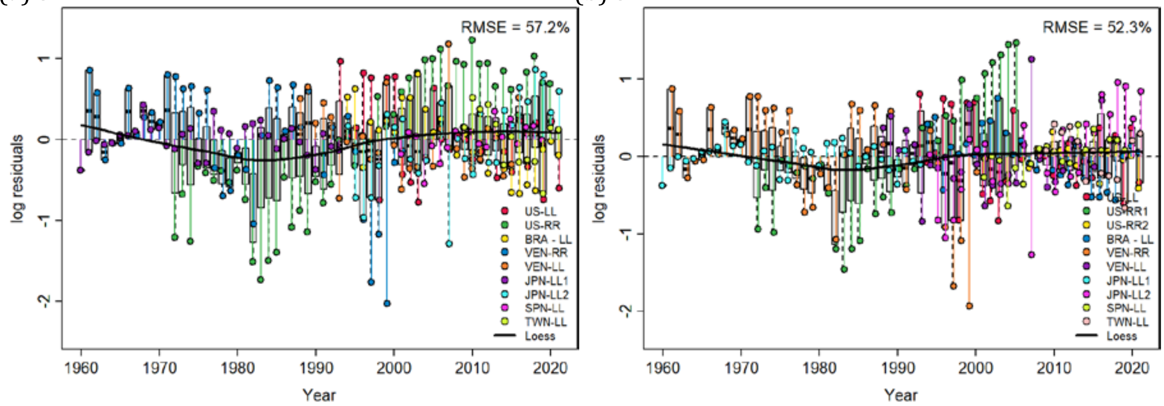


Figure 25. W-SAI. Residual diagnostic plots of CPUE indices for the West Atlantic sailfish JABBA S1 (a: left panel) and S2 (b: right panel) scenarios. Boxplots indicate the median and quantiles of all residuals available for any given year, and solid black lines indicate a loess smoother through all residuals.

(a) S1 (b) S2

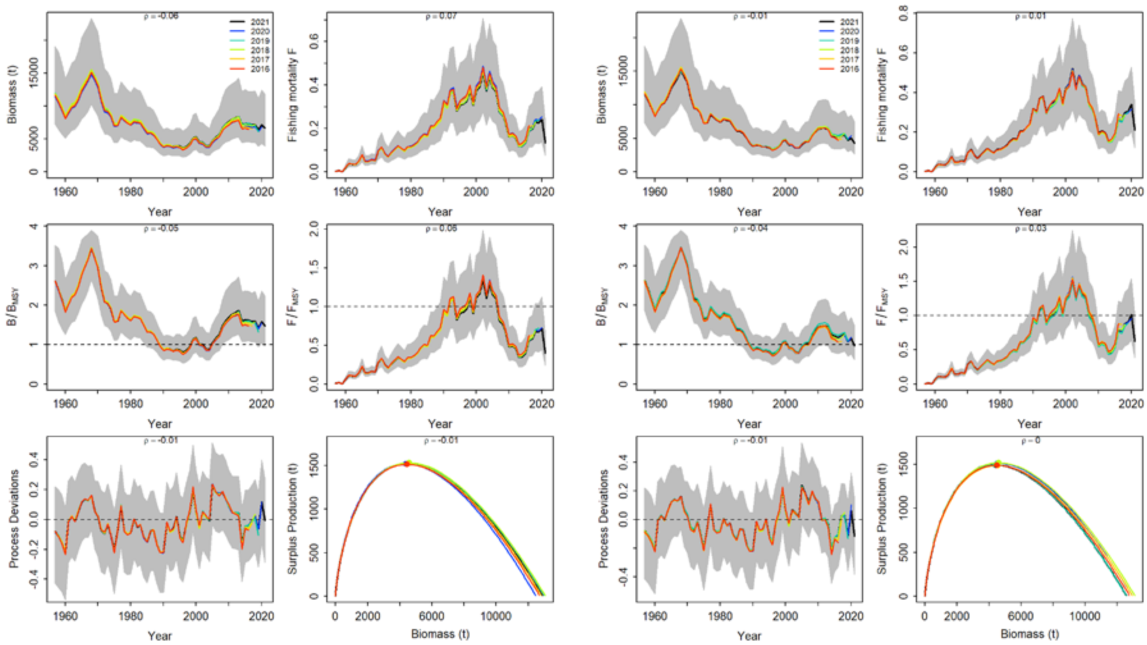


Figure 26. W-SAI. Retrospective analysis of the JABBA S1 (a: left panels) and S2 (b: right panels) scenarios for West Atlantic sailfish, by removing one year at a time sequentially (n=5) and predicting the trends in biomass and fishing mortality (upper panels), biomass relative to B_{MSY} (B/B_{MSY}) 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).

(a) S1 (b) S2

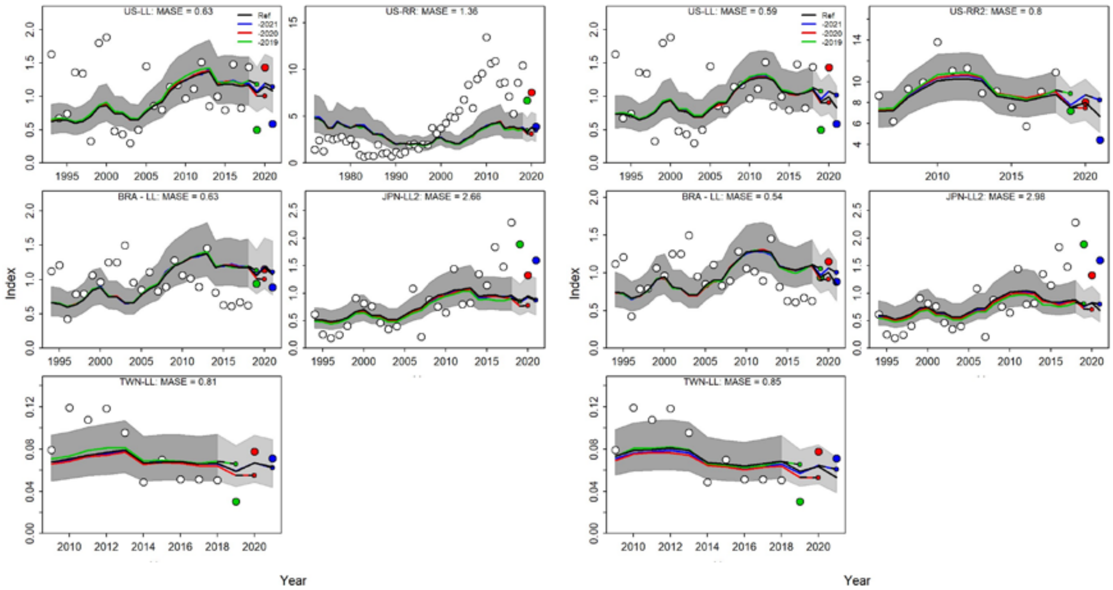


Figure 27. W-SAI. Hindcasting cross-validation results for the JABBA S1 (a: left panels) and S2 (b: right panels) scenarios for West Atlantic sailfish, showing one-year-ahead forecasts of CPUE values (2017-2021), performed with five hindcast model runs relative to the expected CPUE. The CPUE observations used for cross-validation are highlighted as color-coded solid circles with the 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).

(a) S1 (b) S2

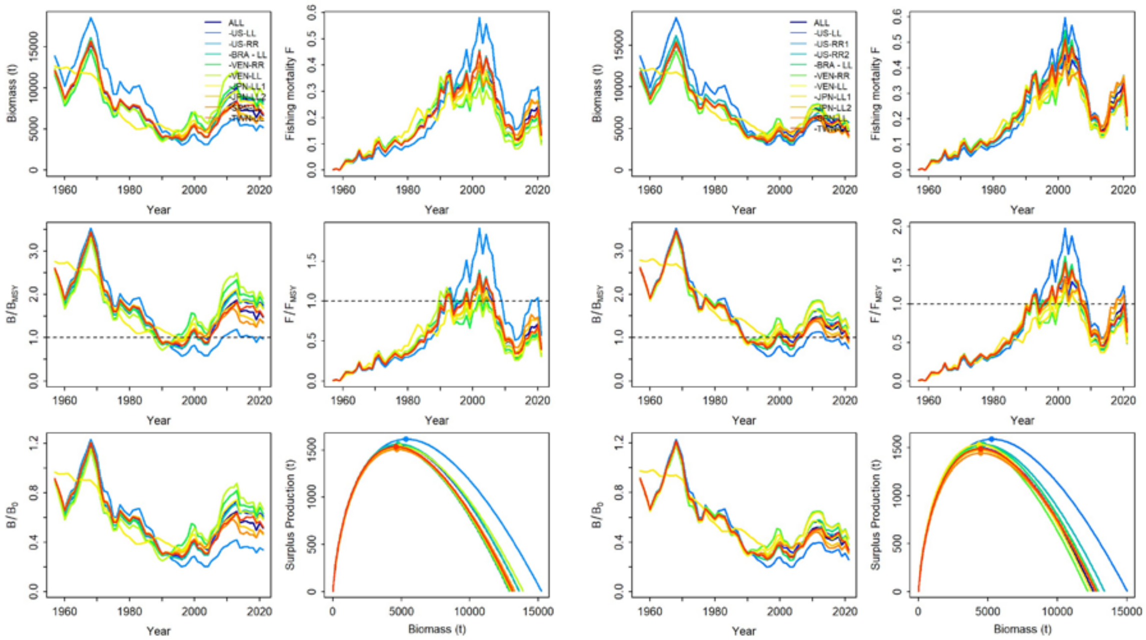


Figure 28. W-SAI. Jackknife index analysis of the West Atlantic sailfish JABBA S1 (a: left panels) and S2 (b: right panels) scenarios, by removing one CPUE fleet at a time and predicting the trends in biomass and fishing mortality (upper panels), biomass relative to B_{MSY} (B/B_{MSY}) and fishing mortality relative to F_{MSY} (F/F_{MSY}) (middle panels) and biomass relative to K (B/K) and surplus production curve (bottom panels).

(a) process error

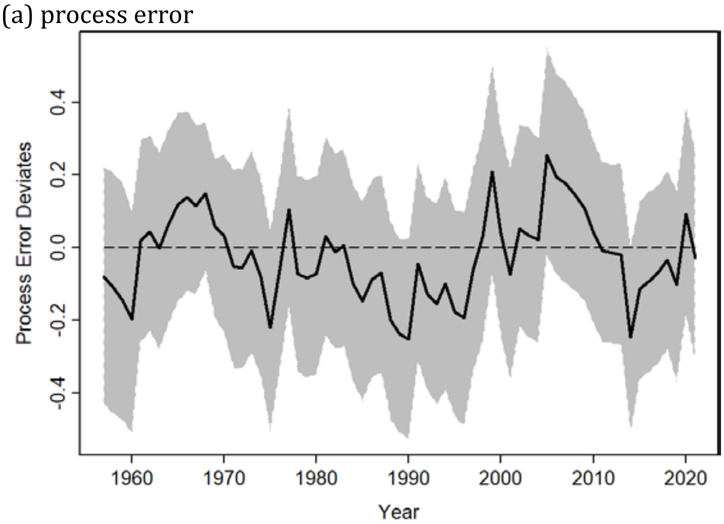
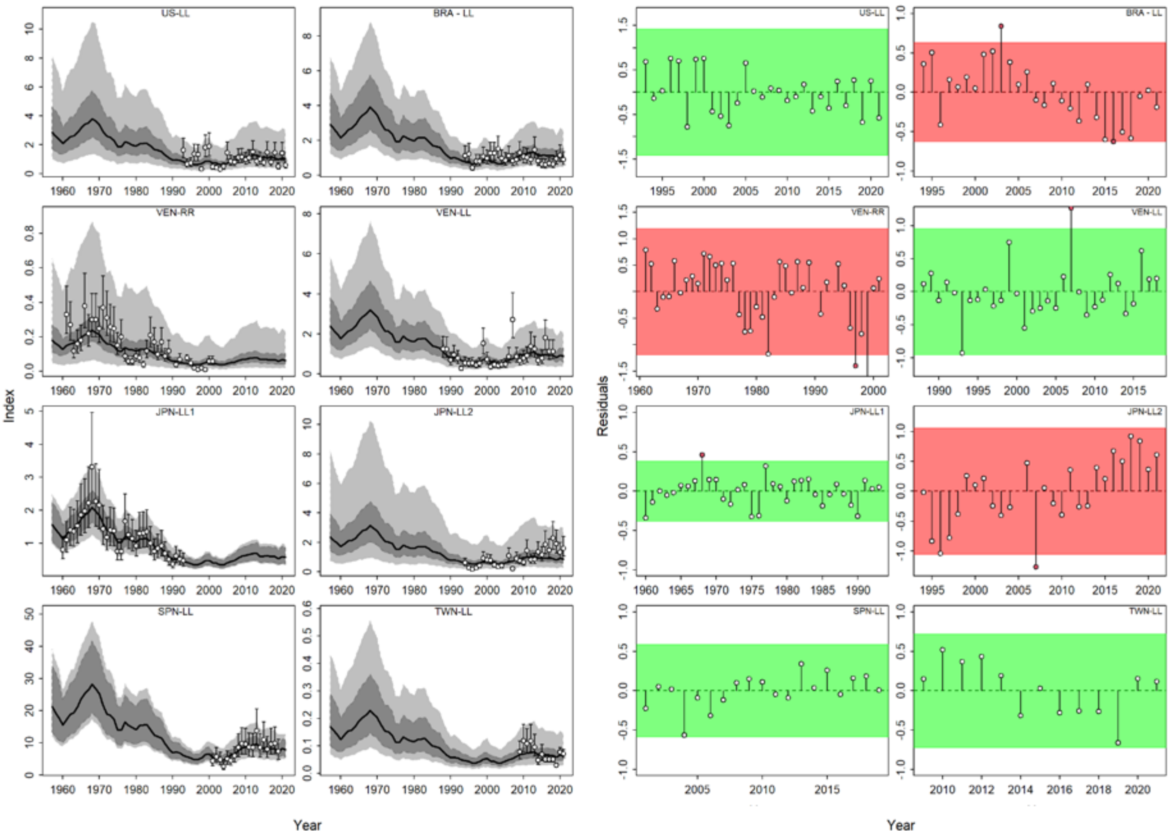


Figure 29. W-SAI. The JABBA S3 scenario for West Atlantic sailfish. (a) process error, (b) CPUE fitting with runs tests, (c) Residual diagnostic plots of CPUE indices, (d) jackknife analysis, and (e) Hindcasting cross-validation analysis.

(b) CPUE fitting



(c) RMSE

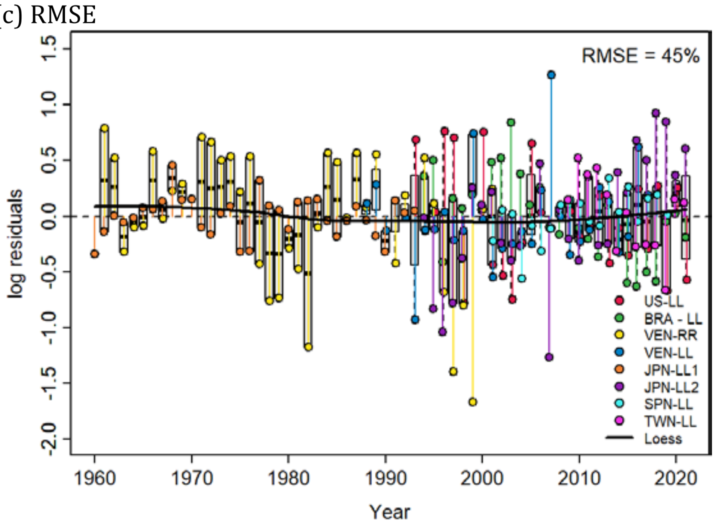
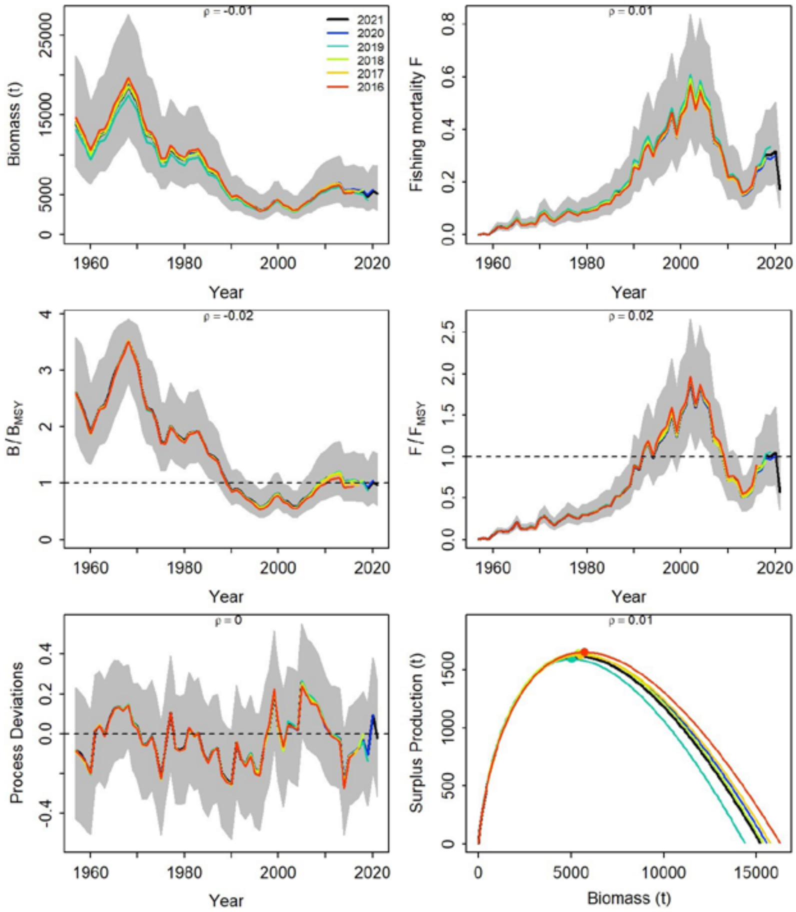


Figure 29. W-SAI. Continued.

(d) retrospective analysis



(e)hindcast

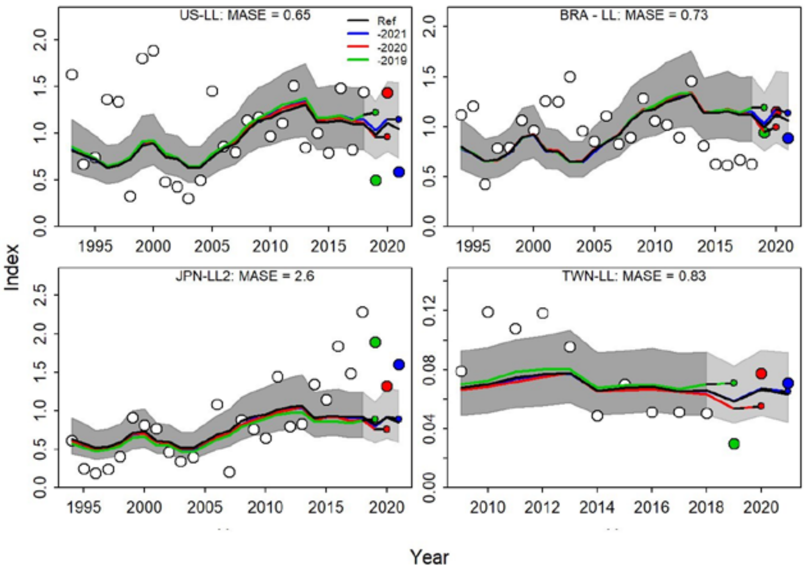


Figure 29. W-SAI. Continued.

(a) S4 (b) S5

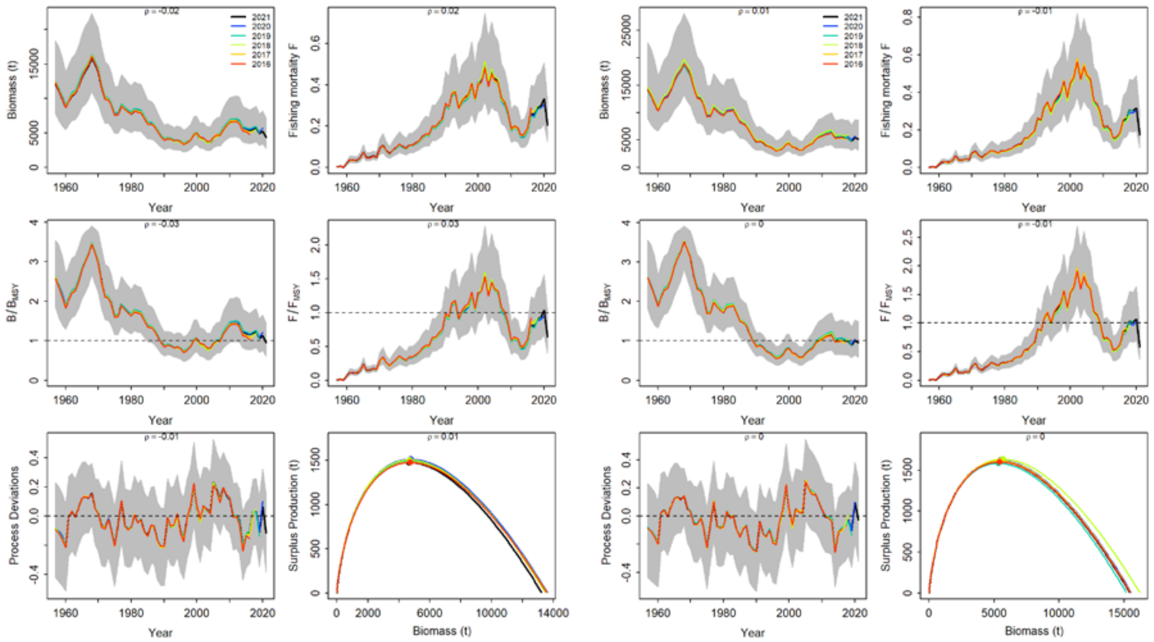
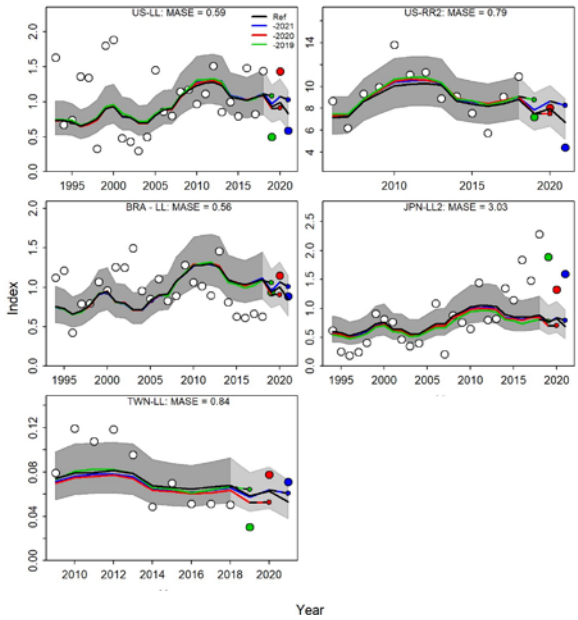


Figure 30. W-SAI. Retrospective analysis of the JABBA S4 (a: left panels) and S5 (b: right panels) scenarios for West Atlantic sailfish, by removing one year at a time sequentially (n=5) and predicting the trends in biomass and fishing mortality (upper panels), biomass relative to B_{MSY} (B/B_{MSY}) 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).

(a) S4



(b) S5

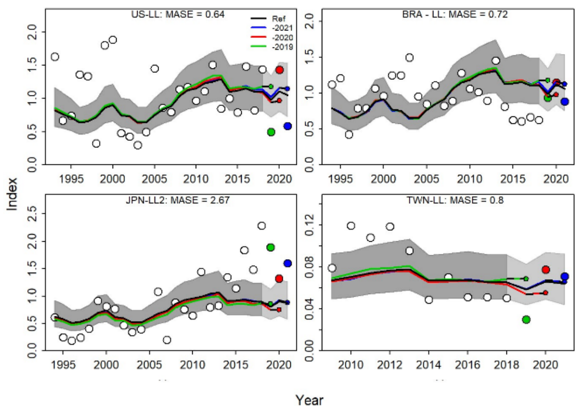


Figure 31. W-SAI. Hindcasting cross-validation results for the JABBA S4 (a: left panels) and S5 (b: right panels) scenarios for West Atlantic sailfish.

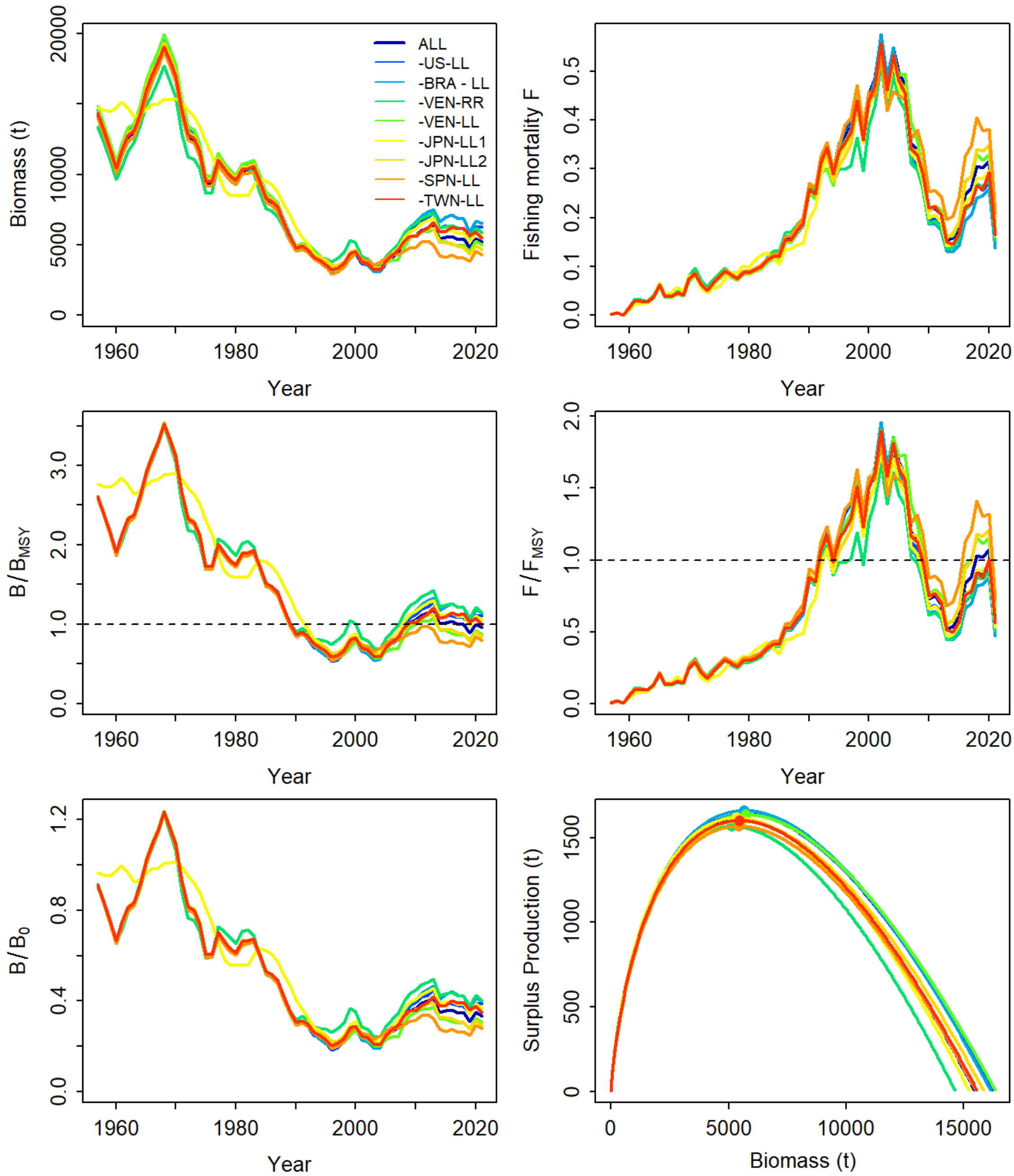


Figure 32. W-SAI. Jackknife index analysis of the West Atlantic sailfish JABBA S5 scenario, by removing one CPUE fleet at a time and predicting the trends in biomass and fishing mortality (upper panels), biomass relative to B_{MSY} (B/B_{MSY}) and fishing mortality relative to F_{MSY} (F/F_{MSY}) (middle panels) and biomass relative to K (B/K) and surplus production curve (bottom panels).

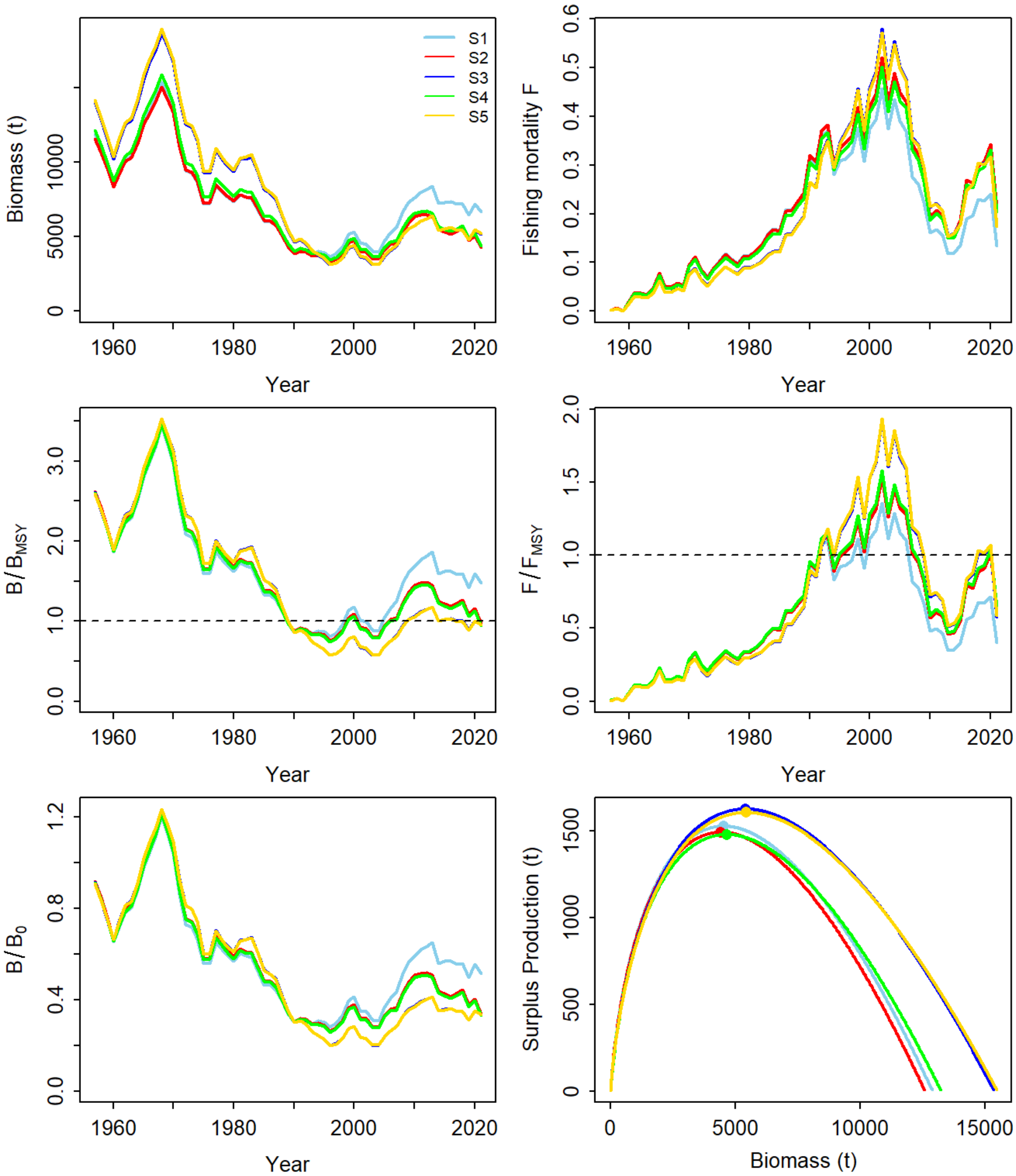


Figure 33. W-SAI. Comparisons of outputs between the JABBA S1-S5 scenarios for West Atlantic sailfish one at a time and predicting the trends in biomass and fishing mortality (upper panels), biomass relative to B_{MSY} (B/B_{MSY}) and fishing mortality relative to F_{MSY} (F/F_{MSY}) (middle panels) and biomass relative to K (B/K) and surplus production curve (bottom panels).

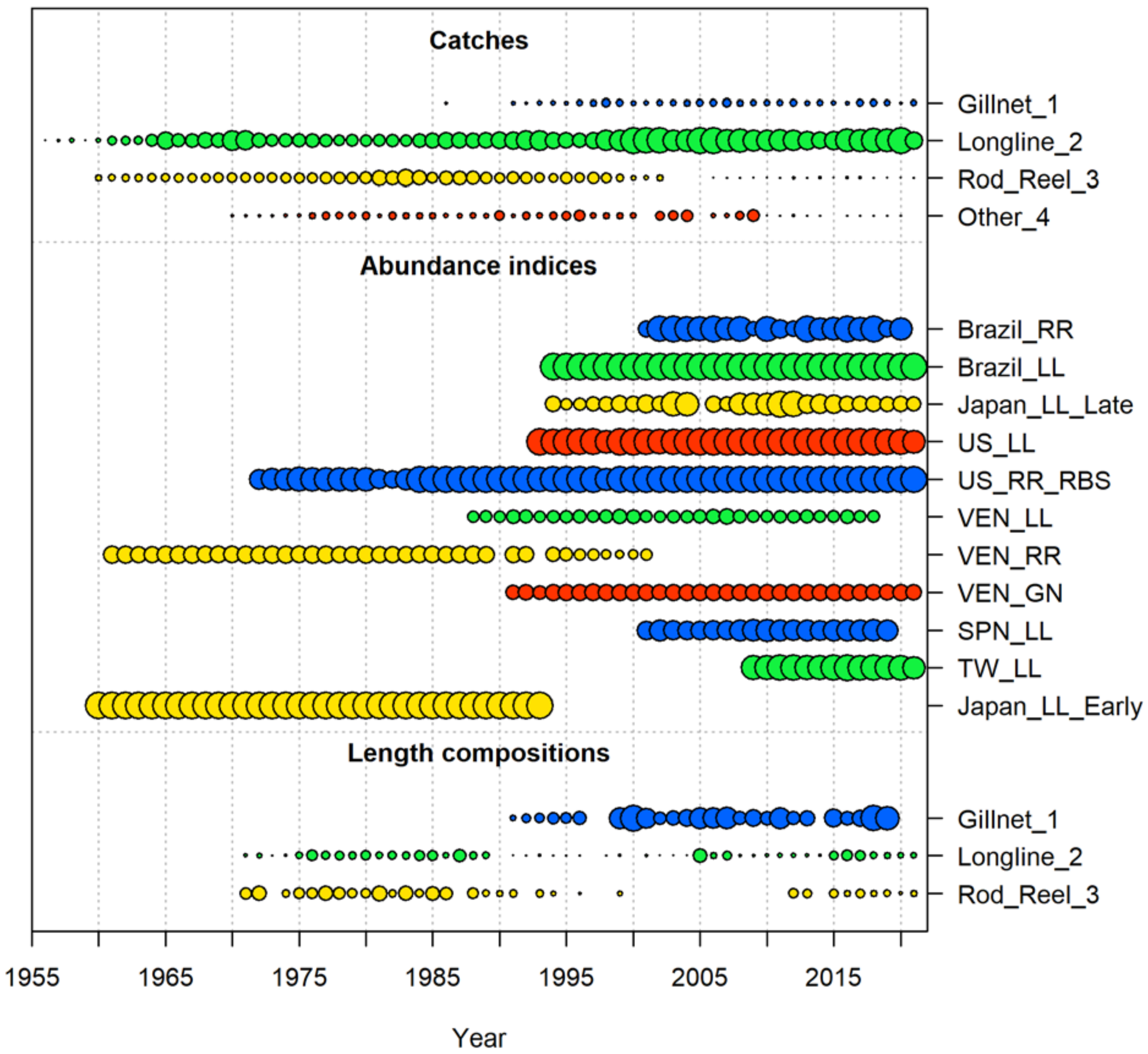


Figure 34. W-SAI. Summary of data time series modelled in Stock Synthesis for the western sailfish stock.

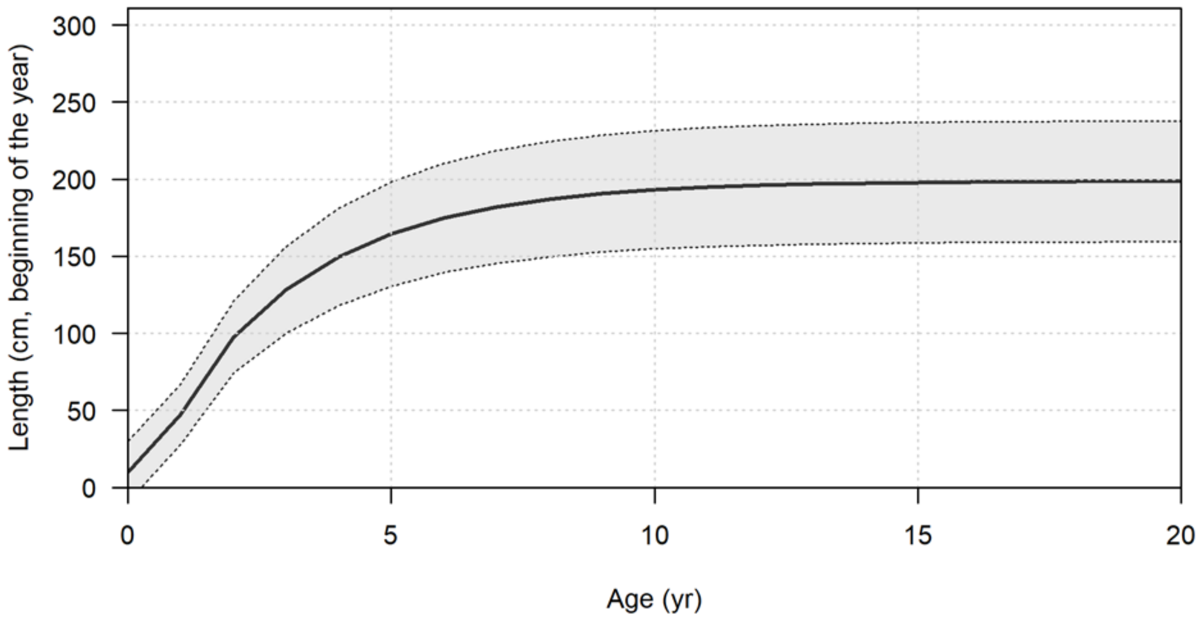


Figure 35. W-SAI. Estimated growth model for West Atlantic sailfish within the stock synthesis model (sex combined). The *x*-axis represents the model age-bin settings in the model (see text for further details).

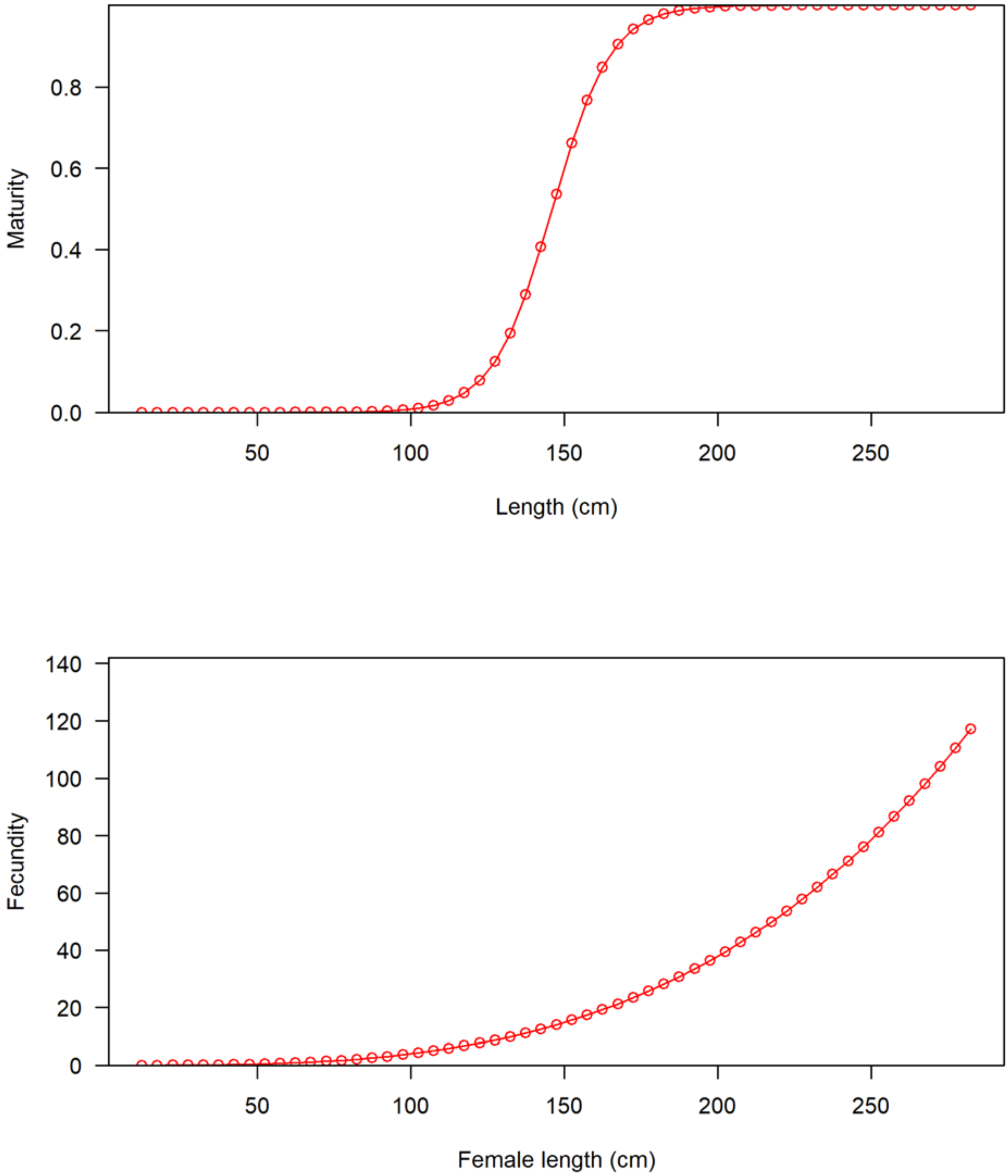


Figure 36. W-SAI. Assumed percent maturity (top) and fecundity (bottom) of West Atlantic sailfish. Length corresponds to the LJFL measurement.

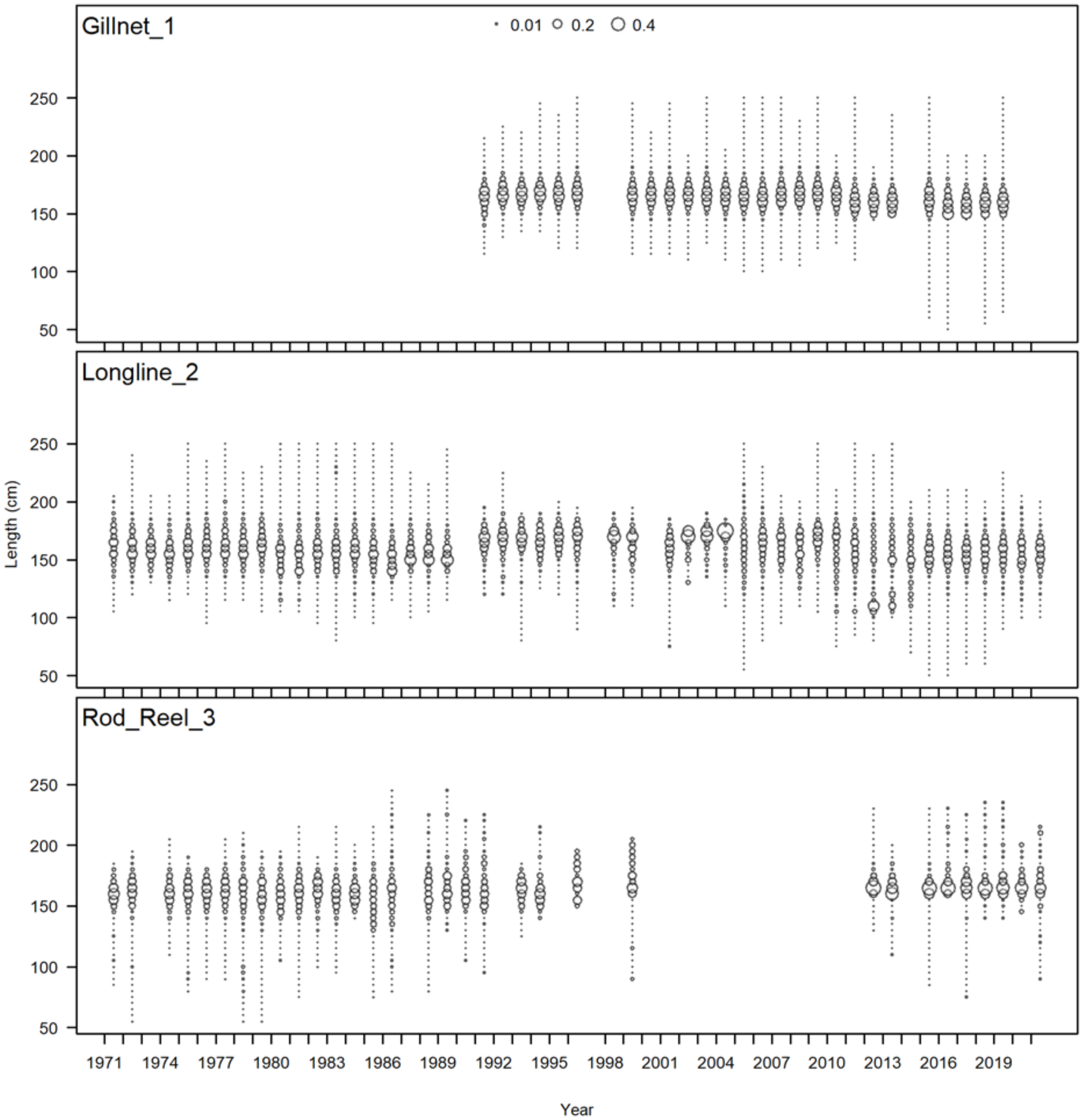


Figure 37. W-SAI. Time series of length composition by fleet used as input in Stock Synthesis.

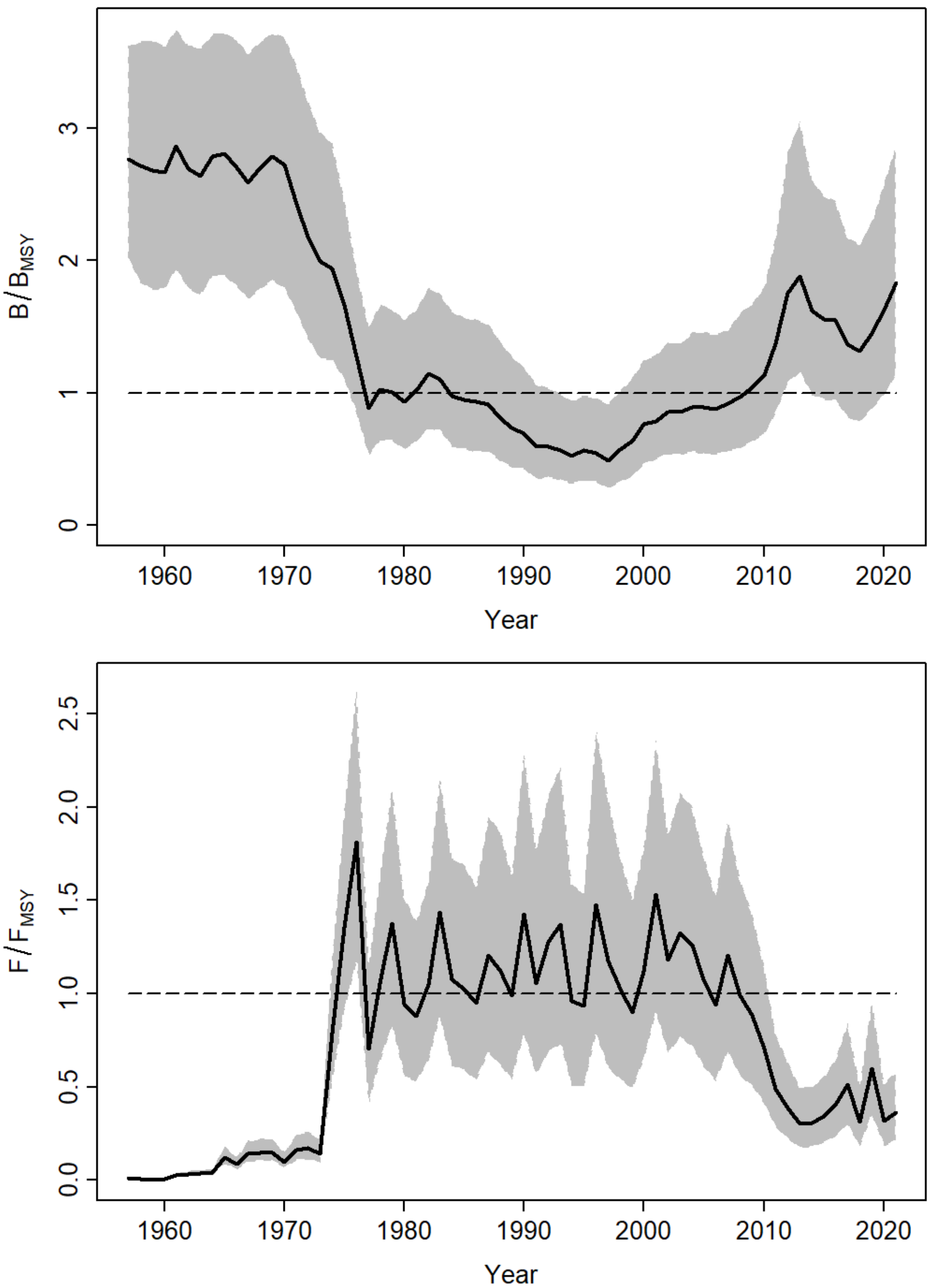


Figure 38. E-SAI. Annual trends of B/B_{MSY} (top) and F/F_{MSY} (bottom) as estimated by the final JABBA model (S1). The solid line represents the median value, and the shaded area indicates the 95% credibility interval.

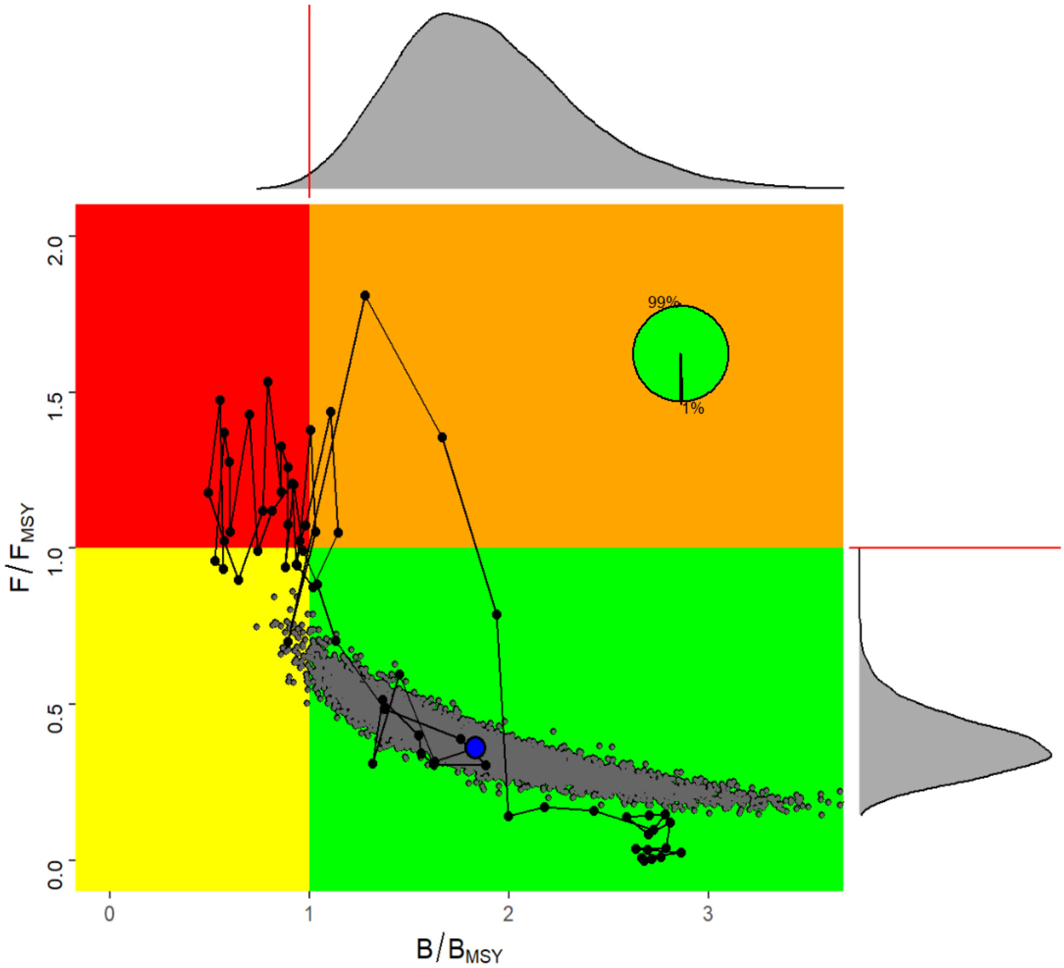


Figure 39. E-SAI. Kobe plot of the status of the East Atlantic sailfish stock from the final JABBA model (S1). The blue dot indicates the median value of the stock status in the final year (2021), the marginal density histograms show the variability associated with the estimates, and the pie chart in the plot shows the percentage of results in each quadrant of the Kobe plot.

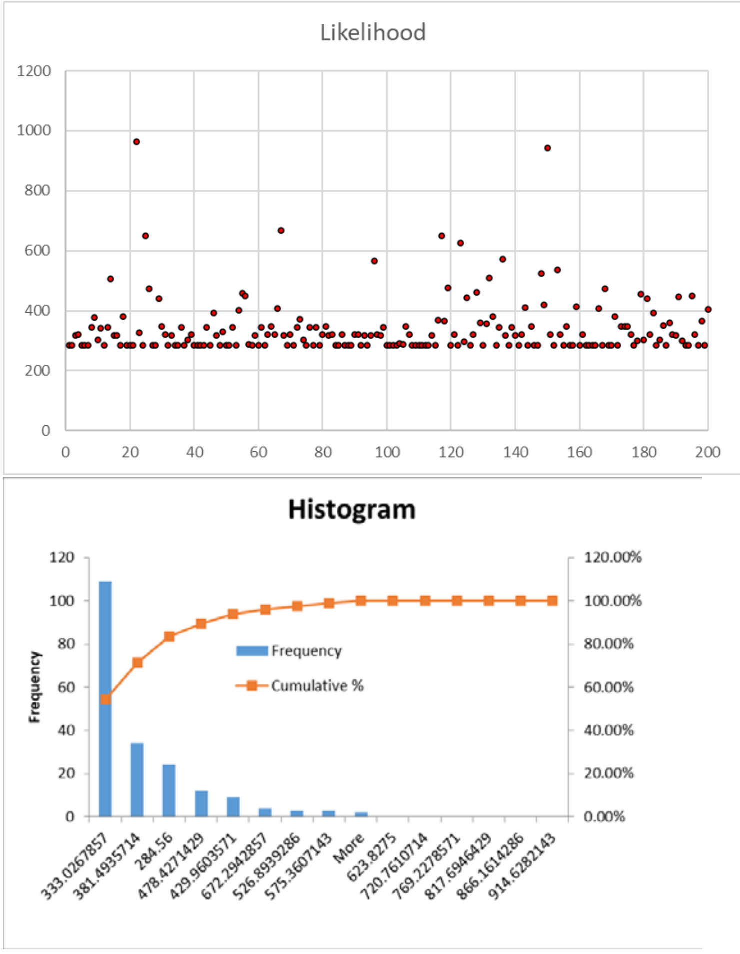


Figure 40. W-SAI. Diagnostic jitter analysis for the final Stock Synthesis model for the West sailfish stock. The top plot shows the results of 200 iterations and the resulting overall likelihood of each model fit. The bottom plot shows a histogram of the jitter results on the overall likelihood.

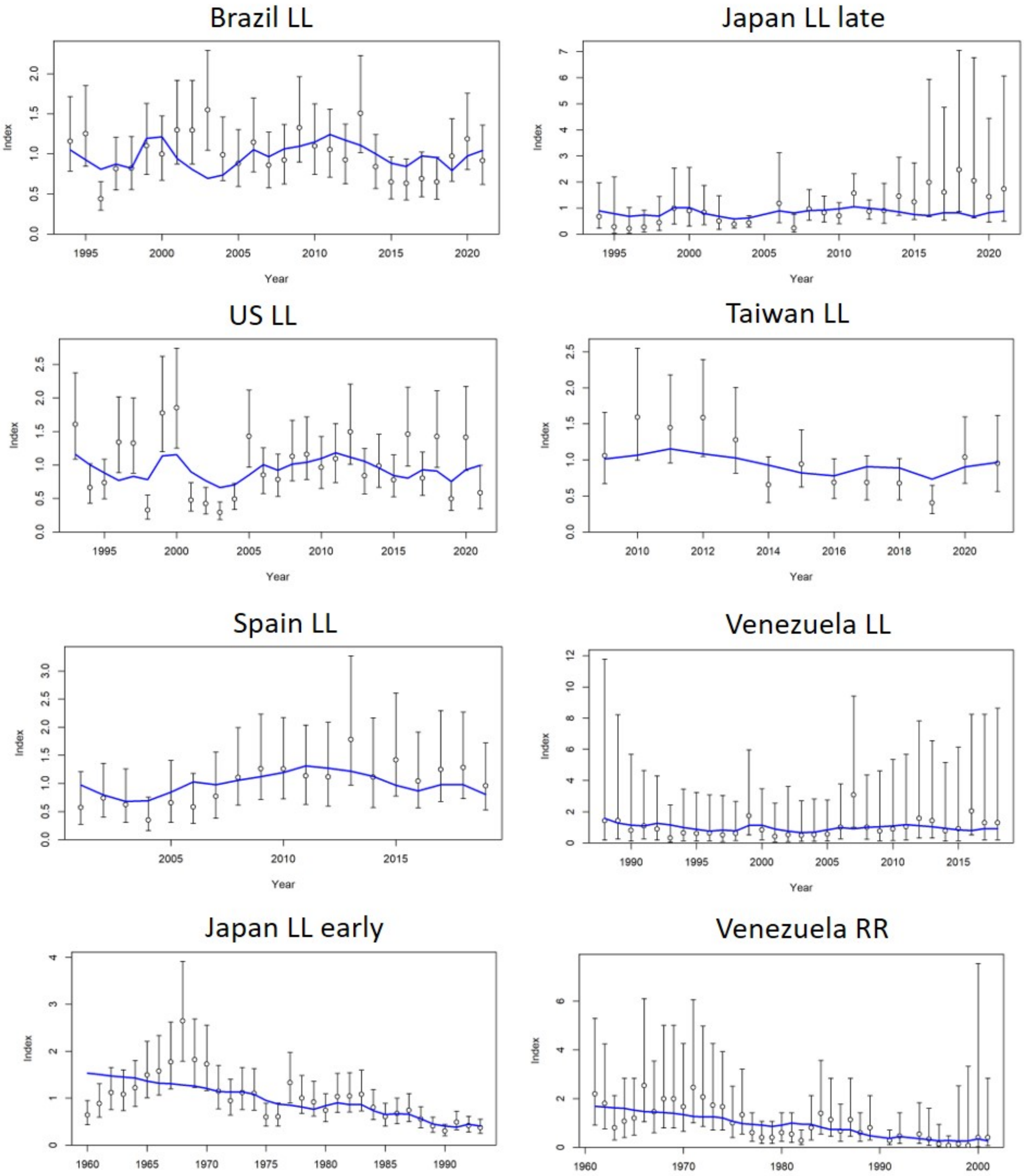


Figure 41. W-SAI. Stock Synthesis model fits to West Atlantic sailfish indices of relative abundance.

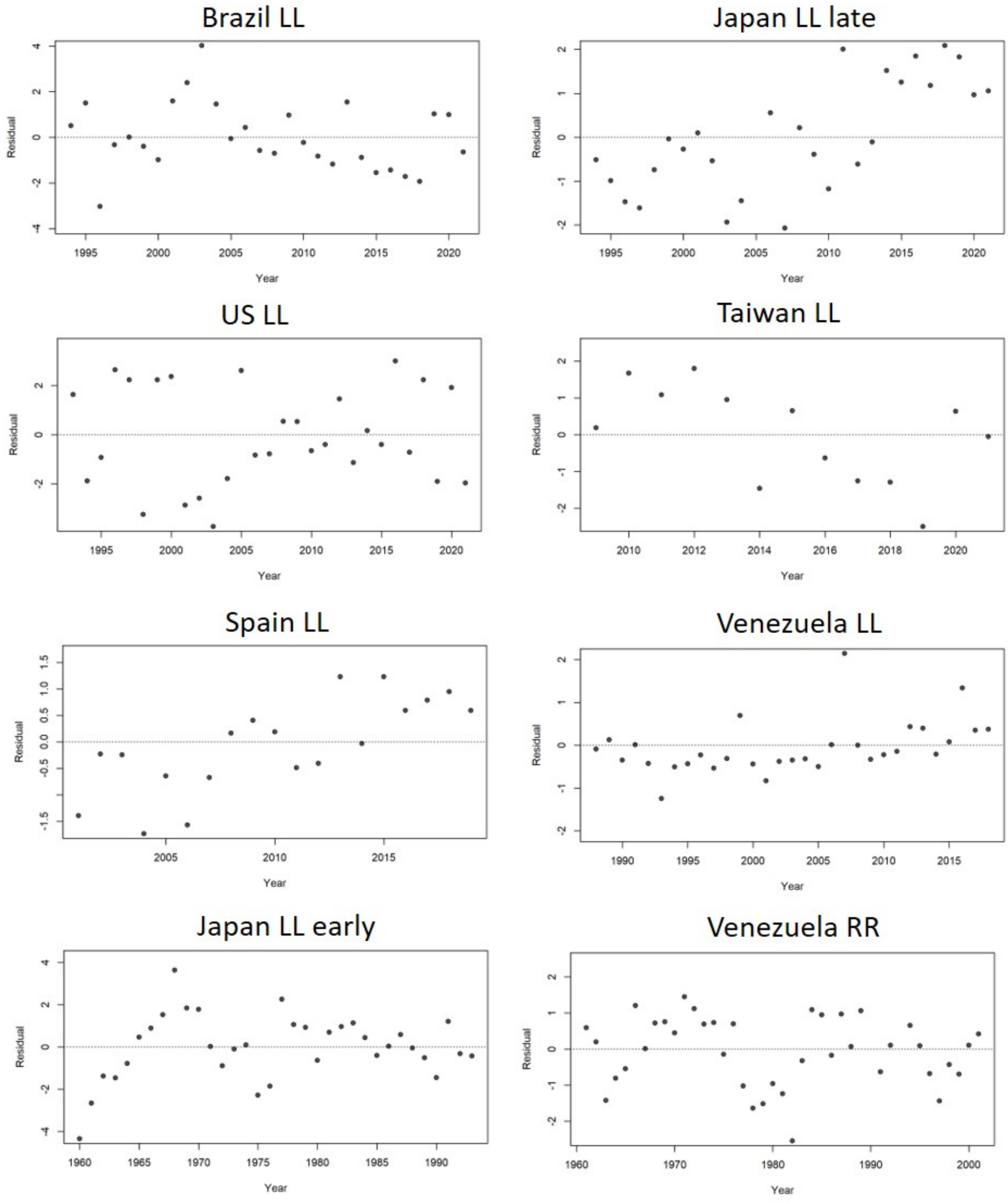


Figure 42. W-SAI. Stock Synthesis model fit residual errors around West Atlantic sailfish indices of relative abundance.

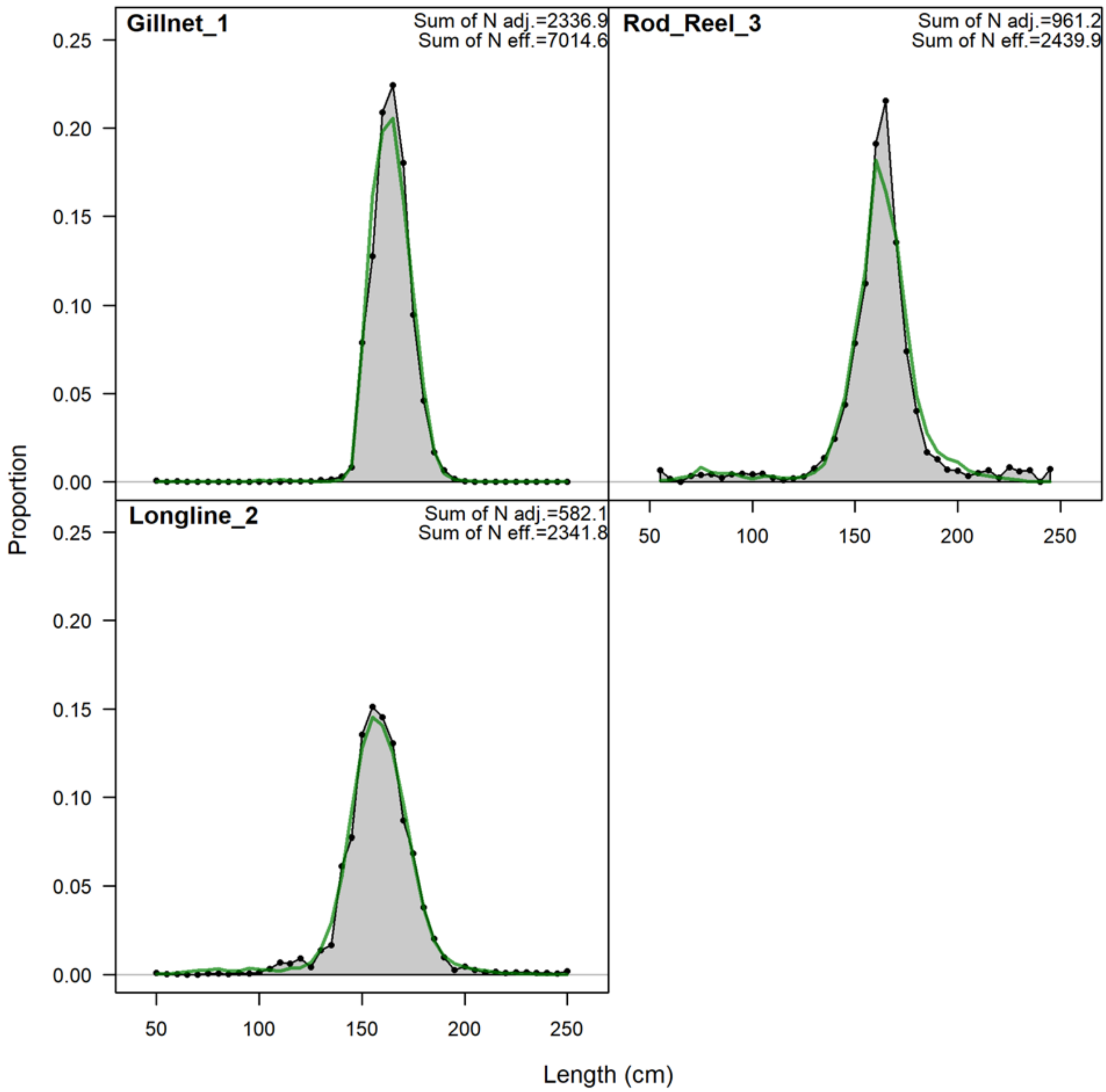


Figure 43. W-SAI. Stock Synthesis fits to West Atlantic sailfish length compositions by fleet. The grey distributions show the observed aggregated length composition by fleet and the green line shows the model predicted length composition.

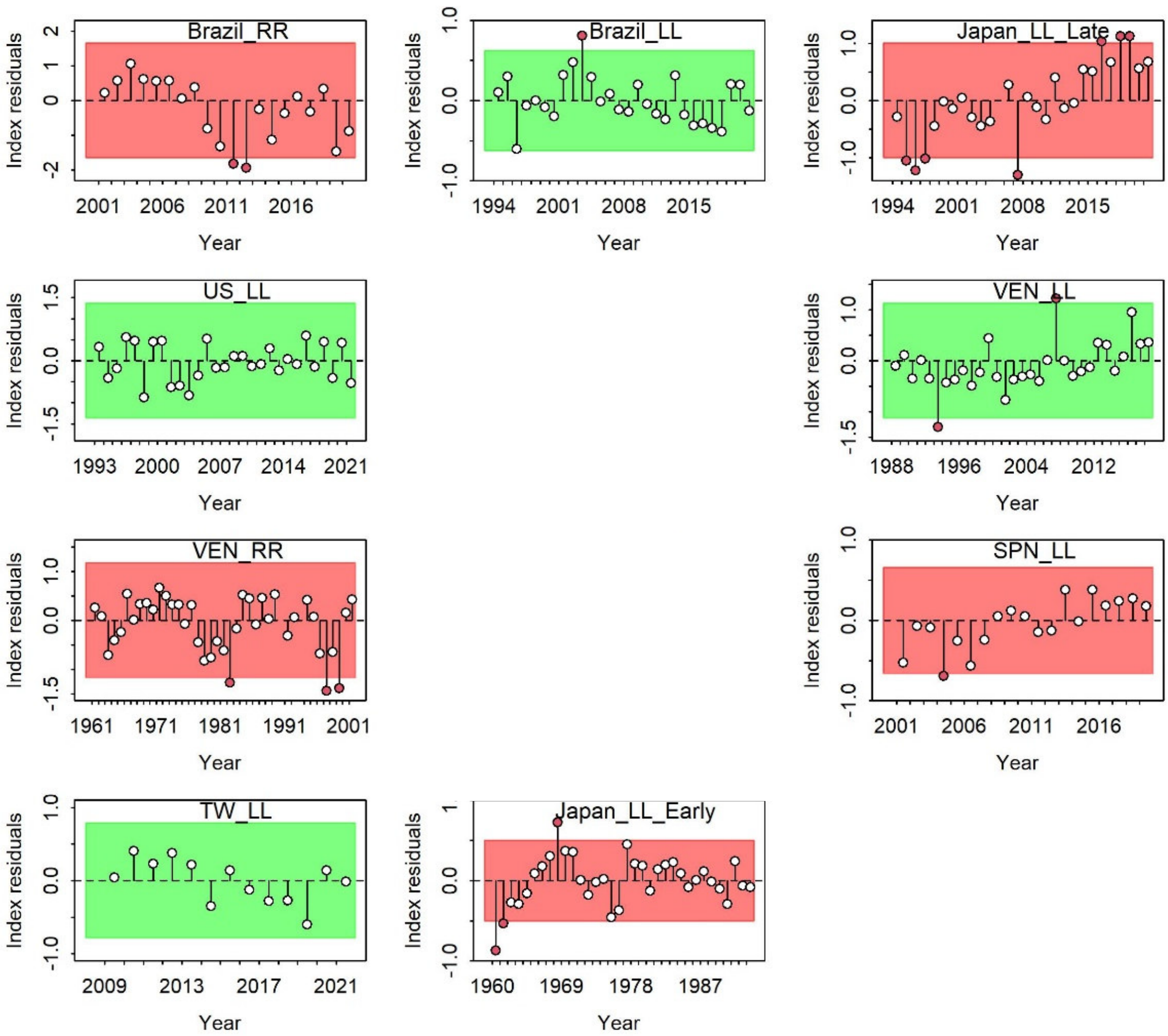


Figure 44. W-SAI. Diagnostic residual runs test on model fits to the indices of abundance.

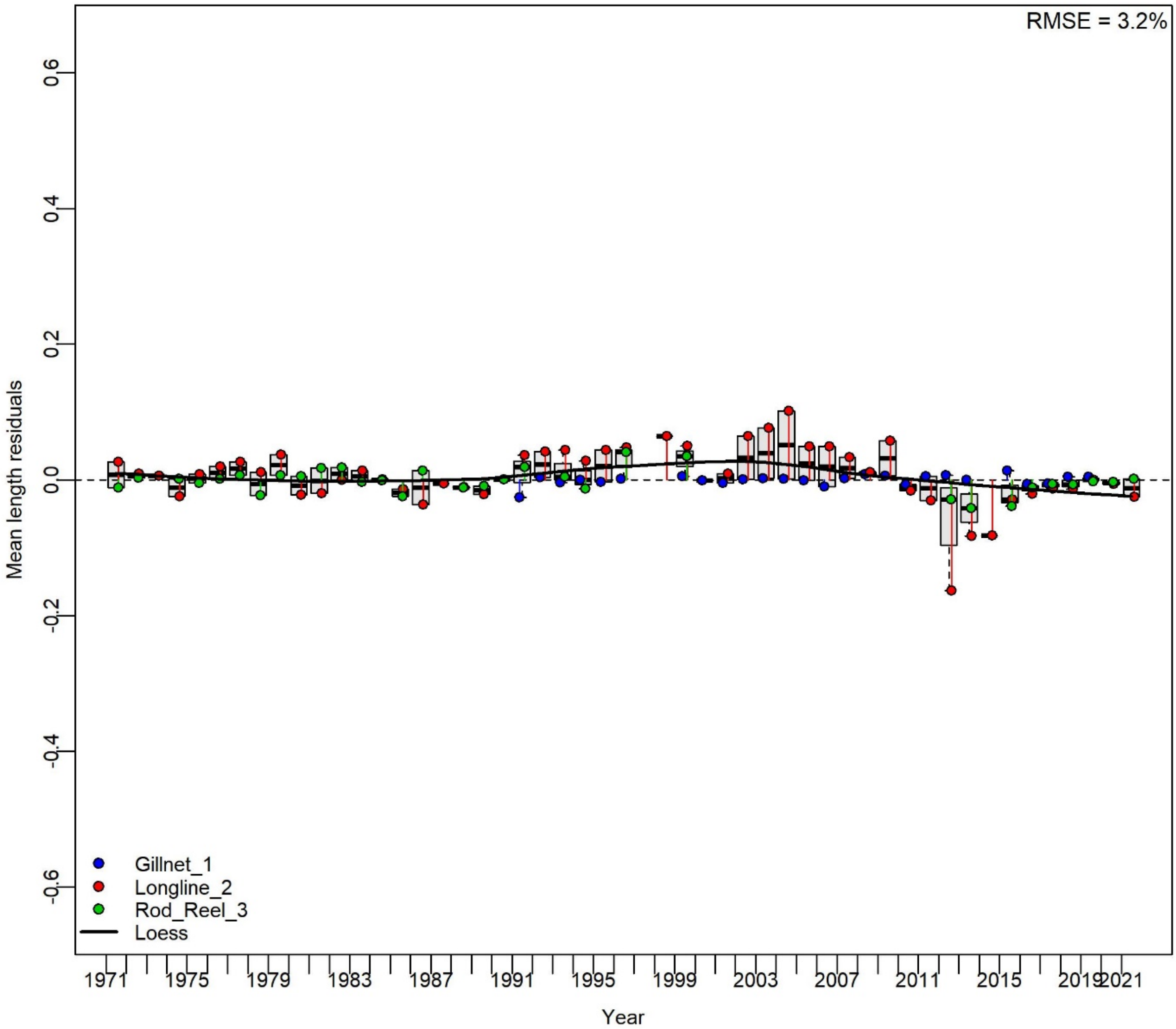


Figure 45. W-SAI. Diagnostic residual runs test on model fits of the fleet length compositions.

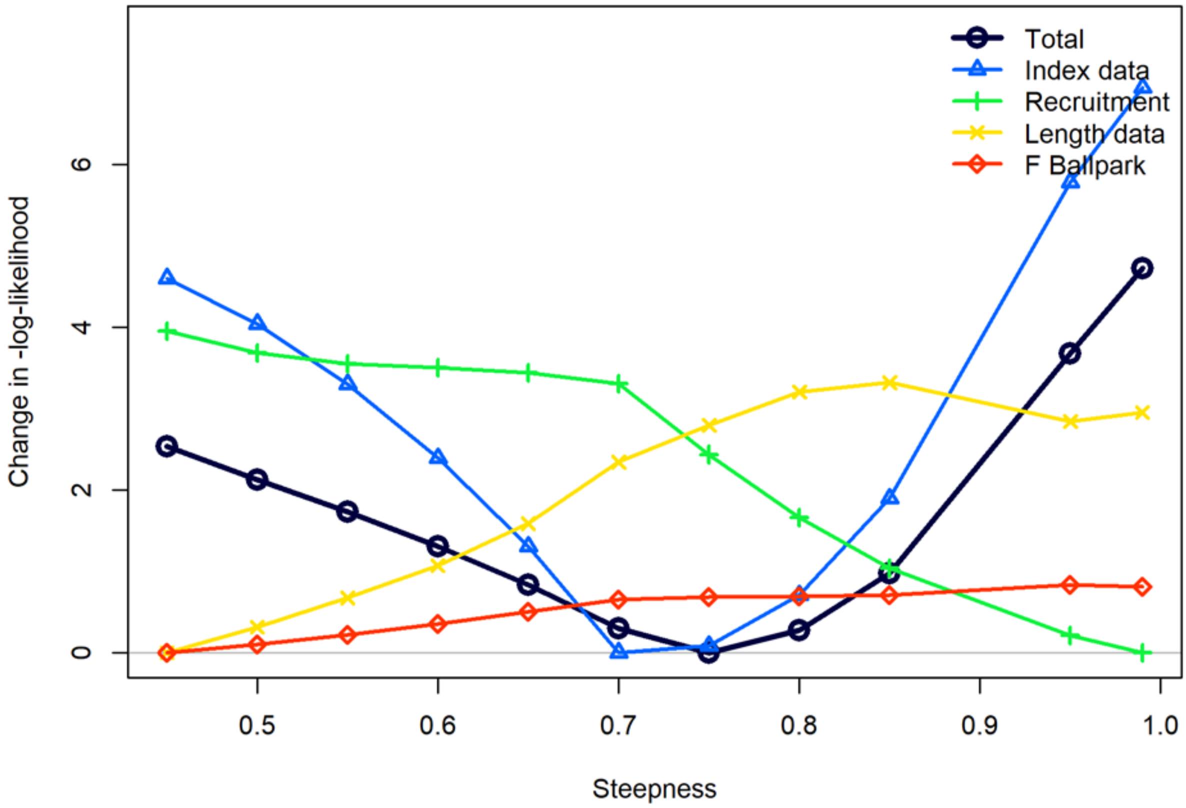


Figure 46. W-SAI. Likelihood profile on steepness.

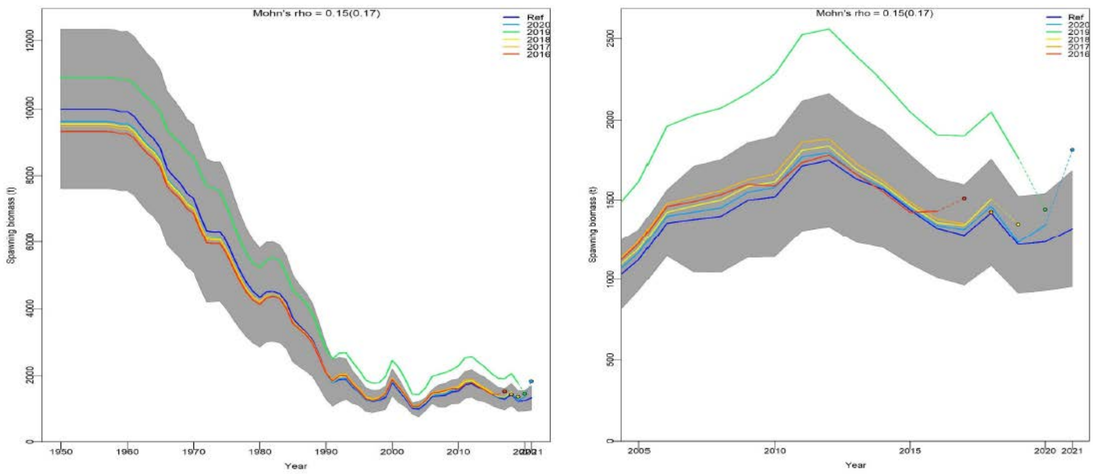


Figure 47. W-SAI. Stock synthesis retrospective analysis of SSB. The left plot shows the whole time series, the right plot indicates the last 17 years.

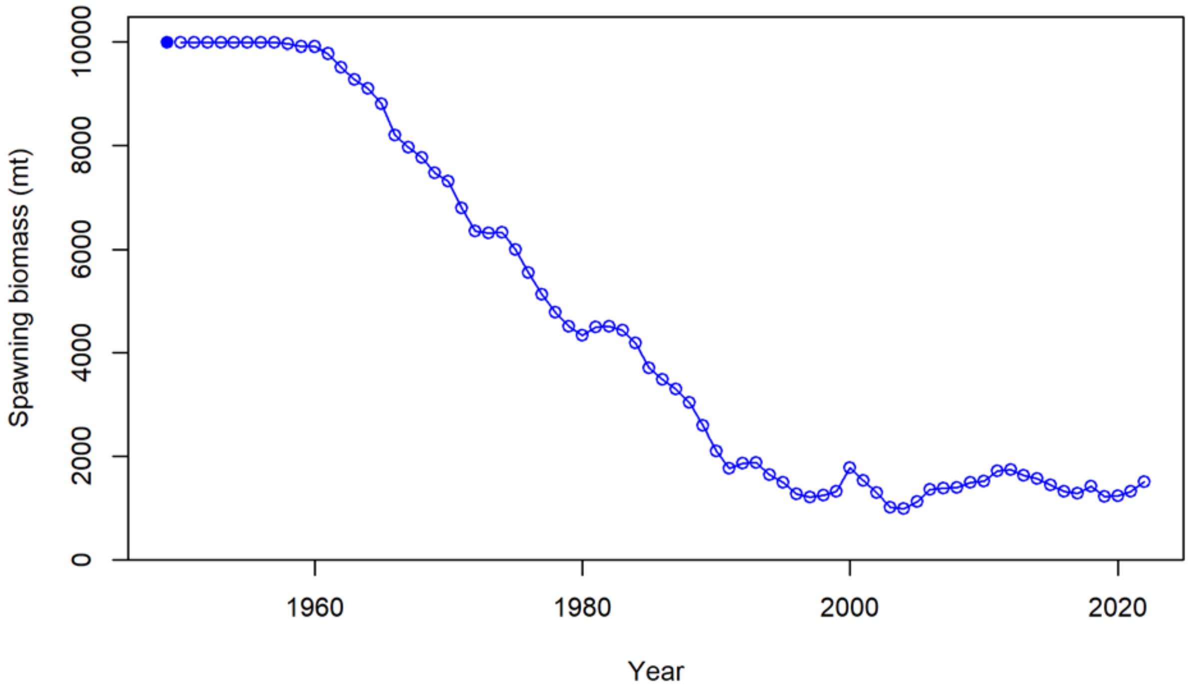


Figure 48. W-SAI. Stock Synthesis estimated time series of West Atlantic sailfish spawning stock biomass.

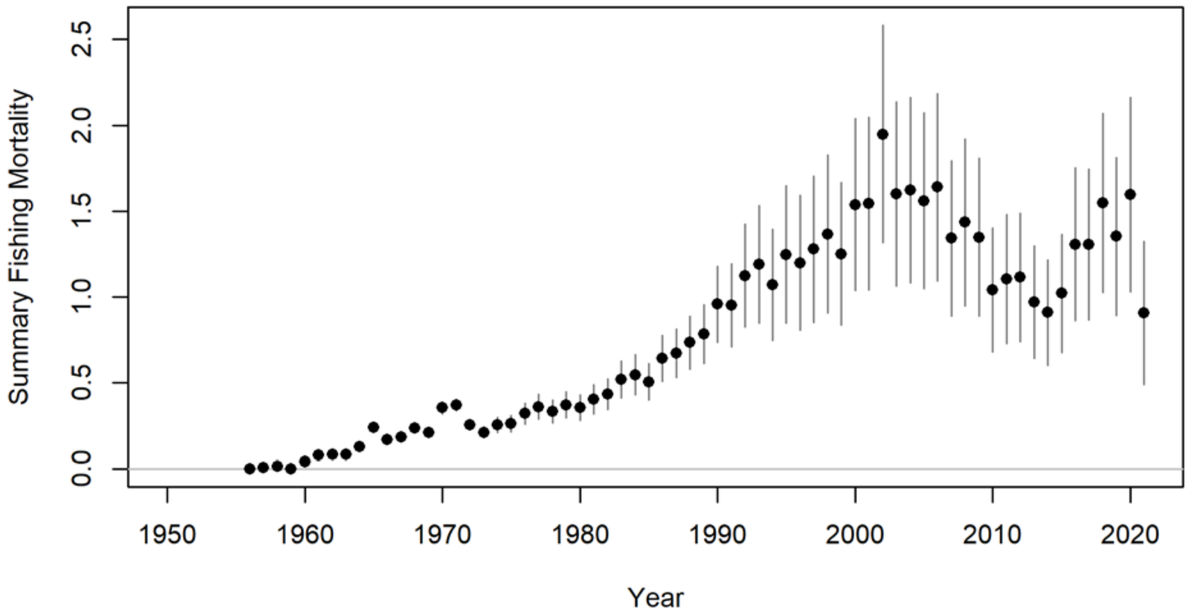


Figure 49. W-SAI. Stock Synthesis estimated time series of fishing mortality of West Atlantic sailfish.

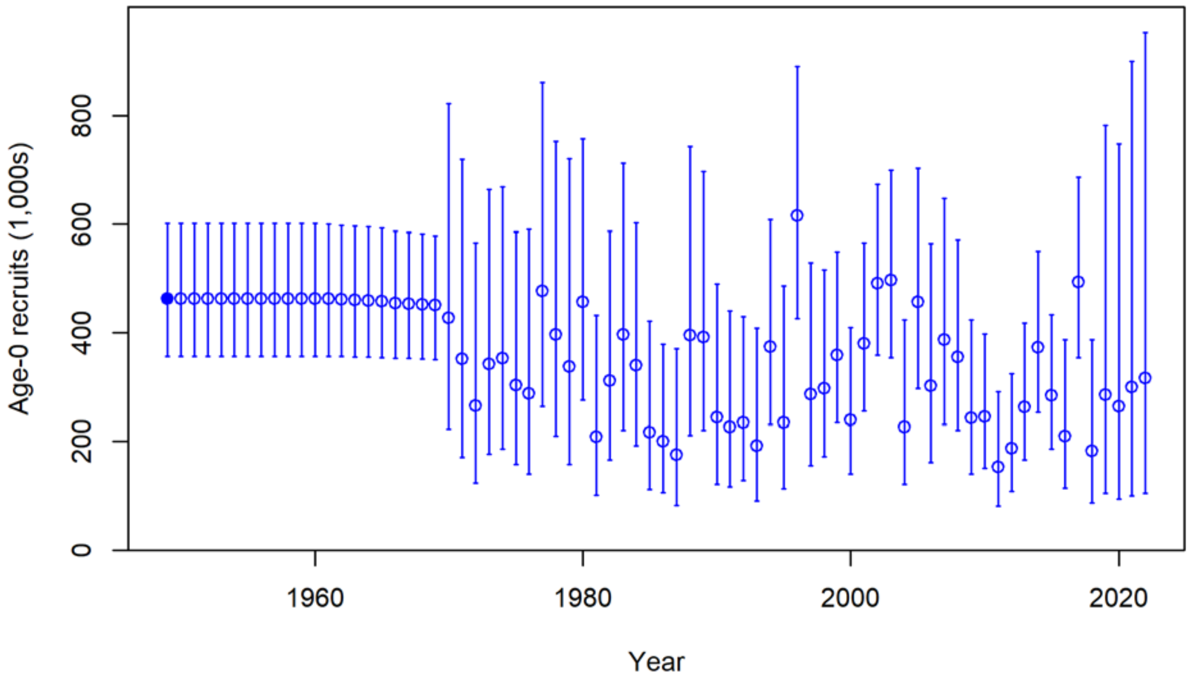


Figure 50. W-SAI. Stock Synthesis estimated time series of West Atlantic sailfish recruitments.

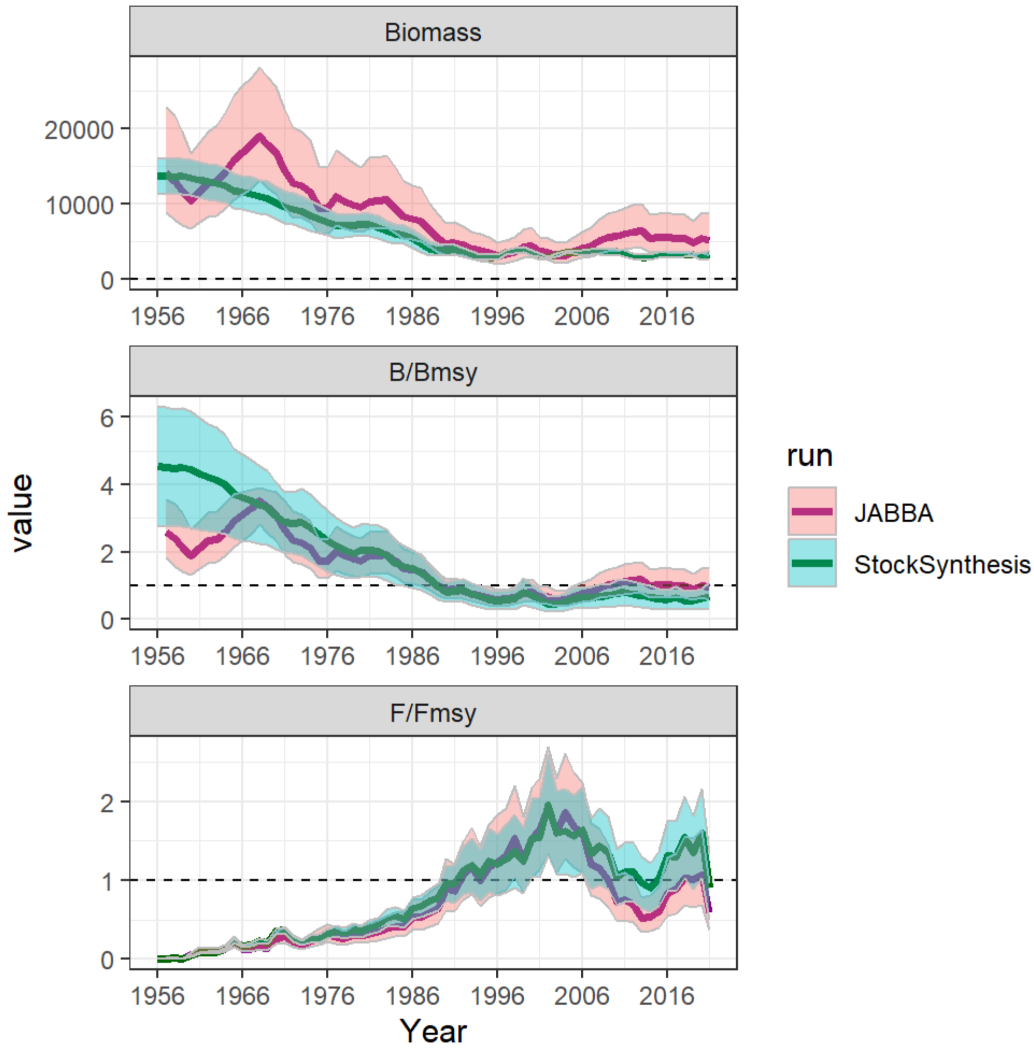


Figure 51. W-SAI. The comparisons between JABBA (S5, purple lines) and Stock Synthesis (Model 6, green lines) for total biomass, B/B$_{MSY}$ (JABBA) or SSB/SSB$_{MSY}$ (Stock Synthesis), and F/F$_{MSY}$. JABBA 95% credibility intervals, Stock Synthesis 95% confidence interval using the SD from its output.

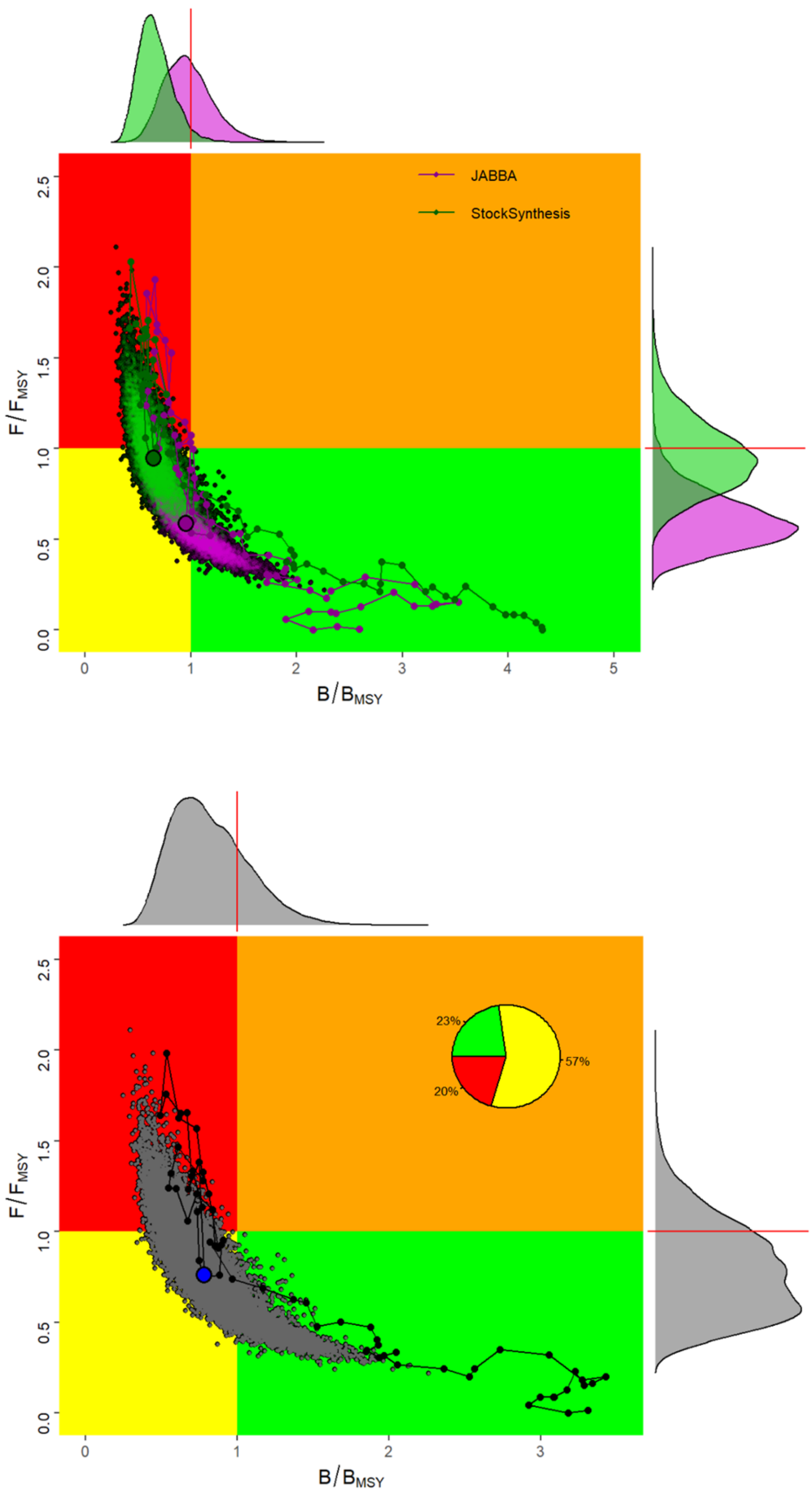


Figure 52. W-SAI. Joint Kobe plot from both JABBA (S5, purple in the upper panel) and Stock Synthesis (Model 6, green in the upper panel) for West Atlantic sailfish.

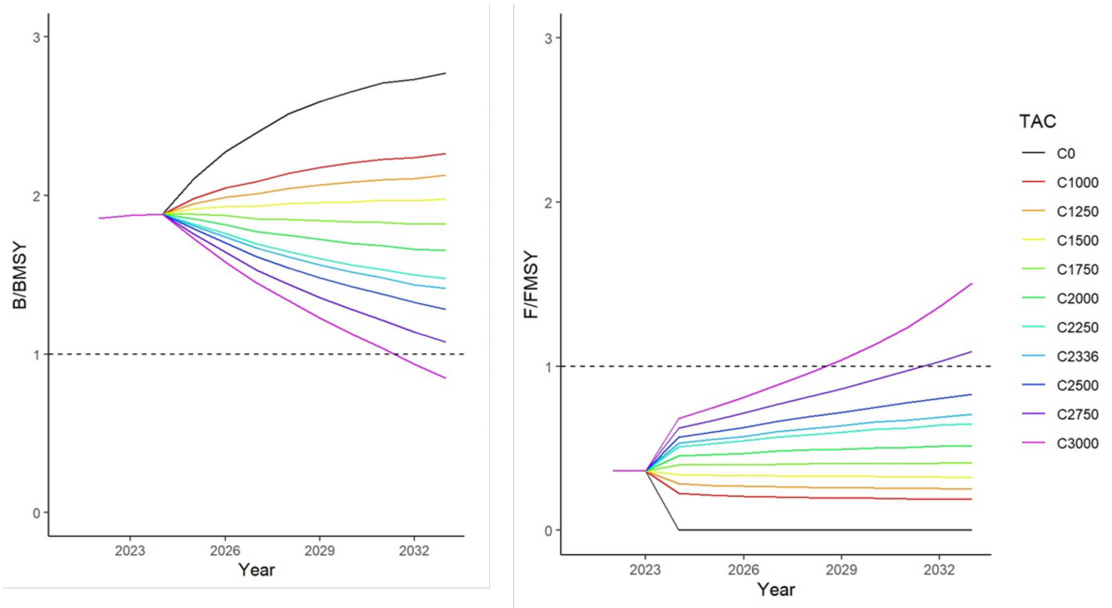


Figure 53. E-SAI. Projections for B/B_{MSY} and F/F_{MSY} based on the JABBA final model for East Atlantic sailfish for various levels of future constant catch ranging from 1,000 – 3,000 tons, including a zero-catch scenario starting in 2024. The catch for the years 2022-2023 was set to 1,586 t, which is the average catch of the recent three years (2019-2021). The projections are run until 2033.

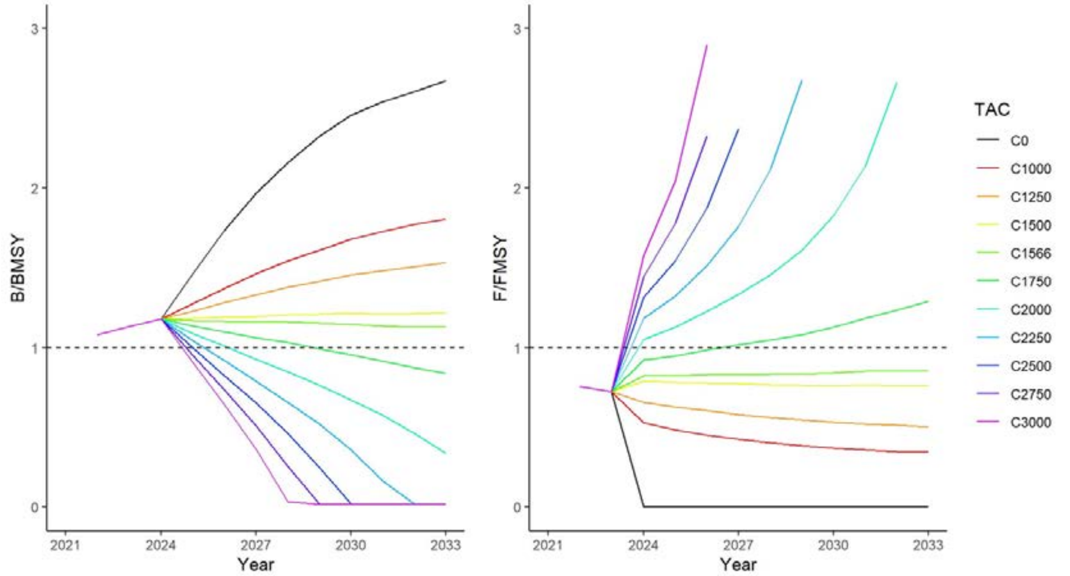


Figure 54. W-SAI. Stochastic projections for B/B_{MSY} and F/F_{MSY} based on the selected JABBA model (S5) for West Atlantic sailfish for various levels of future catch ranging from 1,000 – 3,000 tons, including a zero-catch scenario.

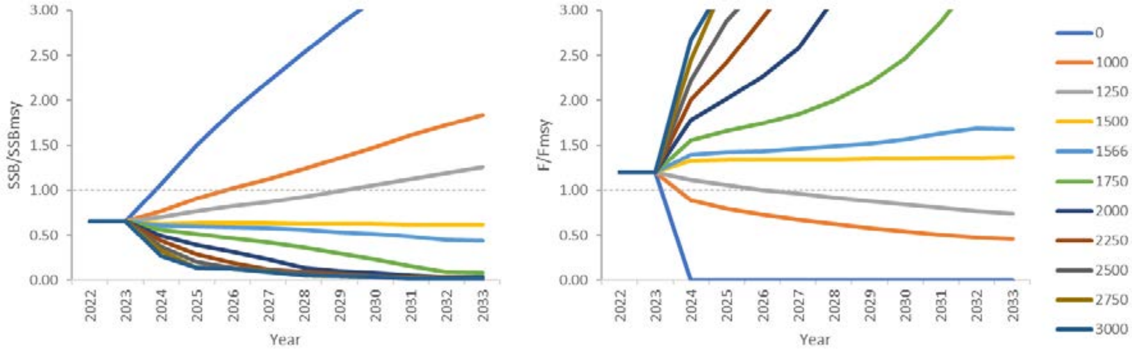


Figure 55. W-SAI. Deterministic projections for B/B_{MSY} and F/F_{MSY} based on the selected Stock Synthesis model (Model 6) for West Atlantic sailfish for various levels of future catch ranging from 1,000 – 3,000 tons, including a zero-catch scenario.

Appendix 1

Agenda

1. Opening, adoption of agenda and meeting arrangements

2. Review of historical and new information on the biology

3. Review of fishery statistics/indicators

    3.1 Task 1 (catches) and discards data and spatial distribution of catches
    3.2 Task 2 catch/effort
    3.3 Task 2 size data
    3.4 Tagging data

4. Review of available indices of relative abundance by fleet

    4.1 East
    4.2 West

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

    5.1 Production models
    5.2 Catch Statistical integrated model Stock Synthesis
    5.3 Other methods

6. Stock Status results

    6.1 Production models
    6.2 Catch statistical integrated model Stock Synthesis
    6.3 Other methods
    6.4 Synthesis of assessment results

7. Stock projections

8. Recommendations

    8.1 Research and statistics
    8.2 Management

9. Responses to the Commission

10. Other matters

11. Adoption of the report and closure

Appendix 2

List of participants*[1]

CONTRACTING PARTIES

ALGERIA
Ouchelli, Amar *
Sous-directeur de la Grande Pêche et de la Pêche Spécialisée, Ministère de la Pêche et des Productions Halieutiques, Route des cuatres canons, 16000 Algiers
Tel: +213 550 386 938, Fax: +213 234 95597, E-Mail: amarouchelli.dz@gmail.com; amar.ouchelli@mpeche.gov.dz

BRAZIL
Leite Mourato, Bruno
Profesor Adjunto, Laboratório de Ciências da Pesca - LabPesca Instituto do Mar - IMar, Universidade Federal de São Paulo - UNIFESP, Rua Carvalho de Mendoça, 144, Encruzilhada, 11070-100 Santos, SP
Tel: +55 1196 765 2711, Fax: +55 11 3714 6273, E-Mail: bruno.mourato@unifesp.br; bruno.pesca@gmail.com; mourato.br@gmail.com

Lopes da Silva Ferrette, Bruno
Senckenberganlage 25, 60325 Frankfurt, Germany
Tel: +49 152 285 22119, E-Mail: bruno.ferrette@senckenberg.de

EGYPT
Ahmed Mahmoud, Reem
25 Elkoraany St, Suez, 8134805
Tel: +20 106 815 4856, E-Mail: reem_95_ahmed@yahoo.com

Elsayed Ramadan, Wessam
8134805 Faisal, Suez
Tel: +20 109 334 1600, E-Mail: wessam.elsayed@yahoo.com

EUROPEAN UNION
Coelho, Rui
Researcher, Portuguese Institute for the Ocean and Atmosphere, I.P. (IPMA), Avenida 5 de Outubro, s/n, 8700-305 Olhão, Portugal
Tel: +351 289 700 508, E-Mail: rpcoelho@ipma.pt

Di Natale, Antonio
Director, Aquastudio Research Institute, Via Trapani 6, 98121 Messina, Italy
Tel: +39 336 333 366, E-Mail: adinatale@costaedutainment.it; adinatale@acquariodigenova.it

Fernández Costa, Jose Ramón
Instituto Español de Oceanografía, Ministerio de Ciencia e Innovación, Centro Costero de A Coruña, Paseo Marítimo Alcalde Francisco Vázquez, 10 - P.O. Box 130, 15001 A Coruña, Spain
Tel: +34 981 218 151, Fax: +34 981 229 077, E-Mail: jose.costa@ieo.csic.es

GABON
Angueko, Davy
Chargé d'Etudes du Directeur Général des Pêches, Direction Générale des Pêche et de l'Aquaculture, BP 9498, Libreville Estuaire
Tel: +241 6653 4886, E-Mail: davyangueko83@gmail.com; davyangueko@yahoo.fr

GHANA
Sawyerr, Eric Boyce
Fisheries Scientific Survey Division, P.O. Box BT. 62, Tema
Tel: +233 244 508 922, E-Mail: eriksawyerr@gmail.com

* Head Delegate
[1] Some delegate contact details have not been included following their request for data protection.

GUINEA (REP.)
Kolié, Lansana
Chef de Division Aménagement, Ministère de la Pêche et de l'Economie maritime, 234, Avenue KA 042 – Commune de Kaloum BP: 307, Conakry, GUINEA (REP.)
Tel: +224 624 901 068, E-Mail: klansana74@gmail.com

JAPAN
Kai, Mikihiko
Senior Reseacher, Tuna Fisheries Resources Group, Tuna and Skipjack Resources Department, National Research Institute of Far Seas Fisheries - NRIFSF, Japan Fisheries Research and Education Agency, 5-7-1, Orido, Shimizu, Shizuoka 424-8633
Tel: +81 54 336 5835, Fax: +81 54 335 9642, E-Mail: kai_mikihiko61@fra.go.jp; kaim@affrc.go.jp; billfishkai@gmail.com

Uozumi, Yuji [1]
Advisor, Japan Tuna Fisheries Co-operation Association, Japan Fisheries Research and Education Agency, Tokyo Koutou ku Eitai 135-0034

MAURITANIA
Braham, Cheikh Baye
Halieute, Géo-Statisticien, modélisateur, Chef du Service Statistique, Institut Mauritanien de Recherches Océanographiques et des Pêches (IMROP), BP 22 Nouadhibou
Tel: +222 2242 1038, E-Mail: baye.braham@gmail.com; baye_braham@yahoo.fr

PANAMA
Duarte, Robert
Biólogo, Autoridad de Recursos Acuáticos, Calle 45, Bella Vista, Edificio Riviera, 0819-02398
Tel: +507 511 6036; +507 696 56926, E-Mail: rduarte@arap.gob.pa

Pino, Yesuri
Jefa encargada del Departamento de Evaluación de Recursos Acuáticos, Ministerio de Desarrollo Agropecuario, Autoridad de los Recursos Acuáticos de Panamá, Evaluación de los Recursos Acuáticos, Edificio Riviera, Ave. Justo Arosemena, Calle 45 Bella Vista, 05850
Tel: +507 511 6036, E-Mail: yesuri.pino@arap.gob.pa

SENEGAL
Ba, Kamarel
Docteur en Sciences halieutiques et modélisation, Ministère de l'Agriculture et de l'Equipment Rural, Institut Senegalais de Recherches Agricoles (ISRA), Centre de Recherches Oceanographiques de Dakar Thiaroye (CRODT), Pôle de Recherches de Hann, Route du Front de Terre, 2241 Dakar
Tel: +221 76 164 8128, Fax: +221 338 328 262, E-Mail: kamarel2@hotmail.com

Kebe, Papa
Conseiller, Ministère de la Pêche et de l'Économie Maritime, Direction des Pêches Maritimes, Diamniadio, Sphère ministérielle Ousmane Tanor DIENG, Immeuble D, 2e étage, Dakar Fann
Tel: +221 33 867 92 82; Tel. Cellular : +221 77 565 02 87, E-Mail: papa.amary@gmail.com

Sow, Fambaye Ngom
Chercheur Biologiste des Pêches, Centre de Recherches Océanographiques de Dakar Thiaroye, CRODT/ISRA, LNERV - Route du Front de Terre - BP 2241, Dakar
Tel: +221 3 0108 1104; +221 77 502 67 79, Fax: +221 33 832 8262, E-Mail: ngomfambaye2015@gmail.com; famngom@yahoo.com

UNITED STATES
Díaz, Guillermo
NOAA-Fisheries, Southeast Fisheries Science Center, 75 Virginia Beach Drive, Miami, Florida 33149
Tel: +1 305 361 4227; +1 305 898 4035, E-Mail: guillermo.diaz@noaa.gov

Forrestal, Francesca
NOAA Fisheries, Southeast Fisheries Science Center, Sustainable Fisheries Division, 75 Virginia Beach Dr., Miami, Florida 33149
Tel: +1 305 903 4535, E-Mail: francesca.forrestal@noaa.gov

Geddes, Katie
University of Miami, 4600 Rickenbacker Causeway, Miami, Florida 33149
Tel: +1 770 655 2236, E-Mail: katie.geddes@earth.miami.edu

Lam, Chi Hin (Tim)
Oceanographer, Large Pelagics Research, University of Massachusetts, P O Box 3188, Gloucester, Massachusetts MA 01931
Tel: +1 978 238 8208; +1 847 877 3278, Fax: +1 978 283 0297, E-Mail: tagtuna@gmail.com

Lauretta, Matthew
Fisheries Biologist, NOAA Fisheries Southeast Fisheries Center, 75 Virginia Beach Drive, Miami, Florida 33149
Tel: +1 305 209 6699, E-Mail: matthew.lauretta@noaa.gov

Schirripa, Michael
Research Fisheries Biologist, NOAA Fisheries, Southeast Fisheries Science Center, 75 Virginia Beach Drive, Miami, Florida 33149
Tel: +1 305 445 3130; +1 786 400 0649, Fax: +1 305 361 4562, E-Mail: michael.schirripa@noaa.gov

Schueller, Amy
NOAA, 101 Pivers Island Road, Beaufort, NC 28557
Tel: +1 252 666 7408, E-Mail: amy.schueller@noaa.gov

URUGUAY
Domingo, Andrés *
Dirección Nacional de Recursos Acuáticos - DINARA, Laboratorio de Recursos Pelágicos, Constituyente 1497, 11200 Montevideo
Tel: +5982 400 46 89, Fax: +5982 401 32 16, E-Mail: dimanchester@gmail.com

Forselledo, Rodrigo
Investigador, Dirección Nacional de Recursos Acuáticos - DINARA, Laboratorio de Recursos Pelágicos, Constituyente 1497, CP 11200 Montevideo
Tel: +598 2400 46 89, Fax: +598 2401 3216, E-Mail: rforselledo@gmail.com

VENEZUELA
Arocha, Freddy
Asesor Científico, Instituto Oceanográfico de Venezuela, Universidad de Oriente, A.P. 204, 6101 Cumaná Estado Sucre
Tel: +58 424 823 1698; +58 412 692 8089, E-Mail: farochap@gmail.com

Narváez Ruiz, Mariela del Valle
Lab. 34, Edif. Instituto Oceanográfico de Venezuela, Universidad de Oriente, Departamento de Biología Pesquera, Av. Universidad, Cerro Colorado, DBP-31 Laboratory, 6101 Cumaná Estado Sucré
Tel: +58 412 085 1602, E-Mail: mnarvaezruiz@gmail.com

Novas, María Inés
Directora General de la Oficina de Integración y Asuntos Internacionales, Ministerio del Poder Popular de Pesca y Acuicultura - MINPESCA
Tel: +58 412 456 3403, E-Mail: oai.minpesca@gmail.com; asesoriasminv@gmail.com

OBSERVERS FROM COOPERATING NON-CONTRACTING PARTIES, ENTITIES, FISHING ENTITIES

CHINESE TAIPEI
Chen, Yun-Ju
Researcher, Department of Environmental Biology and Fisheries Science, National Taiwan Ocean University, No.2, Beining Rd., Zhongzheng Dist., Keelung City, 202301
Tel: +886 224 622 192 ext. 5046, Fax: +886 224 633 920, E-Mail: 00931001@email.ntou.edu.tw

Su, Nan-Jay
Associate Professor, Department of Environmental Biology and Fisheries Science, National Taiwan Ocean University, No. 2 Beining Rd., Zhongzheng Dist., 202301 Keelung City
Tel: +886 2 2462 2192 #5046, Fax: +886-2-24622192, E-Mail: nanjay@ntou.edu.tw

COSTA RICA
Álvarez Sánchez, Liliana
Funcionaria de la Oficina Regional del Caribe – Limón, Instituto Costarricense de Pesca y Acuicultura, 4444
Tel: +506 863 09387, Fax: +506 263 00600, E-Mail: lalvarez@incopesca.go.cr

OTHER PARTICIPANTS

SCRS CHAIRMAN
Brown, Craig A.
SCRS Chairman, Sustainable Fisheries Division, Southeast Fisheries Science Center, NOAA, National Marine Fisheries Service, 75 Virginia Beach Drive, Miami, Florida 33149, United States
Tel: +1 305 586 6589, E-Mail: craig.brown@noaa.gov

*****

ICCAT Secretariat
C/ Corazón de María 8 – 6th floor, 28002 Madrid – Spain
Tel: +34 91 416 56 00; Fax: +34 91 415 26 12; E-mail: info@iccat.int

Manel, Camille Jean Pierre
Ortiz, Mauricio
Palma, Carlos
Kimoto, Ai
Mayor, Carlos
De Andrés, Marisa
García, Jesús

Appendix 3

List of papers and presentations

Doc Ref	*Title*	*Authors*
SCRS/2023/062	Report of the Workshop on swordfish, billfishes and small tunas age reading	Anonymous
SCRS/2023/063	Atlantic sailfish standardized CPUE index and size distribution from the artisanal drift-gillnet fishery operating at the billfish hotspot, off La Guaira, Venezuela (1991-2022)	Narvaez M., Marcano L.A., Arocha F.
SCRS/2023/064	Standardized catch rates and size distribution for Atlantic sailfish from the Venezuelan pelagic longline fishery in the Caribbean Sea and adjacent waters of the western central Atlantic (1987-2018)	Narvaez M., Ortiz M., Narvaez M., Marcano J. H., Evaristo E.
SCRS/2023/079	Update the standardized catch rates of sailfish (*Istiophorus albicans*) caught as bycatch of the Spanish surface longline fishery targeting swordfish (*Xiphias gladius*) in the Atlantic Ocean	Ramos-Cartelle A., Garcia-Cortes B., Mejuto J., Fernandez-Costa J.
SCRS/2023/081	Update of input data (Catch and size) for the Atlantic Sailfish (*Istiophorus albicans*) stock assessment models 2023	Ortiz M., Kimoto A., Palma C., Mayor C.
SCRS/2023/082	Update standardization of Atlantic sailfish (*Istiophorus albicans*) catch rates in the East Atlantic from the Portuguese pelagic longline fishery (1991-2021)	Coelho R., Rosa D., Lino P.G.
SCRS/2023/092	Catch rates of sailfish from the Brazilian longline fisheries in the western Atlantic (1991-2022)	Mourato B., Sant'Ana R., Kikuchi E., Cardoso L.G.
SCRS/2023/093	Estimated Atlantic sailfish catch rate for the Brazilian billfish sport fishing tournaments (2001-2020)	Mourato B., Sant'Ana R., Pimenta E., Amorim A.F.
SCRS/2023/098	Estimated sailfish catch-per-unit-effort for the U.S. recreational billfish tournaments (1972-2021)	Forrestal F., Lauretta M., Schirripa M.J.
SCRS/2023/103	U.S. Pelagic longline standardized indices of sailfish (*Istiophorus albicans*) relative abundance	Lauretta M.
SCRS/2023/105	CPUE standardization for sailfish (*Istiophorus platypterus*) caught in the Chinese Taipei tuna longline fishery in the Atlantic Ocean for 2009-2021	Su N-J., Huang W.H.
SCRS/2023/106	Standardization of Atlantic sailfish (*Istiophorus albicans*) CPUE in the Eastern Atlantic from the Senegalese artisanal fishery	Ba K., Sow F.N.

SCRS/2023/109	Spatio-temporal model for CPUE standardization: application to eastern Atlantic sailfish caught by Japanese tuna longline fishery from 1994 to 2021	Kai M.
SCRS/2023/110	Spatio-temporal model for CPUE standardization: application to western Atlantic sailfish caught by Japanese tuna longline fishery from 1994 to 2021	Kai M.
SCRS/2023/111	Assessment of the eastern Atlantic sailfish stock using JABBA model	Mourato B., Sant'Ana R., Kikuchi E., Cardoso L.G., Sow F.N., Arocha F., Kimoto A., Ortiz M.
SCRS/2023/112	Western Atlantic sailfish stock status with JABBA model	Mourato B., Mourato B., Sant'Ana R., Kikuchi E., Cardoso L.G., Sow F.N.; Arocha F., Kimoto A., Ortiz M.
SCRS/2023/113	Updated U.S. conventional tagging database for Atlantic sailfish (1955-2022), with comments on potential stock structure	Orbesen E., Snodgrass D.J.G.
SCRS/2023/114	Refinement of the maximum age estimate of Atlantic sailfish (*Istiophorus platypterus*) with the clarification of long-term mark-recapture reports	Snodgrass D., Walter J.F., Orbesen E.S.
SCRS/P/2023/077	Genomic stocks delimitation for the sailfish	Ferrete B., Mourato B., Arocha F., Janke A.
SCRS/P/2023/078	Western Atlantic Sailfish Assessment SS3 2023	Schirripa M.

Appendix 4

SCRS Documents and Presentations Abstracts as provided by the authors

SCRS/2023/062 - This report describes the Workshop on swordfish, billfishes, and small tuna age reading that took place in IPMA-Olhão, Portugal in February 2023. The three species groups have ongoing biology programs for the improvement of the biological knowledge of the various species, specifically, the small tuna year program (SMTYP) for small tunas (focused on *Euthynnus alletteratus*, *Sarda sarda,* and *Acanthocybium solandri*), the swordfish year program (SWOYP) for swordfish (*Xiphias gladius*), and the Enhanced Programme for Billfish Research (EPBR) dedicated to billfishes (focused on *Tetrapturus albidus, Makaira nigricans and Istiophorus albicans*). The three programs include age and growth studies, with a collection of both spines and otoliths for the scope species, therefore the major objectives of the workshop were to enhance expertise among ICCAT scientists for these species by sharing knowledge between experts, standardize methodologies, review work already completed and progress plans for next steps in these research programs.

SCRS/2023/063 - Standardized index of relative abundance for sailfish (*Istiophorus albicans*) was estimated using a Generalized Linear Mixed Models approach assuming a lognormal model distribution. The data used corresponds to the artisanal drift-gillnet fishery of the Venezuelan billfish hotspot known as "El Placer de La Guaira" located off the central coast of Venezuela from 1991 up to 2022. The variables considered for the model were Year, Season, and their interaction, with season as a random effect factor. Diagnostic plots were used as indicators of overall model fitting, finding no considerable departure from expected and in general, a good fitting for the final model. In this updated series (2013-2022), the standardized CPUE (in weight) shows a relatively stable trend with no distinctive pattern, but lower catch rate values than the earlier period are noticeable for the updated period. Mean size has also been relatively stable over the years, with higher mean sizes for females in contrast with males.

SCRS/2023/064 - A standardized index of relative abundance for sailfish (*Istiophorus albicans*) was developed by the combination of three data sources, the international billfish program (1987-1990), the 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. 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. The time series shows that the relative abundance of sailfish caught by the observed Venezuelan longline fleet reflects a strong drop in the early period of the series, thereafter the series remains somewhat stable except for three peaks that occurred in 1999, and 2007, and a smaller one in 2016.

SCRS/2023/079 - Standardized catch rates of the sailfish (*Istiophorus albicans*) were obtained from 14,473 trip observations of surface longline fishing targeting swordfish during the period 2001-2019. The nominal effort modelled represented 80.65% of the total effort developed by this fleet during that period. In roughly 28% of these trips, at least one individual belonging to this species was found. Because of the low prevalence of this species in this fishery, the standardized CPUE was developed using a Generalized Linear Mixed Model assuming a delta-lognormal error distribution. The results indicate that the overall trend of the standardized CPUE was similar for the Atlantic Ocean and for the East and West stocks. The results showed an increasing trend for the Atlantic Ocean and for the East and West stocks reaching a peak in 2015 or 2013 following a decreased trend in the recent years analyzed although remaining at higher values than at the beginning of the series.

SCRS/2023/080 - A multitude of changes in vessel size, conservation attitudes, and electronic equipment has led to changes in the recreational fishery for billfish over time, which has an impact on the fishery's ability to catch fish. The majority of these changes have originated from or been heavily influenced by USA participants. For much of the history of the recreational fishing fleet, media outlets have included stories that are intended to educate and involve the fishers. The utilization of the content of these forms of media could be a data mining source for representative information pertaining to the evolution of the billfish fishery. The available magazine media were used to collect data on the size of vessels in new and brokerage advertisements (new and used boat sizes), conservation attitudes, and electronic aids or assistance. These data were used to estimate a change in the mean vessel size over time of the fleet mediated by factors such as electronic assistance, which can serve as a proxy of changes in the catchability of the fishery fleet for the stock assessment. The changes estimated in this analysis will be applicable to not only sailfish but also for other billfish fisheries.

SCRS/2023/081 - The Billfish Species Group (BILSG) was scheduled to carry out an evaluation of the East and West Atlantic sailfish stocks in 2023. In preparation, the BILSG established a modelers team to advance preliminary analyses for the assessment meeting. The BILSG requested the Secretariat to provide input data of catch and size until 2021 for Stock Synthesis and Surplus Production models based on the preliminary fleet structure used in 2016. This document summarizes the revision and update of the available detailed catch and size data per fleet up to 2021.

SCRS/2023/082 - This working document updates the catch, effort and standardized CPUE trends for the eastern Atlantic stock of Atlantic sailfish (*Istiophorus albicans*) captured by the Portuguese pelagic longline fleet between 1999-2021. Nominal annual CPUE was calculated as kg/1000 hooks and was standardized with Generalized Linear Models (GLM) with Tweedie distribution and using year, quarter, area, and targeting effects (ratios) as explanatory variables. Model goodness-of-fit was determined with AIC and the pseudo coefficient of determination, and model validation was analyzed with residual analysis. The final standardized CPUE series shows a general decrease in the initial years, between 1999 and 2010, followed by a general increase until 2015, and then a more stable period in recent years with inter-annual oscillations. This paper updates the previous index of abundance for Atlantic sailfish estimated from captures from the Portuguese pelagic longline fleet in the east Atlantic and can be used for the stock assessment of the species.

SCRS/2023/092 - Catch and effort data performed by the Brazilian tuna longline fleet in a wide area of the South Atlantic Ocean from 1994 to 2020 were analyzed. The fishing effort was distributed in a wide area of the Atlantic Ocean. The CPUE of the sailfish was standardized by a GLM using a Delta Lognormal approach. The factors used in the models were: year, quarter, vessels, clusters, hooks per floats, hooks, and the lat-long reference for each 5 by 5 spatial square. The standardized CPUE series an increasing between 1996 and 2003, followed by decreasing trend until the final of the time series.

SCRS/2023/093 - In the present study, a generalized linear model (GLM), assuming a Tweedie distribution, was used to generate a standardized CPUE series for the sailfish caught by sport fishing boats based in São Paulo, Rio de Janeiro, Espirito Santo, and Bahia States, from 2001 to 2020. The response variable was the number of sailfish caught per number of boats registered in the tournament per day. The following factors were tested in the analyses: "year", "target", and "local", representing the main effects of the explanatory variables. The target species was estimated by cluster analysis, based on the proportion of each species or group of species in relation to the total catch, using the "K Means" method. The standardized catch rate's general pattern shows a trend of reduction from 2000 to 2012, followed by a trend of relative stability in more recent years up through 2020. Our estimates could be taken to accurately reflect the stock's local relative abundance and might be applied to assessment models.

SCRS/2023/098 - An index of abundance for sailfish using catch and effort data from the United States recreational billfish tournament survey was constructed for the period of 1972-2021. Tournament catch-per-unit-effort (number of fish caught per hours fishing) was estimated from catch and effort data submitted by recreational tournament coordinators and U.S. National Marine Fisheries observers under the Recreational Billfish Survey program. Two data selection approaches were explored to restrict the data to tournaments that primarily target sailfish. The first used tournaments that specifically targeted sailfish while the second data selection approach limited the tournaments that had sailfish encounters at any point in the tournament records. The catch per unit effort standardization procedure included several time and area variables depending on the data selection approach. Several modeling frameworks were explored: an assumed Gamma and log-normal error distributions using Generalized Linear Mixed Models on positive catches as well as a constant added to all catch rates using a Generalized Linear Mixed Model. The final selected model used an assumed Gamma error distribution with years, months, and tournaments as explanatory factors.

SCRS/2023/103 - Standardized indices of sailfish relative abundance in the Northwest Atlantic Ocean are presented for the U.S. pelagic longline fishery. The index is based on scientific observer-reported catch, effort, and covariate data associated with individual longline sets. Alternative models incorporating time/area, gear configuration, and environmental condition covariates were evaluated by change in information criterion and factor influence diagnostics. The final selected model included year, area, month, hook type, sea surface temperature, and species targeted. The influence of hook type on the index was highly significant; the standardization results showed a cyclical but flat long-term index compared to the sharp decline in observed CPUE after the implementation of circle-hook regulations. The overall effect of circle hooks and weak circle hooks on sailfish catch rates was estimated to be approximately 42% and 58% reduction compared to J-hook sets, respectively.

SCRS/2023/105 - Catch and effort data of sailfish (*Istiophorus platypterus*) were collected and analyzed for the Chinese Taipei distant-water tuna longline fishery in the Atlantic Ocean. Nominal CPUE (catch per unit of effort) was standardized using generalized linear models (GLMs). Two separate eastern and western stocks of sailfish were considered in the standardization, with information on operation type (i.e. number of hooks between floats) included as a potential effect in the models. All of the main effects were statistically significant in the GLM analyses. Relative abundance indices of eastern Atlantic sailfish increased from 2009 to a higher level but then dropped in 2014-2015 and increased again in recent 2 years. Similar trend was observed for the western stock, for which the sailfish CPUE showed a decreasing trend during 2010 and 2014 with a slight increase in 2015 and increasing during the recent 2 years 2020-2021.

SCRS/2023/106 -In Senegal, the artisanal fleet uses a mixture of fishing gears to harvest demersal and pelagic species. Atlantic sailfish (Istiophorus albicans) is the most commonly pelagic species found in large seasonal concentrations near the Senegalese coast and neighboring West African countries. The gears used are mainly handlines with bait or subsurface lines, and gillnets. Purse seine catches also incidentally sailfish during the hot season. The index of abundance from the artisanal fleets uses the nominal catch per unit of effort (number of fishing trips) data collected by the Oceanographic Research Centre of Dakar-Thiaroye in the main harbors of the Senegalese coasts during the period 1981-2021. Data collected consisted of total catches, fishing effort (number of canoes), year, month, gear, and harbor. The main artisanal landing harbors include Grande Cote (St-Louis, Kayar), Cap Vert (Yoff, Ouakam, Soumbedioune, Hann, Rufisque), and Petite Cote (Mbour, Joal). Gears selected gillnet, troll, handline, and seine. The standardization model applied a Gaussian GLM on log (CPUE) assuming a lognormal error distribution to estimate a standardized abundance index. The final model was selected based on the smallest AIC and higher performance including factor interactions.

SCRS/2023/109 - Abundance indices of Eastern Atlantic sailfish caught by Japanese tuna-longline fishery were estimated using the logbook data from 1994 to 2021. The nominal CPUEs were standardized using the spatio-temporal generalized linear mixed model (GLMM) to provide the annual changes in the abundances. The author focused on spatial and interannual variations of the density in the model to account for spatially and annual changes in the fishing location due to the target changes of tuna and tuna-like species. Overall, the estimated CPUEs of Eastern stock revealed upward trends from 1994 to 2021 with extremely high CPUEs in 2013 and 2014, and the standard deviations after 2013 were wider than those in 1990s and 2000s due to a reduction of fishing effort. The estimated CPUE using the spatio-temporal model with a large amount of data collected in the wide waters in the Eastern Atlantic is a very useful information about the abundance of Eastern Atlantic sailfish.

SCRS/2023/110 - Abundance indices of Western Atlantic sailfish caught by Japanese tuna-longline fishery were estimated using the logbook data from 1994 to 2021. The nominal CPUEs were standardized using the spatio-temporal generalized linear mixed model (GLMM) to provide the annual changes in the abundances. The author focused on spatial and interannual variations of the density in the model to account for spatially and annual changes in the fishing location due to the target changes of tuna and tuna-like species. Overall, the estimated CPUEs revealed an upward trend from 1994 to 2021 with a quite high CPUE in 2005, and the standard deviations after 2013 were wider than those in 1990s and 2000s due to a reduction of fishing effort. The estimated CPUE using the spatio-temporal model with a large amount of data collected in the wide water in the Western Atlantic is a very useful information about the abundance of Western Atlantic sailfish.

SCRS/2023/111 - We first attempted to apply the JABBA Models for the Eastern Atlantic sailfish (*Istiophorus platypterus*) with the best available data through 2021. Results suggest reasonably robust fits to the data as judged by the presented model diagnostic results. The resulting stock status for 2021 was generally consistent and predicted with high probabilities that current fishing levels are sufficiently low to preclude overfishing (F2021< FMSY), whereas biomass is above the sustainable levels that can produce MSY (B2021>BMSY). As such, our models conclusively estimate that stock is not overfished and is not subject to overfishing, with probability ranging from 86.4% - 95.5% for the green quadrant of Kobe. Similarly, it was not observed substantial differences in biomass and fishing mortality yearly trends among models, with the S2 model indicating a slightly more productive stock.

SCRS/2023/112 - We first attempted to apply the JABBA Models for the Western Atlantic sailfish (*Istiophorus platypterus*) with the best available data through 2021. Results suggest reasonably robust fits to the data as judged by the presented model diagnostic results. The resulting stock status for 2021 was generally consistent and predicted with high probabilities that current fishing levels are sufficiently low to preclude overfishing (F2021< FMSY), whereas biomass is above the sustainable levels that can produce MSY (B2021>BMSY). As such, our models conclusively estimate that stock is not overfished and not subject to overfishing, with probability ranging from 75.1% - 84.6% for the green quadrant of Kobe. Similarly, it was not observed substantial differences in biomass and fishing mortality yearly trends among models, with the S2 model indicating a slightly more productive stock.

SCRS/2023/113 - We examined the U.S. conventional tagging database, which consists of data from the NOAA Southeast Fisheries Science Center's Cooperative Tagging Center (CTC), and The Billfish Foundation (TBF). We examine the 112,979 tagged and released fish with specific comments to regional and seasonal abundance. We also examine the 2,488 tag recaptures, which show no trans-Atlantic or trans-equatorial movements. We discuss the importance of these findings and the potential implications for stock structure.

SCRS/2023/114 - This examination of conventional tagging information for sailfish (*Istiophorus platypterus*), is comprised of data from the National Marine Fisheries Service (NMFS), Southeast Fisheries Science Center's Cooperative Tagging Center, The Billfish Foundation, the South Carolina Department of Natural Resources Marine Gamefish Tagging Program and the NMFS/Northeast Fisheries Science Center's Shark Tagging Program. The tag release and recapture files were examined relative to providing insight into the maximum time at large for this species and its relationship with the maximum age for the stock.

SCRS/P/2023/77 - Not provided by the authors.

SCRS/P/2023/78 - Not provided by the authors.